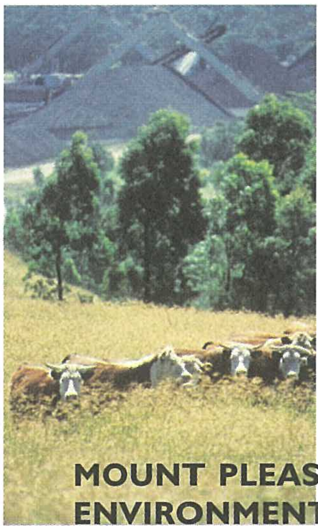
C&A

MOUNT PLEASANT MINE

ENVIRONMENTAL IMPACT STATEMENT

VOLUME 1

ERM MITCHELL McCOTTER



MOUNT PLEASANT MINE
ENVIRONMENTAL IMPACT STATEMENT
For
COAL & ALLIED OPERATIONS Pty Ltd

94019
September, 1997

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Report No. 94019

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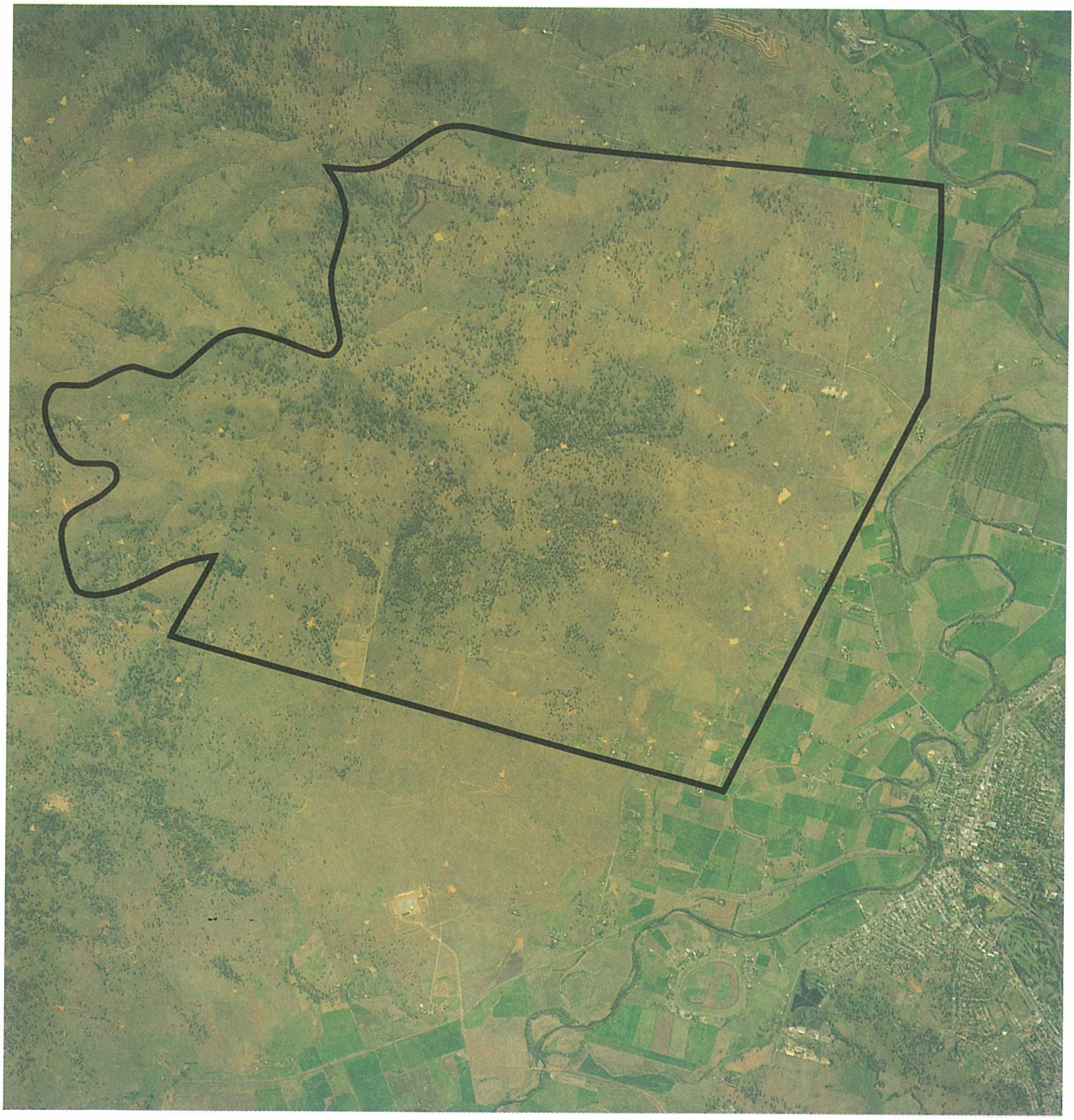


EXECUTIVE SUMMARY

BACKGROUND

Coal & Allied Operations Pty Limited (Coal & Allied) proposes developing a major open cut coal mine at Mount Pleasant, which is approximately three kilometres west of Muswellbrook in the upper Hunter Valley of New South Wales. The mine will extract about 197 million tonnes of run-of-mine (ROM) coal to produce about 142 million tonnes of saleable coal over a period of 21 years.

The Mount Pleasant site occupies 3,800 hectares on predominantly undulating to rolling country to the west of the Hunter River, with small areas on the eastern boundary extending into the floodplain. The site is mainly used for grazing on native/natural pasture with some partly improved pasture along its eastern boundary. Surrounding land uses include pecan nut plantations, grape vines, horse and cattle studs, minor cultivation such as turf, flower and market gardens, and rural residential areas. Bengalla Mine adjoins the southern site boundary, while the proposed Kayuga Mine and surface facilities for the underground Dartbrook Mine are to the north.

Run-of-mine coal will be washed on site to produce a range of thermal coals. Product coal will be transported to the Port of Newcastle via a rail loop built to the south of the Mount Pleasant infrastructure area. This will be connected to mine infrastructure by an overland conveyor.

In the future, coal reserves beyond current economic open cut limits might be recovered by other methods including underground extraction and highwall mining. Coal & Allied will investigate these methods at a later stage.

Coal & Allied is one of Australia's leading producers and exporters of black coal. It is now part of the Rio Tinto Group, one of the most significant diversified miners in the world. Its mining assets include two large open-cut coal mines (Mount Thorley Operations and Hunter Valley No. 1 Mine) each of which includes coal preparation facilities. These mines can produce up to 11 million tonnes of product coal each year for thermal and coking markets.

From July 1994 to June 1995 coal exports from New South Wales to Asia and Europe totalled 58.8 million tonnes. Since existing mines operated by Coal & Allied at Mount Thorley and Hunter Valley No. 1 are approaching operational maturity, a new long-term resource is required to meet developing markets and to sustain current demands. Increased competition from Indonesia and South America, which may limit Australia's share of the international market, increases the national importance of these developments that can maintain existing markets.

New and more specialised markets are evolving for products such as coal-water mixture (CWM.) Coal & Allied has development approval for a CWM plant on Kooragang Island and should demand for CWM be realised in the near future, Mount Pleasant has a suitably large low ash coal resource which could be used to feed the plant.

Mining provides significant economic benefits to the Hunter Region, the State and Australia through employment, income and output. Direct benefits generate additional economic activity in other sectors.

OPTIONS DEVELOPMENT

Phases in the progressive development of the proposed Mount Pleasant mine are outlined below.

Mining Method

There are two ways of mining the coal resource at Mount Pleasant; underground or open-cut. Geological constraints mean that the resource can be most effectively mined by open-cut techniques.

Mine Plan

Open-cut coal mines start where coal is shallowest and they work down the coal seams until the excavation becomes too deep. At Mount Pleasant this meant that the mine would start in the east and work west.

The mine plan was based on a conventional multi-seam dragline operation with two areas mined concurrently.

The dip of the coal seams and local topography meant that the most efficient transport direction was from the base of the pit (west) to the surface (east). Typically, conventional mine planning locates infrastructure near the most accessible point at the start of the mine.

Assessment of Infrastructure Alternatives

A preliminary assessment examined 33 infrastructure layouts to service the mine, based on conventional mine planning. These included three different locations and a number of options for transporting ROM and product coal. The initial 33 options were amalgamated to a short list of 11 based on similarities in environmental impacts. A further option examined at this stage placed the infrastructure outside the Mount Pleasant Authorisation.

The eastern boundary of the Authorisation was favoured for infrastructure and a rail loop with loading facilities, based on economic viability, technical feasibility and environmental acceptability.

An initial Planning Focus meeting held in March 1995 gave control authorities a preliminary overview of the proposal and associated environmental issues. Mine planning and environmental impact assessment work advanced during 1995 and early 1996.

Muswellbrook Shire Council then expressed reservations about having infrastructure on the eastern side of the mine. Consequently, a Joint Working Party was established by Coal & Allied and Council under the guidance of an independent facilitator. The working party, which included mine planners and infrastructure designers, sought to reach an outcome that met local community needs, while still ensuring the economic viability of the mine.

Other infrastructure locations and rail access options on the western side of the site were examined. One of these was a joint user facility with the proposed Bengalla Mine, while another connected to the Bengalla Mine rail loop by overland conveyor.

Approval of the Bengalla project in 1996 paved the way for an immediate commencement of its infrastructure and rail loop. This meant that Bengalla could not commit to a joint user facility because Mount Pleasant could not be developed in time.

The Proposal

Coal & Allied therefore proposed that mining infrastructure be located in the southwest corner of the site. This was about twice as far from Muswellbrook residential areas as the original proposal. Relocating mine infrastructure to the southwest changed access to the pit and lead to a rail loop to the south of the Mount Pleasant infrastructure area. This could be connected to the mine surface facilities by an overland conveyor.

THE PROPOSAL

Coal will be extracted from eight seams in the Wittingham Coal Measures, commencing at the base of the Edderton seam in the east and working west down the dip in strips parallel to strike.

The proposed mine plan is based on a conventional multi-seam dragline operation with prestripping by a truck and shovel fleet. Most rock will be loosened by blasting and excavated with a large dragline accompanied by two electric shovels, a large hydraulic excavator and a number of front-end loaders. A fleet of rear dump trucks will haul rock and coal from the mine to emplacement areas and coal preparation facilities, respectively.

Coal will initially be extracted from a small pit in the Warkworth seam adjacent to the coal preparation facilities whilst the permanent mine infrastructure is built. Overburden from this excavation will be used as fill for the coal handling facilities, haul roads and fine reject emplacements. Coal from this pit will be washed at a portable modular plant before the main washery is built.

Once coal handling and preparation facilities are completed, mining will start in the South Pit. At the same time, the Piercefield Pit to the west will be developed to take advantage of favourable strip ratios and proximity to the coal preparation facilities. Overburden will be transported to the southwest out-of-pit emplacement and will be used to form the southern bund, which will effectively screen mining operations and haul roads from Muswellbrook.

Dragline operations in the North and South Pits will commence in Year 5 and operations could continue past Year 21. Coal will be hauled to the infrastructure area in the southwest corner of the site. Mine infrastructure will include a coal preparation plant, coal stockpiles, maintenance workshop, staff amenities and administration building.

Run-of-mine coal will be transferred to the coal preparation plant via a hopper or stockpiled. Coarse reject from the washing process will be trucked to emplacements, while fine rejects will be pumped to the fines emplacement area near the south west corner of the site.

Product coal will be stockpiled in the infrastructure area from where it will be fed onto a conveyor leading to the rail loop.

The mine will operate 24 hours per day, seven days a week. The coal preparation plant, facilities and equipment will take two years to build and employ up to 253 people. The average operational workforce will be 332, with a peak of 380 in Year 13.

The site will be accessed via a single controlled gate to the infrastructure area off Wybong Road. A section of Castlerock Road within the site will be closed and a new section constructed linking Castlerock and Dorset Roads. Future closure of a section of Wybong Road in conjunction with Muswellbrook Shire Council will allow land between Mount Pleasant and Bengalla to be mined. To facilitate community transport the closed section will be replaced by a link road west of the site.

ENVIRONMENTAL ASSESSMENT PROCEDURES

The project is a designated development under the *Environmental Planning and Assessment Act* 1979. As such an environmental impact statement (EIS) must accompany a development application to Muswellbrook Shire Council for the proposal. The EIS must be exhibited publicly and all affected landowners notified.

A direction under Section 101 of the Act applies to the proposal. This states that an application for a new coal mine which requires a new coal lease, must be determined by the Minister for Urban Affairs and Planning. As a consequence, Muswellbrook Shire Council will refer an assessment of the development application and all public submissions to the Minister for Urban Affairs and Planning.

CONSULTATION

The general community and public authorities were consulted extensively during all phases of the project. Community consultation included individual briefings, interviews, public displays, media liaison, information brochures and day-to-day contact. Government authorities were briefed on the proposal and environmental assessment at a number of planning focus meetings and technical consultation group presentations. Extensive discussions were also held with Muswellbrook Shire Council. These involved informal talks, briefings of Council staff, Councilors and community representatives, as well as making information available to various Council committees.

ENVIRONMENTAL ASSESSMENT

The environmental issues associated with the proposal were identified from consultation with government authorities, discussions with the community, operating experience from Coal & Allied's other Hunter Valley mines, and the experience of the study team preparing the EIS. No single environmental issue dominated and a number of factors were considered in detail.

Assessment findings are summarised below.

Bio-physical Environment

- Flora and Fauna

  The proposal will not significantly affect any rare or endangered flora and fauna. Proposed rehabilitation will further minimise potential impacts and will result in a more diverse ecosystem in the long-term.

- Noise and Blasting

  Up to 71 non-company owned residences will be affected by significant noise increases. The company proposes to offer affected landowners a choice of either property purchase at a fair and equitable market value or the installation of noise abatement measures at affected residences.

- Air Quality

  Up to 65 non-company owned residences will receive more dust than the assessment criterion. The company proposes to offer these landowners a choice of either property purchase at a fair and equitable market value or the installation of ameliorative measures. Assessment of dust deposition in relation to human health indicates that the proposal will not significantly affect mine employees or the surrounding community. Studies indicate that dust from the mine will not significantly affect plant growth or grazing animals.

- Water Quality

  Coal hardrock aquifers will be depressurised which will cause borehole water levels to decline near the mine, but this may improve alluvial water quality for up to 80 years after mining.

  All runoff from disturbed areas of the mine will be contained in the mine water management system. Mine development will affect 30 to 70 per cent of the drainage catchments on the eastern side of the site. The fine rejects emplacement will reduce downstream runoff water from catchments west of the site. Where loss of yield causes economic hardship, water supplies will be replaced.

  Potential groundwater seepage from the fine emplacements will be minimal because fine rejects have low permeability. Monitoring and management measures will be installed downstream of the emplacement area to contain seepage which could affect ground water quality in the catchment. Seepage from overburden emplacements could affect water quality in localised areas of the floodplain alluvium, albeit at a very low rate.

Human Environment

- Heritage and Archaeology

  The site does not have a substantial archaeological resource. Most of the area contains sparse archaeological material. The eastern part of the site bordering the Hunter River floodplain has been largely disturbed by previous land uses. This limits its potential to provide specific information of past Aboriginal use. Less disturbed areas on the western portion of the site are potentially more significant. Recommendations are made for salvage excavation and collection of important sites.

  Heritage items around the site could possibly be affected by vibration from blasting. Coal & Allied will protect those buildings not already safeguarded by other mining developments.

- Visual

  The post mining landform will change the local landscape. The landform was designed to emulate existing landforms and vegetation patterns. Progressive rehabilitation will limit the extent of disturbance during construction.

- Local Road Network

  Future traffic impacts have been assessed for Mount Pleasant Mine and for cumulative traffic from Bengalla, Mount Pleasant and Kayuga Mines. Traffic impacts are only significant on the future mine link roads, with minimal traffic increases on most existing roads.

  Dangerous goods such as explosives or fuel would generally be transported to the site via Thomas Mitchell Drive, effectively bypassing the town of Muswellbrook and other residential areas.

  Future closure of the section of Wybong Road adjacent to Mount Pleasant Mine will reduce through traffic on Kayuga Bridge from Wybong Road. There will also be significant reductions in existing local traffic because rural properties will be acquired for mining.

  Mount Pleasant and Bengalla mines will generate minimal future traffic on Kayuga Bridge. Kayuga Mine may generate some traffic along this route but overall future movements on the bridge will be much lower than existing traffic volumes.

- Socio-Economic

  The operational phase of the development will provide significant economic benefits to the region, the State and Australia through employment income and output. Direct benefits will generate additional economic activity in other sectors.

- Land Use

  The staged development of the project will allow areas not affected by mining to remain available for grazing. Rehabilitation of land after mining will maintain the pre-mining land capability of the agricultural lands.

Cumulative Impacts

Concern has been raised by the community and government authorities about the potential of mining and other activities in the Upper Hunter Valley to cause cumulative impacts that extend beyond each discrete industry. This has been the subject of a wide ranging investigation titled the *Upper Hunter Cumulative Impact Study* (Department of Urban Affairs and Planning, 1997). The findings of this report have been considered in the assessment of the Mount Pleasant project.

Cumulative impacts from vegetation clearing and habitat loss will be offset by habitat enhancement of proposed rehabilitation areas. Mount Pleasant, Bengalla and Kayuga Mines do not individually or cumulatively link to surrounding larger vegetated areas or conservation reserves. None of the proposed mines will disturb any unique ecosystems or habitats of conservation significance.

Cumulative operations from the Mount Pleasant, Dartbrook, Bengalla and Kayuga Mines will depressurise the hardrock coal measures resulting in lower pit inflow rates at each mine. Cumulative depressurisation is expected to be regionally more extensive although seepage to and from alluvial areas is not expected to differ from that calculated for Mount Pleasant Mine.

Potential cumulative socio-economic impacts include substantial increases in direct employment, income and output and significant flow on effects for the local area and Upper Hunter Region. This will provide an economic base capable of fostering community growth, development and expanded services. Associated with increases in employment opportunities will be a greater demand for rental accommodation, housing and community services.

Mount Pleasant will interact with the Bengalla and Kayuga developments, with the distance between the mines sufficient to separate their influence on air quality. Cumulative predictions for the developments are conservative and therefore actual levels are expected to be lower than those predicted. Significant increases in cumulative dust levels will be confined to an area west of Muswellbrook.

One residence south west of the Mount Pleasant Infrastructure area could be cumulatively affected by noise from the Mount Pleasant and Bengalla Mines. At other residences most likely to be affected by cumulative noise, calculated values are within the relevant criteria for a single mine. A number of residences in Kayuga village will receive less than 40 dB(A) daytime noise from either the Mount Pleasant or Kayuga Mines alone, but more than this value for the two combined.

Cumulative landscape changes will be evident over 11 kilometres from the southern part of Bengalla Mine to the northern part of Kayuga Mine. Assuming the three commence within five years the most evident cumulative effect will be the rapid development of emplacement formations, most of which would continue to grow throughout the life of each project until final rehabilitation.

Cumulative traffic from the Bengalla, Mount Pleasant and Kayuga Mines will be limited to significant increases on the future mine link roads, with minimal increases on existing roads.

Analysis of future rail operations has indicated that most sections of the Main Northern rail line from Muswellbrook to Newcastle have adequate spare capacity to accommodate additional coal train movements during both average and peak daily periods. However future peak demand from the Bengalla, Mount Pleasant and Kayuga Mines is expected to exceed the current capacity of the Muswellbrook to Antienne section of the rail line, which currently has 11 or 12 allocated coal train paths in each direction daily. This may need to be increased by revised timetabling or other means to accommodate 13 coal trains in each direction daily, at peak periods.

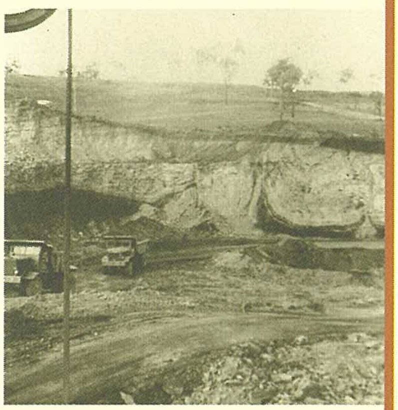
CONCLUSION

Environmental studies found that the project could cause significant adverse environmental effects. Measures to safeguard adverse effects were incorporated into the proposal.

Overall, the project is justified because the social and economic benefits exceed the environmental costs.

PART A
BACKGROUND

INTRODUCTION 1



This chapter introduces the Mount Pleasant Project and site. A profile of the proponent company and the project history is provided. The structure of the Environmental Impact Statement is explained with suggestions on how to read the report.

1.1 BACKGROUND

Coal & Allied Operations Pty Limited (Coal & Allied) proposes developing a major open cut coal mine at Mount Pleasant, which is approximately three kilometres west of Muswellbrook in the upper Hunter Valley of New South Wales (*Figure 1*). The mine will extract about 197 million tonnes of run-of-mine coal to produce about 142 million tonnes of saleable coal over a period of 21 years.

Run-of-mine (ROM) coal will be washed on site to produce a range of thermal coals. Low ash coal could also be used to make coal-water mixture, a new fuel product which can be stored, handled and burned in similar ways to fuel oils. Product coal will be transported to the Port of Newcastle via a rail loop built to the south of the Mount Pleasant infrastructure area and connected to it by an overland conveyor.

The project is a designated development under the *Environmental Planning and Assessment Act*, 1979. As such an environmental impact statement (EIS) must accompany a development application to Muswellbrook Shire Council for the proposal. The EIS must be exhibited publicly and all adjoining landowners notified.

A direction under Section 101 of the Act applies to the proposal. This states that an application for a new coal mine which requires a new coal lease must be determined by the Minister for Urban Affairs and Planning. As a consequence, Muswellbrook Shire Council will refer the development application and assessment of the EIS, along with all public submissions, to the Minister for Urban Affairs and Planning.

This Environmental Impact Statement (EIS) examines the implications of proceeding with the proposal.

1.2 SITE AND SURROUNDS

The Mount Pleasant Authorisation (No. 459) is 5.8 kilometres long by 5.6 kilometres wide and is located on predominantly undulating to rolling country to the west of the Hunter River. There are small areas on the eastern boundary extending into the floodplain. In this document a reference to the "site" means the Mount Pleasant Authorisation and three additional areas, two of which adjoin the northwest and southwestern corners of the Authorisation. The third is a narrow strip of land approximately 300 metres long and 100 metres wide which is required for rail access. The two larger areas were included in the "site" as there was insufficient area available on the Authorisation to extract the coal resource and provide emplacements for non-coal materials. The third was included because it is outside the area previously studied as part of the Bengalla mine development (Envirosciences, 1993). *Figure 2* shows the site and surrounds.

The site covers 3,800 hectares and is mainly used for grazing on native/natural pasture with some partly improved pasture along the eastern boundary. Surrounding land uses include pecan nut plantations, grape vines, horse and cattle studs, minor cultivation such as turf, flower and market gardens, and rural residential areas. Bengalla Mine adjoins the southern boundary, while the proposed Kayuga Mine and surface facilities for the underground Dartbrook Mine are to the north.

1.3 COMPANY PROFILE

Coal & Allied is one of Australia's leading producers and exporters of black coal. It is now part of the Rio Tinto Group, one of the most significant diversified miners in the world. Its mining assets include two large open-cut coal mines (Mount Thorley Operations and Hunter Valley No. 1 Mine) each of which includes coal preparation facilities. These mines can produce up to 11 million tonnes of product coal each year for thermal and coking markets.

The two mines are near Singleton in the upper Hunter Valley. Hunter Valley No. 1 Mine has a rail loading facility which allows coal to be transported directly to the Port of Newcastle, while Mount Thorley Operations dispatches coal to the port through the joint Mount Thorley coal terminal. These mines are responsible for all of Coal & Allied's saleable output and are amongst the largest operating coal mines in New South Wales.

Coal & Allied has been recognised for its mine rehabilitation and environment-related work with the following awards:

- NSW Conservation Service's Jubilee award;
- inaugural Hunter Rural Tree Award (Mine Site section);
- inaugural NSW Minerals Advisory Council Award for Environmental Excellence;
- NSW Landcare Award (Business Section); and
- Environmental Performance Award (Highly Commended) from the Hunter Catchment Management Trust.

1.4 PROJECT HISTORY

Coal mining commenced in the Mount Pleasant area in the 1890s and Kayuga Colliery, a small underground mine, operated from this time until about 1930. Over the next 40 years there was little recorded mining or exploration activity. In 1970 interest in the area rekindled when Buchanan Borehole Collieries drilled several boreholes in what is now the Bengalla site. Over the next 20 years various exploration programs were completed in the Mount Pleasant area and ultimately three Authorisation areas were allocated:

- *Authorisation No. 256.* This is immediately north of Mount Pleasant and contains the operating Dartbrook underground coal mine and proposed Kayuga open-cut mine;
- *Authorisation No. 438.* This is the Bengalla mine area immediately south of Mount Pleasant; and
- *Authorisation No. 459.* This is the Authorisation granted to Coal & Allied in April 1992.

Coal & Allied had the following objectives in seeking an Authorisation to Prospect at Mount Pleasant:

- to secure a long life thermal coal resource. New and more specialised markets were evolving for Coal & Allied for which the company had no available production as its two other mines were now mature operations; and

- to prove up coal reserves at Mount Pleasant which could supply low ash coal to a proposed coal-water mixture (CWM) plant. CWM is a new, alternative fuel which is mainly used for power generation. The fuel is a highly concentrated suspension of finely ground coal in water that can be stored, handled and burned in a similar way to fuel oils. A development application for a CWM plant on Kooragang Island was approved in 1995.

An initial Planning Focus Meeting was held in March 1995, giving control authorities and stake-holders a preliminary overview of the proposal and associated environmental issues. Mine planning and environmental impact assessment work continued during 1995 and early 1996.

During this time Muswellbrook Shire Council expressed reservations about locating mine infrastructure on the eastern side of the mine. This location had been selected after assessing several sites' economic viability, technical feasibility and general environmental effects. The eastern site was found suitable as:

- it was located at the centre of easiest access to a number of coal resource blocks with the seams dipping away to the west. Mining could commence at the shallowest end of the resource blocks, thereby minimising haulage distances to coal preparation facilities; and
- environmental safeguards including earth bunds and sensitive building design could visually shield infrastructure from Muswellbrook. Noise impacts could have been reduced through a combination of earth bunds and appropriately selected building materials.

Nevertheless, the company wished to develop an outcome that met local community needs, while still ensuring the economic viability of the mine. A joint working party was established under the guidance of an independent facilitator and included mine planners and infrastructure designers. It was found that infrastructure could be built in the south-west corner of the mine and whilst not ideal, would be feasible under altered mining operations. This process and the alternatives considered are detailed in Chapter Five.

1.5 EIS STRUCTURE

This EIS was prepared in accordance with the requirements of the *Environmental Planning and Assessment Act*, 1979. Details of statutory requirements and an identification of the major environmental issues are provided in Chapter Four. The main volume of the EIS is divided into four sections as follows:

- PART A has four chapters describing the project background, needs and objectives. The decision-making process and key issues from community and government consultation are identified;
- PART B has two chapters outlining alternatives and the proposal;
- PART C identifies interactions between the proposal and the environment. This part of the EIS contains nine chapters including a summary of measures to mitigate environmental effects; and
- PART D presents a validation for the project. An analysis of the project's relation to the principles of ecologically sustainable development is given in this part of the EIS.

Specialist studies were undertaken by ERM Mitchell McCotter staff and external specialists. Where work was completed by internal staff, their findings are presented in the main volume (Volume 1). Where external specialists were used, a summary is presented in the main volume whilst full reports are presented in Volumes 3 and 4.

1.6 HOW TO READ THE EIS

This EIS was prepared by a team of environmental consultants. If you are interested in all aspects of the proposal and its environmental interactions, then it is suggested that you read the document as presented.

If, however, you are interested in specific issues then you can save time by referring directly to the chapters where they are considered. It will be helpful if you first read the description of the mining proposal presented in Chapter Six as it describes:

- how the mine will be developed and operated;
- where the mine infrastructure will be located; and
- processes which will be performed on site.

After reviewing Chapter Six you can then refer to the Table of Contents which will direct you to the relevant chapter in this volume. Figures referenced in the text are presented in Volume 2. Overlays showing the extent of mine operations, property boundaries and residences (*Figure 67* and *68)* are also provided in Volume 2. Reports from external specialists are included in Volumes 3 and 4. It is worth noting that Chapter Fifteen summarises all mitigation measures incorporated in the proposal.

For example, if you are specifically interested in Air Quality then you could adopt the following course of reading:

- first, read Chapter Six describing the mining proposal;
- then read Chapter Eleven. All chapters in the main volume have been written with a minimum of jargon so they can be analysed by people who may not have technical training in the particular issues. Where jargon is unavoidable, terms used have been listed in a glossary in Volume 1. Chapter Eleven refers to four additional specialist studies which are presented as Supplementary Reports 6, 7, 8 and 9; then
- finally, read any specialist studies of particular interest. Supplementary Report 6 gives the results of dust deposition and concentration computer modelling, Supplementary Report 9 describes the effects of dust on human health, Supplementary Report 7 assesses the impact of coal dust on plant growth and Supplementary Report 8 considers the impact of increased dust deposition rates on grazing animals.

NEED FOR THE PROJECT

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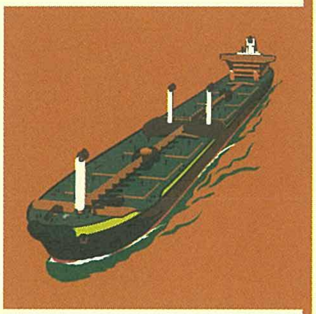
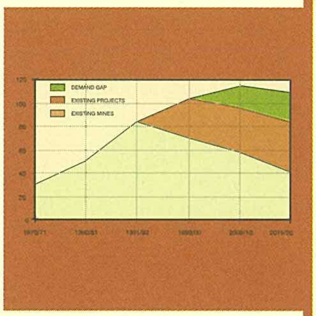




This chapter describes the coal resources of New South Wales and the site, the coal mining industry and its economic outputs, and the need for the Mount Pleasant Mine.

2.1 GEOLOGY AND COAL RESOURCES

2.1.1 *Regional Geology*

Mount Pleasant is situated on the north-eastern margin of the Sydney Basin, a geological structure containing the major coal resources of NSW. These coal deposits are of Permian age and have been grouped into four main divisions, the:

- Upper Coal Measures, also known as the Singleton Super Group, containing two subdivisions, the Wollombi Coal Measures and the Wittingham Coal Measures;
- Upper Marines or Maitland Group;
- Lower Coal Measures or Greta Coal Measures; and
- Lower Marines or Dalwood Group.

The coal seams at Mount Pleasant are part of the Wittingham Coal Measures which are the lower part of the Singleton Super Group and contain the major coal resource of the Hunter Valley. Seams within these coal measures are also mined at Coal & Allied's Mount Thorley Operations and Hunter Valley No. 1 Mine. Regionally, the Wittingham Coal Measures crop out (that is, are exposed at the surface) on the western flank of a major fold structure in the Hunter Valley known as the Muswellbrook Anticline and dip to the west at generally less than five degrees.

Seams of the lower Jerrys Plains and Vane Subgroups are part of the Wittingham Coal Measures. This lower section of the Jerrys Plains Subgroup is up to 300 metres thick in the Mount Pleasant area and contains the Bowfield, Warkworth, Mount Arthur, Piercefield, Vaux, Broonie and Bayswater Seams. Rock strata between coal seams typically comprise sandstone, siltstone, conglomerate and tuffaceous claystone (known as the Fairford Formation).

Underlying the Jerrys Plains Subgroup is the Vane Subgroup which is about 150 metres thick. This Subgroup can be further subdivided into the Foybrook Formation containing the Wynn, Edderton, Clanricard, Bengalla, Edinglassie and Ramrod Creek seams and the Archerfield Sandstone/Bulga Formation. This latter formation is of marine origin and effectively separates the seams of the Jerrys Plains Subgroup and the underlying Foybrook Formation.

2.1.2 *Site Exploration*

The Mount Pleasant Authorisation to prospect was granted to Coal & Allied in April 1992. Prior to this some limited geological exploration had been undertaken in the area by the Department of Mineral Resources and two private companies. In 1992 Coal & Allied commenced a three stage exploration program designed to allow an orderly progression through the conceptual, feasibility and detailed mine planning phases.

Stage One exploration, which began in September 1992, collected sufficient data for conceptual mine planning. It involved drilling 32 small diameter (or slim core) and seven large diameter drill holes with a combined drill length of 5,300 metres. All slim core holes were analysed for lithological, geophysical and geotechnical data. Coal quality was assessed from samples taken in each drill hole. An aerial magnetometer survey was completed to define the extent of igneous intrusions in the area.

Stage Two exploration started in October 1993, providing additional data for mine feasibility studies. Slim core holes were drilled on a 500 metre grid together with 9 large diameter holes with a combined drill length of 12,500 metres. Nine open holes were drilled on a 250 metre grid and geophysically logged to confirm seam correlations. Samples from all drill holes were again used to assess coal quality. A ground radar survey was completed to determine the orientation of an igneous dyke.

Stage Three exploration which commenced in early 1995 extended open hole drilling to a 250 metre grid. High definition magnetometer surveys were used to define igneous intrusions. Further open hole drilling on a 125 metre grid was also undertaken to identify areas of faulting and anomalous seam structures.

Figure 3 locates the exploration drillholes and identifies significant geological features.

2.1.3 *Coal Reserves*

Open-cut methods optimise the extraction of relatively shallow coal resources at Mount Pleasant. Several seams considered uneconomic for open-cut mining have potential for extraction by underground techniques. Coal & Allied intends to seek approval to extract these resources in the future during the operating life of the current proposal. This would be the subject of a separate development application and environmental impact statement which would take into account the cumulative effects of open-cut and underground operations.

Large variations in coal seam thickness are a characteristic of the geology of Mount Pleasant. All seams divide into distinguishable sub-seams or splits. These either coalesce in different combinations to form single working sections or occur as discrete mineable units. *Figure 4* shows two east-west sections through the deposit illustrating this variation and relative seam positions. In general, seams diverge to the north and west with total thickness of the geological sequence between the Warkworth to Edderton seams increasing in the same direction. The seams best suited to open cut mining are listed in order from top to bottom, with their maximum number of splits, are:

- Warkworth, the upper seam (five splits);
- Mount Arthur (three splits);
- Piercefield (six splits);
- Vaux (five splits);
- Broonie (four splits);
- Bayswater (four splits);
- Wynn (nine splits); and
- Edderton, the lowest seam (four splits).

These seams can produce a range of thermal coals from a low to medium ash export product to a higher ash domestic product. Low ash coal could also be used to make coal-water mixture, a new fuel product described in Chapter One.

The quantity of coal in the deposit was calculated according to the *Australian Code for Reporting Identified Coal Resources and Reserves* (Department of Mineral Resources, 1986). The code includes the following definitions:

- 'resource' refers to all the in-situ coal identified by the geological data; and
- 'reserves' are those resources which are planned to be mined.

The total resource is estimated to be 1,423 million tonnes. It is expected that about 439 million run-of-mine (ROM) tonnes of coal reserves could be recovered by open-cut mining.

2.1.4 *Structure and Igneous Intrusions*

All coal seams intersect the surface along a general north-south line and dip (or slope) to the west. In the north they dip at about three to four degrees, steepening to about four to five degrees in the south.

Faulting is expected to be similar to that reported in adjacent areas, with main fault lines trending east-west.

Igneous intrusions and heat affected coal were found by drilling and also inferred from an aeromagnetic survey. The aeromagnetic survey showed a prominent dyke trending west of north through the mining area. A dyke is a wall-like, vertical or steep volcanic rock intrusion with more or less parallel sides. Minor volcanic plugs, or vertical tubes of igneous rock, were also identified.

Drilling also located a zone next to the western side of the site that has silling and heat affected coal in various seams. A sill is a generally horizontal sheet of igneous rock. The heat affected zone forms a boundary for any potential mine. Each seam has a different extent of silling and heat affectation.

Significant geological features are shown on *Figure 3*.

2.1.5 *Rock Characteristics*

Open-cut mining removes rock layers over and between the coal seams. These rock layers are referred to as overburden, interburden, midburden or partings depending upon their position. In this EIS "rock" describes all non-coal material.

Excavated rock is either placed in mined out areas or taken to out-of-pit emplacements and incorporated into the post-mining landform. Emplacements have areas of exposed, unweathered and fragmented rock from which salt and other soluble elements can sometimes be leached. Leachates could drain water onto undisturbed areas, or if the rock is close to the surface, may affect plant growth on rehabilitated land. These rock characteristics were therefore investigated.

There are three leachate characteristics that can be a cause of concern:

- acidity;
- high salinity; and
- sodicity.

Rock characteristics were investigated by the NSW Department of Mineral Resources as detailed in Supplementary Report 1. Analyses were completed on 62 samples of the dominant rock types obtained from the exploration program. The investigations were designed to identify rocks that could produce acidic, saline or sodic leachates.

Fourteen samples were described as potentially sodic, seven samples were potentially saline and acidic, while one had high sulphate levels. The remaining 40 could not produce acidic, saline or sodic leachate. Importantly, acidic and saline results were only associated with the Wynn coal seam. Sodic rock layers were more widespread, particularly in the interburden between the Broonie and Mount Arthur coal seams.

2.2 PROJECT CONTEXT

2.2.1 *Coal Resources*

The major coal resources of New South Wales are contained in the Sydney-Gunnedah Basin; a geological structure stretching from the south coast to the central north-west of New South Wales (NSW Department of Mineral Resources, 1995). Five major coal fields are located within the basin. These are the:

- Hunter coal field. This stretches from south of Singleton to Aberdeen in the Hunter Valley and comprises mainly open cut mines with some underground operations;
- Newcastle coal field. This coal field is dominated by underground mines located between Newcastle and Tuggerah Lakes;
- Southern coal field. All mines are underground and extend south from the Royal National Park to Port Kembla and west to Picton and Berrima;
- Western coal field. These are almost all underground mines extending from Lithgow north to Kandos; and
- Gunnedah coal field. Several small open cut and underground mines are located around Gunnedah.

Additional coal fields outside the Sydney - Gunnedah Basin include the Oaklands Basin (one potential open cut coal mine in southern New South Wales) and the Gloucester Basin (two open cut coal mines near Gloucester).

Table 2.1 shows existing recoverable coal reserves in New South Wales and includes only coal within mine leases or exploration licence areas for which at least conceptual mine plans have been prepared.

Table 2.1 RECOVERABLE COAL RESERVES IN NEW SOUTH WALES

Coal Field	Reserves (millions of tonnes)
Hunter	4,890
Newcastle	1,050
Southern	1,160
Western	1,420
Gunnedah	1,140
Oaklands	1,120
Gloucester	50
TOTAL	**10,830**

Source: Department of Mineral Resources, 1995.

Research undertaken by the Coal Resources Development Committee found there was a commonly held view that New South Wales has sufficient coal resources to satisfy any future demand. The Committee, however, found that:

> *"New South Wales is likely to face a serious shortage of economically mineable coal in the future"* (Coal Resources Development Committee, 1994).

Although substantial coal resources remain, about half are affected by competing land uses such as National Parks and productive agriculture. The Mount Pleasant proposal would add 439 million tonnes of coal reserves which could be recovered by open cut coal mining.

2.2.2 *Development in the Upper Hunter Valley*

The Hunter coal field is located in the upper Hunter Valley and represents about 45 per cent of current recoverable coal reserves in New South Wales. These reserves are found in 19 open cut coal mines and six underground mines. In addition, about six new open cut mines are proposed or in the development stage, as are two underground coal mines.

These coal mines are located between Branxton and Aberdeen and form the largest coal producing area in New South Wales. Annual ROM coal production from the Hunter coal field is currently about 59 million tonnes. Much of this coal is washed to reduce the non-coal content, producing about 46 million tonnes of saleable coal (Department of Mineral Resources, 1995).

Major development projects in the Hunter coalfield are now focused on Muswellbrook as mining ventures around Singleton approach maturity. This development pattern occurred at least in part because those resources were closer to the port and industry in Newcastle. Three new development projects are to the west of Muswellbrook: Bengalla, Mt Pleasant and Kayuga. Bengalla has been approved and construction works are in progress, whilst Kayuga like Mt Pleasant is subject to approval.

Mining is constrained by development around regional centres such as Singleton and Muswellbrook and the Wollemi and Yengo National Parks which cover the western boundary of the coalfield. In addition, mining is also constrained by rich agricultural land along the Hunter River floodplain. Consequently, most available coal resources between Branxton and Muswellbrook in the upper Hunter are already subject to mining or proposed mining activities.

Concern was raised by the community and government regulatory agencies that mining and other activities in the upper Hunter Valley were causing cumulative impacts that extended beyond each discrete industry. This was the subject of a wide ranging investigation titled the *Upper Hunter Cumulative Impact Study* (Department of Urban Affairs and Planning, 1997). The findings of this report are considered in the context of environmental interactions presented in PART C of the EIS.

2.2.3 *Economic Outputs*

i. World Coal Demand Forecasts

From July 1994 to June 1995 coal exports totalled 58.8 million tonnes, representing 66.4 per cent of saleable coal production from New South Wales. Thermal coal contributed 63.5 per cent of total exports with grades of coking coal representing the remaining 36.5 per cent.

Coal exports increased from 57.3 to 58.8 million tonnes from the 1993/94 to 1994/95 financial years. This was mainly due to a growth in demand for thermal coals with exports increasing from 34.1 to 37.3 million tonnes. During the past decade coal exports expanded by over 50 per cent.

The strong growth in demand for thermal coal over recent years is predicted to continue over the next decade. The Australian Bureau of Agriculture and Resource Economics predicted that world demand for seaborne thermal coal will increase by 45 per cent over the next five years, with a projected two per cent decline in coking coal over the same period (Department of Mineral Resources, 1995).

ii. New South Wales Coal Production

New South Wales exports coal to 27 countries worldwide with Japan being the main export destination for thermal (53 per cent) and coking coals (66 per cent). Other Asian countries such as Korea, India and China have established themselves as regular customers, accounting for 27.6 per cent of all exports. The major industry statistics for New South Wales coal are summarised in *Table 2.2*.

Coal mining accounts for approximately 80 per cent of income generated by mining in New South Wales. In 1994-1995 this contributed about $2.8 billion in export earnings for New South Wales from the export of 58.8 million tonnes of coal as shown in *Table 2.2*.

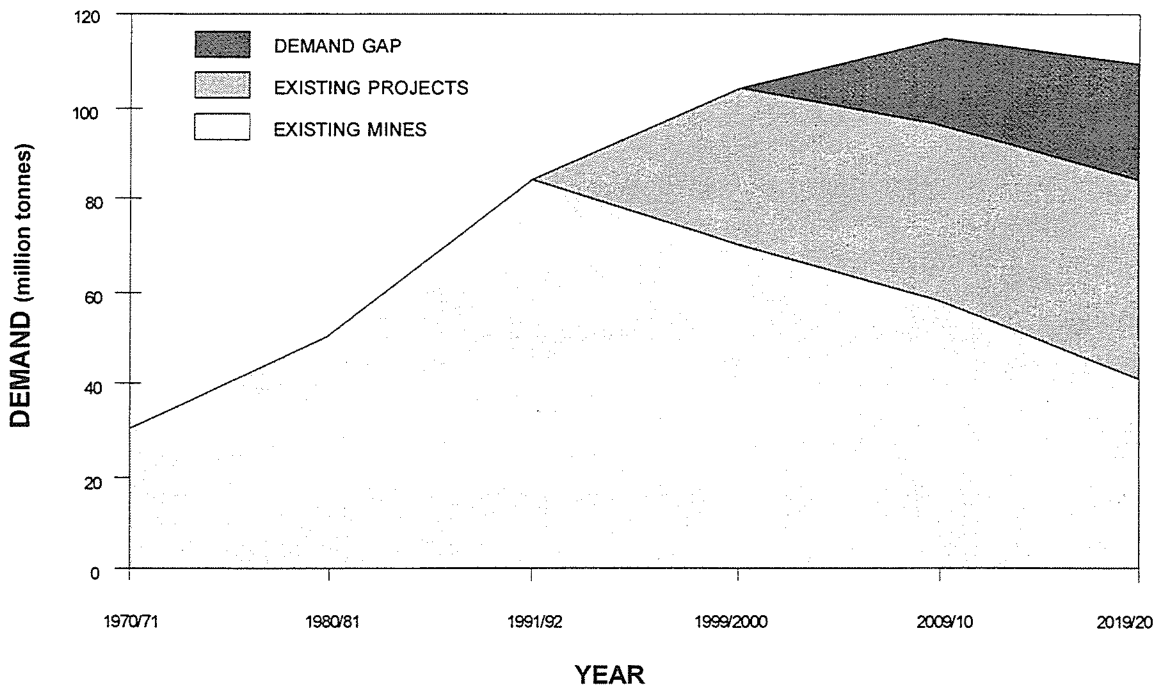
Table 2.2 COAL STATISTICS FOR NEW SOUTH WALES

	1990-91	1991-92	1992-93	1993-94	1994-95
Production ('000t)					
ROM Coal					
- Open cut	45,563	51,488	52,495	55,164	59,079
- Total	96,697	101,170	102,914	101,955	107,781
Saleable Coal					
- Open cut	34,376	39,627	39,384	42,576	45,579
- Total	80,116	83,874	84,211	84,014	88,588
No. of Mines (1)	20	20	20	22	24
Employment (1)	5,008	5,096	5,114	4,841	4,802
Exports ('000t) (2)	51,264	53,544	57,361	57,324	58,801
Value of Exports ($million) (2)	2,709	2,814	3,128	2,991	2,764

Notes: 1 *Open-cut mines only.*
2 *From all mines.*
T *tonnes*

Source: Department of Mineral Resources, 1995

New South Wales exports of coking coal are forecast to remain relatively stable in the medium term mainly due to technological advances in steelmaking. In contrast, the growth in thermal coal exports over the next 10 to 15 years is expected to be significant due to the rapid growth in demand for electricity in the Asian region. *Graph 1* shows the contribution made by existing and proposed mines to meeting the demand for New South Wales coal. It indicates that there is a developing shortfall between supply and demand which will need to be met by new coal developments.



Source: Coal Resources Development Committee, 1994

Graph 1 PROJECTED SUPPLY AND DEMAND FOR NSW COAL

The Hunter/Gunnedah coalfield region is forecast to be the major new mine development area. The strategic value of undeveloped resources in this region is becoming increasingly important as options for new mines in other coalfields diminish (Coal Resources Development Committee, 1994).

Coal & Allied aims to make a significant contribution to continuing exports of Australian coal by developing the Mount Pleasant project. At a peak output of 10.5 million ROM tonnes per annum, Mount Pleasant mine will have an estimated production value of $340 million per year, with an additional $292 million generated from flow-on effects (see Section 10.3.6). The mine will also provide approximately 320 permanent job opportunities, accounting for around $24.6 million in wages and salaries per year.

2.3 NEED FOR THE PROPOSAL

Since existing mines operated by Coal & Allied at Mount Thorley and Hunter Valley are approaching operational maturity, a new long-term resource is required to meet developing markets and to sustain current demand. Current annual production from Mount Thorley Operations and Hunter Valley No. 1 Mine total 11 million tonnes, with potential resources available to 2014 and 2030 respectively. Increased competition from Indonesia and South America, which may limit the share of the international market, increases the importance of these developments that can maintain existing markets. Mount Pleasant contains a suitable thermal coal resource for which there is expected to be a significant increase in export demand over the next 10 to 15 years within the Asian region.

New and more specialised markets are evolving for products such as coal-water mixture. Coal & Allied has development approval for a coal-water mixture plant and should demand for this technology be realised in the near future, the Mount Pleasant site contains a suitably large low ash resource which could be used to feed the plant.

As outlined above, New South Wales has extensive coal resources that have yet to be developed. However, conflicting land uses limit the potential resources available, requiring the careful planning of future mining activities. As demand continues to grow, supply is being constricted by a limited accessible resource and ongoing expansion of conflicting land uses. It is therefore important that new mines be developed in an environmentally acceptable manner to minimise land use conflicts whilst using suitable resources to meet existing and future coal demands.

Mining also generates significant economic benefits to the Hunter Region, the State and Australia through employment, income and output. Direct benefits generate additional economic activity in other sectors.

PROJECT OBJECTIVES

3

This chapter provides a statement of the objectives of the development, as required by Schedule 2 of the EPA Act, and provides the basis for assessing feasible alternatives and justification of the proposal.

3.1 OBJECTIVES OF THE PROPOSAL

The aims of developing a new mine at Mount Pleasant are to provide Coal & Allied with long term coal reserves whilst achieving a balance between impacts on the local environment, community needs and economic viability. The objectives of the proposal have been categorised into production and operational, environmental, and socio-economic objectives.

3.1.1 Production and Operational Objectives

Coal & Allied aims to meet a number of production and operational objectives. These are to:

- establish a world class, competitive open cut coal mine producing export quality coal products;
- provide the company with long term coal reserves so that it can supply existing and emerging markets;
- develop and manage the mine in an environmentally sensitive manner according to regulatory requirements and best environmental practices, whilst ensuring economic viability;
- maximise operational flexibility;
- optimise resource use; and
- develop and operate a mine that meets or exceeds community expectations in terms of environmental outcomes and costs.

3.1.2 Environmental Objectives

The company has an outstanding record in implementing sound environmental management practices at its mines. This record will be continued at Mount Pleasant should this proposal be approved. Coal & Allied will aim to achieve the following objectives:

- to protect native flora and fauna;
- to provide site rehabilitation that enhances existing fauna habitat values;
- to minimise the dispersal of noxious weeds and feral animals;
- to protect the quality of local surface and groundwaters;
- to maximise on site mine water usage and minimise extraction from the Hunter River;
- to maximise available runoff water to surrounding catchments;

- to minimise public health risks from mine operations;
- to ensure that plant growth and grazing animals on areas surrounding the site are not adversely affected by dust; and
- to minimise noise and blasting impacts on surrounding residences.

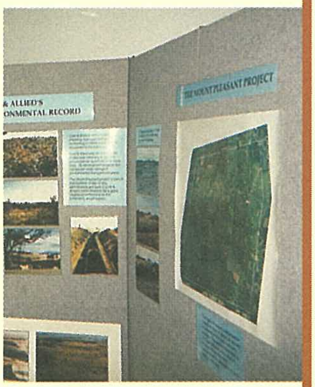
3.1.3 *Socio-Economic Objectives*

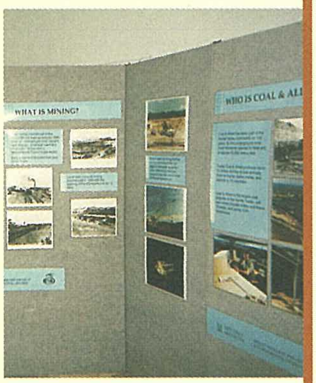
Coal & Allied must ensure that the project does not adversely affect the long-term land capability of the site, local visual amenity, community infrastructure and services, Aboriginal and European heritage, road network and surrounding residential amenity. Therefore, Coal & Allied will aim to achieve the following objectives:

- to maximise the potential to rehabilitate mined areas to their original land capability;
- to minimise impacts on the visual quality of the local area;
- to maximise local employment and educational opportunities;
- to provide affected landowners with the opportunity of property purchase based on market value, to allow relocation without economic loss;
- to protect surrounding residential amenity during the operation of the mine with appropriate environmental safeguards;
- to ensure that the cost of increased demands on community infrastructure and services that are a direct result of the mine development is provided by the company;
- to identify and protect sites of Aboriginal and European cultural and heritage significance;
- to liaise with the Local Aboriginal Land Council, Tribal Council and other appropriate agencies on management of the known and unknown archaeological resource;
- to protect surrounding landowners from the economic loss of water supplies resulting from the proposal;
- to assist in implementing regional road network changes according to the recommendations of Muswellbrook Shire Council's Western Roads Strategic Transport Strategy;
- to maintain road safety; and
- to establish an environmental monitoring program and provide procedures for the resolution of community concerns.

4

PLANNING REQUIREMENTS, CONSULTATION AND KEY ISSUES





This chapter describes the planning framework and the statutory processes that must be followed in preparing the EIS and obtaining approval for the proposed mining activity. The consultation undertaken during the EIS preparation and main environmental issues identified from this process are given.

4.1 PLANNING FRAMEWORK

The proposal cover 3,800 hectares within Muswellbrook Shire Council Local Government Area.

Several planning instruments at the state, regional and local level are relevant to the mine proposal. These are discussed below.

4.1.1 *Permissibility*

The proposed mine is covered by State Environmental Planning Policy No. 45 - Permissibility of Mining and Muswellbrook Local Environmental Plan 1985.

i. State Environmental Planning Policy No.45 - Permissibility Of Mining

This state environmental planning policy was gazetted on 4 August 1995 and relates to the permissibility of open cut and underground mining. The general objective of the policy is to promote the social and economic development of the State by ensuring that there are clear planning controls applying to the determination of mining projects across the State.

As stated by the Department of Urban Affairs and Planning Circular No. B37:

> *"SEPP 45 applies to development proposals for mines where mining would be permissible in accordance with an environmental planning instrument, but the permissibility, without SEPP 45 being in effect, would be subject first to provisions in that environmental planning instrument being satisfied.*
>
> *In these circumstances, SEPP 45 provides that mining is permissible on that land without those provisions having to be satisfied. Such provisions have no effect either in determining whether or not mining is permissible on the land, or in the determination of a development application to carry out mining on the land."*

ii. Muswellbrook Local Environmental Plan 1985

The Muswellbrook Local Environmental Plan was gazetted on 9 August 1985 and has been subject to several amendments. Under the LEP, the proposed site is in two zones as shown on *Figure 35*. These are a Rural 1(a) zone and a General Environment Protection 7(L1) Alluvial Areas zone.

Mines are permitted in the Rural 1(a) zone with development consent. Under the Environment Protection L1 zone, mines are prohibited unless special requirements outlined in Clause 17(2) of the LEP are considered to be satisfied by Council. These are where the development will not:

> *"(i) destroy or impair the agricultural production potential of the land or, in the case of underground mining, unreasonably restrict or otherwise affect any other development on the surface;*
>
> *(ii) detrimentally affect in any way the quantity and quality of water in either subterranean or surface water systems; or*
>
> *(iii) in the case of an extractive industry, visually intrude into its surroundings, except by way of suitable screening; or*
>
> *a purpose permissible in an adjoining rural or environment protection zone, where it is satisfied that the land is not physically part of the alluvial plain and the development will not have the affects referred to in paragraph (a)(i), (ii), and (iii)".*

These special requirements to determine permissibility are however, overridden by SEPP 45 which enables the development to be classified as permissible without having to satisfy these requirements. A discussion of the background to SEPP 45 is contained in the Department of Urban Affairs and Planning Circular No. B37 which is reproduced in Appendix G.

Whilst SEPP 45 overrides other environmental planning instruments in determining the permissibility of a mining project, their provisions are still relevant to the Minister's consideration. This was clarified in Rosemount Estates v Minister for Urban Affairs and Planning which found that SEPP 45 *"does not oblige the Minister to disregard these provisions in determining the application"* but only renders ineffective those parts that determine whether or not mining is permissible. The following sections therefore outline relevant sections of environmental planning instruments that the Minister must consider in the determination process. A brief summary of these considerations and where they have been addressed in the EIS is also given.

4.1.2 Hunter Regional Environmental Plan 1989

The Hunter Regional Environmental Plan (REP) 1989, is a revision of an earlier plan which was gazetted in March 1982. It sets a policy framework for the Hunter Region over a 20 year period. The plan guides the preparation of local planning instruments and the processing of development applications, in accordance with regional objectives. The Hunter Region covers an area of 797 square kilometres.

Much of the Hunter Region's contribution to the national economy is attributable to its coal-resource base, which remains a major resource in the regional economy. One aim of the REP is to *"encourage coal development, through the careful assessment of coal bearing land in relation to other developments"*.

Parts of the REP directly relevant to coal mining are:

- Part 4 - Land Use and Settlement;
- Part 5 - Transport;
- Part 6 - Natural Resources; and
- Part 7 - Environment Protection.

The requirements of these parts are outlined below.

i. Land Use and Settlement

Division 1 of Part 4 (Land Use and Settlement) relates to rural land. The objective of this division is to protect prime crop and pasture land from alienation, fragmentation, degradation and sterilisation. Prime crop and pasture land is defined as:

> *"Class 1, 2 or 3, or special purpose lands on maps prepared by the Department of Agriculture and Fisheries from time to time, or land identified by the Department of Agriculture and Fisheries as being Classes 1, 2 or 3, or special purpose lands."*

Clause 27(2) requires that if this land is to be used other than for commercial farming, the consent authority should be satisfied that the proposal will not significantly reduce the agricultural potential of the land.

> The proposed development will be undertaken in a series of stages which will allow areas not affected by mining to remain available for agricultural use. Rehabilitation of land after mining will maintain the existing levels of Class I, II and III land capabilities. These are primarily the more productive agricultural lands in the eastern portion of the site.

Clause 27(3) relates specifically to open-cut coal mines on areas identified as prime crop or pasture land. Matters listed for consideration by consent authorities include:

> *"(a) the degree to which the mining or resource extraction area can be restored for further agricultural use;*

> As outlined in Section 7.2.5 the rehabilitation program will return most mined areas to their pre-mine land capability or better. An unavoidable exception to this is the loss of land associated with the final void which is unsuitable for agricultural use.

(b) *the likely affects on agricultural land and surface and groundwater resources in the vicinity; and*

Agricultural lands not directly affected by mining activities will be available for continued production. An assessment on the effects of dust deposition on plant growth and grazing animals indicates that the levels resulting from the mine are not likely to be significant. The mine will result in a reduction of surface runoff in surrounding catchments and a reduction in borehole levels, but may result in improved water quality. Where economic loss of yield results from the proposal, water supplies will be replaced.

(c) *the cost of sterilisation of the coal resource, mineral resource or extractive material if mining or extraction does not proceed."*

The total coal resource is estimated to be 1,423 million tonnes. It is expected that about 439 million run-of-mine tonnes could be extracted by open-cut mining. At a peak output, the Mount Pleasant Mine will have an estimated value of production of $340 million per year, with an additional $292 million generated from flow-on effects.

These issues are further discussed in Chapters Seven, (Description of the Physical Environment, Nine (Surface and Ground Water Management) and Five (Alternatives) of the EIS.

ii. *Transport*

Part 5 (Transport) of the REP seeks to maximise accessibility and facilitate the movement of people and goods throughout the region in a manner that recognises social, economic, environmental and safety considerations. This includes the need to encourage the transport of bulky goods, especially coal, by rail or other non-road modes where practicable.

Clause 34 of the plan states that consent should not be granted to a development which involves delivery by heavy transport vehicles, unless other alternative transport modes were considered.

The Mount Pleasant project proposes that coal will be transported by rail from the mine to the port of Newcastle. Employee and materials transport will be on the local road network with a range of regional road network changes proposed in accordance with the recommendations of the Muswellbrook Western Roads Strategic Traffic Study (Muswellbrook Shire Council, 1997). Traffic impacts will generally only be significant on future mine roads, with minimal increases on existing roads. Transport is discussed in Chapter Fourteen of the EIS.

iii. *Natural Resources*

Division 1 of Part 6 (Natural Resources) relates to planning strategies for mineral resources and extractive materials. The objectives of the plan are to:

"(a) *manage the coal and other mineral resources and extractive materials of the region in a coordinated manner so as to ensure that adverse impacts on the environment and the population likely to be affected are minimised;*

Assessment of the development was undertaken in consultation with statutory authorities, the local community and Muswellbrook Shire Council to identify key issues. An assessment of cumulative impacts was undertaken including consideration of the draft Upper Hunter Cumulative Impact Study.

(b) *ensure that development proposals for land containing coal and other mineral resources and extractive materials are assessed in relation to the potential problems of rendering those resources unavailable; and*

Assessment of alternative mining methods indicated that to most effectively utilise the resource requires mining by open-cut methods. Development of the mine plan and alternative infrastructure options considered the potential for sterilisation of future coal resources.

(c) *ensure that the transportation of coal and other mineral resources and extractive materials has minimal adverse impact on the community".*

Coal will be transported by rail from the mine to the port of Newcastle. Project objectives include implementing regional road network changes according to recommendations of the Muswellbrook Western Roads Strategic Traffic Study and to maintain road safety.

iv. *Environment Protection*

Division 1 of Part 7 of the REP relates specifically to pollution control, the objective of which is to minimise air, noise and water pollution. Ways to reduce the impacts of a proposal include:

- an appropriate buffer zone to ensure that the effects of noise, dust and vibration are maintained at acceptable levels;

  The area within which adverse noise, blasting or air quality effects may potentially be experienced has been determined. An offer to either purchase or to install amelioration measures will be available to landholders within this area.

- the incorporation of technology in the design and operation of equipment and facilities to control air, water and noise pollution; and

  A range of mitigation measures to minimise air, noise and water impacts is proposed using the best available. These are summarised in Sections 15.1.2, 15.1.5 and 15.1.6.

- measures to control emissions from equipment or facilities so there is no significant deterioration of air or water quality.

  Measures to control dust emissions from equipment include the use of water sprays, wind guards, landscaping, watering of working surfaces, and controls on blasting. The mine water management system has been designed to separate mine water from undisturbed or rehabilitated areas. These aspects are discussed in Sections 11.6, 6.4 and 9.6.

Division 3 deals with environmental hazards. The objectives are to minimise effects of soil erosion and land slip, to control developments on flood liable lands and encourage floodplain management practices which ensure maximum personal safety and appropriate land uses.

The soils on site generally have a moderate erosion potential although limited areas of high to very high erosion potential also occur. Erosion control during stripping, stockpiling and respreading will primarily be controlled through retention of a vegetative cover and grading along the contour. The development will not be affected by flooding.

4.1.3 *Hunter Regional Environmental Plan 1989 - Heritage*

The Hunter REP contains details of heritage items considered to be of State or Regional significance. It provides legally binding controls against major alteration or demolition of such items, without public evaluation and consent.

The plan seeks to conserve the environmental heritage of the Region, promote the appreciation and understanding of the Region's heritage and to encourage conservation. It lists four schedules of heritage significance:

- items of State significance (Schedule 1);
- items of regional significance (Schedule 2);
- items of local significance (Schedule 3); and
- items requiring further investigation (Schedule 4).

Several heritage items within proximity of the site are listed in *Table 10.17*, although none is located on the site.

Clause 13 of the REP relates to development proposals in the vicinity of a heritage item. This states that Council shall not grant consent to development in the vicinity of a heritage item unless;

"it has made an assessment of the effect the carrying out of that development will have on the heritage significance of the item and its setting."

It should be noted that this Clause does not apply to an item listed within Schedule 4 (items requiring further investigation).

An assessment of the effects of the development on surrounding heritage items is given in Section 10.5.1. Management safeguards to protect heritage significance are given in Section 10.5.2.

4.1.4 *Muswellbrook Local Environmental Plan 1985*

This section addresses those parts of Muswellbrook LEP 1985 that are not related to permissibility of the proposed mine as discussed earlier. The principal aims of the LEP are:

"(a) *to provide the council with the means of managing the urban growth of Muswellbrook and Denman resulting from major resource based development projects;*

(b) *to ensure that growth and development in the Shire of Muswellbrook occurs in a way which preserves existing environmental qualities and minimises adverse environmental impacts;*

(c) *to retain options for long term land use and transport structural change;*

(d) *to protect the agricultural production of rural land in the Shire of Muswellbrook; and*

(e) *to ensure that existing and future residents enjoy a range of attractive living environments and have access to the widest possible range of services and amenities."*

Detailed objectives to achieve the aims are set out in Schedule 1 of the LEP. Of relevance to the mine proposal are:

- an allowance for an urban buffer to protect Muswellbrook and Denman from any adverse impacts of future mining;

  At its closest point the mine will be 3 kilometres from Muswellbrook. The area within which adverse noise, blasting or air quality effects may potentially be experienced has been determined. An offer to either purchase or to install amelioration measures will be available to landholders within this area. Properties outside this zone will be protected against reduced residential amenity by the environmental safeguards detailed in this EIS.

- to allow for the continued economic growth of business in the Shire;

  The peak production value of the mine is $340 million, with a further $292 million generated through flow-on effects.

- to increase employment opportunities;

  The mine will directly employ an average of 320 people with additional employment opportunities during the construction period. It is estimated that direct employment from the mine may create a further 528 jobs in the region.

- to promote a high standard of visual amenity through scenic protection within the Shire;

  The post mining landform will introduce changes to the local landscape. The landform was designed to emulate existing landforms and vegetation patterns in the area, and as far as practicable, has considered adjoining mining developments. Progressive rehabilitation will limit the extent of visual impacts during construction.

- to conserve items of Aboriginal, European, cultural and natural heritage; and

  Generally, the site does not contain a substantial archaeological resource, although a large concentration of artefacts was recorded in the northern catchment of the fines emplacement area. Recommendations have been made for salvage excavation and collection of important sites. Potential impacts on heritage items surrounding the site primarily relate to vibration from blasting. Coal & Allied will undertake to protect buildings, not already committed to protection by other mining developments, through implementation of appropriate safeguards.

- to ensure that land uses are compatible with their environment and adjoining uses and that they operate in an effective manner.

  Agricultural lands not directly affected by mining activities will be available for continued production. The final landform has been designed as far as practicable to conform with surrounding land uses.

i. Zone No. 7 (L1) (Environment Protection General Alluvial Areas Zone)

The objectives of the 7(L1) Environment Protection General (Alluvial Areas) zone are:

"*(a) to ensure that prime alluvial and irrigable land is preserved for agricultural use;*

Rehabilitation of land after mining will maintain the existing levels of Class I, II and III land capabilities. As outlined in Section 7.2.5 most mined areas will be restored to their pre-mine land capability with the exception of the final void.

(b) to ensure that any development of a non-agricultural nature is located and designed in such a way that the reduction of productive land is minimised, flooding risks are minimised, and surface or subterranean water systems are not adversely affected;

An unavoidable consequence of mining is the loss of land associated with the final void which is unsuitable for grazing or pastoral production. The development will not be affected by flooding. The mine will reduce surface runoff in surrounding catchments and lower borehole levels, for up to 80 years after mining, but may result in improved water quality. Where economic loss of yield results from the proposal, water supplies will be replaced.

(c) to form part of the urban buffer for the towns of Muswellbrook and Denman and, to this extent, to meet the objectives specified in respect of land within Zone No. 7 (L2);

At it's closest point the mine will be 3 kilometres from Muswellbrook. The zone of affectation has been determined and an offer to either purchase properties or to install amelioration measures will be available to landholders within this area. Residential amenity outside this zone will be protected by the environmental safeguards listed in Chapter Fifteen.

(d) to enable the future construction of a railway, and to ensure that development does not foreclose this option; and

The development does not inhibit the potential for future construction of a railway.

(e) *to enable development that is associated with, ancillary to or supportive of the primary agricultural uses of the land."*

Class I lands will not be disturbed by the development. An equivalent area of Class II and III lands disturbed by the proposal will be rehabilitated. Areas not directly disturbed by mine activities will be available for continued agricultural use including the more productive agricultural lands on the eastern portion of the site.

While the land is not zoned 7(L2), it is noted from objective (c) above, that the 7(L2) objectives apply. The objectives of this are to establish a protective buffer around Muswellbrook to separate the town from future surface mining activity.

ii. Zone No. 1(a) (Rural "A" Zone)

Relevant objectives of the Rural 1(a) zone are:

"(c) *to ensure that building development in rural areas does not detract from the scenic quality of rural areas;*

The infrastructure buildings have been located and designed to minimise visual impacts on surrounding rural areas. Buildings will mostly be visible during construction. Bunding, dense screen planting and landscaping will effectively eliminate views after a few years.

(d) *to enable mining to occur in an environmentally acceptable manner; and*

The mine will be developed and managed in an environmentally sensitive manner according to regulatory requirements and best environmental practices. Coal & Allied has been recognised for its mine rehabilitation and environment related work with the granting of a number of environmental performance awards.

(g) *to minimise the economic disadvantages to farmers from unjustified speculative increases in land values".*

The displacement of residents from within the site and zone of affectation combined with the in-migration of mine employees will increase the demand for housing and rental accommodation in Muswellbrook and surrounding rural residential areas. An increase in demand may result in a slight increase in property values but this is difficult to quantify due to the number of variables which may modify the value of land at a particular location.

Mines are permitted within this zone with development consent.

iii. Miscellaneous Provisions

Division 5 of the LEP covers miscellaneous provisions. Three of these are directly relevant to mining. Under Clause 34(1)(b) Council must assess the need to impose conditions for the reinstatement of land and the need to secure public safety and amenity.

> Should circumstances arise which prevent further mining then a Final Void Management Plan would be prepared in the last seven year mine sequence. It would address public safety, access, visual amenity, stability, post-mining land-use options and water management.

Clause 35 applies to flood-prone land.

> The development will not be affected by flooding.

Clause 38 concerns payments for amenities and services.

> Payments for amenities and services are discussed below.

iv. Development Contributions

Under Section 94 of the *Environmental Planning and Assessment Act, 1979* contributions to Muswellbrook Shire Council are required to offset increased demands on community services that result from the proposal. The current contribution levy is $2,280 per employee which must be paid to Council prior to commencement of construction. Proposed expenditure of contributions is outlined in Council's Development Control Plan No. 5 and includes:

- completion of existing pedestrian and cycle links between residential areas in North and South Muswellbrook;
- provision of concrete paths, open space, tree planting, lighting and facilities in Denman and Muswellbrook;
- enlarging and upgrading active open space areas and facilities;
- upgrading social infrastructure such as halls, child health facilities, libraries, and community centres; and
- upgrading bush fire services, rural roads and carparking.

