SECTION 6 : LAND USE, ZONING AND OWNERSHIP

6.1 LAND USE

Figure 6.1 depicts the land use in the project area and surrounding locations.

6.1.1 Bellbird South Development Area

Coal was extracted from the Cessnock No. 1 Colliery, from 1917 to 1961. Thereafter the Colliery was abandoned. The land at this site is disused apart from three cottages to the perimeter of the colliery, which are owned by the Company and currently tenanted. No other coal mining activities have existed in the past in the Bellbird South project area and none occur at present.

The predominant land uses occurring within the Bellbird South development area include the grazing of cattle and horses, forestry and associated recreational activities, the latter occurring within the Aberdare State Forest. Limited poultry production is also practised.

The area is not renowned as a high quality rural locality.

6.1.2 Surrounding Land Uses

Agricultural

Beef cattle grazing and horse grazing are undertaken on undulating land surrounding the development area to the east and south. In addition, a Hereford Stud, a horse stud and an Ostrich Farm exist to the south of the study area.

Residential

Residential blocks occur at Kitchener, Abernethy, Bellbird, Paxton, Pelton and Ellalong. In addition, there are a few rural residential blocks along Holmes Street and Glennie Street on the fringe of Ellalong village.

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A mixture of hobby farms, small rural residential and larger properties are concentrated to the east and south of the site along Sandy Creek Road and Quorrobolong Road.

Irrigation

One current irrigation licence exists within the study area. The licence permits pumping from Cony Creek in the vicinity of the junction of Cony and Quorrobolong Creeks.

Apart from the current licence, no irrigation licences have existed for Quorrobolong or Cony creeks, within the study area, since 1944.

Other

The Aberdare State Forest occupies a large area outside (and within) the project site, constituting the major land use in the vicinity of the development site. Other landuses located in the vicinity of the Bellbird South project area include a Bobcat hire, rubbish tip, memorial gates and an abandoned colliery.

6.2 LAND OWNERSHIP

Current land ownership within and adjacent to the project area and development area boundaries are shown in **Figure 6.2.** Details of property ownership and land area are given in **Appendix 11.**

Approximately one third of the land encompassed by the Bellbird South proposal is privately owned. A total of 22 private properties occur wholly within the Bellbird South development area, whilst two properties occur partly within the area proposed to be mined.

The majority of residences outside, but in close proximity to the proposed Bellbird South mining area, occur to the east of the project area along Sandy Creek Road and Quorrobolong Road. A few properties are located just to the south, west and northwest.

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The remaining land within the Bellbird South development area is owned by NWCC/Southland Pty Ltd and the Forestry Commission who manage the Aberdare State Forest and Crown Land.

The impact of the mine on residences within and around the project area is discussed in **Section 8.15.**

6.3 LAND ZONING AND STATUTORY PLANNING CONTROLS

Development and landuse throughout the Cessnock local government area is governed by various environmental planning instruments at local, regional and State levels. A summary of those environmental planning instruments relevant to the Bellbird South proposal is presented below.

Cessnock Local Environmental Plan 1989

The area to be undermined is zoned 1(a) Rural "A" and 1(f) Rural (Forestry). A corridor of Zone No. 5 (b) Special Uses (Railways) passes through the subject area, however, the railway is dismantled and not used.

The objectives of Zone No. 1(a) are to enable the continuation of existing forms of agricultural landuse and occupation and to ensure that potentially productive land is not withdrawn from production. Mining is a permissible form of development within this zone, subject to development consent being obtained.

The objectives of Zone No. 1(f) are to recognise and protect the renewable resources of State and private forests and their recreational functions. Mining is a permissible form of development within this zone, subject to development consent being obtained.

Hunter Regional Environmental Plan, 1989

The Hunter Regional Environmental Plan 1989, provides a statutory framework to guide and

control the Hunter Region's growth and development. The Bellbird South project is considered to comply with the stated objectives and policies for controlling development within that section of the Plan entitled "Part 6 - Natural Resources". In particular, Objective 39 of the Plan states that the objectives in relation to planning strategies concerning mineral resources and extractive materials are to:

> " *(a) manage the coal and other mineral resources and extractive materials of the region in a co-ordinated manner so as to ensure that adverse impacts on the environment and the population likely to be affected are minimised;*
>
> *(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; and*
>
> *(c) ensure that transportation of coal and other mineral resources and extractive materials has minimal adverse impact on the community.* "

The proposed development does not conflict with any of the landuse planning issues or strategies outlined above. The incorporation of comprehensive environmental planning, monitoring and rehabilitation programmes into the mine extension reduces or eliminates any potential land use conflict.

Hunter Region Environmental Plan, 1989 - Heritage

The general aim of the Hunter Regional Environmental Plan, 1989 - Heritage is to conserve the environmental heritage (including the historic, scientific, cultural, social, archaeological, architectural, natural and aesthetic elements) of the region. Heritage aspects of the project are discussed fully in **Section 6.6**.

6.4 SOCIAL AND ECONOMIC ASPECTS

For this assessment, statistical information is based on the Cessnock local government area

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which covers an area of 1,970 km^2.

6.4.1 Population

The population of Cessnock City was 43,859 at the 1991 Census (ABS, 1991).

The average annual rate of population growth in the Cessnock local government area was slightly lower than for the Hunter region as a whole during the period 1986 to 1991 (1.02 per cent compared with 1.2 per cent). This followed a higher rate of growth in the previous inter-censal period. **Table 6.1** gives population and growth rates for Cessnock and the Hunter region from 1981 to 1991.

TABLE 6.1
CESSNOCK/HUNTER REGION POPULATION CHANGE 1981 - 1991

Statistical Area	Population			Population Change		Average Annual Rate %		
	1981	1986	1991	1981/86	1986/91	1981/86	1986/91	1981/91
Cessnock	37,854	41,733	43,859	3,879	2,126	2.05	1.02	1.59
Hunter Region	458,722	482,775	513,550	24,053	30,775	1.05	1.2	1.19

Source: ABS Census 1981, 1986, 1991

Within the local government area, the population is distributed widely between the urban centres of Cessnock-Bellbird and Kurri Kurri-Weston, rural villages and rural areas. It was mining development which induced the rapid growth of Kurri Kurri and Cessnock, along with a number of small villages.

The population distribution is shown in **Table 6.2.** Over 80 per cent of the population lives in the urban centres of Cessnock-Bellbird, Kurri Kurri-Weston and Branxton-Greta. Over 40 per cent of the population is in Cessnock-Bellbird (these urban centres are defined by the Australian Bureau of Statistics). These proportions have changed little between the Census periods, although the rate of growth in the rural areas was more than double that of the urban centres.

Population growth up to 1998 is likely to be both steady and consistent with the growth rates experienced in the last inter-censal period, taking the population to approximately 47,770 to 48,780 (Cessnock City Council, 1993). The Department of Planning (1994) anticipates a slow reduction in Cessnock's share of the regional population up to the year 2021. However, in the Department of Planning's publication *"Sydney's Future"*, the possibility of encouraging greater growth in the Hunter region is canvassed, with potential for a 30,000 increase in projected dwellings in the Lower Hunter by 2011. The State Government's policy directions may have a significant impact on future population development.