An extract from DCP No. 5 detailing proposed expenditure is given in Appendix M.

4.1.5 Other relevant planning instruments and policies

i. State Environmental Planning Policy No. 11

Planning instruments that apply to the proposed mine include State Environmental Planning Policy No. 11 - Traffic Generating Development and Hunter Regional Environmental Plan No. 1.

SEPP 11 requires that the development application be referred to the Roads and Traffic Authority for consideration.

ii. Matters for Consideration (section 90 EPA Act, 1979)

Section 90 of the EPA Act specifies matters which are considered when determining a development application.

A checklist of where these matters are addressed in this EIS is given in Appendix N.

4.2 STATUTORY PROCESSES

4.2.1 Development Consent Procedures

Section 101 of the Environmental Planning and Assessment (EPA) Act, 1979 states,

> *"Where the Minister is of the opinion that it is expedient in the public interest to do so, having regard to matters which in the opinion of the Minister are of significance for State or regional environmental planning, the Minister may give a direction in writing to a consent authority to refer to the Secretary for determination by the Minister in accordance with this section a particular development application or a development application of a class or description of development applications".*

The Mount Pleasant project is a new coal mine, requiring a new coal lease, and is therefore subject to a direction under this clause. Consequently the Minister for Urban Affairs and Planning will determine the project's development application. The application will be lodged with Muswellbrook Shire Council for the area shown on *Figure 66*, who will process the development application and assess the project. Council will then refer the application with recommendations to the Minister for Urban Affairs and Planning.

The project is also a designated development under Schedule 3 of the EPA Regulation. As such, an environmental impact statement must be prepared and exhibited publicly. The Minister must consider all relevant provisions of the EPA Act and any submissions made by Muswellbrook Shire Council, other government bodies and the public.

Preparation of an impact statement is regulated by a number of provisions within the EPA Act and Regulation. It must address the matters set out in Clause 51 of the Regulation and it is also necessary to consult with the Department of Urban Affairs and Planning to determine the Director's requirements for the EIS. Copies of these are reproduced in Appendix A, with a guide to where they are addressed provided in *Table A.2*. Due to the extended development of the project, additional consultation with the Department of Urban Affairs and Planning was required. This is also included in Appendix A.

An EIS acts as the main means of communication between a proponent and the consent authority, statutory authorities, interest groups and the general public. It quantifies and assesses potential impacts as well as documenting the benefits associated with a project. It also provides a permanent and public record of undertakings given by proponents on matters relating to the environment.

Once a development application with an accompanying EIS is lodged it is then processed in accordance with the relevant provisions of the EPA Act and Regulation. This includes placing the EIS and DA on exhibition for a minimum period of 30 days, although the exhibition period may be longer at the discretion of the consent authority. The consent authority is required to notify landowners affected or adjacent to the development. Any person may inspect the documents and make a submission on the project during the period of exhibition. Details of this process are shown on *Graph 2*.

4.2.2 *Preparation of the EIS*

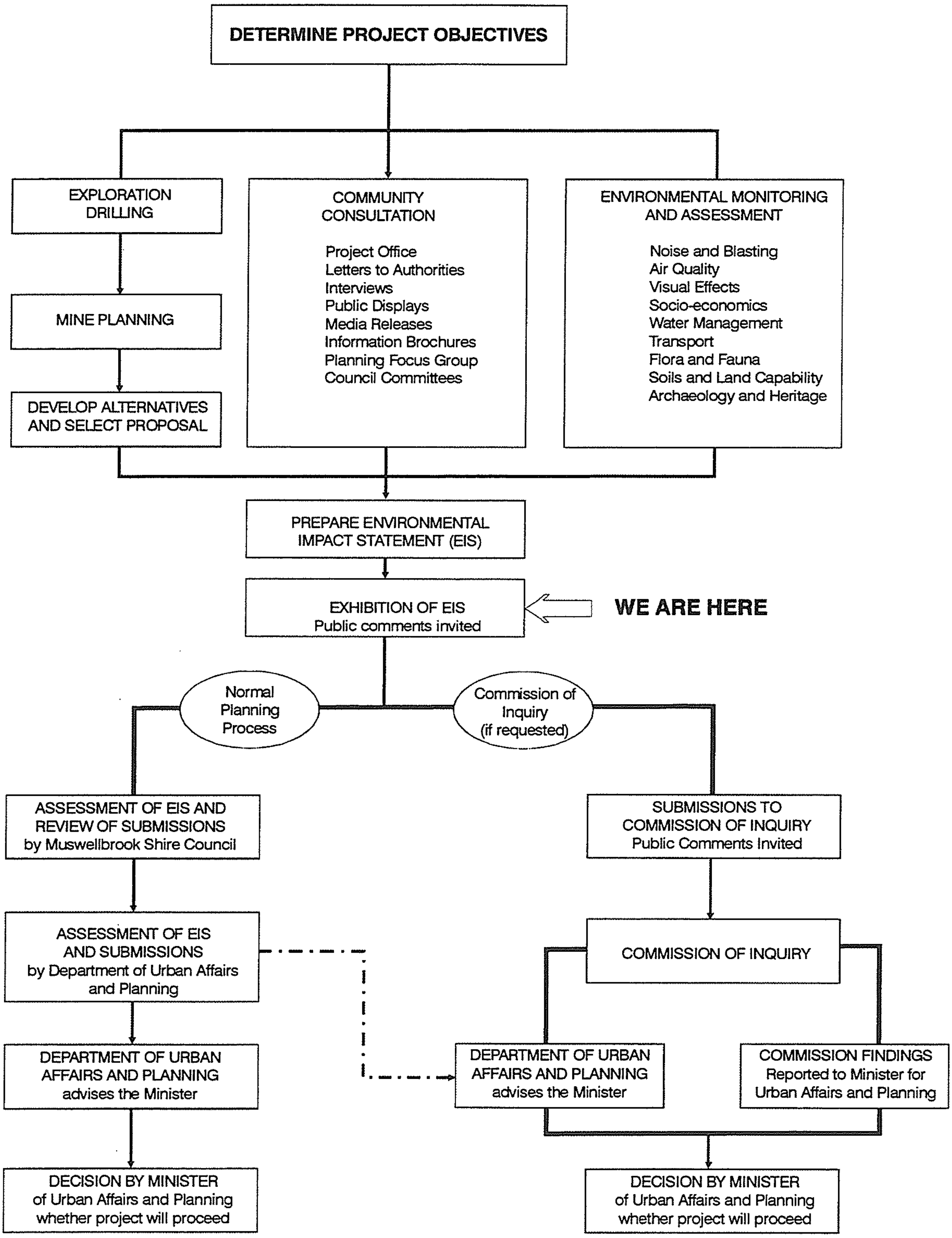
This EIS has been prepared in accordance with the requirements of the EPA Act and Regulation. It also takes into account comments from the public consultation process and requirements of authorities who have a statutory responsibility for some aspect or consequence of the proposal. The certificate required by Clause 50 of the Regulation is included as Appendix D.

The EIS was prepared by a multi-disciplinary study team. The companies and individuals involved are described in Appendix E.

4.2.3 *List of Approvals*

Schedule 2 of the EPA Regulation requires that an EIS contains a *"list of any approvals that must be obtained under any other Act or law before the development or activity may lawfully be carried out"*. Key approvals relevant to the environmental effects of the proposal are listed below while Appendix F lists other legislation which may apply to the project:

- development consent from the Department of Urban Affairs and Planning under the *Environmental Planning and Assessment Act, 1979;*
- the issuing of a mining lease under the *Mining Act, 1992;*
- approval from the Environment Protection Authority (EPA) under the *Pollution Control Act, 1970.* This Act deals with the issuing of licences and approvals under the Clean Air Act, the Clean Waters Act and the Noise Control Act. The EPA was established under the *Protection of the Environment Administration Act, 1991;*
- open-cut approval from the Department of Mineral Resources under the *Mining Act, 1992*. The Department of Land and Water Conservation must also approve the open-cut approval application;
- a permit must be obtained under the *Rivers and Foreshores Improvement Act, 1948* from the Department of Land and Water Conservation for any development within 40 metres of the banks of any watercourse;
- consents to destroy archaeological sites must be obtained from the National Parks and Wildlife Service under the *National Parks and Wildlife Act, 1974;*
- approval to temporarily close local roads when blasting approaches closer than 500 metres. This approval is issued by Muswellbrook Shire Council under the *Local Government Act, 1993;*



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Graph 2 THE EIS PLANNING PROCESS

- licensing under the *Dangerous Goods Act, 1975* for the use, carriage and storage of explosives;
- approval must be sought from the Department of Land and Water Conservation before closing any Crown Roads. In addition, approval must be obtained for closing sections of Castlerock Road, Dorset Road and Wybong Road affected by mining and opening the reconstructed roads;
- approval from the Dams Safety Committee to construct large dams under the *Dams Safety Act, 1978.*

4.3 COMMUNITY CONSULTATION

4.3.1 Community Consultation Program

Community access to the Coal & Allied project team began even before the Authorisation was granted. A shop front office was opened in Muswellbrook in March 1992. Subsequently, public information materials such as information sheets and a model were prepared. Staff were made available to answer questions about the project both during office hours and at other times by appointment. Initially the project team provided advice about the exploration program, environmental monitoring, the mine planning process and the later environmental approvals.

ERM Mitchell McCotter was commissioned to prepare this EIS in 1994, about two years after the Authorisation was granted. The consultation program was then expanded to give the community more comprehensive information about the proposal and to identify the issues and concerns of all interested parties. The consultation program started very early in the EIS process to ensure that community concerns would be addressed in the study.

A number of techniques were used to facilitate communication between the community and the study team during preparation of the EIS. These included:

- interviews with residents. Separate interviews were conducted by Coal & Allied and later by ERM Mitchell McCotter;
- public displays held over two weekends in April/May 1995 and January/February 1997;
- media liaison;
- information brochures;
- community comment forms. These were available during interviews with residents and at the public displays;
- receipt of submissions from individuals and community groups; and
- day-to-day contact.

Details of the community consultation methodology are provided in Appendix C.

4.3.2 *Consultation Outcomes*

Overall, there was a high degree of interest in the proposal. This was clear from attendance at the public display, completion of the voluntary community comment forms by residents near the site as well as the broader Muswellbrook community, and the willingness of residents to make time available for interviews.

A number of issues were consistently ranked as being of most concern. *Table 4.1* summarises the five principal issues from two resident surveys and from the community comment forms. A wide range of other issues were raised in these surveys, during the public displays and in individual submissions. The findings of the community consultation program are given in Appendix C.

Table 4.1 COMMUNITY ISSUES

	Issue and Ranking*				
	1	**2**	**3**	**4**	**5**
Survey Technique					
1. Resident interview (Coal & Allied)	Air Quality	Water Quality	Noise	Socio-economics	Land use
2. Resident interview (ERM Mitchell McCotter)	Air Quality	Effect on local residents	Water Quality	Noise	Vibration
3. Community Comment Forms	Air Quality	Effect on local residents	Water Quality	Noise	Traffic

Notes: * highest concern

Issues that consistently caused the most concern were air quality (dust), water quality, noise, vibration and impact on local residents. Additional issues raised frequently included:

- the impact of closure and deviation of Castlerock Road (also known as Coal Creek Road) on local residents;
- visual impact of the mine;
- ensuring that employment opportunities would be available to local people rather than recruiting from outside the area;
- declining property values;
- the need for ongoing consultation once the mine begins to operate; and
- effective noise and dust monitoring.

4.4 GOVERNMENT CONSULTATION

Government authorities were consulted both formally and informally. Formal consultation involved Planning Focus meetings held on the 8 March 1995 and 4 December 1996 in Muswellbrook. Responses were sought from the government bodies following those meetings. A summary of issues raised and copies of submissions received are included as Appendix B.

A Technical Consultative Group was also formed early in the EIS preparation. Members of the group included Coal & Allied, ERM Mitchell McCotter, the Department of Mineral Resources, the Department of Urban Affairs and Planning, the Environment Protection Authority and Department of Land and Water Conservation. The group allowed informal input from government bodies at an early stage of the project. This information feedback assisted in refining the environmental studies.

Extensive discussions were also held with Muswellbrook Shire Council. These involved informal talks, briefings of Council staff, Councillors and community representatives, as well as making information available to various Council committees.

4.5 KEY ISSUES IDENTIFICATION

Environmental issues associated with the mine extension were identified from consultations with government authorities, discussions with the local community, the operating experience of Coal & Allied at its existing mines and the experience of the study team preparing the EIS. A summary of the major issues raised and where they are addressed in the EIS is given in *Table 4.2*.

No single environmental issue dominated, though a number of factors were considered in detail. For ease of reference these are assessed in eight chapters of this EIS as follows:

- *Chapter Seven* describes the physical characteristics of land use, land capability, climate and bushfire risk. These characteristics are relevant for most areas of impact assessment;
- *Chapter Eight* examines the flora and fauna of the site and surrounds;
- *Chapter Nine* considers the management of surface water and groundwater;
- *Chapter Ten* reviews social implications for the local and regional community;
- *Chapter Eleven* describes air quality including effects on community health, grazing livestock and plant growth ;
- *Chapter Twelve* examines noise and blasting;
- *Chapter Thirteen* discusses the visual affects of changes to the area's landform. Long term uses of the area are addressed; and
- *Chapter Fourteen* outlines mining transport issues.

Measures proposed to mitigate adverse effects of the proposal are summarised in Chapter Fifteen. Alternatives to the proposal are given in Chapter Five. Chapter Sixteen justifies the project on environmental grounds.

Table 4.2 SUMMARY OF MAJOR ISSUES RAISED

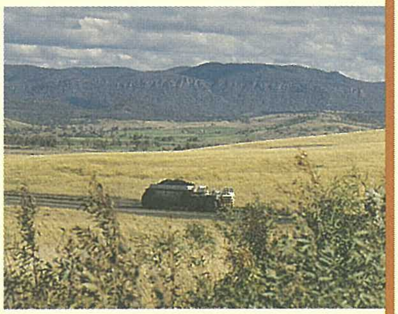
Issue	Sections of EIS where addressed
Noise	Chapter 12
Vibration	12.4
Dust	Chapter 11
Visual impact	Chapter 13
Water quality	9.6
Traffic	14.2, 14.3
Road closures	6.1.6, 14.2.3
Employment opportunities	10.2.1, 10.2.4, 10.3.6
Property values	10.3.7
Monitoring	15.3
Lighting	6.1.5, 6.3.7
Health impacts	11.7, 12.3.5
Agricultural impacts	7.2.5, 9.6, 11.8
Drainage	9.2, 9.3
Water management	6.4, 9.5
Compensation	6.7
Complaints handling	15.2.6
Blasting	12.2.3, 12.4
Landscaping	6.5, 13.4
Rehabilitation	6.5, 7.2.5
Workforce accommodation	10.2.3, 10.3.4
Economic effects	10.2.4, 10.3.6
Buffer zones	7.1.3

Note: *Issues are not listed in any particular order.*

PART B
THE PROPOSAL

ALTERNATIVES

5



This chapter outlines the development of the proposal. An overview is given of the options investigated. The mining methodology is described, identifying constraints to the mining methods and infrastructure alternatives. A preliminary assessment of potential sites for the mine's infrastructure is undertaken together with further analysis of a rail branch line. Further options are considered in developing the final proposal. Finally the consequences of not proceeding with the development and justification for selecting the proposal are given.

5.1 STUDY FUNCTION

5.1.1 Purpose

The purpose of this section of the EIS is to explain the investigations that helped shape the proposed Mount Pleasant project. These investigations involved an assessment of feasible alternatives with regard to the objectives identified in Chapter Three, as required by Schedule 2 of the *EPA Act, 1979.* To explain these investigations this chapter is divided into three sections:

i. Proposal Development

This section considers:

- the mining methodology. The area's geology determines the viability of open-cut and underground techniques. Both factors constrain potential infrastructure and run-of-mine (ROM) coal transport options, in particular the direction of transport from the pit to the coal preparation plant;
- alternative infrastructure arrangements which led to a preferred site;
- a number of ways to build a rail line from the preferred site; and
- the establishment of a Joint Working Party to help develop and assess additional options.

ii. Consequences of Not Proceeding With the Development

This section outlines the implications of not proceeding with a mine and how this relates to the production and operational, environmental and socio-economic objectives given in Chapter Three.

iii. Justification of the Proposal Selection

Justification of the proposal with regards to the objectives outlined in Chapter Three is provided in this section.

5.1.2 *Overview of the Proposed Development*

Phases in the progressive development of the proposed Mount Pleasant Mine are outlined below with a more detailed assessment discussed in the following sections.

i. Mining Method

There are two alternative ways of mining the coal resource at Mount Pleasant, underground or open-cut. Geological constraints mean that the resource can be most effectively mined by open-cut techniques.

ii. Mine Plan

Open-cut coal mines start where the coal is shallowest and they work down the coal seams until the excavation becomes too deep. At Mount Pleasant this required the mine to start in the east and work west. The mine plan was based on a conventional multi-seam dragline operation with two areas mined concurrently.

The dip of the coal seams and local topography meant that the most efficient transport direction was from the base of the pit (west) to the surface (east). Typically, conventional mine planning locates the infrastructure near the most accessible point of the start of the mine.

iii. Assessment of Infrastructure Alternatives

A preliminary assessment examined 33 infrastructure layouts to service the mine, based on conventional mine planning. These included three different locations and a number of options for transporting ROM and product coal. The initial 33 options were amalgamated to a short list of 11 based on similarities in environmental impacts. A further option examined at this stage placed the infrastructure outside the Mount Pleasant Authorisation.

The eastern boundary of the Authorisation was favoured for infrastructure and a rail loop with loading facilities, based on economic viability, technical feasibility and environmental acceptability.

An initial Planning Focus meeting held in March 1995 gave control authorities a preliminary overview of the proposal and associated environmental issues. Mine planning and environmental impact assessment work advanced during 1995 and early 1996.

Muswellbrook Shire Council then expressed reservations about having mine infrastructure on the eastern side of the mine. Consequently, a Joint Working Party was established by Coal & Allied and Council under the guidance of an independent facilitator. The working party, which included mine planners and infrastructure designers, sought to reach an outcome that met local community needs, while still ensuring the economic viability of the mine.

Other infrastructure locations and rail access options on the western side of the site were examined. One of these was a joint user facility with the proposed Bengalla Mine, while another connected to the Bengalla mine rail loop by overland conveyor.

Approval of the Bengalla project in 1996 paved the way for an immediate commencement of its infrastructure and rail loop. This meant that Bengalla could not commit to a joint user facility because Mount Pleasant could not be developed in time.

iv. The Proposal

Coal & Allied therefore proposed that mining infrastructure could be located in the southwest corner of the site. This is about twice as far from Muswellbrook residential areas as the original proposal. Relocating mine infrastructure to the southwest changed mine access to the pit and led to a rail loop located to the south of the Mount Pleasant infrastructure area which will be connected to the mine surface facilities by an overland conveyor.

5.2 MINING METHODOLOGY

5.2.1 *Alternative Mining Methods*

Regional and local geology is described in Chapter Two.

i. Open-cut Mining

The geology of the coal resource at Mount Pleasant constrains any potential mining proposal. The complexity and number of the coal seams and their sub-divisions or splits means that to most effectively recover the resource, mining must use open-cut techniques. Where open-cut mining is possible, it is the most efficient way of recovering resources. Underground techniques will be considered in the future for areas where open-cut mining is uneconomic.

The coal seams at Mount Pleasant can be divided into three groups according to their depth from the surface. The upper and middle seam groups are suitable for open-cut mining while the lower seams are only suitable for underground mining. For open-cut development the Authorisation was broadly divided into three parts:

- in the north-east, no seams can currently be mined economically by open-cut techniques. This area is excluded from the current mining proposal but may be mined in the longer term. Any proposal to mine in this area would be subject to future development applications;
- in the north-west, only the upper seam groups can be viably mined; and
- in the south, both the upper and middle seams are viable.

ii. Underground Mining

The comparison of underground and open-cut coal reserves for the open-cut area of the Authorisation shows there is a distinct difference in potential coal recovery. The underground potential at 66.46 million tonnes (ROM coal) would only recover 15 per cent of the 439 million tonnes (ROM coal) of open cut potential. This comparison is based on seam sections in the area with potential for underground extraction. It includes identified limits of these coal sections due to thickness, quality, interburden, intrusions and depth of cover.

Coal reserves within the Authorisation but outside the open-cut area would still be accessible for underground extraction. Access to underground reserves from the open-cut highwall may also be the most cost effective option for future underground development.

Overall, the open-cut plan for the Authorisation far exceeds underground extraction in maximising coal recovery.

These constraints led to an open-cut mine plan involving two principal mining areas developed concurrently. The north-west area (the North Pit) will recover the upper seams while the southern area (the South Pit) will mine the upper and middle seams.

Figure 2 shows the location and extent of the two pits.

5.2.2 *Mine Planning*

i. Conventional Mine Plan

A mine plan based on a conventional multi-seam dragline operation was proposed. Suitable equipment based on the coal to overburden ratio and production rate included a large dragline, two electric shovels, a large hydraulic excavator, a number of front-end loaders and a fleet of rear dump trucks. The design allowed for a highly efficient mine using proven techniques and equipment with a large degree of development and operational flexibility. During the initial 21 years of mining about 846 million cubic metres of rock needed to be excavated to extract about 197 million tonnes of ROM coal.

Coal mining techniques are determined by an area's geology and topography. Open-cut coal mines start where the coal is shallowest and then work down dip. At Mount Pleasant this required the mine to start in the east, where the lowest coal seams outcrop, and then advance in a westerly direction.

The coal seams at Mount Pleasant dip, or slope downwards, at four to five degrees to the west. The local surface topography rises to the west at a similar rate. These two characteristics significantly affect the way coal and rock is transported from the open-cut pit to either the coal preparation facilities or out-of-pit emplacements. Haulage trucks are limited to a maximum grade of approximately 6.8 degrees (or 1 in 8.3) but for efficiency reasons grades are preferably restricted to less than 4.6 degrees (1 in 12.5).

To start the mine all rock must be placed out-of-pit. As mining advances, rock is then placed into mined out areas. Typically, efficient mine planning involves locating infrastructure near the most accessible point of the resource so that mining proceeds downward, away from the starting point. This reduces coal haulage distances and simplifies operations at the critical, early mining years.

A conventional mine plan based on these constraints would involve transporting rock and coal out of the pit by a series of ramps generally orientated west (base of the open-cut) to east (surface). Locating mine infrastructure on the deepest side of the resource would then require it to be transported west, significantly increasing haulage distances and costs.

ii. Alternative Mine Plan

Transporting coal out of the pit to infrastructure located on the deepest side of the resource would require complex technical design to overcome the practical difficulties of crossing the highwall, the advancing face of the open-cut.

A series of end-wall ramps and parallel highwall ramps developed along the strike would be required with each advancing strip, to haul coal and excess rock from the pits to the ROM coal stockpiles and out-of-pit emplacements respectively. Rock would be transported to in-pit emplacements via a series of end-wall and low-wall ramps. While this is possible, costs would increase.

5.2.3 Infrastructure Constraints

The preceding sections indicate a number of constraints to the location of the mine's infrastructure under conventional and unconventional mine plans. In summary these constraints are:

- upper and middle coal resources at Mount Pleasant are best mined by open-cut techniques;
- infrastructure should not be built on coal resources which could be mined in the next twenty or thirty years;
- mining should begin in the east and work towards the west; and
- coal and rock should be transported from the mine workings towards the east under a conventional mine plan.

Two additional requirements are:

- the site must be economical to develop and operate; and
- construction and operation must only be carried out in an environmentally acceptable manner.

Within the Mount Pleasant deposit and environs these constraints led to two main areas being identified for mining infrastructure: along the eastern boundary of the Authorisation; and along the western boundary of the Authorisation.

5.3 PRELIMINARY ASSESSMENT OF INFRASTRUCTURE ALTERNATIVES

5.3.1 *Infrastructure*

The mine's infrastructure consists of:

- a coal preparation plant. To minimise transport costs this should be located as close as possible to where ROM coal leaves the open-cut pits;
- facilities to handle and dispose of reject material produced in the preparation plant;
- an industrial area with workshops, administration and employee facilities;
- environmental controls such as water pollution control dams, visual screens and landscaping; and
- access to rail transport.

i. Alternatives Considered

Several alternatives were examined for the location and type of infrastructure to service the mine. These were: three broad plant locations; a variety of options for transferring ROM coal from the mine to the preparation plant; and several options to load product coal onto rail. Thirty three combinations of these three elements were considered. Phases in the progressive development of alternative infrastructure arrangements are shown schematically on *Graph 3*.

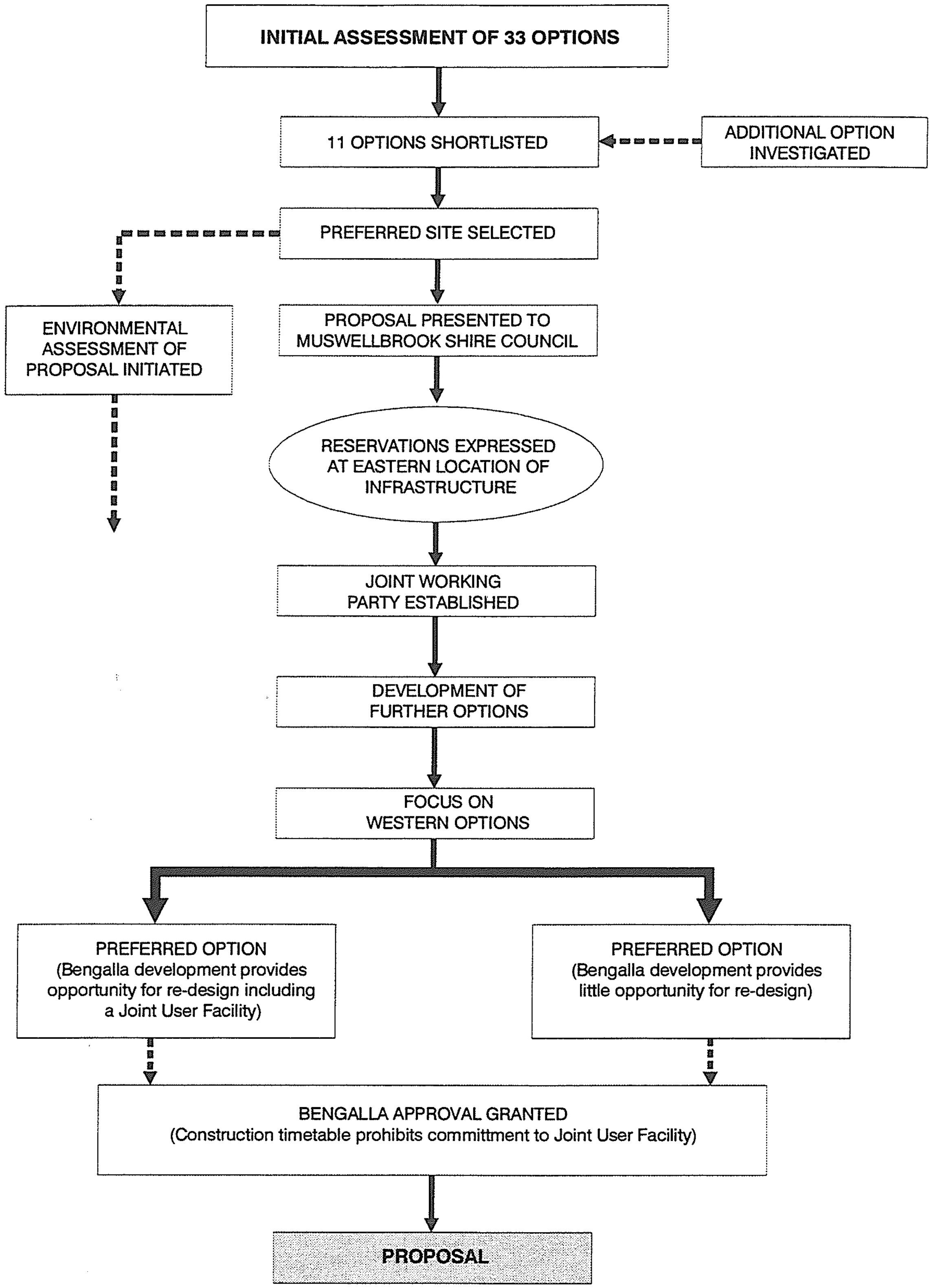
The three plant locations were:

- in the south-west corner of the Authorisation (Site A). This was the lowest cost site along the western boundary. Any other option had longer conveyors or haul roads to transport ROM coal from the mine to the plant area;
- in the central east of the Authorisation (Site B); and
- in the north-east corner of the Authorisation (Site C).

The three plant locations are shown on *Figure 5*.

Sites A and C were above potentially mineable coal, though no mining is planned in these areas in the present development consent. Underground mining might be contemplated in these locations within 20 to 30 years or less. Siting infrastructure in either location is unlikely to constrain later exploitation of this resource but is not preferable due to the cost of relocating infrastructure.

At Site A, only the shallower Warkworth Seam would be difficult to extract without relocating the mining infrastructure. However, after 21 years of open-cut mining numerous potential sites would be available for relocating the infrastructure if this were required.



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Graph 3 SCHEMATIC OF INFRASTRUCTURE ALTERNATIVE DEVELOPMENT

Site B was preferred from a mine planning perspective because it would be nearest to the pit access and potential rail loading point.

Three options were examined to access the main railway system:

- the existing Dartbrook rail loop;
- the proposed Bengalla rail loop; and
- a separate rail loop at either Site B or Site C. Due to steep grades, major earthworks would be required to construct a rail line directly to Site A. This was not considered economically viable at that time within the framework of a conventional mine plan.

Another permutation in the infrastructure investigations was the location of product stockpiles. Alternatives included placing stockpiles at the mine surface facilities or the rail loop.

The initial 33 options were reduced to a short list of 11 based on similarities in environmental impacts. The 11 options are summarised in *Table 5.1*.

A further site was investigated after the initial studies, located outside the Mount Pleasant Authorisation. It is shown as Site D on *Figure 5*.

This site left the mine plan unaltered. Run-of-mine coal would be conveyed from a central location between the two pits to the infrastructure. Product coal stockpiles would be located next to the coal preparation plant. Product coal would be transported by conveyor to the Bengalla rail loop.

Table 5.1 SHORT-LISTED INFRASTRUCTURE OPTIONS

Plant Location	Rail Loop	Product Stockpiles	Option Number
A. South-west	Bengalla	Bengalla	3
	Bengalla	Mount Pleasant	7
B. Central	Dartbrook	Mount Pleasant	27
	Bengalla	Bengalla	9
	Bengalla	Mount Pleasant	11
	Mount Pleasant	Mount Pleasant	21
C. North-east	Dartbrook	Mount Pleasant	31
	Bengalla	Mount Pleasant	19
	Bengalla	Bengalla	15
	Mount Pleasant	Mount Pleasant	33
	Mount Pleasant (central)	Mount Pleasant	25

ii. Environmental Appraisal

If the infrastructure were separated from the actual mining operations, then significant parameters distinguishing the infrastructure sites would be visual effects, noise and air quality. This assumes that the effects of the three sites on factors such as water quality, flora and fauna and archaeology would be similar.

Infrastructure Sites A and D would be better from an environmental perspective. Their distance from Muswellbrook and relative isolation means that noise and air quality impacts would potentially only affect a few residences. Although the sites are elevated there are several ridgelines that screen rural residences and also much of the Hunter River floodplain. The sites would be visible from residential areas of Muswellbrook but at distances of more than 7.5 kilometres. Screening using bunds and vegetation would limit the potential for significant visual change.

Infrastructure Sites B and C are nearer more residences than Sites A and D and hence have a greater potential for adverse noise and air quality effects. Both sites when unprotected are visible from nearby rural areas and also from more distant viewers in residential areas of Aberdeen or Muswellbrook. The existing topography at Site B offers far greater opportunities than Site C to incorporate measures to reduce noise and visual effects.

iii. Development Costs

Approximate capital costs for the infrastructure sites were estimated, excluding operating costs. These were based on an early mine planning scenario with a conventional mine plan and ROM coal production rate of five million tonnes a year.

Operating costs were not estimated but the four sites could be ranked according to their proximity to the ROM and product coal transport systems. This is because the energy costs associated with coal transport are a major input to operating costs. Further energy would be needed to transport rejects material from the preparation plant to emplacement areas. In general the most economic solution is to process the ROM coal as close as possible to where it leaves the mine and to place it on the final transport system as close as possible to the coal preparation plant.

Under a conventional mine plan, no matter where the preparation plant is located, the ROM coal should leave the pit at the most accessible point, which is in the east. The lowest cost solution would therefore be Site B followed by Site C and finally Sites A and D. The most economical solution for transporting product coal onto rail would be a loop located as close as possible to Site B.

Costs incurred at the start of a project before producing coal are critical to a project's economic viability. All mine infrastructure must be constructed and operational before product coal can be sold. Capital investment for infrastructure is therefore vital in the overall economic viability of the Mount Pleasant project.

iv. Site Selection

A mine at Mount Pleasant must achieve the twin objectives of economic viability and environmental acceptability. To achieve these objectives, environmental effects must be balanced against the costs of their control. A mine plan that is uneconomic would have no environmental impact as there would be no mine. Conversely, the most economic mine plan may be not be viable if environmental impacts are totally unacceptable to the company and community.

Economic analyses indicated that under conventional mine planning, infrastructure at Sites A and D (and any other site along the western boundary of the Authorisation) would lead to an uneconomic project at the calculated production rate of five million tonnes per year. It would therefore not proceed.

None of the sites would be above a coal resource that will be mined in the next 20 years. Deposits below Site C could be mined in the longer term while Site A is above only marginal economic reserves. Both sites are above potential future underground mining reserves. Site D is within the Bengalla Authorisation but outside the area proposed for mining in the first 21 years of the Bengalla Project. It overlies a potential coal resource. There are no open-cut coal resources below Site B.

On environmental grounds, Sites B and C are similar although Site B can be better screened. Site B also has lower capital and operating costs compared to Site C. Site B was therefore selected as the preferred infrastructure location.

Table 5.2 summarises the ranking of the three sites according to cost, potential environmental impacts and resource sterilisation, with one representing the preferred case and three the worst case.

The analysis of infrastructure site locations was based on a ROM coal production rate of five million tonnes a year. Mine planning investigations found that higher production rates would be necessary to establish an economically viable mine. The mining proposal now reaches a production rate of 10.5 million tonnes of ROM coal a year. This increased output did not change the rationale for selecting Site B as the preferred infrastructure location.

Table 5.2 SITE COMPARISON

Comparison	Site and Ranking*			
	A	B	C	D
1. Economics				
- capital	3	1	2	3
- operating	3	1	2	3
2. Environmental				
- noise	1	2	3	1
- air	1	2	2	1
- visual	1	2	3	1
3. Resource Sterilisation	2	1	2	2

* *Note: sites ranked in order of 1 (best) to 3 (worst).*

5.3.2 *Access onto Rail*

i. Alternatives Considered

Three options were considered for transferring product coal onto rail from site B:

- a rail loop and loading facilities close to the mine infrastructure;
- a joint rail loop with Bengalla Mine using the rail loop described in the Bengalla Mine proposal. The loop would be accessed by a 7.5 kilometre overland conveyor, with all product stockpiles at the Mount Pleasant infrastructure site; and
- a joint loading facility with Bengalla Mine. This would be located at the proposed Bengalla stockpiles and rail loop. It would involve a 7.9 kilometre overland conveyor from the Mount Pleasant infrastructure with product coal stockpiles located at the joint facility.

Each option was designed for a peak mine production of 10.5 million tonnes of ROM coal a year.

ii. Environmental Implications

Five environmental issues were used to assess these options. These included:

- air quality;
- train movements;
- water management;
- noise; and
- visual effects.

From an environmental perspective the three alternatives would be distinguished mainly on noise and visual effects, with air quality, train movements and water management being less important.

a. Air Quality

The principal differences between the three options were the location and orientation of the product stockpiles, the length and size of overland conveyor and the location and size of the loading bin. All other components were similar.

Product coal stockpiles are not significant dust sources in the context of a coal mine. Modelling for Mount Pleasant Mine indicated that these stockpiles contributed about four per cent of the total dust generated by the mine. The three options would not result in significantly different dust deposition.

The north-west to south-east orientation of stockpiles at Site B was designed to minimise exposure to the area's dominant winds. At Bengalla this orientation was not possible. As a result there was a potential for more dust from the joint loading facility, but in the context of overall mining activity this was not significant.

b. Train Movements

The three access options had different rail loops, at Mount Pleasant and/or at Bengalla. For both alternatives, trains would travel at similar speeds through the urban areas of Muswellbrook.

The main difference between the two loops would be train queuing and loading. Discussions with FreightCorp indicated that either option could be designed to operate efficiently. Two separate loops would give additional loading flexibility as two trains could be loaded simultaneously. If a single loop were used for both mines, it would need to be enlarged so three trains could stand within the loop line.

c. Water Management

The main issue for water management is coal spillage. This has the most potential to occur during rail car loading although minor spillage can take place at conveyor transfer stations. For all options the rail car loading points would be in fully contained catchments with all drainage directed to coal separation facilities.

d. Noise

A separate Mount Pleasant rail loop would have less potential for adverse noise impacts than either a shared rail loop at Bengalla or a joint loading facility at Bengalla. This was because:

- it involved significantly shorter conveyor lengths;
- it did not require extensive lengths of raised conveyor;
- a smaller load-out bin was required;
- effective noise screening could be provided for operations on product stockpiles at Mount Pleasant; and
- the rail route offered greater opportunities for practical noise mitigation measures.

e. Visual Effects

It would be significantly easier to ameliorate visual effects at a Mount Pleasant rail loop than at Bengalla. The location and size of components for rail access at Bengalla would introduce locally dominant visual features.

iii. Economics

The economics of the three options were compared using the Mount Pleasant rail loop as the base case. The other two options either reduced or increased these costs.

The Mount Pleasant rail loop had the most economic capital and operating costs. Joint loading facilities had marginally greater capital costs compared to a Mount Pleasant rail loop on the basis of costs being shared equally between the mines. Consequently, using the Bengalla rail loop added significantly greater costs. Operating costs for both options were similar and greater than for the Mount Pleasant option.

iv. Conclusions

Table 5.3 compares the three rail access options against the environmental and economic criteria outlined above. The comparison ranks the options one to three, with one representing either the best or the most economic option. If two options are given the same ranking then they are similar for that criterion.

Table 5.3 RAIL ACCESS COMPARISON

Comparison Criteria	Access Option		
	Mount Pleasant	**Bengalla**	**Joint Facility**
1. Air quality	1	1	2
2. Train movements	1	1	1
3. Water management	1	1	1
4. Noise	1	2	3
5. Visual effects	1	2	2
6. Economics	1	3	2

For train movements and water management there would be no significant difference between the three options. The joint facility ranked lower than the other options for air quality because of the orientation of coal stockpiles.

There are more significant differences for the remaining three criteria of noise, visual effects and economics. For all three criteria the Mount Pleasant rail loop was the preferable option. Because of its location and design this option has less potential for adverse noise and visual effects. It was also the most economic for both capital and operating costs.

The proposal was presented to a Planning Focus Meeting in March 1995 which gave control authorities a preliminary overview of the infrastructure site (Option B in *Figure 3*) and associated rail loop on the eastern boundary of the site. This site was found most suitable as:

- it was located at the subcrop of the coal resource with seams dipping westward. Mining would commence at the shallowest end of the resource, reducing haulage distances to coal preparation facilities; and

- environmental safeguards including earth bunds and sensitive building design could visually shield infrastructure from Muswellbrook. Noise reduction was possible through a combination of bunds and appropriately selected building materials.

Detailed mine planning and environmental impact assessment proceeded during 1995 and early 1996. During this time Muswellbrook Shire Council expressed reservations about locating infrastructure on the eastern side of the mine. Council noted that there was strong community preference for the infrastructure to be further from Muswellbrook because it was perceived as the location of "the mine". It was also felt that as mining progressed westward, potential effects on nearby residential areas would diminish whilst those associated with the infrastructure would remain. Consequently, Council believed that the western infrastructure option should be investigated in more detail. This was considered more environmentally friendly.

Although the assessment identified a preferred site, the company nevertheless wished to develop an outcome that met local community needs, while still ensuring economic viability. A joint working party was therefore established to consider further options.

5.4 ASSESSMENT OF FURTHER INFRASTRUCTURE OPTIONS

5.4.1 *Joint Working Party*

A joint working party was established by Coal & Allied and Muswellbrook Shire Council under the guidance of an independent facilitator. The group, which included mine planners and infrastructure designers met on four occasions to develop further infrastructure options. The group sought an outcome that met local community needs, while still ensuring the economic viability of the mine. Three infrastructure options were compared with the preferred site. These are outlined below.

5.4.2 *Infrastructure Alternatives Considered*

The working group proposed three new options:

- infrastructure at either site A or D with a conveyor between the North and South Pits transporting ROM coal to the coal preparation plant and a joint user facility and rail loop at Bengalla (Option E);
- infrastructure at either site A or D with a ROM coal conveyor along Wybong Road to the mine facilities and a product coal conveyor to a joint user rail facility at Bengalla (Option F); and
- infrastructure at site C with a rail loop either on the eastern boundary of the site or a joint user facility at Bengalla (Option G).

The options were compared with site B. Possible changes to conventional mining methods were assessed including coal preparation and handling, pit access and ROM and product coal transport.

5.4.3 *Preferred Options*

Two options were preferred by the joint working party, depending on whether the Bengalla development could be re-designed as a joint user facility. These included:

- a coal preparation plant and associated facilities at site A/D with a joint user facility including a rail loop and product coal stockpiles to the west of the Bengalla facilities. ROM coal would be transported by conveyor from the east of the mine area to the coal preparation plant; or
- infrastructure at site A/D including ROM and product coal stockpiles with a conveyor and rail loading bin on the Bengalla rail loop. ROM coal would be transported from the mine to the coal preparation plant by conveyor.

Approval of the Bengalla project in 1996 paved the way for an immediate commencement of its infrastructure and rail loop. This meant that neither party could commit to a joint user facility because of the different development schedules for the two mines. Also, commitment to a joint user facility would require the re-design of the Bengalla infrastructure and a large capital investment prior to any approval for the Mount Pleasant Mine.

Coal & Allied therefore proposed that mining infrastructure could be located in the south west corner of the site (Site A). The location is about twice as far from Muswellbrook as the original proposal. The main benefits of this relocation are:

- reduced visual exposure to Muswellbrook;
- simplified noise management as most residences will be further from the infrastructure; and
- reduced community concern about impacts from surface facilities.

5.4.4 *The Proposal*

Relocating mine infrastructure to the south west changed mine development and pit layout, pit access, coal handling and preparation, and product coal dispatch.

i. Mine Development and Pit Layout

Initially, coal will be extracted from a small pit in the Warkworth seam next to the coal preparation facilities. This will occur whilst permanent mine infrastructure is built. Overburden from this excavation will be used as fill for the coal handling facilities, haul roads and fine reject emplacements.

Once coal handling and preparation facilities are completed, an initial boxcut will be excavated in the South Pit with a concurrent development in the Piercefield seam further west. This will take advantage of lower stripping ratios and proximity to the coal preparation facilities, providing income during the critical early mine development. In addition this will maximise reserves in the North Pit which can be recovered by dragline operations.

On current economics coal below the Piercefield seam can be recovered, so it is not intended to backfill this pit which could sterilise coal reserves. Therefore, additional out-of-pit emplacements are required.

Whilst this pit layout maximises the quantity of rock which can be returned to the pit, a significant volume must be directed to out-of-pit emplacements to allow adequate working space for mine equipment. Available emplacement areas are limited by the alluvial floodplain to the east, the limited strike length and the desire to minimise resource sterilisation. The total out-of-pit requirement is 224.5 million cubic metres which can be accommodated in four locations:

- southern bund wall;
- north-eastern emplacement;
- north west out-of-pit emplacement; and
- south west out-of-pit emplacement.

Alternatives were considered to the placement of rock to the western out-of-pit emplacements but proved to either be not viable, sterilise coal or result in unacceptable final rehabilitation landform elevations and slope angles.

With the exception of the southern bund are it is not possible to place overburden rock to the east of the eastern coal seam subcrop lines in the South Pit as this would impinge on the flood plain. In the North Pit, eastern extension of the emplacements would have sterilised areas of open cut coal that are currently considered economical as well as extend unnecessarily, environmental impacts to the east.

Increasing the height and slope angle of the in-pit backfilled areas beyond what is currently proposed creates difficulties for mine rehabilitation requiring special approval from the Minister for Mineral Resources. Even if additional placement was undertaken in these areas, out-of-pit emplacement areas would still be required.

Backfilling of the Piercefield and Warkworth South Pit would sterilise coal in the seam below.

ii. *Pit Access*

Relocating the infrastructure to the southwest meant coal access had to be changed from conventional low wall ramps to a system of temporary parallel ramps along strike with each advancing strip. Coal will then be hauled in the pit via a series of ramps to the surface, west of the excavation. From this point it will be sent to the coal receival facilities in the south west corner of the mine. This is not an optimal mine plan, as haulage costs will increase, but it is the best compromise available.

Transporting ROM coal by conveyor to the preparation plant was not preferred because:

- increased capital costs;
- the conveyor would have to be relocated as the mine progressed to the west; and
- the haul road to the west is required to access the south western out-of-pit emplacement.

iii. Coal Handling and Preparation

Key elements of the coal handling and preparation infrastructure included:

- a 20,000 tonne ROM coal stockpile. Provision was also made for an additional 100,000 tonne ROM coal stockpile equipped with a rail mounted mobile stacker and reclaimer;
- a ROM coal receival hopper and crusher with surge bin to even out deliveries to the coal washery;
- a coal preparation plant;
- a 500,000 tonne product stockpile with a travelling stacker; and
- a reclaim conveyor beneath the product stockpile.

iv. Fine Rejects Emplacements

Of the ROM coal processed through the coal preparation plant, approximately seventy per cent is saleable. Of the remaining thirty per cent, approximately sixty per cent, or eighteen per cent of the total processed is coarse reject material which is disposed via truck into the rock emplacements. The remaining reject material consists of fine particles typically less than 0.7 millimetres and occurs in slurry form. A number of options were investigated for the disposal of the fines rejects material, including:

- fines rejects emplacement dams;
- codisposal of fines and coarse rejects; and
- belt press filters.

The use of fines rejects emplacement dams is the preferred disposal method for a number of reasons. Firstly, the method is the most attractive economically. The technology is well proven and there exists extensive experience in the management of the process including the rehabilitation of the emplacement area. The technique does however require a suitable area to locate the emplacement dams. The relocation of the infrastructure to the south west of the site provided the opportunity for utilising valleys immediately west of the coal preparation plant. This area is close to the coal preparation plant reducing the required pumping distance, is visually remote from Muswellbrook and does not sterilise open cut or underground coal reserves. Local topography allows for the staged development and rehabilitation of the emplacements minimising the total area disturbed.

The environmental implications of fines rejects emplacement is well understood with potential impacts able to be managed with established practices. The placement of fines materials into a working pit is not favoured due to slope stability implications arising from the infiltration of water into the emplacements. Recovering water for reuse in the mine or coal preparation plant is also more difficult. It is intended that fines reject material will be pumped back into the final void of the northern mining area once this pit has been mined out which is predicted to occur in Year 22 or 23.

Codisposal is a relatively new technology which is used at a number of operations in Australia. It involves the coarse rejects material being mixed with the fines material and pumped as a slurry to emplacement dams where the material is allowed to de-water. Analysis of coal washability and sizing data obtained from bore cores was undertaken to assess the suitability of Mount Pleasant coal seams for codisposal. From this analysis, conceptual engineering plans were developed for a number of alternative operating systems for disposal of the reject material using codisposal techniques. These alternatives included pumping the reject material into a system of small dams for dewatering, following which the reject material would be excavated by loaders into trucks and transported to the rock emplacements. A second alternative examined involved pumping material into a large dam located in the north east of the Authorisation.

The first alternative presented concerns as to the practicality of rehandling the rejects. Analysis of the second alternative suggested there would be some separation of the coarse and fine portions of the rejects which would result in an area similar to conventional fines disposal dams. Following a number of site visits to operations using codisposal, which illustrated a significant variability in the success of the technique, it was decided that the application of codisposal as the sole means of reject disposal presented an increased technical and operational risk. It is however intended to continue investigations, including trials, into the viability of codisposal for Mount Pleasant once the mine is in operation. Should these trials prove successful, the site of the proposed fines rejects emplacement dams is considered the most suitable location for the placement of the rejects using codisposal.

The use of belt press filters involves the mechanical de-watering of the fines rejects material. The de-watered material can then be loaded into trucks for haulage to the rock emplacement. This method was proposed as the preferred option for the eastern coal preparation plant location owing to the limited space available for fines reject emplacement dams. Due to the much higher capital and operating cost associated with belt press filters, this method is generally only considered where there is insufficient area to locate fines rejects emplacement dams as is the case at Mount Thorley and Bengalla mines. The eastern infrastructure site offered no suitable area for the location of fines reject emplacement dams without the sterilisation of coal resources or encroaching on the flood plain. These factors were implicit in the decision to relocate the infrastructure from the eastern location to the south west.

Due to the increased mining costs associated with the relocation of the facilities and the resulting changes to the mine plan, there was a need to offset these costs in other areas in order to maintain the economic viability of the project. One of the principle changes was to replace the system for handling the fines proportion of the rejects from belt press filters to the use of fines reject emplacements. The relocation of the facilities also provided access to a suitable area of land considered technically and environmentally acceptable for the emplacements which was already own by Coal & Allied.

The design and operation of the belt press filters is complex and difficult to optimise. De-watered fines also present difficulties in handling due to the remaining high water content of the material. A further consideration to the use of belt press filters as an alternative to the fines rejects emplacements, is that emplacement capacity for rock and coal reject material at Mount Pleasant is extremely limited. If the de-watered fines material was to be placed back in-pit there would be a need to create additional emplacement capacity in which to place this material. This increased capacity could be obtained by moving the toe of the eastern out-of-pit emplacements in the North further east. This is not favoured as it would sterilise potentially open cut mineable coal and push environmental impacts further towards Muswellbrook.

Alternatively increased capacity could be achieved by steepening the outside slope of the emplacements to fourteen degrees from the current ten degrees, a change which would require ministerial approval. Coal & Allied consider this would result in an unacceptable final land form and lead to difficulty in its rehabilitation. A third alternative allowing the placement of the de-watered fines rejects back into the pit is to haul rock displaced by the fines material, to an out-of-pit emplacement in the area currently proposed for the fines rejects emplacement dams. This would result in greater visual, noise and dust pollution for those residents south west of this area. This was not considered desirable.

The increased haul distance for this rock would significantly increase project costs. In addition, the placement of the reject material in a single location provides an opportunity to later recover this material for use as a fuel source for power stations. This would not be the case if the material was spread throughout the emplacements.

v. Product Coal Dispatch

Formerly, it was proposed to dispatch coal to the Port of Newcastle via a rail loop on the eastern side of the Mount Pleasant site. It is now proposed that a rail loop will be to the south of the Mount Pleasant Mine infrastructure with a connecting overland conveyor.

Dispatching product via conveyor to the Bengalla rail loop was not preferred because:

- it would require extensive lengths of high capacity conveyor;
- a larger load-out bin would be required;
- there would not be suitable loading flexibility;
- the Bengalla rail loop would have to be enlarged so three trains could stand on the loop line; and
- the location and size of rail access components would be visually more locally dominant.

5.5 JUSTIFICATION OF THE PROPOSAL SELECTION

Justification of each major component of the proposal is given below with regard to the project objectives identified in Chapter Three.

5.5.1 Mining Method

A key production and operational objective of the Mount Pleasant mine is to optimise resource use and minimise resource sterilisation. Open-cut mining methods provide the most efficient means of utilising the resource at Mount Pleasant.

5.5.2 *Infrastructure Location*

Locating the infrastructure in the south west corner of the site meets the operational, environmental and socio-economic objectives outlined in Chapter Three. The main advantages of this site over other alternatives considered is the acceptability to the community in terms of environmental outcomes and costs. This location maximises the opportunity for maintaining the visual quality of the local area and minimises noise impacts on residences surrounding the site.

5.5.3 *Rejects Emplacement*

The proposal for the fine rejects emplacement and additional out-of-pit emplacements, developed from the need to locate the infrastructure in the south west corner of the site. In order to achieve an outcome that was both acceptable to the community and economically viable, less expensive means of handling fine rejects was required. By placing rejects conventionally to the west of the coal preparation plant, some of the project costs could be reduced to a level that allowed the project objectives to be met. In addition, the placement of reject material in a single location provides an opportunity to recover this material for use as a potential fuel source for power stations.

The extent of out-of-pit emplacements for coarse rejects results from the objective to maximise resource use and minimise resource sterilisation. Alternatives to the proposed emplacement areas did not meet project objectives, due to either coal sterilisation or unacceptable landform elevations and slope angles. Backfilling of the Piercefield and Warkworth South Pits would sterilise coal below these areas.

5.5.4 *Product Coal Dispatch*

The objectives of the Hunter Regional Environmental Plan, 1989 (Section 4.1.2) encourages the transport of coal by rail or other non-road means. All product coal from Mount Pleasant will be transported by rail from the mine to the Port of Newcastle. The Mount Pleasant rail loop will be located to the south of the Mount Pleasant Infrastructure and connected to the site facilities by an overland conveyor. Alternative product dispatching involving joint-user facilities at the Bengalla site or high capacity overland conveyors were not feasible due to the difference in the timing of the two projects. These options also reduced operational flexibility and reduced the ability of the project to meet visual amenity objectives.

5.6 CONSEQUENCES OF NOT PROCEEDING WITH THE PROPOSAL

If the project does not proceed then the following consequences will occur:

- a new coal mine producing export quality coal products will not be developed;
- the company would not establish a long term coal reserve which will limit it's ability to supply existing and emerging markets (including the potential for coal water mixture technology);
- the coal resource on site may not be developed. There may be other proposals initiated which do not optimise resource use, for example underground mining, but this could not be guaranteed;
- constraints and uncertainty regarding the future development of the site will remain;

- regional road network changes related to the development will not be implemented;
- rehabilitation opportunities that enhance existing fauna habitat values will not be realised;
- there will be a loss of local employment opportunities, both short-term construction work and also long-term operation work; and
- a new source of revenue will not be established. Revenue will not flow through to all levels of government (local, state and federal) as well as to Coal & Allied;
- development contributions towards community infrastructure and services as a result of the project will not be provided;
- wages and salaries paid to mine employees will not flow on to the local and regional economy.

The environmental consequences of the proposal are not discussed in this section. If the project does not proceed then the environmental outcomes discussed in this EIS such as dust levels, noise, water management and visual effects would not eventuate.

THE PROPOSAL 6

This chapter describes the mining proposal including general mining methods, infrastructure requirements, workforce needs as well as the development program, water management and rehabilitation.

6.1 MINE PLAN

6.1.1 *Development Investigations*

The Mount Pleasant mine plan was prepared over three years and was designed to:

- use proven mining methodologies based on the best available technology and practice;
- minimise resource sterilisation;
- incorporate environmental considerations to achieve sound environmental performance;
- provide a continuous supply of low ash coal which could be used at a coal water mixture plant, for which Coal & Allied have development consent at Kooragang Island near Newcastle; and
- provide other products that could be sold in both export and domestic markets.

The mine plan was developed in four stages. Firstly, geological studies defined the extent, distribution and quality of the coal resources. Secondly, each of the coal seams, including splits, was economically evaluated and ranked. This ranking included mining costs for each seam and anticipated economic returns. Thirdly, conceptual mining schedules were prepared to determine the type and scale of mine operations required to support the necessary capital investment. Finally, detailed mine plans were prepared for the feasible mine operations identified by the first three stages.

Mining investigations indicated that Mount Pleasant coal seams could be divided into three groups: the upper four seams consisting of the Warkworth to Vaux seams; four middle seams including the Broonie and Edderton seams; and those below the Edderton. The upper and middle seams are suitable for open-cut mining whilst the lower seams have potential only for underground mining extraction.

The site can be divided into three parts for open-cut development. These are:

- *the north-eastern area.* All seams are marginally viable for open-cut mining on current economics. This area was excluded from the current mining proposal but could be developed in the longer term. Any mining proposal in this area would be the subject of other development applications;
- *the north-western area.* Only the upper seams are viable for open-cut mining; and
- *the southern area.* Both the upper and middle seams in this area are viable for open-cut mining.

These considerations led to a mine plan with two principal mining areas which will be developed concurrently. The north-western area (the North Pit) would mine the upper seams while the southern area (the South Pit) would mine the upper and middle seams. Economic analyses indicated that the most viable operation would require coal production rates of up to 10.5 million ROM tonnes a year.

Figure 2 shows the location and extent of the two pits at Year 15.

6.1.2 *Mining Methodology*

The proposed mine plan is based on a conventional multi-seam dragline operation with prestripping operations using a truck and shovel fleet. Most rock will be excavated with a large dragline accompanied by two electric shovels, a large hydraulic excavator and a number of front-end loaders. A fleet of rear dump trucks will haul rock and coal from the mine to emplacement areas and coal preparation facilities, respectively. The overall design concept is a highly efficient mine that uses proven techniques and equipment and also has a high degree of development and operational flexibility.

Mining operations can be divided into five parts:

- clearing, then topsoil stripping;
- rock fragmentation;
- rock excavation;
- coal seam fragmentation and mining; and
- progressive rehabilitation.

Figure 6 shows a schematic of the general mining sequence as described below.

Mine operations are indicated on a time scale of between minus 2 and plus 21 years as shown in *Graph 4* and on *Figure 7*. Negative years indicate the preliminary development period before any coal is produced. Year 1 is the first year of coal production following commissioning of the coal preparation plant. Coal production from the nominated mining areas is expected to take 21 years.

i. Clearing and Topsoil Stripping

The proposed mining area has a mixture of pasture and scattered trees. Trees suitable for on-site uses, such as fencing or for other uses, will be removed prior to clearing. Remaining vegetation will then be pushed into windrows and removed or burned in accordance with local bushfire and EPA requirements. Clearing will be limited to a maximum of 40 hectares in advance of mining.

A topsoil stripping plan will be produced as part of detailed mine planning. These plans are required to gain open-cut mining approvals under the *Mining Act, 1992*.

Topsoil will be either removed by scrapers or pushed into stockpiles by dozers and removed using loaders and trucks. Generally, soil will be replaced directly onto areas being rehabilitated. Where it is necessary to store topsoil before using it for rehabilitation, the following procedures will be adopted:

- stockpiles will be located away from trafficable or mine areas, trees or watercourses and placed on flat areas or along the contour to minimise erosion;
- stockpiles will be generally less than two metres deep and set out in windrows to maximise surface exposure to the atmosphere. This helps maintain soil oxygen levels and health;

- topsoil stockpiles will be clearly signposted to prevent contamination or disturbance;
- stockpiles to be kept for longer than six months will be fertilised and sown with a cover crop of deep rooting and nitrogen fixing species to maintain topsoil viability and minimise erosion; and
- weed growth will be controlled by spot spraying with specific herbicides.

Soil types and quantities are discussed in Chapter Seven.

ii. Rock Fragmentation

All rock must be fragmented prior to excavation. Thin horizons will be ripped by tracked dozers then pushed into heaps for loading by front-end loaders. Thicker horizons will be drilled and blasted prior to excavation. Studies during initial operations will determine the minimum practical thickness for drilling and blasting.

iii. Rock Removal

Rock will be moved either by a dragline, trucks and shovels, trucks and front-end loaders, hydraulic excavators or dozers. Rock not handled by the dragline will be removed by the following methods depending on the horizon thickness and deposit characteristics:

- the rope shovel will generally be limited to stripping in thicker (> 8 metres) horizons where conditions are optimum in terms of equipment productivity.;
- horizons not suitable for the rope shovel will be excavated by either front-end loaders or hydraulic excavator loading rear dump trucks; and
- as part of the dragline operation in the South Pit, some rock will be pushed into the previously mined out strip by tracked dozers.

Initially all rock will be hauled out of pit to either the eastern out-of-pit emplacement in the north, the southern bund wall or to the western out-of-pit emplacements. As mining progresses, rock will be placed back into the mined out areas. Insufficient capacity exists to allow all rock to be returned back to the previously mined out areas and therefore material will be required to be hauled to the out-of-pit emplacements located to the west of the North and South Pits. These are shown in *Figures 9* and *10*. By approximately Year 15, sufficient capacity exists for all material to be placed back into the mined out void.

Rock will be hauled across pit via a series of parallel low wall and highwall ramps to the emplacement areas. These routes were designed so that in-pit haulage is maximised and trucks are shielded from eastward exposure by acoustic bunds. Generally, trucks will only be exposed directly to the east when tipping the final lift of the eastern emplacements.

The rock layers stripped by the dragline vary between the South and North pits. In the North Pit the dragline will make a single pass uncovering the lower Piercefield seam. In the South Pit the dragline utilises a full offset strip technique to uncover the Broonie and lower Wynn horizons. This involves the dragline making two passes. Firstly the dragline casts Broonie interburden on to the Wynn horizons in the previous strip. Where applicable, thin horizons below the Broonie seam are then dozed into the previous strip so as to form a pad from which the dragline rehandles the rock into the next adjacent mined out void. Where necessary rock may be stripped by loaders and trucks and transported to emplacement areas.

In this plan approximately 846 million cubic metres of rock and 197 million tonnes of ROM coal will be excavated from the mining area to produce about 142 million tonnes of saleable coal. *Figure 7* summarises rock and coal production.

Initial development will be undertaken by contractors. This will include rock and coal mining as well as ancillary operations such as drilling and blasting. For rock mining it is proposed that contractors will use hydraulic excavators and front-end loaders to load a fleet of rear dump trucks. The use of contractors will allow production to start earlier while Coal & Allied's equipment is ordered and built. Contract equipment will be required to meet the environmental standards for noise specified in Chapter Twelve.

iv. Coal Mining

Initially coal will be mined by contractors prior to the commissioning of Coal & Allied equipment. Contractor equipment is likely to include an hydraulic excavator and front-end loaders with a fleet of rear dump trucks.

Following commissioning of Coal & Allied equipment, coal will be mined by a fleet of front-end loaders and rear dump trucks. Coal haulage will be via a series of temporary in pit high-wall ramps connecting to the main western coal haul road to the coal handling and preparation facilities. Haulage will be kept in pit where practical. The main coal haul road has been designed to take advantage of natural topography to shield areas to the east from noise and visual affects.

Thin coal horizons will be ripped using tracked dozers while thicker seams will be drilled and blasted. As for rock blasting, studies will be conducted to determine the minimum practical thickness for coal blasting.

v. Progressive Rehabilitation

The final landforms will be reshaped progressively to an approved rehabilitation plan. Initially rock will be placed as close as possible to the final landform with final shaping by dozers and/or scrapers. The final landform will then be revegetated using the techniques described in Section 6.5.

6.1.3 *Mine Development*

Plans showing the mine at years 2, 5, 10, 15, and 20 are presented as *Figures 8* to *12*.

i. Preliminary Extraction

Initial excavation will commence in the Warkworth seam which out crops in the area near the infrastructure. This pit is known as the Warkworth South Pit. It is intended that rock from this excavation will be used as fill for construction of the infrastructure, haul roads and fine reject emplacements. Rock not required for these purposes will be placed in the south west out-of-pit emplacement. It is intended that the initial excavation will be carried out by contractors during the construction phase of the coal preparation and handling plant and other infrastructure and prior to the commissioning of the Coal & Allied mining equipment.

This initial phase of mining will expose approximately 542,000 tonnes of coal. It is intended to mine this coal during the coal preparation plant construction phase for processing with an on-site demountable modular coal washery operated by contractors. Water will be supplied to the coal washery via a pipeline from the Hunter River. Fine coal reject material will be disposed of into the fine rejects emplacement areas.

On completion of the Mt Pleasant rail loop and load out bin during the first half of Year -1, product coal will be loaded on to the product conveyor via a temporary hopper facility then onto trains for transport to the Port of Newcastle by rail.

In addition to the coal processed via the contract washery, approximately 100,000 tonnes of coal will be washed in the commissioning of the coal preparation plant and to build initial product coal stockpiles.

The extent of the proposed Warkworth South Pit is shown in *Figure 8*. Potential exists to expand the Warkworth South Pit and to include recovery of extra coal reserves by highwall mining techniques. This will be investigated at a later stage. Since the coal in seams below the Warkworth South Pit is considered economic, the pit will not be back filled. The final highwall will be blasted down and landscaped to reduce the visual impact after initial mining is completed.

ii. Established Operations

Established coal mining will commence in Year 1. An excavation to the Piercefield seam located in the central part of the South Pit will establish the Piercefield Pit. Simultaneously an initial boxcut to the Edderton Seam in the north eastern part of the South Pit will be commenced. Rock will be hauled via a series of ramps to form the southern bund to the east of the Edderton seam crop line wall. This will effectively screen the mining operation and associated haul roads from Muswellbrook. The southern bund will take approximately four years to complete and will extend from the northern end of the South Pit to Wybong Road.

Approximately half the rock excavated will be hauled to the southern bund which has been designed to provide effective noise mitigation. Rock not hauled to the southern bund will be hauled to the south west out-of-pit emplacement.

Coal will be hauled via a series of temporary parallel high wall ramps to the central coal haul road and on to the coal preparation plant.

Coal extraction of the Piercefield Pit will conclude in Year 3. As with the Warkworth South Pit, the coal seams beneath the pit are considered economic and therefore the pit will not be back filled so as to allow the extraction of the lower seams at a later stage. Again, in order to mitigate views of the final highwall, it will be blasted down and landscaped following completion of coal extraction.

Development of the initial box cut in the North Pit will commence in Year 3. Rock from the excavation will be hauled either to the north-eastern out-of-pit emplacement or to the south-western out-of-pit emplacement.

At Year 5 the initial box cuts in the North and South Pits are complete and the dragline has commenced operation alternating between the South and North Pit. The electric rope shovel, hydraulic excavator and front-end loader will excavate those horizons not assigned to the dragline or dozer assist operation. Rock from the truck and shovel operation will be hauled via a series of end wall and cross pit ramps to either the north-eastern out-of-pit emplacement or via a series of parallel highwall ramps to the western out-of-pit emplacements. The southern bund and the north-eastern out-of-pit emplacements will be completed and initial backfilling of the North and South Pits has commenced.

Lower seam coal in both the North and South Pit will be hauled via a series of parallel low wall ramps and then via a series of end wall and parallel high wall ramps to the central coal haul road and on to the coal preparation plant. Upper seam coal will be hauled within the pit and via the parallel high ramp system to the central coal haul road and thence to the coal preparation plant.

At Year 10, the southern end of the North Pit and northern end of the South Pit will merge to form a joint access system for the upper seam coal in both pits. Access to lower seam coal will continue via the system of parallel low wall and end wall ramps. As space for in pit emplacement of rock will still not be sufficient, excess quantities will be placed in the south west and north west out-of-pit emplacements. By this stage the full length of the South Pit has been developed.

At Year 15, the North Pit is approaching its final western limits. The north west and south west out-of-pit emplacements are complete. Backfilling of the southern blocks of the North pit has commenced. Coal access is as per Year 10.

At Year 20, prestripping of the upper benches in the North Pit are complete. Dragline operations in the North pit will continue though only in the northern half of the pit. Truck and shovel operations will continue in the South Pit. The progressive back filling of the North Pit final void is continuing. In the South Pit the upper benches have extended into the Piercefield Pit. Coal access is essentially unchanged.

Potential exists for the extraction of coal reserves beyond the economic open cut limits in both the North and South Pits by other methods including underground extraction and highwall mining techniques. Coal & Allied intends to investigate these methods at a later stage.

It is intended that mining operations will continue past Year 21. If production is maintained after Year 21 at similar rates, the North Pit will be mined out by approximately the end of Year 22 at which time all operations will be in the South Pit. Truck and shovels will be used to continue backfilling the North Pit void. It is intended that the North Pit void will eventually be back filled to a point where it is free draining.

Should circumstances result in operations not extending past Year 21, a walk away landform is shown in *Figure 13*.

iii. *Mining of Mine Barriers*

The Mount Pleasant Mine Authorisation area adjoins the proposed Kayuga Mine in the north and Bengalla Mine in the south. Coal barriers will occur between these respective operations.

The barrier between Mount Pleasant and the proposed Kayuga Mine will contain the corridor for the diverted Castlerock Road which will follow approximately the current alignment of the eastern section of the Dorset Road. Accordingly open cut mining is not intended in this area.

The barrier between Mount Peasant and Bengalla Mine will be the subject of ongoing negotiations between the two companies. At present a protocol has been agreed between the two organisations that will allow these discussions to proceed. This is provided in Appendix J.

Mining of the barrier between Mount Pleasant and Bengalla will ultimately require the diversion of Wybong Road and closure of that section between the two operations. This diversion and closure has been the subject of a study by Muswellbrook Shire Council - "The Muswellbrook Western Roads Strategic Traffic Study". Coal & Allied will seek the closure of this section of road, in conjunction with Muswellbrook Council, at the appropriate time.

6.1.4 *Equipment*

Table 6.1 lists major equipment to be used in the initial mine development while *Table 6.2* lists operational equipment. An annual listing of operational equipment is provided for the first five years, indicating the build-up of equipment, while totals at five yearly intervals are provided thereafter. The site will also require a number of smaller equipment items, primarily for use in and around the coal preparation plant and mine workshop area, such as a 10 tonne mobile crane, all-terrain fork lift, flat bed trucks, skid loaders and light vehicles etc.

Table 6.3 is an inventory of major contract equipment during the initial two years of mine development.

Table 6.1 MINE DEVELOPMENT EQUIPMENT (YEAR -1)

	Item	Example Equipment Description*	Quantity
i.	***Coal Handling and Preparation Area Earthworks***		
	Tracked Dozer	Cat D10	2
	Scrapers	Cat 621	8
	Roller	Cat 825C	2
	Grader	Cat 16G	2
	Water Cart	20 kL	2
	Fuel Tender Light Truck		2
ii.	***Paving Base Material***		
	Grader	Cat 16G	1
	Roller 3 point 10t smooth drum		1
	Water Cart	20 kL	1
	Roller pneumatic tyre		1
	Light Truck		1
iii.	***Drainage (Infrastructure Area)***		
	Light Truck	10 t	1
	Back Hoe	Cat 436	1
	Light Crane		1
	Roller smooth drum vibrating		1
iv.	***Rail Loop***		
	Tracked Dozer	Cat D10	1
	Scrapers	Cat 621	4
	Roller	Cat 16G	1
	Grader	Cat 16G	1
	Water Cart	20 kL	1
	Truck for Fuel		1
v.	***Fine Rejects Emplacement Area***		
	Self Powered Bowl Scraper	(Cat 631)	3
	Water Cart	(20 kL)	1
	Small FEL	(Cat996)	1
	Tracked Dozer	43 tonne (Cat D9)	1
	Compactor	43 tonne	1

Notes: *t = tonnes,* *m^3 = cubic metres,* *kL = Kilolitres*

* *description indicative of size and make only. Other equivalent plant may be used.*

Table 6.2 OPERATIONAL EQUIPMENT INVENTORY

Item		Example Equipment Description*	Project Year							
			1	2	3	4	5	10	15	20
i.	*Rock Removal*									
	Dragline	100m³ (Marion 8750)					1	1	1	1
	Dozer - Dragline Support	100t (Cat D11)					1	1	1	1
	Rope Shovel	44m³ (P&H 4100)	1	1	1	1	1	2	2	2
	Large Excavator	530t (Liebherr 996)	1	1	1	1	1	1	1	1
	Rear Dump Truck	270t (Dresser 930E)	5	6	6	6	6	11	10	8
	Large Drill	(Drillteck D90)	1	1	1	1	2	3	2	2
	Medium Drill	(Drillteck D75)	1	1	1	1	1	2	2	2
ii.	*Rock & Coal Removal*									
	Front-end Loader	23 wm (L1800)	1	1	1	1	1	1	1	1
	Front-end Loader	20 wm (L1400)	2	2	2	2	2	2	2	2
	Rear Dump Truck	218t (Dresser 830E)						11	14	14
	Rear Dump Truck	190t (Dresser 730E)	8	8	12	11	10			
	Drill	(Drillteck D40)	1	1	1	2	2	2	2	2
iii.	*Miscellaneous*									
	Dozer - General Operations	100t (Cat D11)	3	3	3	3	4	4	3	3
	Dozer - Coal Handling	100t (Cat D11)	2	2	2	2	2	2	2	2
	Rubber Tyred Dozer	(Tiger 690)	1	1	1	1	1	2	2	2
	Scraper	(Cat 651)	1	2	2	2	2	1	1	1
	Water Truck	(70 kL)	3	3	3	3	3	3	3	3
	Grader	(Cat 166)	2	2	2	2	2	3	3	3
	Cablereeler		1	1	1	1	1	1	1	1
	Fuel and Lube Truck		3	3	3	3	3	4	4	4
	Low Loader		1	1	1	1	1	1	1	1
	Pit Pump		4	4	4	4	4	4	4	4
	Mobile Lighting Set		8	8	8	8	10	12	12	12
iv.	*Fines Rejects Emplacement Area*									
	Self Powered Bowl Scraper	(Cat 631)	3	3	3	3	3	3	3	3
	Water Cart	(20 kL)	1	1	1	1	1	1	1	1
	Small FEL	(Cat996)	1	1	1	1	1	1	1	1
	Tracked Dozer	43 t (Cat D9)	1	1	1	1	1	1	1	1
	Compactor		1	1	1	1	1	1	1	1

Notes: *t = tonnes, m^3 = cubic metres, kL = Kilolitres*

* *description indicative of size and make only. Other equivalent plant may be used.*

Table 6.3 CONTRACTOR EQUIPMENT

Item	Example Equipment Description**	Project Year -2	-1	1	2
Hydraulic Excavator	various		2		
Front-end Loader	10m³ (Cat 992D)		1		
Rear Dump Truck	135t (Cat 785)		4		
Rear Dump Truck	85t (Cat 777)		5		
Tracked Dozer	(Cat D10)		2		
Rubber Tyred Dozer	(Cat 834)		1		
Rotary Drill	270mm				
Hydraulic Drill	125mm		1		
Grader			1		
Water Cart			2		
Compactor			1		
Roller			1		
Lighting Sets			3		
Fuel & Lube Truck			1		
Pumps			1		
Scraper			3		

Notes: t = tonnes, m^3 = cubic metres, mm = millimetres

* *description indicative of size and make only. Other equivalent plant may be used.*

** *larger trucks may be used in the future.*

i. Rock Removal

Rock will be moved either by a dragline, trucks and shovels, trucks and front-end loaders or hydraulic excavators or dozers. It is proposed that contractors will use hydraulic excavators (200 to 450 tonne class) and front-end loaders to load a fleet of rear dump trucks (most likely in the 135 tonne class). However, depending on contract details, the contractor may wish to use larger equipment.

Following the commissioning of Coal & Allied's equipment, rock not handled by the dragline will be removed by electric shovel, front-end loader or hydraulic excavator depending on horizon thickness. There will be two electric rope shovels of a nominal bucket capacity of 44 cubic metres (eg. P&H 4100) which will place rock into rear dump trucks of 270 tonne capacity for haulage to emplacement areas. Horizons not suitable for the rope shovel will be excavated by either front-end loaders of 23.6 cubic metres capacity (e.g. Le Tourneau L1800) or the hydraulic excavator (530 tonne class) loading rear dump trucks of initially 190 tonne class. These will be replaced, as production increases, by 218 tonne class rear dump trucks.

ii. Coal Mining

Initial coal mining by contractors is likely to include a 100 tonne class hydraulic excavator and front-end loaders with a fleet of 85 tonne rear dump trucks.

Coal & Allied equipment will include a fleet of front-end loaders (nominally 19.9 cubic metres) and rear dump trucks. Initially rear dump trucks of 190 tonnes capacity will be used. These will be replaced, as production increases, by 218 tonne class rear dump trucks

6.1.5 Mine Lighting

Mining will continue 24 hours per day, so overburden drills, electric shovels, the dragline and pit work areas will be lit. Impacts will be minimised by providing only sufficient lighting for safe and efficient operation using the latest innovative technology and design methods.

Overburden drills will sometimes operate near the natural ground surface. Fugitive light will be reduced by using low level localised light sources which will be set at minimum safe operating levels.

Electric shovels will begin pre-stripping near to existing ground levels. Lights will be aimed down and fitted with hoods and screens to reduce light spillage and glare.

The dragline will be a continuously moving light source. Emissions will be restricted by mounting lights so as to provide the minimum illumination required for the safe operation of the machine. Lighting will generally be on the lower portions of the dragline boom instead of the whole boom, as is customary. For safety reasons the dragline bucket will also need to be illuminated. All lights will be aimed down and fugitive emissions will be mitigated by hoods and screens. In addition, lights will be fitted with lenses to give sharp cut-off, focused light with low spill characteristics.

Mobile lighting towers will be used in the operating mine. These will usually be located on top of the high wall above the work area, on the western side of the operating mine and will direct light downward into the pit. These will be fitted with hoods and screens to minimise fugitive light emissions. Where possible, towers will be located in the pit rather than on the high wall to further reduce fugitive light emissions.

Trucks will direct light toward Muswellbrook when travelling eastward. This will be mitigated by the eastern bund as trucks progress further east. As far as is practical, the location of the haul road will be designed to maximise the shielding from existing topography.

On the permanent east west haul road to the infrastructure site, Coal & Allied will investigate whether it is safe to have permanent lighting (with hoods to minimise fugitive light) in place of high beam truck lights.

Consequently, light from trucks will primarily be observable when they are furthest from urbanised areas.

6.1.6 *Road Relocations and Blasting Closures*

A 5.2 kilometre section of Castlerock Road that is within the site will be closed to allow mining in the North Pit. A new 5.5 kilometre section will be constructed along the approximate alignment of the existing Dorset Road linking Castlerock and Dorset Roads.

Wybong Road will initially remain open to maintain community transport needs. However, in accordance with the recommendations of Council's Western Roads Strategy Sub-Committee, Coal & Allied will seek the future closure of a 4.1 kilometre section of Wybong Road. This will occur in approximately Year 9 of production to allow for the extraction of coal in the barrier between Mount Pleasant and Bengalla Mines. To facilitate community transport the closed section will be replaced with a new 4.9 kilometre section of road in the west of the site as shown on *Figure 65*.

The new road sections will have a design speed of 100 kilometres an hour and will be visually screened to minimise potential views of the mine and emplacement areas. Both roads will be within existing road reserves or a new reserve established on land owned by Coal & Allied and/or Kayuga Mine in the case of Dorset Road. The implications of these relocations are discussed in Chapter Fourteen.

At various times, it will be necessary to close roads adjacent to the mining operations where blasting occurs within 500 metres of the road. It is intended to keep the frequency and duration of the road closures to a minimum. On average, roads will be required to be closed for blasting operations approximately one day in ten. The duration of the closure will be approximately ten to fifteen minutes. At least twenty four hours notice will be provided prior to blasts requiring road closure. Signs will be erected at the nearest major intersection at both ends of the road to be closed, as shown on *Figure 65*, warning drivers of potential closures, the likely duration and alternative routes. Personnel supervising road closures will undertake traffic control training in accordance to Roads and Traffic Authority and Council requirements. Roads will be inspected after blasting prior to re-opening to ensure no fly rock is lying on the road. Blasting operations requiring road closure will be scheduled so as not to occur during school bus times.

Mount Pleasant will liaise with Bengalla mine and the proposed Kayuga Mine to ensure road closures are kept to a minimum. Anticipated closure times for Wybong Road due to the Bengalla Mine are approximately 10 minutes on an average of one day in twenty. Blasting closures of Dorset Road due to the Kayuga Mine will range from approximately 32 times per year (Years 7 to 17) to 48 times per year (Years 18 to 21). *Table 6.4* lists roads subject to periodic closure due to blasting for the Mount Pleasant Mine and the years during which they may be affected.

Table 6.4 ROAD CLOSURES DUE TO BLASTING

Road	Years Potentially Affected
Kayuga Road	Year -1 to 3
Castlerock Road	Year -1 to 3
Dorset Road (Mount Pleasant Northern Link)	Year 2 onwards
Wybong Road	Years 7 to 9

6.1.7 *Final Void*

It is expected that mining will continue in the North and South Pits beyond Year 21. Any development beyond the limits proposed in this EIS would be the subject of separate development applications. Should circumstances prevent future mine development then a final void would remain. This is shown on *Figure 13* as a "walk-away" scenario for the mine. Three voids would remain including the North Pit and two areas in the South Pit.

6.2 CONSTRUCTION AND OPERATION

6.2.1 *Development Program*

A project development program is shown in *Graph 4*. A nominal two year construction program is proposed for the permanent coal preparation plant, mine facilities, electric shovel No. 1 and rail loop with regular coal production beginning in the third year (Year -1). Dragline and electric shovel No. 2 assembly will start in Years 3 and 6 of regular operations respectively. Two years development work is required before coal production. During this initial period mine planning and design work will be on-going and major plant will be designed and commissioned.

6.2.2 *Construction Workforce*

A workforce of up to 253 people will be needed over a construction period of sixteen to eighteen months. *Figure 22* gives a histogram of construction personnel numbers. This excludes the permanent operational workforce which is shown in *Table 6.5.*

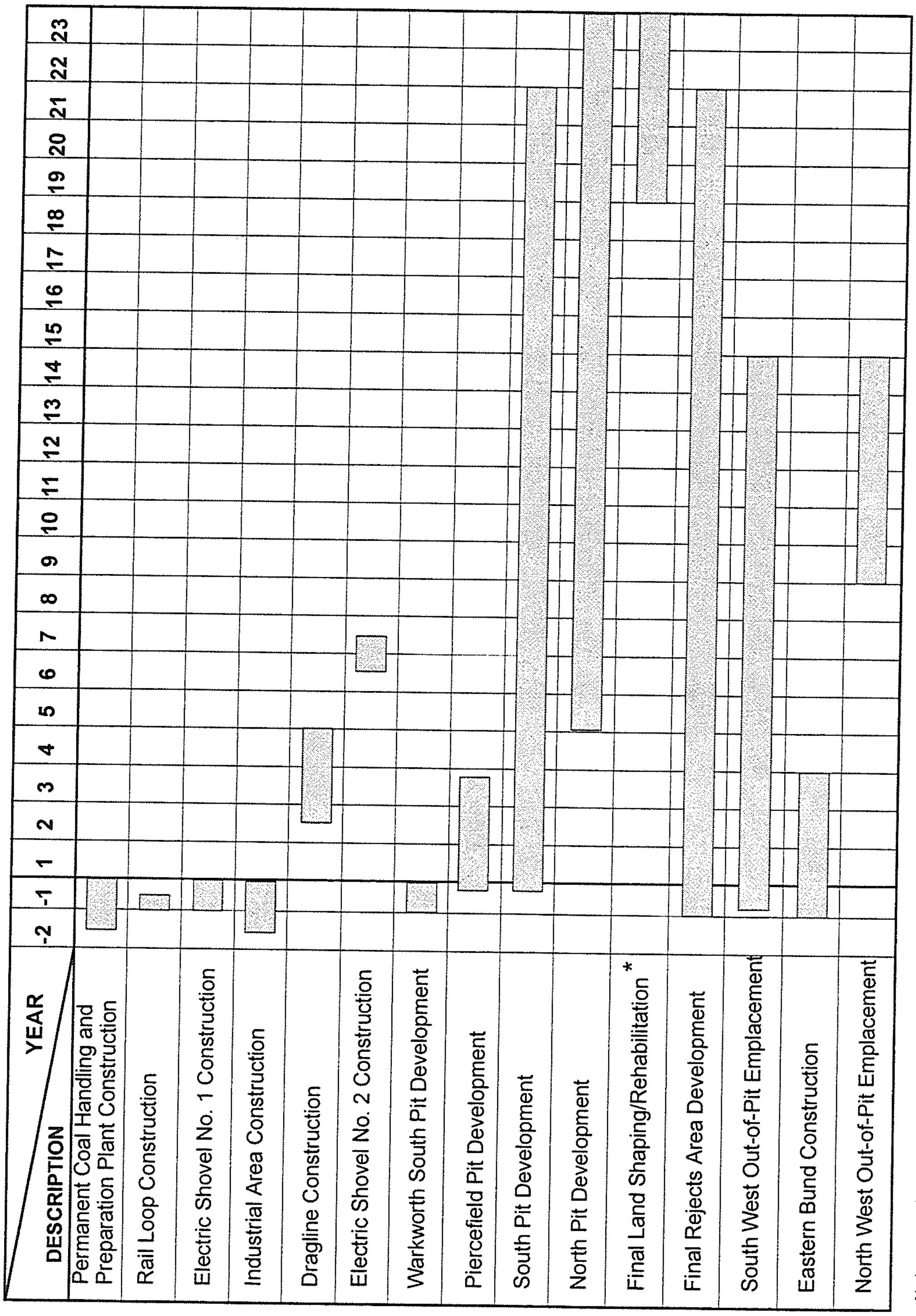
6.2.3 *Operational Workforce*

The average operational workforce over the life of the mine will be 332.

There will be a steady build up in the workforce over the first nine years, after which numbers will fluctuate between 364 and a peak of 380 in Year 13.

Table 6.5 OPERATIONAL WORK FORCE

Project Year	-1	1	2	3	4	5	10	15	20
Mining	5	97	127	151	151	147	199	196	191
Technical Services	9	13	13	13	13	14	14	14	14
Maintenance	4	41	50	55	55	59	72	71	66
Coal Preparation (max)	22	57	58	59	59	64	64	64	64
Administration	13	15	15	15	15	15	15	15	15
TOTAL	**53**	**223**	**263**	**293**	**293**	**299**	**364**	**361**	**351**



Note: Regular Coal Production commences in Year 1

* *Providing mining does not continue.*

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Graph 4 PROGRAM TIMING

6.2.4 *Access*

Access to the site will be via a single controlled gate to the infrastructure area off Wybong Road. The remainder of the site will be fenced to prevent unauthorised access to the mine.

The access road will be a two lane sealed road (3.5 metres per lane) with one metre sealed shoulders. An Austroads Type C intersection from Wybong Road will be provided to provide sufficient turning space for truck access to the site.

Once recommended future road network changes are made, as outlined in Section 6.1.6, including the closure of sections of Castlerock Road and Wybong Road, mine traffic will mainly approach from the south via the Bengalla Link Road. The implications for local traffic movements are discussed in Chapter Fourteen.

Within the site, the infrastructure area and site facilities will be accessed via a sealed road. The main haul road will link operating mine areas including the pits and emplacement areas. All major haul roads will be gravelled and watered to minimise dust generation.

6.2.5 *Operating Hours*

The mine will operate 24 hours per day, seven days a week. Workforce numbers have been calculated on the basis of two 12 ½ hour rotational shifts.

The coal preparation plant will also operate 24 hours per day, seven days per week. The coal loader and rail loadout facility will be available to load trains at any time specified by the Rail Access Corporation or any other future schedulers.

6.2.6 *Site Decommissioning*

Site decommissioning will involve remediation of any contaminated areas and rehabilitation to the final land capability as discussed in Section 6.5. Buildings will be available for alternative use or demolished. Following this the site will be sold.

6.3 MINING INFRASTRUCTURE

6.3.1 *General Description*

Mining infrastructure will be built in the south west corner of the site as shown on *Figure 8* and detailed on *Figure 14*. It will include:

- an industrial area with workshops and administration and employee facilities;
- ROM and product coal stockpiles; and
- a coal preparation plant.

A key feature of the development is its distance from Muswellbrook. The Bengalla Link and Wybong Roads will give access to all mining infrastructure which in turn is connected by a system of internal roads to the pits lying to the east and north-east.

6.3.2 *Industrial Area*

A plan of the industrial area shown on *Figure 14* will comprise:

- an administration building. This will be a single storey office building about 650 square metres in area, providing accommodation for management, technical and administrative staff. It will have a main reception area, partitioned offices for about 29 staff, meeting rooms, library, storerooms and male and female toilets, as well as toilets facilities for the disabled. The building will be of brick or other construction material with Colourbond roof sheeting;

- an operations building and changehouse. This will be a multi-function single storey building. One part will have a clean and dirty side change room with separate male and female areas for up to 380 staff. The other part will be an air conditioned central operations room. The building will have an area of about 2,000 square metres, and will be of brick or other construction material and Colourbond roofing; and

- a workshop and warehouse. This complex will be housed in a twin bay, steel frame and Colourbond metal clad building with a floor area of about 5,500 square metres. The workshop will occupy 3,840 square metres and the warehouse the remainder. The workshop will have separate facilities for mechanical and electrical work. It will have road access and will be serviced by a pair of overhead travelling cranes. An external covered storage bay will be provided and there will be apron slabs and cantilevered awnings at all doorways. Tyre handling and lubrication facilities will be located in an adjoining roofed structure with a floor area of 2,400 square metres. A vehicle washdown facility will also be provided in a separate structure to the workshop.

Elevations of mine buildings are shown on *Figures 15* and *16*.

6.3.3 *Rom and Product Coal Stockpiles*

Coal from the mine will be discharged from haul trucks to a hopper or alternatively a 20,000 tonne ROM coal stockpile as shown on *Figures 14* and *18*. This stockpile will be used to minimise the effect of variations in production or inclement weather on the continuity of supply to the coal preparation plant. Coal will be transferred from this stockpile to the hopper using a front-end loader and trucks. From the hopper, it will be crushed and then conveyed to surge bins to even out the rate of coal supply. These facilities may be augmented by an additional 100,000 tonne ROM coal stockpile equipped with a rail mounted mobile stacker and reclaimer if this proves to be necessary during the life of the project. The stacker and reclaimer would be supported on rail systems along the length of the stockpile. Coal will be conveyed from these stockpiles to the coal preparation plant as shown on *Figure 19*. Conceptual conveyor cross sections are shown on *Figure 17*.

From the coal preparation plant, product coal will be conveyed to the product stockpile which will have a maximum capacity of about 500,000 tonnes as shown on *Figure 20*. Approximately 200,000 tonnes of product will be stockpiled by a mobile luffing stacker mounted on rails and a dozer will then push stacked coal away from the stacking line, providing an additional 300,000 tonnes stockpile capacity.

A reclaim conveyor will be located beneath the product stockpile. It will be connected to the stockpile by a number of feeders, with the capability for more than one feeder to operate at a time so that coal can be blended during reclaiming. Up to two dozers will push coal toward the feeder or feeders during loading. Product coal reclaimed via the feeders will be conveyed to the loadout bin at the rail loop as shown on *Figure 20*.

6.3.4 *Coal Preparation*

The need to clean coal arises from the contamination of ROM coal with non-coal material. This contamination typically comprises sedimentary rocks from above, below and within the coal seam as well as mineral matter dispersed within the coal. Most coals exported from NSW are crushed and cleaned to remove a proportion of the non-coal material. Cleaning reduces the mineral content of the coal and leads to less ash being formed when it is burnt at customer power stations. The crushing and cleaning processes are referred to as coal preparation.

At Mount Pleasant it is planned that ROM coal will be crushed in stages down to a top size of about 125 millimetres. It is planned to process this coal in three major size fractions: large coal nominally greater than about 16 millimetres, small coal nominally smaller than about 16 millimetres but able to be retained on screens with an aperture of about 0.5 millimetres and fine coal which passes through screens with an aperture of about 0.5 millimetres.

The coal cleaning circuits planned for Mount Pleasant rely largely on the fact that the coal has a lower specific gravity than the non-coal material. Both large and small ROM coal size fractions are cleaned by gravity separation of the coal from non-coal material when these ROM coal size fractions are placed into a fluid referred to as dense medium. This fluid is a suspension of very tiny particles of magnetite (an oxide of iron) in water whose overall density is closely controlled by adjusting the proportion of magnetite in the suspension.

The large coal circuit relies on relatively simple gravity separation within the dense medium. The large coal particles that have a lower density than the dense medium rise to float at the surface of the medium while the heavier particles of non-coal material sink in the dense medium. The separation is enhanced in the small coal circuit by pumping dense medium and ROM coal together through particular cyclones referred to as dense medium cyclones.

In the large coal circuit, product coal is drained and rinsed before being crushed to a marketable size which for export is usually no more than 50 millimetres. After crushing, the product is conveyed to stockpiles. The coarse reject is drained and rinsed and then discharged to the reject conveyor.

Small product coal is also drained and rinsed but because of its smaller size it is dewatered in a centrifuge before discharging it to the product conveyor. After draining and rinsing, fine reject is pumped to the fine rejects emplacement area.

Dense medium and magnetite is recovered from both the large and small coal washing processes by way of the draining and rinsing operations and by the use of magnetic separators. The recovered dense medium and magnetite is recycled to the process.

Fine ROM coal is cleaned in a process circuit that does not use dense medium. In this circuit the ROM fine coal mixed with water is first pumped through classifying cyclones to remove very fine particles which generally contain a high proportion of non-coal material including clays. It is then fed to spiral separators which have been arranged in a two stage configuration in the conceptual/preliminary plant design. The spirals perform a relatively simple gravity separation taking advantage of the differing centrifugal effects produced on the coal and non-coal particles as they wind their way down the spiral pathways. After thickening in fine coal cyclones the fine coal product stream is dewatered in fine coal centrifuges before discharge to the product conveyor. Fine reject from the spirals is thickened in cyclones and then combined with other fines rejects in a thickener which is described below.

Reject material contained in dilute streams leaving the plant primarily consists of clays and other very fine mineral particles together with some relatively small losses of fine coal particles and very fine magnetite. These reject materials are fed to a thickener (shown on *Figure 14*) which concentrates and recycles large quantities of process water to the coal preparation plant. The thickener works by providing quiescent conditions in which the fine solids settle and are collected. Flocculants and coagulants are added to enhance the settling characteristics of the very fine particles. Some inorganic chemicals may also be added within the overall process to control pH.

Flocculants and coagulants will be used at the coal preparation plant for the thickening of tailings. Chemicals may also be used for pH control. It is expected that in general flocculants based on synthetic anionic polyelectrolytes will be used when processing coal and when required, coagulants based on synthetic cationic polyelectrolytes or inorganic coagulants will also be used to assist with the coagulation and flocculation of very fine particles.

The selection of specific flocculants and coagulants will be made on the basis of technical and commercial evaluations including large scale trials. It is likely that at any one time a single anionic flocculant will be used, supplemented when required by a single coagulant. However, occasionally more than one flocculant and one coagulant would be stored on the site to accommodate trials and changeovers and to meet any different requirements that arise in processing different coals.

Synthetic polyelectrolyte/polymer based flocculants and coagulants will be supplied to the plant in powder/granular form and/or in liquid form. Where liquids are used the polyelectrolytes/polymers will be delivered within water in hydrocabon emulsions or in aqueous solutions.

For regular use anionic synthetic flocculants (and if ever required non ionic synthetic flocculants) will be stored in bulk hoppers of up to 12 cubic metres capacity. Where powder/granular types are used they will be stored in tanks of up to 20 cubic metres capacity. Anionic flocculants will be made up to a stock solution (approximately 1 per cent) using specialised mixing equipment and stored in two aging tanks with a combined capacity of about 10,000 litres. In the case of powder/granular flocculants the mixing equipment will incorporate a tank with a capacity of about 2,000 litres between the bulk hopper and the aging tanks. Further dilution of the flocculant (to approximately 0.02 per cent) takes place just prior to dosing into the thickener. Dilution is by a small mixing box ahead of the flocculant distribution system. Dilution water will be raw water pumped from the storage dam.

Synthetic coagulants containing cationic polyelectrolytes (which are sometimes referred to as cationic flocculants) may also be stored in bulk storage hoppers where powder/granular types are used and/or in fixed storage tanks where liquid types are used. However, it is expected that smaller storages would be used for these coagulants compared to those used for anionic flocculants and that these coagulants would be dosed directly into the process without further dilution or aging. Appropriate storage and handling facilities and procedures will be established for any inorganic coagulants and for any chemicals used for pH control.

Portable dosing rigs supplied from bags, bulk bags and portable liquid containers may be used at times to meet short term intermittent requirements, especially for flocculant and coagulant trials.

Safety and environmental procedures for handling and using all chemicals will be implemented. These will be based on supplier information and company experience gained from similar facilities at its existing Hunter Valley mines.

The thickened tailings and fine reject from the spirals plant section will be pumped to the fine reject emplacement area.

The density of various process streams and the underflow density of the tailings thickeners will be monitored/controlled using nuclear (nucleonic) density gauges. The conceptual plant design also provides for the quality of the product coal to be monitored continuously using analysers which incorporate nucleonic gauges.

The proposed coal preparation processes are already widely used in the coal mining industry. It is planned that the plant layout will be modularised.

6.3.5 *Rejects Disposal*

Coal preparation produces both marketable coal and rejects. Processing large and small coal sizes yields coarse reject while fine coal processing gives a fine reject stream. Coarse reject is easily dewatered, while tailings, which may have a high clay content is more difficult to dewater. Rejects primarily contain shale, sandstone, claystone, carbonaceous mudstone and clay minerals with some coal and other minerals.

i. Coarse Rejects

Coarse reject will be carried from the coal preparation plant on a conveyor to a 400 tonne bin located immediately west of the ROM coal receival station as shown on *Figure 21*. It will then be placed into trucks and transported to spoil emplacements. Reject will be randomly placed at least three metres below the final rehabilitated surface in order to minimise the likelihood of spontaneous combustion. It will also be used to build fine reject emplacement walls.

ii. Fine Rejects

All fine rejects (as opposed to coarse) will be pumped to a series of stepped emplacements near the south west corner of the site. Initially, two emplacement walls will be formed at the top end of the catchment and an environmental dam will be constructed in the centre of the catchment. The central location of the environmental dam will maximise the amount of catchment water to downstream users, by only treating water from those upstream areas disturbed by fines emplacement operations. At about Year 10, the central environmental dam will be enlarged to facilitate continued fines emplacement. Prior to this a new environmental dam will be built at the lower end of the catchment. Water from rehabilitated areas in the top of the catchment will then be diverted around the central dam in order to maximise downstream flows.

Emplacement walls will be raised in stages of approximately five metres to suit the operation of the dam and to avoid having to build a large dam wall at once. Emplacement walls will be built from coarse reject and other rock, with provision for a filter area and spillway. The building or raising of the dam walls will involve course reject material being stockpiled near the dam wall from where it will be picked up and rehandled by a number of self powered bowl scrapers onto the new section of dam wall. For safety reasons and except in emergencies this operation will occur only during daylight hours. Reject material will be used with crushed, sized rock in the filter area which will allow some water to flow through as the fine reject drains. The environmental dams will be impermeable to prevent off-site discharges.

Fine reject will be pumped into the emplacements as a slurry. Excess water will be returned to the mine water management system for reuse in the coal preparation plant, dust suppression and other site uses. In general, two emplacements will be active at any one time. As each emplacement fills another will be placed immediately downstream. The filled emplacement will be allowed to dry out before being covered by a layer of rock, topsoiled and then revegetated. Rehabilitation timing will depend upon drying rates which are controlled by rainfall and evaporation. Ultimately, a series of emplacement terraces will be constructed. They will be shaped to blend into the surrounding topography. The dams will be designed and constructed to a standard that would ensure sufficient stability for any future potential underground operations in this area.

Two catchments were investigated as fine reject emplacement areas, as shown in *Figure 33*. Although only the northern catchment is likely to be used, a second is included in this proposal and environmental assessment, in case more fine reject is generated than is currently predicted.

The area encompassed by the fines reject emplacement does not contain coal reserves which could be considered viable for open cut extraction. Information from boreholes located in the centre and margins of the area indicate that the upper seams are thin and highly weathered. The vertical separation between individual seams is large resulting in a high rock to coal ratio which is not viable for open cut extraction.

Underground reserves in this area are at sufficient depth for the rejects emplacements not to prohibit their extraction. The permeability of the intervening rock strata is low, effectively limiting any seepage from the surface which could be significant to future underground operations.

iii. Spontaneous Combustion

Spontaneous combustion of coal is started by the continuous accumulation of heat resulting from oxygen in the air chemically reacting with coal substances at the surface of coal particles. This process is termed spontaneous heating. Spontaneous heating slowly causes the bulk temperature to rise without the addition of an external heat source. For spontaneous combustion to occur, the rate of heat being generated through oxidation must exceed the rate of heat removed by natural cooling methods (i.e. conduction, convection, and thermal radiation). As the coal temperature rises, the rate of heat generation will often also increase. The result is a "runaway" reaction which may ultimately cause ignition. If the rate of heat removal exceeds the rate of generation, the material will not ignite.

The propensity of coal to self heat is dependent on inherent coal properties (eg. sulphur content, volatile matter), physical factors (eg. moisture content, particle size), stockpile factors (eg. shape, permeability) and environmental factors (eg. wind, humidity).

Analyses of nine ROM coal samples and ten product samples from Mount Pleasant were undertaken to assess oxidation and self heating characteristics. Tests included moisture holding capacity, water holding capacity, oxidation rate and relative ignition temperature.

Results indicate a moderate potential for self heating with little variation in oxidation rates. This is typical of Hunter Valley coals. Existing industry standards and management techniques are therefore applicable to all ROM and product coals.

Higher oxidation rates corresponded to lower ash and moisture contents. However, no relationship between self heating propensity and coal properties such as sulphur, ash or volatiles was detected. The water and moisture holding tests indicate the coals have moderate porosity with significant variation across seams. Tests indicate that a reduction in moisture content increases self heating potential. Thus if ROM or product coal is unusually dry or allowed to dry during stockpiling the risk of self heating will increase.

Practical experience in the management of spontaneous combustion gained at Coal & Allied's other Hunter Valley mines has effectively eliminated spontaneous combustion at these mines. Techniques gained from this practical experience will be applied to the Mount Pleasant Mine as outlined below.

❖ Management Initiatives

Propensity for spontaneous combustion can be determined and appropriate management instigated for its control.

Spontaneous combustion is basically a fire. To have a fire requires fuel, heat and oxygen.

Management techniques centre around careful monitoring and reducing or eliminating one or more of the above. The methods adopted depend on the circumstances of the occurrence. Management techniques currently planned for the mine area include:

- regular surveys using visual and infra-red techniques to highlight areas of concern will be conducted; and
- keeping coal work areas clean and tidy so as to minimise any accumulation of coal or any loss of coal into the overburden emplacement areas.

Management of stockpiles will include:

- dozer push out operations designed and implemented as far as practical to reduce the development and/or effect of size segregation from stacking onto the product stockpile;
- windbreaks parallel to the two major sides of the product coal stockpile area to reduce the effect of wind across the stockpiles;
- compaction of stockpiles planned for long storage;
- minimising length of storage as far as practical;
- monitoring by observation and with infra-red sensing; and
- maintenance of stockpile shape, particularly height.

❖ Response Strategy

In the event that self heating is detected the following response strategy will be implemented in the mine area:

- determine the nature and extent of the problem;
- decide on the most effective technique which may include:
  - dig out the burning material (remove the coal from further fuel supplies);
  - spread the material to allow it to cool;
  - compact the cooled substance (to eliminate further ingress of oxygen);
  - cover the material with an inert substance (to eliminate oxygen); and
- continue to monitor after the control methods have been implemented.

The response strategy for the stockpiles area will include:

- compact stockpile if temperature measured within reaches 75°C;
- once heating has commenced, water must not be added to the affected stockpile;
- remove heated material as soon as practical;
- rehandle coal into the stockpile system when cooled and stable;
- continue to monitor to ensure heating has been contained and permanently controlled or extinguished; and
- record all response procedures and results for both mine and stockpile situations.

6.3.6 Rail Loading Facility

The product coal reclaiming system and railcar loading facility will load coal into railcars at a nominal rate of 5,000 tonnes per hour. Coal will be fed from the product stockpile onto the underlying reclaim conveyor. The reclaim conveyor will lead about one kilometre south to a rail loading facility. It will pass underneath Wybong Road but will otherwise be constructed above the surface until it approaches the rail loading bin where it will be elevated to deliver coal to the bin top, as shown on *Figure 20*. The length of ramp and overall bin height will be reduced by placing the rail line in a cutting whilst the conveyor will be fully or partially enclosed as shown on *Figure 17*. The rail loading bin will have a capacity of about 1,000 tonnes and an overall height of about 44 metres. The bin will provide a storage prior to product coal being loaded out, and it will also help to modulate surges in coal delivery from the conveyor. It will hold the contents of the conveyor system. It is planned that this bin will incorporate a batch weighing system to accurately meter coal into the rail wagons.

The bin will be located on a rail loop connected to the Muswellbrook-Merriwa railway (commonly known as the Ulan Line). The facilities are located to the south of the Mt Pleasant Mine infrastructure area. The rail line between the bin and the Ulan Line will be about 6.1 kilometres long as shown on *Figure 2*.

The rail loop will have capacity for two 9,000 tonne capacity trains, one being loaded whilst the other waits. Each train could be filled in less than two hours by the proposed rail loading facility. Trains with this capacity are not presently used but are being investigated for the future.

Railway signals will be located at the end of the loop to control trains entering the Ulan Line.

6.3.7 *Infrastructure Lighting*

This section details infrastructure lighting, while mine lighting was discussed in Section 6.1.5. Supplementary Report 10 details mine infrastructure lighting which is outlined below. Infrastructure lighting will minimise visual impacts by incorporating the following criteria:

- only sufficient lighting for safe and efficient operation will be provided;
- where suitable and where safety will not be compromised, access lighting will be fitted with time delay automatic cut-offs. This will also reduce energy consumption;
- all buildings, conveyor galleries and transfer stations will be enclosed; and
- current, innovative technologies and design methods will be used.

The ROM coal receival station driveway will require substantial lighting so that rear dump haul trucks can safely manoeuvre and deposit coal into receival hoppers. It will be lit to an average of 50 lux at ground level (in comparison moonlight has an illumination of 0.1 lux while sunlight is measured in thousands of lux). The area around the coal receival station will be floodlit with 30 metre high mast lighting. Lights will be pointed down to minimise spillage and glare, and they will not be aimed east, thereby minimising impacts to Muswellbrook. Western and southern spillage will be contained by careful siting and the natural topography which provides additional protection.

Coal stockpiles including the stackers and reclaimer will be lit for night-time operations, however, intense lighting will not be required.

The product coal stockpile will be illuminated sufficiently to operate one dozer during stacking and two during train loading. These dozers will also use their standard headlights.

Lighting of product stackers will also be designed to minimise outward and upward light spillage. Lighting of these areas will be sufficient to maintain adequate safety for operations.

Where lighting is required for the coal preparation plant, office buildings, bathhouses, workshops and elevated conveyors, it will be fully enclosed.

The truck washdown facility will be internally well lit with the spillage from the open ends screened locally.

Rail load out facilities will be fully clad with lighting for the loading operation mounted at the base of the bin structure and aimed directly at the ground.

Haul trucks will manoeuvre and park on the industrial area hardstand. Safe lighting will be achieved with an average ground light level of 15 lux. Lights will be located on 20 metre high masts using shielded fittings. All lights in the employee car park and access roads will be mounted on low poles to give a sharp cut-off.

6.3.8 Viewing Platform/Tourist Facility

A viewing platform will be constructed on the northern boundary of the mine. It will incorporate a car park accessed from Dorset Road. Stairs will lead to the platform so that community members and visitors can inspect mining activities.

6.3.9 Utilities

i. Electricity Supply

A 66 kilovolt overhead power transmission line crosses the site from north to south. It supplies Dartbrook Mine and has sufficient capacity to also service Mount Pleasant. It is proposed that the main line will be relocated along the eastern boundary of the site as shown on *Figure 9*. The mine infrastructure substation will be located next to the relocated transmission line. The existing transmission line will be retained to supply the dragline and two rope shovels via two portable substations.

ii. Water Supply

A pump station will be located on the northern bank of the Hunter River directly south of the Bengalla surface facilities. The pump station will be located in consultation with the Department of Land and Water Conservation. The water supply pipeline will follow the rail loop and connecting conveyor alignment to the infrastructure facilities.

Potable water for the industrial area will be sourced from the Hunter River and treated on site to the required standards.

iii. Sewerage

A separate sewerage system with a package treatment plant will be built. It will collect sewage and wastewater from the industrial area and sewage from the coal preparation plant. Treatment will include removing phosphorus and disinfection. Effluent will then be irrigated onto landscaped areas of the mine. Storage will be provided for wet weather periods and the irrigation system will be designed to achieve zero runoff.

iv. Telecommunications

Telecommunications will include phone, facsimile, electronic mail and security alarms. Microwave links may also be used for remote real time monitoring.

Existing telephone lines affected by the proposal will be relocated in consultation with Telstra to maintain service to existing properties.

v. Fuel Supply

Most mobile plant will be powered by diesel fuel. An above ground two megalitre storage tank will be provided on the western edge of the industrial area. It will be bunded in accordance with Australian Standard 1940 - *The Storage and Handling of Flammable and Combustible Liquids.*

A diesel dispensing facility will be located next to the main workshop and connected to the tank via above ground pipelines. This area will be roofed and drained to the workshop oil separator system.

vi. Explosives Storage

Explosives used in blasting operations on site will be delivered under contract on an as needs basis. Storage of ancillary devices such as detonators, fuses and ignition systems will be in accordance with Australian Standard 2187.1, 1984 - *The Storage and Land Transport of Explosives.* Storage facilities will be located in the south western corner of the site in conjunction with the Department of Mineral Resources and the licenced contractor.

6.3.10 Waste Disposal

All office and putrescible waste will be removed by a licenced commercial waste disposal contractor. The contractor will be required to provide on site bulk bins which will be regularly removed.

Scrap steel will be placed in storage bins and removed by a licenced scrap metal contractor. Non-putrescible building wastes such as concrete will be buried in designated areas within the mine.

Waste oil will be decanted to an on site storage tank where it will be collected for recycling by a licenced contractor. Oily sludges will be also be removed from site by a licenced contractor for recycling and disposal. Investigations will be undertaken into the feasibility of establishing an on site bio-remediation system for oily sludges.

Tyres from earth moving equipment will be buried in backfilled areas of the mine pits.

6.3.11 Temporary Facilities

i. Office and Store

During the initial mine development there will be a need for a temporary office and store. This will provide facilities for Coal & Allied design, administration and contract supervision personnel. A training centre and small store for items such as office consumables and survey equipment will also be required. These facilities will be located in the south west corner of the site.

ii. Contractor Facilities

During the project construction phase there will be a need for contractor offices, workshop amenities and stores. The facilities will be demountable and located in two areas: adjacent to the coal preparation plant site; and next to the main workshop site. Amenities will also be provided at construction areas away from the main facilities, such as the railway loadout bin. Contractor facilities will be provided with power, water and telecommunications. All amenities will have pump-out sewage services.

iii. Construction Camp

There may be a need for a construction camp to accommodate workers during the project's construction phase as discussed in Chapter Ten. If required, Coal & Allied would use the existing construction camp at Ravensworth to reduce pressure on the area's temporary accommodation. The construction camp comprises:

- accommodation facilities;
- a meal and recreation building;
- car parking; and
- a pump-out sewerage system.

iv. Rock Crushing

Crushed and graded rock will be required for roads, working pads and other ancillary mine operations. If suitable raw material exists on site a mobile crushing plant will most likely be located near the mine infrastructure construction area. The crushing plant will be placed in the rock extraction pit to ameliorate noise impacts.

The plant will crush rocks to less than 18 millimetres diameter. It will process about 100 tonnes per hour and operate five days per week as required during construction and may operate as required following this period. Source rock will be fed into the crusher by a front-end loader. If no suitable material exists on site, crush and graded rock will be imported.

v. Dragline Construction Pad

The dragline and shovel will be assembled on a construction pad as shown on *Figure 8*. This position minimises potential views from surrounding residential areas because existing landforms act as natural visual barriers. The pad will be landscaped and bunded along Wybong Road to screen potential views from this location.

The pad will be used to assemble the dragline in Years 3 and 4 and electric shovels No. 1 and No. 2 in Years 1 and 6 respectively. The pad may also be used for assembling other mining equipment such as the hydraulic excavator and trucks etc, as required.

6.4 WATER MANAGEMENT

6.4.1 *Proposed System*

The water management system proposed for Mount Pleasant can be considered as two interconnected parts: water supply and pollution control. *Figure 34* presents a schematic of the proposed water management system, showing operations for the North and South Pits, the Piercefield and Warkworth South Pits, the coal preparation plant, fine rejects emplacement area, proposed draw points for dust suppression and the Hunter River pumping station. *Figure 33* shows the location of the system's major components.

Chapter Nine details the future water balance and water management of the mine under varying climatic conditions. Management of groundwater and seepage to the void is also dealt with in Chapter Nine.

6.4.2 *Water Supply*

Water requirements for the mine and coal preparation plant will be met from minepit groundwater inflows, harvested catchment runoff and make-up water from the Hunter River. Principal water demands will be for:

- the coal preparation plant;
- dust suppression on mining haul roads, coal conveying and stockpile areas;
- machinery washdown; and
- potable supplies for bathing and other domestic uses.

Water budget simulations indicate that the mine will operate with a water deficit under most weather conditions. Water demands will be preferentially supplied using water harvested from the mine site. When these sources are inadequate the shortfall will be made up from the Hunter River.

6.4.3 *Water Pollution Management*

The water management system consists of two separate water circuits. The clean water circuit comprises all runoff water derived from undisturbed or rehabilitated lands, while the mine water circuit comprises all water derived from disturbed active mining areas.

The management strategy has been developed to convey clean water around mining operations, harvest runoff waters to provide operational water supply, and to control and manage stormwater and groundwater to maintain efficient operating conditions.

i. Clean Water Diversion - Undisturbed Catchments

Runoff from undisturbed natural catchments as distinct from mine water or rehabilitated catchments will be directed via contour banks, drains and diversion channels to local water courses. Nominal diversion channel and dam locations are shown on *Figure 33* for the mine development scenario at Year 10.

Runoff from disturbed but rehabilitated catchments will be controlled and managed by impeding sheet runoff. This will be achieved by deep ripping and furrowing to contour banks and drains which direct all runoff to sedimentation dams as shown in *Figure 33*. Proposed drainage details for 2, 5, 10, 15 and 20 year development scenarios are provided in Supplementary Report 3 with summary calculations relating to catchment runoff and dam concept design.

a. Diversion drains

Diversion drains and channels will contain peak runoff discharge rates for a 1 in 5 year Average Recurrence Interval (ARI) storm event. Drains and channels will be excavated to a conventional trapezoidal section with sectional area and hydraulic grades giving acceptable flow velocities of less than 2 metres per second.

b. Sedimentation dams

Figure 33 shows numerous sediment dams, diversion dams, contour banks and channels in the western part of the site which will convey runoff around the mine pit. All dams will be designed in accordance with established engineering design principles and Dam Safety Committee requirements. Certain dams will be designed to overflow or pump to contour drains while other dams will have an outlet structure for release to local water course including suitable drainage line erosion protection.

Eight dams are categorised as sedimentation dams. Dam capacity has been sized to collect the total runoff from a 1 in 20 year, ARI storm. All dam structures will have the capacity to retain the design storm with sufficient free-board and spillway width to convey a 1 in 10 year (time of concentration) storm. During rainfall events runoff will enter the dams with sediment removed by providing quiescent conditions which allows sediment to settle out of suspension. Dams will be maintained at a minimum of 75 per cent of their design capacity by periodic removal of accumulated sediment.

ii. Mine Water Management System

The proposed mine water management system involves a series of interconnected dams that provide pollution control and water storage. The dams can be categorised into five types:

- the rail loop dam;
- mine water dams;
- main water storage dams;
- the coal preparation plant storage dam; and
- environmental dams for the fine rejects emplacements.

Table 6.6 summarises the staging of the proposed dam system over the life of the mine.

There are in-pit drainage sumps in addition to these surface dams. Drainage within the mining areas is directed to these sumps for pumping to the main storage dam.

The in-pit sumps generally have a capacity of between five and ten megalitres. Waste water containing suspended solids and some oil from the vehicle wash down bay will be collected in an in-ground sump, within the mine facilities hardstand area. Water from the sump will feed to the mine water storage dam MW1 or coal preparation plant (CPP) dam via an oil-water separator.

Fresh water will be drawn from the Hunter River to supply the bathhouse and office areas from a localised tank. Wastewater will be pumped to a treatment plant and then disposed of via spray irrigation.

Table 6.6 SCHEDULE OF WATER MANAGEMENT DAM USEAGE

	Dam Type and Reference	Year 1	Year 2	Year 5	Year 10	Year 15	Year 20
i.	*Sedimentation Dams*						
	SD1	✓	✓	✓	✓	✓	✓
	SD2	✓	✓	✓	✓	✓	✓
	SD3	✓	✓	✓	✓	✓	✓
	SD4	✓	✓	✓	✓	✓	✓
	SD5	✓	✓	✓	✓	✓	✓
	SD6			✓	✓	✓	✓
	SD7			✓	✓	✓	✓
	SD8			✓	✓	✓	✓
ii.	*Rail Loop Dam*						
	RL1	✓	✓	✓	✓	✓	✓
iii.	*Mine Water Dams*						
	MW1	✓	✓	✓	✓	✓	✓
	MW2	✓	✓	✓	✓		
	MW3/MW3a	✓	✓	✓	✓		
	MW4	✓	✓	✓	✓	✓	✓
	MW5			✓	✓	✓	
	MW6				✓		
iv.	*Main Water Storage Dam*						
	RW1	✓	✓	✓	✓	✓	✓
v.	*Preparation Plant Storage Dam*						
	CPP	✓	✓	✓	✓	✓	✓
vi.	*Environmental Dam (Rejects Emplacement area)*						
	ED1	✓	✓	✓			
	ED2				✓	✓	✓
	ED3						✓

iii. Rail Loop Dam

A small catch dam will be constructed below the rail loop loadout area to collect any runoff from that area. Water will be pumped northward to the mine water dam (MW1). This dam will have a capacity of five megalitres.

iv. Mine Water Dams

Five mine water dams will receive both surface water runoff and water pumped from within the open-cut pits. These dams provide water storages for the mine. Runoff from facilities and stockpiles will be directed to a localised hardstand sump and pumped to mine water dam MW1, east of the infrastructure. Water will also be pumped north from other minewater dams to MW1. Storage in dam MW1 will be pumped to either the main water storage dam (RW1) or the coal preparation plant dam (CPP dam). Dam MW3 will provide storage for dust suppression. All haul roads will be constructed with catch drains on the downslope verge. Runoff will be directed via these catch drains to the nearest mine water dam.

During early mine development, runoff from the South Pit will be pumped from the north end wall and the southern ramp to dam MW3 located near the South Pit haul road. This will provide storage for dust suppression.

With development of the North Pit, seepage and runoff will be directed either via the north end wall to dam MW5 or via the southern ramp to dam MW4. These dams will be connected by pipeline located alongside the haul road to facilitate supply of water to the main storage dam (RW1) and the coal preparation plant. Any surplus water during early mine development will be directed to the Piercefield Pit. Temporary transfer dams and sumps may be constructed in spoils or prestrip areas on an as needs basis.

By Year 10 of operations water from the South Pit will be pumped either to dam MW3 or the Piercefield Pit. The main water storage dam (RW1) will continue to be supplied from surplus water from the mine water dams. By Year 15, dam MW4 will be mined through while dam MW5 may be relocated within the same catchment. In pit temporary storage will be pumped to mine water dam (MW5) or directly to the southern end haul road and on to the Piercefield Pit. Temporary transfer dams and sumps may be constructed in spoils or prestrip areas as required.

v. Main Water Storage Dams

Dam RW1 and the Piercefield Pit will provide the main water storage for the mine. Dam RW1 will be supplied by surplus water from mine and sedimentation dams. Make-up water drawn from the Hunter River will be pumped directly to dam RW1 which will have a capacity of 200 megalitres.

The Piercefield Pit will also receive surplus water from the mine water circuit. Dam MW3 will be mined through by Year 10 and South Pit mine water will be directed to the Piercefield Pit where dust suppression water will be drawn from truck fill points. The Piercefield Pit will be mined through by Year 20 and all surplus mine water will be directed to the main storage dam (RW1).

Surplus water will be discharged from the main storage dam (RW1) to the natural watercourse and into the Hunter River via the major drainage line west of the Bengalla Mine. Water will mainly be released during high rainfall periods in compliance with the Hunter Salinity Trading Scheme. Some lower flow releases may also be required during the later years of mining.

vi. Coal Preparation Plant Storage Dam

Water will be directed to the coal preparation plant storage dam (CPP) from mine water dams MW1 and MW4 and the main water storage dam. Make-up water will also be pumped directly to the dam from the Hunter River. This dam will have a capacity of 10 megalitres.

vii. Environmental Dams in the Fines Rejects Emplacement Area

The function of the environmental dams is to intercept stormwater runoff from the disturbed catchment area, thereby minimising potential impacts on downstream water quality.

The environmental dams have been designed according to advice from the NSW Dams Safety Committee to contain 50 per cent of probable maximum precipitation (PMP) from the upstream catchment. A spillway will be installed in each dam with capacity to convey the calculated peak discharge from a PMP design storm. Nominal sizes of the environmental dams will be 50 megalitres.

Initially an environmental dam (ED1) will be constructed in the centre of the northern fines emplacement catchment. This location will maximise the amount of catchment water to downstream users, by only treating water from those upstream areas disturbed by fines emplacement operations. Water from the environmental dams will be pumped back to the main storage dam (RW1).

At about Year 10, the central environmental dam (ED1) will be enlarged to facilitate continued fines emplacement. Prior to this a new environmental dam will be built at the lower end of the catchment (ED2). Provision has been made for the construction of an environmental dam in the southern fines emplacement catchment in Year 20, if this is required.

6.4.4 Erosion and Sediment Control

i. Temporary Controls

As described in Section 6.1.2 the area disturbed ahead of mining operations will be limited to minimise the total area disturbed at any one time. Progressive rehabilitation will also reduce the potential for erosion from disturbed areas. Minimising disturbed areas will reduce runoff volumes and sediment transport.

Construction of the clean water diversion works outlined in Section 6.4.3 will be undertaken prior to earthworks. Design of diversion channels will restrict flow velocities sufficiently for vegetation establishment. This will reduce the entrainment of sediment from the channel and minimise any sediment loading of downstream dams.

Runoff from reshaped and topsoiled out-of-pit emplacements will be managed through deep ripping and furrows along the contour. Diversion channels and banks will also be constructed along the contour as required. The locations of banks and the required spacing will depend on the detail of the final landform. Following construction, banks will be surveyed to ensure they have sufficient capacity and grade to provide effective erosion control. Flow from contour banks and channels will be directed to a sedimentation dam to remove suspended sediment prior to release. Where necessary, downstream release areas will be reinforced to prevent erosion. Maintenance of these structures will be undertaken as required.

Runoff from haul roads will be collected in catch drains constructed on the down gradient verge and directed to the nearest mine water dam. The use of saline mine water for dust suppression on haul roads requires that runoff from these areas is contained within the mine water management system.

ii. Long Term Controls

As discussed in Section 6.5.7 a final void management plan will be prepared during the last seven year mining sequence if proposed further development applications are not approved.

Sediment control works with low or no maintenance requirements would be retained on completion of mining. Works requiring high levels of maintenance to ensure stability will be removed once they are no longer required. Clean water diversion banks on overburden emplacements will be retained to divert water away from fill areas. Vegetation established during rehabilitation will ensure the long term channel stability. The long-term stability of the fine rejects emplacements is discussed in Section 9.4.

Following site decommissioning the long term stability of the landform will be dependent on land management practices. Post mining land uses such as grazing and cultivation will need to be appropriately managed to ensure the long term stability and productivity of the site.

6.5 REHABILITATION

6.5.1 *Regulatory Requirements*

The *Mining Act* 1992 includes provisions for rehabilitating mined areas. Rehabilitation requirements will be included as conditions of a mining lease. A general policy requirement of the Department of Mineral Resources is that after mining, land should have the same capability as its original condition. Detailed rehabilitation plans must be submitted to the department before a surface mining approval is granted. These plans provide information on matters including suitability of topsoil for rehabilitation purposes, reshaped land contours, surface drainage and erosion control and revegetation species to be used. Rehabilitation reports must be submitted as part of the annual Environmental Management Plan. This gives an effective reporting structure for mine operations.

Security deposits usually in the form of a bank guarantee must be lodged with the department to ensure that the rehabilitation plan and any consent conditions are complied with. These deposits are either progressively released as areas are rehabilitated or credited towards future works. Such releases or credits follow reshaping, topsoiling and successful revegetation.

6.5.2 *Rehabilitation Planning*

Rehabilitation planning has been integrated into early mine planning to ensure compatibility with site constraints and mining operations. The rehabilitation plan and design of the final landform also incorporates other considerations such as community expectations, pre-mining land use, final land use, drainage, stability, soils, erosion control, and visual compatibility. Detailed rehabilitation plans will be prepared during the detailed mine planning stage.

6.5.3 *Landform Design*

The proposed final landform is shown on *Figure 13*. It consists of two long undulating ridgelines in the west and east of the site. The ridgelines have a north-south orientation and are designed to emulate the surrounding topography. The north west out-of-pit emplacements and backfilled central portion of the North Pit will form local high points that are subordinate to Mount Pleasant. The final voids will be located in the northern and southern central portions of the site.

The slopes of the final landform will vary according to the erosion hazard, stability, and drainage requirements. Maximum slopes on site will generally be 10 degrees (equivalent to a slope of one vertical to six horizontal) except for areas of local steepening for drainage which may be up to 14 degrees (one vertical to four horizontal).

Runoff from the final landform will be designed to be compatible with surrounding drainage patterns. This will be achieved using a combination of controls such as graded banks, designed channels and, where necessary, water course reinforcement.

Areas to be rehabilitated will firstly be reshaped in accordance with the slopes determined in the rehabilitation plan. Following reshaping operations, areas will either be topsoiled and sown, or directly seeded.

6.5.4 *Topdressing*

Where topsoil is to be used it will either be replaced directly from stripped areas or from stockpiles. The area will then be cultivated prior to sowing or planting. Grazing areas will have a minimum of 0.1 metres of topsoil respread on the reformed surface. Arable lands disturbed by mining (Class II and III) will require reconstruction of a full soil profile (topsoil over a subsoil). Profile requirements and topsoil suitability is discussed in Section 7.2.

6.5.5 *Rehabilitation Species*

It is proposed that the rehabilitated final landform will have a mix of pasture and timbered areas. The basis for the revegetation strategy is discussed in Chapter Thirteen, using four types of revegetation. These are described below.

i. Pasture Species

Pasture species listed in *Table 6.7* have been successfully used at Coal & Allied's other mines. This mix will form a basis for initial revegetation work. Scattered groups of trees will also be planted in pastures to give shade and shelter for livestock.

ii. Forest Species

Subject to the approval of relevant government authorities up to 40 per cent of rehabilitated areas will be planted with a permanent forest of trees, shrub and groundcovers. Trials will determine the most appropriate species mix from those listed in *Table 6.8* which were derived from Coal & Allied's experience at its other local mines, together with species found in the original vegetation of the Muswellbrook area. The pollution control benefits of using salt tolerant tree species will also be investigated in co-operation with Muswellbrook Shire Council and the CSIRO. Forest plantings, where possible, will also function as wildlife corridors.

iii. Silviculture Species

Parts of the final landform will be planted with forests which could be developed as commercial timber resources. These will be developed on the edges of native forest areas. Species will be selected in consultation with the local timber industry but will include Spotted Gum (*Eucalyptus maculata*), White Box (*E. albens*) and Narrow-leaved Ironbark (*E. crebra*). These three species also form part of the native forest plantings.

iv. Cash Crops

The feasibility of cash crops such as olives will be investigated.

Table 6.7 PASTURE SPECIES

Autumn Sowing	**Spring Sowing**
Wimmera Rye	Callide Rhodes
Sirosa Phalaris	Couch (hulled)
Praneet/Callide Rhodes	Green Panic
Lucerne	Kikuyu
Sephi Medic	Lucerne
Haifa White Clover	Setaria
Seaton Park Sub-clover	Clover - White
Kikuyu	
Sataria (Kazungula) Woolly Pod Vetch	

Note: Application rate 45 to 50 kilograms per hectare

Table 6.8 NATIVE FOREST SPECIES

Common Name	Scientific Name
Trees	
Forest Red Gum	*Eucalyptus tereticornis*
White Box	*Eucalyptus albens*
Narrow-leaved Ironbark	*Eucalyptus crebra*
Spotted Gum	*Eucalyptus maculata*
Kurrajong Tree	*Brachychiton populneum*
Bull Oak	*Casuarina luehmannii*
Shrubs	
Cooba	*Acacia salicina*
Fan Wattle	*Acacia amblygona*
Peach Heath	*Lissanthe strigosa*
Native Cherry	*Exocarpus cupressiformis*
Native Blackthorn	*Bursaria spinosa*
	Pultenaea cunninghamii
Native grasses	
Spear Grass	*Stipa sp*
Wallaby Grass	*Danthonia sp*
Threeawn Speargrass	*Aristida vagans*
Barbed wire Grass	*Cymbopogon refractus*

6.5.6 *Rehabilitation Techniques*

Coal & Allied has undertaken extensive research into rehabilitating open-cut mines. This was carried out at Hunter Valley Mine No.1 either by company personnel or in conjunction with organisations such as the NSW Soil Conservation Service (now the Department of Land and Water Conservation), the Forestry Commission (now NSW State Forests) and the NSW Minerals Council. A number of techniques were developed that will be used and further developed at Mount Pleasant including:

- establishing forests by direct seeding. These have been successfully grown by directly seeding rock emplacements or coal washery reject without topsoil. Fertilisers are applied with the initial seeding;
- growing pastures on rock emplacements with and without topsoil. An application of fertiliser is made with the initial seeding and further applications made annually;
- developing a pasture mix that provides year round grazing capacity; and
- managing rehabilitated areas so that viable grazing land is maintained.

Figure 23 shows examples of rehabilitated areas at Hunter Valley No. 1 Mine.

More detailed pasture and tree planting techniques are described below.

i. Cultivation

All areas to be sown to pasture or planted with trees will be cultivated prior to sowing or planting. Cultivation provides a seed bed and improves rainfall infiltration. Cultivation equipment will be selected that minimises the occurrence of stones on the surface. Surface erosion will be minimised by cultivating along topographic contours.

ii. Pastures

Pasture will be sown into cultivated topsoil in Spring or Autumn depending on rainfall. This gives the best opportunity for seed germination and persistence.

Seed will be mixed with fertiliser and spread from a tractor mounted broadcaster working along the contour where possible. This allows the seed to be reasonably uniformly distributed. More fertiliser will be applied by an aircraft.

During annual maintenance, fertiliser will be applied as shown in *Table 6.9*

Table 6.9 FERTILISER APPLICATION

Fertiliser	Application	
	Season	Rate (kg/ha*)
Starter 15	At sowing	400
	Autumn maintenance	200
Nitram	Spring maintenance	100
Super-phosphate	Autumn maintenance (pastures over five years old).	100

*Note: * kilograms per hectare*

iii. Trees

Tree planting will involve three steps: site selection; site preparation and sowing.

Planting sites will be chosen according to their physical suitability, their effect on the visual character of the rehabilitated surface and their usefulness as stock shelter. Concept plans for tree planting at Mount Pleasant are shown on *Figure 13* and discussed in Chapter Thirteen.

Coarse reject will be transported to the rehabilitation area and spread by dozer. The area will then be cultivated along the contour. Seed will generally be sown in April and May using a tractor-mounted broadcaster. The seed will be mixed with fertiliser to assist uniform spreading. Appropriate seed application rates will be determined from trial plantings. Seed quantities successfully used at Coal & Allied's other Hunter Valley mines typically range from 2.0 and 2.5 kilograms per hectare.

Fertiliser will be applied annually at the same time as the pasture seeding program.

6.5.7 *Final Land Use*

Rehabilitation will restore the site to its pre-mining land capability with a mixture of forest and pasture. There will be an overall change in land use, as more forests are proposed than at present.

A final void will remain at the end of mining. It is currently proposed that further development applications will be made in the future to continue mining in the South Pit beyond Year 21. Should circumstances arise which prevent further mining then a void would be left as shown in *Figure 13*. A Final Void Management Plan would be prepared in the last seven year mine sequence. It would address:

- engineered barriers or bunds to ensure public safety;
- access;
- visual amenity by revegetating batter slopes;
- geotechnical stability criteria for highwalls, ramps and refitted areas;
- future post-mining land-use options; and
- water management. Estimates of long-term water levels in the final void are presented in Chapter Nine, including specific estimates for the equilibrium level.

6.6 ACQUISITION POLICY

i. Properties Affected by Mount Pleasant Mine

Coal & Allied is committed to ensuring that landowners impacted by the mine will have their interests and reasonable requirements met. This EIS has identified the extent of impacts on properties from the proposed mine development.

Properties within the site or identified as being within the effects envelope (as shown on *Figure 51*) will be subject to Coal & Allied's Land Acquisition Policy as outlined in Appendix K. The Company proposes to offer affected landowners a choice of either property purchase at fair and equitable market value, lease, or the installation of appropriate abatement measures at their residence.

ii. Properties Cumulatively Affected

Coal & Allied and Kayuga Coal Limited recognise that there will be areas affected by the cumulative activities of Mount Pleasant and Kayuga Mines, that will not be affected by either mine on its own (as shown on *Figure 52*). The companies have therefore adopted a joint policy to assist in the resolution of possible land use conflicts. This is attached as Appendix O.

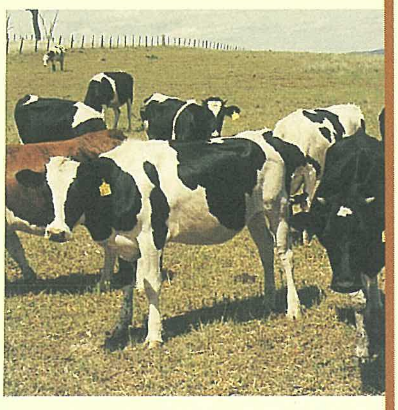
Properties affected by the cumulative activities of Mount Pleasant Mine and the existing Bengalla Mine, that are not affected by either mine on its own, will be addressed as part of the planning approval process.

PART C

ENVIRONMENTAL INTERACTIONS

DESCRIPTION OF THE PHYSICAL ENVIRONMENT

7



This chapter describes characteristics of the existing physical environment. Aspects covered include land use, land capability, climate and bushfire risk.

7.1 LAND USE

7.1.1 Land Use

The Mount Pleasant site is located on predominantly undulating to rolling country to the west of the Hunter River, with small areas on the eastern boundary extending into the floodplain. Land use patterns reflect local topography, soil characteristics and proximity to the river, which dictates water availability for irrigation.

Figure 26 shows the main land uses of the site and surrounds. Floodplain lands support a combination of improved pasture and dairying. Soil properties and water availability for irrigation distinguish these areas from adjacent grazing areas. Other land uses include pecan nut plantations, grape vines, horse and cattle studs, minor cultivation such as turf, flower and market gardens and rural residential areas.

The site is mainly used for grazing on native/natural pasture with some partly improved pasture. Small areas of improved pasture occur along the eastern site boundary and near Dorset Road, where irrigation water is available.

7.1.2 Agricultural Productivity

i. Regional Productivity

The Hunter Region is used for a wide variety of agricultural enterprises with more productive activities such as dairying, cropping, viticulture and horse studs on the Hunter River Floodplain and dryland sheep and cattle grazing on adjacent areas.

The Australian Bureau of Statistics publishes agricultural production figures for holdings generating an income in excess of $22,500 per year. *Table 7.1* provides an indication of the relative economic importance of each activity and the amount of land devoted to it within the Muswellbrook local government area (LGA).

Within the LGA there are 288 agricultural holdings totalling 108,358 hectares, of which 28,151 hectares is native pasture.

Table 7.1 indicates that beef production is carried out by the largest number of establishments and occupies the largest area. However, dairying generates the greatest value of production per year, followed by beef and fruit/nut production.

Table 7.1 AGRICULTURAL PRODUCTIVITY OF MUSWELLBROOK LGA (1993/94)

Industry	Number of Holdings	Area or Number of Beasts #	Productivity ($)
Lucerne	-	6,283 ha	-
Vegetable Farms	4	15 ha	72,000
Fruit Farms	17	1,176 ha	3,610,000
Grape Vines	15	1,052 ha	8,725t
Dairy Cattle	73	11,355#	12,625,000
Beef Cattle	225	49,748#	8,981,000
Sheep (wool and meat)	21	7,710#	243,000
Horse Studs	40	2,235#	-
Pigs	7	1,708 #	375,000

Source: Australian Bureau of Statistics, 1994
(1) includes nut production
t - tonnes
ha - hectares

ii. *Site Productivity*

Most of the site is used for agricultural production with variations in the intensity and productivity of enterprises reflecting those of the broader Hunter Region.

A convenient measure of the relative value of different agricultural enterprises is gross productivity. *Table 7.2* shows the annual gross income per hectare for various rural land enterprises.

The equivalent annual gross productivity for the mining proposal is $111,500 per hectare based on the total area disturbed over 21 years of production. This figure does not include site areas affected by mining which will remain available for agricultural production.

Table 7.2 ANNUAL PRODUCTIVITY OF RURAL LAND ENTERPRISES

Enterprise	Gross Productivity ($ per hectare)
Grazing (1)	
Improved pasture	276.90
Partly improved pasture	239.70
Irrigated Pasture (Lucerne) (5)	2,100.00
Dairying (2)	1,647.00
Vineyards (3)	14,300.00
Pecan Nuts (4)	9,000.00

Notes:
1. *Davies and Llewelyn, 1994*
2. *Davies and Ware, 1993*
3. *Hedberg and Doyle, 1993*
4. *Ross Lobell - Pecan Grower (pers com)*
5. *Davies and Watson, 1992*

Table 7.3 EFFECT OF THE PROPOSAL ON RURAL LAND AVAILABILITY

Enterprise	Area of Site (ha)	% of site	Available area in Muswellbrook LGA (ha)	Area of Site as a Percentage of available rural land in Muswellbrook LGA
Mixed Grass and Legume	132	3.5	9,389	1.4
Improved/Irrigated Pasture	192	5.0	10,594	1.8
Native Pasture (horse, sheep, cattle)	3,470	91.3	28,151	12.2
Other Agricultural Enterprises (1)	6	0.2	-	-
TOTAL	**3,800**	**100.0**	**122,427**	**3.1**

Notes: 1. Includes, mixed vegetables and market gardens

Source: Australian Bureau of Statistics, 1994

Table 7.3 indicates the relative importance of the site's rural land use in comparison to equivalent areas in the LGA. Approximately 91.3 per cent of the site is used for grazing on native pasture, representing 12.2 per cent of equivalent lands in the Muswellbrook LGA.

Other rural uses on site include small areas of mixed vegetables. These areas represent 0.2 per cent of the site and are generally associated with Class 1 and 2 agricultural lands.

Areas of improved/irrigated pasture are generally associated with the more productive irrigated lands. These areas constitute approximately 1.8 per cent of equivalent lands in the LGA.

The progressive staging of mining and rehabilitation works will significantly reduce the area disturbed at any one time allowing continued limited agricultural use on site. Final land capabilities will ensure that following the completion of mining the majority of the site will be suitable for pre-mining agricultural activities. This will include rehabilitation of equivalent Class II and III land capabilities as outlined in Section 7.2.5. Class I land will not be affected by the proposal.