TABLE 6.2
POPULATION DISTRIBUTION - CESSNOCK LOCAL GOVERNMENT AREA

	1986 Population	Proportion of LGA - 1986 (%)	1991 Population	Proportion of LGA - 1991 (%)
Urban Centre:				
Cessnock-Bellbird	17,506	41.9	17,914	40.8
Kurri Kurri-Weston	13,411	32.1	14,172	32.3
Branxton-Greta	3,208	7.7	3,423	7.8
Rural remainder	7,608	18.2	8,345	19.0
Total LGA	41,733	100.0	43,854	100.0

Source: ABS Census 1986 and 1991 (Preliminary Release)

The Cessnock local government area as a whole has a "maturing" age profile (Cessnock City Council, 1994). **Table 6.3** shows the age structure of the population in 1991. There was a substantial decline of 12.8 per cent in the 25 to 29 years age group, and a dramatic increase of 46 per cent in the 40 to 44 age group between 1986 and 1991.

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TABLE 6.3
AGE STRUCTURE - CESSNOCK LOCAL GOVERNMENT AREA 1991

Age Group	Males	Females	Persons	Prop. 1991 (%)	Change 1986/91 (%)
0-4	1854	1797	3651	8.3	3.5
5-9	1801	1873	3674	7.4	6.2
10-14	1862	1675	3537	8.1	-6.8
15-19	1746	1686	3432	7.8	3.5
20-24	1533	1469	3002	6.9	0.6
25-29	1454	1557	3011	6.9	-12.8
30-34	1823	1870	3693	8.4	10.0
35-39	1689	1787	3476	7.9	6.0
40-44	1624	1519	3143	7.2	46.0
45-49	1232	1166	2398	5.5	13.3
50-54	959	957	1916	4.4	6.6
55-59	891	896	1787	4.1	-6.7
60-64	924	996	1920	4.4	3.7
65-69	767	901	1668	3.8	6.3
70-74	597	792	1384	3.2	11.1
75+	679	1345	2126	4.9	12.6
Total	21,430	22,388	43,818	100.0	5.1

Source: ABS 1991 Census

6.4.2 Employment

Table 6.4 shows the break-up of employment by industry sectors at the time of the 1991 census for residents of the Cessnock local government area. **Table 6.5** indicates the occupations of the workforce.

The major areas of employment are manufacturing and the wholesale and retail trades, followed by community services and mining. Together, these areas provide employment for over 63 per cent of the workforce. There was a 6 per cent decrease in employment within the mining industry from 1986 to 1991, however, mining still provides the most jobs for males (23 per cent), reflecting the area's strong historical association with coal.

TABLE 6.4
EMPLOYMENT BY INDUSTRY - CESSNOCK LOCAL GOVERNMENT AREA 1991

Industry	Male	Female	Total	1991 %	1986 %
Agriculture, forestry, fishing and hunting	254	163	417	2.6	3.2
Mining	2,215	27	2,242	14.1	20.0
Manufacturing	1,838	814	2,652	16.7	19.0
Electricity, Gas & Water	201	36	237	1.5	2.0
Construction	816	138	954	6.0	4.6
Wholesale & Retail Trade	1,205	1,410	2,615	16.5	14.2
Transport & Storage	368	62	430	2.7	3.5
Communication	116	30	146	0.9	1.2
Finance, property and business services	364	494	858	5.4	4.8
Public administration and defence	286	211	497	3.1	3.1
Community services	859	1,648	2,507	15.8	16.0
Recreation, personal and other services	415	705	1,120	7.1	5.5
Not classifiable	24	3	27	0.2	
Not stated	683	463	1,146	7.2	2.8
Total	9,644	6,204	15,848	100.0	100.0

Source: ABS 1991 Census

TABLE 6.5
WORKFORCE OCCUPATION - CESSNOCK LOCAL GOVERNMENT AREA 1991

Occupation	Male	Female	Total	%
Managers and Administrators	720	410	1,130	7.1
Professionals	544	451	995	6.3
Para-professionals	571	476	1,047	6.6
Tradespersons	2,610	234	2,844	17.9
Clerks	296	1,205	1,501	9.5
Sales and personal service workers	472	1,495	1,967	12.4
Plant and machine operators and drivers	1,911	544	2,455	15.5
Labourers and related workers	1,812	1,017	2,829	17.8
Inadequately described	105	24	129	0.8
Not stated	557	427	984	6.2
Total	9,598	6,283	15,881	100.0

Source: ABS 1991 Census

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Most of the area's workforce residing in Cessnock and the surrounding villages are employed at locations outside the local government area, including Maitland, Newcastle, Singleton and the Central Coast.

There has been a steady decline in employment in mines in the South Maitland Coalfield (which includes Cessnock) largely due to the depletion of available coal reserves in existing mines. Ellalong/Pelton is now the only mine operative in the Cessnock area. The 360 jobs it provides (284 of which are taken up by Cessnock residents) constitute a valuable sector of employment.

The rate of unemployment in the Cessnock local government area was 16.8 per cent in the June quarter of 1994. The Hunter regional unemployment rate was 13.7 per cent in the same period (DEET, 1994).

6.4.3 Economic Activity

Cessnock's economy in the past was largely reliant upon coal mining and manufacturing, but it is slowly changing to a more service-based economy centred on the hospitality of the Vineyards District (Cessnock City Council, 1994).

The wholesale and retail trade sector grew to provide 27.9 per cent more jobs between 1986 and 1991, and similarly, the finance, property and business service sector grew by 24.9 per cent (refer **Table 6.4**).

6.4.4 Place of Residence of Ellalong Workforce

The workforce of Ellalong Colliery consists of 360 administrative, production and engineering personnel. The demographic break-up of the workforce on a permanent residency basis indicates a spread through seven local government areas (LGAs). **Table 6.6** illustrates the number of employees by residential location for November 1994.

The largest proportion of employees reside in the Cessnock LGA, the LGA in which the Pelton/Ellalong Colliery is located.

TABLE 6.6
PELTON/ELLALONG EMPLOYEES BY RESIDENTIAL LOCATION

Local Government Area	Number of Employees
Wyong Shire	6
City of Lake Macquarie	34
City of Cessnock	284
Singleton	1
Maitland	14
Newcastle	18
Port Stephens	1
Muswellbrook	2
Total Workforce	360

Source: Pelton/Ellalong Colliery

6.5 ABORIGINAL HERITAGE

The southern half of the study area was surveyed by Brayshaw (1987) as part of the EIS for Southland, and two archaeological sites were located: a small open site Quorrobolong 1 and an isolated artefact 1F-1 (Refer **Figure 6.3**). In 1993, Appleton located an isolated artefact on the edge of Paxton. An archaeological survey was conducted for this EIS and one Aboriginal site, a stone artefact (EL-1) was located (refer to **Figure 6.3**).

Open sites are defined as the remains of camp sites where archaeological material consists mainly of stone artefacts, charcoal and food debris. Isolated finds are single occurrences of archaeological artefacts, usually stone artefacts. It is considered possible that scarred trees (trees from which the bark has been removed for use on an artefact) could occur in the less intensively cleared parts of the study area. Rock shelters, some with art, have been reported from the wider area but no suitable outcrops occur in the study area.

The results of archaeological surveys described above reflect a combination of low effective coverage and an Aboriginal settlement pattern that may have produced small, low density sites.

6.6 EUROPEAN HERITAGE

The small settlers who occupied the Cessnock area from the 1820s were involved in grazing sheep and cattle, growing wheat and maize, and timber getting. Vineyards developed after the 1840s and formed an important part of the farming economy. The farms produced items such as wool and grain that were in the short term at least non-perishable and thus could survive a longer trip to market.