7.1.3 *Land Ownership and Residences*

i. Mine Site

Details of property ownership and the location of residences within and adjacent to the mine site are shown on *Figures 24* and *25* and summarised in *Table 7.4*. Land ownership details are given in Appendix P.

As shown in *Table 7.4* a total of 79 properties occur wholly or partly within the site. Of these 49 are privately owned, 26 are owned by local mining companies, 3 are vested in the Crown and 1 is owned by Muswellbrook Shire Council.

There are 44 non-company owned residences within the site, 4 of which are owned by the adjacent Bengalla Mining Company. The locations of these residences are shown on *Figures 24* and *25.* Approximately 24 of these will be directly affected by mining activities, mine infrastructure and out-of-pit emplacements.

Approximately 139 non-company owned residences are located within a 2 kilometre radius of the site, 32 of which are owned by surrounding mining companies.

Table 7.4 PROPERTY OWNERSHIP AND RESIDENCES WITHIN AND SURROUNDING THE MOUNT PLEASANT SITE

Property Owner	No. of Properties within or partially within the site	No. of Residences within the site	No. of Residences within 2 kilometres of the site
Coal & Allied	16	12	28
Bengalla Mining Co	6	4	15
Kayuga Pty Ltd	1	0	2
Dartbrook Joint Venture	3	0	15
Muswellbrook Shire Council	1	0	0
Rural Lands Protection Board	1	0	0
Crown Land	2	0	0
Private	49	40	107
TOTAL	**79**	**56**	**167**

The nearest residential area is the village of Kayuga about 0.5 kilometres north of the site boundary. Muswellbrook is the nearest urban area, located about 3 kilometres to the east of the site. Properties and residences surrounding the site which have been assessed as being affected by the Mount Pleasant Mine are shown on *Figure 51* and listed in Appendix P. Residences affected by the development are listed in *Table 12.6* which includes those owned by Coal & Allied, other mining companies, and private individuals. Privately owned residences affected by the development will be offered a choice between installation of ameliorative measures or property purchase under Coal & Allied's acquisition policy which is discussed in Section 6.6.

Residential amenity outside these areas will be protected from degradation by the environmental safeguards outlined in this EIS. The purchase of properties within the effects envelope will provide a buffer zone between the mine and surrounding areas. The outer boundary of this zone is approximately 1 kilometre from Muswellbrook at its nearest point as shown on *Figure 51*.

Properties and residences which have the potential to be cumulatively affected by the Mount Pleasant, Bengalla and Kayuga Mines are shown on *Figure 52* and listed in Appendix P.

ii. Rail Corridor

The proposed rail corridor to the west of the Bengalla site and connecting conveyor traverses four properties as shown on *Figure 24*. The rail loop and conveyor connecting it to the Mount Pleasant infrastructure is located on private property with the remainder of the line located on land owned by the Bengalla Mining Company. The nearest residence that is not subject to purchase for the Mount Pleasant

7.2 SOILS AND LAND CAPABILITY

7.2.1 *Soil Investigations*

Soils were investigated by Veness and Associates (1997) with supplementary work by ERM Mitchell McCotter (1995). The purpose of these studies was to map the soils and determine stripping depths and rehabilitation suitability. A land capability assessment was also completed. Both soil surveys complied with the requirements of the Department of Land and Water Conservation for open-cut mines.

This section summarises the surveys which are included as Supplementary Report 2.

Principal soil units were initially mapped from aerial photographs. Subsequently, soils were examined by field inspection and laboratory analysis. The Veness and Associates survey gave full soil descriptions at 145 sites. Physical and chemical laboratory analyses were carried out on 54 representative samples. These investigations were supplemented by the ERM Mitchell McCotter survey with nine full profile descriptions and laboratory analyses on 21 samples. This procedure determined the soils' suitability for stripping and re-spreading.

7.2.2 *Soil Assessment*

The rehabilitation program will return most mined areas to their original land capability or better by reconstructing a soil profile capable of supporting the pre-mine land capabilities.

The suitability of soils for rehabilitation was assessed using the methodology described by Elliot and Veness (1981) and the results of physical and chemical analyses of the soils. Factors used to distinguish suitable and unsuitable soil materials are listed in decreasing order of importance.

- *Structure.* This refers to the arrangement of soil particles noted by their degree of aggregation. Structure influences water infiltration and therefore plant growth. As a consequence it is a key to a soil's rehabilitation suitability. Soils with good permeability and aeration characteristics are more suited to topdressing.

- *Coherence.* Soil is coherent when it is able to maintain a certain structure grade at a given moisture content unless force is applied. Soils which are not coherent and contain a high proportion of sand and silt are prone to structure loss and surface sealing which restricts plant germination and establishment.

- *Mottling.* Mottling is commonly an indicator of poor drainage which can restrict infiltration, moisture availability and available air. A mottled soil is not suitable for rehabilitation.

- *Macrostructure.* This means the arrangement of aggregates in the soil. Soils with large peds and few void spaces are unsuitable for rehabilitation.

- *Ped Strength or Consistence.* These terms indicate the resistance of soils to deformation. When peds are difficult to disrupt, the soil becomes poorly structured on wetting. Therefore these materials are unsuitable for rehabilitation.

- *Texture.* Soil texture reflects the range and proportion of the various soil particle sizes. Sands and sandy soils can be extremely erodible and have a low capacity to retain moisture. They are poorly suited to plant growth (Charman and Murphy, 1991). The more coarse a soil's texture, the less suited it is for rehabilitation.

- *Gravel and Sand Content.* If the combined amount of gravel and sand exceeds 60 per cent of the soil volume, plant growth may be retarded (Charman and Murphy, 1991). Such material is unsuitable for rehabilitation.

- *pH and Salt Content.* For a soil to be suitable for top dressing, the salt content must not be too high and the pHs (1:5 soil:water) should be between 4.5 and 8.4.

7.2.3 *Soils Description*

Five soil mapping units were found on site. The distribution of these units is shown on *Figure 27.* Their extent is described in *Table 7.5,* which indicates the soil units within the survey area and the mining area. The soil units are described below.

Table 7.5 SOIL UNITS

Description	Survey Area		Area of site affected by Mining	
	Area (ha)	% of survey area	Area (ha)	% of mining area
Alluvial	136	3.6	14	0.7
Drainage Lines/Flats	82	2.2	70	3.3
Hillslope	2,924	76.9	1,599	75.8
Sandy Hillslope	608	16.0	405	19.2
Volcanic Hillslope	50	1.3	21	1.0
TOTAL	**3,800**	**100.0**	**2,109**	**100.0**

i. Floodplain Soils

The floodplain soils of this unit are located along part of the eastern boundary of the site. Soils from this unit comprise mainly uniform medium or fine textured clay soil profiles consisting of clay loam, silty clay loam or light clay topsoils overlying a number of depositional layers with clay loam or clay texture. The soil materials are slightly to highly dispersive with high erodibility.

ii. Drainage Lines and Flats Soils

Soils of this unit mainly occur adjacent to the catchment drainage lines immediately above the floodplain. These soils comprise brown solonised soils and brown and yellow solidic soils. They generally have a fairly clear transition between the somewhat coarser-textured slightly acidic to neutral topsoil (A horizon), to a generally finer textured (more clayey) subsoil which becomes more alkaline with depth. Soils have slightly dispersible topsoils to very highly dispersible subsoils. Erodibility values for soil unit are moderate.

iii. Hillslope Soils

Soils from this unit dominate the study area. They are variable in occurrence consisting of uniform non-cracking clay soils, gradational solonised brown soils, red-brown earths, and red-yellow solodic and solonetzic soils. They consist of clay loam or light clay topsoil overlying fine sandy clay loam lower topsoils. The subsoils are light clay to light medium clay. The topsoils are stable, but occasionally are moderately to highly dispersible, while the subsoils range from stable to very highly dispersible. This unit is moderately erodible.

iv. Sandy Hillslope Soils

These soils occur on sandy parent materials and comprise red massive earths, sandy red and yellow solodic or solonetzic soils, yellow solods and yellow podzolic soils. This mapping unit has two topsoil layers. The first consists of light sandy clay loam, loam fine sandy or fine sandy clay loam, while the second is clayey sand, sandy loam or light to fine sandy clay loam. On steep, shallow sites this material grades into weathered sandstone. The subsoil is sandy to light medium clay overlying similar, deeper subsoil layers or weathered parent material. It is slightly to very highly dispersible, with moderate erodibility.

v. Volcanic Hillslope Soils

This unit overlies extrusive volcanic dykes. The main soil types include uniform structured clay soils, together with gradational solonised brown soils and some alkaline red duplex soils. Topsoil is fine sandy clay loam or light clay which sometimes overlies a sandy clay loam or light clay lower topsoil layer. Subsoils consist of silty to light medium clays. Dispersibility is slight to moderate and erodibility is moderate.

7.2.4 *Land Capability*

i. Land Capability Assessment Methods

Land capability is defined as *"the ability of land to accept a type and intensity of use permanently, or for specified periods under specific management, without permanent damage."* (Houghton and Charman, 1986). There are two methods of classifying rural lands in NSW:

- The Agricultural Suitability Classification System used by NSW Agriculture; and
- the Rural Land Capability Classification developed by the former Soil Conservation Service of NSW, now part of the Department of Land and Water Conservation.

The five class agricultural suitability classification system used by NSW Agriculture ranks land for general agricultural use, including cropping and pastoral purposes. This system uses land capability as a basis and then incorporates socio-economic factors such as proximity to markets to determine an appropriate suitability class. Class 1 and 2 are the more productive agricultural lands being suited to regular cultivation whilst Class 3 to 5 lands are more suited to grazing with limited cultivation.

The land capability classification system used by the Department of Land and Water Conservation (DLWC) takes into account a range of factors including local climate, soils, geology, geomorphology, soil erosion, topography and the effect of past land uses. The system has a hierarchical sequence, ranging from Class I land (the greatest potential for agricultural or pastoral use), to Class VIII (which is entirely unsuitable for either). The aim of the system is to classify the capability of rural land to remain stable under a particular agricultural use. This classification does not consider existing land uses or other aspects of agricultural suitability such as proximity to markets and processing facilities or the availability of irrigation water. It therefore considers the optimum use of land for crop production, pasture improvement and grazing.

The DLWC classification system has been used to assess the capability of the site. It was adopted in preference to the Department of Agriculture version as it gives the maximum physical capability of the land without introducing economic factors such as market proximity. Both classifications are described in the following sections.

ii. NSW Agriculture Classification

NSW Agriculture has published maps showing the agricultural land classification of the Hunter Valley. On these maps the site is classified as mostly Class 3 agricultural land (61.1 per cent) or Class 4 land (36.5 per cent). Small areas of Class 1 land on the eastern site boundary will not be affected by mining. Much of the site is Class 3 agricultural land, which in theory would make it suitable for grazing and cropping in rotation with pasture. However, there are a range of structural and chemical limitations to these activities. Whilst small areas of the site are cropped in rotation with pasture, most are only used for grazing on native pasture as shown on *Figure 26*.

iii. Land Capability

Seven land capability classes were identified in the study area, ranging from Class I through to Class VII. These are shown on *Figure 28*. *Table 7.6* summarises their distribution in the study area and in the more limited area affected by mining.

The seven classes are briefly described below:

- Class I - Prime Agricultural Land. Land of low soil erosion hazard, where no special soil conservation works or practices are necessary. These areas are suitable for a wide variety of agricultural uses. The alluvial flats along parts of the eastern boundary and in the south eastern corner of the study area are Class I lands.

Table 7.6 LAND CAPABILITY

Class	Survey Area		Area of site affected by Mining	
	Area (ha)	% of survey area	Area (ha)	% of mining area
I	103	2.7	0	0
II	43	1.1	14	0.7
III	41	1.1	22	1.0
IV	1,175	30.9	760	36.0
V	2,254	59.3	1,231	58.4
VI	178	4.7	76	3.6
VII	6	0.2	6	0.3
TOTAL	**3,800**	**100.0**	**2,109**	**100.0**

- Class II - Good Agricultural Land. These areas have a moderate soil erosion hazard, where simple soil conservation practices are necessary, including contour cultivation, crop rotation and good soil management. They are usually gently sloping and are suitable for a wide variety of agricultural uses. They often adjoin Class I lands but are distinguished by steeper slopes.

- Class III - Rotational Cultivation. Land of moderate to high soil erosion hazard, subject to sheet, rill and gully erosion, where soil erosion can be controlled with structural soil conservation measures. They are found on sloping sites suitable for cropping on a rotational basis, forming generally fair to good agricultural lands. Pockets of these lands are found in the north, east and south-east sections of the study area.

- Class IV - Limited Cultivation. This land is not suitable for cultivation on a regular basis, being limited by slope, soil erosion, shallowness or rockiness, climate, or a combination of these factors. It forms good grazing land where simple conservation practices such as pasture improvement, livestock control and the application of fertiliser are necessary. These lands are usually found on flatter ridge tops, less steep slopes and sandier flow lines whose soils cannot support regular cultivation.

- Class V - Occasional Cultivation. Land of moderate to high soil erosion hazard, subject to severe sheet, rill and gully erosion. Soil conservation works include absorption bands, diversion banks and contour ripping, together with practices used in Class IV lands. These areas may support an occasional crop, but are predominantly suited to grazing. Class V lands cover most of the study area.

- Class VI - Unsuitable for Cultivation. This land is not suited for any type of cultivation and is best used for grazing. Soil erosion hazard various from nil to high. Necessary soil conservation practices include stocking limitations, broadcasting of seed and fertiliser, fire prevention and vermin destruction. Some structural works may be required though it is still less productive grazing lands. Pockets of this class occur mainly in the north-west of the study area.

- Class VII - Land Unsuitable for Agricultural or Pastoral Use. Owing to its high soil erosion hazard and severe site limitations, this land should be used for forestry. These are often steep slopes, shallow soils and/or rock outcrops. Adequate ground protection must be maintained by limiting or totally excluding grazing. Isolated areas of these lands are in associated with rocky knobs and ridgelines where the skeletal soil is shallow or non-existent.

7.2.5 *Rehabilitation*

i. Stripping Suitability

A rehabilitation program seeks to return mined areas to their original land capability or better.

Soil surveys determined if existing soils could be stripped and subsequently respread. The method developed by Elliott and Veness (1981) recognises that not all available soil material is suitable for agricultural use. Physically such material may be too weakly structured, too poorly drained, too sandy or too gravely to support vegetation. The physical properties used to separate suitable and unsuitable materials are soil structure, macrostructure, coherence, texture and the force necessary to disrupt peds.

ii. Stripping Recommendations

The Elliot and Veness methodology was applied to field and laboratory results to assess how much topsoil would be suitable for rehabilitation. Topsoil striping depth is shown on *Figure 29* and discussed below for each of the soil units.

- Alluvial Soils

Approximately the top half metre of this soil unit is suitable for topsoil, while all remaining materials down to at least 2.5 metres are suitable for subsoil.

- Drainage Flat/Drainage Line Soils

The surface layer of this unit is nearly always suitable for topsoil. The depth of stripping is generally 0.2 metres but, depending on site-specific soil characteristics, this depth can range from 0.1 metres to 0.7 metres. The soil below this surface material is not appropriate for rehabilitation because of unsuitable pH, dispersion characteristics, structure and force to disrupt peds.

- Hillslope Soils

Surface soil material can be stripped down to a pale coloured (A_2) horizon or, in places, down to a brighter coloured subsoil clay layer.

- Sandy Hillslope Soils

Only the surface layer is suitable for topsoil. The depth of this material is usually 0.1 metres, with occasional pockets to 0.2 metres. There are a number of instances where, because of the shallow depth of the surface layer, high sand and gravel content or sandy texture, this layer is not suitable for stripping.

❖ Volcanic Hillslope Soils

The surface 0.1 metres are suitable for topsoil stripping, sometimes extending to a depth of 0.2 metres. In specific situations, the surface layer is unsuitable because it is shallow or has a high gravel or rock content.

iii. Topsoil and Subsoil Availability

Based on the above recommendations, estimates were made of available topsoil and subsoil volumes. Subsoil stripping is only recommended on arable lands covered by Class I, II or III land capability. Over the remainder of the site, which has a grazing capability, it is recommended that only topsoil be stripped in areas affected by mining.

About 4.5 and 2.9 million cubic metres of topsoil and subsoil material respectively will be available from the authorisation. An additional 591,000 cubic metres of potential topsoil material is available from the north west out-of-pit emplacement area and fine rejects area. On this basis there will be sufficient soil resources to meet the required topsoil and subsoil demands of the rehabilitation program outlined below.

iv. Soil Handling Strategies

Stripping and stockpiling soil materials can adversely affect soil properties. Soil structure declines, internal drainage patterns are disrupted, fertility can be lost and other physical and chemical changes can occur if soils are not handled carefully. A number of methods will be used to strip and stockpile soils, as outlined below:

- most soils can be stripped by scraper. However, some sandy hillslope soils have a fragile structure. These will be stripped with trucks and shovels or excavators;
- all stockpiled material will be left with a rough surface finish to minimise any unnecessary mechanical working of the soil. Stockpiles will not exceed two to three metres high to maintain biological activity, and they will be located in favourable locations or protected by graded banks to minimise erosion; and
- stockpiled soil material will be grassed as soon as practicable to control water and wind erosion. Every effort will be made to control weed infestation of the stockpiled material.

v. Respreading of Stripped Soil Material

Rehabilitation will require the spreading of topsoil or other suitable topdressing on grazing lands (Class IV to VII), while arable lands (Class I to III) require the reconstruction of a complete soil profile. Grazing lands will have a minimum 0.1 metres topsoil respread on the reformed surface. The depth of the reconstructed profile (a topsoil over a subsoil) in arable areas will be sufficiently deep to support a cropping practice, with greater than 0.3 metres topsoil placed over a subsoil layer. A minimum reconstructed depth will be 1.5 metres. Based on the available soil resources, such a profile reconstruction will be achievable as outlined in Supplementary Report 2.

vi. Final Land Capability

As outlined above, the rehabilitation program will return most mined areas to their original land capability or better. An unavoidable exception to this is the loss of land associated with the final void which is unsuitable for agricultural activities (land capability Class VIII). Pre-mining and post-rehabilitation land capabilities are given in *Table 7.7.*

Table 7.7 FINAL LAND CAPABILITY

Class	Pre-Mining Land Capability (hectares)	Post-Mining Land Capability (hectares)	Change from existing Land Capability (hectares)
I	103	103	0
II	43	43	0
III	41	41	0
IV	1,175	998	- 177
V	2,254	1,779	- 475
VI	178	227	+ 49
VII	6	138	+ 132
VIII	0	471	+ 471

Class I lands will not be affected by the proposal. An area equivalent to Class II lands disturbed by mining will be allocated on the eastern edge of the northern out-of-pit emplacement area. The area will be graded to a low slope with 1.2 metres of subsoil overlain by 0.3 metres of topsoil to be placed on the overburden. The area will be cultivated and sown to pasture.

Class III land disturbed by mining will rehabilitated in an area allocated on the central backfilled portion of the North Pit. Slope gradients will conform with the criteria for Class III capability, with a similar profile reconstruction to that of the Class II land. The area will be cultivated and sown to pasture and/or planted with trees.

A reduction in available Class IV and V land capabilities will be offset by a small increase in areas of Class VI and VII land, as well as the final void.

7.3 CLIMATE

7.3.1 Climatic Patterns

The climate of the Upper Hunter Valley is characterised by warm dry summers and cool, dry winters. In summer, the weather in the Muswellbrook region is dominated by synoptic high pressure systems which alternate with low pressure systems, "southerly busters", every three to five days. Rainfall is highest during the summer months (Hyde et al, 1981).

In winter the climate is modified by the mid-latitude westerlies and high pressure systems alternating with cold fronts. The prevailing winds are north-westerly and are created via cold air drainage flows associated with the terrain. Winter is drier than summer, with regular frosts and fogs occurring from mid-autumn to late spring (Muswellbrook Shire Council, 1995).

The closest long term weather station to the site is Scone Post Office (approximately 25 kilometres north of the site). Monthly rainfall data are available for 111 years and daily temperature data for 20 years, as summarised in *Table 7.8*. The nearest representative evaporation records have been obtained from the Scone Research Centre for the period 1973 to 1994.

7.3.2 *Rainfall*

Annual rainfall records for Muswellbrook range from 330 to 990 millimetres with a number of distinct wet (1988, 1990) and dry (1973-75, 1979-82, 1994) periods over the last 27 years (Maurice Grey - *Muswellbrook Resident*). While the average annual rainfall is relatively low, there is a distinct summer peak.

7.3.3 *Temperature*

The area experiences average monthly daytime maximum temperatures between 28 and 31°C during summer, and 17 and 19°C during the autumn-winter period. Average monthly minimum temperatures range from 13 to 17°C during summer and 3 to 6°C during autumn-winter (Envirosciences, 1990).

Table 7.8 RAINFALL, EVAPORATION AND TEMPERATURE DATA

Month	Rainfall (mm)	Evaporation (mm)	Temperature (°C)	
			Minimum	Maximum
January	82	217	17.2	31.4
February	69	175	16.9	30.5
March	57	155	14.9	28.4
April	43	105	10.5	25.3
May	44	67	6.5	20.6
June	47	49	4.8	17.1
July	42	57	3.2	16.6
August	40	84	4.5	18.9
September	44	116	7.1	21.8
October	54	154	10.4	25.1
November	55	184	13.2	28.0
December	68	227	15.8	30.9
Annual	**645**	**1,590**	**10.4**	**24.6**

Source: *Bureau of Meteorology*
mm - millimetres
°C - degrees Celsius

7.3.4 *Evaporation*

Mean pan evaporation in the Upper Hunter, based on available records, is in excess of mean rainfall in all months, the deficit being least during the winter months. (Envirosciences, 1990). The annual evaporation is 1590 millimetres.

7.3.5 *Wind*

Annual and seasonal wind roses for the Mount Pleasant site are shown on *Figure 37*. Prevailing winds generally blow along a north west to south east axis which corresponds to the orientation of the Hunter Valley. Winds from the south west are most frequent during the afternoon and evening. The highest proportion of winds from the north west occur at night and in the morning.

Seasonal variations in the prevailing winds indicate a general south westerly direction in summer. In winter the sector between north and west accounts for the majority of wind.

More specific climatic data were used in the water management and air quality assessments which are discussed in Chapters Nine and Eleven respectively.

7.4 BUSHFIRE

The Department of Planning Circular C10 "Planning in Fire Prone Areas" gives a methodology for mapping bushfire hazard. The bushfire hazard rating indicates the long-term fire hazard. The method involves:

- placing the site into one of the major fire zones of New South Wales, which have broadly similar topography, climate, fuel types and fire behaviour;
- dividing the site into vegetation type, based on fuel production capacity, flammability of vegetation and slope units. Each vegetation type and slope unit is then assigned a hazard index; and
- assigning a bushfire hazard score to each of these units, which is the product of the vegetation hazard index and slope index.

The site falls within the Eastern fire zone as defined in the circular.

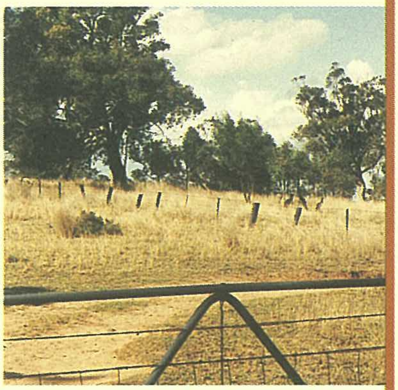
Vegetation type is characterised by patches of White Box and Spotted Gum open forest, with most of the area covered in native grassland (*Figure 30*). The Spotted Gum open forest is found along the ridgeline running north from Mount Pleasant. Slope gradients in this area are up to 20 per cent. In the White Box open forest, slope gradients range up to 15 per cent, while in the grasslands, slopes are up to 20 per cent.

The bushfire hazard determined for the above vegetation/slope combinations is high. This is a worst case scenario and in reality only small areas of the site will have a high hazard. This is modified by the proximity of an open cut mine which reduces the potential for fire hazard. Firstly, by its nature, an open cut coal mine involves vegetation clearing, which will reduce fuel loads and hazard potential. Secondly, mine infrastructure, such as roads, will act as barriers in the event of fire. Thirdly, continued grazing on the site will help to reduce fuel loads. Finally, the location of high fire hazard areas on the site mean that a fire would not pose a threat to surrounding development.

Indications from the Muswellbrook Fire Brigade (pers. comm.) are that the area has a low fire incidence. There is no history of significant fires on the project site as evidenced by a lack of charcoal fragments in soil profiles and absence of fire indicators, such as burnt tree stumps.

FLORA AND FAUNA

8



Vegetation communities, fauna habitats and fauna assemblages are described in this chapter. The presence of rare or threatened species is discussed.

8.1 FLORA

8.1.1 Survey Methodology

Site vegetation communities were examined, described and mapped. The methodology adopted included:

- a review of available literature;
- interpretation of 1:10,000 and 1:25,000 aerial photographs;
- review of the National Parks and Wildlife Service (NPWS) Wildlife Atlas and Rare or Threatened Australian Plants database records;
- field investigations in November 1994, July 1995, November 1996 and February 1997); and
- consultation with the NPWS in Muswellbrook.

Much of the site is grazed or cropped with little remaining native vegetation. Survey sites were selected on the basis of:

- access;
- current land use; and
- presence of native vegetation.

Where possible, species were identified in the field or a sample taken for later identification. Vegetation communities were classified according to the dominant species, height of the tallest stratum and percentage cover, and structural and floristic characteristics. Species names follow Harden (1990; 1991; 1992; 1993). A list of species found is provided in Appendix H.

Four communities were identified in the area. These were:

- Grassland;
- Spotted Gum - White Box Open Forest;
- White Box - Narrow-leaved Ironbark Open Forest; and
- Bull Oak Woodland.

The distribution of each community is shown on *Figure 30* and is described below.

8.1.2 Vegetation Communities

Each vegetation community was classified according to dominant species, structure, species composition and distribution.

i. Grassland

Grassland is the most common vegetation community on the site which is mostly used for cattle grazing. Common grass species include Spear Grass (*Stipa* sp.), Wallaby Grass (*Danthonia* sp.), Rhodes Grass (*Chloris gayana*), Common Couch (*Cynodon dactylon*) and Kikuyu (*Pennisetum clandestinum*). Some areas are heavily infested with Scotch Thistle (*Cirsium vulgare*). Scattered Kurrajong (*Brachychiton populneus*) is also found throughout the grazing land.

ii. Spotted Gum - White Box Open Forest

Distribution: This community is mainly found in two areas: on the ridge and slopes of Mount Pleasant, in the north-west of the site; and a small remnant pocket alongside an intermittent stream in the centre of the site.

Dominant Species: Spotted Gum (*Eucalyptus maculata*) and White Box (*E. albens*) dominate this community.

Structure: This open forest community has canopy species between 15 and 20 metres high with little or no shrub understorey. Ground cover is a mixture of native and introduced grass species.

Description: The canopy is dominated by Spotted Gum (*Eucalyptus maculata*) and White Box (*E. albens*). An additional canopy species Narrow-leaved Ironbark (*E. crebra*) is also present. A sub-canopy of Kurrajong Tree (*Brachychiton populneus*) is commonly found within this community. Ground cover consists of Spear Grass (*Stipa* sp.), Wallaby Grass (*Danthonia* sp.), Kangaroo Grass (*Themeda australis*) Rhodes Grass (*Chloris gayana*), Common Couch (*Cynodon dactylon*), Prickly Pear (*Opuntia stricta*) and Kikuyu (*Pennisetum clandestinum*).

iii. White Box - Narrow-leaved Ironbark Open Forest

Distribution: This community is found throughout much of the site on flat and slightly undulating land.

Dominant species: White Box (*Eucalyptus albens*) and Narrow-leaved Ironbark (*E. crebra*) are the dominant species in this community.

Structure: This community forms an open forest structure with canopy species between 15 and 25 metres high. Canopy cover is between 30 to 50 per cent of density within the vegetation community. In general, the shrub layer is extremely sparse with only a sporadic distribution of the introduced species African Boxthorn (*Lycium ferocissimum*) and the native Kangaroo Thorn (*Acacia paradoxa*). A moderate to well developed grassy ground cover occurs throughout this community.

Species composition: In addition to the canopy species mentioned above, there is a sporadic distribution of Kurrajong (*Brachychiton populneus*) and Pepper Tree (*Schinus areira*). Kurrajong is often grown in grazing areas for shade and fodder for cattle. The ground is covered by a moderate distribution of both native and introduced grasses. Common groundcover species include Spear Grass (*Stipa* sp.), Wallaby Grass (*Danthonia* sp.), Rhodes Grass (*Chloris gayana*), Common Couch (*Cynodon dactylon*), Prickly Pear (*Opuntia stricta*) and Kikuyu (*Pennisetum clandestinum*).

iv. Bull Oak Woodland

Monospecific stands of Bull Oak (*Casuarina luehmannii*) grow along ephemeral watercourses in the central and southern sections of the site. Between 50 and 100 individuals of this species make up this stand which contains no other species. The open understorey is probably due to a thick layer of fallen "needles" which prevents other flora species from germinating.

8.1.3 Species of Conservation Significance

Threatened flora species in New South Wales are listed on Schedules 1 and 2 of the *Threatened Species Conservation Act, 1995*. In addition, a listing of Rare or Threatened Australian Plants (ROTAP) has been compiled by Briggs and Leigh (1996) which has no legal status but is a reference to the national status of threatened species. Species listed under the TSC Act, ROTAP and previously recorded on the Muswellbrook 1:100,000 map which might be found in the study area are described below.

i. Threatened Species

At least four threatened species listed on Schedule 2 have been recorded in the Muswellbrook area. These are:

- *Bothriochloa biloba;*
- *Eucalyptus pumila;*
- *Lasiopetalum longistamineum;* and
- *Prostanthera cineolifera.*

Species requirements and status are provided in *Table 8.1* so the likelihood of their presence on site can be assessed.

Of the species listed in *Table 8.1*, the project site provides suitable habitat for *Bothriochloa biloba* which might be found on site. However, the likelihood is low due to intensive grazing over many years. The potential impact of the proposal on this species, should it occur, is assessed under Section 5A of the *Environmental Planning and Assessment Act, 1979* in Appendix H.

Table 8.1 LIKELY PRESENCE OF THREATENED SPECIES ON SITE

Species	Status	Requirements	Likely presence in study area
Bothriochloa biloba	Schedule 2 (Vulnerable)	• erect perennial grass growing to one metre tall • grows in woodlands on poor soil • considered vulnerable by Briggs and Leigh (1996)	• possible presence on site • suitable habitat available
Eucalyptus pumila	Schedule 2 (Vulnerable)	• small tree growing to six metres tall • grows in sclerophyll shrubland on sheltered sandstone soils • extremely rare - known only from a single stand near Pokolbin • conserved in Pokolbin Flora Reserve	• no suitable habitat available • restricted distribution south-west of site suggests the presence of this species is unlikely
Lasiopetalum longistamineum	Schedule 2 (Vulnerable)	• spreading shrub to 1.5 metres tall • grows in rich alluvial deposits in the Gungal to Mount Dangar area • considered vulnerable by Briggs and Leigh (1996) • conserved in Goulburn River National Park	• suitable alluvial deposits not available • not expected to be found on site
Prostanthera cineolifera	Schedule 2 (Vulnerable)	• erect shrub growing to four metres • grows in sclerophyll forests on the north and central coast of New South Wales • distribution is unknown and significance not accurately determined	• suitable habitat not available • not expected to be found on site

ii. Rare or Threatened Australian Plants

Many of the ROTAP species listed in New South Wales by Briggs and Leigh (1996) are also recorded in the *Threatened Species Conservation Act, 1995.* Those recorded on the Muswellbrook 1:100,000 map sheet are listed in *Table 8.2.*

Table 8.2 RARE OR THREATENED AUSTRALIAN PLANTS

Species	Description	Code	Reservation
Boronia rubiginosa	• shrub to 1.5 metres producing bright pink flowers • found in dry sclerophyll forest on sandstone derived soils of the Nandewar and Gibraltar Ranges and in the Bylong - Sandy Hollow - Denman district	• 2RCa	• Goulburn River National Park • Gibraltar Range National Park • Kanangra - Boyd National Park • Wollemi National Park
Gonocarpus longifolius	• an erect shrub to one metre tall • grows in sandstone communities on the ranges between Armidale and the Blue Mountains	• 3RC-	• Goulburn River National Park • Blue Mountains National Park • Border Ranges National Park

Notes: 2. *Geographic range in Australia < 100 km*
3. *Geographic range in Australia > 100 km*
R. *Rare in Australia but currently does not have any identifiable threat*
C. *At least one population within a national park, other proclaimed conservation reserve or in an area otherwise dedicated for the protection of flora*
- *reserved population size is not accurately known*
a *1,000 plants or more are known to occur within conservation reserve*

Source: *Briggs and Leigh (1996)*

8.1.4 *Conservation Value and Significance*

The conservation significance of vegetation communities on site was determined by the following criteria.

- *Size of an area and links to other natural areas* influence whether an area can support viable animal populations;
- *Representativeness* considers whether flora communities are unique, typical or common in the region. It accounts for communities presently held in reserves;

- *The existence of rare or endangered species* increases conservation value;
- *Diversity* is an indicator of biological richness. Higher species richness usually indicates greater value, though some communities have a naturally low species richness;
- *The degree of naturalness* indicates whether human influence has affected the condition of the vegetation communities; and
- *The presence of special natural features* considers unique or unusual natural features not normally associated with a particular vegetation unit.

These criteria were applied to the site as detailed below.

i. Size and Linkages

The total area of native forest, woodland and grassland affected by the proposal is approximately 2,109 hectares. The site has similar vegetation communities to the north and south. Given the extent of modification and open nature of communities on site, there is no significant link to larger, vegetated areas.

ii. Representativeness

Open forest communities and remnant forest are widely distributed in the Hunter Valley as depicted on the 1:250,000 structural vegetation map (NPWS, 1995). Although these communities were once more widespread, they remain common in the region and are conserved in the Goulburn River National Park and Wollemi National Park to the west and south of the site.

iii. Rare or Endangered Species

The site is likely to provide suitable habitat for only one rare plant, the grasslike species *Bothroichloa biloba*. It is unlikely that it survives on site due to the long history of intensive grazing.

iv. Biological Diversity

Vegetation communities on the site have been significantly modified by past grazing and other agricultural activities. As a result, species diversity is extremely low.

v. Degree of Naturalness

Vegetation communities have been highly modified by past clearing and extensive grazing. This has substantially reduced the natural values of the area and decreased its conservation significance.

vi. Special Natural Features

No special natural features were recorded on site during field investigations. This further reduces the degree of naturalness and the conservation significance.

8.1.5 Conservation Value

Overall, the conservation value of vegetation communities on site is low. They are common to the Hunter Valley and are conserved in national parks and nature reserves to the west and south. The communities have been highly disturbed and do not have any special natural features. The site is unlikely to link other vegetated areas due to the highly modified and open nature of the vegetation.

8.1.6 Potential Impacts

The proposal will result in clearing approximately 561 hectares of open forest and woodland. Loss of this vegetation is not significant, as it is common throughout the Hunter region.

It is proposed to rehabilitate the site with native forest and pasture. Rehabilitation will be progressive and some screen planting will be established as an initial stage of the project.

Rehabilitation will use species either already growing on site or those that were part of the original vegetation cover. These were described in Section 6.5. Where possible, seed collected from the site will be used in the rehabilitation work. Where it is not practical to collect this seed, commercial supplies will be used.

At Year 21 of mining site vegetation will include:

- 922 hectares of native forest;
- 2,407 hectares of pasture; and
- 471 hectares final void.

8.2 FAUNA

This section includes a discussion about the types of faunal habitats found on the site and the results of faunal surveys.

8.2.1 Fauna Habitats

Potential fauna habitats identified from the vegetation communities were:

- open forest;
- low open forest; and
- grasslands.

Most native animals do not detect floristic differences but choose habitat based on structural characteristics, such as the number of layers, vegetation density and height. For many specialised groups, survival may depend upon the availability of water, a certain species of tree or a particular microclimate. Alterations to the structure or cover of vegetation would also modify habitat characteristics and may change faunal assemblages.

Fauna habitats are described below according to their vegetation communities, structure, habitat features and human elements.

i. Habitat 1: Open Forest

Vegetation Communities: White Box - Narrow-leaved Ironbark and Spotted Gum - White Box Open Forests.

Structure: There is a tall open canopy with dominant species 15 to 25 metres high. The canopy cover is 30 to 50 per cent. No shrub layer is found except for a sporadic distribution of saplings up to two metres high. The ground is densely covered with a variety of native and exotic grasses.

Habitat features: Some living mature trees containing hollows suitable for arboreal mammals or birds are found in both vegetation communities. Ring barked trees are distributed throughout the site, with hollows suitable for fauna. They also provide perches and shelter for predatory birds.

Fallen trees give shelter and basking sites for reptiles and the dense ground cover of native grasses is a suitable food for macropods. Small dense clumps of African Box-thorn shelter small mammals and the substrate is suitable for burrowing fauna species. Numerous ant nests and insects are a food source for insectivorous mammals and reptiles.

Human Elements: Many mature trees were either ringbarked or felled. Past clearing and disturbance from cattle grazing caused gully erosion in some areas. Vehicle tracks, fencing, powerlines and minor weed invasion were also evident.

ii. Habitat 2: Low Open Forest

Vegetation Communities: Bull Oak Stand

Structure: There is a small dense stand of Bull Oak up to six metres high in the centre of the site containing between 50 and 100 individuals. No understorey or ground cover has formed but a thick layer of fallen needles covers the ground.

Habitat Features: The intertwined canopy of Bull Oaks shelters small birds. The stand is in the gully of an intermittent stream below a constructed dam. Several burrows were observed in the substrate during field investigations

Human Elements: Gully erosion is evident in the intermittent creek, possibly caused by cattle grazing. The constructed dam and fencing show human disturbance.

iii. Habitat 3: Pasture

Vegetation Community: Grazing land.

Structure: Grazed open pasture with a moderate to dense cover of native and exotic grasses. Occasional eucalypt or wattle trees remain.

Habitat Features: Grasses and grains are suitable food for birds, macropods and small mammals.

Human Elements: This community was heavily grazed, leading to gully erosion.

8.2.2 Fauna Survey

i. Methodology

Fauna habitats were initially identified from vegetation communities, aerial photograph interpretation and reviews of existing information including records from the National Parks and Wildlife Service Wildlife Atlas.

Fauna surveys were conducted on 21 to 24 November 1994, 20 and 21 July 1995 and 30 November 1995. They included trapping, spotlighting, recording bat echolocation calls, playing owl calls, and searching for scats and tracks. Each habitat was investigated on foot and their condition and significance for native wildlife assessed. All fauna species and important habitat features were noted. Features sought included:

- *Mammals*: the amount of ground cover including litter layer, extent of shrubs and/or tree canopy, occurrence of old trees with hollows and type of substrate (for burrowing etc.). Signs of various species such as droppings, diggings, footprints, scratches on trees, nests, burrow paths and runways were sought.

- *Birds*: structural features such as the extent and nature of understorey and ground stratum, extent of the canopy and flowering characteristics of vegetation species were noted. Bird species observed were recorded.

- *Reptiles and Amphibians*: cover, shelter, suitable substrate, basking sites and breeding sites with free water were noted for these species. Likely sheltering places were also investigated.

Direct survey techniques for each fauna group are described in the following sections.

ii. Non Flying Mammals

Small ground dwelling mammals were surveyed using Type A and Type B aluminium Elliot traps and hair tubes. These were laid in transects through each fauna habitat as shown on *Figure 31*. Traps and hairtubes were placed together and were baited alternately with either chicken or peanut butter, rolled oats and honey mixture.

Fifty Elliot traps and 50 hair tubes were placed out over three consecutive nights to provide a total of 150 trap nights. A large cage trap was also used. This was baited with chicken and placed near a large farm dam.

Spotlighting with a 100 watt hand held halogen light was conducted each evening to survey nocturnal mammals. Spotlighting transects are shown on *Figure 31*. Searches for scats, tracks, burrows and scratchings were carried out during the day.

iii. Bats

An Anabat II detector recorded bat echolocation calls across the site. This was placed in two locations for only one night due to windy weather conditions. To supplement the bat survey, potential roosting sites were assessed such as hollow bearing trees, caves and old buildings. These were searched for signs of bats.

iv. Birds

Bird point counts were carried out in all habitat types during the morning and evening for a period greater than 15 minutes. Birds observed or heard opportunistically during the course of the day were also identified and recorded. Nocturnal birds were identified during evening spotlighting and specific owl calls were played to entice a response from owls.

v. Reptiles and Amphibians

Suitable reptile breeding and basking sites were searched by overturning rocks and logs and listening at ponds and dams for frog calls.

8.2.3 *Survey Results*

A list of fauna that could occupy habitats in the study area was compiled from a number of sources including:

- recordings during field investigations using methods described in Section 8.2.2;
- opportunistic sightings;
- compilation of fauna from previous studies in nearby areas;
- the National Parks and Wildlife Services Wildlife Atlas database; and
- the expected presence of fauna based on available habitats.

Species of each fauna group are discussed below.

i. Mammals

Only a small number of mammal species have been recorded on site. This is most likely due to the clearing and extensive grazing.

No mammals were trapped during the field survey although several species were observed opportunistically. A lack of groundcover would suggest that ground-dwelling fauna are limited and this was reflected in the lack of trapping success. Species that may use the site are listed in *Table 8.3*.

Table 8.3 MAMMALS LIKELY TO OCCUR ON SITE

Common Name	Scientific Name	Observed during field surveys
Short-beaked Echidna	*Tachyglossus aculeatus*	✓
Red-necked Wallaby	*Macropus rufogriseus*	
Swamp Wallaby	*Wallabia bicolor*	
Eastern Grey Kangaroo	*Macropus giganteus*	✓
Common Brushtail Possum	*Trichosurus vulpecula*	✓
Sugar Glider	*Petaurus breviceps*	✓
Yellow Footed Antechinus	*Antechinus flavipes*	
Brown Antechinus	*Antechinus stuartii*	
Common Dunnart	*Sminthopsis murina*	
Common Wombat	*Vombatus ursinus*	
Northern Brown Bandicoot	*Isoodon macrourus*	
Bush Rat	*Rattus fuscipes*	
House Mouse	*Mus musculus*	
Black Rat	*Rattus rattus*	
Rabbit	*Oryctolagus cuniculus*	✓
Hare	*Lepus*	✓
Fox	*Vulpes vulpes*	✓
Cat	*Felis catus*	

Numerous mobs of Eastern Grey Kangaroos were seen during field investigations. These usually contained between five and ten individuals although one mob of at least 50 was observed. Sightings were common at dusk and early morning when this species is most active. The combination of extensive grass paddocks, semi-wooded areas, numerous dams and intermittent streams provides ideal habitat for kangaroos.

Several foxes were spotted during the day and evening. Rabbits and Brown Antechinus were identified from scats and the common Brushtail Possum and Sugar Glider were sighted while spotlighting.

ii. Avifauna

Twenty seven bird species were identified during field investigations and a further 10 species were reported by local residents. All species are listed in *Table 8.4*.

It is expected that the birds listed in *Table 8.4* form only a part of those which may occupy the site. An expanded species list including those expected in the local area is given in Appendix H.

iii. Herpetofauna

The small number of reptiles and amphibians identified during field investigations is possibly the result of prevailing drought conditions. These are not ideal either for amphibians or many reptiles. Only four reptile species were seen. These were the Bearded Dragon (*Amphibolurus muricata*); Blue-tongued Lizard (*Tiliqua scincoides*); Lace Monitor (*Varanus varius*) and Whites Skink (*Egernia whitii*).

It is expected that more reptile and amphibian species would normally occupy the site.

8.2.4 *Threatened Species*

Threatened fauna of New South Wales are listed on Schedules 1 and 2 of the *Threatened Species Conservation Act, 1995*. This classification is determined by a number of factors including known population numbers and threatening processes. The National Parks and Wildlife Service Wildlife Atlas lists five threatened species (three birds and two mammals) on the Muswellbrook 1:100,000 map sheet. These are the:

- Bush Thick-knee *(Burhinus grallarius);*
- Glossy Black Cockatoo *(Calyptorhynchus lathami);*
- Powerful Owl *(Ninox strenua);*
- Brush-tailed Rock-wallaby *(Petrogale penicillata);* and
- Koala *(Phascolarctos cinereus).*

The Muswellbrook branch of the National Parks and Wildlife Service identified an additional bird species, the Regent Honeyeater (*Xanthomyza phrygia*) as possibly occurring on site. Other surveys of Muswellbrook suggested the Common Bent-wing Bat and Yellow-bellied Sheathtail Bat may also be present.

The field investigations included attempts to locate these eight threatened species. Each is discussed below with particular reference to habitat requirements and their relation to those habitats found on site.

Table 8.4 AVIFAUNA

Common Name	Scientific Name	Identified during field surveys
Pied Butcher Bird	*Cracticus nigrogularis*	✓
White-winged Chough	*Corcorax melanorhamphos*	✓
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	
Noisy Minor	*Manorina melanocephala*	✓
Australian Ravens	*Corvus coronoides*	✓
Australian King Parrots	*Alisterus scapularis*	
Galah	*Cacatua roseicapilla*	✓
Eastern Rosella	*Platycercus eximius*	✓
Wood Duck	*Chenonetta jubata*	✓
Black-faced Cuckooshrike	*Coracina novaehollandiae*	
Richard's Pipit	*Anthus novaeseelandiae*	
Sulphur-Crested Cockatoos	*Cacatua galerita*	✓
Willy Wagtail	*Rhipidura leucophrys*	✓
Barn Owl	*Tyto alba*	✓
Australian Kestrel	*Falco Cenchroides*	✓
Tawny Frogmouth	*Podargus strigoides*	✓
Brown Falcon	*Falco berigora*	
Wedge-tailed Eagle	*Aquila audax*	✓
Black-shouldered Kite	*Elanus notatus*	✓
Laughing Kookaburra	*Dacelo novaeguineae*	✓
Common Mynah	*Acridotheres tistis*	✓
Australian Magpie	*Gymnorhina tibicen*	✓
Superb Fairy Wren	*Malurus cyaneus*	✓
White-browed Scrubwren	*Sericornis frontalis*	
Yellow-billed Spoonbill	*Platalea flavipes*	✓
Pacific Black Duck	*Anas superciliosa*	
Grey Teal	*Anas gibberifrons*	✓
Crested Pigeon	*Geophaps lophotes*	✓
Grey Fantail	*Rhipidura fuliginosa*	✓
Zebra Finch	*Taeniopygia guttata*	
Banded Lapwing	*Vanellus tricolor*	✓
Noisy Friarbird	*Philemon corniculatus*	
White-faced Heron	*Ardea novaehollandiae*	✓
Sacred Ibis	*Threskironis aethiopicus*	✓
Welcome Swallow	*Hirundo neoxena*	✓
Black Swallow	*Hirundo rustica*	✓
Silver Eye	*Zosterops lateralis*	

i. Bush Thick-knee (Burhinus grallarius)

The Bush Thick-knee is listed in Schedule 1 (Endangered) of the Act. The population of this species has been reduced to a critical level because of egg collection and predation by foxes and feral cats (Marchant and Higgins, 1993). Preferred habitat includes lightly timbered open forest or woodland with a ground cover of short sparse grass and few or no shrubs (Marchant and Higgins, 1993). It may also be found in partially cleared farmland with remnants of woodland. It is usually associated with woodlands of *Casuarina* but occasionally is found in *Eucalyptus* or *Acacia* woodland (Marchant and Higgins, 1993).

There is suitable marginal habitat for this species on site. Its only sighting in the Muswellbrook area was in 1978, approximately 12 kilometres west of the site (NPWS database). No indication of its presence was found during field investigations and it is unlikely that this species lives on site.

ii. Glossy Black Cockatoo (Calyptorhynchus lathami)

The Glossy Black Cockatoo inhabits forests, woodlands, riparian vegetation and partially cleared areas, feeding on the seeds of *Casuarina* species. Its distribution is determined by its primary food source, seeds from *Allocasuarina torulosa* and *Allocasuarina littoralis*. The Glossy Black Cockatoo probably does not utilise on the site as neither *Allocasuarina* species occur, although other *Casuarina* species including Bull Oak (*Casuarina luehmannii*) are present. No signs of the cockatoo were observed during field investigations. It is unlikely that this species would occupy the site because there is no suitable habitat.

iii. Powerful Owl (Ninox strenua)

This species is found in a range of habitats including dense mountain gullies, coastal forests, coastal woodlands, coastal scrubs, pine plantations and both wet and dry sclerophyll forests (Pizzey, 1991). Its preferred habitat is tall open forests (Simpson and Day, 1989) and it feeds primarily on arboreal species including possums, bats and birds (Schodde and Mason, 1980). The home range of the Powerful Owl is about 1,000 hectares (Simpson and Day, 1989).

The Powerful Owl was recorded in 1978 approximately 16 kilometres south-west of the site (NPWS database). Suitable food animals including arboreal mammals and birds are found on site so it could form part of the owl's large home range. No signs of the Powerful Owl were observed during field investigations and it has not been recorded by local residents.

iv. Brush-tailed Rock-wallaby (Petrogale penicillata)

The Brush-tailed Rock-wallaby lives on rocky sites in sclerophyll forests which have a grassy understorey. Shelter includes windblown caves, rock cracks, tumbled boulders or dense stands of lantana (Strahan, 1991).

One specimen was recorded approximately 16 kilometres south-west of the site in 1978. It is unlikely that this species extends to the site because there is no suitable habitat.

v. Koala (Phascolarctos cinereus)

Koalas are limited to areas where there are acceptable food sources. The Koala feeds on the foliage of various *Eucalyptus*. They use a range of vegetation structural types from wet sclerophyll forest to stunted woodland. The species appears to prefer dry or wet sclerophyll forests on high nutrient soils generally along river flats and drainage lines (Strahan, 1991).

No Koalas were observed during field investigations. The NPWS Wildlife Atlas suggests that this species has been seen in adjoining areas ranging from the alluvial plains of the Hunter River to the north-east of the site and also in forested hills to the west.

State Environmental Planning Policy 44 (SEPP44) - Koala Habitat Protection encourages the conservation and proper management of natural vegetation that forms habitat for koalas. SEPP44 defines potential Koala habitat to trigger the application of the policy. Under that definition the site has potential Koala habitat. More than 15 per cent of tree species are Koala feed trees.

If an area has potential Koala habitat, SEPP44 requires a determination of whether it is core Koala habitat. No Koalas have been seen on site, there are no signs of their presence including scratchings on trees or scats and no historical sightings are recorded by the National Parks and Wildlife database or Muswellbrook NPWS. The site therefore does not contain core Koala habitat and it is unlikely to contain Koalas. Details of the SEPP 44 assessment are provided in Appendix H.

vi. Regent Honeyeater (Xanthomyza phrygia)

This species lives in open forests and woodlands, timbered water courses, coastal heaths and banksia scrubs (Pizzey, 19910). It favours relatively large trees where a high percentage are in flower (Garnett, 1992). The species has not been recorded on site and there was no evidence of its presence during the fauna survey. Limited habitat is available on site for this species.

vii. Common Bent-wing Bat (Miniopterus schreibersii)

The Common Bent-wing Bat occupies areas with wet to dry sclerophyll forests and rainforest along the eastern and northern coast of Australia (Strahan, 1991). They roost through the day in caves, mine tunnels, stormwater channels and buildings, hanging from the ceiling or walls in closely massed clusters (AMBS, 1994). These clusters appear to contain individuals of similar age and sex and the same roosts are used each year. This species forages above the forest canopy in well timbered areas, feeding on small flying insects (Strahan, 1991).

The Common Bent-wing Bat moves over large areas while foraging and also when it seeks suitable maternal roosts. No records of this species are entered on the NPWS Wildlife Atlas database, however its call was detected in the region by Hoye (1993) during extensive bat surveys at Mt Arthur, south of Muswellbrook. It was also found at Mount Thorley, east of Bulga village (ERM Mitchell McCotter, 1995).

No Common Bent-wing Bats were detected during field investigations. There are no suitable roosting sites and foraging habitat is limited.

viii. Yellow-bellied Sheathtail Bat (Saccolaimus flaviventris)

The Yellow-bellied Sheathtail Bat inhabits woodland and open forest habitats. In eucalypt forests it feeds above the canopy on small flying insects (Richards, 1983). In mallee or open country it feeds much closer to the ground.

This species roosts in tree hollows, abandoned Sugar Glider nests and occasionally building walls (Hall and Richards, 1979; Richards, 1983; Parnaby, 1992; and AMBS, 1994).

No sightings of this species were recorded on the NPWS Wildlife Atlas database. In a study conducted by Hoye (1993) at Mt Arthur, Muswellbrook, calls of this species were detected.

Although this species was not observed or recorded during field investigations, potential tree roosts on Mt Pleasant in the north-west of the site were identified. It is possible that the Yellow-bellied Sheathtail Bat uses this habitat to roost.

8.2.5 Potential Impacts

At any one time mining operations will disturb up to 830 hectares of grazing lands and 313 hectares of woodland/open forest of the total site area of 3,800 hectares. Associated with clearing will be the loss and reduction in available fauna habitats. This will affect all fauna species present both during the clearing and mining stages. Direct and indirect impacts of the proposal on fauna groups, in particular on rare or endangered fauna species, is considered below.

i. Direct

The potential direct impacts associated with the clearance of vegetation include:

- mortality of individuals during clearance of open forest, particularly when felling mature hollow bearing trees;
- mortality due to competition for remaining habitat following clearance of open forest. Some species will move off site into adjoining areas and compete with fauna already there. If the carrying capacity of the habitat is limited, not all individuals will survive;
- a reduction in the number of potential den or roost sites for arboreal mammals;
- minor reduction in foraging habitat for all species, both those inhabiting the site and those which forage from other areas;
- temporary reduction in the number of water bodies provided by farm dams.

Limited vegetation cover and fauna species on site suggest that impacts on fauna are likely to be minimal. Mobile species such as the Eastern Grey Kangaroo and Common Brushtail Possum are common in the area.

Vegetation along the ridge at Mount Pleasant and adjacent corridors will be retained and fenced off during mining. It is within this vegetation where most fauna were identified. Due to this, it is unlikely that fauna will be displaced due to habitat removal for mining.

ii. Indirect

The potential indirect impacts of the proposal are those associated with mining activities including:

- use of artificial lights;
- noise;
- dust generation; and
- sedimentation of drainage lines.

The effects of artificial lighting on wildlife are generally not well known. Artificial lighting may actually benefit some fauna species which forage in the open, as insects attracted to the light may increase the abundance of this food source.

The effect of noise on fauna is difficult to assess. Fauna species may react to sudden loud noises, such as blasting noise which may cause flocks of birds to disperse and groups of terrestrial fauna to scatter (Resource Planning, 1994). Noise associated with mining operations may also interfere with communications among fauna groups (Resource Planning, 1994). As with noise, the effect of dust generation on wildlife is difficult to assess.

Studies undertaken at Mount Thorley Mine (ERM Mitchell McCotter, 1995) identified fauna species, including threatened bat species, adjacent to active mining areas. The individuals present had adapted to the noise and dust climates associated with mining.

To prevent sedimentation of local streams and drainage channels, erosion control measures are proposed. Details of these controls are presented in Chapter Six and Nine of the EIS. No change in sediment loading is expected downstream of the mine activities.

8.2.6 Effects on Rare or Endangered Fauna

Section 5A of the *Environmental Planning and Assessment Act, 1979* establishes the factors that must be considered in determining if a proposed development will have a significant effect upon the environment of threatened fauna. Eight factors are listed for consideration and were applied to the threatened flora and fauna identified in Sections 8.2.4 and 8.1.4 respectively. These are provided in Appendix H.

The results of the analysis concludes that the proposal is not on land that is, or is part of critical habitat and is not likely to have a significant effect on threatened species, populations or ecological communities or their habitats and therefore a Species Impact Statement is not required under Section 77(d1) of the EPA Act, 1979.

Table 8.5 SUMMARY OF POTENTIAL EFFECTS ON ENDANGERED FLORA AND FAUNA

Species	Habitat Requirements	Findings of 8 Part Test
Bothriochloa biloba	• erect perennial grass up to one metre tall • grows in woodlands on poor soil	• suitable habit available on site • no critical habitat on site • no regionally significant area affected • not represented in conservation reserves • not at limit of distribution • not significantly affected by proposal
Bush Thick-knee (*Burhinus grallarius*)	• lightly timbered open forest with sparse grass • *Casuarina, Eucalyptus* or *Acacia* woodland	• suitable marginal habitat on site • habit modification not regionally significant • no critical habitat on site • well represented in nearby conservation reserves • not at limit of distribution • not significantly affected by proposal
Powerful Owl (*Ninox Strenua*)	• wet and dry sclerophyll forests • mature trees for nesting and roosting • large home range	• unlikely to occur on site due to limited roosts and prey • habitat modification not regionally significant • no critical habitat on site • habitat well represented in conservation reserves • not at limit of distribution • not significantly affected by proposal
Koala (*Phascolarctos cinereus*)	• wet sclerophyll forest to slanted woodland • presence of preferred *Eucalyptus* sp. forage trees	• suitable marginal habitat on site • no threatened populations • habitat modification not significant • no critical habitat • conserved in nearby major conservation reserved • not at limit of distribution • not significantly affected by proposal

Table 8.5 SUMMARY OF POTENTIAL EFFECTS ON ENDANGERED FLORA AND FAUNA *(Contd)*

Species	Habitat Requirements	Findings of 8 Part Test
Regent Honeyeater *(Xanthomyza phrygia)*	• temperate eucalypt woodland and open forest • flowering box and ironbark eucalypts	• no suitable foraging habitat on site • habitat modification not regionally significant • no critical habitat listed • habitat not adequately reserved in Region • not at limit of distribution • not significantly affected by proposal
Common Bent-wing bat *(Miniopterus schreibersii)*	• moist and dry forests providing foraging habitat • suitable roosting sites • caves, mine, stormwater channels including channels and bridges	• foraging habitat on site • no roosting sites located • habitat modification not significant • no critical habitat on site • well represented in conservation reserves • not at limit of distribution • not significantly affected by proposal
Yellow-bellied Shaethtail Bat *(Saccolaimus flaviventris)*	• rainforests, schlerophyl forests and woodlands • suitable roosting sites including hollow trees and buildings	• suitable foraging/roosting habitat on site • habitat modification not regionally significant • no critical habitat on site • limited conservation records • not at limit of distribution • not significantly affected by proposal
Brush-tailed Rock Wallaby *(Petrogale penicillata)*	• steep, rocky cliff faces with ledges, caves and boulders • grassy feeding areas near cliffs	• no suitable feeding or shelter habitat on site • habitat modification not regionally significant • no critical habitat on site • species and habitat well conserved within regional reserves • not at limit of known distribution • not significantly affected by proposal

8.2.7 *Cummulative Impacts*

The proposed development will involve disturbing approximately 561 hectares of native vegetation and 1,548 hectares of pasture on the site. Native vegetation includes the White Box/Narrow-leaved Ironbark, White Box/Spotted Gum open forests and the Bull Oak woodland communities. These communities, and the fauna habitats they contain, are not considered to be of high conservation value as detailed in Section 8.1.4.

These vegetation communities are widely distributed in the Hunter Valley, contain no significant features and are conserved in Goulburn River, Yengo and Wollemi National Parks to the west and south of the site.

Disturbing a total area of 2,109 hectares of vegetation from the site will contribute to the cumulative impacts of vegetation clearance and habitat loss occurring in the Hunter Valley. Impacts will however be offset by the rehabilitation and habitat enhancement proposed for the site as described in Sections 6.5 and 8.2.8 respectively.

Areas to be cleared and rehabilitated at Mount Pleasant are provided in *Table 8.6*. Equivalent details for the Kayuga and Bengalla Mines which lie to the north and south of Mount Pleasant are also given in *Table 8.6* indicating the relative contribution to cumulative impacts. None of the proposed mines will disturb any unique ecosystems or habitats of conservation significance. Mount Pleasant, Bengalla and Kayuga mines do not individually, or cumulatively represent any significant link to surrounding larger vegetated areas or conservation reserves.

Table 8.6 CUMULATIVE IMPACTS ON VEGETATION

Mining Area	Total area cleared (ha)	Rehabilitated area (ha)	Final void/remaining areas (ha)
Mount Pleasant	2,109	1,638	471
Bengalla	614	348	266
Kayuga	446	211	235
TOTAL	**3,169**	**2,197**	**972**

Table 8.6 shows that 69 per cent of the total area cleared by the three mines will be rehabilitated following mining. There will be a net loss of approximately 31 per cent of the area currently vegetated attributed to the final voids or future mine extensions.

Although a net loss in vegetated land will result from these three mines, the proposed rehabilitation will result in habitat enhancement of the remaining areas by increasing the abundance and diversity of flora species compared to that which currently exists.

This can be demonstrated with the revegetation proposed at Mount Pleasant where 561 hectares of native vegetation will be removed while approximately 660 hectares of native vegetation is proposed to be revegetated, representing 40 per cent of the rehabilitated area. The site currently has a low species diversity as a result of past disturbance with only five tree, and one shrub species occurring. Rehabilitation proposed includes six tree and six shrub species (see Section 6.5).

Overall, the proposed developments are not likely to result in significant cumulative impacts on flora and fauna.

8.2.8 Mitigation Measures

Measures proposed to mitigate impacts on flora and fauna include:

- minimising vegetation removal;
- retaining vegetation on Mount Pleasant and other small pockets throughout the site for ecological and visual purposes;
- checking for potential habitat in logs and hollows prior to clearing;
- maintenance of rehabilitation areas to control weed invasion;
- staged replanting to keep pace with mining sequence;
- control of feral species in consultation with the Rural Lands Protection Board;
- creation of several large waterbodies, consisting of the final voids, which could be used as a water source by native fauna;
- overall increased areas of woodland/forest available for use by fauna.

These are discussed in more detail below.

i. Habitat Value

As stated previously, more than half of the site consists of grazing land which has little value for native fauna. Although areas of open forest remain where the canopy is well developed, there is little evidence of understorey anywhere on site due to clearing and grazing.

A large area of Spotted Gum open forest will be retained along the Mount Pleasant ridge. Additional vegetation to be preserved is located within the south-west fines emplacement area and along the eastern site boundary.

It is expected that fencing off areas to be retained during mining will increase their habitat value by decreasing grazing pressure. All vegetation is or has in the past been subject to grazing which is evidenced by the sparse groundcover and limited shrub layer.

Clearing of canopy species, particularly mature trees will be minimised. The haul route and other facilities will be located so as to avoid vegetation wherever possible.

The proposed revegetation and rehabilitation strategy is to create a landscape of similar or better land capability than currently exists with the exception of areas attributed to the final void. Rehabilitation will use flora species indigenous to the area and preferably grown from locally collected seeds in order to maintain genetic viability. Rehabilitation areas will be maintained to control weed growth. The presence of feral animals such as rabbits, foxes, dogs and cats have the potential to interfere with native fauna and regenerating flora on site. Measures to control feral species including the use of tree guards, baiting and predator proof fencing will be used if required. Measures will be implemented in consultation with the Rural Lands Protection Board.

Overall, the area of vegetation and fauna habitat on the site will be greater than currently exists on site. In the long term, there is likely to be better habitat than that which is currently available.

ii. Waterbodies

As a result of the mining process, many small farm dams which are used by fauna as a water source will be lost over time due to the progressive mine development. Water sources in the western portion of the site will not be affected until late in the mining sequence.

Additional water sources included in the mine water management programme will effectively balance the loss of farm dams. These could provide a potential water source for fauna. Following the completion of mining, the voids remaining from pits will be allowed to fill with water. These will provide a significant water source for native fauna and grazing animals in the long term.

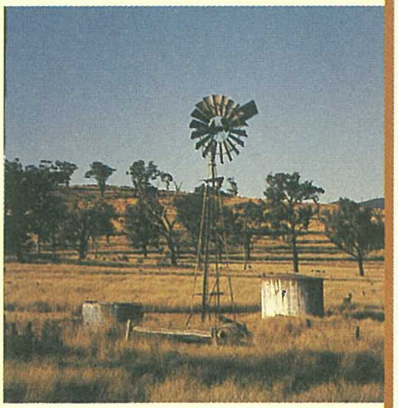
iii. Conclusion

Overall it is expected that the project will have a minimal impact on native flora and fauna due to :

- the limited vegetation communities, fauna habitats and fauna species currently present;
- past grazing pressures on the above;
- preservation of larger ridgeline forest remnants with fencing; and
- ameliorative measures proposed which will increase the area of habitat and its long term value.

SURFACE AND GROUND WATER MANAGEMENT

9



This chapter examines surface and groundwater management. Existing surface and groundwater quality is described, groundwater inflows examined and the mine's water balance calculated. Potential effects of the mine on surface and groundwaters is assessed.

9.1 WATER QUALITY

A detailed assessment of surface and groundwaters is included as Supplementary Report 3. A preliminary assessment of the sizing, construction and structural stability of the fine rejects storages is also included as Supplementary Report 4. This chapter summarises these studies.

9.1.1 *Monitoring Program*

Envirosciences Pty Ltd measured water quality at the Mount Pleasant Project site at monthly intervals from January 1993 to December 1994, to determine the baseline water quality of the area. The Hunter River was sampled at four locations both upstream and downstream of the site (Sites W1, W2, W3 and W4) and Dartbrook, a tributary of the Hunter, was sampled at one location (Site W11) as shown on *Figure 32*. A further six sampling points were located on various drainage lines within or near the site. The prevailing dry weather conditions during the monitoring period limited the availability of data for these locations.

Monitoring was undertaken on a monthly basis except when creeks were dry. Provision was also made to sample sites under wet weather conditions, which occurred only once during the monitoring period. Water quality indicators measured included pH, electrical conductivity, total dissolved solids and total suspended solids.

9.1.2 *Existing Water Quality*

i. Hunter River and Dartbrook

The results of the water quality analyses for the Hunter River and Dartbrook are given in *Table 9.1* to *Table 9.4*

Levels of conductivity recorded along the Hunter River have medians in the range 359 to 544 microsiemens per centimetre, indicating that the river water is generally of medium salinity. Conductivity values increase gradually downstream. Site W11 has elevated levels of conductivity, particularly in 1994, which may reflect localised saline seepage within the Dartbrook catchment. Variation between the 1993 and 1994 results, suggests an external influence such as variable climate conditions.

Measured pHs in the Hunter River and Dartbrook catchment are slightly alkaline with median values in the range 8.1 to 8.4. There is no significant variation in these results either downstream or with time.

Table 9.1 HUNTER RIVER, ELECTRICAL CONDUCTIVITY (microsiemens per centimetre)

Site and Sampling Period	Samples Taken	25%	Median	75%	Range
SITE W1					
Jan 93 - Dec 93	13	369.5	429.5	560.8	354 - 671
Jan 94 - Dec 94	12	348.5	358.5	374.0	337 - 400
SITE W2					
Jan 93 - Dec 93	12	386.0	431.0	576.5	338 - 698
Jan 94 - Dec 94	13	356.3	372.8	391.4	342 - 421
SITE W3					
Jan 93 - Dec 93	13	402.8	461.3	624.1	345 - 702
Jan 94 - Dec 94	12	369.5	400.0	421.0	345 - 488
SITE W4					
Jan 93 - Dec 93	13	442.5	543.8	684.6	376 - 751
Jan 94 - Dec 94	12	398.0	427.0	466.5	368 - 619
SITE W11					
Jan 93 - Dec 93	13	712.5	932.5	1,693.8	310 - 2,950
Jan 94 - Dec 94	12	2,200.0	2,910.0	3,075.0	1,126 - 4,420

Table 9.2 HUNTER RIVER, TOTAL DISSOLVED SOLIDS (milligrams per litre)

Site and Sampling Period	Samples Taken	25%	Median	75%	Range
SITE W1					
Jan 93 - Dec 93	13	221.1	253.3	297.3	185 - 436
Jan 94 - Dec 94	12	199.5	222.0	226.5	168 - 239
SITE W2					
Jan 93 - Dec 93	12	216.5	269.0	316.0	180 - 424
Jan 94 - Dec 94	13	188.1	216.8	224.5	164 - 342
SITE W3					
Jan 93 - Dec 93	13	236.0	272.0	336.5	143 - 452
Jan 94 - Dec 94	12	218.5	233.0	253.0	204 - 267
SITE W4					
Jan 93 - Dec 93	13	269.3	311.3	407.1	223 - 525
Jan 94 - Dec 94	12	223.0	256.0	284.0	198 - 304
SITE W11					
Jan 93 - Dec 93	13	374.4	591.8	1,003.4	211 - 1,540
Jan 94 - Dec 94	12	1,230.0	1,615.0	1,885.0	684 - 2,500

Table 9.3 HUNTER RIVER, pH

Site and Sampling Period	Samples Taken	25%	Median	75%	Range
SITE W1					
Jan 93 - Dec 93	13	8.2	8.3	8.5	7.9 - 8.6
Jan 94 - Dec 94	12	8.3	8.4	8.4	8.2 - 8.9
SITE W2					
Jan 93 - Dec 93	12	8.3	8.4	8.6	8.1 - 8.6
Jan 94 - Dec 94	13	8.4	8.4	8.5	8.2 - 8.7
SITE W3					
Jan 93 - Dec 93	13	8.1	8.2	8.3	7.9 - 8.4
Jan 94 - Dec 94	12	8.1	8.3	8.4	8.1 - 8.5
SITE W4					
Jan 93 - Dec 93	13	8.1	8.2	8.2	7.8 - 8.4
Jan 94 - Dec 94	12	8.1	8.2	8.3	7.8 - 8.5
SITE W11					
Jan 93 - Dec 93	13	8.0	8.1	8.2	7.8 - 8.5
Jan 94 - Dec 94	12	8.1	8.1	8.3	7.7 - 8.4

Table 9.4 HUNTER RIVER, TOTAL SUSPENDED SOLIDS (milligrams per litre)

Site and Sampling Period	Samples Taken	25%	Median	75%	Range
SITE W1					
Jan 93 - Dec 93	13	2.0	3.0	5.0	1 - 139
Jan 94 - Dec 94	13	2.0	1.5	4.5	1 - 14
SITE W2					
Jan 93 - Dec 93	12	2.0	6.5	10.5	1 - 86
Jan 94 - Dec 94	13	1.0	2.0	3.0	1 - 23
SITE W3					
Jan 93 - Dec 93	13	6.6	10.8	14.9	4 - 226
Jan 94 - Dec 94	12	1.0	2.5	5.0	1 - 33
SITE W4					
Jan 93 - Dec 93	13	8.3	13.8	24.9	2 - 363
Jan 94 - Dec 94	12	2.5	6.0	14.5	1 - 85
SITE W11					
Jan 93 - Dec 93	13	6.6	14.0	20.8	4 - 83
Jan 94 - Dec 94	12	4.5	8.5	17.5	2 - 25

Levels of suspended solids have median values in the range 1.5 to 14.0. There is variation between the results for 1993 and 1994 with a 50 per cent reduction in suspended solids concentrations. This is most likely due to the low total rainfall experienced during 1994, which at 279 millimetres, is less than half the yearly average of 619 millimetres at Muswellbrook. The resultant decrease in runoff would effectively limit the export of suspended sediment from the land.

ii. Mount Pleasant Project Site

Table 9.5 to 9.8 show the water quality results for the sampling points within or adjacent to the site. Data was only available for 1994 due to the dry conditions prevailing in 1993. In addition, no data was available for sites W7 and W8, as shown on *Figure 32*.