With the development of mines at East Greta in 1891, exploitation of the South Maitland Coalfields began and mines began to open as the Greta Coal Measures were followed south. Mines were established in the Cessnock area by 1906 and were linked to what later became the South Maitland Railway. Collieries to the southwest of Cessnock (within and adjacent to the study area) were established in the 1920s (Eardly 1969).

The effect of coal mining was to increase the regional population and improve the transport links to Maitland and Newcastle. Maze (1933:37-38) notes two opposing effects of coal mining on the agriculture of the area. Firstly, people gave up farming and became miners and secondly, the growing demand for fresh food increased the production of vegetable, fruit and dairy products. Maze paints a picture of changing land use patterns from small farms growing grain or grazing sheep and cattle, to a mining landscape with the mines themselves, transport networks to take the coal out to Newcastle, and a network of residential towns (such as Ellalong and Paxton) for miners. The agricultural landscape changed to dairying and vegetable production on the richer soils with the marginal farms being abandoned.

Within the study area it was expected that two types of post-contact sites would be located: those relating to agriculture; and mining related sites. Agricultural sites are likely to be small farms and possibly contain evidence of change in land use. Evidence of abandoned farmland might be expected as well. Agricultural sites have the potential to date from the 1820s. Mining sites are likely to be the mines themselves consisting of head frames, winding gear, coal screens, changing rooms and rail connections. Associated sites are the railways and the dormitory townships.

There was little evidence of agricultural sites in the areas surveyed. In Area 4, it was apparent from the vegetation that the area had been cleared and was now revegetating. A large scarred tree, killed by ringbarking, was located and recorded as EL-2 (refer **Figure 6.3**).

The majority of the post-contact sites were those relating to coal mining. The abandoned Kalingo Junction to Millfield and Paxton branch line forms the southern boundary of Proposed Emplacement Area 4. As well, the abandoned Kalingo Junction to Cessnock No. 1 Colliery line runs through the broader area of the study area. The Department of Urban Affairs and Planning has confirmed that a Section 130 order, under the Heritage Act 1977, which applies to the South Maitland Railway, does not affect the railway line within the study area (refer **Appendix 6**).

Finally, the Cessnock No. 1 Colliery was inspected as part of the survey to assess possible damage to the site due to recent bushfires. This identified that only the former administration block had suffered damage, it having been burned out, but appears to still be structurally sound.

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SECTION 7 : PROPOSED EXTENSION OF MINING OPERATIONS

7.1 GENERAL DESCRIPTION OF THE EXTENSION

It is planned that the Bellbird South area be mined from the present Ellalong Colliery by extending Ellalong's underground workings into Bellbird South, and that Ellalong's existing surface infrastructure may continue to be used.

7.2 MINING PLAN

7.2.1 Constraints to Underground Mining

The Development Application (DA) is confined to an area largely west of a major geological structure where the depth of cover ranges from 400 to 680 m. Faulting and seam quality may cause the mining plan to be revised during the life of the mine.

Although the area east of the geological structure is presently held under mining title (part of Consolidated Mining Lease No. 2), most of this area will not be mined as part of this DA (refer to **Figures 1.2 and 1.3**).

7.2.2 Proposed Mine Plan and Schedules

The conceptual mine plan is shown in **Figure 1.3.**

The longwall blocks are oriented in a generally northeast to southwest direction which approximates the direction of principal horizontal stress (**Figure 1.3**) and provides better mining conditions in the gates roads. The longwall panels in the eastern area are oriented in a more east to west direction because of a change in the principal horizontal stress in this area.

The mining sequence proposed is to mine the southern longwall blocks initially where there is available access from Ellalong's 1 East workings and to progressively mine this area from west to east. A ventilation shaft adjacent to Sandy Creek Road may be required by about 1997 to ventilate the more easterly of these longwall blocks. Later, Cessnock No. 1 Shafts may be

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holed or new shaft(s) sunk in this vicinity and the northern blocks worked again from west to east. Finally, the area east of the expected geological structure would be accessed and the longwall blocks extracted. Depth of cover in this eastern area ranges up to 750 m, which presents new challenges. However, as it is expected to be about 20 years before the area is reached, technological advances may have brought solutions for successful mining of this area.

It has been decided to confine the DA to the area largely west of the geological structure (where the depth of cover ranges from 400 to 680 m), because of the mining uncertainties about the eastern area, the time before it will be ready to be mined, the probability of additional new entries being required and the fact that a development consent lasts for 21 years only. The eastern area would be the subject of a separate DA at a later date. Nevertheless, it is important to point out that a lease is held over the area and mining is proposed.

It is emphasised that the mine plan is conceptual and layouts may change, as additional geological information becomes available especially in the northern and eastern areas. Also, the longwall block widths may change; currently the blocks are 200 m wide, but an increase to 250 m is being considered and this increased width has been used in the conceptual mining plan in the northern and eastern areas.

7.3 MINING METHOD

7.3.1 Equipment

The present mining equipment in use at Ellalong Colliery, that is continuous miners for development work and a Longwall Unit, will continue to be utilised in this proposal to mine the Bellbird South area.

The existing roof supports have a working height limit of 4.1 m. It is planned to replace the supports progressively so that in the future the maximum working height will be 4.5 m, which is approximately the maximum working height of successful longwalls utilising current technology. This will result in the top coal, generally higher in sulphur content, being left

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behind in the extracted area.

7.3.2 Transportation and Ventilation

Ellalong Colliery's existing surface infrastructure will continue to be used in the proposed development. Coal will be brought out via the Ellalong Drift conveyor and then by the existing overland conveyor system to the Pelton site where stockpiling, washing and rail loading will continue as at present. Men and materials access will continue to be via the Ellalong Drift and No. 1 and No. 2 Shafts. Ventilation will continue in the early years as at present, with the fans at No. 1 Shaft. In about 1997, a ventilation shaft adjacent to Sandy Creek Road may be required. From about 2001, it is planned to re-use the old Cessnock No. 1 Colliery shafts or new shaft(s) in the vicinity for ventilation and possibly man riding.

The above timing is based on maintaining the present scale of operations at Ellalong in terms of annual output. This could change in the future depending on economics, mining conditions or technological changes, but, in any event, the planning is based on operating within the present infrastructure constraints or with minor changes.

7.4 MINING SUBSIDENCE

When a seam of coal is mined, the overlying strata are disturbed. When a sufficiently wide area is extracted, such as occurs in longwall mining, the roof beds break and collapse into the mined out area under the influence of gravity and other forces. The collapse causes cracking of the higher beds and bending downwards of those near the surface, and this is known as subsidence.

The term subsidence defines downward and sideways movement of the surface. It also includes strains which occur as rocks move, as well as tilt and curvature of the surface. The most common parameter used when subsidence is discussed is the downward (vertical) movement because this determines the magnitude of all the other parameters. The parameter of concern when assessing impact on the surface or improvements is strain, but since it is

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dependent on the vertical subsidence, and is calculated from it, most attention focuses on vertical movement.

The principal factors determining the amount of subsidence are the mining method, the thickness of coal being mined, the depth of the coal seam, the dimensions of the area being mined, the local geology and the surface topography. All these need to be considered in determining the likely magnitude and impact of subsidence resulting from mining coal. Practical experience of mining from areas with similar conditions can also be incorporated into assessment of subsidence. Reasonable estimates of likely subsidence can then be determined.

Clearly a mining method which maximises coal extraction is always a preferred method, and the longwall mining method satisfies this criterion. The method extracts a wide area of coal from a panel, commonly 200 m in width, for a distance up to several kilometres. This affects the rock strata between the mined area and the surface.

The development of subsidence at the surface will logically following the mining sequence. The mine schedule allows estimates of the timing of subsidence to be made.

G.E. Holt and Associates Pty Ltd have conducted an assessment of the impact of subsidence from the proposed development and their report is included in **Appendix 10** of this EIS.

7.5 VIBRATION

7.5.1 Introduction

Renzo Tonin and Associates conducted investigations and predictions of ground vibration in the vicinity of Ellalong Colliery relating to current and proposed operations. The report on these investigations is included in **Appendix 10.**

It is now widely recognised that ground subsidence resulting from underground mining may also have associated with it ground vibration caused by the failure of the rock strata above.

Over the years, Ellalong Colliery and the Mines Subsidence Board have monitored a number of ground vibration events at various locations in Ellalong resulting from the current mining activity. After analyses of the data the conclusion reached was that the vibration data were shown to scale in a manner consistent with ground vibration associated with subsidence.

7.5.2 The Nature and Cause of Vibration Resulting from Ground Subsidence

The longwall mining technique utilised to extract the coal resource permits a controlled collapse of the roof or goaf of the area from which coal has been extracted.

In ideal circumstances, the earth subsides gradually over a period of time to fill the void. The pillars and abutments load up and ultimately this can result in a tensile failure of the immediate roof cantilevers. This sudden release of energy results in ground vibration not dissimilar to a heavy weight falling on the ground. These vibration events may be referred to as "ground tremors".

Two possible mechanisms for ground tremors include the following:

1. a sudden fracture of the rock lying above the mined out area due to the tensile and cantilever failure caused by the advancing mining face, and

2. slippage along a fault line or rock fracture zone.

The ground vibrations experienced at Ellalong have been and are at present being monitored by a number of highly sensitive vibration instruments. These instruments record the vibration traces and the time of their occurrence.

The central issue of concern is the potential damage to residences caused by the ground tremors.

While very low amplitudes of vibration can be felt, this does not necessarily mean that such vibrations cause damage to buildings. Therefore, central to the discussion is a review of

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standards used by the international community to assess damage to structures caused by vibrations.

7.5.3 Vibration Damage Criteria

There are no standards anywhere in the world that relate specifically to ground vibration caused by tensile failure. However, the nature of the vibration trace is similar to that produced by blasting in open cut mines. For this reason, and in the absence of any other directly applicable standards, those standards which specifically relate to damage produced in structures by ground vibration caused by blasting are relied upon.

Without exception, these standards measure vibration amplitude by reference to the vibration velocity (i.e. the speed of backwards and forwards ground motion) and the units of measurement are millimetres per second, denoted mm/sec.

AS2187

The only standard in Australia which specifically relates to vibration damage resulting from ground vibration is Australian Standard AS2187 - 1993 "*Explosives - Storage, transport and use*".

This standard specifically relates to vibration effects produced by blasting but is relevant to ground tremors because the vibration resulting from both events is similar in nature.

Based on this information, a level of 5 mm/sec peak vibration has been adopted as a conservatively low level below which damage due to vibration is unlikely to occur.

A report has been compiled by Renzo Tonin and Associates dealing with ground vibration caused by mining subsidence. This report is included in **Appendix 10** of this EIS.

7.6 REJECT HANDLING AND DISPOSAL

Under the Coal Mines Regulation Act 1982, washery reject emplacement creation and procedures must be approved by the Department of Mineral Resources.

7.6.1 Coarse Reject Material

Over the 21 year life of the Development Consent, it is estimated that 3.67 million cubic metres of coarse reject material will be produced. The existing emplacement area at the Aberdare Extended Open Cut site has an estimated remaining capacity of 1.28 million cubic metres. Coarse reject disposal will continue in the same manner and in the same general location up to 2002 (approximately).

After this period new reject emplacements will be established around the Colliery. The proposed location of these emplacements is shown in **Figure 7.1.** As a result of the availability of the current coarse reject disposal site for seven more years, detailed design of emplacements has not been addressed as part of this EIS but will form part of a later application to the Department of Mineral Resources.

This EIS outlines conceptual plans which have been developed in relation to the method of emplacement of reject material, the method of construction of reject emplacements, and the management and rehabilitation of emplacement areas. The location and characteristics of each reject emplacement area is also described. Area 1 is described in detail, for reasons outlined below.

Three emplacement areas have been delineated which will provide sufficient disposal capacity to exceed the life of the mining proposed by this DA. Each of these areas is located on land surface owned by The Newcastle Wallsend Coal Company Pty Limited. The areas are likely to be utilised in the sequence: Area 1, Area 3, then Area 4. A further possible site for reject disposal is the Pelton Open Cut final void, discussed below. Area 1 is located within the Bellbird Creek catchment. Areas 3 and 4 are within the Congewai Creek catchment. Due to

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the size of the catchments affected by Areas 3 and 4, Area 1 is considered to be the preferred emplacement area. The proposed surface elevation for Reject Emplacement Area No. 1 is shown in **Figure 8.1.**

The surface area covered by each emplacement, maximum depth of reject, minimum distance from public roads and the volume of coarse reject disposed of in each emplacement is indicated in **Table 7.1.**

TABLE 7.1
COARSE WASHERY REJECT EMPLACEMENTS

Area	Surface Area (ha)	Volume of m^3 coarse reject	Depth of emplacement (max)	Approximate Minimum Distance from roads (m)
Aberdare Extended	21.8	1,240,000	16 m (old open cut void)	50
1	32.9	2,100,000	20 m (gully fill)	350
3	13.9	320,000	7 m	100
4	12.1	320,000	7 m	60
Pelton Open Cut	Approx. 15	up to 500,000	Variable	300

Source: Pelton/Ellalong Colliery

Reject Emplacement Area 1 covers a gully which drains the existing clean water catchment north of the Pelton Coal Preparation Plant and dams. The proposed final contours will be elevated up to 20 m above the original surface contours. These are depicted in **Figure 7.3.**

Reject Emplacement Areas 3 and 4 will involve infilling of two gullies which currently drain into the Congewai Creek system. In Areas 3 and 4, the final surface will be elevated some 7 m above the original.

Emplacement of reject in Area 1 would commence upon completion of filling of Aberdare Extended Open Cut, in approximately 7 years time.

Following recent approval by Cessnock Council of a longer term out-of-pit emplacement for Pelton Open Cut overburden, Pelton Open Cut void(s) may become available for the disposal of some washery reject material.

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Preliminary calculations indicate that it may be possible to dispose of approximately 0.5 million cubic metres in this manner. The stored material from the out-of-pit emplacement could be used in the long term (many years hence) for the final capping and rehabilitation of the Aberdare Extended and Pelton sites, and other degraded areas on the mine site. Depending on the actual amount of reject disposed in the open cut, the commencement of use of Emplacement Areas 1, 3 and 4 could be delayed by up to two years. Areas 3 and 4 may not then be required during the life of the Development Consent.

The methods of emplacement and management proposed for the emplacements are designed to eliminate sources of pollution and erosion of watercourses including Congewai Creek and Black Creek catchments, and to facilitate self-sustaining revegetation and rehabilitation of the new land surface above the emplaced reject.

Emplacement Method

Proposed Reject Emplacement Areas 1, 3 and 4 are in valleys, and this determines the emplacement method to a large extent. Basically, construction can commence at the head of the valley, or alternatively, the emplacement can be constructed from the lower end upwards.