Table 9.5 SITE, ELECTRICAL CONDUCTIVITY (microsiemens per centimetre)

Site and Sampling Period	Samples Taken	25%	Median	75%	Range
SITE W5					
Jan 94 - Dec 94	7	465	519	658	445 - 1300
SITE W6					
Jan 94 - Dec 94	5	237	281	331	221 - 450

Table 9.6 SITE, TOTAL DISSOLVED SOLIDS (milligrams per litre)

Site and Sampling Period	Samples Taken	25%	Median	75%	Range
SITE W5					
Jan 94 - Dec 94	7	347	449	505	280 - 905
SITE W6					
Jan 94 - Dec 94	5	227	277	396	158 - 508

Median values of conductivity and total dissolved solids are slightly higher than the values for the Hunter River at Site W5, but lower at Site W6. These variations reflect the characteristics of individual catchments on site.

Table 9.7 SITE, pH

Site and Sampling Period	Samples Taken	25%	Median	75%	Range
SITE W5					
Jan 94 - Dec 94	7	7.3	7.5	7.7	7.3 - 7.9
SITE W6					
Jan 94 - Dec 94	5	6.8	7.1	7.5	6.6 - 8.3

The pH values on site are slightly lower than those for the river, however, this is not considered significant.

Table 9.8 SITE, TOTAL SUSPENDED SOLIDS (milligrams per litre)

Site and Sampling Period	Samples Taken	25%	Median	75%	Range
SITE W5					
Jan 94 - Dec 94	7	20	71	276	8 - 515
SITE W6					
Jan 94 - Dec 94	5	47	82	120	41 - 347

Total suspended solids levels on site are an order of magnitude higher than the Hunter River. This variation is due to catchment characteristics. Both catchments exhibit severe gullying in their upper reaches, which would increase the suspended solid load. In addition, quarrying in the catchment of Site W6 would further raise suspended solids levels.

iii. Wet Weather Results

One wet weather sample was taken with results shown in *Table 9.9*.

Results for the Hunter River and Dartbrook under wet conditions show similar trends to those observed for the remainder of the sampling period. This suggests that there is little effect from the site on overall water quality in the Hunter River.

Results from the sampling points on, or adjacent to, the site show considerable variation. Site W8 has elevated levels of suspended solids which may be due to active gullying within the catchment. In addition, the range of conductivity and dissolved solids values reflects individual catchment characteristics. However, the variations in dry and wet weather results at sites W5 and W6 is not significant.

Table 9.9 WET WEATHER RESULTS - ALL MONITORING SITES

Sampling Site	Conductivity (microsiemens/cm)	Total Dissolved Solids (mg/L)	pH	Total Suspended Solids (mg/L)
Hunter River				
SITE W1	386	240	8.3	2
SITE W2	384	222	8.3	2
SITE W3	401	232	8.1	4
SITE W4	528	315	8.0	6
Project Site				
SITE W5	605	785	7.6	110
SITE W6	528	616	6.6	17
SITE W7	153	264	6.9	16
SITE W8	304	312	6.0	648
SITE W9	84	196	6.5	127
Dartbrook				
SITE W11	2,780	1,540	7.9	12

Notes: mg/L = milligrams per litre cm = centimetres

9.2 GROUNDWATER

9.2.1 *Hydrogeology*

The regional hydrogeology can be broadly classified in terms of two distinct groundwater regimes; the consolidated hardrocks and the unconsolidated alluvium (material deposited by rivers). The hardrock may in turn be sub-classified as either the very shallow weathered hard rock aquifer (water bearing strata) or the deeper coal measures. The Mount Pleasant site is underlain by hardrock Wittingham Coal measures. The open cut plan includes the Warkworth seam down to the Vaux seam in the North Pit. The South Pit extends deeper into the stratigraphy to the Edderton seam The Vaux seam B split will form the North Pit floor while the base of the Edderton Seam will form the South Pit floor.

Results of drilling and testing confirm the presence of three basic aquifer regimes:

- hardrock coal measures;
- a shallow weathered zone of the coal measures; and
- alluvium overlying the coal measures.

The geometry of the regional water table or aquifer pressure distribution relates to the direction of groundwater movement. Water levels have been measured at 23 locations in the hardrock aquifers and three in the alluvium. Results indicate a regional aquifer flow regime consistent with topography. Pressure gradients in the coal measures show an easterly flow direction towards the alluvium, while groundwater levels within the alluvium indicate a downstream flow direction consistent with the Hunter River. Elevated pressures within the coal measures imply that groundwater seeps naturally from the coal measures upwards into the alluvium. This upward seepage may influence water quality due to increased salinity in the coal seams.

9.2.2 *Pit Hydrogeology*

Proposed mining operations will commence in the eastern part of the site and extend westward down dip. During mine operations, the excavation will progressively expose all coal seams to gravity drainage. Complex interburden leakage is expected to develop.

Mine pit development will initially induce localised depressurisation of the coal measures followed by a regional depressurisation. During the life of the mine hydraulic grades will be inward towards the pits.

9.2.3 *Investigations*

Groundwater management studies have been conducted for the site. The studies included drilling, sampling, testing and monitoring of the groundwater environment and detailed assessment and computer simulation modelling of proposed groundwater management. Both alluvium and hardrock environments were field tested to determine hydraulic properties of aquifers. Studies tested coal seams and interburden at more than 20 bore locations.

i. Hardrock Aquifers

Investigations identify the coal seams as the main water transmission zones within the hardrock aquifer system. Results indicate that sandstones and siltstones within the coal measures have extremely low permeability (high resistance to underground flow) with some sections having the potential to isolate vertical exchange of groundwaters. The shallow weathered zone provides rainfall recharge to the deeper coal measures.

ii. Alluvial Aquifers

Most of the floodplain area is alluvium. The alluvial material offers increased groundwater storage and transmission. Gravel zones are known to provide the highest storage and permeability. The alluvium acts as storage for the river system of the area. With the onset of high river levels following rainfall, water from the Hunter River moves into aquifer sand and gravel raising the water table in the alluvium. This is reversed during dry periods when river levels fall below groundwater levels causing water to move from the aquifer to the river.

Testing at three bore locations has indicated a permeability range of 8.8 to 33.2 metres per day with an average of 20.3 metres per day.

iii. Regional Water Table

Geometry of the regional water table or aquifer pressure distribution relates to the direction of groundwater movement, permeabilities and aquifer recharge and discharge areas. Water levels have been measured at 23 locations in the hardrock aquifers and a number of locations in alluvium to the east. Elevated water pressures occur in the west of the site with lower pressures in the east and within the alluvium.

Higher aquifer pressures within the coal measures and the regional gradients towards the alluvium imply that groundwater is forced towards the Hunter River. It is likely that beneath the river alluvium, groundwater seeps naturally from the coal measures, upwards into the alluvium. This upward seepage may influence water quality due to increased salinity in coal seams. This most likely contributes to the variable and often poor groundwater quality in some alluvial areas.

iv. Groundwater Quality

Groundwater samples were collected at eight bores, five in the coal measures and three in the alluvium. Mean concentrations for tested parameters are summarised in *Table 9.10.*

Table 9.10 GROUNDWATER QUALITY (MEAN CONCENTRATIONS)

Sample Source	Alluvial Sediments	Coal Measures
pH	7.2	7.0
Total Dissolved Solids *(milligrams per litre)*	380.0	2,440.0
Calcium *(milligrams per litre)*	77.3	65.0
Magnesium *(milligrams per litre)*	43.0	114.7
Potassium *(milligrams per litre)*	1.4	10.6
Sodium *(milligrams per litre)*	40.7	736.0
HCO_3 *(milligrams per litre)*	286.7	1056.0
Chloride *(milligrams per litre)*	43.3	746.0
Sulphate *(milligrams per litre)*	27.0	87.8

Water within the coal measures is moderately saline with Total Dissolved Solids ranging from 468 to 3,510 milligrams per litre.

Mining activities will have little impact on groundwater quality within the coal seams. Beneath the alluvium, the rate of upward leakage of saline waters will be slowed and eventually reversed due to seepage from the undisturbed coal measures to the pits. Rainfall recharge may migrate to increased depths thus potentially leading to groundwater quality improvements. When water levels recover following mining, a flow reversal may again occur leading to re-establishment of upward movement from the coal measures to the alluvium. The quality of water moving upwards will initially reflect alluvial water but will ultimately tend towards a mixed water quality based on contributions from remaining in-situ coal seams, void and spoils water quality.

v. Spoil Leachate Quality

Chemical characteristics of the spoil material were tested by the Department of Mineral Resources Development Laboratory (Mountford and Wall, 1995). Sixty two samples were tested with most producing a weakly saline leachate and seven found to be acid producing. All seven acid samples were from the Wynn Seam however calculations suggest dilutions and neutralisation are likely to negate such potential.

A leachable salt load (LSL) for specific samples has been calculated using weathering test results. The calculated LSL indicates the amount of salt that has the potential to be leached over a long period of time. It should be noted however, that laboratory testing has produced LSL under extreme conditions which provide a conservative estimate of levels from field conditions. *Table 9.11* provides an estimate of spoils volumes together with the calculated LSL.

Estimates of final spoil leachate quality have been made. Assuming a maximum leachable spoils volume of 963 million cubic metres, a bulk pore space of 15 per cent and a leachable salt load of 696,560 tonnes, the calculated instantaneous salt concentration of leachate is 4,836 milligrams per litre. This is approximately double the current regional mean estimate for coal measures water quality. However, groundwater modelling indicates that the long term hydraulic grade between the mine void and the alluvial lands will be approximately half the present grade. Therefore, salt load transfers are not expected to change significantly. Since the spoils are unlikely to fully saturate and leaching efficiency will most likely be less than 100 per cent, the salt load transfer may be lower than at present.

Table 9.11 SPOILS VOLUMES AND LEACHABLE SALT LOADS FROM ROCK MINED

Lithology	Spoil Volume (million cubic metres)	Leachable Salt Load (kilograms per cubic metre)	Leachable Salt (tonnes)
Warkworth overburden	143	0.4	57,200
Mt. Arthur midburden	95	1.14	108,300
Piercefield overburden	186	0.13	24,180
Piercefield A midburden	154	1.38	121,520
Piercefield C midburden	150	1.37	205,500
Vaux A midburden	61	0.38	23,180
Vaux E midburden	21	0.19	3,990
Broonie B overburden	40	0.21	8,400
Broonie A midburden	28	0.77	21,560
Broonie B midburden	18	0.50	9,000
Bayswater midburden	17	0.48	8,160
Wynn EF midburden	16	0.23	3,680
Wynn I midburden	29	0.31	8,990
Edderton midburden	5	0.38	1,900
TOTAL	**963**		**696,560**

9.3 GROUNDWATER MODELLING

Groundwater investigations considered variations in both time and space involving complex interactions. Computer modelling enabled an assessment of these interactions. Modelling simulated the groundwater aquifers using mathematical equations based on Darcy's Law for flow through porous media. The process involves defining the aquifer system according to the following:

- aquifer geometry in three dimensions;
- aquifer hydraulic properties such as permeability, porosity and leakage between layers; and
- inputs and outputs to and from the system (rainfall recharge, throughflows and outflows).

A finite element approach has been adopted because it offers a high level of flexibility in simulating the complex geometry related to stratigraphy, alluvial extent and mine pit development.

The complex nature of the hydrogeological environment, in particular the multi layered nature of the coal measures, required development of a number of models to assess groundwater impacts. A vertical cross sectional model was used to assess vertical component of groundwater flow, while a regional plan model was used to simulate the horizontal flow component and regional impacts. In addition a layered strip model based on finite difference methods has been adopted for assessment of the rejects emplacement.

9.3.1 *Vertical Model Simulation*

The vertical cross sectional model simulates vertical water movements in the multi-layered aquifer system present in the coal measures. The model accounts for the hydraulic properties of individual layers within the hardrock environment and also simulates groundwater interaction between the alluvial and hardrock environments.

i. Calibration

The model has been calibrated against measured hydraulic gradients in both the horizontal and vertical directions. Vertical gradients predicted, range from two to five metres of downward flow. This gradient is consistent with measured vertical gradients. Modelled horizontal gradients compare favourably with measured regional gradients. A calculated 12 per cent absolute error is considered reasonable given the uncertainty in some aquifer parameters.

ii. Results

The vertical model has been used to predict likely pit inflows. Seepage from the pit faces will be initiated from Year 1, rising to a maximum in Years 15 to 20. The estimated rate of seepage for the proposal is based on pit excavation to the Edderton Coal seam at approximately 155 metres below ground level.

The net model water balance for the proposal is:

- Model Inflow
  - Boundary inflows — 450 kilolitres per day
  - Alluvial seepage (downwards) — 810 kilolitres per day

- Balanced By
  - Pit seepage — 1,260 kilolitres per day.

9.3.2 *Regional Simulation Model*

A regional model was used to assess the horizontal component of groundwater flow and to evaluate groundwater impacts on both hardrock and alluvial aquifers.

The model considers two layers, the upper layer representing the hardrock aquifer above the Edinglassie coal seam and the lower layer representing the hardrock aquifer below this seam. The alluvial aquifer was considered in the upper layer with direct leakages to and from the Hunter River.

i. Calibration

Water levels from monitoring were used to calibrate the upper layer of the model. Calibration of the lower layer was not possible because monitoring did not extend below the Edinglassie seam. Based on monitoring results from the above seams, it has been assumed that water levels in the lower layer are similar to the upper layer.

Comparison of the simulated water table with the field measured water tables indicates broad agreement of hydraulic gradients within most of the site.

ii. Results

Expected pit inflows using the plan model have been assessed for the 5, 10, 15 and 20 year mine stages. At Year 20 a marked depressurisation occurs in the North and South Pits with depressurisation in the coal seams extending westward more than five kilometres to Sandy Creek. No significant depressurisation is evident within the alluvial lands.

Table 9.12 summarises estimated pit inflows. Predicted rates are consistent with other mine sites in the Upper Hunter. Seepages will be confined primarily to the more permeable coal seams, as indicated by the vertical section model.

Table 9.12 ESTIMATED PIT INFLOWS

Mine Development Stage	Pit Seepage (megalitres per day)
0	0
2	0.2
5	0.6
10	1.2
15	1.5
20	1.8
21	1.9 approx.

9.3.3 *Water Table Recovery*

Following mining, the pit or void will continue to attract seepage from the surrounding coal measures. The rate of seepage will steadily decline as the system approaches a state of equilibrium. Recovered void water levels in the North and South Pits are predicted to be between 130 metres Australian Height Datum (mAHD) and 150 mAHD.

Estimated recovery rates of water levels indicates that initially this will occur rapidly, followed by a period of more than 80 years to levels equivalent to restore river and alluvium levels. Recovery water includes rainfall recharge and alluvium leakage.

9.3.4 *Cumulative Aquifer Impacts*

Rates of inflow to the North and South Pits were calculated for the Mount Pleasant, Bengalla and Dartbrook operations. If the proposed Kayuga Mine proceeds, the additional effects from this site will be negligible due to the shallow depth of excavations.

Cumulative operations will accelerate depressurisation of the hardrock coal measures resulting in lower rates of inflow at each mine site. Results are summarised in *Table 9.13* and indicate that inflows from the Mount Pleasant, Bengalla and Dartbrook Mines will be 22 per cent lower than Mount Pleasant alone.

Table 9.13 SEEPAGES FOR CUMULATIVE FLOWS

Model Scenario	Pit Development Stage				
	Year 0	Year 5	Year 10	Year 15	Year 20
Pit seepage without cumulative effects (megalitres per day)	0	0.60	1.20	1.50	1.90
Pit seepage with cumulative effects (megalitres per day)	0	0.45	0.97	1.21	1.55

9.4 FINE REJECTS EMPLACEMENT

As discussed in Section 6.3.5, fine rejects will be emplaced in two areas within catchments located immediately west of the Authorisation. It is expected that the northern catchment will provide sufficient storage for the projected twenty one years under consideration, but the southern catchment has been included in the analysis in the event that greater volumes of reject are produced. The emplacements will extend over about three square kilometres of the total northern and southern catchments which occupy 4.1 and 4.89 square kilometres respectively. Progressive development of storages will minimise the extent of the catchment disturbed at any one time and maximise natural runoff downstream.

9.4.1 Loss of Catchment Runoff

Construction of the fine rejects emplacements will require runoff from disturbed areas to be redirected into the mine water system. This will reduce downstream runoff availability. Emplacements will be undertaken in two stages. The first stage will consume about 1.75 square kilometres for about nine years resulting in a loss of available runoff from the northern catchment of 122 megalitres per year or 43 per cent. Most of this area will be rehabilitated following Year 9 and the runoff restored to the natural drainage. The second stage will result in decreased runoff in the northern catchment of up to 34 per cent or approximately 97 megalitres. About 100 megalitres or a 30 per cent reduction will occur in the southern catchment if emplacements 8 and 9 are constructed. Approximately 3.6 per cent of runoff will be lost from the upper Sandy Creek catchment (above the confluence with the southern sub catchment) during the life of the mine.

The reduction in available catchment is not expected to affect runoff water quality but will reduce supply to existing dams.

9.4.2 Subsurface Seepage

Fine rejects will include fine clayey materials, fine coaly shales with some sand and occasional fine pyrites. These will be pumped to the emplacement storage and allowed to beach out towards the impoundment wall. The beaching process will result in a central axis of higher permeability (coarser) materials located along the existing drainage line with more distant areas (valley slopes) comprised of finer materials offering a lower permeability. The coarser materials will provide an internal drainage collector which will transport most seepage and seal drainage pathways downwards into the underlying coal measures.

The wall will contain fine rejects whilst permitting seepage downstream to the environmental dam. Surface runoff are from disturbed as will be contained in the environmental dam and recycled to the mine water system.

The emplacements have the potential to accumulate salinity and certain trace elements. Expected leachate chemistry has been determined from interburden leachate and weathering tests and from experience with washery fine rejects at other locations. Leachate salinity is expected to decrease over time as water migrates downwards through the emplacement. It is therefore expected that fines rejects storages will tend towards a benign condition with time.

Likely seepage rates and potential impacts on the local groundwater system of leachate have been considered using a three dimensional computer model. This allows estimation of likely subsurface flow paths and flow rates. Geological field inspections were conducted to identify lithology and structural aspects for model development.

Model simulations calculated seepage rates and flow directions for the progressive down hill development of the rejects emplacements. Seepage will initially migrate towards Sandy Creek. Water is however, unlikely to physically reach Sandy Creek since development of the mine pit will cause subsurface flows to migrate eastwards towards the pit. Those seepage flows will be reversed towards the mine pits within two to five years of mining and reversal will prevail for more than 80 years. Modelling indicates that following flow reversal up to 90 per cent of seepage will flow to the east. Expected maximum deep seepage from beneath the emplacement storages is 20 kilolitres per day over a creek length of 400 to 500 metres.

Anticipated seepage water quality will include a mix of rainfall recharge and seepage. Based on washery and supernatant estimates salinity of the seepage is expected to be in the order of 4,000 EC (2600 mg/L). Surface water quality in drainages within the catchments contributing to Sandy Creek ranges from 2,064 to 9,853 EC microsiemens per centimetre. The potential contribution from seepage is within the range of existing water salinities and is not expected to change the prevailing groundwater or surface water salinity.

A review of other water quality parameters suggests that trace elements from the fine rejects will not be significant in any seepage waters.

9.4.3 *Management of Seepage*

Detailed site investigations will be undertaken prior to final design of the fine rejects storage dams. Investigations will determine the extent of rock discontinuities within the localised geological structure of the weathered zone and underlying coal measures. Identified discontinuities will be treated to reduce the potential for leakage to the coal measures during initial filling of the rejects dams. As fines are progressively deposited, sealing will occur.

A number of regional observation boreholes will be installed prior to commissioning of the storage dams. The bores will monitor seepage and changing aquifer pressures at depth which may lead to flow reversals (seepage towards the mine pit). Any seepage identified with potential to significantly impact the groundwater or surface water quality within the catchments will be managed using shallow trenches and deep capture wells. Specific measures will include:

- installation of drainage measures below the environmental dams to contain and manage seepage in the shallow weathered zone;
- installation of pumping boreholes below the environmental dams to attract seepage and inhibit regional migration; and
- grouting of obvious structural disturbances which have the potential to provide pathways for seepage.

Seepage collection structures will return all seepage to the environmental dam during the mine operational period and during the aftercare period. Following the decommissioning of each dam, seepage rates are expected to decline due to a reduction in water pressures from gravity drainage and consolidation. Capping and rehabilitation will inhibit rainfall infiltration.

Detailed survey of dam surfaces will be undertaken during the rehabilitation of each dam. Reshaping will be undertaken, where required, to ensure surface rainfall runoff is managed effectively and erosion potential is minimised. Runoff from the reshaped dam surfaces will be conveyed away from steep slopes to a controlled discharge point. During the first few years of rehabilitation, runoff will be directed through the environmental dams to remove suspended sediment. When water quality is acceptable, runoff will be returned to natural drainages.

9.4.4 *Structural Stability*

Fine rejects storage dams will be constructed from coarse reject and have been designed to ensure structural stability and facilitate rehabilitation. Walls have be designed to stability criteria for normal operations but in the event of local slumping under extreme conditions, any movement of fine reject material or water would be contained by the next downstream storage. A number of controls will be used to minimise stormwater storage in the fine rejects dams including progressive raising of the dam wall, installation of drainage measures (bywashes) and continuous removal of stored water for recycling in the mine water system.

Once the storages are full and the fine reject de-watered they will be capped and rehabilitated. Following this any slumping of the wall and movement of the fine reject material would likely result in a minor local flattening of the slope grade between successive storages. Further study will be undertaken during the detailed design of the fine rejects dams to ensure structural stability during construction, operation and following rehabilitation. A preliminary review of materials characteristics and potential failure mechanisms is provided in Supplementary Report 4.

9.5 WATER MANAGEMENT STRATEGY

A water management plan has been developed addressing the following key aspects:

- conveyance of clean runoff from undisturbed areas around mining operations to discharge into natural drainages;
- control and management of stormwater and groundwater collected in the pits to maintain efficient operating conditions;
- harvesting, storage and treatment of runoff waters to provide an operational water supply for dust suppression, coal washery and other uses;
- supply of make up water from the Hunter River on a needs basis; and
- release of surplus water to the Hunter River in compliance with the Hunter Salinity Trading Scheme.

9.5.1 *Water Demand and Supply*

Figure 34 provides a schematic of the mine water system showing operations for the North and South Pits, the washery, fine rejects storage area and proposed draw points for dust suppression. Clean water comprises all runoff derived from undisturbed or rehabilitated lands and mine water includes runoff from disturbed areas with potential for increased suspended solids or dissolved salts.

Water demand has been estimated on the basis of proposed Coal Preparation Plant (CPP) operations and the likely extent of mining. *Table 9.14* summarises expected water demands.

Table 9.14 PROJECTED WATER DEMAND

Use	Demand (megalitres per day)	Water Type
Coal Preparation Plant	7.2	clean/dirty
Haul roads dust suppression	1.5	clean/dirty
Stockpile Dust Suppression	0.35	clean/dirty
Truck Washdown	0.1	clean/dirty
Bath house	0.05	clean
Other	0.2	clean/dirty
TOTAL	**9.4**	

A summary of water supply sources is provided in *Table 9.15*. Minimum contributions up to 0.1 megalitres per day can be expected from pit groundwater inflows during the first year of mining, requiring additional water from catchment runoff or alternative sources. The water deficit will steadily decrease as contributions increase from pit seepage.

Table 9.15 WATER SUPPLY SOURCES

Source	Supply (megalitres per day)	Water Type	Comments
Mine pit inflows	0 to 1.55	dirty	rising groundwater influx (Year 0 to 20)
Catchment runoff	variable	clean	rainfall dependent
Hunter River water	7.5 to 9.4	clean	overall deficit (Year 0 to 20)

9.5.2 *Water Management Simulation Model*

A water management model has been used to evaluate likely catchment yields and assess storage needs and management requirements.

Contributing catchments have been identified within and outside the mining area. The catchment runoff component of the model incorporates parameters which characterise catchments in terms of interception storage, hardrock exposure, soil moisture storage, capacity to infiltrate rainfall, etc. Catchments include pit areas, prestrip benches, shaped and unshaped spoils and rehabilitation areas. Catchment types and areas within the mine operational area used in the runoff simulation are summarised in *Table 9.16.*

Table 9.16 CATCHMENT TYPES

Catchment Area (square kilometres)	At Year 1	At Year 5	At Year 10	At Year 15	At Year 20
Pit Areas	0.09	0.11	0.14	0.23	0.27
Overburden Prestrip Areas	0.50	1.20	2.00	2.60	2.70
Spoils Emplacements	1.40	1.80	3.70	5.00	4.40
Rehabilitated Areas	0.50	1.20	2.00	2.70	2.90
Developed Areas	0.63	0.63	0.63	0.63	0.63
Fine Rejects area*					

*Note: * 0.3 to 0.6 square kilometres will direct water to the mine water system from the fine rejects emplacement area immediately to the west of the Authorisation.*

Undisturbed catchments have been simulated using calibrated parameters from other regional catchments which have been gauged by the Department of Land and Water Conservation. Parameters for pit areas, prestrip benches, spoils and rehabilitation areas have been assigned on the basis of experience and monitoring at other mine sites.

i. Rainfall and Evaporation

An analysis of rainfall and evaporation was incorporated in the regional hydrologic and hydrogeologic water balance. Long-term continuous rainfall data was used from a station at Muswellbrook (High School) from 1870-1994. This data set while extensive, is discontinuous. A representative continuous record was therefore established for analytical purposes by including Aberdeen Post Office data. The nearest representative evaporation records have been obtained from the Scone Research Service Centre for the period 1973 to 1994 and are given in *Table 7.8.*

ii. Simulation

A water balance has been calculated based on net water supply and consumption. The water balance calculates net daily storages and provides summaries on a weekly basis. Overflows resulting from supplies exceeding maximum storage capacity is also provided. An initial total mine storage capacity of 1,000 megalitres was used. Catchment areas were then progressively modified according to *Table 9.16.*

Eight rainfall periods of 21 years duration each were selected from the rainfall data. These periods included the wettest (1947 to 1949) and driest three years (1939 to 1941) and the wettest and driest years on record (1889 and 1978, 1935 and 1944 respectively). Each period was then used to generate typical storage and overflow characteristics for the mine.

Results indicate storage requirements less than 500 megalitres for much of the period with higher storage required during 1950-51, 1953 and 1955 to 1957. Overtopping of 3,000 megalitre storage would have occurred in the 1955 flood year.

9.5.3 *Storage Requirements and Surface Water Channels*

Calculations indicate that water would be present within dam storages between 50 and 70 per cent of the time. Therefore, make up water will be required to be drawn from the Hunter River and/or harvested from natural runoff in some catchments for large periods of time.

The minimum mine water storage required to limit discharge in compliance with flood flows as defined by the Hunter Salinity Trading Scheme is 1,000 to 2,000 megalitres. The total volume of the major storage dams on site ranges from 385 megalitres to 4,385 megalitres, following development of the Piercefield Pit in Year 2.

i. Clean Water Circuit

Runoff from undisturbed catchments will be directed by contour banks, drains and diversion channels to staging dams for limited harvesting or for discharge to natural drainages. All dams will be designed in accordance with established engineering principles and the Dam Safety Committee requirements. Some dams will be designed to overflow or pump to contour drains while other dams will have an outlet structure for release to existing drainages.

Diversion drains and channels will contain peak runoff discharge rates for a 1 in 5 year Average Recurrence Interval (ARI) storm event. Drains and channels will be calculated to restrict flow velocities to less than 1.5 metres per second.

Sedimentation dams have been sized to contain the total runoff from a 1 in 10 year ARI storm event. All dam structures will have the capacity to retain the design storm with sufficient freeboard and spillway width to convey a 1 in 20 year time of concentration storm event.

ii. Mine Water Circuit

Runoff from the facilities and stockpiles will be directed to a localised hardstand catchment dam and a dam east of the facilities area as shown on *Figure 33*. A small dam down slope from the rail loop loading area will contain runoff from the area. Stored water will be pumped north to the dam east of the facilities area. From there, it will be pumped either to the main water storage dam or to the coal preparation plant dam. Haul road runoff will be directed to the nearest mine water dam by catch drains.

During initial mine development of the South Pit, runoff will be pumped to a dam, near the pit haul road, which will provide storage for dust suppression. North Pit seepage will be directed to dams near the north end wall and the southern ramp. These dams will supply water to the main storage and preparation plant dams. Temporary transfer dams and sumps may be constructed in spoils or prestrip areas as needed. By Year 10, mine water from the South Pit will be pumped directly to the Piercefield Pit for use in dust suppression. As dams for the North pit are mined, in-pit temporary storage will be pumped to the

Piercefield Pit via the southern end haul road. When the Piercefield Pit is mined in Year 20 all surplus mine water will be directed to the main storage dam.

Makeup water from the Hunter River will be pumped directly to the coal preparation plant dam and the main water supply storage dam. Surplus water will be discharged from the main storage dam to existing drainage and into the Hunter River via a drainage line west of the Bengalla mining operation.

9.5.4 *Surplus Water Discharges*

Water management studies indicate that the mine will operate with a deficit in water supply. Surplus water discharges are predicted to occur when extreme storm events lead to unacceptably high levels of water in the Piercefield Pit, less than 5 per cent of the time. Occasional clean water dam overtopping may lead to releases to local drainages.

9.6 ENVIRONMENTAL IMPACTS

9.6.1 *Loss of Catchment Runoff*

Development of mine pits and facilities areas, together with spoil emplacements will reduce the available catchment area contributing to localised runoff on the eastern side of Mount Pleasant. Approximately 30 to 70 per cent of catchment runoff within the eastern part of the site will be directed to the mine water system with the remainder diverted to natural drainages.

Loss of runoff to alluvial areas east of the site is not expected to significantly affect groundwater quantity or quality. Rainfall and localised runoff will continue to permeate the shallow alluvium with groundwater flow downstream. Alluvial groundwater levels will generally be unaffected, although changes may occur in areas connected to structural conduits within the coal measures and disconnected from the mainstream alluvium. Runoff will be re-established from rehabilitated areas to natural drainages during mining.

Development of rejects emplacements will result in a loss of runoff to Sandy Creek during the development. Existing dams will be affected and alternative supplies for dam water will be provided.

Loss of runoff is not expected to significantly affect subsurface groundwaters which will continue to seep from springs for two to five years after commencement of mining. Some loss of pressure resulting from mine pit development may cause premature drying after this period. This loss of seepage may improve runoff quality at some locations because springs produce poorer quality water than surface runoff.

9.6.2 *Regional Groundwater Tables*

Groundwater levels in hardrock aquifers will steadily decline as water is drained from storage during the course of mining. The area affected will increase to a distance of more than five kilometres from the mine pits after 20 years operation. More than 10,000 hectares may be impacted by a five metres loss of groundwater pressure with maximum impacts of 100 metres adjacent to the pit faces. Regular monitoring of boreholes within the five kilometre zone will be undertaken to assess any water loss.

Loss of groundwater levels will require deeper pump inlets at those locations where water is currently drawn from deep aquifers. Following mining, groundwater levels will rise in the final void and ultimately reverse pressure gradients in the coal measures as the system reaches equilibrium. Coal seam aquifer pressures are not expected to return to current pressures. A long term equilibrated water level in the voids is predicted to be between 150 and 170 mAHD.

Natural upward leakage from the coal measures is estimated to be about 0.04 litres per square metre of alluvial material daily. Reversal due to depressurisation of the coal measures would result in a downward leakage rising from zero to 0.1 litre per square metre per day. The resulting impact on the alluvium will be countered by natural groundwater recharge. Rainfall and river recharge will replace the volumes of groundwater lost to downward seepage. Since it is unlikely that the frequency of rainfall and high river flows will change significantly, the water table within the alluvial sediments will continue to be regularly recharged and will remain largely unaffected by depressurisation within the coal measures. Therefore the impacts on river water users and irrigators will be negligible.

9.6.3 *Regional Water Quality*

As discussed in Section 9.2.3, depressurisation of coal seams is expected to have little impact on the water quality within the seams. The salinity of void water has been estimated to potentially rise from 2,400 milligrams per litre to about 4,800 milligrams per litre. The predicted upper salinity level is unlikely to be reached due to the very slow leaching process commencing after water levels in the void recover (after 80 years).

Salts will accumulate in the final void and potentially leak to alluvial areas through the coal measures. The final groundwater level in spoils of 150mAHD will reduce flow rates to the alluvium to about half the initial rate. The combination of reduced flow rates with higher salt loads will maintain current salt transfer rates from within the alluvium.

9.6.4 *Hunter River Water Quality*

Changes in groundwater salinity arising from mining operations are predicted to have negligible impact on the water resources of the alluvial lands and as a consequence, negligible impact on the Hunter River. Possible localised improvements in alluvial lands groundwater will be masked by the wider changes relating to natural recharge and discharge processes.

Mine water runoff will be entirely contained within the mine water management system. Studies have indicated a mine water deficit for most of the operational period and a need to draw water from the Hunter River. Surplus storage of mine water will be released during high rainfall periods in compliance with the Hunter Salinity Trading Scheme. Releases in accordance with salinity credit allocations may also be required for lower flows during the later years of mining.

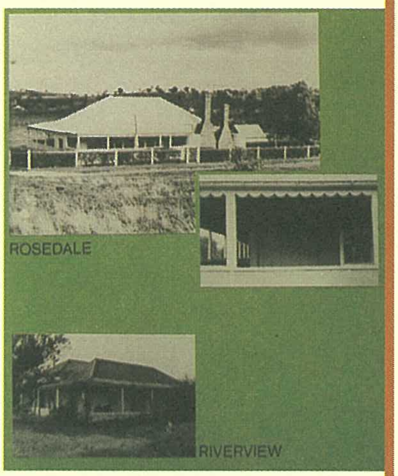
9.6.5 *Hunter River Water Supply*

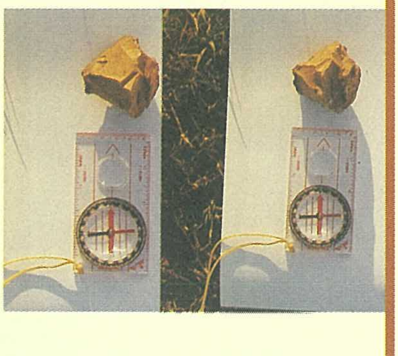
Detailed water management studies using a daily rainfall-runoff model have indicated a mine water deficit for most of the operational period and a need to draw water from the Hunter River. The maximum rate that water will be drawn from the river will be 9.4 megalitres per day. Probabilities of daily makeup water from the Hunter River have been determined indicating requirements ranging between 1 megalitre (45 per cent of the time) to 7 megalitres (less than 5 per cent of the time). Water will be drawn from the Hunter River under Department of Land and Water Conservation licence conditions and will therefore not affect regulated flows in the river.

During exceptional rainfall periods, surplus storage of mine water will be released to the Hunter River in compliance with the Hunter Salinity Trading Scheme. The probability of such releases occurring falls within the 6 per cent opportunity window for releases during periods of flood flow in the Hunter River.

The mine and associated infrastructure are located outside the extent of a 1 in 100 year flood and will therefore not be affected by flooding.

THE SOCIAL ENVIRONMENT 10





This chapter describes and assesses the project's interaction with the social environment which is defined as aspects associated with socio-economics and heritage.

10.1 SOCIAL AND ECONOMIC PROFILE

This section addresses the socio-economic impacts of the proposal. It is presented in two sections; the first describes the existing social and economic characteristics of Muswellbrook local government area and the Upper Hunter region. The second section identifies the potential effects of the proposed mine.

10.1.1 Population Trends

There has been strong population growth in Muswellbrook since the mid 1970s in response to new coal mining and electricity generation projects in the Upper Hunter. Muswellbrook and Singleton were the two larger Upper Hunter towns that expanded to service these activities. The Upper Hunter is defined in the Hunter REP (DoP, 1989).

Table 10.1 shows a consistent rise in Muswellbrook's population between 1976 and 1986. It expanded by 3,295 people at an average annual growth rate of 2.76 per cent and 2.34 per cent for the 1976-81 and 1981-86 periods respectively. During that time the Upper Hunter region as a whole experienced growth, most noticeably in Muswellbrook, Singleton and Scone.

After 1986 population growth eased significantly and a much slower annual rate of growth was experienced to 1991. Muswellbrook only grew by 0.82 per cent compared with 2.18 per cent for Singleton, 1.22 per cent for the Upper Hunter and 1.46 per cent for the Hunter region. This slower growth followed from fewer resource developments during the late eighties and the rationalisation of the steel industry and power stations. Bayswater Power Station was completed in 1986 with the subsequent loss of a large transient population. Data from the Australian Bureau of Statistics show that while the population increased by 1,035 due to natural growth, this was offset by a loss of 419 persons who moved out of the local government area (ABS, 1993).

Latest population estimates show Muswellbrook Shire's population at 16,060 persons at June 1995 (ABS, 1996). This is an increase of about 630 people since 1991 at an average growth rate of 1.0 per cent per annum. Growth was again slower than Singleton for this period.

Population projections for the Muswellbrook area based on 1991 census data were prepared by the Department of Planning (1994). These indicated that slow but steady growth will continue as shown in *Table 10.2*. In the short term these projections appear to be low given the 1995 estimated resident population figure.

Table 10.1 POPULATION CHANGE

Local Government Area	Estimated Resident Population				Average Annual Growth Rate		
	1976	1981	1986	1991	1976-81	1981-86	1986-91
Muswellbrook	11,520	13,200	14,815	15,431	2.76	2.34	0.82
Merriwa	2,252	2,400	2,438	2,466	1.28	0.31	0.23
Murrurundi	2,357	2,350	2,361	2,415	-0.06	0.09	0.82
Scone	7,382	8,500	9,452	9,706	2.86	2.15	0.53
Singleton	12,359	15,250	17,126	19,073	4.29	2.35	2.18
Total Upper Hunter	35,870	41,700	46,192	49,091	3.06	2.07	1.22
Total Hunter Region*	421,983	472,900	494,690	531,965	2.30	0.91	1.46

Source: Department of Planning (1994)

* *Hunter Region Statistical District.*

Table 10.2 POPULATION PROJECTIONS FOR MUSWELLBROOK

Growth Rate	1991	1996	2001	2006	2011	2016	2021
Low	15,400	15,800	16,100	16,300	16,300	16,400	16,300
Medium	15,400	15,900	16,300	16,600	16,900	17,200	17,500
High	15,400	15,900	16,500	17,000	17,500	18,000	18,500

Source: Department of Planning (1994)

10.1.2 *Demographic Characteristics*

Data from the 1991 census gave an insight into the demographic characteristics of the Shire and allowed these to be compared with the Hunter Statistical District and the State. These included age structure, educational qualifications, household ownership and income.

Muswellbrook has a relatively young age structure, with nearly 10 per cent of the population under four years of age as shown in *Table 10.3*. This is significantly higher than averages for the Hunter region and NSW. It also has more 5 to 9, 10 to 19 and 20 to 49 year olds than regional and State averages. The area has substantially fewer elderly persons.

Table 10.3 AGE STRUCTURE

Age Group	Muswellbrook	Hunter	NSW
0-4	9.8	7.6	7.5
5-9	8.9	7.6	7.3
10-19	16.1	14.8	14.9
20-49	46.2	42.8	44.8
50-64	11.2	14.1	13.6
Over 65	7.8	13.1	11.9
TOTAL	**100.0**	**100.0**	**100.0**

Source: Australian Bureau of Statistics, 1991 Basic Community Profiles

Table 10.4 indicates that Muswellbrook has a similar level of educational attainment to the Hunter region. The highest proportion of the Muswellbrook population possess no formal qualifications. This percentage is similar for the Hunter region and slightly higher than the State average. Skilled vocational training is the next highest proportion of population in Muswellbrook. This proportion is higher than in the Hunter region or the rest of the State.

Table 10.4 EDUCATIONAL ATTAINMENT

Qualification	Muswellbrook	Hunter	NSW
Degree or higher	4.1	5.0	7.9
Diploma	4.5	5.3	5.2
Skilled vocational	13.8	13.1	10.6
Basic vocational	4.1	3.8	3.9
Not qualified	61.8	61.5	58.8
Not stated	11.1	10.4	12.5
Inadequately described	0.6	0.9	1.1
TOTAL	**100.0**	**100.0**	**100.0**

Source: Australian Bureau of Statistics, 1991 Basic Community Profiles

Household ownership data in *Table 10.5* show that significantly fewer dwellings are owned in Muswellbrook compared to the Hunter region and NSW. There is a high proportion of households in rental accommodation. In Muswellbrook, 32.3 per cent of households rent homes whereas in the Hunter, 23.5 per cent of homes are rented. This may be attributable to the area's industrial base, part of which supports a transient population.

Table 10.5 HOUSEHOLD OWNERSHIP

Nature of Occupancy	Muswellbrook	Hunter	NSW
Owned	33.0	46.7	41.6
Being purchased	26.9	24.4	24.6
Rented			
Housing Commission	8.9	6.0	5.7
Other Govt. Agency	4.2	1.2	1.2
Other	18.1	15.6	19.3
Not stated	1.1	0.7	0.9
Other	7.8	5.4	6.7
TOTAL	**100.0**	**100.0**	**100.0**

Source: Australian Bureau of Statistics, 1991 Basic Community Profiles

Table 10.6 indicates that significantly fewer households have an income of $20,000 or less compared to the Hunter region and State averages. More households in Muswellbrook earn over $50,000 per annum compared to the average for the region. This reflects the relatively high incomes from the local industries, particularly mining.

Table 10.6 HOUSEHOLD INCOME

Income ($)	Muswellbrook	Hunter	NSW
0-12,000	10.6	14.7	12.8
12,001-20,000	13.1	17.7	15.1
20,001-30,000	12.5	13.7	13.2
30,001-50,000	20.2	20.0	20.6
50,001-70,000	14.6	10.8	11.4
70,001-100,000	5.5	4.7	6.1
100,001-150,000	4.3	1.8	3.1
Over 150,000	0.4	0.3	0.7
Partial income stated	15.6	15.3	14.1
No incomes stated	3.2	2.7	2.9
TOTAL	**100.0**	**100.0**	**100.0**

Source: Australian Bureau of Statistics, 1991 Basic Community Profiles

10.1.3 Overview of Economic Activity

The Muswellbrook area has, for many years, supported a mixture of pastoral activities, mining and large scale electricity generation. Over the last two decades there has been intensive development of coal resources, particularly by open-cut mining.

The Muswellbrook area developed as a rural and primary industry base and agricultural remains the dominant land use, covering 114,939 hectares (Australian Bureau of Statistics, 1993). The main farming activities within the area include beef cattle grazing on native and improved pastures, and intensive cultivation and dairying on the river flats. The area is well-known for its wine, with vineyards centred around Muswellbrook and nearby Denman. In the 1992-1993 season there were 228 agricultural establishments in the area with a gross value of production of $32.7 million. Milk ($11.4 million), viticulture ($8.9 million), cattle ($8.4 million) and lucerne/pasture hay ($2.8 million) were the major sources of revenue (Australian Bureau of Statistics, 1994).

In 1990-91 there were 17 manufacturing establishments in the LGA. These had a turnover of $123.8 million and paid out $13.3 million in wages and salaries. These comprised mainly food and beverage manufacture, machinery and equipment and non-metallic mineral products (Australian Bureau of Statistics, 1995).

During the past decade Muswellbrook Shire has also seen a significant growth in both industrial and residential development which has resulted in some residential areas in close proximity to light industry. These areas have developed in response to the mining and power generation industry of the Hunter Valley region.

The coal industry is now the most significant contributor to the Upper Hunter economy producing employment, income generation and flow-on effects for other sectors. Input-output models developed by the Hunter Valley Research Foundation show that wealth from the coal industry flows throughout the rest of the Hunter economy. This results from job created directly at the mines and further jobs to support increased patronage of local establishments, accommodation and shops as well as demands for local materials and services.

To June 1995, current investment in the Hunter region was $4.3 billion, with more than 20 per cent invested in the mining sector. Most coal mining investment occurs in the Upper Hunter (HVRF, 1995).

During 1993-94 the Singleton-North West District exported more than 32 million tonnes of coal to overseas markets at a value of $1.7 billion. This was 56 per cent of total coal export earnings in NSW. The Upper Hunter coal mines have contributed most to the growth of the coal industry in NSW (HVRF, 1995).

With further demand for the State's coal resources, coal mining and electricity generation are gaining momentum and will undoubtedly become the principal economic base of Muswellbrook in the future.

Four coal mines are currently operating in the Muswellbrook area; Dartbrook underground, Bayswater open-cut, Drayton open-cut and Muswellbrook No. 2 which is an open-cut mine. The location of these mines in relation to the township and their production details are summarised in *Table 10.7*. Bayswater Mine was recently extended and its production increased.

Production has commenced at the Dartbrook Mine, which is located 10 kilometres west of Muswellbrook. This is an underground mine with a proposed capacity of 3.3 million tonnes of coal per annum. Bengalla is an open-cut mine five kilometres west of Muswellbrook. Construction of the mine site access and surface facilities are currently under way. It has a proposed raw coal output of 7.0 million tonnes per annum and is scheduled to commence coal production in early 1999 .

In addition to Mount Pleasant two other open-cut mines are proposed, Mount Arthur North and Kayuga. The Mount Arthur North proposal is planned five kilometres south west of Muswellbrook. It is expected to serve domestic and export markets when developed. Tenders have been called for the allocation of this area to a specific mining company or consortium. The proposed Kayuga Mine which is in an advanced planning stage is located north-west of Muswellbrook, on the northern boundary of the Mount Pleasant site.

Table 10.7 OVERVIEW OF CURRENT MINE OPERATIONS

Mine	Location (from Muswellbrook)	ROM Production (mt)[1]	Saleable Coal (mt)
Bayswater No. 2	10 km south	2.15	1.92
Drayton	10 km south	3.89	3.89
Muswellbrook No. 2	6 km north-east		
- open cut		1.32	1.32
*- underground**		0.23	0.23
Dartbrook	10 km north-west	0.20	0.19
TOTAL		7.79	7.55

Source: Department of Mineral Resources (1996)

Note : 1. Production figures are for 1994/95.

mt million tonnes

* *Operations have now ceased in the underground mine.*

The combined annual ROM and saleable production for the 1994/95 period figures for these mines totalled 7.79 million tonnes and 7.55 million tonnes respectively. The ROM production total represents 13 per cent of all coal produced in the Hunter Coalfield during this period.

10.1.4 *Employment*

Table 10.8 shows the main employment sectors in the Muswellbrook area in relation to the Hunter region and the State of NSW.

Mining is the most important local industry employing 1,017 people in 1991 or 15.1 per cent of the labour force. This is three times greater than the Hunter region and 15 times greater than the State average.

Wholesale and retail trades (14.6 per cent), community services (10.7 per cent), electricity, gas and water (10.7 per cent) and agriculture (9.2 per cent) are the other main employers in the area.

The electricity, gas and water sector is prominent reflecting the location of two of the State's largest power stations, Liddell and Bayswater, approximately 16 kilometres south-east of Muswellbrook. Each station currently employs about 250 permanent staff plus contractors.

Table 10.8 EMPLOYMENT SECTORS

Industry	Muswellbrook			Hunter Region		NSW	
	1981	**1986**	**1991**	**1986**	**1991**	**1986**	**1991**
Agriculture	11.8	10.0	9.2	4.0	3.4	4.7	3.9
Mining	12.6	16.3	15.1	6.5	5.0	1.3	1.0
Manufacturing	6.2	5.3	7.5	16.6	13.7	15.4	13.1
Electricity, Gas, Water	11.4	15.0	10.7	3.5	2.4	2.1	1.4
Construction	10.7	12.0	4.6	6.6	7.2	6.3	6.2
Wholesale & retail trade	11.3	10.5	14.6	17.7	18.6	18.9	18.9
Transport & Storage	3.5	3.2	3.1	5.6	4.2	5.7	5.0
Communication	1.4	0.8	0.9	1.5	1.2	2.2	1.7
Finance, property & business	4.3	5.0	6.6	7.6	8.6	11.7	12.7
Public admin & defence	3.1	3.2	3.1	5.1	4.9	5.5	5.0
Community Services	8.6	9.4	10.7	16.6	17.5	16.4	17.0
Rec, personal & other	5.7	6.1	6.4	5.8	6.9	6.3	7.3
Not classifiable/ not stated	9.4	3.2	7.5	2.9	6.3	3.5	6.8
TOTAL	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Australian Bureau of Statistics, 1991 Basic Community Profiles

Since 1981 agriculture has declined slightly. Minor increases have been recorded in the wholesale and retail trades, finance, property and business sector, community services and recreation as a result of Muswellbrook's strengthening role as a service centre for the Upper Hunter.

The mining, electricity generating and construction industries increased substantially between 1981 and 1986, but declined in the next five years. The largest declines were in electricity generation and construction. This was probably associated with the completion of Bayswater Power Station in 1986. Bayswater is a 2,640 mega-watt capacity station and its construction workforce peaked at around 2,300 workers.

About 5,300 people were employed in Upper Hunter mines in 1995. The four mines in the study area currently employ about 824 people (DMR, 1995). As production expands over the next decade, employment is expected to increase and then decrease in the longer term as reserves are exhausted (HVRF, 1995).

The occupational status of the labour force is shown in *Table 10.9*. Most workers are tradespersons (17.2 per cent), labourers and related workers (16.9 per cent) or plant and machine operators and drivers (15.0 per cent). The proportion of employees in each of these occupations is higher than averages for the Hunter region and NSW. These categories largely reflect the skills required in the coal and electricity generation industries and associated activities.

Table 10.9 OCCUPATION

Status	Muswellbrook	Hunter Region	NSW
Managers & Administrators	10.8	9.4	12.1
Professionals	7.4	10.4	12.9
Para-professionals	5.6	6.9	6.6
Tradespersons	17.2	16.3	13.5
Clerks	10.1	12.9	15.8
Sales & personal service	10.4	14.1	13.6
Plant & machine operators & drivers	15.0	9.5	6.9
Labourers & related workers	16.9	14.5	12.2
Inadequately described	1.6	1.1	1.2
Not stated	5.0	4.9	5.2
TOTAL	**100.0**	**100.0**	**100.0**

Source: Australian Bureau of Statistics, 1991 Basic Community Profiles

10.1.5 Housing and Accommodation

Real estate agents in Muswellbrook, Scone and Singleton report that there is a very limited supply of vacant rental accommodation in these areas (pers. comm., 1997).

Temporary accommodation is available in caravan parks, motels and hotels. Muswellbrook has nine motels, two hotels and two caravan parks and Scone has five motels, three hotels and two caravan parks. There are also caravan parks at Denman and Sandy Hollow. Singleton, situated 45 kilometres to the south-east of Muswellbrook on the New England Highway has six motels as well as two caravan parks. These towns have about 550 motel or hotel rooms (NRMA, 1995). Rental or temporary accommodation may be used to house the construction workforce or provide interim accommodation for the operational workforce that migrates into the area.

Future residential land releases are planned for South Muswellbrook. Muswellbrook Shire Council expects to release 180 residential lots at South Muswellbrook at the end of 1997 and a further two subdivisions totalling 60 lots are planned (pers. comm., 1997). Landcom intends to release rural residential lots at Denman in the future.

10.1.6 Community Facilities and Services

Muswellbrook is a central service centre for the Upper Hunter. It provides all basic facilities and services to the surrounding rural areas, towns of Scone, Aberdeen, Denman and Sandy Hollow, and the town itself. These include children's services, education facilities, medical facilities, welfare services and leisure and recreational facilities.

i. Children's Services

Muswellbrook has two long day care centres. Muswellbrook Multi-Care Childcare Centre is a community based centre which provides 35 places. This centre is currently operating at capacity. Rutherford Road Childcare Centre is a joint venture between Pacific Power and Muswellbrook Shire Council offering 22 work based places for children of Pacific Power employees and 11 general community places. This centre currently has eight places available (pers. comm., 1997).

Pre-schools operate in Muswellbrook and Aberdeen. Muswellbrook Pre-school offers 60 all day places and 20 half day places. The pre-school has adequate staffing and space available to accommodate future demand, however, recurrent funding would be required to employ additional staff (pers. comm., 1997).

Family day care based in Scone serves Muswellbrook, Scone and Merriwa LGAs. This service has 150 full time places of which 140 are currently filled. The Commonwealth government has indicated that it will support the expansion of this service (pers. comm., 1997).

There are nine playgroups which operate daily in the local area. An additional playgroup will begin operation in early June to meet current demands (Pers. comm., 1997).

As highlighted in *Table 10.3* Muswellbrook has more 5 to 9 year olds than the State average. Council's Community Profile (1994) has identified a need for the provision of after school and vacation care to cater for this age group.

ii. Education Facilities

a. Primary Schools

The towns of Muswellbrook, Scone, Aberdeen and Denman have seven primary schools: five government and two catholic. There are three schools in Muswellbrook. Current enrollments for State schools are shown in *Table 10.10*. Muswellbrook's two government schools have over 1,100 pupils enrolled. All schools, with the exception of Muswellbrook South Public School, have advised that they can accommodate additional children without requiring new facilities and staff. The NSW Department of School Education advises that there is room for additional demountables if required at these schools. Muswellbrook South is included in a Building Program that is designed to cater for anticipated future student numbers.

Table 10.10 PRIMARY SCHOOL ENROLMENTS

School	1997	Maximum Capacity[1]	Available Places
Aberdeen	279	289	10
Denman	94	104	10
Muswellbrook	610	630	20
Muswellbrook South	585	585	0
Scone	471	500	29
TOTAL	**2,039**	**2,108**	**69**

Source: Individual schools pers. comm. (1997)
Note: 1. Given current facilities and staffing levels.

b. Secondary Schools

Muswellbrook High (750 pupils) and Scone High (555 pupils) are the main secondary schools serving the study area. Both have sufficient accommodation to cater for any reasonable increase in enrollments (pers. comm., 1997)

Regional Catholic secondary schools are located at Aberdeen and Singleton. Scone Grammar School provides places for primary and secondary students.

c. Technical and Further Education (TAFE)

TAFE facilities are located in Muswellbrook, Scone and Singleton. In 1996 1,200 places were available in Muswellbrook, 1100 in Singleton and 800 in Scone. Enrollments at Muswellbrook campus are stable. This facility is not operating at capacity and can accommodate further demands. TAFE has advised that resources can be moved throughout the Hunter region to meet growing demands for a particular course (pers. comm., 1997).

iii. Health, Welfare and Support Services

The Upper Hunter is served by four hospitals: Muswellbrook and Singleton District Hospitals and community hospitals at Denman and Scone. Muswellbrook Hospital has 42 acute beds and 18 nursing home beds. The hospital is currently operating at 60 per cent occupancy rate (pers. comm., 1997).

Muswellbrook Community Health Centre provides a range of both generalist and specialist services including treatment of physical and mental illness, social welfare, counselling, women's health, speech pathology, geriatric assessment and a school dental clinic. An early childhood health clinic is also attached to this centre. Current demands are met by the centre and it can accommodate increases in demand as well as additional services (pers. comm., 1997).

Family support, women's housing and other counselling services are provided in Muswellbrook.

Regional offices of the Department of Social Security and Commonwealth Employment Service are based in Muswellbrook.

iv. Leisure and Recreation Facilities

Leisure in rural areas is often centred around sporting organisations. A wide range of sporting and recreational facilities are provided in Muswellbrook. Sixteen public playing fields cater for a variety of organised sports including rugby league, rugby union, soccer, cricket, netball, softball and athletics. Indoor sports centres operate in Muswellbrook and Denman. There are swimming pools at both Muswellbrook and Denman. Squash, gym, aerobics and dancing are catered for by private facilities.

Council has identified existing demand for additional playing fields and the upgrading of Muswellbrook swimming pool (pers. comm., 1997).

Muswellbrook has four major clubs: the Workers Club, RSL Club, Golf Club and Bowling Club as well as other licensed premises. It also has a regional gallery, historical museum, arts/crafts groups, cultural groups and a regional library. There are bowling clubs located in Denman, Scone and Aberdeen. Scone also has a golf club.

10.2 PROFILE AND IMPACT OF CONSTRUCTION WORKFORCE

10.2.1 Profile and Size

Construction will occur over three distinct phases. The first approximately 16 months will involve construction of the coal preparation plant, handling facilities, rail loop and electric shovel No. 1, before the mine begins to operate in its permanent operational mode. The average construction workforce over this period will be 123 persons, peaking at 253 during the tenth month. The second phase will be the construction of the dragline, which will extend for 18 months about 2.5 years after the mine begins operating. Workforce estimates are provided in *Table 10.11* below. The third construction period will be for the second electric shovel, about 6 years after the mine begins.

Table 10.11 CONSTRUCTION EMPLOYMENT

Construction Phase	Commence (Project Month)*	Duration (months)	Average Workforce	Peak Workforce
1. Infrastructure	-14*	16	123	253
2. Dragline	31	18	60	83
3. Electric Shovel No. 2	70	9	16	21

*Note: * Project months are measured from commencement of regular coal production.*

The construction workforce will be largely skilled workers qualified as plant and machine operators and drivers, trades persons and some unskilled workers. Management, supervisory, professional and support staff will also be employed during these initial stages.

Contractors will carry out the construction work. The source of construction workforce will depend on which groups are successful tenderers for the project. The principal contractor is expected to be based in the Hunter Valley and hence the workforce will be drawn from construction industry employees who live in the region and commute daily to the mine site.

It is common for contractors to hire the unskilled labour from local sources. The local pool of unemployed persons is discussed in Section 8.4.2 with sufficient numbers available to supply the mine.

There is little recent research on the recruitment of a relatively large construction workforce. Experience of other new mines in the Hunter during the late 1980s indicated that approximately 80 per cent of the construction workforce was local and 20 per cent was imported (Mitchell McCotter, 1989). During the late 1970s and early 1980s there was a significant increase in construction work associated with mining and power generation. At that time a larger proportion of the construction workforce relocated temporarily to the Hunter.

It is not possible to precisely determine what proportion of the construction workforce will temporarily relocate. To assess potential social effects, two scenarios were considered. The first drew on the experience of new projects during the late 1980s (that is 80 per cent recruited locally and 20 per cent through in-migration). The second assumed that 50 per cent of workers could be recruited locally while the remaining 50 per cent would re-locate temporarily. *Table 10.12* summarises the origin of the peak construction workforce of 253 persons.

The company will actively encourage contracting companies involved in the construction stages to employ people from the local region.

Table 10.12 CONSTRUCTION WORKFORCE ORIGIN

		Local	Migrant
Scenario 1.	80:20	202	51
Scenario 2.	50:50	127	127

With other new mines in the Muswellbrook area (in particular Bengalla), it is possible that the construction workforce could be shared. That is, as a crew completes a job at one mine they could move on to the next. This would depend on the timing of different construction stages at each of the mines.

10.2.2 *Associated Population*

The short duration of the construction phase means that only a relatively small associated population is expected to accompany construction workers who in-migrate to the area.

Previous studies have shown that most construction workers are male, relatively young and are not married. In a survey of temporary residents in Muswellbrook in 1981, Graham and Collins (1981), showed that only 15 per cent of workers brought their partners or families.

It is anticipated that a similar situation would occur at Mount Pleasant Mine. Applying these proportions to the imported construction workforce, between 8 and 19 workers would move their families to Muswellbrook. This would result in a total temporary population increase of between 66 and 163 if an average family size of 2.9 persons (ABS, 1993) is assumed.

10.2.3 *Accommodation Requirements*

Based on the scenarios described above, between 51 and 127 workers will seek temporary accommodation during construction.

Muswellbrook, Scone, Denman, Aberdeen and Singleton are well served by a range of motels, hotels and caravan parks. Between September 1995 and September 1996 hotels and motels had an average occupancy rate of 57 per cent while caravan parks recorded an average occupancy rate of 50 per cent over the same period (ABS, 1996). There were some variations between towns, with Muswellbrook and Singleton generally having higher occupancy rates than Scone. Both towns had a peak occupancy rate of 69 per cent for the full week. Some rental accommodation is available, however it is limited. Accommodation requirements and availability are summarised in *Table 10.13* below.

Table 10.13 ACCOMMODATION REQUIREMENTS

	Migrants	Population Increase[1]	Accommodation Required[2]	Units Available[3]	Average Occupancy
Scenario 1	51	66	51	550	57%
Scenario 2	127	163	127	550	57%

Notes: 1 *assumes 15 % of workers bring partners/families and average family size is 2.9 persons.*
2 *assumes each worker will require one unit of accommodation*
3 *includes total number of hotel/motel rooms available in nearby towns, does not include caravan parks*

Given the number of workers seeking temporary accommodation, the availability of tourist accommodation and residential capacity showed by occupancy rates, it is expected that a construction camp would not be required for this development alone. A peak demand of 127 accommodation units is 23 per cent of the available motel rooms.

If other regional projects coincide, there may be a need for a construction camp. If this is the case, the company would use an existing construction camp at Ravensworth to reduce the potential load on the area's temporary accommodation.

10.2.4 Socio-economic Impacts

Construction of the mine would provide a number of benefits to the community, including: employment opportunities for local residents; increased patronage of local establishments, accommodation and shops by the construction workforce; and use of local materials and services. The start up capital cost of the project is estimated at $310 million. The majority of materials and equipment will be purchased and supplied from within Australia, with major pieces of equipment containing some components from overseas. The amount spent outside of Australia is small. It is estimated that $81 million would be spent in the Hunter region on materials and equipment.

10.3 PROFILE AND IMPACT OF OPERATIONAL WORKFORCE

10.3.1 Operational Workforce Characteristics

The project will be a major employer in the Muswellbrook area, requiring an average workforce of 320 during the 20 years of coal production. The workforce will peak at 380 during the thirteenth year. Workforce needs are discussed in Chapter Six.

The workforce will typically comprise management, supervisory, professional and support staff and skilled mine and maintenance technicians. The labour requirements are based on some use of contract labour. It is proposed that explosive supply and blasting, long term mine planning and geological studies will be contracted out. Major overhauls of mining equipment and at the coal preparation plant may also be contracted out. These are excluded from the operational workforce.

10.3.2 *Sources of Operational Labour*

Operational labour for this project will be drawn from three potential sources:

- those currently unemployed in the area;
- those currently employed in the area; and
- in-migration.

i. Local Unemployed

Estimates from the Department of Employment, Education and Training (DEET) indicate that 9.2 per cent of Muswellbrook's potential labour force were unemployed and actively seeking work in the March quarter of 1996. With the exception of Murrurundi (9.7 per cent), unemployment rates for surrounding Shires were slightly lower: Merriwa (7.1 per cent), Scone (6.7 per cent) and Singleton (7.0 per cent). These were below the State average of 8.5 per cent for the corresponding quarter.

The Commonwealth Employment Service at Muswellbrook expects that there will be sufficient workers available during the construction and operational phases of mine development. These would either be sourced from local labour who possess relevant skills or other workers who move to take up the positions. The company is an Equal Opportunity Employer and will be actively seeking to maximise employment of the operational work force from people in the local region. Suitable training or retraining courses through TAFE will be organised by Coal & Allied in conjunction with the Commonwealth Employment Service and other relevant organisations.

Recent mine closures in the Lower Hunter have created a pool of unemployed underground mine workers in the region. The United Mineworkers Federation of Australia has about 250 retrenched workers registered (pers. comm., 1997). Information on the distribution and skill level of these workers could not be released, however, workers were spread through the Hunter region. There are 98 unemployed mine staff in the Hunter region currently registered with the Australian Collieries Staff Association.

Suitable training or retraining courses coordinated by an organisation representing the mine and the DEET could give retrenched underground miners an opportunity to be retrained for open cut operations.

Joint Coal Board statistics for mines in the Singleton-North West District indicate that 5,803 workers were employed in June 1992, falling to 5,500 workers in June 1995. This represents a loss of 303 jobs in the three year period, some of which would have added to the pool of potentially unemployed miners in the region.

ii. Employed with Appropriate Skills

Labour turnover between mines in the Hunter region is generally high. The Mount Pleasant project is likely to be relatively attractive for people already employed in the area as it offers scope for long term employment security and possibly improved career prospects for others.

It is difficult to estimate the number of jobs that will be filled by this source. Using 1991 census data on occupation for the Muswellbrook LGA, a potential labour pool of those employed and possessing skills transferable to the mining sector has been calculated. There is an additional pool in neighbouring townships.

Table 10.14 EMPLOYED PERSONS WITH TRANSFERABLE SKILLS

Occupation	Persons
Managers and Administrators	717
Tradespersons	1,138
Plant and Machine Operators and Drivers	993
Labourers and related workers	1,123
TOTAL	**3,971**

Source: Australian Bureau of Statistics, 1991 Basic Community Profile

Not all the people highlighted in *Table 10.14* would have skills applicable or transferable to the mining industry. Nor would all be willing to change jobs, but nevertheless they represent a significant potential local labour source. Wage differences between coal mine employees and non-mine employees is an incentive to change jobs. However, the Bengalla and Bayswater projects may also compete for this labour.

iii. In-migration

A useful guide to the proportion of employees who would move to the region can be obtained from recruitment at other mines.

Gibbs and Wiggers (1982) in a study of mines near Singleton estimated that 62 per cent of labour for open-cut mines was obtained from within the region. The remainder was sourced from in-migration. The Drayton mine in Muswellbrook found that 80 per cent of its workforce was recruited locally. These findings are consistent with the experience of mines in the western coalfields.

It is assumed that for the Mount Pleasant project the ratio of local (80 per cent) to in-migrant (20 per cent) workers will be similar to the Drayton Mine and that most of the workforce will be people who either reside in the Upper Hunter or are willing to commute from elsewhere in the region, notably Branxton, Cessnock or Maitland. Improvements to the road network and car pooling makes commuting easier for mine employees.

The in-migrant workforce is likely to be largely managerial, professional and technical staff.

10.3.3 *Associated Population*

The Mount Pleasant project could increase the local population by 146 people and it is anticipated that this could be during the first eight years of the project while the workforce builds to peak levels. This estimate was based on the following assumptions:

- 20 per cent of the average mine workforce of 320 in-migrates from outside the region;
- two-thirds of the incoming workers are married; and
- an average family size of 2.9 persons, which was the average occupancy rate for the LGA in the 1991 census.

The demographic structure of in-migrants is likely to reflect a relatively young and mobile population.

10.3.4 *Housing and Accommodation*

Assuming an additional accommodation unit will be required for each employee migrating to the area, the mine will create a demand for approximately 64 dwellings. This demand is likely to affect both rental and permanent accommodation.

Experience with similar populations suggests that families will prefer detached housing. Single people also frequently seek detached housing but this group is more willing to accept unit or town house accommodation.

The in-migrant population is expected to concentrate in Muswellbrook and surrounds. Singleton, Scone, Aberdeen and Denman are alternative residential locations for new employees and their families. These towns are about 30 minutes travelling time from the mine. The residential choice will primarily depend upon the relative merits of each town when assessed against:

- travel times to the mine site;
- land availability and costs;
- housing availability and costs;
- the relative size of the towns, with Muswellbrook and Singleton providing a greater range of facilities and services; and
- the general amenity of the town.

Examination of the distribution of employees at Coal & Allied's other Hunter Valley mines indicates that 85 per cent of employees live within 40 kilometres of the mine.

The incoming population will be housed in either purchased dwellings or rental accommodation or in new residences built on vacant residential land. Temporary accommodation may be used as an interim measure while permanent dwellings are being secured.

10.3.5 *Community Facilities and Services*

The mine will increase demands on existing social infrastructure.

It is expected that the new population will be similar to the existing age structure of Muswellbrook and comprise a high proportion of children aged 0 to 9 years, youth aged 10 to 19 years and adults 20 to 49 years. These groups are likely to create additional demands for children's services, education, health, support and welfare services and recreation facilities.

Assuming that 9.8 per cent of the incoming population is aged from 0 to 4 years and using the standard provision for childcare of 1 place per 10 children aged 0 to 4 years, 1.4 childcare places would be required. This demand can be met by existing services.

The NSW Department of School Education advised that primary and secondary schools in the area have the capacity to absorb additional students. The development is not expected to adversely affect educational facilities in Muswellbrook.

The area is well serviced by health and welfare facilities. Muswellbrook Hospital has adequate facilities to meet additional demands from the population associated with the project.

There may be an increased need for support services as a result of the development. This could be generated from the incoming population, who may be separated from friends and family, as well as owners and residents relocated from the mining area. Re-location can be stressful for residents, especially if they have lived in their houses for a long period before the move. Assistance could help the affected community adjust to new circumstances.

Most sporting and recreational demands are expected to be catered for by the existing range of sporting and recreational facilities provided in the area. The incoming population will add to existing demand for recreational facilities including playing fields and heating of Muswellbrook swimming pool.

10.3.6 *Economic Impacts*

The operational phase of the project will deliver significant economic benefits to the region, the State and Australia through employment, income and output.

These direct benefits will generate additional economic activity in other sectors. For example, the mine will purchase goods and services from businesses in the region and wages spent by workers and their families will add to the local economy. These flow-on effects can be measured through economic multipliers.

An employment multiplier estimates the total jobs that may be generated by a project. This includes employment generated directly by the development and jobs generated indirectly in linked or ancillary activities such as input supply and transport. Employment opportunities may also be created from the monetary expenditures in the community or region by those directly employed at the mine.

An income multiplier quantifies the total regional effect on income of an initial increase in income. This includes the wages and salaries of those employed at the mine.

An output multiplier determines the total output effect within a region from the sale of coal from the mine.

These three types of multipliers are applied in *Table 10.15*. Multipliers were derived from the Hunter Valley Research Foundation based on their input-output model for multiplier effects in the Hunter region.

Table 10.15 MULTIPLIERS ON THE REGIONAL ECONOMY

	Direct Benefit	2A Multiplier[1]	Flow-on Effect	Total Benefit
Employment[2] (persons)	320	2.65	528	848
Income[2] ($M)	24.6	1.66	16.2	40.8
Output[2] ($M)	340	1.86	292	632

Note: 1. *Multipliers include direct, indirect and induced effects*
2. *Average annual figures*

As a result of the 320 jobs created directly at the mine, a further 528 jobs may be created in the region, leading to 848 new employment opportunities as a result of the mine. These are most likely to be in related industries such as transport, plant and equipment hire and maintenance.

It has been estimated that wages and salaries paid to the average number of employees at the mine will be around $24.6 million per year. With an income multiplier of 1.66 the flow on effect to the regional economy is expected to be $16.2 million, a total input to the region of $40.8 million.

At peak production Mount Pleasant Mine will have an estimated value of production of $340 million per year, generating a further $292 million in associated output.

In addition to these favourable employment, income and output impacts, the construction and operation of Mount Pleasant Mine will have a significant beneficial effect on revenue to the public sector. These benefits will follow from the employment generated by the mine and from the production and transport of coal. They will include the following:

❖ Federal Government

The Federal government will receive revenue from company tax, excise on imported equipment and goods and other taxes such as sales tax, income tax and fuel excises.

❖ State Government

The State Government will receive additional revenue from various taxes, royalties and payments for services provided by statutory bodies. These include rail freight for transporting coal to the port of Newcastle and port charges. Payroll tax is also levied on the wages of direct employees of the mine and on those jobs created by the mine development.

❖ Local Government

Financial returns to Local Government could result from rates and charges paid by Coal & Allied plus increases in rate revenue from direct employees and others attracted to the area from elsewhere in Australia.

10.3.7 *Social Impacts*

The mine will generate employment and revenue for the region and State. This will in turn help foster community growth and strengthen the provision of services. The mining industry has made a major contribution to the social and economic infrastructure of the Upper Hunter.

Mining employs 15.1 per cent of Muswellbrook's population compared to the New South Wales average of 1.0 per cent and the percentage of high income earners is substantially greater than both the Hunter region and State averages. These figures emphasise the higher incomes associated with the mining industry compared to other local industries and the importance of mining to the social structure of the area.

Residents living within and immediately surrounding the site will experience some disruption as a result of the proposal. Land within the site and in zones of affectation will be purchased at a price based on market value so that residents will be able to relocate without economic loss. Others living near the mine but outside the property acquisition area will be protected against reduced residential amenity during the operation of the mine by the environmental safeguards detailed in this EIS.

The effect of the project on surrounding land values is difficult to quantify because of the number of variables which may modify the value of land at a particular time and location. Measures to safeguard the visual amenity have been incorporated into the proposal to protect sensitive locations as well as the regional landscape. The displacement of residents from within the site and zone of affectation combined with the in-migration of mine employees will increase the demand for housing and rental accommodation in Muswellbrook and surrounding areas. An increase in demand may result in a slight increase in property values.

Properties purchased by Coal & Allied within the site and zone of affectation that are not directly affected by mining activities will be available for continued agricultural use. This will include areas within the zone of affectation which will not be disturbed by mining activities, as well as areas disturbed during various stages of mining operations which have been rehabilitated.

10.3.8 *Cumulative Impacts*

Assessment of the Mount Pleasant project must also be considered in the context of other developments in the area. Potential impacts from each development may be more significant if they are combined.

Table 10.16 summarises key statistics and estimated impacts of proposed and recently approved mine projects in the area including Bengalla, Bayswater and Kayuga. Data were obtained from relevant EISs. Whilst all reports state that the majority of positions will be filled by local and regional labour, sources from further afield may be required to fill positions if programming leads to competing labour demands. This will have the effect of increasing in-migration. Another mine is also proposed for Mount Arthur North located to the south of the Muswellbrook township. Production details for this mine are not currently available.

Table 10.16 CUMULATIVE IMPACTS OF CURRENT COAL MINE PROPOSALS

	Mount Pleasant	Bengalla	Bayswater	Kayuga
Location in relation to Muswellbrook GPO	3km west	3.6km west	12km south	10km northwest
Type of mining operation	Open cut	Open cut	Open cut	Open cut
Capacity per annum (ROM coal)	10.5 mt	7.0 mt	3.0 - 3.8 mt	2.0-2.3 mt
Commencement of coal production	To be determined	1999	1995	1999
Length of Construction period	16 months	2 years	n/a	12 months
Size of construction workforce	253 (peak)	310	n/a	80
Associated population	66 - 163	n/a	n/a	n/a
Accommodation requirements	51 - 127 units	n/a	n/a	n/a
Avg size of operational workforce	320	300	318 (peak)	70 - 100
Associated population	146	80	n/a	25(1) - 35(2)
Accommodation requirements	64 dwellings	20	n/a	> 15
Annual wages and salaries	$24.6 M	$25 M	$22M	$5.2 - $8.9M
Annual value of production	$340M	$296M	$199M	$75M
Total employment impact	848	594	n/a	140 - 208(1) 200 - 298(2)
Total income impact	$40.8M	$42M	n/a	$9.5(1) - $16.3M(3)
Total output impact	$632M	$462M	n/a	n/a

Source: *Department of Mineral Resources (1995)*
Resource Planning (1993)
Envirosciences (1993)
Rust PPK (1997) (1) Years 1-7 (2) Years 8-17 (3) Years 18-21

Note: *n/a* *Information not provided in the EIS*
mt *million tonnes*

It is anticipated that these four mines will directly employ over 1,000 workers and generate $80.1 million in wages and salaries and more than $900 million in output. Additional employment and income will be generated in other sectors within the Hunter region economy. The total impact of Mount Pleasant and Bengalla mines is estimated at 1,442 jobs, $82.8 million in income and $1,094 million in output over the life of the current proposed operations.

Mount Pleasant and Bengalla will have combined operational workforces of around 600. Variations in the associated population and accommodation requirements for these projects are due to differences in assumptions used in terms of proportion of the workforce who will in-migrate to the area, residential location of these workers, the proportion of workers who are married and occupancy rates (number of person per dwelling).

This study has assumed that 20 per cent of the workforce will be sourced from outside the area with the majority taking up residence in Muswellbrook LGA. These assumptions are based on the experience of other mines and an examination of employee distribution patterns for Coal & Allied's other operations in the Hunter Valley. Two thirds of these workers are assumed to be married and the occupancy rate of 2.9 persons per dwellings (obtained from the 1991 census) has been adopted.

The Bengalla study has assumed that 12 per cent of the workforce will move from areas outside of the region, with 57 per cent workers taking up residence in Muswellbrook and the remainder in Singleton and Scone. All workers were assumed to be married and households comprised two adults and two children.

The annual value of production for Mount Pleasant is based on 72 per cent recovery of product coal from ROM coal production.

Different multipliers have been used in the EISs to derive total impacts. This study has utilised multipliers available from the Hunter Valley Research Foundation (1997) based on their input-output model for multiplier effects for the coal industry in the Hunter region. Multipliers used for Mount Pleasant are given in *Table 10.15*.

Potential cumulative impacts are summarised below:

- an increased demand for rental accommodation and housing;
- an increased demand on community facilities;
- substantial increases in direct employment, income and output and significant flow-on effects for the Upper Hunter and Hunter regions; and
- stable economic base fostering community growth, development and provision of expanded services.

10.3.9 Mitigation Measures

The following mitigation measures are proposed:

- ongoing consultation with local residents during the construction and operation of the mine and implementation of effective complaints handling procedures;
- liaison with CES and others regarding training needs and measures that can be implemented to assist youth unemployment and increasing the skill base such as study scholarships and grants;
- liaison with Muswellbrook TAFE to provide mine related, administration and environmental courses;
- monitoring of demand for temporary accommodation and need for a construction camp;
- monitoring in conjunction with Muswellbrook Shire Council to assess demands on community services and formulation of community development programs if required.

10.4 ABORIGINAL HERITAGE

10.4.1 *Archaeological Investigations*

Archaeological investigations have been undertaken in a number of stages over the mine Authorisation area, out-of-pit emplacements and adjoining fines emplacement area. In addition, a small portion of the proposed rail link on the Bengalla mine site which was not subject to previous archaeological survey was examined.

Survey of the project site was undertaken by Rich (1995). A full copy of the archaeological report is included as Supplementary Report 5. The report described the environment and previous land use in the area, previous archaeological investigations, survey strategy and results and made recommendations for the management of Aboriginal sites located within the Authorisation.

Additional survey of the proposed north-west out of pit emplacement to the north of Mount Pleasant was undertaken by ERM Mitchell McCotter in 1995. The addendum report (ERM Mitchell McCotter, 1996) forms a supplementary report to Rich (1995). The north-west out of pit emplacement area forms part of the coal Authorisation area covered by Rich's (1995) original report and subsequent amendments to this resulting from changes to the mine plan.

Further archaeological survey was undertaken to the west of the mine Authorisation area where the proposed fines emplacements are situated (ERM Mitchell McCotter, 1997). A small section of the proposed rail loop which was not investigated as part of the Bengalla Mine approval was also inspected. The purpose of the archaeological investigations was to record items of Aboriginal heritage, identify impacts to sites and items and to provide management recommendations and safeguards to protect sites of archaeological significance.

10.4.2 *Findings*

A total of 327 artefact locations or sites consisting of 1,408 artefacts were recorded by Rich (1995) as shown on *Figure 36*. The majority of artefact locations were single isolated finds, followed by sites with two to three artefacts and sites with more than ten artefacts. Rich (1995) stated that artefact identification was somewhat constrained by the extent of ground exposures with sufficient visibility to locate artefacts. Artefact density along gullies tended to be higher than on hillslopes and ridges. Silcrete appeared to be the main artefact material.

Investigations in the mine Authorisation area and north west out of pit emplacement area indicate that in general, the Mount Pleasant Authorisation does not contain a substantial archaeological resource (Rich, 1995; ERM Mitchell McCotter, 1996). Rich (1995: 6) states that "compared to some other parts of the Hunter lowlands, the Mount Pleasant site appears to have a fairly sparse archaeological record" which is consistent with artefact assemblages reported for the Bengalla site to the south. Most of the Authorisation comprises the upper and middle catchments of drainage lines containing sparse archaeological material. However, Rich (1995: 29-30) states that the results should be regarded "as general indications, rather than as conclusive statements regarding the archaeology of the lease". It should be noted that the reference to the lease refers to the Authorisation area.

The eastern part of the Authorisation bordering the Hunter River flats has been largely disturbed by previous land uses, effectively limiting the potential of the area to provide archaeological information. Areas of relatively less disturbance lie within the upper and middle reaches of catchments towards the western part of the Authorisation, and smaller areas in the lower reaches of catchments in the north/north-west.

Field investigations of the north-west out of pit emplacement area identified 24 artefact locations with a total of 79 artefacts (ERM Mitchell McCotter, 1996). Most locations contained two to four artefacts, followed by isolated artefacts, then sites with five to ten artefacts and one site with more than ten artefacts. Sites were located on ridge tops, hillslopes and along drainage lines and gullies. Site distribution was comparable to the pattern identified by Rich (1995) over the remainder of the Authorisation.

Investigations of the proposed fines emplacement area west of the Authorisation located 90 sites (see *Figure 36)*, most of which were stone artefact scatters or isolated artefacts, with a total of 3,952 artefacts. The northern catchment contained 47 sites with 3,227 artefacts recorded in the sites. There were 43 sites with a total of 725 artefacts recorded in the southern catchment which is a provisional fines emplacement area. Sites recorded also included a number of scarred and possible scarred trees were found throughout the catchments.

The majority of artefact scatters recorded in the fines emplacement area contained one to three artefacts, followed by sites with four to ten artefacts, then sites with 11 to 50 artefacts. A small number of sites contained 50 to 150 artefacts. Artefact numbers within sites was similar to the pattern identified by Rich (1995) for the remainder of the Authorisation. The majority of finds were situated along gullies and drainage lines, however, artefacts were also identified on slopes and ridges.

A large concentration of artefacts (site 44) was recorded in the northern catchment (near the west border) of the fines emplacement area. There were 2,551 artefacts recorded on both sides of the creekline at its junction with the minor drainage line to the north of the Broomfield homestead. Artefacts were located in exposures along the minor drainage line and adjacent vehicle track, with a large, dense concentration at the creekline. Although large numbers of artefacts were recorded in this area, further unrecorded surface and subsurface artefacts are anticipated.

The large concentration of artefacts appears unique in a local and possibly regional context given the artefact numbers recorded over the remainder of the Mount Pleasant Authorisation and Bengalla Mine site as documented by Rich (1995). The largest site in terms of artefact numbers previously recorded in the Mount Pleasant Authorisation contained 63 artefacts and was situated at the confluence of two catchments in the north of the site (Rich, 1995).

Investigation of a portion of the proposed rail link to the south of the site identified one open camp site on a hillslope comprising nine artefacts.

10.4.3 Impacts

The proposal will impact most of the recorded artefact locations in the Authorisation. Sites which will not be impacted by proposed works are not considered representative of the affected artefact locations (Rich, 1995). Most sites recorded in the north west out of pit emplacement area will be affected by the proposed development from Year 10 (ERM Mitchell McCotter, 1996, 1997). Some of the sites recorded as part of the survey of the north-west out of pit emplacement were situated outside the site and will not be affected by proposed works.

A number of archaeological sites will be impacted by the proposed development of the fines emplacement areas. Impacts will be greatest in the northern catchment due to the progressive construction of fines emplacement and environmental dams from the upper catchment from east to west. A number of sites within the northern catchment and the provisional southern catchment will not be impacted by proposed operations. Additional sites will require further assessment to determine the impact of the development.

The establishment of an environmental dam in the westernmost part of the northern catchment will affect the largest concentration of archaeological deposits. The construction of the dam will not take place until Year 10.

The southern catchment is a provisional fines emplacement in case greater quantities of fine rejects are generated than currently anticipated. As such, it is unlikely that this area will be disturbed within this development consent. One recorded site in the southern catchment contained a number of petrified wood artefacts which will not be impacted by the proposed works.

10.4.4 Management Recommendations and Safeguards

Rich (1995: 7) states that "surface survey within the Authorisation provided an indication of the nature and range of archaeological material; enabled identification of potentially sensitive areas; and also enabled identification of areas which were too disturbed to warrant further consideration. Test excavation for the EIS stage is not necessary. However, some sensitive areas within the Authorisation do warrant additional archaeological work prior to development impact". Further archaeological investigations were recommended in the form of a salvage project (Rich, 1995). Conservation measures for other areas were detailed in the recommendations.

Rich (1995) recommended that salvage, particularly of less disturbed areas of archaeological potential, should be carried out prior to the proposed development proceeding. Archaeological salvage should be conducted to recover information able to contribute to an understanding of the landscape context of artefact assemblages, including site function, as well as technological issues of regional concern. An approach for salvage work was recommended by Rich (1995: 50-51). Salvage excavation and collection should be completed in those areas identified by Rich (1995) prior to the commencement of mining activity.

Formal recommendations were given by Rich (1995:54). However, the findings of the archaeological survey were presented as four summary measures which should be adopted to mitigate against impact. The recommendations were:

- the development, dam construction or other works should be designed so as to avoid impact on Aboriginal sites and particularly avoid works within less disturbed areas as identified by Rich (1995);

- a plan of management should be prepared to ensure the protection of sites and areas within the lease which would not be destroyed by the proposed development;

- sites or areas adjacent to works should be protected, for example by fencing, to ensure that they are not accidentally damaged or destroyed during construction or operation of the mine; and
- an archaeological salvage program should be implemented to recover material and information from sensitive areas which would be affected by the development.

The north-west out of pit emplacement area was considered of low archaeological significance relative to other archaeological resources in the region, particularly resources recorded in the remainder of the Authorisation area (ERM Mitchell McCotter, 1996). There were no constraints imposed upon the development.

A number of measures may be adopted to limit the potential impact of the development on the archaeological resource of the fines emplacement area. These measures are consistent with those outlined by Rich (1995) for the remainder of the site. Sites adjacent to works should be protected from inadvertent damage and a management program prepared, in consultation with the local Aboriginal community. This should outline measures for protecting sites and areas which will not be affected by the proposal.

The most significant location is the large concentration of artefacts (site 44) within the proposed environmental dam area. This location will not be affected until Year 10 of operations. Therefore, continued consultation with the Wanaruah Local Aboriginal Land Council and Wonnarua Tribal Council Incorporated during this period should determine appropriate options for managing this area or further works in the ten year period prior to proposed operations.

Under section 90 of the *National Parks and Wildlife Act 1974*, it is an offence to knowingly deface, damage or destroy an Aboriginal relic or place without first obtaining written consent from the Director-General of the National Parks and Wildlife Service. Permits may be obtained to allow the destruction of a site. Consent to destroy known artefacts which would be affected must be obtained from the National Parks and Wildlife Service prior to the commencement of operations.

10.4.5 Aboriginal Consultation

Consultation with the local Aboriginal community has been undertaken throughout the archaeological investigations. A representative of the Wanaruah Local Aboriginal Land Council participated in the initial survey of the Authorisation (Rich, 1995). Following the survey the Wanaruah Local Aboriginal Land Council had a change of personnel and Wonnarua Tribal Council Incorporated was established. The survey of the north-west emplacement was undertaken at a time when the Land Council did not retain a sites officer and the Tribal Council was not yet established. A subsequent on-site inspection of the Authorisation was carried out by Rich in July 1996 with representatives of both groups. This provided an overview of the nature of the archaeological resource over the Authorisation. Reports outlining the views of the Land Council and Tribal Council regarding the Authorisation area were included in the archaeological report (Rich, 1995). Consultation is continuing regarding changes under the amended mine plan which may affect Aboriginal archaeological sites.

Recent investigations of the fines emplacement area were undertaken in consultation with the Wanaruah Local Aboriginal Land Council and Wonnarua Tribal Council Incorporated. Representatives from both groups were involved during all field investigations. Regular discussions were held on-site during the investigations regarding the conduct of the fieldwork, survey results and potential impacts. This allowed formulation of management recommendations to incorporate views from both Land Council and Tribal Council representatives.

Formal views of the Tribal Council and Land Council regarding the fines emplacement area had not been submitted at the time of preparing the EIS. Consultation will continue to determine the Aboriginal significance of this area to the local Aboriginal community.

The views of the Aboriginal community will be sought by the National Parks and Wildlife Service when reviewing the recommendations of the archaeological reports.

10.5 AUSTRALIAN HERITAGE

As one of the longest settled regions in Australia, the Hunter region is considered to have a unique variety of structures, buildings, towns and landscapes worthy of conservation status. The Hunter REP (DoP, 1989) contains details of heritage items considered to be of State or regional significance. It provides legally binding controls against major alteration or demolition of such items, without public evaluation and consent.

The plan seeks to conserve the environmental heritage of the region, promote the appreciation and understanding of the region's heritage and to encourage conservation. It lists four schedules of heritage significance:

- items of State significance (Schedule 1);
- items of regional significance (Schedule 2);
- items of local significance (Schedule 3); and
- items requiring further investigation (Schedule 4).

Items of State significance are considered to be of exceptional interest, as forming part of the State's heritage. The plan includes about 90 such items, but none fall within the Shire of Muswellbrook.

Items of regional significance are identified as excellent examples of a type or style which are generally representative of community life during the development of the region. Several such items fall within the Shire of Muswellbrook, but none of these are located within the proposal site.

Seven items listed within Schedule 2 are located within four or five kilometres of the site as shown on *Figure 36*. These are listed in *Table 10.17* along with local items and those requiring further investigation (Schedules 3 and 4).

Items of local significance are considered to have a special quality and interest to the local area and contribute individually or as part of a group to the environmental heritage and character of an area. Several items of this description are listed within Schedule 3 as being located within Muswellbrook Shire although, none are located on the proposed site.

Clause 13 of the REP relates to development proposals in the vicinity of a heritage item. This states that Council shall not grant consent to development in the vicinity of a heritage item unless;

> *"it has made an assessment of the effect the carrying out of that development will have on the heritage significance of the item and its setting."*

It should be noted that this Clause does not apply to an item listed within Schedule 4 (items requiring further investigation).

In addition to the specific heritage items listed, the site borders the Muswellbrook-Jerrys Plains Conservation Area to the south-east. This has been listed in the National Trust Register for its aesthetic and social contributions to the region. No specific provisions for development within or adjoining a conservation area are set out in the REP. The conservation area is discussed further in Chapter Thirteen.

Table 10.17 SIGNIFICANCE OF HERITAGE ITEMS

Regional Significance (Schedule 2)
Keys Family Cemetery, *Bengalla Road*
Old Kayuga Cemetery, *Kayuga Road*
Muswellbrook Bridge, *Kayuga Road*
Negoa Homestead, *Kayuga Road*
Balmoral, *Denman Road*
Edinglassie, *Denman Road*
Rouse-Lench, *Denman Road*
Local Significance (Schedule 3)
Overdene, *Bengalla Road*
Items Requiring Further Investigation (Schedule 4)
Kayuga Homestead, *Kayuga Road*
Bengalla, *Bengalla Road*
Rosedale Cottage, *Kayuga Road*
Conservation Area
Muswellbrook-Jerrys Plains Conservation Area

Those items listed in Schedule 4 (items requiring further investigation) are currently being considered as part of the Muswellbrook Heritage Study being prepared for Muswellbrook Shire Council. None of these are located within the boundaries of the proposal site. These may be recommended for inclusion in other schedules of the Hunter REP.

10.5.1 *Impacts*

Whilst there are no heritage items located on the site there are a number surrounding the Authorisation. Potential impacts on heritage items are primarily related to vibration from blasting and increased dust levels. Buildings assessed and the predicted maximum vibration levels are listed in *Table 10.18*.

Table 10.18 HERITAGE ITEMS AFFECTED BY BLASTING

Heritage Listed Sites	Predicted Maximum Vibration Level (millimetres per second)
Rosedale Cottage, Kayuga	2.40
Negoa Homestead	1.85
Old cemetery, Kayuga	1.87
Kayuga 1827 homestead	1.78
Bengalla homestead	1.23
Overdene homestead	2.44

Bengalla and Overdene homesteads have been purchased by the Bengalla Mining Company who have undertaken to protect these buildings from mine related impacts. An additional 0.5 to 1.5 $g/m^2/month$ dust deposition at these buildings will result from the Mount Pleasant Mine. No other heritage items will be affected by dust deposition in excess of the relevant air quality criteria.

Rosedale Cottage is the only other building with a predicted vibration level above 2 mm/s. The predicted maximum vibration level at 2.4 mm/s occurs in Year 5. If with refinement of blasting operations during the initial years of mining, levels are predicted to remain above 2 mm/s, Coal & Allied will undertake to protect this building through implementation of the safeguards outlined below.

The Negoa homestead is within the zone affected by adverse noise levels and will be subject to an offer to purchase or installation of noise mitigation measures. Coal & Allied will undertake to protect this building, if required, through the installation of additional management safeguards as outlined below.

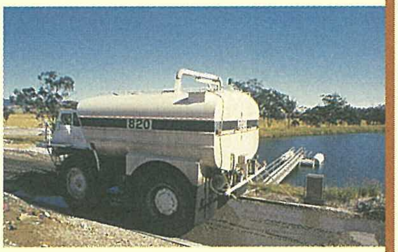
10.5.2 *Management Safeguards*

Management safeguards that will be used to protect heritage items, subject to the owner's permission, include :

- surveying buildings to assess their condition and ability to withstand expected maximum levels of vibration and overpressure;
- subject to the above, temporary reinforcement of buildings to minimise damage induced by blasting;
- regular monitoring, and
- restoration of damage once impacts are within accepted standards.

AIR QUALITY

11



This chapter examines the project's effects on local air quality. Computer modelling results for dust deposition and concentration are presented. Potential effects on local agriculture and human health are discussed. Greenhouse gas emissions are also identified.

11.1 DESCRIPTION OF INVESTIGATIONS

Open-cut coal mines generate dust and therefore influence surrounding air quality. Dust generating activities include construction of access roads, vegetation clearing, drilling, blasting and hauling coal and rock overburden shaping and rehabilitation. Five studies were undertaken to investigate the potential for the proposal to influence local air quality:

- monitoring of existing air quality over the period 1993 to 1996;
- dust generation and dispersion modelling. This study was undertaken by P. Zib & Associates Pty Ltd (1997);
- an examination of dust impacts on human health by Douglas Consulting Pty Ltd (1997);
- an examination of the impact of increased dust deposition on grazing animals by N.J. Kannegieter (1995); and
- a report on the effects of dust deposition on plant growth by L.C. Campbell (1995) of the University of Sydney.

The latter four studies are included as Supplementary Reports 6, 9, 8 and 7. A discussion of the monitoring results is presented in the report by P. Zib & Associates Pty Ltd. This section of the EIS summarises the four studies.

11.2 ASSESSMENT CRITERIA

11.2.1 Dust Deposition

Assessment criteria for dust deposition developed by the Environment Protection Authority are given in *Table 11.1*. Criteria are based upon maximum acceptable increases above existing levels. The acceptable increase varies according to existing deposition level and land use. For example, in residential areas with existing annual average deposition levels below 2 g/m^2/month, an increase of up to 2 g/m^2/month would be permitted before it is considered that a significant degradation of amenity due to air quality had occurred.

Table 11.1 ASSESSMENT CRITERIA FOR DUST DEPOSITION

Existing Deposition Level (g/m^2/month)*	Maximum Acceptable Increase (g/m^2/month annual average)	
	Residential/Suburban Land Use	Other Land Use(1)
up to 2	2	2
2 - 3	1	2
3 - 4	0	1

Note * *grams per square metre per month, annual average.*
(1) Rural, semi-rural, urban commercial and industrial land use.

11.2.2 *Dust Concentration*

Dust concentration is assessed differently from deposition as it is necessary to make reference to criteria for both long term (annual averages) and short term (24 hour) periods. Two sizes of dust are also considered: total suspended particulate matter (TSP) which are particles sized less than 50 micrometres (μm); and particles less than 10μm (PM_{10}). TSP concentration measurements therefore include PM_{10} particles.

PM_{10} particle concentrations are of interest because they can reach the lower parts of the respiratory system and may involve health as well as nuisance effects. Most PM_{10} particles result from combustion processes in motor vehicles, bushfires and industrial processes. Some PM_{10} particles are generated by evaporation of sea spray and from vegetation. Most mining dust is composed of coarser particles with a potential to cause nuisance effects rather than health effects.

The assessment criteria adopted were:

- *short-term.* A 24 hour standard of 260 and 150 micrograms per cubic metre ($\mu g/m^3$) for TSP and PM_{10} particles respectively. These levels should not be exceeded more than once per year; and
- *long-term.* A maximum annual average TSP level of 90 $\mu g/m^3$ and a maximum annual average PM_{10} level of 50 $\mu g/m^3$.

A secondary TSP standard of 150 $\mu g/m^3$ over 24 hours has been used by the USEPA to protect against nuisance dust. The NSW EPA has adopted the standard of 260 $\mu g/m^3$ as its objective but not the secondary standard of 150 $\mu g/m^3$.

11.3 EXISTING AIR QUALITY

Existing atmospheric dust levels at Muswellbrook are generated by a variety of sources including plant pollen, farming activities such as ploughing, wind erosion from bare surfaces, traffic on dirt roads and coal mining and power generation. Domestic wood or coal fires also add to the particulate matter in the air. Coal & Allied established a monitoring program in 1992 to determine the existing, or background, dust levels.

A network of 14 dust deposition gauges was used to determine monthly rates of dustfall at various locations in the project area. The mean deposition rates at each of the 14 sampling sites are summarised in *Table 11.2* and the 14 monitoring locations are shown on *Figure 32*.

Mean annual rates of dust deposition were consistently less than 2.0 $g/m^2/month$. The exceptions were site D4 (Grid Reference K10) near Kayuga with 2.7 $g/m^2/month$ in 1994 and site D3 (Grid Reference K12) near Muswellbrook which recorded an annual mean of 2.1 $g/m^2/month$ in 1994. The average of all sites over each year was 1.2 $g/m^2/month$ in 1993, 1.3 $g/m^2/month$ in 1994 and 1.1 and 1.0 $g/m^2/month$ in 1995 and 1996 respectively.

Monitoring of TSP and PM_{10} was undertaken at the same time at seven monitoring sites marked HV1 to HV6 and HV8 in *Figure 32*. Mean values calculated from measurements over 24 hours, every sixth day, are summarised in *Table 11.3*.

Values measured over periods of 24 hours ranged from a peak of 46 $\mu g/m^3$ at site HV1 (Grid Reference I9) to peaks of 121 $\mu g/m^3$ at HV6 (Grid Reference H10) and 136 $\mu g/m^3$ at HV8 (Grid Reference L13) in 1993. In 1994 the highest 24 hour values ranged from 63 $\mu g/m^3$ at site HV1 to 200 $\mu g/m^3$ at HV2 (Grid Reference F13) and 220 $\mu g/m^3$ at HV8. Drought conditions during 1994 were the most likely reason for a rise in the concentrations recorded in 1994.

Dust concentration values determined as geometric means from dust concentrations measured over periods of 24 hours, ranged from 20 to 42 $\mu g/m^3$ in 1993 and 28 to 52 $\mu g/m^3$ in 1994. The consistently higher mean concentrations recorded in 1994 were most likely due to dry weather conditions throughout much of the year.

Table 11.2 MEAN ANNUAL DUST DEPOSITION ($g/m^2/month$*)

Site	Deposition Rate				Total Number of Measurements
	1993	1994	1995	1996	
D1	0.6	0.6	0.7	0.5	45
D2	1.4	1.5	1.5	1.3	45
D3	2.0	2.1	2.0	1.2	45
D4	1.5	2.7	1.6	1.0	40
D5	1.4	1.3	1.1	1.6	42
D6	1.1	1.3	1.2	0.9	44
D7	1.4	1.0	1.1	1.1	43
D8	1.5	0.8	1.1	1.0	40
D9	0.8	0.8	0.7	0.4	43
D10	1.1	1.5	0.7	1.2	41
D11	1.5	1.0	1.0	1.2	41
D12	0.5	0.5	0.5	0.6	45
D13	0.8	1.4	1.2	0.9	43
D14	1.3	1.7	1.4	1.2	44
Average	1.2	1.3	1.1	1.0	

Note: * *grams per square metre per month.*

Table 11.3 MEAN ANNUAL DUST CONCENTRATION

Site	Concentration (μg/m³)*		Number of Measurements	
	1993	1994	1993	1994
HV 1	20.4	28.0	10	16
HV 2	37.4	48.7	7	13
HV 3	33.7	40.8	11	22
HV 4	21.7	38.5	15	19
HV 5	30.0	43.5	15	12
HV 6	38.2	40.2	13	14
HV 8	42.4	51.7	30	11

Notes: * *micrograms per cubic metre.*

A total of 21 samples of PM_{10} were collected during monitoring intervals in 1993 and 1994. Nineteen of the 21 samples collected had 24 hour concentrations of PM_{10} ranging from 8 to 33 μg/m³. Two samples collected in early October 1994, at the peak of drought, recorded 24 hour concentrations of 70 μg/m³ (site HV1 within the site) and 76 μg/m³ (site HV6 near the eastern boundary of the site).

Results of PM_{10} monitoring supported the view that the existing ratio of TSP particles in the air in proximity to the site is within a range of 40 to 60 per cent (Envirosciences, 1993).

11.4 IMPACT ASSESSMENT

11.4.1 Computer Model

A computer model was developed to provide estimates of the project's influence on dust deposition and concentration. Technical aspects of the model are discussed in Supplementary Report 6. The model has been validated by comparing modelled results with actual deposition levels from an existing mine. The validation indicates that the model predictions are conservative.

Base modelling information included details of mining operations and the generation and dispersion of dust particles from mining. Dust particles will be generated by a number of operating equipment and range in size from minute particles to much heavier particles which settle rapidly.

Particles remaining in the air will be carried by wind and dispersed. The particle's weight and shape causes their distance of deposition to vary under continuously changing atmospheric conditions.

Key inputs to the model are meteorological conditions, details of the mining activity and the characteristics of the dust generated.

i. Meteorological Data

A meteorological station was established on site as part of the monitoring program. The station was located north of Castlerock Road approximately one kilometre west of Kayuga Road as shown on *Figure 32*. Data from the 24 month period between December 1994 and November 1996 were used in the air quality modelling. Annual wind roses are shown on *Figure 37*. Prevailing winds occur along a north-west to south-east axis. Generally south-east winds dominant in summer while in winter winds from the west and north dominate.

A second meteorological station was established near the south-east corner of the site. The aim of the second station was to account for any differences in meteorological conditions between the flatter areas of the Hunter River floodplain and the more elevated terrain of the site represented by the permanent station.

Data from the stations confirm the north-west to south-east axis of the prevailing winds. Variations between the stations indicated that the land nearer the Hunter River experienced generally lower wind strengths. The site adjacent to the floodplain also tended to experience north to north-easterly air flow at night while the more elevated station recorded winds from the north-west and north-north-west.

These differences indicate that the area between the site and Muswellbrook experiences less frequent strong north-westerlies than the site. The computer model uses the data from the higher station resulting in conservative dust deposition predictions for areas east and south-east of the site.

ii. Mine Planning

Five representative years of mining operations were modelled. Selected years of coal production were 2, 5, 10, 15 and 20 which are described in Chapter Six of the EIS.

Detailed emission inventories of atmospheric dust were prepared for each year using a range of dust emission factors for individual types of mining activities. Emission factors where based on values determined experimentally at coal mines in the Hunter Valley. Emission factors for other mining activities for which Hunter Valley data has not been determined were adopted from published results. Resulting dust emission rates were divided into three particle size categories corresponding to fine (0 to 2.5 microns), inhalable (2.5 to 15 microns) and coarse dust (15 to 30 microns). The inventories are contained in Supplementary Report 6 while *Table 11.4* summarises the annual dust emissions.

Table 11.4 DUST EMISSION SUMMARY

Year	Annual Emission of Dust (tonnes)	Mine Quantities		Dust: coal ratio (kg/tonne)*
		ROM coal (Mtyr)	Rock (Mm^3/yr)	
Year 2	6,361.5	5.25	19.0	1.21
Year 5	6,916.9	8.5	36.2	0.82
Year 10	11,405.0	10.5	50.6	1.09
Year 15	11,333.5	10.5	49.2	1.08
Year 20	10,674.1	10.5	45.6	1.02

*Notes: * Mtyr = million tonnes per year, Mm^3/yr = million cubic metres per year, kg/tonne = kilograms of dust per tonne of ROM coal.*

A breakdown of dust generated by each major mining operation is given in *Table 11.5* for Year 10 of coal production. Emissions of atmospheric dust will peak in Year 10 due to the need to remove larger quantities of rock than in other years. About 80.8 per cent of the dust is generated by activities associated with the removal and emplacement of rock material. Of the remaining 19.2 per cent, 16 per cent is generated by coal mining and haulage from the pits; while 3.2 per cent is from coal loading.

Table 11.5 ORIGIN OF DUST EMISSIONS (YEAR 10)*

Activity	Location			Per cent of Total
	South Pit	North Pit	Total	
A. ROCK				
- overburden mining	1,593.9	3,993.1	5,587.0	48.9
- dragline operation	377.1	1,265.4	1,642.5	14.4
- overburden placement	550.5	1,430.9	1,981.4	17.4
SUB-TOTAL ROCK	2,521.5	6,689.4	9,210.9	80.8
B. COAL				
- mining, haulage and loading	412.9	1,418.1	1,831.0	16.0
- preparation	-		363.1	3.2
SUB-TOTAL COAL	412.9	1,781.2	2,194.1	19.2
TOTAL	**2,934.4**	**8,107.5**	**11,405.0**	**100.0**

Note: * *figures given as tonnes of dust per year.*

iii. Particle Size

Characteristics of dust are important in determining how a dust particle will be transported. Particle sizes categorised as fine, inhalable and coarse fractions were used. These correspond to diameters of 0 to 2.5 microns, 2.5 to 15 microns and 15 to 30 microns respectively. For the purpose of modelling, the mean values of each class were then assigned values of 1.0, 6.1 and 21.1 microns.

11.4.2 Dust Deposition

Figures 38 to 42 show that dust deposition increases for the five years modelled. The figures show dust deposition contours in 0.5 $g/m^2/month$ increments. Areas contained within the 2.0 $g/m^2/month$ contour were predicted to experience increases in dust deposition above the criteria. The contour shapes reflect both the location of the mining operations and the effects of the prevailing north-west to south-east winds.

Residences within the 2.0 $g/m^2/month$ contour are shown on *Figure 43* and listed in *Table 12.7*. There are 65 non-company owned residences that will be affected by dust, 14 of which are owned by surrounding mining companies. Coal & Allied will offer the provision of ameliorative measures at private residences adversely affected by dust deposition or alternatively purchase the property.

11.4.3 Dust Concentration

Figures 38 to 42 show predicted increases in the mean annual concentration of TSP. An increase of 50 μg/m^3 would be needed to raise the total concentration from the current level of about 40 μg/m^3 to the assessment criterion for residential environments of 90 μg/m^3.

The 50 μg/m^3 contour lines estimate the area where the criterion will potentially be exceeded. The contour for dust concentration is contained wholly within the dust deposition contour. Subsequently all locations where the annual average dust deposition criterion is satisfied the annual average concentration criterion will also be satisfied.

A second assessment criterion for dust concentration is that the annual average concentration of PM_{10} particles should not exceed 50 μg/m^3. The PM_{10} particles typically form about 40 to 60 per cent of the TSP particles. As the PM_{10} assessment criterion is greater than 50 per cent of the TSP criterion, the assessment criterion for PM_{10} particles will almost certainly be met or bettered where the objective for TSP particles is met.

11.4.4 Episodic Events

Episodic events refer to a brief period (ranging from minutes up to 24 hours) when dust concentrations increase mainly from disturbed surfaces. Dust concentrations generated by either a blast, or a period of windy and dry conditions are extremely difficult to assess reliably because of the difficulty of estimating short term dust emission rates.

There a number of difficulties in assessing the impact of episodic events that were identified in the Upper Hunter Cumulative Impact Study (DUAP, 1997). The report stated that:

> *".. in practice it is hard to reliably estimate the frequency, intensity and duration of exposure to dust during an episode and even if this could be achieved there is very little data that allows the assessor to objectively assess how the community will react to the exposure."*

Current experience indicates that dust episodes are more frequent and lead to higher episodic concentrations of wind-blown dust in locations where the long-term predictions of annual dust levels already indicate a reduction in amenity. Modelling indicates that the amenity criterion of 2.0 g/m^2/month (mean annual increase) is restricted to land outside the town of Muswellbrook.

The relevant assessment criterion is that 24 hour concentrations of PM_{10} particles and TSP should not exceed 150 μm/m^3 and 260 μm/m^3 respectively. Such levels were not exceeded in the monitoring period at Mount Pleasant, which included dry and windy weather.

Mount Pleasant operations will operate under strict EPA licence conditions which will address dust control measures to be implemented during dry weather and high winds. Atmospheric dust from episodic events is therefore not expected to be in quantities which could cause dust nuisance in Muswellbrook residential areas.

11.5 CUMULATIVE EFFECTS

Existing air quality in the Muswellbrook area is a result of a number of factors. Monitored results discussed earlier reflect the presence of operating mines and power generation as well as dust emissions released by traffic, agricultural activities and natural processes.

Potential for existing operating or proposed mines to contribute to combined air quality effects with the proposal was considered. Operating coal mines considered were Muswellbrook No. 2, Dartbrook and Bayswater No. 3. The proposed Bengalla and Kayuga mines were also considered.

Developments at Dartbrook, Bayswater No. 3 and Muswellbrook No. 2 are located far enough from the Bengalla and Mount Pleasant sites that their areas of increased dust deposition (and hence concentration) would not interact. Monitoring results from Bayswater No. 3 Mine for 1996 confirm that dust deposition rates and dust concentrations (PM_{10}) are well below specified limits at monitoring sites nearest to the Bengalla Mine.

To assess cumulative effects it was necessary to examine the potential for the proposed Bengalla, Kayuga and Mount Pleasant projects to interact. Published material for Bengalla was combined with the air quality projections for Mount Pleasant. Operating years with the most potential to interact were used as there is a level of uncertainty about the relative starting times for each project. These were Year 14 of Bengalla and Year 15 of Mount Pleasant. The resultant combined dust deposition contour is shown on *Figure 43*.

The distance between the proposed mines at Kayuga and at Bengalla is sufficient to separate their influence on air quality. It was however, necessary to assess cumulative effects of mining at Mount Pleasant and Kayuga. Due to the uncertainty regarding the relative starting dates of the projects a number of possible combinations were examined to determine the worst-case scenario for the early mine development stages. Cumulative dust deposition was determined for Mount Pleasant Year 5 and Kayuga Year 2, as well as for Year 2 of both mines. As a result of the effective separation of the two operations in the early years of mining, the potential for extending the area of impact as a result of the cumulative influence of both mines is greatest towards the end of the first 20 years of operation than in the earlier stages. The cumulative dust deposition contour for both mines is depicted in *Figure 43*.

The cumulative predictions were derived using conservative assumptions and are expected to be higher than the actual levels. The resultant 2.0 $g/m^2/month$ dust contour is confined to an area west of Muswellbrook.

11.6 MITIGATION MEASURES

A variety of dust mitigation measures will be incorporated into the proposal. These will be applied during development and operation.

i. Design Measures

The following dust mitigation measures will form part of the mine design:

- the length of haulage routes will be minimised. This will reduce the length of truck travel and hence reduce the potential for dust generation;
- haul roads will be constructed within the pit where possible. The in-pit location has the effect of retaining a proportion of the dust generated;
- the use of bunding. Bund walls will assist in retaining some of the generated dust especially in the early years of mine development; and
- a variety of dust control measures will be used at the coal stockpiles and preparation plant:
  - coal dump hoppers will be equipped with fogging sprays;
  - water sprays will be installed where practical to reduce dust escaping from initial ROM coal crusher feed chutework and from the final ROM coal crusher delivery chutework;
  - conveyors transfers will be largely enclosed and/or fitted with water sprays at those transfer points likely to generate significant amounts of dust;
  - conveyors will be equipped with wind guards and/or partially enclosed by sheeting connected to the conveyor or be largely enclosed by gantry sheeting (see *Figure 17*) or, in the case of the underground sections of the reclaim conveyor will be located in a tunnel. An exception to this will be the elevated conveyor feeding the product stackers which will not be enclosed due to the high moisture content of the product coal;
  - travelling stackers will have a luffing capability so that the distance that the coal is permitted to free fall is kept to practical minimum;
  - water sprays will be available for use on the stockpiles in high winds and during very dry weather conditions; and
  - reclamation of coal from the product stockpiles will be by reclaimers located below the coal stockpile.
- prestripping will be strictly limited and rehabilitation works designed to minimise exposed area;
- out-of-pit emplacements will be minimised; and
- blasting will be designed to avoid premature venting.

ii. Operational Measures

The following dust mitigation measures will be undertaken during the mine's operation:

- limiting exposed areas. Restricting the disturbed surface area is an effective approach to dust control. This is achieved by minimising the area disturbed ahead of mining and maximising the rate of rehabilitation after the completion of mining in an area;
- watering of working surfaces, and watering and route marking of active haul roads;
- regular maintenance of all haul roads. Watering and regular maintenance are expected to result in a control efficiency of at least 50 per cent;
- care in truck loading to prevent spillage of overburden material and coal;
- collection of dust during drilling. Drill rigs will be fitted with dust aprons and dust extraction cyclones;
- controls on blasting during periods of high winds. Blasting on exposed areas will be stopped during periods of wind speed in excess of 10 metres/second blowing from the north to west sector if it is considered safe to do so;
- progressive rehabilitation of rock emplacements will be undertaken;
- if coarse angular drill chips are not available then imported stemming will be used rather than drill fines;
- NONEL initiation will be used in preference to surface detonation chord;
- monitoring will be performed to assist in optimising blast design parameters to minimise dust generation;
- to provide advanced warning of meteorological conditions that are likely to result in adverse impacts the mine will subscribe to the Bureau of Meteorology weather service for regular updates;
- restriction and/or shutdown of some or all activities when wind speed exceeds 10 metres per second in key directions, if it is considered safe to do so; and
- water sprays will be operated to control dust at the dump hoppers in the vicinity of the ROM coal crushers, at conveyor transfer points and on the coal stockpiles.

11.7 HUMAN EFFECTS

11.7.1 Methodology

A report on the effects of air quality on human health (included as Supplementary Report 8) was prepared with reference to:

- the air quality report for Mount Pleasant by P. Zib and Associates (Supplementary Report 5);
- monitoring results from Coal & Allied's existing Mount Thorley mine; and
- literature outlining the current state of knowledge on human health aspects of air pollution in the Hunter Valley.

11.7.2 Dust

In addition to the impact assessment of dust levels predicted by the modelling of P. Zib and Associates, probable dust levels of the proposal were extrapolated from occupational and environmental dust monitoring at Coal & Allied's Mount Thorley open-cut mine. Monitoring results were below current standards for occupational health and environmental exposures prescribed by the *NSW Coal Mines Regulation Act 1982* for respirable dust and quartz. Health surveillance by the Joint Coal Board has not identified any cases of dust related disease (coal miners pneumoconiosis, silicosis, and bronchitis) attributable to open-cut mining in the Hunter Valley.

Episodic events during dry conditions have the potential to cause greater impacts on air quality amenity. Mitigation measures outlined in Section 11.6 will be implemented to reduce the potential for dust generation. Such measures are not readily available for other potential dust sources such as farms, unsealed roads, construction sites and industries. Based on current experience and monitoring at existing mines it is not expected that dust from episodic events will have any adverse effects on human health.

Based on the modelling results outlined in Sections 11.5 and 11.6, the proposal should not contribute in any measurable way to cumulative dust deposition or concentrations in Muswellbrook. To date, the NSW Environment Protection Authority (EPA) has stated that because most dusts and other agents are contained within mine sites, the potential for cumulative impacts is minimised (Cleland, 1994). Exceptions to this may occur along boundaries between mines which at Mount Pleasant are located within the area where the noise and air quality criteria are already exceeded and therefore subject to acquisition.

11.7.3 Other Agents

Whilst dust from the proposed mine has the most obvious potential to impact on air quality, other agents were also considered in relation to health effects. These include:

- sulphur dioxide (SO_2) and oxides of nitrogen (NO_x) from blasting;
- salts in airborne dusts;
- emissions from rail locomotives, mine vehicles and employees' vehicles; and
- fertiliser dust from aerial topdressing of land being rehabilitated.

In general SO_2 , NO_x and salts in dust have been considered in relation to other proposed mines and dismissed as not making any measurable contribution to air quality external to the site (Cleland, 1994).

The components of PM_{10} most likely to adversely affect human health are those derived from burning fossil fuels (motor vehicles, incinerators and power plants) because they are typically much smaller (less than 1.0 μm) and more acidic than particles from other sources. The PM_{10} particles derived from abrasion (open cut mines, quarries, roads, farms) are generally in the 5 to 10 μm range and very rarely as small as 1.0 μm. Therefore, vehicle emissions and direct combustion probably have the greatest impacts on health from air pollution. Emissions from mine associated vehicles will only contribute a small fraction (less than 5 per cent) of all vehicle emissions in the Muswellbrook district.

Aerial application of dry fertiliser will follow the same safeguards used by the agricultural industry elsewhere in the Hunter Valley. This will ensure proposed rehabilitation methods do not impact on community health.

Smoke from the spontaneous combustion of coal contains a complex mixture of particulates and gases which can cause short and long-term health effects. The potential for spontaneous combustion of coal is well recognised, and has been addressed in detail in Section 6.3.5. The prevention initiatives and response strategy outlined will ensure that the potential for a spontaneous combustion event is effectively eliminated. The health risks, in the unlikely event that spontaneous combustion occurs, will be confined to occupational exposures within the mine only. If required respiratory protective equipment will be used during response to spontaneous combustion to safeguard against occupational exposure.

11.7.4 *Asthma*

The causes of asthma are complex, and the *Hunter Valley Health Service Expert Advisory Group on Asthma* has no current information which implicates any particular environmental agents. Based on available research, pollutants in the external environment which can contribute most to the causation and aggravation of asthma are acute irritants such as SO_2 and NO_x, and allergens such as mould spores and grass pollens. European research suggests that inhalation of SO_2 and NO_x in relatively low concentrations may enhance the response to inhaled allergens in people with asthma.

Inorganic materials from the types of dust that will be generated by the proposal have not been implicated as causing asthma.

11.7.5 *Conclusions*

The main conclusions of Supplementary Report 9 are:

- *"Dusts generated by the proposed mine site should be controlled by appropriate management plans and work practices so as to be well below EPA objectives for environmental particulates;*
- *Other potential pollutants, including vehicle emissions, SO_2 and NO_x from blasting, salts from deep excavation, and dry fertiliser dust from aerial applications should be readily controllable or in such low airborne concentrations as to have negligible impact on air quality;* and
- *The operation of the proposed mine will not cause adverse acute or chronic health effects, nor alter the incidence or prevalence of asthma in the population living and/or working in the Muswellbrook district."*

11.8 AGRICULTURAL EFFECTS

11.8.1 *Assessment Methodology*

Two reports were commissioned to review the potential effects of increased dust levels upon agricultural production. The first (Supplementary Report 7) examined the effect of dust deposition on plant growth. The second (Supplementary Report 8) examined the effect of dust deposition upon grazing animals. The objectives of the two studies were similar and involved:

- a literature review of the effects of dust deposition upon plants or grazing animals; and
- an assessment of the effects of the following levels of additional dust deposition:
  - up to 2 $g/m^2/month$ (annual average);
  - 2-4 $g/m^2/month$; and
  - 4-10 $g/m^2/month$.

These are additional deposition levels above the existing level which is generally between 1 and 2 $g/m^2/month$. It should be noted that the assessment criterion for dust deposition is an increase of 2 $g/m^2/month$.

11.8.2 Vegetation

The conclusion of Supplementary Report 7 was that the *"effects of dust arising from the proposed Mount Pleasant coal mine are not likely to be significant for plant growth'.* The report examined literature on the effects of coal dust on plant growth. It assessed blockage of leaf stomata (pores), reduced photosynthesis, increased leaf temperature and chemical effects.

Given that the area of a leaf which is occupied by stomata is relatively small it is concluded that there is a low chance that a dust particle would land on a pore (approximately ten per cent). There would also be a low chance that the dust would block the pore due to the physical nature of the dust and the likelihood of it being dislodged by wind and rain.

Review of studies on the effects of dust on photosynthesis indicated that photosynthesis of crops is unlikely to be reduced at total dust levels up to four grams per square metre per month. At 12 grams per square metre per month photosynthesis may be reduced on cloudy days. The likelihood of adverse impacts is further mitigated by the rapid removal by wind and rain of dust deposited on leaves and high light intensities experienced in Australia.

Based on the characteristics of overburden and interburden materials from the Mount Pleasant area it was concluded that dust would be unlikely to do any significant chemical damage to plant tissues. Most dust is expected to be neutral or contain carbonates. The amount of sulphur in spoil with acid producing potential is negligible and unlikely to damage plant tissues.

The report finds that only black dust has the potential to raise leaf temperatures and the consequences of this would be favourable for plant growth up to the temperature optimum for the plant. This is expected to occur at air temperatures greater than 40 degrees celsius.

At dust levels up to twice the background, the report concludes that pollination is unlikely to be affected and consequently pecan nut farms are not expected to be impacted.

11.8.3 Grazing Animals

The report gives further information about the effects of an increase in dust deposition on grazing animals. The main conclusion of Supplementary report 8 was that *"it would seem unlikely that an increase in dust deposition would adversely affect grazing horses or dairy cattle."*

The report reviews literature on the effects of dust on grazing animals. In terms of inhalation the report finds that there is little scientific evidence in the veterinary literature to support a proposition that increases to dust deposition rates accepted by the EPA may be detrimental. Increases in dust levels have been documented to cause increases in respiratory disease of stabled animals, however this is considered to be primarily due to the high content of fungi, actimycetes and ammonia in stable dust. These results could not be extrapolated to grazing animals where high ventilation rates and lack of exposure to dust from hay, bedding and manure would result in different effects.

Dust ingestion effects are also reviewed. They would depend on the precise composition of the dust but are unlikely to create problems.

11.9 GREENHOUSE GASES

11.9.1 Background

The "greenhouse effect" is a term used to describe the gradual warming of the earth due to increased concentrations of certain trace gases in the atmosphere. These gases are generally called "greenhouse gases" and include carbon dioxide, methane, chlorofluorocarbons, nitrous oxide and ozone. Greenhouse gases trap energy given off by the surface of the earth, preventing its escape into space. Human activities appear to be increasing the greenhouse effect.

It has been estimated that carbon dioxide accounts for approximately 75 per cent of greenhouse gas emission in Australia (NGGIC, 1994). In 1990, the Federal Government adopted an interim planning target:

> *"to stabilise greenhouse gas emissions (not controlled by the Montreal Protocol on Substances that Deplete the Ozone Layer) based on 1988 levels, by the year 2000 and to reduce these emissions by 20 per cent by the year 2005.....subject to Australia not implementing response measures that would have adverse economic impacts nationally or on Australia's trade competitiveness, in the absence of similar action by major greenhouse producing countries."*

A National Greenhouse Gas Inventory was published in 1994 for the years 1988 and 1990. The Australian and New Zealand Environment and Conservation Council estimated that Australia contributes less than two per cent of the total world emissions of greenhouse gases (ANZECC, 1990).

11.9.2 Greenhouse Gas Emissions from Coal Mining

The National Greenhouse Gas Inventory assumes that methane is the only greenhouse gas produced directly from black coal mining (OECD, 1993). While emissions of carbon dioxide are associated with the operation of the mine, very little monitoring data is available on greenhouse gas emissions from coal mining. In 1993, the Australian Coal Association in conjunction with the CSIRO carried out surveys to determine measurement methods for methane emissions from open-cut mines in Queensland and New South Wales. Seam emission tests for the Hunter Valley show that methane emissions are negligible at depths of less than 200 metres.

Methane emissions have been estimated from Mount Pleasant borecore gas desorbtivity analysis and converted to an equivalent carbon dioxide value. Emissions ranged from 23,000 tonnes for Year 1 to 64,000 tonnes for the peak year. The figures are conservative as they represent an average of samples from 275 metres in depth. The maximum depth of mining in the current proposal is to 180 metres.

Estimates of carbon dioxide emitted during mining can be made based on energy consumption.

Electricity, diesel and explosives are the main energy sources consumed in open-cut mines:

- electricity: draglines, shovels, coal preparation plant, pumps, lights, workshops and offices;
- diesel: haulage trucks, dozers, loaders, excavators, drills, water trucks, fuel/lube trucks, graders, scrapers and service vehicles; and
- explosives: blasting operations for overburden removal.

Annual carbon dioxide emissions for Year 1 of the mine operation and the peak year are presented in *Table 11.6*.

In 1990, it was estimated that the total world wide emission of carbon dioxide was 28.3 giga tonnes per year. Australia contributed 0.4 giga tonnes per year or 1.4 per cent of the total world wide emission (ANZECC, 1990). During peak energy consumption, greenhouse gas emissions from the mine will be less than 0.05 per cent of the total carbon dioxide emitted by Australia in 1990.

11.9.3 Greenhouse Action Plans

Coal & Allied currently operates two open-cut mines in the Hunter Valley, Mount Thorley Operations and Hunter Valley No. 1 Mine. A greenhouse action plan has been developed for both these operations and a number of initiatives have already been implemented to reduce greenhouse gas emissions. Experience gained at Mount Thorley and Hunter Valley No. 1 Mines will allow the Mount Pleasant Project to incorporate greenhouse gas action plans from the outset as discussed below. The following are some specific initiatives that have been implemented at other Coal & Allied operations and will be applied where appropriate at the Mount Pleasant Mine.

i. Haul Truck Monitoring System

An equipment monitoring and control package would improve plant utilisation and reduce fuel consumption per unit of mined material.

ii. Coal Preparation Plant

Reductions in unloaded running time and operation of electrical equipment at optimal efficiency will reduce greenhouse gas emissions.

Table 11.6 ESTIMATED ANNUAL EMISSIONS IN CARBON DIOXIDE FROM MOUNT PLEASANT MINE

Source	Stage	Consumption	Carbon Dioxide Emission (tonnes per year)
Electricity			
	Year 1	30,090 MWh	27,984
	Peak**	140,730 MWh	130,879
Diesel			
	Year 1	6,130 kL	16,551
	Peak***	24,288 kL	65,578
Explosives			
	Year 1	5,609 tonnes	963
	Peak****	25,355 tonnes	4,329
Total			
	Year 1	-	**45,498**
	Peak	-	**200,786**

Notes: *MWh* = *Megawatt hours*
kL = *Kilolitres*
** = *Peak electricity consumption will occur from Year 11 to 15 of the operation*
*** = *Peak diesel consumption will occur at Year 13 of the operation*
**** = *Peak explosive consumption will occur in Year 13 of the operation*

iii. *Rail Loading System*

The rail loading facility will trigger an automatic shutdown system for the overland conveyor during periods of unloaded operation.

iv. *Equipment Monitoring and Control Systems*

These systems will provide data on each item of plant, allowing improved management of operations and reduced energy use.

v. *Haul Road Conditions*

Road surfaces and climbing grades have a direct influence on truck fuel consumption. Optimisation of these factors will save fuel and extend engine life.

vi. *Drill and Blast Operations*

Optimisation of the number and depth of blast holes versus the quantity of explosives used will reduce overall energy consumption.

vii. Energy Audits

Energy audits of administration offices, workshops and other facilities will maintain electrical energy savings through use of more efficient equipment.

viii. Management Initiatives

Rio Tinto Ltd which owns Coal & Allied has entered into a co-operative agreement with the Commonwealth Government for a programme of greenhouse gas reduction. Mount Pleasant will be integrated into this programme through development of an action plan for the mine.

Mine design will include energy efficient measures in the construction and operation of the facilities with particular attention to lighting, efficiency of electric motors, building heating, air conditioning and water heating systems.

Energy and fuel efficiency will be considered in mining equipment selection. Rehabilitation will include up to 40 per cent tree plantings, subject to agreement with relevant government authorities, which will assist in reducing local carbon dioxide.

NOISE AND BLASTING 12

This chapter examines the effects of the proposed mine on the local noise climate. The potential for cumulative noise impacts from existing and proposed mines is also considered.

12.1 EXISTING NOISE ENVIRONMENT

The Mount Pleasant mine site is situated between Dartbrook underground coal mine to the north and the proposed Bengalla open cut mine to the south. Muswellbrook Mine lies to the far east of the site. In addition, the proposed Kayuga open cut mine will be immediately north of the site. The eastern boundary of the site borders the Hunter River floodplain and at its closest is about three kilometres from Muswellbrook. *Figure 44* shows the site in relation to the river and Muswellbrook.

A number of houses are located on the site and scattered across the Hunter River floodplain to the north-east, south-east and east as shown on *Figure 50.* Existing background noise at these locations is generated by a variety of sources including agricultural activity, birds, insects, traffic on local roads and the New England highway, rail traffic and mine operations at the Dartbrook and Muswellbrook mines.

Environmental noise levels vary with time requiring statistical descriptors to characterise the noise environment. The following descriptors are commonly used to assess noise impacts. The L_{10} level is the noise level which is exceeded for 10 per cent of the time and is approximately the average of the maximum noise levels. The L_{90} level is the level exceeded for 90 per cent of the time and is approximately the average of the minimum noise levels. The L_{90} level is often referred to as the "background" noise level and is commonly used to determine noise criteria for assessment purposes. The L_{eq} level represents the average noise level. Noise level measurement units are decibels (dB). There are several scales for describing noise with the most common being the "A" scale.

Existing noise levels have been monitored at seven locations as shown on *Figure 32.* These include:

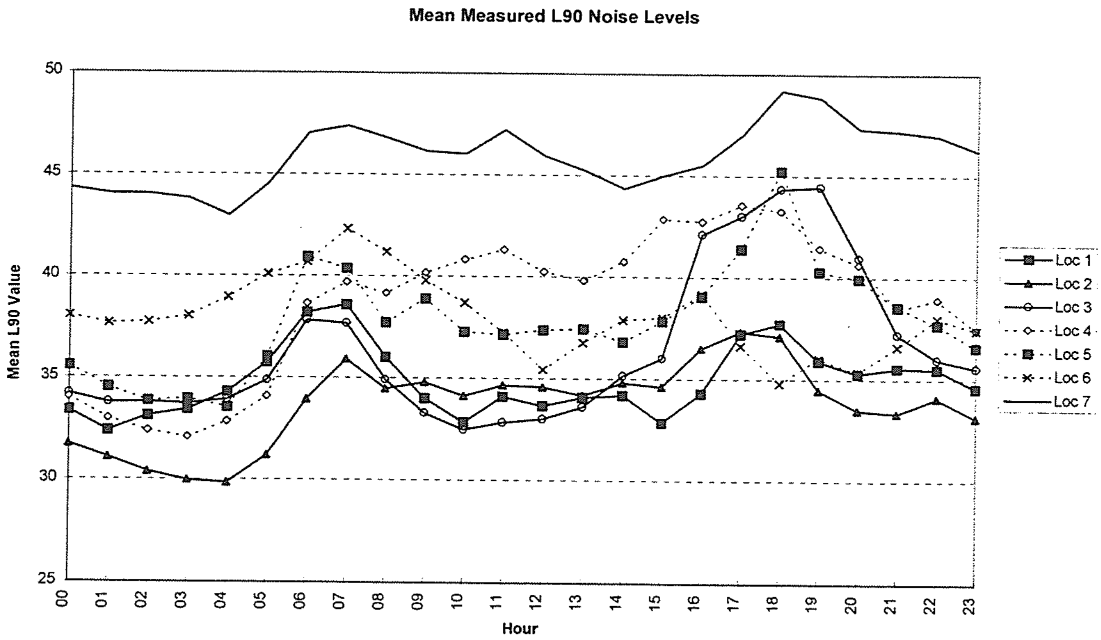
- *location 1,* at the driveway of the River Ridge property in the township of Kayuga (Grid Reference J10);
- *location 2,* on Kayuga Rd approximately 1.4 kilometres north of the Wybong Road intersection. This is the front yard of the Moore property 20 metres from the road (Grid Reference F11);
- *location 3,* on Wybong Rd approximately 1.4 kilometres east of the Kayuga Road intersection (Grid Reference D10). This is in the former Gladioli farm approximately 50 metres from Wybong road;
- *location 4,* in the back yard of 137 Hill Street, Muswellbrook (Grid Reference D12);
- *location 5,* in the back yard of 59 Forbes Street, Muswellbrook (Grid Reference B12);
- *location 6,* the "Fairview" residence, Kayuga (Grid Reference K10); and
- *location 7,* in the park opposite Muswellbrook swimming pool (Grid Reference C13).

Measuring equipment included RTA Technology and ARL noise loggers, programmed to record statistical noise levels every 15 minutes. Locations 1 to 5 were monitored from 28 March to 5 April, 1995. For location 6, monitoring was between 4 and 13 July, 1995 and for location 7, between 10 and 16 August, 1994. The loggers were calibrated before and after the measurements using a Bruel and Kjaer type 4230 calibrator. No significant drift in calibration was detected.

Local meteorological records were used to identify periods during which the wind speed exceeded 5 metres per second, and measurements during these periods were excluded from the analysis to avoid contamination of data by noise from wind on the microphone. There was no rainfall during monitoring.

Measured L_{10}, L_{90} and L_{eq} noise levels at each monitoring location are shown in Appendix L.

Graph 5 shows the average of measured L_{90} values by time of day for each site. Measured noise levels at site 7 are relatively high due to noise from nearby mechanical plant. Daytime levels at sites 4 and 5, within Muswellbrook, are higher than the remaining sites. Night-time levels at site 6 were affected by insect noise.



Graph 5 AVERAGE MEASURED L_{90} NOISE LEVELS

For determining noise level criteria, the Environment Protection Authority recommends minimum repeatable background noise levels be used, rather than average values as shown in *Graph 5*. Although a precise policy has yet to be formulated, it is generally accepted that the "minimum repeatable" level may be estimated by calculating the 90th percentile of measured L_{90} background noise levels, for the time period of interest. Minimum repeatable background noise levels, calculated in this way, are shown in *Table 12.1* below.

Table 12.1 MINIMUM REPEATABLE L_{90} BACKGROUND NOISE LEVELS

Location	Measured Minimum Repeatable L90 Level, dB(A)	
	Day (7 am - 10 pm)	Night (10 pm - 7 am)
1	30	30
2	30	29
3	30	32
4	38	30
5	34	32
6	32	34
7	42	41

From *Table 12.1*, for sites outside Muswellbrook, daytime and night-time noise levels are similar. However in some cases, night-time noise levels are slightly higher due to insect noise.

In addition to the above data, monitoring was also conducted at three other locations - all remote from major built-up areas - by Envirosciences Pty Ltd (1993). The results from these measurements are presented in the Envirosciences Pty Ltd annual reports for 1993 and 1994. For these other locations, measurement data were not available in electronic form to allow direct calculation of the 90th percentile of the measured L_{90} values. However, inspection of the graphical output indicates measured noise levels consistent with those reported above, in that the minimum repeatable L_{90} background noise level in these areas is approximately 30 dB(A) during both daytime and night-time periods.

12.2 ASSESSMENT CRITERIA

The proposal consists of four main noise sources:

- mine construction;
- mine operation;
- blasting operations; and
- transportation.

12.2.1 *Initial Mine Development*

Noise will be emitted during construction of rail loading facilities and coal handling plant; surface facilities; initial mine development including screening bund construction, and earthworks for levelling and drainage. Road traffic will also be a source of noise during construction. The highest noise levels will be generated during construction of earthworks.

For construction noise, assessment criteria are suggested in the Environment Protection Authority's Environmental Noise Control Manual. These are expressed in terms of the L_{10} level of noise from the construction site. The criteria depend on the existing background noise level at the assessment location, which is measured as the L_{90} level.

The Environment Protection Authority's criteria for noise from construction sites are:

- for construction periods of four weeks and under, the L_{10} noise level due to the construction site should not exceed the existing L_{90} background noise level by more than 20 dB;
- for construction periods of between four and 26 weeks, the L_{10} noise level due to the construction site should not exceed the existing L_{90} background noise level by more than 10 dB; and
- for construction periods longer than 26 weeks, the criteria for a continuously-operating source should apply, which generally means that the L_{10} noise level due to construction should not exceed the existing L_{90} background noise level by more than 5 dB.

Earthworks carried out for the four main construction activities outlined above will extend over a longer period than 26 weeks, and hence noise from these activities should meet the same criteria as operational noise. These criteria are described below.

12.2.2 Mine Operation

The Environment Protection Authority lists objectives for environmental noise in its Environmental Noise Control Manual. These specify that:

- noise from any single source should not intrude greatly above the prevailing background noise level, generally by more than 5 dB; and
- the background noise level should not exceed an appropriate level for the particular locality and land-use.

From *Table 12.2*, minimum repeatable night-time background noise levels are estimated as approximately 32 dB(A) within Muswellbrook and 30 dB(A) elsewhere. Hence, from the first of the above principles, the L_{10} noise level from the mine should not exceed 37 dB(A) in Muswellbrook or 35 dB(A) elsewhere.

Daytime background noise levels can be estimated from *Table 12.2* at 35 dB(A) within Muswellbrook and 30 dB(A) elsewhere, giving daytime noise criteria of 40 dB(A) and 35 dB(A) for these areas respectively. However, it is often considered appropriate that daytime noise criteria be set at a higher level than night-time criteria, given the greater prevalence of other intrusive noises during this period and the generally lower community sensitivity to environmental noise. This is reflected in the EPA's "maximum acceptable" background noise levels, which for a rural residence are 35 dB(A) for the night-time and 45 dB(A) during the daytime. In a recent decision in relation to the Bengalla mine, it was determined that appropriate criteria would be 40 dB(A) L_1 for the night-time period (approximately equivalent to 35 dB(A) L_{10}) and 43 dB(A) L_{10} for the daytime period.