For the emplacement at Pelton Colliery site, a programme of reject emplacement construction commencing from the lower end of the valley and progressing uphill in a number of stages, of dimensions suitable for operating earthmoving equipment, is proposed because the method provides a number of advantages as follows:

- area disturbed at any one time is minimised,
- superior drainage control,
- superior compaction control,
- permanent revegetation as the emplacement progresses,
- screening of construction operations.

The typical method of progressive construction and rehabilitation of the emplacement together with clean and dirty water drainage arrangements are shown in **Figure 7.2**.

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It is anticipated that slopes of surfaces will be in the order of 3 per cent though this may be varied in the final design to increase the capacity of Emplacement Area 1, and thus reduce the total number of discrete emplacements required.

Reject Characteristics

The coarse reject contains a relatively high percentage of inherent and free pyritic sulphur in addition to carbonaceous matter. A typical analysis of the currently produced reject is shown above in **Table 5.3**. The sulphur has been known to cause acid leachate to be produced on exposure to water, and to propagate spontaneous combustion of the carbonaceous material in the reject.

Iron pyrite (FeS_2) is oxidised at normal temperatures by moist air to form ferrous sulphate and sulphuric acid, and this reaction is exothermic.

Pyrite, if present in sufficient proportion, and particularly when finely divided and associated with carbonaceous matter, increases the tendency towards spontaneous combustion in reject. Where heating occurs, the oxidation of pyrite and organic sulphur in the coal will form sulphur dioxide, and where there is insufficient air for complete combustion, hydrogen sulphide will be given off. The characteristic odour of these gases sometimes provides a means of detecting a heating.

Moisture, present as free moisture, is essential for the oxidation of pyrite, and in the presence of pyrite, moisture accelerates oxidation and contributes to heating.

The current reject disposal method has demonstrated that both the formation of acid leachate and propagation of spontaneous combustion can be prevented in the emplacement by excluding water and air from the reject. This is achieved at Ellalong by using the method, well known in the coal industry, of compaction of the reject in thin layers.

The moisture in the reject, approximately 10 per cent, aids compaction of the reject and is

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usually evaporated as it is brought to the surface by the compaction process. Any residual moisture contributes to oxidation but the heat generated is dissipated in the mass of the reject.

Emplacement Area Characteristics

Reject Area 1 is described in the following discussion as it will be the first and largest emplacement area to be utilised in the proposed development. Other emplacement areas, if required, will be designed in a similar manner to Area 1, as described below.

Reject Area 1 is located immediately north of the coal preparation plant facility, associated dams, and rail spur. It is proposed that the final surface levels of the emplacement will blend with those of the abovementioned facilities and be incorporated with the site of those facilities when the mine is eventually closed and decommissioned.

Area 1 is approximately 1 km long in the east-west direction and 0.5 km wide. It is located upon the lower slopes of Broken Back Range and is characterised by gently sloping hills on the north side of a valley. Slopes in Area 1 range from approximately 4% to 10%, the steeper slopes occurring in the northern part of the area. The coal preparation plant facilities are present to the south of the proposed emplacement area. A well developed watercourse which has its upper catchment in the Broken Back Range flows along the southern boundary of Area 1. Waterflow in the watercourse is generally west to east on a gradient of up to 1 in 50 into the north-east flowing Bellbird Creek. Due to the area of the catchment above the proposed emplacement, the watercourse will be diverted north of the emplacement to rejoin Bellbird Creek via another arm of that creek (refer **Figure 7.3**).

Area 1 supports vegetation which has been less disturbed than that which generally covers the remainder of the study area, apart from Aberdare State Forest. This area was unaffected by bushfire at the time of the Flora and Fauna Survey. Area 1 is covered by Ironbark-dominant tall open forest, which has been subjected to logging. Other forest species are predominantly *Eucalyptus crebra*, *E. maculata* and *E. microcorys*. The understorey is typical of open forest or East Coast ranges, including *Dodonea* sp., *Macrozamia* sp., *Hardenbergia violacea*,

Breynia oblongifolia and *Imperata cylindrica*.

Fauna species observed in Area 1 were, Grey Kangaroo, rabbits, Rufous Whistler, and Fuscous Honeyeater. **Appendix 9** contains details of other fauna species which would be expected to occur in the vegetation communities present in Area 1.

Area 1 contains a 15 ha area of habitat which may support endangered microchiropterans (bats). However, extraction of timber from this area has diminished the number of suitable roosting trees. Linkages to similar or superior forest occur to the west of Area 1 where a large expanse of forest occurs along a steep ridgeline. This forest would provide a refuge for fauna displaced by emplacement of reject material in Area 1 and is unlikely to be developed or logged due to its steep slopes.

Further field investigations of flora and fauna communities in Area 1 are proposed to be carried out prior to utilisation of Area 1 (refer **Appendix 9**).

Under the rural land capability classification, Area 1 is predominantly Class V land, apart from a narrow belt of Class IV land along the southern margin of the area. This land is suitable for grazing. Agricultural land suitability for Area 1 is mapped by NSW Agriculture as being Class 4, land suitable for grazing but not for cultivation.

Logging for pit timber is the only land use to have been practised in Area 1 in recent times.

The scenic quality of Area 1 is relatively good since it supports relatively less disturbed forest vegetation, in comparison to surrounding areas. However, Area 1 is adjacent to and encroaches upon the extractive landscape of Pelton Colliery, which is of less favourable scenic quality.

Area 1 is unlikely to be visible from Wollombi Road due to the presence of tree screens. The area would be visible from residences on the higher slopes of Mount View to the west as are the present Pelton Colliery facilities.

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Soils in Area 1 are classified as Millfield Red Podzolic Soils in the City of Greater Cessnock Land Resources Study. A description of this soil is presented in **Section 4.4.1.**

Soils within the emplacement area are suitable for revegetation of the emplacement when spread as a capping layer, however it may need to be treated with gypsum and/or lime to improve dispersability and pH, and to retain structural integrity. These topsoils will be stored in suitably placed topsoil dumps and if not being respread within three months will be fertilised and revegetated with a mixture of pasture grasses and legumes. Where possible, the topsoil dumps will be less than 2 m deep to ensure the continued viability of soil micro-fauna.

An archaeological survey was conducted in Area 1 (refer to **Appendix 6**). No Aboriginal sites were located, however, the survey was constrained by the low level of visibility in the area.

The company intends to conduct a further archaeological survey of Area 1 at least six months prior to its utilisation.

Areas 3 and 4 occur in gullies in undulating land and support woodland and open forest vegetation affected by logging and grazing. *Eucalyptus maculata* is the dominant tree species, with other species including *E. punctata*, *E. fribrosa fibrosa*, *E. moluccana* and *E. microcorys*. The understorey is thick in places, and is dominated by *Hakea gibbosa*, *Callistemon linearis* and *Casuarina* sp. Many weeds are also present. The scenic quality of these areas is favourable.

Fauna species observed in Areas 3 and 4 were: Rufous Whistler, Grey Kangaroo; Dollar Bird and beef cattle were observed in Area 3 while Fuscous Honeyeater and Pallid Cuckoo were observed in Area 4.

Rural land capability in Areas 3 and 4 is mapped as Class IV and V. Agricultural land suitability is Classes 4 and 5 for Area 4 and Class 4 for Area 3. The Class 4 land is suitable for grazing and the Class 5 land is suitable for light grazing only. The soil in Areas 3 and 4 is mapped as Kutting Yellow Podzolic Soil, described in **Section 4.4.1.**

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Emplacement activities in these areas will be visible from Paxton Road due to the sparser nature of the vegetation, but are unlikely to be visible from Wollombi and Ellalong roads due to the greater distance.