In view of these factors, it is considered appropriate that the daytime noise criterion in areas outside Muswellbrook be set somewhat higher than the night-time criterion of 35 dB(A) L_{10}. A value of 40 dB(A)

L_{10} has been selected, based on recent determinations in similar cases. This is also approximately 5 dB above the mean (as distinct from minimum repeatable) daytime L_{90} background noise level.

To satisfy the second of the EPA's objectives, total background noise levels should be kept within the "maximum acceptable" noise levels suggested in the EPA's Environmental Noise Control Manual. For residences in a "rural" or "residential" area these are a night-time background noise level of 35 dB(A) and a daytime level of 45 dB(A).

For typical open-cut mining operations, previous measurements indicate that background noise levels from mining are at least 5 dB below the L_{10} level. Taking this into account, *Table 12.2* shows that if L_{10} noise levels are controlled to within the criteria above, then total L_{90} noise levels will also be within the EPA's "maximum acceptable" levels in all cases.

Hence, for noise from mine operations the L_{10} noise level criteria shown in *Table 12.2* are adopted for this assessment. As recommended by the EPA these criteria apply under neutral meteorological conditions. Noise levels under other conditions are discussed in Section 12.3.4.

Table 12.2 NOISE LEVEL CRITERIA FOR MINE OPERATIONS, dB(A)

Parameter	Within Muswellbrook		Other Areas	
	Day	Night	Day	Night
Existing minimum repeatable L_{90} noise level	35	32	30	30
Proposed L_{10} noise level criterion	**40**	**37**	**40**	**35**
L_{90} level from mine operations if L_{10} criterion is met	35	32	35	30
Total L_{90} noise level if L_{10} criterion is met	38	35	36	33
Maximum acceptable L_{90} noise level	45	35	45	35

In assessing the cumulative impact of more than one development, two approaches are possible. First, a comparison of total noise from all developments with the criteria listed above which provides a more conservative criterion. Alternatively, criteria based on the EPA's recommended maximum background noise levels can be adopted for the area in question, on the basis that these are intended to provide controls on "creeping background noise". This would indicate that the maximum acceptable L_{90} background noise level due to the combined noise sources would be 35 dB(A) at night and 45 dB(A) during the daytime. In terms of L_{10} noise levels from mine operations, this is approximately equivalent to 40 dB(A) and 50 dB(A) L_{10}. Both criteria were used for assessing cumulative noise from Mount Pleasant and other sources.

The above criteria are appropriate for assessing noise from continuous and intermittent sources, such as engine noise from mobile plant, the coal preparation plant and pit equipment. However, transient noise sources such as bulldozer track plates, reversing alarms, train shunting and the banging of shovel tailgates after tipping also require assessment. Given the transient nature of these events, the L_{10} noise level from such sources would not be calculable since the noise in question may not be present for 10 per cent of the time. Hence the above criterion is not relevant for this type of noise.

The most important effect of these transient noises would be the possibility of disturbing the sleep of nearby residents. The EPA's Environmental Noise Control Manual suggests that to avoid sleep disturbance, the L_1 noise level due to the source (that is the noise level which is exceeded for one per cent of the time) should not exceed the background noise level by more that 15 dB.

Recent research into sleep disturbance (Bullen et al, 1996) has shown that other characteristics of transient noise, such as the maximum noise level and number of events, also affect the amount of sleep disturbance caused, and therefore this criterion does not fully address the effects of transient noise. This research indicates that where the maximum noise is less than 45 dB(A) inside a bedroom, there will be virtually no detectable sleep disturbance, either from awakening or changes in sleep state. If bedroom windows are open, this corresponds to an external maximum noise level of approximately 55 dB(A) at a residence. This was adopted as the noise level criterion for transient noise events.

12.2.3 *Blasting Operations*

For noise and vibration during blasting operations, criteria are proposed in the EPA's Environmental Noise Control Manual. However, the EPA has indicated that these have been superseded by values from the Australian and New Zealand Environment Conservation Council (ANZECC). The ANZECC guidelines are the same as those found in the Environmental Noise Control Manual except for blasting times. Blast overpressure levels should not exceed 115 dB(Lin) at any residence, and ground vibration levels should not exceed 5 millimetres per second peak particle velocity. However, it is accepted that some limited exceedance of the overpressure limit may occur on infrequent occasions. This should be limited to not more than 5 per cent of the total number of blasts, and should not exceed 120 dB(Lin) at any time.

The ANZECC guidelines recommend that blasting should occur only between 9 am and 5 pm, Monday to Saturday, and there should be no blasting on Sundays and public holidays. In addition, blasting should not occur more than once per day. These guidelines were adopted in this report.

12.2.4 *Road Transport*

Two road transport activities associated with the development and operation of the Mount Pleasant mine may affect the present acoustic climate of residential properties. These are construction traffic and employee vehicles.

The EPA currently recommends that for intermittent or low traffic flow an L_{eq} value should be used as the noise descriptor. It is recommended that the L_{eq} level calculated for the peak traffic hour should not exceed 50 dB(A) for rural residences and 55 dB(A) for suburban situations. Where existing traffic noise already exceeds the above criteria, it is recommended that new traffic flows should not increase the existing level by more than 2 dB. These criteria were adopted to assess traffic noise from the mine.

12.2.5 *Rail Transport*

Where locomotives on the proposed rail loop idle for long periods close to the loading bin, this noise is most appropriately considered as part of general mine operational noise, and assessed against the criteria discussed above. However, intermittent noise from rail movements on the loop is most appropriately assessed under general rail traffic noise criteria. These are set out in the EPA's Environmental Noise Control Manual, and limit both the maximum noise level during a passby and the L_{eq} noise level, which is the average noise energy from all operations.

For new rail tracks, the recommended criteria are:

Maximum noise during passby:	80 dB(A)
Maximum L_{eq} level from all rail movements:	55 dB(A)

Criteria for a new rail track were adopted for this assessment which are 5 dB lower than for an existing track.

12.3 NOISE DURING MINE DEVELOPMENT AND OPERATION

This section includes noise impact assessments for the rail loop construction and for Years 2, 3, 5, 10, 15 and 20 of mine operations.

12.3.1 Rail Loop Construction Noise

The rail loop construction will take place over a period of 9 months. Bulk earthworks and drainage construction will be undertaken over the first 6 months, followed by track laying and ballasting in the remaining 3 months.

For the purpose of assessing noise from the construction activities, the noise levels at the most potentially affected private residences were modelled using ENM environmental noise model. The closest residences located to west of the rail loop are shown on *Figure 24* as property numbers 97, 119 and 268.

Earthworks have the potential to generate more noise than track laying and ballasting and were therefore modelled over the entire 9 month period. Major noise generating equipment included:

- 1 tracked dozer;
- 4 scrapers;
- 1 roller;
- 1 water cart;
- 1 fuel cart; and
- 1 air drill.

Predicted noise levels were determined by generating terrain sections from the 1:25,000 Muswellbrook topographic map assuming a temperature of 20°C, relative humidity of 50 per cent and no wind or temperature inversions. Predicted noise levels are given in *Table 12.3*.

Table 12.3 PREDICTED NOISE LEVELS FROM RAIL LOOP CONSTRUCTION ACTIVITIES

Residence No (1)	Property Owner	Noise Level (dB(A))
97	J B Moore	21.4
119	J B & H R Hofman	32.1
268	G W & G M Collins	35.0

Note: 1. See Figure 24 for location of residences.

Table 12.3 indicates that the noise levels from rail loop construction activities will not exceed the background noise level for the area.

As outlined in Section 12.2.1, the EPA criterion for construction activities operating for a period longer than six months states that *the L_{10} noise level from the construction activities should not exceed the background noise level by more than 5 dB(A) when measured at any residence.*

Construction activities for the rail loop will therefore be within the relevant EPA criterion.

12.3.2 *Noise Generation Mine Equipment*

Table 12.4 shows the major areas of noise from mine operations.

Table 12.4 OPERATIONAL NOISE AREAS

Area	Noise Sources
Pit Areas	Drills; dragline; rope shovels; front-end loaders; trucks; dozers; graders; generators for lighting sets, pumps and cribhuts
Overburden Emplacements, Rejects Disposal Area and Haul Roads	Trucks; dozers; graders; scrapers; generators for lighting sets
Coal Preparation and Rail Load-Out Facility	Yard and overland conveyors; conveyor drives; surge bins; hoppers; stacker/reclaimer machinery; coal preparation plant; rail load-out bin; idling coal trains

The equipment used during noise modelling of earthmoving and associated operations, generally in the pit, overburden emplacement areas and rejects disposal area, is listed in *Table 12.5*. Note that the numbers of plant items assumed in noise modelling are in some cases slightly different from those presented in *Table 6.2*. The equipment list in *Table 6.2* is a refinement of the list available at the time noise modelling began. In almost all cases, noise modelling assumed a slightly higher number of operating items, and hence noise predictions will be slightly overestimated. Where technological refinements in new equipment purchased for the mine result in lower sound power levels than modelled, greater operational flexibility will be available within the limits of the affects envelope for the Mount Pleasant Mine as shown on *Figure 50*.

Sound power levels shown in *Table 12.5* assume that all mobile equipment has residential class mufflers and that haul trucks use the best available technology to minimise noise emissions. These sound power levels are considered practicably achievable.

Table 12.5 MAJOR EQUIPMENT LIST FOR EARTHMOVING AND ASSOCIATED EQUIPMENT

Equipment Type	Year 2	Year 3	Year 5	Year 10	Year 15	Year 20	Assumed Sound Power Level, dB(A)
Shovel (e.g. P & H 4100)	1	1	1	2	2	2	113
Hydraulic Excavator, 530T	1	1	1	1	1	1	115
Dragline (e.g. Marion 8750)			1	1	1	1	114
Front-end Loader (e.g. L1800)	1	1	1	1	1	1	116
Front-end Loader (e.g. L1400)	2	2	2	2	2	2	116
Dump Truck (e.g. Dresser 930E)	6	6	6	11	10	8	117
Dump Truck (e.g. Dresser 830E)				14	20	17	117
Dump Truck (e.g. Dresser 730E)	12	13	13				117
Dozer (e.g. D11)	5	8	8	9	7	7	114
Rubber-Tyred Dozer (e.g.Tiger 690)	1	1	1	2	2	2	114
Drill (e.g. Drilltek D90)	1	3	3	3	3	2	115
Drill (e.g. Drilltek D75)	1	1	1	2	3	2	115
Drill (e.g. Drilltek D40)	1	2	2	2	2	2	115
Water Truck	3	4	4	4	4	3	108
Grader (e.g. 16G)	1	2	2	3	3	2	114
Scraper (e.g. 651E)	4	5	5	4	4	4	115
Fuel/Lube Trucks	3	3	3	4	2	3	110
Lighting Sets (generators)	3	9	9	12	10	9	104

The main noise-producing items from the coal preparation and rail load-out areas are presented in *Table 12.6*.

Table 12.6 MAJOR EQUIPMENT IN COAL PREPARATION AND RAIL LOAD-OUT AREAS

Equipment	Sound Power Level, dB(A)
Dump Hoppers	110
Conveyors	83 (per metre)
Conveyor Drives	102
Stacker/Reclaimer	115
Coal Preparation Plant	113
Rail Load-out Bin	107
Diesel Trains Idling	110

12.3.3 *Modelling of Mining Operations*

To determine the acoustical impact of mining operations, noise contours were generated using the ENM environmental noise model. This model takes account of noise reduction by geometric spreading, atmospheric absorption, barriers and ground attenuation. It gives consistently reliable predictions of environmental noise. As recommended by the EPA, initial calculations were performed with no wind or temperature gradient, for comparison with the criteria described above. Assumed temperatures were 20°C for daytime and 10°C for night-time, with relative humidity 70 per cent for daytime and 80 per cent for night-time. Noise levels during other conditions are discussed below.

Noise levels were calculated for six stages of the project; Years 2, 3, 5, 10, 15 and 20. For Years 5, 10, 15 and 20 of the operation, two different cases were modelled. In one case, the majority of mining equipment was positioned in and around the northern pit and in the second case they were positioned in and around the southern pit. Final noise contours were the outer envelope of calculated contours for each of these cases.

The model used digitised ground contours for the surrounding land and mining operations. Contours of the mine and overburden emplacement areas for each project stage were superimposed on the base topography as shown on *Figures 44* to *49*. Equipment was placed at various locations and heights, representing operating conditions throughout the life of the mine. Precise equipment locations for each stage of mining and each pit differed. They were chosen to represent operations for that year and the likely locations of benches within the pits.

Separate equipment locations were used for daytime and night-time operations, since operations during these periods will differ. In particular, trucks will not operate on sensitive overburden emplacement areas outside the pits during the night (10 pm to 7 am) unless reductions in sound power levels in new equipment allows greater operational flexibility. To give maximum protection for residences near Muswellbrook during the most sensitive period of mining (Years 7 - 12), even under adverse weather conditions, night-time activities in the pit during this period will take place only up to the second-highest bench.

The noise model estimates maximum noise levels and assumes all plant and equipment operates simultaneously and at full power. In practice, such an operating scenario would be unlikely to occur. Measurements at similar mining operations have indicated that there is a difference of up to 7 dB(A) between the maximum noise level, as predicted by the model, and the L_{10} level generated by the operations. To estimate the L_{10} noise level, a smaller value of 5 dB(A) was deducted from the calculated maximum level.

12.3.4 Results

Figures 44 to *49* show calculated noise contours for daytime and night-time in each year.

To the east of the site, the main contribution to total operational noise from daytime mining operations is made by trucks and other machinery operating on the overburden emplacements. The noise from all other sources combined is generally at least 10 dB below equipment on the emplacements. During the night-time, trucks will not operate on the upper levels of those emplacements, and noise levels are due largely to in-pit operations.

To the west of the site, the total noise comes from a combination of sources in the coal preparation and load-out area and in the daytime, machinery on the western fine rejects emplacement area.

It can be seen from *Figure 50* that there are a number of existing residences inside the criterion noise level contours from the Mount Pleasant project. There are 71 non-company owned residences that will be affected by noise, 12 of which are owned by surrounding mining companies as listed in *Table 12.7*. Coal & Allied will offer to install noise mitigation measures or seek to acquire these residences as part of this project.

12.3.5 Noise During Other Meteorological Conditions

It is well known that under various wind and temperature gradient conditions, noise levels may be increased or decreased compared with neutral conditions - that is, zero wind and temperature gradient. The EPA's noise criteria, as reported above, apply under neutral conditions. Nevertheless, it is useful to investigate the proportion of time when noise levels will be higher or lower than those calculated for neutral conditions.

The ENM model calculates noise levels under various combinations of wind speed and direction, and vertical temperature gradient. The US Nuclear Regulatory Commission classification of temperature gradients and stability categories allows vertical temperature gradients to be estimated from atmospheric stability classes. Hence, the proportion of time during which certain noise levels will be experienced can be calculated from the probabilities of various combinations of wind speed, wind direction and stability category.

Table 12.7 SUMMARY OF AFFECTED RESIDENCES

Property No. (1)	Property Owner	Affected by Noise	Affected by Dust Deposition	Property No. (1)	Property Owner	Affected by Noise	Affected by Dust Deposition
1.	Kropp R & J	✓		115.	Steman LH	✓ (2)	✓ (2)
2.	Lonergan JA	✓		116.	McLean D & R		✓
6.	Dartbrook Joint Venture	✓ (3)	✓ (3)	117.	Coal & Allied		✓ (2)
11.	Lonergan J & NM	✓		121.	Skippen SE	✓	✓
14.	Dartbrook Joint Venture	✓	✓	125.	Bengalla Mining Co	✓	✓
16.	Casey GM	✓	✓	126.	Coal & Allied	✓	
22.	Lonergan JA	✓	✓	130.	Moore C & JM	✓	✓
25.	Fell CM	✓	✓	131.	Moore DL & PA	✓	✓
27.	Casey JO	✓		132.	Coal & Allied	✓	✓
31.	Coal & Allied	✓	✓	134.	Coal & Allied	✓	✓
32.	Coal & Allied	✓	✓	135.	Marshall DJ	✓	✓
33.	Coal & Allied	✓	✓	136.	Budden GB & DM	✓	✓
34.	Lonergan PJ	✓	✓	137.	Budden GG & PE	✓	✓
35.	Watts WF & PJ	✓	✓	138.	Coal & Allied	✓	✓ (2)
43.	Coal & Allied	✓	✓	141.	Gray ML	✓	✓
44.	Coal & Allied	✓	✓	142.	Coal & Allied	✓	✓
48.	Farrel MJ	✓	✓	143.	Barry TD	✓	✓
50.	Yore KJ & GM	✓		144.	Coal & Allied	✓	✓
57.	Lecky KG & JA	✓	✓	145.	Coal & Allied	✓	✓
58.	Turner G	✓	✓	146.	Chalker BGM & JA	✓	✓
63.	Bates CF & GP	✓	✓	148.	Gibson JS	✓	✓
66.	Rosebrook P/L	✓ (2)	✓ (2)	149.	Wilton BL	✓	✓
67.	Coal & Allied	✓	✓	150.	Coal & Allied	✓	✓
69.	Schlegel JG & FA	✓	✓	151.	Coal & Allied	✓	✓
73.	McLean MA & RE		✓ (2)	152.	Hayes MA	✓	✓
76.	Bengalla Mining Co	✓	✓	153.	Coal & Allied	✓	✓
77.	O'Keefe OJ & Others	✓	✓	154.	Mather AJ	✓	✓
78.	Thompson K & M		✓	155.	Austin C	✓	✓
79.	Riley AJ & A		✓	156.	Collins WF	✓	✓
80.	Scriven GJ		✓	157.	Gray RP	✓	✓
81.	McKinnon P & B		✓	158.	Coal & Allied	✓	✓
82.	Ellis N & R		✓	159.	Seaby EA & MD	✓	✓
83.	Hamson L & C	✓	✓	160.	Roach FW & YL	✓	✓
84.	Bengalla Mining Co	✓	✓	161.	Coal & Allied	✓	✓
85.	Lawrence R & M	✓	✓	162.	Coal & Allied	✓	✓
86.	Bengalla Mining Co	✓	✓	163.	Jazipa P/L	✓	✓
87.	Bengalla Mining Co	✓	✓	170.	Simpson JM		✓
88.	Reynolds J	✓	✓	172.	George VC & NA		✓
89.	Bengalla Mining Co	✓	✓	173.	Coal & Allied		✓
91.	Gardiner AL	✓	✓	174.	Galivin RJ		✓
64.	Gamper HJ & JA Ellul	✓	✓	175.	Coal & Allied		✓
95.	Coal & Allied	✓	✓	181.	Lonergan J	✓	
99.	Bengalla Mining Co	✓		183.	Parkinson RB & SA	✓	
108.	Bengalla Mining Co		✓	197.	Hoath C & N	✓	
110.	Bengalla Mining Co		✓	198.	Hoath C & N	✓	
111.	Carter FJ DJ & JM		✓	201.	Paton G	✓	
113.	Bengalla Mining Co	✓	✓	228.	Bengalla Mining Co		✓

Note: 1. Property Number as shown on Figures 24 and 25.

In the present assessment, the atmospheric data used in the air quality analysis, as reported in Section 11.4, were also used to assess noise under non-neutral meteorological conditions. Calculations were performed for three receiver locations:

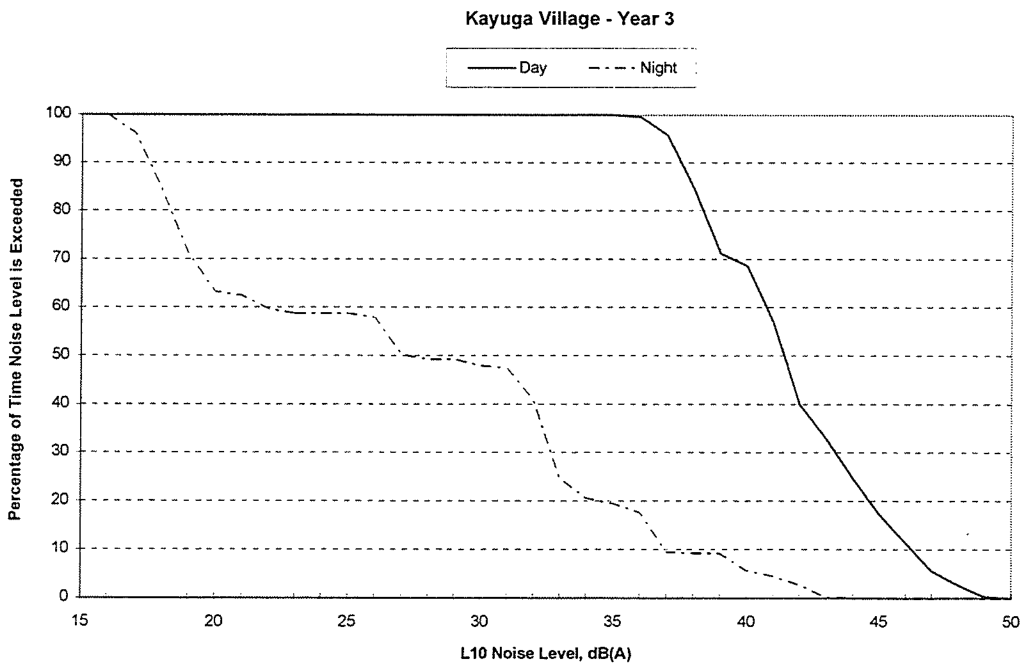
- *location 1*, in Kayuga village;
- *location 2*, at Campbells Corner, Muswellbrook; and
- *location 3*, corner of Wybong and Roxburgh Roads.

These represent the closest residences to the north-east, south-east and south-west of the mining area respectively.

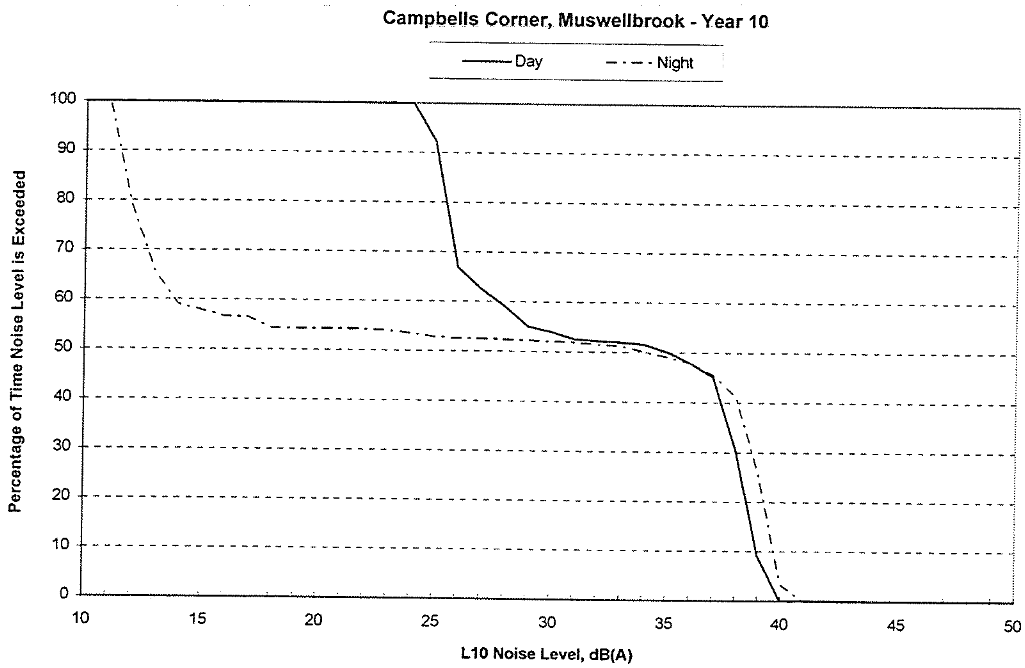
In each case, calculations focused on the year and scenario when predicted noise will be highest for the relevant location - Year 3 for location 1; Year 10 for location 2; and Year 20 for location 3.

Noise levels for these locations were calculated for the range of possible combinations of wind speed, wind direction and temperature gradient. Then, using the proportion of time when each of these combinations applied, the probability distribution of noise levels at those points was calculated. In calculations, wind speeds greater than 3 metres per second were replaced with 3 metres per second. This is required because the ENM model does not accurately predict turbulence effects associated with higher wind speeds. The cut-off value of 3 metres per second is believed to be conservatively high.

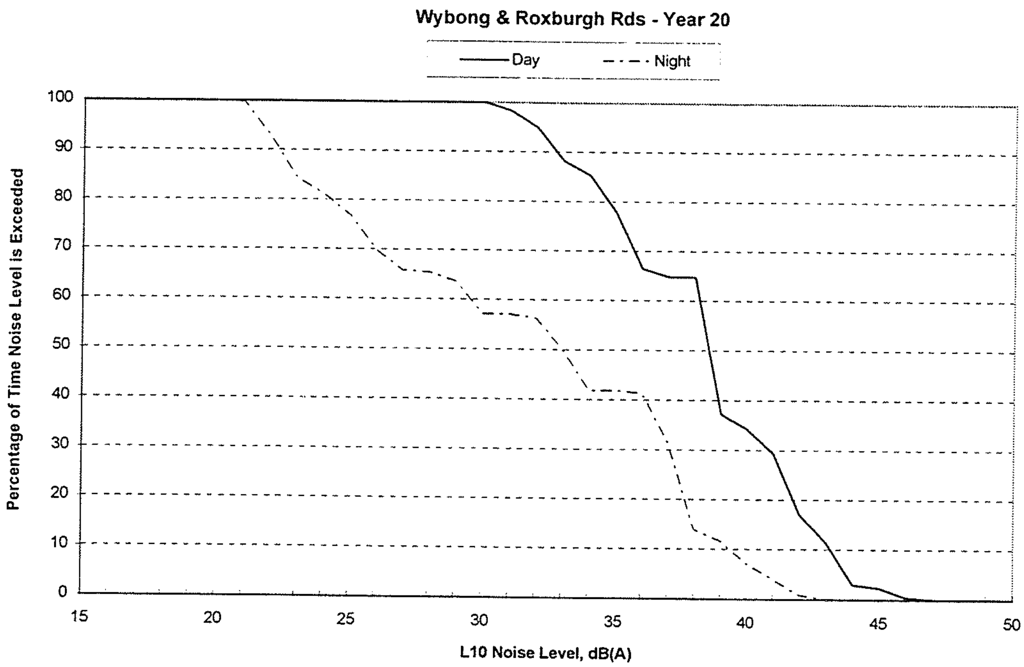
The results are shown in *Graphs 6* to *8*.



Graph 6 CALCULATED NOISE LEVEL DISTRIBUTION, KAYUGA VILLAGE - YEAR 3



Graph 7 CALCULATED NOISE LEVEL DISTRIBUTION, CAMPBELLS CORNER, MUSWELLBROOK - YEAR 10



Graph 8 CALCULATED NOISE LEVEL DISTRIBUTION, CORNER OF WYBONG AND ROXBURGH ROADS - YEAR 20

From the above graphs, predicted noise levels are above the "neutral conditions" level for substantial periods in all cases, due to a combination of wind and temperature gradient effects. For locations at Kayuga Village and Wybong & Roxburgh Roads, daytime noise levels are predicted to exceed the "neutral conditions" criterion of 40 dB(A) for approximately 70 per cent and 35 per cent of the time respectively. However, exceedances are generally limited to approximately 5 dB, with exceedances of more than 7 dB being extremely rare. At night, the "neutral conditions" criterion of 35 dB(A) is predicted to be exceeded approximately 20 per cent and 40 per cent of the time respectively Once again, exceedances of greater than 7 dB are predicted to be extremely rare.

Within Muswellbrook, there are clearly two distinct types of noise exposure - one associated with south-easterly winds or neutral conditions and one with north-westerly winds. The latter case gives the more adverse conditions. Even under adverse meteorological conditions, daytime noise levels are predicted to be within the "neutral conditions" noise criterion of 40 dB(A) at all times. The "neutral conditions" night-time noise criterion of 37 dB(A) is predicted to be exceeded by at most 4 dB under the most adverse conditions.

It should be noted that higher predicted noise levels are often associated with higher wind speeds, and in these cases background noise levels will also be elevated above those used to derive the "neutral conditions" noise level criteria.

From the above it can be concluded that noise from mining operations will often be audible at residences in the surrounding areas. At the worst-affected locations, in the worst-case years of operation, exceedances of up to 7 dB above the "neutral conditions" noise level criteria can be expected for limited periods, with some exceedance occurring up to approximately 70 per cent of daytime periods and 40 per cent of night-time periods. These exceedances may annoy some residents over a limited period. However, no formal assessment procedure exists by which the acceptability of such exceedances may be judged.

Finally, it should be noted that the above calculations apply to stable meteorological conditions with a constant wind speed and linear temperature gradient. There will be occasions when a particular combination of non-linear wind and temperature gradients will result in "focusing" of noise from a particular source on a particular point, and under these conditions higher enhancements can be expected. The area of enhancement is limited - often of the order of 200 to 400 metres - and may move over periods of tens of minutes, so that noise levels at the receiver will also change over these time periods. The frequency and intensity of such events are not predictable with currently-available data. However, experience suggests that in these cases enhancements of up to 20 dB may be encountered over short periods.

12.3.6 Sleep Disturbance

Sleep disturbance may be caused by transient noise sources such as shovel gates banging, bulldozer track plates, heavy vehicle reversing alarms and train shunting operations. *Table 12.8* presents previously-measured noise levels from these noise sources.

Table 12.8 MEASURED L_{max} NOISE LEVELS OF TRANSIENT NOISE SOURCES

Noise Source	Measured Lmax Noise Level, dB(A)	Distance From Source (metres)
Shovel Gate Banging	60	400
Bulldozer with Reversing Alarm	69	80
Train Shunting	76	50

Table 12.9 shows calculated maximum noise levels from these sources at the three locations identified above. In each case, the noise source has been placed at the closest location to the residence at which it could be expected to operate during the night-time at any stage of mining operations. Calculations are for neutral meteorological conditions.

Table 12.9 CALCULATED L_{max} NOISE LEVELS OF TRANSIENT SOURCES

Noise Source	Maximum Noise Level, dB(A)		
	Kayuga Village	Muswellbrook	Wybong & Roxburgh Rds
Shovel Gate Banging	27	22	19
Reversing Alarm	22	24	31
Train Shunting	13	21	28

From *Table 12.9*, calculated noise levels are well within the sleep disturbance criterion of 55 dB(A) in all cases. Nevertheless, such noise will definitely be audible at the closest residences, particularly under adverse meteorological conditions, and hence all practical measures will be used to control it wherever possible. In particular, noise from reversing alarms can be controlled by either:

- using a radar-based warning system which does not require an audible alarm; or
- using an alarm which allows for the emitted noise level to be altered depending on the surrounding noise environment, so that the minimum required sound power level is used in all cases.

The practicability of either of these systems for the proposed mine site needs to be thoroughly investigated. In particular, to our knowledge the reliability of the first of the above systems has not been verified under Australian mining conditions. It is proposed that an alarm with variable sound level will be trialed during initial work at the site to determine its safety, practicality and efficiency in reducing emitted sound levels. If these prove acceptable, this system will be adopted throughout the site.

12.3.7 *Cumulative Noise Impacts*

Areas potentially impacted by noise from the Mount Pleasant Mine are also potentially impacted by other mines, notably Bengalla to the south and the proposed Kayuga Mine to the north. The cumulative impact from more distant mines such as Bayswater No.3 will be much lower than that from the two adjacent mines. Monitoring results from Bayswater No. 3 mine for 1996 indicate that the 35dB(A) night-time and 40 dB(A) daytime noise contours are located to the south of the "Windmill" and "Roxburgh" properties on Denman Road. Consequently, cumulative impacts of the Bengalla, Kayuga and Mount Pleasant developments need to be addressed.

In the case of Bengalla Mine, for residences outside the criterion noise level contours shown in *Figure 50*, cumulative impacts will be most pronounced at two locations - residences near the eastern part of Wybong Road near the intersection with Kayuga Road, and residences near the intersection of Wybong and Roxburgh Roads.

Predicted noise levels from the Bengalla Mine nearest to these locations were taken from Appendix 6 of the Environmental Impact Statement for Bengalla Coal Mine - a noise impact statement by Caleb Smith Consulting Pty Ltd. The locations are represented by residences designated 56 and 145 respectively in that report.

In comparing predicted noise levels for various stages of the Bengalla and Mount Pleasant mines, it is necessary to assume a difference between the starting times for the two operations. It was assumed that Mount Pleasant would begin operation two years after Bengalla - that is Year 1 for Mount Pleasant corresponds to Year 3 for Bengalla. Because data are not provided for every year in the Bengalla EIS, it was necessary in some cases to estimate noise levels in a specific year based on predicted levels for nearby years.

Table 12.10 shows calculated L_{10} noise levels from both the Mount Pleasant mine and Bengalla mine at the two locations described above, for selected years of Mount Pleasant's operation. From *Table 12.10*, combined noise levels from the Mount Pleasant and Bengalla mines will be within relevant criteria for a single mine at all times, at the residences most likely to be affected by cumulative impact.

An exception to this is the 'Moore' residence located to the south west of the Mount Pleasant Infrastructure area (see *Figure 24)* which has the potential to be cumulatively affected by noise. Interpretation of noise levels from the nearest residences assessed in the Bengalla EIS indicate that combined noise levels at the residence will marginally exceed the relevant criteria and therefore be subject to Coal & Allied's Land Acquisition Policy.

Table 12.10 COMBINED IMPACT OF MT PLEASANT AND BENGALLA

Location	Year (for Mt Pleasant)	L10 Noise Level, dB(A)				
			Mt Pleasant		Total	
		Bengalla	Day	Night	Day	Night
Wybong Rd	2	31	26	26	32	32
near	3	30	26	24	31	31
Kayuga Rd	5	27	27	24	30	29
	10	32	34	27	36	33
	15	28	30	27	32	31
	20	21	26	23	27	25
Cnr. Wybong	2	28	33	31	34	33
and	3	28	35	31	36	33
Roxburgh Rds	5	28	35	29	36	32
	10	28	37	34	38	35
	15	28	35	30	36	32
	20	28	37	30	38	32
Criterion (single mine)					40	35

In the case of Kayuga mine, detailed noise level predictions were provided by Holmes Air Services on a grid covering the area most likely to be affected by cumulative impact with Mount Pleasant, for a number of years throughout the mine plan. This enables the presentation of combined noise contours for the two mines. Noise levels provided for Kayuga were early results which have since been refined, and hence cumulative noise predictions will be slightly overestimated. Predicted noise levels provided for Kayuga were maximum levels, and in keeping with the approach outlined in Section 12.3.2, 5 dB was subtracted from these levels to give estimated L_{10} values before combining them with data for Mount Pleasant.

The most critical year in terms of cumulative impacts from Mount Pleasant and Kayuga will be Year 3 of Mount Pleasant (assumed to be equivalent to Year 2 of Kayuga). Noise level contours for the combination of noise from Kayuga mine (Year 2) and daytime noise from Mount Pleasant (Year 3) are shown in *Figure 50*. Night-time noise levels from Mount Pleasant in this area are much lower, and do not add significantly to those from Kayuga.

It is clear that there are a number of residences within the village of Kayuga which do not fall within the 40 dB(A) daytime noise level contour due to either of the mines alone, but which do fall within the contour for the combination of the two. Noise from the combined sources therefore exceeds the daytime criterion for noise from a single mine. On the other hand, the criterion of 50 dB(A) L_{10}, derived from consideration of the EPA's maximum acceptable background noise levels, is not exceeded at any residences in this area.

12.3.8 *Mitigation Measures*

i. Noise and Vibration from Blasting

The maximum instantaneous charge required to meet the overpressure assessment criterion of 115 dB(Lin) is less than that required to satisfy the vibration criterion. Overpressure will therefore dictate the maximum instantaneous charge that can be used. The highest predicted values of overpressure and vibration will be in the south-west of the township of Kayuga in Years 4 and 5.

Techniques to reduce blast overpressure will be investigated during future mine development. This will include:

- close attention to blast design and execution in the North Pit during Years 4 and 5;
- providing sufficient stemming to ensure that excessive overpressure is not produced;
- controls on blasting under low cloud conditions, where a temperature inversion may be inferred;
- conducting a small trial detonation to monitor overpressure during unfavourable conditions; and
- co-ordinating blasting operations with adjacent mines wherever practical.

If it is not possible to limit overpressure to the assessment criterion then Coal & Allied will offer to purchase affected residences.

ii. Noise Control Measures

The noise amelioration measures proposed include:

- construction of an extensive noise mitigation bund along the eastern edge of the South Pit;
- limiting machinery and truck operations on overburden dumps in the east of the site to daytime hours;
- limiting night-time machinery and truck operations within the pit during years 7 - 12 to the second-highest bench;
- minimising transient noise, in particular truck reversing alarms. Use of alarms with variable sound levels will be trialled;
- plant and machinery used on site (including contractor machinery) will conform to the modelling criteria;
- use of best noise minimisation technology wherever practicable. This includes noise considerations in the selection of suitable plant and machinery for the site;

- to offer the installation of noise abatement measures at residences determined to be affected by noise from the mine. Affected residences are those receiving noise levels in excess of the criterion as shown on *Figure 50* and summarised in *Table 12.7*. The extent of noise abatement measures would depend on the building type and level of attenuation required. However, measures may include the installation of air conditioning, heavy glazing on windows facing the mine and possibly treatment of the roof/ceiling; and

- as an alternative to provision of noise mitigation measures the company would offer to purchase residences affected by noise levels which exceed the criterion.

12.4 NOISE AND VIBRATION FROM BLASTING

The EPA suggests a criteria of 5 mm/s and 115 dB(Lin) for blast induced vibration and overpressure respectively, which is the level that may cause concern or discomfort at residential properties. These criteria relate to daytime blasting (9.00am to 3.00 pm Monday to Saturday) and are significantly lower than levels likely to cause damage. The Standards Association of Australia establishes a ground vibration limit of 2 mm/s for heritage buildings. No limit is imposed on overpressure for heritage properties.

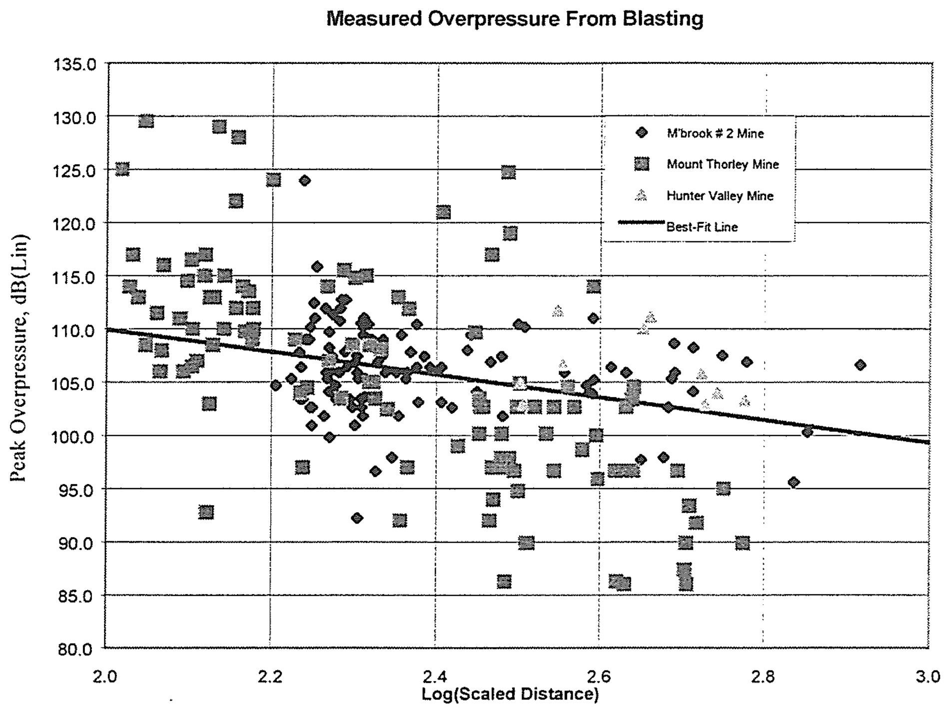
Noise and vibration levels due to blasting may be related to the "scaled distance" from the blast, which is defined as

Scaled Distance = $D/W^{(1/3)}$ for airblast overpressure, and

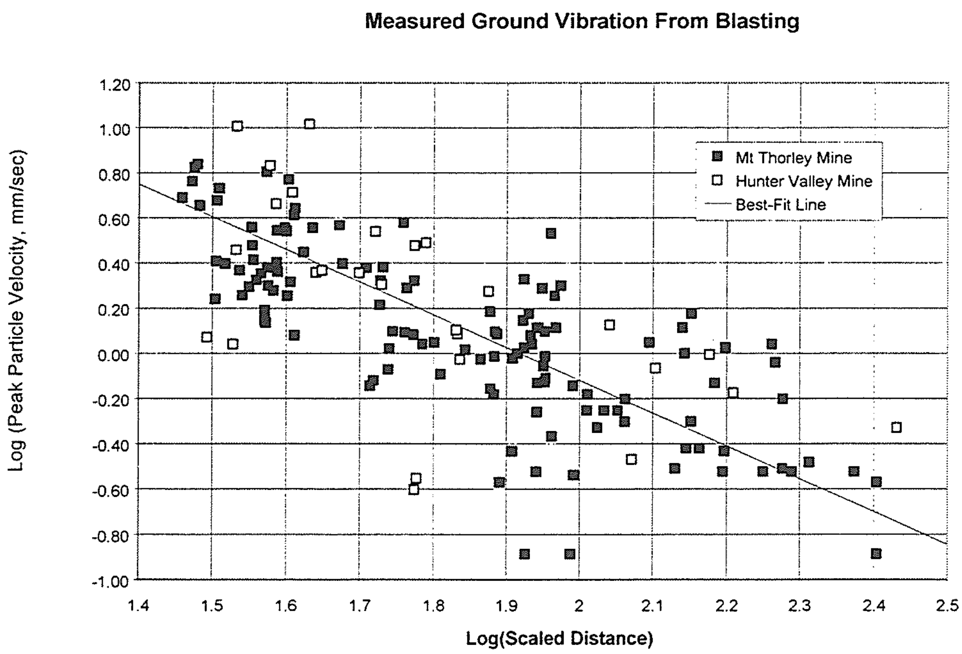
Scaled Distance = $D/W^{(1/2)}$ for ground vibration.

where D is the distance from the blast to the monitor, in metres, and W is the maximum instantaneous charge in kilograms.

The relationship between scaled distance and overpressure and ground vibration are to some extent site specific. Consideration was given to conducting small scale experimental blasts to develop a site specific equation for the Mount Pleasant Project. However, the smaller scale and quantity of data from this approach would not be representative of production blasts. As an alternative, a large number of blasts at the Mount Thorley Operations and Hunter Valley No. 1 Mine, as reported in Blastronics report "Drill and Blast Study: Mount Pleasant Project" were analysed and scaled distance equations developed. Airblast overpressure data for a further 115 blasts at Muswellbrook No. 2 Colliery were analysed. *Graphs 9* and *10* show airblast overpressure and peak particle velocity,



Graph 9 MEASURED OVERPRESSURE FROM BLASTING



Graph 10 MEASURED GROUND VIBRATION FROM BLASTING

From these data, likely overpressure and ground vibration at Mount Pleasant can be estimated for blasts at a given location and maximum instantaneous charge. The maximum instantaneous charge weight is calculated assuming a blasthole diameter of 270 mm loaded with emulsion at 1.3 g/cc density. The model predicted levels at properties outside the area of affectation due to noise or dust, as well as surrounding heritage listed buildings. Maximum vibration and overpressure levels are predicted to occur to the south west of Kayuga, during the blasting in the northern most mining blocks in Years 4 and 5. Predicted levels for overpressure and ground vibration at the nearest residence outside the zone of affectation is 109.1 dB(Lin) and 2.4 mm/s respectively.

As stated previously the scaled distance equations are to some extent site specific. To confirm the relevance of predictions for Mount Pleasant, predicted levels were compared to data published in the Bengalla and Bayswater No. 3 environmental impact statements. Predictions based on the Hunter Valley No. 1 Mine, Mount Thorley Operations and Muswellbrook Coal data were assessed separately. The predicted overpressure and vibration levels for the above location using the data published in the Bengalla and Bayswater No. 3 EIS's are 114.1 dB(Lin) and 2.27 mm/s and 114.2 dB(Lin) and 1.76 mm/s respectively. Using the Mount Thorley Operations and Hunter Valley No. 1 Mine data only, levels were calculated at 113.4 dB(Lin) and 2.4 mm/s. The overpressure level predicted using only the Muswellbrook coal data is 106.9 dB(Lin).

It should also be noted that whist the levels predicted are both below the criteria of 115 dB(Lin) and 5 millimetres per second, they were predicted using the derived average (ie. 50 per cent) curves, whereas the EPA require that 95 per cent of blasts produce overpressure and vibration levels below the nominated criteria. It will therefore be necessary for Mount Pleasant to limit overpressure and vibration levels more than what is required at Hunter Valley No.1 Mine or Mount Thorley Operations. The higher levels associated with these operations exist because neither of these mines is significantly constrained by overpressure or peak particle velocity limits due to the greater distance from the operations to the nearest residences. Muswellbrook Coal is required to place greater controls on their blasting operations in order to achieve acceptable vibration and overpressure levels as nearby residences, as will be the case for Mount Pleasant.

Mount Pleasant will however need to pay particular attention to the design and control of blasting operations. As indicated above, by the time the mine reaches the critical locations, operational personnel would have some years site-specific experience to draw upon in controlling blasting impacts. In effect there will be three or more years data collection from production blasts from which to determine specific Mount Pleasant scaled distance equations as well as to refine blasting techniques before reaching the critical areas.

Higher levels of overpressure and vibration are generally associated with poor blast design and/or control of blasting operations, and in the case of overpressure, meteorological conditions. Factors which influence the levels of vibration and overpressure include:

- Design Factors

  - stemming length;
  - burden and spacing;
  - maximum instantaneous charge weight; and
  - initiation sequence system and sequence.

- Control Factors

  - insufficient and/or quality of stemming;
  - inadequate burden and spacing;
  - overcharging of blasthole; and
  - inadequate delays between blastholes.

- Meteorological Factors

  - low cloud; and
  - presence of a temperature inversion.

Blasting in this critical area to the north-east of the North Pit will be well designed and managed. Having optimised the design to limit the maximum instantaneous charge, strict control will be placed on drilling and blasting operations to ensure the design is followed. In addition, blasting will not take place under adverse weather conditions such as low cloud conditions, or other situations where a temperature inversion may be inferred. To assess weather conditions, a further measure which will be adopted is to monitor a small trial detonation, for example firing a booster, prior to the main blast. If the overpressure level from the detonation is above a predetermined level, blasting will be delayed until conditions are more appropriate. This measure will be adopted if other measures such as correlation of weather station data fails to ensure that the blast overpressure is kept within the required limits.

The ANZECC guidelines, adopted by the EPA to assess blast overpressure and vibration, recommend that blasting should be conducted only once per day. For the Mount Pleasant Mine, it is proposed that blasting be limited to a maximum of one blast period per day (except where additional blasting is required for safety reasons). Blasting will be restricted to Monday to Saturday between the hours of 8.30 am and 4.30 pm. Blasting will preferably occur on weekdays, with blasting on Saturdays restricted to unavoidable situations such as when there has been extended adverse weather conditions during the preceding week days or there are extreme production constraints necessitating blasting. There will be no blasting conducted on Sundays or public holidays.

Blasting in the two pits will in general affect different receiver locations. For this reason, a network of blast monitors will be positioned around the area. All blasts will be monitored for both overpressure and vibration levels to ensure statutory limits are not exceeded.

12.5 TRANSPORTATION NOISE

12.5.1 Rail Traffic

Rail traffic on the proposed loop is expected to average 3 train loading operations per day (based on the maximum production rate), although the practical maximum useage of the loop is approximately 9 loading operations per day.

Based on a maximum sound power level of 124 dB(A) from a locomotive under full power, and assuming 9 train operations per day on the loop, calculations indicate that the EPA criteria for a new rail track would be met for all residences further than approximately 100 metres from the track. There are no residences within this distance of the proposed track alignment, and hence noise from this source is considered acceptable.

An assessment of the likely cumulative impacts of transporting coal by rail to Port Waratah is discussed in Section 14.4. This includes an assessment of likely impacts on air quality, noise and vibration and the operating capacity of the existing rail network in the Hunter Valley.

FreightCorp recognises that it has a responsibility to minimise the noise and vibration impacts from its operations on local communities living in proximity to rail lines. This responsibility is shared between the Rail Access Corporation, as the owners of the track, and rail operators.

In August 1996, FreightCorp in conjunction with the Rail Access Corporation, launched a range of initiatives to manage noise and vibration impacts from rail operations. The main initiatives included:

- modifications to locomotives to reduce noise from engine operation, generators, compressors and braking systems;
- introduction of larger (100 tonne) coal wagons and modifications of older wagons to reduce air borne vibration when operating empty; and
- establishment of a noise and vibration testing programme and an assessment of FreightCorp's Environmental Complaints database. This identified bunching and stretching noise produced by accelerating and braking wagons as a major source of annoyance. FreightCorp uses solid drawbar technology on all it's modern high capacity coal wagons and is retrofitting these to older style coal wagons to substantially reduce this noise.

12.5.2 Road Traffic

According to the noise level criteria set out in Section 12.2.4, an increase in traffic noise level at any residence of at most 2 dB due to traffic associated with the proposed mine would generally be considered acceptable. If the increase is greater than this, then noise levels would be acceptable only if the final $L_{eq,1hr}$ noise level for the peak traffic hour does not exceed 50 dB(A).

Changes in traffic volumes on various roads would result both from traffic associated with the mine itself and from proposed changes to the road system. These are discussed in detail in Section 14.3. The estimated changes in traffic volumes calculated in that section also include the effect of other proposed mines in the area.

Table 12.11 below shows estimated annual average daily traffic volumes at locations experiencing the largest impact from the proposed changes, as predicted by the modelling procedure described in Section 14.3. Estimated volumes with road alterations and mine traffic include the maximum expected level of mine traffic for any year, and the current level of traffic from other sources. Hence the table provides a conservatively high estimate of the magnitude of any change in traffic volume.

Table 12.11 CHANGES TO EXISTING TRAFFIC VOLUMES AND NOISE LEVELS

Location	Estimated Existing AADT**	Estimated Change in AADT	Change in Leq Noise Level, dB(A)
Castlerock Rd E	172	-7.0%	-0.3
Castlerock Rd W	72	-52.8%	-3.3
Dorset Rd (at Kayuga Rd) / Mt Pleasant N Link	101	877.2%	9.9*
Kayuga Bridge	1,841	-63.4%	-4.4
Kayuga Rd (N/Wybong Rd)	671	-31.6%	-1.6
Wybong Rd (at Reedy Creek)	518	-38.6%	-2.1
Dartbrook Link Rd (at Hwy)	338	57.4%	2.0*
Thomas Mitchell Dr at Denman Rd	1,650	29.6%	1.1
Denman Rd E of Thomas Mitchell	4,281	22.7%	0.9
New England Hwy at rail underpass	17,508	4.4%	0.2
Denman Rd at New England Hwy	8,691	7.3%	0.3
Blairmore Lane	276	63.0%	2.1
Ironbark Rd	903	27.7%	1.1

Notes: * *There are no residences located close to these roads, apart from residences owned by the Company*
** *AADT - Annual Average Daily Traffic*

Table 12.11 shows the change in the L_{eq} traffic noise level which would result from the changes in traffic volume shown. These calculations assume that the mix and average speed of traffic would be unchanged.

From *Table 12.11*, there is only one location - Blairmore Lane, to the north of the proposed mine - where noise level increases of greater than 2 dB are expected and where there are residences located close to the road. In fact, in this case the increase is likely to be higher than shown, since at this location existing traffic was over-predicted by the traffic model used. A better estimate of the existing annual average daily traffic on this road is 176 vehicles, with the future volume being 350 vehicles - equivalent to an increase of approximately 3 dB(A) in the L_{eq} noise level. Approximately half this increase would be due to traffic related to the Mount Pleasant mine.

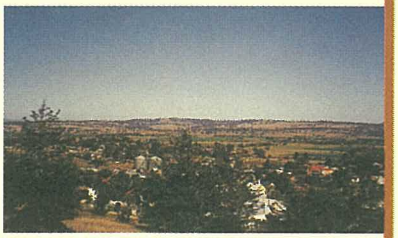
For Blairmore Lane, traffic noise levels with the predicted future traffic volume were calculated using the standard FHWA methodology developed by the U.S. Federal Highways Authority. Assumptions included in the calculations were:

- 6.6 per cent of traffic volume consists of heavy vehicles (modelled as "medium trucks" in the FHWA methodology). This is consistent with the present situation;
- 19 per cent of the total traffic volume would travel during the peak hour. This consists of 33 per cent of mine-related traffic and 5 per cent of other traffic;
- mean traffic speeds are 90 kilometres per hour for light vehicles and 80 kilometres per hour for heavy vehicles; and
- the ground between the road and receiver is acoustically soft.

Results indicate that the criterion peak-hour noise level of 50 dB(A) L_{eq} would be met at all residences greater than approximately 50 metres from the road. There are approximately 12 residences located closer to the road than this.

In practical terms the periods in which the criteria will be exceeded are limited to a one hour peak period during the Mount Pleasant shift changes (6 am to 8 am and 6 pm to 8 pm). During these periods there will be an additional 27 vehicles or 1 additional vehicle every 2 minutes with the majority of these being employee vehicles as discussed above. Outside of these periods traffic increases are expected to be minimal with the resultant noise increases well below 2 dB(A).

VISUAL 13



This chapter assesses the visual effects of the proposal and outlines measures to reduce identified adverse impacts. It was prepared from on-site fieldwork, photographic survey, analysis of aerial photographs and topographic maps and analysis of computer generated images of the mine.

13.1 EXISTING VISUAL CHARACTER

A detailed visual assessment of the proposal which is included as Supplementary Report 10 was completed by Geoffrey Britton. This chapter summarises that study.

13.1.1 Regional Landscape Setting

The regional landscape surrounding Muswellbrook has several distinct landscape types. These include rugged, forested landforms incised by numerous tributaries of the Hunter and Goulburn Rivers, undulating pasture lands and the distinct checkered pattern of crops, vineyards and orchards within the broader floodplain.

Parts of the regional landscape are visually important having been classified by the National Trust of Australia (NSW). The site lies between two classified areas which contain rural scenery of great charm and importantly also draw on the dramatic, forested highlands beyond as backdrops to views. These include the Momberoi-Scone rural landscape to the north and Muswellbrook-Jerrys Plains rural landscape to the south. In classifying these areas the Trust recognises important scenic heritage values worthy of conservation. Although the classifications do not empower the Trust to exercise any legislative controls they generally reflect strong community interest and support.

East of the site the Hunter River forms a distinctive linear graphic on the broad alluvial flats. This flood plain contains numerous agricultural land uses, separating the undulating foothills to the west and east.

Foothills east of the flood plain include the towns of Muswellbrook, Aberdeen and Scone. Those to the west are mostly pasture and grazing land with varying amounts of remnant *Eucalyptus* woodland. Beyond the western foothills the landform is more rugged with a dense forest cover. Distinctive features on the southern horizon include the high ranges of Wollemi National Park.

Other notable visual elements provide evidence of various industrial activities. These include the Muswellbrook open-cut mines between Bells Mountain and Muswellbrook, the Bayswater No. 3 open-cut mine to the south (visible from the Denman Road), the major electricity easement east of Muswellbrook with its various substations and the Bayswater Power Station cooling towers and their prominent steam plumes. Also visible from the New England Highway are the timber mill north of Muswellbrook and, further north near Aberdeen, the coal stockpiles and rail loading facility of the Dartbrook Mine and from Kayuga Road, the main plant area of the Dartbrook Mine.

13.1.2 Visual Catchment

Views of the site are mostly from the south, east and north as shown on *Figure 53*. Potential views from the west are restricted by elevated land west of the site.

The visual catchment is defined by areas between Scone and Aberdeen to the north; the New England Highway, Main Northern Railway and Muswellbrook to the east; Denman Road to the south; and, in the west, parts of the elevated land around Wybong and Roxburgh Roads. Distances from residential areas near the site range from about two kilometres at Muswellbrook to five kilometres at Aberdeen.

Close range views of the site are possible from four rural roads traversing the southern, eastern and northern site boundaries as well as passing through the centre of the site; Wybong, Kayuga, Dorset and Castlerock Roads respectively. Between these roads and the limits of the visual catchment are generally low elevation viewing points within the Hunter River flood plain. Higher land near the site includes parts of the foothills directly to the south ('Overton' ridge), east ('Negoa' ridge) and north ('Maryvale').

Important vantage points with high elevations include the two largest urban settlements within the visual catchment - parts of Muswellbrook at a height of about 200 metres and parts of Aberdeen at about 230 metres.

The landscape within the site is surmounted by the peak of Mount Pleasant at an elevation of 368 metres. Radiating drainage lines from this point have produced a series of well modulated ridges.

The ridges east of Mount Pleasant form a pattern of gently descending fingers towards the north-east, east and south-east. These spurs are abruptly truncated at the western edge of the Hunter River flood plain.

Vegetation cover shows extensive clearing such that only scattered areas of trees remain in the middle and western parts of the site. A few remnant stands of older trees occur near Mount Pleasant and in the south-western corner of the site.

The eastern edges of the site have little vegetation with occasional derelict areas (such as the disused quarry at the corner of Kayuga Road and Castlerock Road) providing a contrast to western parts of the site. The only permanent water elements are numerous farm dams.

13.2 PROPOSED LANDSCAPE CHANGES

13.2.1 Mine Development

i. Mine Areas

Mining results in a number of changes to the existing landscape. These include:

- initial excavation of the 'Piercefield' and 'Warkworth' South Pits;
- progressive excavation of the North and South Pits each about three kilometres long and 150 to 200 metres deep;
- construction of new landforms using overburden from the pits; and
- construction of a series of fine rejects emplacement areas in the west of the site.

ii. Bunding

A key mitigatory technique proposed is an extensive earth bund along the eastern edge of the South Pit. This landform will take several years to construct during which time it will be prominent. Construction will commence early in the project program to reduce not only the visual impact of mining activities but also noise and dust. During construction the bund will be progressively vegetated with grass and trees. From an age of about five years, the trees would improve the screening effect of the bund.

iii. Overburden Emplacement

Four areas of overburden emplacement are planned, two east of the main pits and two large out-of-pit emplacement areas to the west of the pits.

The south-western emplacement will reach an elevation of about RL280 within the first two years of mining. By Year 5 of mining the north refill landform will also be evident at about RL280. By about Year 10 of mining this landform will have an elevation of RL300 while the north western emplacement will range in elevation from RL285 to RL310. Also by this stage the south-western emplacement will reach its maximum elevation of RL325.

The two northern emplacements will reach their maximum height by Year 20 of mining (about RL315 for the refill area and about RL335 for the north-western emplacement). Refill landforms for the South Pit will also reach about RL255 (north) and RL240 (south) at this time.

iv. Fines Rejects Emplacement Areas

Fines rejects emplacement areas are planned within two gullies in the western portion of the site. The gullies are defined by south-westerly trending ridges such that views of the emplacements from public property are limited to two sections of Wybong Road. These are immediately west of the junction with Roxburgh Road and where the road crosses the spur between Spring and Sandy Creeks. In both cases sightlines to the dams are presently obscured by remnant woodland vegetation.

The most likely views of the fines rejects emplacement will be from cleared private property directly facing the gullies.

By incorporating extensive screen planting in the early stages of the project the most likely potential visual impacts will be during dam construction.

13.2.2 *Infrastructure Development*

i. Coal Plant Area

This area, located in the south-western corner of the site, includes the ROM and product coal stockpiles and the coal preparation plant. Components within this area which could be seen above the proposed screening vegetation along Wybong Road include:

- the tallest transfer station tower (up to about RL260);
- the reject bin and tower (up to about RL259);
- the surge bin and tower (up to about RL249);
- the coal preparation plant building and the product coal stockpile (both up to about RL240); and
- the product coal transfer station tower (up to about RL238).

These structures will be located below the enclosing tree-lined ridge in the west of the site ensuring that none of them would be seen in profile along the ridgeline horizon.

Many of these structures will be of open steel frame construction and over a distance of about six kilometres will not be readily noticeable provided surfaces are treated.

ii. Administration and Industrial Area

This area is also located in the south-western corner of the site and includes several low-profile buildings and the large workshop block with an elevation of RL270.

These buildings will be mostly visible during their construction with bunding and dense screen planting along Wybong Road effectively eliminating views after a few years.

iii. Ancillary Infrastructure

Other components of the mine infrastructure with the potential to alter the existing landscape include the rail network with associated cuttings and embankments; coal loading bin and drive house compartment; the relocated 66 Kilovolt (kV) powerline; and construction of the pipeline from the Hunter River pump station.

The rail loadout bin and its open steel-framed tower together with the drive house structure will be potentially visible from nearby areas. These structures will be most evident from the south to east until dense screen planting reaches sufficient maturity after 12 to 15 years. Other proposed measures include the use of appropriate colours and finishes for the structures with revegetation in cuttings and embankments.

The diversion of the 66kV powerline involves moving an existing structure. As the new line will be supported by single poles of non-reflective, coloured finishes rather than large pylon towers this is not anticipated as a major source of potential visual impact.

For the pipeline linking the Hunter River and the process water dam the construction will be the only phase likely to cause visual impact. This would be short term and will be controlled through minimising the width of the pipeline trench as well as the area available for construction access. The pipeline will be constructed in the rail line and connecting conveyor corridor.

iv. New Roadworks

As outlined in Section 6.1.6 and Chapter Fourteen some changes to the surrounding rural road network will be necessary. Anticipated visual effects relating to these roads will be short term, being limited to disturbance from construction.

13.2.3 Operations

i. Mine Vehicles and Dragline

At various stages of mining some of the larger machinery may be seen moving across the site. Such machinery may include haul trucks, the upper part of the dragline boom and vehicles operating immediately west of the highwalls.

Throughout the mining period haul trucks will operate 24 hours per day. Haul roads have been designed to be screened by rehabilitation landforms. Screen planting is also proposed alongside the haul routes. Mine operations will see haul trucks using access ramps on the western sides of emplacements for much of the time. However along sections of the higher parts of emplacement landforms, especially before proposed tree planting has matured sufficiently, the lights of haul trucks and less frequently the flashing safety lights of smaller vehicles, may be momentarily visible at night.

For the duration of the mine most dragline machinery will not be visible beyond the site except where screen planting has not sufficiently matured to shield views from parts of Dorset and Roxburgh Roads. Only when operating on the higher benches will the upper part of the dragline boom be visible from elevated vantage points. The boom structure consists of an open frame with bracing spars and thick cables. This, together with an appropriate non-reflective colour surface, should minimise visual impact from the dragline.

Other mine machinery that may be intermittently visible during the project include drill rigs, mining shovels, front-end loaders and lighting towers where they operate on the higher parts of the site and along the initial overburden removal benches.

ii. Nightlighting

As mining will run continuously, the effects of lights either as localised direct light, or a soft light haze or both may be visible on occasions during the night.

Particular attention has been given to designing lighting for the main plant areas. The height of lights will be fixed as low as possible and directed to the ground or away from possible view locations. Similarly temporary movable lighting systems for more elevated operational areas such as prestripping benches and highwalls will be focused on immediate work areas and away from likely off-site viewing points.

Most lights on the dragline boom will be fixed at a low height. Further lights will only include those necessary for safe operations and illumination of the dragline bucket. The only lights higher along the boom will be for emergency maintenance and therefore will be considerably less powerful than those focussed on the mine work areas.

While a soft, overall light haze may be evident over parts of the site it is likely to be more apparent with low, heavy cloud cover because light is reflected off the lower clouds.

iii. Ephemeral Changes

Another observable change from a distance of some kilometres will be localised dust clouds created by blasting. It is likely that blasting will be undertaken daily, six days a week.

Apart from normal care and planning in setting the explosive charges little can be done to reduce the visible effects of blasting. However, these short-lived dust plumes will not cause major visual impact.

13.3 VISUAL IMPACTS

13.3.1 Views from Urban Areas

i. Muswellbrook

Of the villages and towns surrounding the mine Muswellbrook is considered the most sensitive to visual impact, being the largest settlement in relative proximity to the site. Most of Muswellbrook is located below 180 metres elevation offering potential views of the main bund and the emplacement landscapes (particularly that for the North Pit).

For elevations above 180 metres a representative site was selected within recent subdivisions north-east of the commercial part of Muswellbrook. This is at approximately RL 200 and is 3.5 to 4 kilometres from the closest parts of the mine, with extensive views to the west as shown on *Figures 54* and *55*. It is expected that views from this point will decrease as street and allotment vegetation matures.

Initially the most obvious visual changes will be the construction and planting of the main bund along the eastern edge of the foothills, the Piercefield Pit highwall, upper areas of the south-western emplacement and a small section of the South Pit as shown on *Figure 54*.

Other visual features may be the upper sections of the transfer tower and bin and the coarse reject bin near the coal preparation plant. The top of the workshop block will be visible, albeit over a distance of about 8.5 kilometres.

As shown on *Figure 55*, from Years 5 to 10 of mining, significant visual features will include:

- completion of the eastern bund and establishment of vegetation ;
- the upper levels of the North Pit; and
- north-western and south-western emplacements.

By about Year 15 the following components of the development will become visible:

- south-facing batters of the North Pit emplacement;
- sections of highwall of the North Pit;
- the upper sections of the South Pit emplacement; and
- some of the prestrip sections above the highwall of the South Pit.

By Year 20 the bund and lower areas of the emplacement landforms will have established vegetation while the upper emplacement sections would be mostly grassed. Ultimately no highwalls or cut/fill batters will be apparent.

At night the anticipated visual effects will include a soft haze from reflected light as well as small areas of intermittent and localised light from mine vehicles.

The new revegetated landforms from the placement of overburden will be the most noticeable long-term impact from this location.

ii. *Aberdeen*

The town of Aberdeen is about five to six kilometres from the closest parts of the mine. Most elevated sections of Aberdeen, and locations on the western edge of the town, offer views of the northern and eastern part of the site.

A representative site in Aberdeen at about 235 metres elevation was selected to determine the visual impacts as shown on *Figures 58* and *59*.

Initial views from these parts of Aberdeen include construction of the upper sections of the main bund. From this time to about Year 20, potential visual impact will centre on the North Pit emplacement landform and views of sections of the North Pit highwall.

Over successive years, views of the highwall will vary depending on the progress of the North Pit and adjacent Kayuga open-cut mine. After the North Pit is finished, highwall views will be eliminated by regrading and rehabilitation.

From about Year 10 the north-western emplacement will become visible.

Nightlighting effects will be similar to those described for Muswellbrook, only from a greater distance.

iii. Kayuga

The most visible aspects of the proposal from Kayuga will include:

- the main emplacement landform for the North Pit;
- the north-western emplacement by about Year 10; and
- parts of the North Pit highwall from about Year 5.

As mining progresses to the west, advanced screen planting along Dorset Road will contribute to reducing the extent of visible highwall.

Nightlighting effects will include an ambient haze near the active mine as well as intermittent and localised light from vehicles traversing the emplacement landforms.

In context however the northern part of Kayuga already has the Dartbrook Mine facilities, while the proposed open-cut Kayuga Mine will be west of the village with the main emplacement landform less than one kilometre away. This same emplacement will screen parts of the site from Kayuga.

iv. Rural Properties to the West

a. 'J Moore Property' (RL 245)

Potential mine-related visual impacts from the residence include the top few metres of the workshop building; a soft light haze at night; and ephemeral changes such as blast plumes.

After about Year 12 intervening screen trees will begin to reduce the visible extent of the workshop, as will the architectural design treatments when the building is constructed.

b. 'Gilgai' Homestead (RL 240)

Some of the northern-most parts of the fine rejects emplacements in the gully south of the Broomfield ridge may be visible through intervening trees from 'Gilgai' homestead. Also the top few metres of the workshop building may be visible over a distance of two kilometres from parts of the property. A combination of screen tree planting and architectural design of the workshop will assist in ameliorating potential views of the building.

From the more elevated driveway of 'Gilgai', the fine rejects emplacement will be screened by intervening woodland vegetation while the top few metres of the workshop building may be visible beyond an intervening knoll and mature vegetation within the property.

Other potential visual effects will include a soft light haze at night and ephemeral changes.

c. 'B Bates' Property

The 'Bates' residence will have potential intermittent views of some of the southern-most fine rejects emplacement area and minimal views of the northern-most area. The top few metres of the workshop building may be intermittently visible through a dense band of horizon trees and the closer, intervening trees over a distance of two kilometres.

Other visual changes from the 'Bates' property will be a soft light haze at night and ephemeral effects.

d. 'M Saunders' Property

The Saunders residence will have potential intermittent views of some of the southern-most fine rejects emplacement area. Intermittent views of the highest section of the south-western emplacement landform will also be visible after about Year 8 of mining over a distance of three kilometres.

The top few metres of the workshop building may be intermittently visible through a dense band of horizon trees over a distance of two kilometres, although mitigatory measures described above would assist in ameliorating potential views of the building.

13.3.2 *Views from Travel Routes*

i. New England Highway

The New England Highway is an important travel corridor carrying larger traffic volumes than other roads in the vicinity. The highway is about two kilometres east of the site at its closest point. The southern part of the site is visible from the New England Highway when entering Muswellbrook. From this location the Piercefield Pit highwall will be potentially visible from about eight kilometres away, as will the southern part of the bund (six kilometres away) and the south-western emplacement (10 kilometres away).