Emplacement Construction

It is proposed that the completed emplacement will be progressively constructed and rehabilitated in several stages as shown in **Figure 7.2**. Each stage will be sized to provide sufficient space to allow economic operation of earthmoving equipment while minimising exposure of uncompacted reject to leaching and erosion from rainfall, as well as minimising opportunities for wind erosion.

The construction method is designed to eliminate acid leachate issuing from the emplacement on completion, and to minimise acid leachate formation during construction.

Procedures will be implemented to minimise exposure of uncompacted reject to wet weather, such as increasing the frequency of spreading and compacting operations, and grading the surface of the area under construction to the drainage system to be provided, at such a grade that ponding is prevented. Further, in the event that acid leachate is formed on the area under construction, the addition of a suitable bactericide to the area will be considered.

Sequential construction of the emplacement will be as follows:

i. Construction of a dirty water, sediment, and leachate control dam downstream of the emplacement into which a drainage pipeline from the active emplacement area will deliver dirty runoff, and leachate if formed. Design of these works will be adequate to cater for a 1 in 10 year storm event, or to other criteria as may be specified by the EPA. Water from this dam is to be pumped to the mine dirty water system (Area 1) or drained to undergound workings via boreholes (Areas 3 and 4).

ii. Construction of a perimeter drain on the north side of the emplacement in which clean

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catchment water from above the emplacement will be diverted around the emplacement to rejoin Bellbird Creek as shown in **Figure 7.3.**

iii. Construction of a clean runoff dam or drain above the active area of the emplacement in a location at least one stage ahead of the stage under construction. This will minimise the mixing of clean and contaminated water streams while allowing the area the subject of the next stage of construction to be stripped of topsoil and growing medium.

Clean water from this dam may be pumped or diverted to the mine clean water usage system or clear of the emplacement to Bellbird Creek. Alternatively the water could drain in a pipeline under the emplacement to Bellbird Creek, however it is considered prudent to minimise possible leakage of water into the emplaced reject.

iv. Stripping and stockpiling of sufficient topsoil and growing medium from the base of the emplacement to provide a compacted cap and growing medium for the surface of the emplacement. The sub base of the emplacement will be compacted to reveal the presence of groundwater which could form leachate with the reject, and to provide a solid base for the emplacement of the reject.

v. Installation of an appropriately sized sealed pipeline constructed from concrete or other suitable material, to resist overburden depth, in a trench below the emplacement base in the area under construction. This pipeline will deliver dirty runoff water and perhaps leachate to the abovementioned dirty water dam from a collecting basin located immediately upstream of the area under construction.

The pipeline will be laid in a suitable blue metal bed to form a sub base drainage system. Any springwater flows found in the emplacement base will be drained to this system by agricultural drainage lines in trenches backfilled with blue metal. The drainage lines will be covered by a waterproof clay layer to prevent moisture entering the compacted reject above.

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vi. Moist reject from the coal beneficiating plant will be delivered to the emplacement area in trucks and will be placed in loads to provide a layer of reject approximately 300 mm thick when spread using a bulldozer.

The spread reject will then be suitably compacted using an appropriate vibrating roller. Compaction of the reject will exclude air and moisture from entering the reject and so inhibit acid leachate formation and spontaneous combustion of the carbonaceous matter in the reject. Successive layers of reject will be deposited and compacted until the designed level of the emplacement is reached.

Following a study of the results of the use of a suitable bactericide in the control of acid leachate formation, a decision will be made on the need to treat the initial layers of reject in the emplacement using this material. Bactericides are established as being effective in controlling acid leachate formation because the *Thiobacillus ferrooxidans* bacteria are responsible for the conversion of pyrite and other sulphides, present in coal reject material, into sulphuric acid.

Certain bactericides inhibit these bacteria and are able to arrest acid leachate formation and water pollution by up to 95 per cent. Controlled release pellets are active over several years and perform the functions of inhibiting acid-producing bacteria while stimulating the growth of heterotrophic bacteria which are required for healthy revegetation of the site. Appropriate bactericides are selectively bactericidal to *Thiobacillus ferrooxidans* and do not create an environmental problem of their own.

The bactericides are anionic surfactant chemicals which remove the protective coating surrounding the bacteria, allowing the acid produced by the bacteria to enter and destroy the bacteria.

The decision to utilise bactericide rather than traditional methods of controlling acid leachate involves environmental benefits. Traditionally, acid leachate formation has been controlled by means of compaction of reject material followed by capping

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emplacements with a thick layer of inert material, such as clay to exclude oxygen and water which support bacterial activity. By utilising bactericide, the environmental disturbance caused by extraction and transport of capping material are avoided. Any ingress of water or oxygen into the reject is less of a problem when bactericide is used.

If the results indicate that bactericide is required, then prior to covering with the capping layer, the surface of the reject emplacement will be treated with bactericide in sprayed and slow release pellet form to prevent the formation of leachate due to ingress of rainfall through the capping layer.

vii. A capping layer preferably comprised of non dispersing clay or treated clay will be spread and compacted on the surface of the emplaced reject on reaching designed level. Previous experience has shown that a capping layer in the order of 300 to 500 mm and covered with up to 200 mm of growing medium and topsoil has proven successful. It is proposed that this general practice will continue.

viii. On completion of the placement of the capping and growing medium on the emplacement surface, drainage control banks on a grade of generally 1 in 100 will be constructed at approximately 40 m intervals to drain rainfall runoff water to the northern perimeter drain in order to prevent erosion of the emplacement surface.

The following general rehabilitation procedures will be adopted:

ix. The surface of the emplacement will then be revegetated by sowing down the surface with a seasonably dependent pioneer crop such as Japanese Millet or Oats. At the same time, native tree and ground cover seed will be broadcast sown. Clumps of local native tube stock trees will also be planted immediately above the drainage banks in the appropriate season to provide tree regrowth and a future seed source. Plastic tree guards may be required to prevent attack from animals, and retain moisture around the trees. Gypsum and lime may be sprayed on to the capping material, growing medium and topsoil to minimise clay dispersability and raise pH of the material to accepted

revegetation standards.

x. Depending on rainfall experienced, drip irrigation of the planted tubestock may be installed to promote growth.

Reject Emplacement Management

To ensure the objectives of the construction of the emplacement are met and that the performance of the acid leachate and spontaneous combustion control measures are adequate, a management plan for the emplacement will be implemented. This plan will cover all aspects of the construction and revegetation of the emplacement as well as the results of monitoring of performance as follows:

i. production of acid leachate reporting to the dirty water runoff dam downstream of the emplacement;

ii. possible monitoring of temperature of the emplaced material via borehole thermometers;

iii. possible monitoring of groundwater movement within the emplacement via borehole piezometers.

It should be noted that the foregoing description of the emplacement of reject at Pelton/Ellalong does not include the suite of geological, hydrogeological and geotechnical investigations which would be completed prior to final design of the emplacement.

The Coal Mines Regulation Act 1982 sets out a procedure for gaining Ministerial approval for the creation of an emplacement. This procedure will be followed in respect of each proposed emplacement area, as required over the life of the mine.

Reject Material Transportation

Haul roads for transportation of washery reject material from Pelton Colliery to the emplacement areas will be constructed.

7.6.2 Revegetation

Revegetation projects to date have indicated:

- successful establishment of a range of native tree species sown/planted directly into coarse reject material treated with lime or covered with inert material;
- successful establishment of trees/grass on capped coarse reject emplacements; and
- the apparent benefits of a bactericide in controlling acid generation from pyritic material.

Results from the above trials indicate that successful rehabilitation of coarse reject emplacements can be readily achieved. The main features of future rehabilitated coarse reject sites will include:

- regular compaction of spread material;
- capping layer of inert material;
- application of lime to reject surface to neutralise existing acidity;
- possible use of a suitable bactericide as a pro-active acid prevention treatment.

7.6.3 Tailings

Tailings will continue to be disposed of in the same manner as in existing operations, that is, through selected boreholes into abandoned sections of the Pelton Colliery (refer to **Figure 7.5** and **Section 5.3.6**). Investigations have established that sufficient space exists for disposal of volumes of tailings to be generated by the proposed development - an estimated 58 years of total capacity is available.

7.7 ADDITIONAL SURFACE FACILITIES

7.7.1 Sandy Creek Road Shaft Site

From about the year 1997, a new shaft may be required adjacent to Sandy Creek Road for ventilation purposes for the proposed southern longwall blocks. The shaft would need to be

constructed using conventional shaft sinking techniques or by raise boring. Should the shaft be used as an upcast, then a mine ventilation fan installation would be required. This would require a power supply and short access road to the site.

7.7.2 Use of Shafts and Surface Buildings

From about the year 2001, it is planned to re-use the old Cessnock No. 1 Colliery shafts or sink new shaft(s) in the vicinity for ventilation and possibly man riding. This will necessitate the removal of the seals at the top of the upcast and downcast shafts openings and the construction of a mine fan installation and possibly man riding hoists.

Bathhouse and office buildings together with adequate parking area may also be required as part of this development. A conceptual layout of these buildings is shown in **Figure 7.4.**

Electricity Supply Lines

Additional power supply will be required for ventilation requirements and man riding hoists on the shafts and other infrastructure needs. It will be necessary to upgrade the existing electricity mains which service the area.

Traffic Changes

Although a road presently exists between the main Pelton-Ellalong Road and the disused buildings at Cessnock No. 1, this road will have to be widened and bitumen surfaced to meet the needs of employees who will in the future be based at this location.

7.8 WATER MANAGEMENT

The existing Water Management Plan will continue to be used in future extended mining operations at least for the next 5 to 7 years as water makes in this time are expected to be well within the limits of the existing system. Current water inflows in headings being driven for

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Longwall 13 are normal for a developing section at Ellalong Colliery. The total mine water pumping requirements are currently averaging about 0.8 ML/day, which is well below the design capacity of the mine's Water Management Plan of 1.2 ML/day. Future panels (Longwalls 14 to 22) will be further away from the flooded Cessnock No. 1 workings. A preliminary geohydrological report (**Appendix 8**) concludes that "only minor changes to water quantity inflow" may be expected during mining of this area. Cessnock No. 1 workings will not be approached by the extended workings until development for the northern longwall panels commence, in about 7 years time. Well before this stage of mining is reached, a detailed geohydrological study currently being undertaken will be complete. This study will indicate the likelihood and probable magnitude of any changes in water make due to inflow from the flooded Cessnock No. 1 workings and Quorrobolong Creek. In the event that the study predicts an increase in water make above 1.2 ML/day, there will be adequate time available for a fully upgraded Water Management Plan to be devised and implemented, prior to the increased flow actually being encountered.

Water is not normally discharged from the mine site except under wet weather conditions. The mine's water management plan was upgraded in late 1994 in consultation with the Department of Mineral Resources and the Environment Protection Authority. Water users along Black Creek have also been kept informed of the mine's water management through the Black Creek Salinity Management Committee.

A possible strategy for disposal of mine water from the flooded Cessnock No. 1 workings by land application is not being pursued, following doubts expressed by various Government authorities in response to the Planning Focus Meeting.

Options will be examined as part of the aforementioned geohydrological study including:

- re-injection into other adjoining, abandoned underground workings;
- treatment to reduce conductivity to acceptable levels.

7.9 ENVIRONMENTAL MONITORING

7.9.1 Air Quality

The existing system of air quality monitoring will be maintained as mining continues into the Bellbird South area.

Possible new dust sources associated with the proposed development have been identified as:

- construction activity at Cessnock No. 1 site;
- sinking of new ventilation shafts; and
- creation of washery reject emplacements.

Appropriate dust suppression measures will be applied to these activities. Monitoring of air quality is expected to be required by the Minister for Mineral Resources as part of the Ministerial approval which will be required for the construction of emplacements.

7.9.2 Noise Monitoring Programme

Ellalong Colliery currently has a noise monitoring programme which meets EPA licence requirements. The programme involves monitoring for 72 hours every 3 months at four nominated locations. These locations represent the nearest residential receptors to Ellalong mining activities and plant.

Monitoring of the nearest residences to Pelton washery takes place at Pelton village and the Pyne and O'Hearn residences. Noise emissions from the Hunter Street fan installation are monitored in Hunter Street, Ellalong. The locations of these monitoring sites are shown in **Figures 4.8 and 4.9.**

The proposed extension to mining does not alter operation of Pelton washery. The Pelton village, Pyne and O'Hearn residence locations will continue to be appropriate for noise monitoring of washery operations.

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At this time it is not known where the mine's ventilation shaft will be located. However, it is probable that the Hunter Street fans will be decommissioned when an alternative ventilation shaft is commissioned. The alternative ventilation shaft locations are the old Cessnock No. 1 Shafts (Kalingo) or in close proximity to them, and a proposed site near Sandy Creek road approximately 1,200 metres northeast of the Sandy Creek Road/Dry Creek Road intersection.

If the Cessnock No. 1 Shafts are recommissioned, or new shafts sunk at this location, the Hunter Street monitoring location would be relocated to Glennie Street, Ellalong. Otherwise the relocated monitoring site would be the nearest non-company owned residence to the Sandy Creek Road ventilation fan. Any new installation, re-equipping or re-use of fans or fan shafts will be conducted under the supervision of an accredited acoustical consultant. These fans will be subject to regular testing and monitoring and results of such testing will be made available to Cessnock City Council and as public information

Three monitoring locations (those around the Pelton washery) are expected to remain appropriate for the life of the Ellalong Mine. As the proposed extension progresses and if the ventilation fans are relocated, so too must the ventilation fan monitoring location be relocated.

The EPA requirements for 72 hours continuous monitoring at 3 monthly intervals is considered satisfactory for all current and future noise monitoring locations.

7.9.3 Subsidence

As is the practice with current longwall mining at Ellalong Colliery, monitoring of subsidence will continue in the proposed development.

Over each longwall extraction block, a subsidence monitoring gridline will be established in consultation with the property owners, Mine Subsidence Board and the relevant officers of the Department of Mineral Resources. It is recommended that landowners permit the establishment of grid lines upon private land as it is in their interests to facilitate accurate subsidence monitoring.

Watercourses and archaeological sites will be regularly monitored to detect any changes which may lead to erosion. If such changes occur, they will be detected early and the surfaces graded to preserve drainage and prevent ponding. These measures will also enable erosion to be minimised. The Mine Subsidence Policy (**Appendix 10**) sets out procedures in this regard.