The highway between Muswellbrook and Aberdeen will have potential site views, albeit from low elevations as shown on *Figures 56* and *57*. Some intermittent views of emplacement landforms from about Year 8 would be possible for southbound travellers between Scone and Aberdeen. Viewing distances would range from 12 to 17 kilometres.

Most of the highway from Muswellbrook to 'Lyndema Park' is barely higher than the adjacent alluvial flats. From these points, visual impacts will include construction and rehabilitation of the northern emplacement landforms. Due to the low viewer position, these new landforms will appear as very narrow horizontal bands below the western horizon. The landscape to the west has a low profile unlike, for example, views to the north and east where the enclosing Browns, Colonel and Bells Mountains form a relatively dramatic high profile horizon. Importantly, none of the proposed site changes will impede views of higher ranges to the west as shown on *Figures 56* and *57*.

The section of highway from just north of 'Lyndema Park' to the bottom of the ridge on which is located 'Elgin', 'Dartmouth' and 'Roselea' is generally screened from the mine by the adjacent 'Negoa' and 'Glenmore' ridges west of Kayuga Road which will not be disturbed.

The elevated section of the highway at Dartmouth ridge (180 metres) and unimpeded views from north of the Dartbrook Mine road junction with the highway will provide views for southbound travellers.

The first activities visible from Dartbrook ridge will be the construction and rehabilitation of the North Pit emplacement by Year 5. Limited glimpses may be available of the extreme northern end of the North Pit highwall. By about Year 10 the north-western emplacement will be visible from six kilometres away.

This section of the highway has the main product coal stockpiles and coal loadout facilities from Dartbrook Mine and a large electricity substation near Aberdeen. The proximity of the proposed Kayuga open-cut mine will also be close to the highway.

Views from the highway will also be limited to the time it takes to travel this section of roadway.

Nightlighting visible from the highway will include a general haze of reflected light over the site with small points of intermittent light from mine vehicles.

ii. Main Northern Railway

Views from the Main Northern railway will be similar to those from the highway. The railway runs next to the road for most of this section at a slightly higher elevation.

Consequently, more of the mine will be visible, with nightlighting effects similar to those from the highway.

iii. Kayuga Road

Views from Kayuga Road on the eastern edge of the site are of a low, extended sequence of foothills rising above the flood plain. Likely visual impacts from the proposal include construction of the main bund and rehabilitation of the North Pit emplacement.

Views from the southern part of Kayuga Road and areas near Kayuga village (including nightlighting effects) will be similar to those described in Section 13.3.1.

iv. Wybong Road

From the intersection with Kayuga Road up to where Wybong Road rises from the alluvial flats into the eastern edge of the foothills, noticeable views of the proposal will include the construction of the main bund and until completion of the bund, the Piercefield Pit highwall.

Higher parts of Wybong Road will have close range views of the Piercefield and Warkworth Pits and their highwalls, the south-western emplacement, coal stockpiles, the preparation plant and the coal loadout structure.

From about Year 9 a section Wybong Road will need to be closed so that barrier coal between Mount Pleasant and Bengalla Mines can be recovered. This will be assessed in conjunction with Muswellbrook Shire Council according to recommendations in the Muswellbrook Western Roads Strategy.

Wybong Road between Roxburgh Road and Sandy Creek will have views of the fine reject emplacement areas. However, owing to the dense remnant woodland on intervening ridgelines it is expected that these views will be minimal.

v. Castlerock Road

Castlerock Road (also known as Coal Creek Road) is one of only two public roads that cross the site. The eastern-most section of the road is in the centre of the North Pit and will therefore be closed. To maintain community transport needs a new section of road will be built around the western boundary of the site linking up to a realignment of Dorset Road.

The closest mine activity will be the north-western emplacement which will sit below the enclosing western ridgeline to minimise visibility from the road diversion. The construction of the upper levels of the emplacement may be evident but would become less apparent as screen planting matures. Nightlighting effects will be as described for Section 13.3.1.

vi. Dorset Road

Dorset Road follows the northern site boundary. A buffer zone will be retained along this road with substantial screen planting. Part of Dorset Road will be diverted along the northern site boundary between Mount Pleasant and Kayuga mines.

Until screen planting matures, early construction works such as the formation of the emplacement and early mining phases of the North Pit will be visible.

Visible nightlighting effects will be similar to Castlerock Road with additional close range lighting in active mine areas.

vii. Denman Road

From South Muswellbrook the first two kilometres of Denman Road are low lying with limited site views.

Visible features will include the Piercefield Pit, particularly the highwall, and the main bund and the south-western emplacements. Eventually the tops of the North and South Pit emplacements will also be visible behind the bund after about Year 12.

Denman Road crosses the edges of a foothill north of Mount Arthur about three kilometres from South Muswellbrook. At this point the road reaches about 180 metres elevation, offering the most revealing views of the site from Denman Road as shown on *Figures 60* to *63*. Similarly to other sections of Denman Road visible changes will include:

- the Warkworth South Pit highwall;
- the south-western emplacement landform;
- the southern part of the main bund; and
- possibly the top of the rail loadout facility.

Views of the Piercefield Pit highwall will be possible from this vantage point, but owing to intervening emplacement landforms from Bengalla Mine, these views will be screened. Some advanced planting has already been established along this part of Denman Road for the Bengalla project.

From about Year 10 the North Pit emplacement will become visible. By about Year 15 to Year 20 the uppermost parts of the south-facing batters of the North Pit may be visible. Existing easterly-trending ridges from Mount Pleasant will obstruct views of the north-western emplacement.

Nightlighting effects will be similar to those from the Main Northern Railway and New England Highway.

viii. Roxburgh Road

About one kilometre from Wybong Road, Roxburgh Road passes over a high ridge at RL 270. From this location views of the mine for northbound commuters may include the top of the workshop building and top of the rail loadout tower and bin structure. These views will be limited by remnant woodland vegetation and additional planting proposed in the vicinity of the structures.

ix. Western Link Road

A new link road is proposed to connect Wybong and Dorset Roads which will follow ridges in the western portion of the site. In this location potential visual impacts will include the industrial area, the two western emplacements and the fine rejects emplacement areas. Views from these areas will be reduced by a combination of bunding and screen planting.

13.3.3 Views from the Hunter River Floodplain

The low elevation of this area means that potential visual impacts will be limited to secondary mining activities such as bund and emplacement construction rather than the mine pits themselves. Temporary views of the Piercefield Pit highwall near Logues Lane will occur until the bund is completed.

Long-term views from the floodplain to the east and north east of the site will include of the higher parts of the emplacement landforms. The treeless ridge on which the 'Negoa' Geodetic Station is located together with a ridge further west, effectively obscure views of the mine from this part of the floodplain.

The low-lying section from south of the 'Negoa' ridge to Kayuga Road will have views of the main bund and emplacement landforms during construction.

From the vicinity of 'Edinglassie' to 'Lyndhurst' the most significant changes to the landscape will include the south-western emplacement. Bengalla Mine will effectively screen any other views.

Potential lighting effects will be similar to those for the Main Northern Railway and New England Highway though, owing to the generally lower elevation, fewer mine vehicle lights will be visible. Some fixed lighting may be visible near the coal preparation plant and rail loadout areas from parts of the floodplain south-west of Muswellbrook.

13.3.4 Views from Classified Rural Landscapes

The two rural landscape areas classified by the National Trust of Australian (NSW) are described in Section 13.1.1 and, although the site is outside these areas, they still need to be considered.

i. Momberoi-Scone Rural Landscape

Mount Pleasant is visible from the Momberoi-Scone rural landscape area. Visible aspects of the mine will include the highest parts of the two northern emplacement landforms. These areas will be rehabilitated to give similar character to the rural landscape area. The proposed Kayuga Mine emplacement will also obscure parts of the site from this area.

ii. Muswellbrook-Jerrys Plains Rural Landscape

The Muswellbrook-Jerrys Plains rural landscape south of the site is enclosed at its northern limit by the 'Overton' ridge and adjacent western foothills. Mine-related features visible from this area will include the main bund and, until completion of the bund, the Piercefield Pit highwall.

Visual impacts from the proposal on both rural landscape areas will be very limited, with potential impacts reduced by rehabilitation.

Effects from lighting will be the same as from the respective parts of the flood plain. Both rural landscape areas are likely to be more influenced by the two adjacent mine projects.

13.3.5 Cumulative Impacts

The mines either side of Mount Pleasant were taken into account in assessing cumulative visual impacts.

The assessment indicated that emplacement landforms from adjoining developments will effectively screen aspects of the proposal.

While views of rehabilitated landforms will replace those of mine pit highwalls, cumulative landscape changes will be evident over a distance of up to 11 kilometres from the southern part of Bengalla Mine to the northern part of Kayuga Mine.

Assuming the three commence within five years of each other the most evident cumulative effect will be the rapid development of emplacement formations, most of which would continue to grow throughout the life of each project until final reshaping.

Potential visual impacts incorporating mitigatory measures are summarised in *Table 13.1*.

Table 13.1 VISUAL IMPACT SUMMARY

Representative Vantage Points	High	Medium	Low
Muswellbrook	• Bund • Emplacements	• Active mine areas • Ancillary structures • Mine vehicles • Nightlighting	• Main plant area • Mine vehicles • Ephemeral changes
Aberdeen	• Emplacements	• Active mine areas	• Mine vehicles • Nightlighting • Ephemeral changes
Kayuga	• Active mine areas • Emplacements • Mine vehicles • Ephemeral changes	• Nightlighting • Ephemeral changes	
Main Northern Railway	• Bund • Emplacements	• Active mine areas	• Mine vehicles • Nightlighting • Ephemeral changes
Flood plain	• Bund • Emplacements • Active mine areas (initially only)	• Active mine areas • Mine vehicles • Emplacements	• Nightlighting • Ephemeral changes • Ancillary structures • Mine vehicles
Wybong Road	• Bund • Emplacements • Ancillary structures • Active mine areas (initially only) • Construction of fine rejects emplacements	• Ancillary structures • Mine vehicles • Ephemeral changes • Fine rejects emplacements	• Mine vehicles • Nightlighting • Ephemeral changes
Roxburgh Road		• Workshop building • Rail loadout structure • Ephemeral changes	• Workshop building • Rail loadout structure • Nightlighting
Dorset Road	• Active mine areas • Emplacements • Mine vehicles/ dragline • Ephemeral changes • Nightlighting	• Ephemeral changes • Nightlighting	
Momberoi-Scone Classified Landscape Area	• Emplacements • Active mine areas	• Active mine areas	• Nightlighting • Mine vehicles • Ephemeral changes

Notes: 1. *With mitigatory measures in place, some mine activities or structures may overlap two rating categories either because the potential visual impact diminishes over time or becomes too difficult to differentiate.*

2. *The summary assumes that Kayuga Mine is operating.*

13.4 MEASURES TO MITIGATE VISUAL CHANGE

Visual mitigation priorities are summarised in Chapter Fifteen.

13.4.1 Topographic Measures

The most effective way to minimise longterm visual effects would be to provide a landform similar to the pre-mining topography described in Section 13.1.2. Since the project entails a substantial amount of earthworks and landform reshaping, new landforms were designed to conform with the morphological characteristics of the local landscape. New landforms will emulate the existing pattern of ridges and valleys to form an appropriate link between the retained land to the west and east of the mine site. Because final voids will remain in both southern and northern mining areas it will not be possible to completely restore the continuity between the western and eastern parts of the landscape, although this will only be noticeable from a few locations.

Existing ridgelines that reduce or eliminate potential views of the mine will be largely retained where possible, though some will be mined in the final stages of the project. The main ridge system in the western portion of the site will be retained. The mine will sit below the ridgeline, maintaining the existing horizon character. The central ridge extending easterly from Mount Pleasant will be retained down to the upper levels of the Piercefield Pit. Two existing ridges in the north-east of the site near Kayuga Road will also be retained.

A more indirect measure to address local views is to screen parts of the mine with visual bunds. The main bund along the eastern boundary will significantly reduce visual impacts from the east. The bund has been designed within the spacial limitations of the site to emulate the existing landform scale and shape, including a variable ridgeline elevation.

Closure of sections of Castlerock and ultimately Wybong Road (in conjunction with Muswellbrook Shire Council) will also assist in reducing visible mine areas from the west and south. A visual bund will be constructed with vegetation screening along parts of the replacement road that will follow the western portion of the site.

13.4.2 Vegetative Measures

Vegetation will play an important role in reducing visual impacts from the initial stages of mine development until well after the end of mining. New plantings on the bunds, rehabilitated landforms and fine rejects emplacements will screen these areas as well as re-establishing vegetation patterns consistent with the former woodland character of the site. An advance tree planting program has been initiated by Coal & Allied with about 25,000 trees planted on site to assist in screening initial works.

The bund will be planted or directly seeded using mixed native species, with a preference for those indigenous to the site. Vegetation will be more densely concentrated along ridges and upper side slopes, becoming sparser down the side slopes.

Appropriate plantings of native trees will be interspersed throughout the industrial area and surrounds as shown on *Figure 14* which includes a conceptual landscaping plan for the administration area.

New landforms created as part of the rehabilitation process will be quickly stabilised with grasses and seeded with native tree species. Again, a higher density of trees will be planted on ridgelines and some gullies, with sparser areas across side slopes.

Other general principles to establish vegetation on site include:

- extensive planting programs from the beginning of the project to establish effective screens as quickly as possible;
- direct seeding techniques for large revegetation areas such as emplacement landforms. More mature sized species will be used in limited high profile areas where immediate results are required such as the administration area; and
- consideration of rehabilitated side slopes for planting commercial species.

Coal & Allied will apply the experience with rehabilitation and stabilisation techniques gained from Hunter Valley No. 1 Mine to this project. This will be vital in maintaining the extensive vegetation program proposed. Examples of rehabilitation works and landscaping at Hunter Valley No. 1 mine is shown on *Figure 23*.

13.4.3 Operational Measures

Operational measures to reduce visual effects involve the siting or treatment of mine structures and the design and operational criteria applied to nightlighting. Locating the rail loop, infrastructure and fines rejects emplacement in existing gullies will assist in reducing potential views of these areas. Haul roads will be located behind or to the side of ridges wherever practical.

Structures that are prominent due to their height or size will be treated using appropriate design, colours and surface materials.

Specific lighting modifications will include lowering fixed lighting for operational areas and directing work lights away from settlements. Other design criteria which will be used generally to minimise site lighting effects include:

- providing only sufficient lighting for safe and efficient operation;
- where safety will not be compromised, provision of time delay automatic switch-off for access lighting where suitable;
- enclosing all buildings, most elevated conveyor galleries and parts of the conveyor transfer stations; and
- using bunding and vegetation to screen lighting.

TRANSPORT 14

This chapter outlines transport requirements for the proposal including future road network changes. The assessment of likely traffic impacts and the need for mitigation measures and safeguards is based on daily traffic volume increases on effected roads and peak hour traffic volume increases at intersections. Future mine and cumulative rail operations are also described.

14.1 SUMMARY OF TRANSPORT REQUIREMENTS

Site access will be via the infrastructure area located adjacent to Wybong Road, about eight kilometres west of Muswellbrook. The rural road network is shown on *Figure 64*, which includes recent mine link road connections in the Muswellbrook Area.

Coal produced at the mine will be transported by rail to the port of Newcastle. This will greatly reduce potential heavy vehicle impacts on surrounding communities. Heavy vehicle traffic will generally be limited to construction materials, plant, fuel and consumables. The proposal will nevertheless generate significant volumes of car and other light vehicle traffic during the 16 to 18 month construction period and 21 year operating cycle.

Origins and destinations of traffic were investigated to identify access routes likely to be affected by the proposal. Likely traffic impacts and the need for mitigation measures and safeguards are assessed.

A number of road and rail transport issues were identified in consultations with Muswellbrook Shire Council and government authorities. The following key transport issues were considered:

- future traffic generation and distribution at the mine during both construction and operation;
- future road network changes to be implemented during or after the year 1998 including road closures and diversions;
- potential cumulative traffic impacts of the proposal after the year 1998 in conjunction with the nearby Dartbrook/Kayuga and Bengalla Mines;
- the future use of the Bengalla Mine Link Road as the major access route for the Mount Pleasant Mine, for traffic to and from Muswellbrook and the south;
- other access routes to the New England Highway;
- the suitability of the existing single lane Kayuga Bridge (also known as Muswellbrook Bridge) across the Hunter River;
- temporary local road closures during blasting;
- intersection improvements;
- road safety;
- future use of rail transport and rail line capacity to the port of Newcastle; and
- proposed rail loop construction and transport operations.

14.2 ROAD TRANSPORT

14.2.1 *Existing Roads and Access Routes*

The rural road network surrounding the site is shown on *Figure 64*. A brief description of the relevant roads is given below including any likely changes to traffic patterns resulting from future road connections and road closures determined by the Muswellbrook Western Roads Strategic Traffic Study (Muswellbrook Shire Council, 1997).

i. New England Highway

This is a major state highway passing through Muswellbrook which conveys local, regional and interstate traffic. Outside the Muswellbrook urban area the road is generally a high standard (100 kilometres per hour design speed) rural highway. In Muswellbrook there are a number of intersections with roundabouts or traffic lights.

A significant proportion of future Mount Pleasant mine traffic is expected to travel south via the New England Highway, which connects to Singleton, Maitland, Cessnock and the other regional towns.

ii. Denman Road (MR 209)

This is a main road connecting the New England Highway, at South Muswellbrook, to the town of Denman. It is primarily a two lane rural highway with high standard rural intersections at Thomas Mitchell Drive and Edderton Road.

This road is likely to be used by a significant proportion of future Mount Pleasant mine traffic on the most easterly section between the Bengalla Mine Link Road intersection and Muswellbrook.

iii. Wybong Road

This is a former classified main road, with relatively light traffic volumes. It is currently the major access route between Muswellbrook and rural areas of the Shire such as Sandy Hollow, Roxburgh, Mangoola, Wybong and Brogheda/Manobalai.

Although site access will be located on Wybong Road, it will not serve as a major access route to the Mount Pleasant Mine, because during both mine construction and mine operations the mine traffic will be effectively controlled and directed to use the Bengalla Mine Link Road when travelling to and from the Muswellbrook area.

In the longer term, after Year 9 of mine operations, it is proposed that with the approval of Muswellbrook Shire Council, a section of this road adjacent to the Mount Pleasant and Bengalla Mines will be closed to permit mining of the boundary between the mines.

iv. Aberdeen Street, Muswellbrook

This is partly a former main road (MR 208, de-classified in 1996, between the New England Highway and the Kayuga Bridge across the Hunter River) and partly an unclassified local road which connects into other local roads in west Muswellbrook.

The local road section provides a "short-cut" into Muswellbrook for traffic from the Kayuga Bridge although traffic delays can be experienced at the rail level crossing at Brook Street.

However, the proposed Mount Pleasant mine traffic control plan would generally prevent this road being used as a future access to the site.

v. Kayuga Road and Kayuga Bridge

Similarly to Aberdeen Street this road is partly a former main road (MR 208, between the Kayuga Bridge at the Hunter River and the Wybong Road junction 0.8 kilometres further west) and the remainder is a local road. The Kayuga Bridge section is a single lane bridge approximately 160 metres long, where eastbound traffic has priority over westbound traffic.

vi. Castlerock Road and Dorset Road

These two local roads pass through the site near to and at the northern boundary respectively. They are low volume rural roads providing access to rural properties west of the proposed mines. Castlerock Road continues in a loop which connects to Wybong Road approximately 15 kilometres west of Muswellbrook. However the unsealed central section of this road effectively discourages through traffic.

Further details of the proposed relocations for these roads around the northern boundary of the site are provided in Section 14.2.3. These road relocations are proposed to be implemented by Year 3 of mine operations.

vii. Bengalla Mine Link Road

This road is currently under construction as a public road under development consent conditions for the Bengalla Mine. The road provides direct access to the Bengalla Mine from Denman Road with a new bridge crossing the Hunter River. The proposed route may be amended from the original alignment identified in the Bengalla EIS to connect with Wybong Road near the Roxburgh Road intersection, approximately 10 kilometres west of Muswellbrook.

Muswellbrook Shire Council is working in conjunction with the mines in the area to determine the best future alignment for this road in accordance with the future road strategy for the area.

This connection will provide the major access for Mount Pleasant mine traffic from Muswellbrook and the south and will also provide alternative access to Muswellbrook for most Wybong Road traffic following the closure of the section of Wybong Road adjacent to the Mount Pleasant Mine.

viii. Dartbrook Mine Link Road

This road is not currently dedicated as a public road although there would be significant benefits from its use as a public road. It was constructed by the Dartbrook Mine to provide direct access to the New England Highway for mine traffic. Public dedication would provide improved local access for rural residents west of the Hunter River to areas between Muswellbrook and Aberdeen.

It would also provide more direct access to a future Muswellbrook bypass (to the east of Muswellbrook) from these areas.

14.2.2 *Existing Traffic Volumes*

A summary of existing daily traffic volumes in the Mount Pleasant area has been compiled from RTA daily traffic surveys in the year 1995, and Muswellbrook Shire Council sources as given in *Table 14.1*. Peak hour volumes represent approximately eight per cent of daily traffic volumes on these roads.

Rural road volumes west of the Kayuga Bridge are generally less than 2,000 vehicles per day.

The proportions of heavy vehicles travelling on these roads are also given in *Table 14.1*. These generally vary between 6 and 15 per cent, indicating that virtually all the surveyed roads convey a significant proportion of heavy vehicles.

Table 14.1 SUMMARY OF EXISTING TRAFFIC VOLUMES

Road	Location	RTA Daily Traffic Volume Year 1995 (axle pairs)	Daily Traffic Volume (vehicles)	Proportion of heavy vehicles in traffic
New England Highway	N/Aberdeen Street	10,445	9,083	15%
	at Rail Underpass	19,565	17,013	15%
	S/Muswellbrook Town	10,255	8,917	15%
Denman Road	at New England Hwy	8,363	7,816	7%
	Denman	2,153	1,957	10%
Thomas Mitchell Drive	at Denman Rd		1,969	15%
Kayuga Road	at Kayuga Bridge		2,164	6%
	N/Wybong Road		962	4%
Blairmore Lane	N/Kayuga Road		176	7%
Wybong Road	at Kayuga Road		1,090	24%
	near Reedy Creek Road		233	11%
Castlerock Road	W/Kayuga Road		168	11%

Source: (RTA, 1996) and (Muswellbrook Shire Council, 1997)

14.2.3 *Future Road Network Changes*

Significant future road network changes in the west of Muswellbrook Shire have recently been adopted by Muswellbrook Shire Council in April 1997 following a strategic road network study for the western Shire (Muswellbrook Shire Council, 1997). Future road network changes are proposed to be implemented in stages after the year 1998 to accommodate cumulative traffic changes resulting from the Bengalla, Mount Pleasant and Kayuga/Dartbrook mines, according to the following six objectives, namely.

- to maintain reasonable access for rural residents;
- to provide reasonable access for mine traffic;
- to maximise coal recovery;
- to reduce mine traffic through Muswellbrook CBD;
- to consider environmental and engineering constraints; and
- to consider overall economic benefits.

A range of future road network options were investigated in the strategic roads study resulting in the adoption of five significant changes shown on *Figure 65*, namely.

i. Completion of the Bengalla Mine Link Road

This would connect with Wybong Road, approximately 400 metres west of the Roxburgh Road intersection.

ii. Construct a 500 metre extension to the Dartbrook Mine Link Road

This would connect directly into Kayuga Road. The road would then be dedicated as a public road.

iii. Close Dorset Road within the Kayuga Mine area and construct the Kayuga Mine Northern Link Road (to be undertaken by the Kayuga Mine)

This diverts Dorset Road traffic to the north to Dartbrook or Kayuga Roads. This would reduce travel distances by 2.5 kilometres for journeys to and from the north (50 per cent of movements) and increase travel distances by 0.4 kilometres for journeys to and from the south (approximately 50 per cent of movements).

iv. Close Castlerock Road within the Mount Pleasant Mine area and construct the Mount Pleasant Northern Link Road (Year 3 of Mine Operations)

This diverts traffic to the eastern end of Dorset Road which would remain open. This increases travel distances on Castlerock Road by 1.6 kilometres for journeys to and from the south (approximately 80 per cent of movements) but reduces travel distances by 2.0 kilometres for journeys to and from the north (approximately 20 per cent of movements).

v. Close Wybong Road, adjacent to the Mount Pleasant Mine area and construct the Mount Pleasant Western Link Road (Year 9 of Mine Operations)

This is a longer term proposal which provides an alternative route for Wybong Road traffic travelling to and from the north. The completion of the Bengalla Mine Link Road to connect with Wybong Road will provide an alternative route for Wybong Road traffic travelling to and from Muswellbrook or the south. These detours reduce travel distances by approximately 2.5 kilometres in each direction for traffic travelling to and from the north, but increase travel distances via the Bengalla Mine Link Road by approximately 2.4 kilometres in each direction from Muswellbrook.

The road network changes will result in relatively minor traffic detour costs for rural residents and a small nett benefit for future mine employee and service vehicle traffic.

14.2.4 Intersections

The proposed road improvements shown on *Figure 65* will effectively divert all future Mount Pleasant Mine traffic movements away from the Muswellbrook urban area as well as from the existing access routes to the New England Highway via Wybong Road, the Kayuga Bridge and Aberdeen Street.

Mount Pleasant Mine traffic will primarily only affect traffic conditions on the new link road connections and other rural roads to the west of Muswellbrook.

The additional traffic will require some improved turning and deceleration lanes to be provided at rural intersections according to defined safety standards (Austroads, 1988). These requirements are assessed in Section 14.3.3 at locations where the proposal results in significant peak hour traffic volume increases resulting from either Mount Pleasant Mine traffic or from the cumulative peak hour traffic from the Mount Pleasant, Bengalla and Kayuga Mines.

14.2.5 Road Safety

A review of recent RTA accident statistics for roads in the Muswellbrook Shire was undertaken for the six year period 1990 to 1995 inclusive. A summary of these results is presented in *Table 14.2*.

Most reported accidents occurred on the New England Highway which is to be expected being the most heavily trafficked road in the Muswellbrook Shire. A total of 228 accidents were reported to the RTA on the New England Highway within Muswellbrook Shire including seven fatal accidents, resulting in 17 fatalities.

Two fatal accidents occurred within the Muswellbrook urban area, three to the north of Muswellbrook and two to the south. The fatal accidents in Muswellbrook occurred in 1990 and 1992, the first involving a coach and cyclist and the second a semi-trailer and a motorcycle.

The three fatal accidents on Denman Road during this period all occurred on the western sections of this road in the vicinity of Denman which will not be used by Mount Pleasant mine traffic.

Kayuga and Wybong Roads have good safety records in recent years with no reported fatalities.

Table 14.2 ACCIDENT HISTORY FOR MAJOR ROADS

	Total Accidents	Injury Accidents	Number of Injuries	Fatal Accidents	Number of Fatalities
New England Highway					
1990	43	15	21	3	11
1991	42	16	21	0	0
1992	34	14	16	2	3
1993	38	18	28	1	1
1994	42	19	30	1	2
1995	29	12	14	0	0
TOTAL	**228**	**94**	**130**	7	17
Denman Road (Muswellbrook to Denman)					
1990	7	1	1	0	0
1991	12	2	4	0	0
1992	4	0	0	0	0
1993	10	4	6	2	3
1994	4	0	0	1	1
1995	12	8	20	0	0
TOTAL	**49**	**15**	**31**	**3**	**4**
Kayuga Road (Muswellbrook to Kayuga)					
1990	0	0	0	0	0
1991	2	1	1	0	0
1992	2	1	1	0	0
1993	2	2	2	0	0
1994	1	1	2	0	0
1995	1	0	0	0	0
TOTAL	**8**	**5**	**6**	**0**	**0**
Wybong Road (Muswellbrook to Sandy Hollow)					
1990	2	1	1	0	0
1991	3	2	3	0	0
1992	4	1	1	0	0
1993	3	1	3	0	0
1994	7	3	5	0	0
1995	1	0	0	0	0
TOTAL	**20**	**8**	**13**	**0**	**0**

14.3 ROAD TRAFFIC IMPACTS

14.3.1 *Mine Traffic Generation and Distribution*

All product coal will be transported by rail to the port of Newcastle. In the event of disruption to rail services, coal will be stockpiled at the mine. Traffic movements to and from the site during the construction and operation periods are summarised below.

i. Construction Period Traffic Generation

The mine facilities and infrastructure will be constructed over a 16 to 18 month period during which time traffic movements will include employees, materials and plant deliveries. The mine haul roads will be constructed subsequently during the first year of mine operations.

Peak construction workforce during this initial 16 to 18 month period is estimated to be 250 employees. However, during later mine operations there will also be some employees engaged in the construction of the dragline (Year 3) and second electric shovel (Year 6).

The total number of construction and operations employees during these periods (376 and 349 respectively) will however be lower than the peak operations workforce of 380 in Year 13.

If required an existing construction camp located at Ravensworth will be used with a proportion of the workforce bussed to the site. For the purposes of the construction traffic assessment the worst case has been assumed where all construction employees would travel to the site by private motor vehicle. The level of car sharing would be limited, resulting in a high car usage rate of between 80 to 85 per cent.

The peak construction workforce of 250 employees would bring approximately 206 cars to and from the site each day during construction. There would also be about 25 light vehicle "courier" deliveries to the site each day.

The number of heavy vehicles required to transport construction materials to the site each day has also been calculated based on quantities of construction materials and is summarised in *Table 14.3*. During the 16 to 18 month construction of the mine facilities and infrastructure, the average daily truck deliveries to the site would be approximately 34 (68 truck movements per day). There would also be approximately 24 daily truck movements for gravel deliveries for haul roads during the subsequent twelve month period during the first year of mine operations.

ii. Mine Operations Traffic Generation

The peak operations workforce would be 380 employees including administrative staff. The administrative staff will probably travel individually by car with some sharing by shift workers. Overall car usage is conservatively estimated as 80 to 85 per cent of workers, similar to that for construction employees.

Table 14.3 SUMMARY OF CONSTRUCTION TRUCK TRAFFIC

Materials Delivery	Duration	Total Quantity	Total Truckloads	Truckloads per day *
Concrete	12 months	12,256 m^3	1,750	6.6
Reinforcing Steel	12 months	1,550 tonnes	80	0.3
Structured Steelworks	10 months	3,700 tonnes	190	0.9
Equipment	8 months	5,000 tonnes	250	1.4
Steel Pipes	8 months	750 tonnes	40	0.2
Plant and miscellaneous deliveries	18 months	estimate	900	2.4
Gravel for Mine Infrastructure Works	18 months	110,000 m^3	8,800	22.2
Gravel for Haul Roads	12 months	40,000 m^3	3,200	12.1(1)

Notes: * *Calculation based on 22 working days per month on average*
1. *Occurs after initial 16 to 18 months construction period*

It is planned to have the operational workforce distributed between two shifts, commencing between 6am and 8am, or 6pm and 8pm. With only two shifts per day virtually all mine employees would be present on site during shift changes, resulting in carparking requirements for about 330 spaces.

The future peak mine workforce of 380 employees will bring an estimated 314 cars to and from the site each day. There would also be miscellaneous daytime delivery and courier vehicle traffic bringing an estimated 20 cars, light vans or utilities to the site each day.

The major delivery truck movements generated during mine operations would be fuel deliveries. Established mine operations will typically consume 24 million litres of diesel fuel each year requiring an average of three tanker deliveries per day. Additional truck movements for plant and road maintenance, explosives deliveries and other miscellaneous deliveries would increase this total to approximately ten truck deliveries per day on average.

It is anticipated that the future mine gravel requirements for blasthole stemming and road maintenance will be met from crushing of suitable aggregate material excavated from within the site. If this is not feasible then an additional five to seven truck deliveries could also be required for gravel deliveries to the mine each day.

iii. Mine Employee Traffic Distribution

Future mine traffic distributions will be primarily determined by the residential locations of the workforce as most mine traffic is from employees. Estimated future workforce distributions for the Bengalla, Mount Pleasant and Dartbrook/Kayuga mines are summarised in *Table 14.4* below.

Table 14.4 MINE WORKFORCE DISTRIBUTION

Residential Location	Proportion of Mine Workforce %			
	Existing Dartbrook Underground	Existing Muswellbrook Coal Co	Existing Drayton Coal Pty Ltd	Future Mines (estimated distribution)
Muswellbrook Shire (includes some rural areas)	39%	63%	49%	50%
North (Aberdeen)	5%	14%	8%	9%
North (Scone and Beyond)	20%	10%	6%	12%
West (Denman)	1%	7%	5%	4%
South (Singleton and Beyond)	35%	6%	32%	25%
TOTAL	**100%**	**100%**	**100%**	**100%**

Muswellbrook Mine is a well established enterprise and the traffic distribution will tend to remain the same in the future.

The newer mines in the Muswellbrook area (Dartbrook/Kayuga, Bengalla and Mount Pleasant) will tend to approach the "future mines" estimated distribution in *Table 14.4* after about 3 to 4 years.

Experience with the Dartbrook mine has shown that although the mine initially attracted a significant proportion of the workforce from the Lower Hunter and Lake Macquarie areas, over time these employees found other jobs closer to home or relocated to the Muswellbrook area. Consequently the proportion of the workforce travelling from Singleton or further south will be no more than 25 per cent for future mines after the settling in period.

iv. Temporary Road Closures During Blasting

At various times, it will be necessary to close roads adjacent to the mining operations where blasting occurs within 500 metres of the road. It is intended to keep the frequency and duration of the road closures to a minimum. On average, roads will be required to be closed for blasting operations approximately once in ten days. The duration of closures will be approximately ten to fifteen minutes.

Blasting will be restricted to Monday to Saturday between the hours of 8:30 am and 4:30 pm. As a preference, blasting will occur on weekdays, with blasting on Saturdays restricted to unavoidable situations such as when there has been extended adverse weather conditions during the preceding week days or there are extreme production constraints necessitating blasting. There will be no blasting conducted on Sundays or public holidays.

At least twenty four hours notice will be provided prior to blasts requiring road closures. Signs will be erected at the nearest major intersection at both ends of any road to be closed, warning drivers of potential closures, the likely duration and alternative routes. Proposed sign locations are shown on *Figure 65*. Personnel supervising road closures will undertake traffic control training in accordance with Roads and

Traffic Authority and Council requirements. Roads will be inspected after blasting prior to re-opening to ensure no fly rock is lying on the road.

Blasting operations requiring road closure will be scheduled so as not to occur during school bus times. Mount Pleasant Mine will liaise with Bengalla Mine and the proposed Kayuga Mine to ensure road closures are kept to a minimum. Roads which will be subjected to periodic closure due to blasting operations and the years during which they may be affected are listed in *Table 6.4*.

14.3.2 Assessment of Traffic Impacts

The traffic impacts assessment for the proposal considers cumulative traffic impacts from the Mount Pleasant Mine in conjunction with the recently approved Bengalla Mine (258 employees) and the proposed Kayuga Mine which increases overall employment at Dartbrook/Kayuga from approximately 180 to 280 employees.

Predicted daily traffic generated by each of the mines, on the basis of employee numbers and additional traffic movements is summarised in *Table 14.5*.

Table 14.5 FUTURE MINE TRAFFIC MOVEMENTS

Mine	Future Total Employees	Car Driver Percentage	Daily Employee Car Trips	Other Daily Trips	Total Daily Trips
Dartbrook (Existing)	180	82.5	296	40	336
Dartbrook with (Kayuga Expansion)	280	82.5	462	60	522
Bengalla	258	82.5	426	60	486
Mount Pleasant	380	82.5	627	60	687

The estimated traffic generated by the Mount Pleasant Mine proposal will be significantly greater during the operations phase (687 vehicles movements per day typically, including 20 truck movements) than the construction phase (530 vehicle movements per day typically, including 68 truck movements).

The future mine operations period is therefore the most applicable period for assessing future traffic impacts.

The traffic impacts assessment is a relatively long term assessment, and is made on the basis that all the indicated road network changes summarised in *Figure 65* and Section 14.2.3 of this report would be implemented. These changes would maintain appropriate local access and minimise cumulative traffic impacts with the additional traffic to and from the Mount Pleasant, Bengalla and Kayuga Mines.

i. Direction of Future Traffic Increases

The future distribution of the Mount Pleasant mine traffic will correspond to the future estimated workforce distribution for mines in the Muswellbrook area which is summarised in *Table 14.4*.

Following implementation of all proposed road network changes including the closure of Wybong Road adjacent to the site, the major approach direction of traffic would be via the Bengalla Link Road. In the immediate vicinity of the site approach directions would be as follows.

- 66% to and from the south via Bengalla Link Road;
- 27% to and from the north via Mount Pleasant Western Link Road; and
- 7% to and from the west via Wybong Road and Roxburgh Road.

The corresponding distribution of traffic movements on roads further away from the site is listed in *Table 14.6* below.

Table 14.6 TRAFFIC DISTRIBUTION TO APPROACH ROUTES

Overall Direction	Proportion	Approach Route (to/from)
South via Bengalla Link Road (66%)	38%	Muswellbrook via Denman Road (E)
	25%	via Thomas Mitchell Drive (S)
	3%	Edderton Road via Denman Road (W)
North via Mount Pleasant Western Link Road (27%)	7%	Scone via Blairmore Lane
	5%	Scone via Dartbrook Road
	9%	Aberdeen via Dartbrook Link Road
	3%	local rural areas via Dartbrook Link Road
	3%	local rural areas via Kayuga Road
West via Wybong Road (7%)	4%	Denman via Roxburgh Road
	3%	Sandy Hollow via Wybong Road (W)

ii. Traffic Network Model

Detailed analysis of future traffic movements generated by the proposal has been undertaken using a computer network traffic model (TMODEL-2). The traffic model was used to:

- incorporate significant changes to the existing "base" road network as summarised in *Figure 65*.
- assess traffic movements over a wide area, extending as far west as Sandy Hollow and Denman, as far north as Aberdeen and as far south as Antienne.
- assess traffic impacts from the proposal as well as cumulative impacts from the Mount Pleasant, Bengalla and Kayuga Mines; and

- examine background traffic growth in the Muswellbrook urban area and on the New England Highway as well as reductions from the loss of rural properties along Bengalla, Wybong, Castlerock, Dorset and Kayuga Roads.

The modelling results for daily traffic volumes are included as Appendix I. These identify changes to the "base case" traffic volumes after the year 1998 as a result of proposed road network changes summarised in *Figure 65* as well as future traffic volume changes with the "Mount Pleasant Mine" and the "cumulative impacts of all mines" scenarios.

A summary of relevant traffic increases is provided in *Table 14.7*. The implications of these increases are discussed below.

iii. Traffic Increases to and from the South

The Mount Pleasant mine traffic increases on routes to and from the south in *Table 14.7* are only significant on three sections of road, namely:

- The Bengalla Mine Link Road (61% increase)
- Denman Road east of the Bengalla Mine Link Road (10% increase); and
- Thomas Mitchell Drive to the south (10% increase).

The greatest future traffic increases will occur on the Bengalla Mine Link Road. However, this road is specifically being constructed to provide access to coal mines and to serve as a detour route for Wybong Road when it is closed to permit mining between the Mount Pleasant and Bengalla Mines. These increases confirm that this road would serve its intended purpose.

On Denman Road significant traffic increases would only occur over the short section between the Bengalla Mine Link Road and Thomas Mitchell Drive. These increases would generally not affect overall traffic flows and speeds along this route.

Traffic increases on the Thomas Mitchell Drive are reasonably significant being about 10 per cent for the Mount Pleasant Mine Traffic and about 18 per cent for all mine traffic. These traffic increases are considered acceptable on this route. The road has been specifically re-aligned and upgraded in recent years and is suitable to serve as a bypass route to divert mine and other industrial traffic away from Muswellbrook CBD.

iv. Traffic Increases to and from the North

Traffic volume increases on routes to and from the north in *Table 14.7* are significant on a number of roads. However most of these roads are specifically planned to provide for future mine access and local traffic diversions, namely

- The Mount Pleasant Western Link Road;
- The Mount Pleasant Northern Link Road; and
- The Dartbrook Mine Link Road.

Table 14.7 SUMMARY OF DAILY TRAFFIC VOLUME INCREASES

Traffic Route	Existing Traffic (1996)	Future Base Traffic (1998)	Mount Pleasant Mine with 1998 Base Traffic	Mount Pleasant Mine % Increase	Bengalla, Mount Pleasant and Kayuga Mines with 1998 Base Traffic	Cumulative % Increase
(South)						
Bengalla Mine Link Road	N/A	672	1,080	61%	1,413	110%
Denman Road (W of Bengalla Link)	3,355	3,476	3,492	0%	3,484	0%
Edderton Road	509	522	535	2%	533	2%
Denman Road (E of Bengalla Link)	3,355	4,142	4,558	10%	4,873	18%
Thomas Mitchell Drive	1,650	1,820	2,006	10%	2,139	18%
New England Highway (Antienne)	9,439	9,670	9,857	2%	10,016	4%
Denman Road (at Muswellbrook)	8,691	8,897	9,023	1%	9,177	3%
New England Highway (at Rail U/Pass)	17,508	17,806	17,933	1%	18,135	2%
(North)						
Mount Pleasant Western Link	N/A	730	962	32%	1,073	47%
Mount Pleasant Northern Link	N/A	800	1,026	28%	1,135	42%
Blairmore Lane	276	310	392	26%	450	45%
Dartbrook Link Road	338	609	694	14%	945	55%
Kayuga Road (N of Dorset Road)	498	790	945	20%	1,066	35%
Kayuga Road (N of Wybong Road)	671	428	489	14%	497	16%
New England Highway (Aberdeen)	8,692	8,863	8,921	1%	9,008	1%
New England Highway (Sandy Creek)	8,971	8,875	8,865	0%	8,999	1%
Kayuga Bridge	1,841	569	618	9%	636	12%
(West)						
Wybong Road (W of Roxburgh Road)	1,075	855	888	4%	906	6%
Wybong Road (at Reedy Creek)	518	292	310	6%	318	9%
Roxburgh Road (at Roxburgh)	305	519	543	5%	580	12%
Mangoola Road (at Mangoola)	420	596	625	5%	658	10%

Predicted traffic increases on some other roads such as Blairmore Lane are significant in percentage terms (26 per cent for the Mount Pleasant Mine traffic and 45 per cent for all future mines). However the overall future traffic volumes will remain below 500 vehicles per day and would not affect the current high level of service for this road. However, these increases highlight the general benefits of opening of the Dartbrook Link Road for public traffic use, without which the potential future traffic increases on Blairmore Lane would be more significant.

Elsewhere the traffic model results show moderate traffic volume increases on the Kayuga Road and Kayuga Bridge (9 to 16 per cent generally) in comparison to future base (Year 1998) traffic volumes. However, these traffic volumes are actually much lower than existing (Year 1996) volumes on these roads. This is due to the diversion of Wybong Road traffic from the west to the Bengalla Link Road, and the acquisition of rural properties for mining.

v. Traffic Increases to and from the West

Traffic increases identified in *Table 14.7* for the routes to and from the west, via Wybong Road and Roxburgh Road, are relatively minor ranging from 4 to 6 per cent for the Mount Pleasant Mine and 6 to 12 per cent for all future mines. These traffic increases are not significant. The overall future traffic volumes on these roads will remain below 1,000 vehicles per day and the high current level of service of these roads would not be adversely affected.

14.3.3 *Intersections*

Future peak hour traffic increases have been calculated at a total of 16 intersections on traffic routes affected by the proposal. These increases are summarised in *Table 14.8*.

The results of the intersection traffic increases in *Table 14.8* have been assessed with reference to the following typical intersection capacity limits, for provision of additional turning lanes for rural Type A, B and C intersections, as determined from Austroads, 1988.

- Rural Type A intersection, typical maximum capacity = 240 - 330 veh/hr
- Rural Type B intersection, typical maximum capacity = 450 - 540 veh/hr
- Rural Type C intersection, typical maximum capacity = 2,000 - 2,400 veh/hr
- Urban Traffic Signals, typical maximum capacity = 3,200 - 3,600 veh/hr (2 lanes per approach)

The following intersection requirements have been determined to be necessary to accommodate predicted future peak hour traffic volumes.

i. Urban Traffic Signals

Traffic signals are already provided at the intersection of the New England Highway and Denman Road. Predicted traffic increases at this intersection in *Table 14.8* will remain well within the peak hour capacity.

Table 14.8 PEAK HOUR TRAFFIC VOLUMES AT INTERSECTIONS (VEHICLES PER HOUR)

Intersection Location	Existing Traffic (1996)	Future Base Traffic (1998)	With Mount Pleasant Mine Traffic (Year 1998)	% Increase from 1998 Base	With Bengalla Mount Pleasant and Kayuga Mines Traffic* (Year 1998)	% Increase from 1998 Base
1. New England Highway and Thomas Mitchell Drive	758	777	872	12%	924	19%
2. New England Highway and Denman Road	1,401	1,424	1,488	4%	1,555	9%
3. Denman Road and Ironbark Road	342	387	494	28%	562	45%
4. Denman Road and Thomas Mitchell Drive	371	432	636	47%	744	72%
5. Denman Road and Bengalla Mine Link Road	268	332	542	63%	648	95%
6. Denman Road and Edderton Road	268	278	286	2%	283	2%
7. Bengalla Mine Link Road and Bengalla Mine Access	N/A	54	258	380%	416	670%
8. Mount Pleasant Western Link and Mount Pleasant Mine Access	110	58	408	600%	444	670%
9. Bengalla Mine Link Road and Mount Pleasant W Link	N/A	54	258	380%	305	470%
10. Mount Pleasant Western Link and Castlerock Road	14	67	184	170%	220	230%
11. Mount Pleasant Northern Link and Kayuga Road	47	81	192	140%	231	190%
12. Kayuga Road and Dartbrook Link Road	31	57	136	140%	176	210%
13. Kayuga Road and Blairmore Lane	22	28	69	150%	89	220%
14. New England Highway and Dartbrook Link Road	717	730	764	5%	842	15%
15. Wybong Road and Roxburgh Road	110	110	139	26%	157	43%
16. New England Highway and Blairmore Lane	628	638	676	6%	705	10%

Notes: ** Peak Hour = 8% Daily Volume for Base Traffic, = 50% Daily Volume for Additional Mount Pleasant Mine Traffic, = 33% Daily Volume for Additional Bengalla and Kayuga Mines Traffic*

N/A not applicable

ii. Rural Type C Intersections

This type of intersection has already been provided at a number of locations to accommodate future traffic volumes, namely:

- New England Highway and Thomas Mitchell Drive
- New England Highway and Dartbrook Link Road
- Denman Road and Bengalla Mine Link Road (recently implemented)

At three other locations, Type C intersections will generally be required in the future as a result of the cumulative traffic increases from the Mount Pleasant, Bengalla and Kayuga Mines, namely

- Denman Road and Thomas Mitchell Drive;
- Denman Road and Ironbark Road; and
- New England Highway and Blairmore Lane.

iii. Rural Type B intersections

Future cumulative traffic increases from the Mount Pleasant, Bengalla and Kayuga Mines will also require localised widening for this standard of intersection to be provided at the following locations:

- Denman Road and Edderton Road;
- Bengalla Mine Link Road and Bengalla Mine Access;
- Mt Pleasant Western Link Road and Mt Pleasant Mine Access; and
- Bengalla Mine Link Road and Mt Pleasant Western Link Road.

iv. Rural Type A intersections

Future cumulative traffic increases from the three mines will require minor road shoulder widening works for this standard of intersection to be provided at the following sites:

- Castlerock Road, Mt Pleasant Western Link and Mount Pleasant Northern Link;
- Mt Pleasant Northern Link and Kayuga Road;
- Kayuga Road and Dartbrook Mine Link Road;
- Kayuga Road and Blairmore Lane; and
- Wybong Road and Roxburgh Road.

14.3.4 *Kayuga Bridge Construction Traffic Impacts*

During construction of the Mount Pleasant mine (after 1998), the road improvements identified in *Figure 65* will not be fully implemented. Consideration was given in the strategic roads study (Muswellbrook Shire Council, 1997) to the potential for short term construction traffic impacts to occur on the Kayuga Bridge with other road network options during this period.

During construction of Mount Pleasant and Kayuga Mines, most rural properties within these mine lease areas would still be occupied. Approximately 80 per cent of these properties will still be generating rural residential traffic during the construction period for these mines.

The short term daily traffic volumes at the Kayuga Bridge during construction of the Mount Pleasant and Kayuga Mines were estimated in the strategic roads study (Muswellbrook Shire Council, 1997) for eight future road network options. These are described in *Table 14.9*.

The results in *Table 14.9* indicate that with most road network options the daily traffic volumes on Kayuga Bridge will either increase only marginally (+0 to 3 per cent) or will decrease significantly (-53 to -58 per cent).

Also, some of the road network changes in the base case option listed in *Table 14.9* do not specifically affect daily traffic volumes on the Kayuga Bridge and it will not generally be necessary to implement these changes prior to construction work for the Mount Pleasant and Kayuga Mines, namely:

- to close Castlerock Road within the Mount Pleasant Mine area and construct the Mount Pleasant Northern Link Road; and
- to close Dorset Road within the Kayuga Mine area and construct the Kayuga Mine Northern Link Road.

However, in order to prevent any significant increases in existing Kayuga Bridge daily traffic volumes, the following minimum road network improvements will need to be implemented prior to construction work commencing for the Mount Pleasant and Kayuga Mines.

- to complete Bengalla Mine Link Road, either to Wybong Road as proposed in the Bengalla Mine EIS or to Wybong Road near Roxburgh Road;
- to construct the Dartbrook Mine Link Road extension to link with Kayuga Road and open this road as a public road.

14.3.5 *Road Safety*

The recent accident history of the New England Highway, Denman Road, Wybong Road and Kayuga Road was reviewed in section 14.2.5 of this report for a six year period (years 1990 to 1995 inclusive).

The Wybong Road and Kayuga Road generally have good safety records with no fatal accidents in recent years. There have been three fatal accidents in recent years on Denman Road. However these all occurred in the Denman area, away from the sections of this route which would be used by future mine traffic.

Table 14.9 KAYUGA BRIDGE TRAFFIC PREDICTIONS (YEAR 1998)

Option	Description	Mine Operations Daily Traffic Volume	Mine Construction Daily Traffic Volume	Construction Traffic Percentage Change from Existing Traffic (Year 1996)
N/A	Existing Traffic Year 1996,	(1,841)	(1,841)	-
1A	Base Case Option	2,104	2,168	+18%
1D	Base Case plus Dartbrook Link Road Extension	1,829	1,893	+3%
2A	Base Case plus Mt Pleasant Western Link Road	2,056	2,120	+15%
2D	Base Case plus Mt Pleasant Western Link Road plus Dartbrook Link Extension	1,784	1,848	+0.4%
3A	Base Case plus Close Wybong Road plus Mt Pleasant Western Link Road	707	869	-53%
3D	Base Case plus Close Wybong Road plus Mt Pleasant Western Link Road plus Dartbrook Link Extension	669	813	-56%
4A	Base Case plus Close Wybong Road with Bengalla Mine Link Road Diversion plus Mt Pleasant Western Link Road	674	836	-55%
4D	Base Case plus Close Wybong Road with Bengalla Mine Link Road Diversion plus Mt Pleasant Western Link Road and Dartbrook Link Extension	636	780	-58%

Notes: *The Base Case Option provides the following road network changes*

- *Complete Bengalla Mine Link Road (to Wybong Road as in EIS); and*
- *Construct Mt Pleasant Northern Link Road (to Dorset Road)*
- *Close Castlerock Road for 5 kilometres west of Kayuga Road;*
- *Construct Kayuga Northern Link Road (to Dartbrook Road);*
- *Close Dorset Road between 3 and 5 kilometres west of Kayuga Road;*
- *RTA to construct Muswellbrook Eastern Bypass (by year 2005/6 approximately)*

The New England Highway has had numerous fatal accidents over recent years, both in the town of Muswellbrook and to the north and south. Future traffic safety implications of additional mine traffic in the town of Muswellbrook would generally be minimised by the use of the Thomas Mitchell Drive route to and from the south which bypasses the Muswellbrook urban area.

14.3.6 *Future Road Maintenance*

Away from the New England Highway, the major roads which will be affected by future mine traffic are the proposed mine link roads. These roads will be constructed to pavement standards that do not require structural maintenance for a period of at least twenty years.

14.4 CUMULATIVE IMPACTS OF RAIL TRANSPORT

An assessment of the major issues relating to the cumulative transport of coal by rail to Port Waratah has been undertaken. These include:

- the capacity of rail system;
- noise and vibration; and
- air quality.

14.4.1 *Rail System Capacity*

i. Existing Rail and Port Operations

There are a total of 18 rail loop coal loading facilities in the Hunter Region. These transport about 45-50 million tonnes of coal each year by coal trains to the Port Waratah and Kooragang Island coal terminals at the port of Newcastle .

Major expansions of the Kooragang Island Coal Terminal (Stage II) were completed in 1995 which provided a second ship loading berth. Further expansions are also proposed to provide two further ship loading berths and additional stockpile areas (Stage III). These improvements to the Kooragang Island Coal Loader would provide extra capacity for an additional 55 million tonnes per annum of export coal to be loaded at the Port of Newcastle.

The rail system between Muswellbrook and the Port of Newcastle is 127 kilometres. The capacity of individual sections is given (DUAP, 1995) in *Table 14.10* below. This description of the current capacity is based on timetabled train paths currently allocated to different types of trains. In the future or at peak coal haulage periods, these timetabling arrangements have the potential to be altered to provide additional coal train capacity:

Table 14.10 CURRENT RAIL LINE CAPACITY

Section of Line	Total daily train paths in each direction	Current allocation of train paths in each direction			
		Coal	Grain	Other Freight	Passenger
Ulan-Muswellbrook (single track)	8 or 10	5-6	1-2	2	0
Muswellbrook Antienne (part single part double track)	28 or 30	11 - 12	5 - 6	7	5
Antienne - Singleton (double track)	52 or 53	35	5 - 6	7	5
Singleton - Maitland (double track)	67 or 68	50	5 - 6	7	5
Maitland - Newcastle (four tracks)	126 or 127	53	5 - 6	19	49

Source: DUAP, 1995

Note: Other freight = cotton, general freight and minerals

In May 1997, FreightCorp advised that there was an average of four trainload's of coal per day passing through Muswellbrook toward Newcastle on the Muswellbrook to Antienne section, mainly from the Ulan and Dartbrook Mines. However on peak days the number of trainloads of coal can increase to 9 or 10 each day. This figure approaches the current maximum number of train paths in each direction which are allocated to coal trains, namely 11 to 12 per day.

Similarly, at Tarro, between Maitland and Newcastle, there are currently an average of 30 trainloads of coal per day travelling towards Newcastle, with 41 on peak days. This figure is significally below the number of coal train paths allocated by timetabling on this section which is 53 in each direction per day.

ii. Proposed Mine Rail Operations

The proposed rail loop for the Mount Pleasant Mine would generally follow around the outside of the Bengalla Mine Link Road, joining the Ulan Railway Line immediately west of the Bengalla Mine infrastructure area. The rail loop would extend for approximately 4 kilometres north from the Ulan Railway Line and would receive coal from the Mount Pleasant mine facilities via a conveyor crossing under Wybong Road.

The proposed rail loader will meet the FreightCorp guidelines for category 6 loading facilities and will permit loading of trains up to 9,000 tonnes. The proposed alignment of the rail line is constrained by the local ground contours and has been defined approximately, subject to further design investigations.

The proposed Mount Pleasant Mine will produce up to 7.9 million tonnes of export coal per annum which will all be transported by rail to the Port of Newcastle. In the future the progressive introduction of high capacity coal trains (84 wagons @ 95 tonnes capacity per wagon) to the Hunter Valley Rail System will permit all coal from the Mount Pleasant, Bengalla and Kayuga Mines to be transported in 8,000 tonne trainloads.

iii. Future Cumulative Rail Operations

Future rail capacity requirements for the rail line to the Port of Newcastle were recently reviewed by the Upper Hunter Cumulative Freight Transport Study, Supplementary Report, (DUAP, 1996).

The study prepared a spreadsheet model and used this to estimate future rail line demand from coal, grain and other trains, for the years 1998 and 2016. A number of assumptions were used in the report, namely:

- haulage being restricted to 300 days per year;
- a ratio of 1.25:1 for the number of trains on the 85 percentile day compared to the mean day; and
- average tonnages per train varying between 4,500 and 6,300 for the upper Hunter coal mines.

These assumptions, are all subject to review in the future. In particular the average tonnage per train which is likely to be 8,000 for a number of these mines.

The most recent information available from the future mine operators indicates that the additional annual future tonnage of coal required to be transported over the section of the rail line between Muswellbrook and Antienne would be a total of 16.8 million tonnes (48,000 tonnes per day) from the following sources.

- Mount Pleasant 7.9 M tonnes
- Bengalla 6.7 M tonnes
- Kayuga 2.2 M tonnes

The rail system between Muswellbrook and Antienne is currently operating at well below capacity (four trainloads of coal per day on average) which allows large variations in day to day haulage to occur. However in the future when the system is operating closer to its capacity, the scope for these variations will be much more limited and the ratio of peak to average trainloads per day would be closer to 1.3 to 1, similar to the situation which currently occurs on the line between Maitland and Tarro.

With haulage on 350 days per year the average future additional daily coal tonnage of 48,000 tonnes would correspond to an additional six 8,000 tonne trainloads per day. Assuming no change in existing haulage patterns and volumes from Ulan and Dartbrook Mines, the future average trainloads per day would be 10 on the Muswellbrook to Antienne section, with a potential maximum of 13.

The potential maximum of 13 trainloads per day marginally exceeds the current number of train paths per day which are allocated to coal trains (11 to 12) on the Muswellbrook to Antienne section of the rail line. However, with appropriate future investment in trackwork and signalling by the Rail Access Corporation and improvements in either rolling-stock or train scheduling by FreightCorp (or other rail freight operators), this future operating scenario is likely to be feasible without any need for duplication of the Muswellbrook to Antienne section of rail line.

Similarly, the effect of an additional six trainloads per day (plus return empty trips) on the section of the line between Maitland and Tarro will be within the current range of average to peak daily train movements. Consequently, future improvements to increase the capacity of this section would not be required as a result of the proposal.

14.4.2 *Noise and Vibration*

There are a number of residences located in proximity to the rail line between Muswellbrook and Newcastle, at which existing noise levels already exceed both the EPA's noise level criteria for new track, as described in Section 12.2.5, and the criteria for existing track, which are 5 dB(A) higher. Hence, in considering the impact of noise from rail traffic associated with the Mount Pleasant project, it is necessary to consider the change in noise impact which would occur as a result of the project, and also the cumulative impact of noise from Mount Pleasant and other proposed mines in the area. The EPA generally recommends that where existing noise levels exceed recommended limits, any increase due to additional movements should be limited to 2 dB(A).

As described in Section 12.2.5, the impact of noise from rail traffic is assessed in terms of both the maximum noise level during a train passby and the average (L_{eq}) noise level due to all passbys in a specified period.

In this case, trains operating from Mount Pleasant would be of a similar design to those already operating on the track, and maximum noise levels at any location are expected to be the same as those from existing trains. L_{eq} noise levels can be considered either on a "worst case" basis, representing levels over a day when operations are at a maximum, or on an annual average basis. As described in Section 14.4, peak daily operations on the section of line between Muswellbrook and Antienne are already close to the capacity of the line, although average operations are well below this. Hence, L_{eq} noise levels on a "worst case" day are unlikely to be significantly increased by the Mount Pleasant project. Any increase in noise impact would be due to an increase in the number of "worst case" days during a year, and is represented by the annual average L_{eq} noise level.

The impact of additional rail movements would be greatest on the Ulan - Muswellbrook and Muswellbrook - Antienne rail sections, where the current number of movements is lowest. In assessing the impact of the Mount Pleasant project alone, additional rail movements due to the Bengalla Mine should be included within existing noise levels, since this will begin operations before Mount Pleasant.

Estimated daily movements on these sections of line, and proposed additional movements due to the Mount Pleasant project, are shown in *Table 14.11*. From this table, it is clear that the change in annual L_{eq} noise level due to rail traffic at any residence due to the Mount Pleasant project alone will be less than 2 dB(A).

Table 14.11 ESTIMATED CHANGES TO EXISTING RAIL TRAFFIC VOLUMES

	Estimated Average Daily Freight Movements, Each Direction	
	Ulan - Muswellbrook	**Muswellbrook - Antienne**
Existing Traffic	4	7
Increase due to Bengalla Mine	2	2
Proposed increase due to Mount Pleasant Mine	3	3
Equivalent increase in annual L_{eq} noise level due to Mount Pleasant Mine	1.8 dB(A)	1.2 dB(A)

On the other hand, *Table 14.12* shows the increase in existing noise levels due to the cumulative impacts of Bengalla Mine and the proposed Mount Pleasant and Kayuga Mines. This indicates that when considering the cumulative impact of all three mines, the change in rail traffic noise levels would exceed 2 dB(A) for residences along both sections of track.

Table 14.12 ESTIMATED CUMULATIVE CHANGES TO RAIL TRAFFIC VOLUMES

	Estimated Average Daily Freight Movements, Each Direction	
	Ulan - Muswellbrook	**Muswellbrook - Antienne**
Existing Traffic	4	7
Increase due to Bengalla Mine	2	2
Proposed increase due to Mount Pleasant	3	3
Proposed increase due to Kayuga Mine	-	1
Equivalent increase in existing annual L_{eq} noise level due to all three mines	3.5 dB(A)	2.7 dB(A)

Recent studies indicate that vibration levels from train passbys on this line are well within the relevant criterion for assessment of the possibility of structural damage, even for the most sensitive of building structures located 12 metres from the track. In addition, maximum ground-borne vibration levels are within the recommended criterion for assessment of human response to continuous vibration at all such residences. Some vibration of lightweight building elements such as windows is experienced at residences close to the track, which is due to air-borne sound pressure waves. The intensity of such vibration would not be affected by the proposal, although the average number of occurrences would increase as described above.

14.4.3 *Air Quality*

A recent study prepared for the Land and Environment Court (*Bell v. Minister for Urban Affairs & Planning and Port Waratah Coal Services Limited*) examined cumulative affects on air quality from rail movements between Hunter Valley mines and Kooragang Coal Terminal. The study reported on monitoring of Total Suspended Particulate concentrations near the railway line and at more remote locations.

The study area selected monitoring sites that would not be unduly influenced by dust from mines or industrial areas in Newcastle. Towns with residences along the railway line included in the study were Singleton, Branxton, Greta, Telarah, East Maitland, Thornton and Beresfield.

Direct comparison between simultaneous monitoring of Total Suspended Particulates and sub-ten micron particles (PM_{10}) indicated that the ratio of PM_{10} to TSP was unusually high in proximity to the rail line. Normally, sub-PM_{10} particles are derived from combustion by-products rather than mechanically abraded dust as discussed in Section 11.7.3. This suggests that the primary source of dust in proximity to the rail line does not necessarily result from rail transport.

A comparison of the dust concentrations in proximity to the rail line (25 metres) and more distant locations (100 metres) suggests that dust from rail operations is indistinguishable from surrounding background levels.

The study concluded that air quality near the Main Northern Rail Line is not locally elevated and gross concentrations are comparable to other urban areas in New South Wales. Consequently, the cumulative transport of coal by rail to Port Waratah including an additional three train movements per day (on average) from Mount Pleasant Mine is not expected to have a measurable effect on air quality in proximity to the rail line.

14.5 SUMMARY OF IMPACTS AND MITIGATION MEASURES

14.5.1 Summary of Impacts

i. Road Transport

The future traffic impacts have been assessed for both the Mount Pleasant Mine traffic and for the cumulative traffic impacts from the Bengalla, Mount Pleasant and Kayuga Mines. The traffic increases are generally only significant on the future mine link roads. Traffic increases and traffic impacts are minimal on most existing roads.

The future Mount Pleasant and Bengalla mines will generate only minimal future traffic using the Kayuga Bridge. Overall future traffic volumes on the bridge will be much lower (generally less than half) existing traffic volumes in the longer term with the closure of Wybong Road. In the short to medium term, contractual safeguards will be implemented by the Mount Pleasant Mine to prevent either construction or operations heavy vehicle traffic from the mine using the bridge during existing school bus and commuter per periods (between 6.45 am to 8.45 am and 3.15 pm to 5.15 pm on weekdays).

The future closure of the section of Wybong Road adjacent to the proposed Mount Pleasant Mine in Year 9 of mine operations would effectively reduce through traffic usage of the Kayuga Bridge from Wybong Road to the west. There would also be significant reductions in existing local traffic as a result of the acquisition of rural properties for mining.

Certain roads, Wybong Road, Kayuga Road, Dorset Road, Castlerock Road and the future Mount Pleasant Northern Link Road will all be affected by temporary road closures during periods of the mine operations when blasting occurs within 500 metres of the road.

At least 24 hour's notice will be provided for all temporary road closure due to blasting and highly visible signs will be operated to advise traffic of alternative routes.

Dangerous goods such as explosives or fuel would generally be transported to and from the south via the Thomas Mitchell Drive route to the New England Highway. This route effectively bypasses the town of Muswellbrook and other residential areas in Muswellbrook Shire.

ii. Rail Transport

Analysis of future rail operations has indicated that most sections of the Main Northern rail line from Muswellbrook to Newcastle have adequate spare capacity to accommodate additional coal train movements during both average and peak daily periods.

However the potential future peak daily demand including the cumulative additional coal train demand from the Bengalla, Mount Pleasant and Kayuga Mines is expected to be constrained by the current capacity of the Muswellbrook to Antienne section of the rail line, which is currently 11 or 12 coal train paths in each direction daily. This may need to be increased by revised timetabling or other means to accommodate 13 coal trains in each direction daily at peak periods.

14.5.2 Mitigation Measures and Safeguards

A significant number of road and rail transport improvements in the Muswellbrook area will be required to be implemented the future Mount Pleasant, Kayuga and Bengalla Mines.

These transport improvements will be implemented in consultation with Muswellbrook Shire Council and other government agencies, so as to accommodate the cumulative increases that occur in the locality as a result of the mines.

The following summary provides a description of which safeguards and works are anticipated to be implemented by the Mount Pleasant Mine and which works will be provided by other mines and rail freight operators. A commitment by the Mount Pleasant Mine to implement future roadworks is made on the basis that these works will be implemented at specified stages of mine operations and their implementation may be delayed until such time as the mine development proceeds.

i. Kayuga Bridge Traffic Safeguards (Mount Pleasant Mine)

- Contractual arrangements to prevent heavy vehicle traffic usage of the bridge by the Mount Pleasant mine (during the hours of 6.45 to 8.45 am and 3.15 to 5.15 pm on weekdays) by either construction or operations traffic from the mine.
- Signs to be erected on the bridge, subject to approval from Muswellbrook Shire Council, in both directions to specify the above requirements.

ii. Management of Temporary Road Closures due to Blasting (Mount Pleasant Mine)

- Minimum 24 hours notice of all road closures to be provided.
- Solar powered signs to be installed to advise traffic of road closures and alternative routes.
- Blasting operations at Bengalla, Mount Pleasant and Kayuga Mines to be co-ordinated to minimise traffic disruption from road closures on Wybong Road, Castlerock Road, Dorset Road and the proposed Mount Pleasant Northern Link Road.

iii. *Intersection Improvement Works (Mount Pleasant Mine)*

- Future intersection for Mount Pleasant Mine Access from Mount Pleasant Western Link (Year 9 of mine operations).
- Future intersection of Mount Pleasant Western Link Road with Bengalla Mine Link Road (Year 9 of mine operations).
- Future intersection of Mount Pleasant Western Link Road with Mount Pleasant Northern Link Road and Castlerock Road (Year 3 of mine operations).
- Future intersection of Mount Pleasant Northern Link Road with Kayuga Road (Year 3 of mine operations).
- A 65 per cent contribution towards the cost of future intersection improvements at the Denman Road and Thomas Mitchell Drive intersection.

iv. *Roadworks Improvements (Mount Pleasant Mine)*

- Construction of a bridge to carry the Bengalla Mine Link Road over the proposed Mount Pleasant Rail Loop.
- Close Castlerock Road and construct Mount Pleasant Northern Link Road to Dorset Road (Year 3 of mine operations).
- Close Wybong Road in conjunction with Muswellbrook Shire Council and construct Mount Pleasant Western Link Road (Year 9 of mine operations).
- All roads to be constructed to 100 km/hr design standard to Council and RTA requirements.
- A contribution of 50 per cent to be made to the annual road maintenance costs for the section of the Bengalla Mine Link Road between Denman Road and the western limit of the 1 in 100 year flood level.
- From the time of commencement of mine construction, any additional annual maintenance costs for Wybong Road between the mine access and Kayuga Road (including the Rosebrook Bridge) are to be met by the Mount Pleasant Mine. The calculation of these additional costs is to be based on historic maintenance costs to Council for this section of road for the three year period July 1994 to June 1997.

v. *Roadworks Improvements (by other mines)*

- Construct a 500 metre extension to the Dartbrook Mine Link Road and open this road for public traffic usage (by Kayuga Mine).
- Complete Bengalla Mine Link Road (from Denman Road to Wybong Road) (by Bengalla Mine).

- Close part of Dorset Road and construct Kayuga Mine Link Road (by Kayuga Mine).

vi. *Rail Transport (Mount Pleasant Mine)*

- Product coal from the proposed mine is to be transported by rail.

- A new rail loop with Category 6 coal loading capacity is to be constructed at the Mount Pleasant Mine.

vii. *Rail Transport (Rail Freight Operators)*

- Signalling and scheduling improvements will need to be provided by the Rail Access Corporation and FreightCorp to reduce delays and stops and starts by coal trains at Muswellbrook Junction; and

- Increased coal train capacity with more 8,000 tonne capacity trains will need to be provided by rail freight operators in the longer term to facilitate operations of the Muswellbrook to Antienne section of the Main Northern Rail Line.