7.9.4 Vibration

Ellalong Colliery and the Mine Subsidence Board currently monitor vibration events at various locations in Ellalong. Vibration levels caused by the existing mining activity are continuously measured at Ellalong Colliery No. 2 Shaft. The Mine Subsidence Board monitors vibration at three locations in the community, namely Glennie Street, Church Street and Wallaby Gully Road. It is proposed that monitoring be maintained for the duration of mining activities in the Bellbird South area at three or more points.

7.9.5 Reject Monitoring

Proposed monitoring of reject emplacements is outlined above in **Section 7.6.1.**

7.9.6 Water

The current Water Management Plan incorporates surface monitoring at 25 locations upon the Company owned land and along the Bellbird Creek/Black Creek system. The likely future water makes for mining in Bellbird South are currently being investigated. Preliminary indications, gained from mining development within the sublease area (refer **Figure 1.2**), are that any increase in water make for mining in the southern area of Bellbird South is likely to be marginal only. It is planned to mine this area over the next 7 years. Under such conditions, the current Water Management Plan and monitoring programme is likely to be applied to the extended mining operations subject to licence conditions imposed by the EPA.

Prediction of water makes for later mining in the northern part of the Bellbird South Extension area is not possible at present. Investigations currently in progress are expected to be complete

in late 1995 and water make predictions will be calculated at this time. If a significant increase in water make is indicated, the Water Management Plan and monitoring programme would be modified or replaced with alternative systems to ensure adequate capacity to deal with water makes in an acceptable manner.

Should the option of treatment of Cessnock No. 1 Shaft water be pursued, a monitoring system would be implemented to provide full control over ground and surface water effects.

7.9.7 Archaeological Sites

As previously outlined, both the mining area and coarse reject emplacement areas will be monitored to assess the existence and condition of any archaeological sites which may be affected by the proposed development.

Monitoring of archaeological sites in the Bellbird South mining area is outlined in **Section 7.9.3** above.

Prior to the utilisation of each reject emplacement area, the surface will be surveyed to detect any previously undetected archaeological sites, prior to disturbance of the land surface in these areas.

7.9.8 Spontaneous Combustion

The coal to be produced from the proposed mine will have similar chemical characteristics to the coal currently being produced and is expected to have the same characteristics in respect of spontaneous combustion. Monitoring procedures described in **Section 5.3.7** will be applied to the coal stockpiles produced from the extended operations.

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SECTION 8 : ASSESSMENT OF IMPACT DUE TO THE EXTENSION

8.1 APPROACH

Individual experts were consulted by HLA-Envirosciences and commissioned to assess and report upon the likely impacts due to the proposed extension of Ellalong Colliery. In addition to examining their individual areas of expertise, the impacts arising from other areas of concern were considered in so far as these impacts had the potential for interactive effects.

Once the individual specialist reports were compiled, discussions between HLA-Envirosciences' personnel took place in which the proposal and its impacts were examined on a holistic basis.

Out of these various processes of discussion and evaluation, conclusions were drawn regarding the nature of possible impacts of the proposed development, and their likelihood of occurrence. **Section 8** sets out these findings.

8.2 TOPOGRAPHY AND SOILS

8.2.1 Impact on Topography

The impact of the proposed development upon the topography of the Bellbird South area will be negligible. Mining subsidence and creation of reject emplacements will be the only sources of topographic impacts. Subsidence is discussed below in **Section 8.6**.

In the proposed reject emplacement areas, significant impacts upon topography will occur. These impacts will possibly affect a total area of some 90 ha. In the design of the reject emplacements, all rehabilitated surfaces have been planned to have final slopes of approximately 3 per cent. Elevations for these sites will be from 3 to 20 m higher than the original surfaces. **Figures 7.3 and 8.1** depict the original and proposed final surface contours for reject emplacement area No. 1.

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8.2.2 Impact on Soils

On the land surface above the underground mining, mine subsidence may impact upon soils. This is discussed below in **Section 8.6.**

Impacts upon soils will occur in the coarse reject emplacement areas.

The process of creation of emplacement areas, whilst destroying the original soil profile, also involves rehabilitation measures which have been described above in **Section 7.6.** These measures are aimed at creating, upon the recontoured final surface, a soil profile capable of establishing and sustaining vegetation, so that pre-disturbance land capability is either returned or improved.

Initially, vegetation will be removed and topsoil will be stripped using conventional earthmoving machinery. Topsoil will be stockpiled at locations which minimise rehandling distances. It is envisaged that when long term topsoil stockpiles are required, where possible these stockpiles will be formed at depths not exceeding 2 m to maintain biological viability. The stockpiles will be revegetated according to Soil Conservation Service recommendations. Topdressed areas will be revegetated promptly to minimise erosional losses.

The rehabilitated coarse washery reject emplacement areas will have a covering of topsoil sufficient in quality and depth to allow revegetation and stabilisation and the eventual development of pedological differentiation with depth.

Prior to commencing the creation of the emplacement, more detailed soil surveys will be undertaken to fully evaluate the quantity and quality of topsoil available.

Construction activities at sites of new surface facilities and shafts will also impact upon soils. Any areas disturbed by such activities will be protected by measures designed to prevent erosion, and will be rehabilitated promptly.

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Standard procedures for erosion prevention on small construction sites will be followed.

8.3 FLORA AND FAUNA

A flora and fauna survey and report was conducted by HLA-Envirosciences and forms **Appendix 9** of this EIS.

No rare or endangered flora or fauna were observed during the study conducted over the proposed mining area, proposed coarse washery reject emplacement areas and proposed alternative shaft and surface facility sites.

Habitats within the proposed mining area will not be impacted by the underground mining activity proposed to be carried out below the surface. Habitats in those areas where the surface will be possibly impacted, namely the coarse washery reject emplacement areas and the alternative shaft and surface facility sites, are well represented in comparable areas close to the areas affected by the proposal. Further investigations of flora and fauna in these areas will be carried out prior to disturbance, if appropriate.

The flora and fauna report concluded that the proposed development should not cause adverse impacts upon flora or fauna populations.

8.4 AIR QUALITY

Potential dust sources in the proposed development are the coal preparation plant, coal stockpiles, coal haulage, upgrading works on surface facilities, overland conveyor, coarse washery reject transport and creation of reject emplacement areas, and construction activities associated with possible alternative sites.

Under the current proposal, the coal preparation plant, coal stockpiles, coal haulage and overland conveyor are expected to continue to function at the same levels as presently exist, and hence no increase in dust levels from these sources will occur. Any increase in coal

production would produce only marginal increases in dust levels. As dust levels presently recorded are well below the EPA's criteria of 4.0 $g/m^2/mth$, and no incremental increase is expected to occur, it is concluded that the proposed development will produce no impact upon air quality from these sources.

The existing Air Quality Management System set out in the Environmental Management Plan will be continued in order to maintain acceptable air quality.

Activities associated with the proposed development which are likely to constitute new sources of dust in air are the upgrading works at Cessnock No. 1 Shafts or alternative fan and surface facility sites, and the creation of coarse washery reject emplacements.

With regard to the upgrading works at Cessnock No. 1 Shafts, new office, carpark, bath house and winder and fans would be constructed and the access road between the Colliery and Wollombi Road widened and sealed. It is also possible that some derelict buildings at the site would be demolished. It is important to note that there are no privately owned residences in the vicinity of this site. The existing Air Quality Management System would be extended and applied to these activities (refer **Section 9**). The same measures would be applied should the alternative fan shaft sites be utilised.

The creation of the coarse washery reject emplacements will require Ministerial approval and this will involve the putting in place of effective air quality control measures at the appropriate time. Vegetation and topsoil removal will be carried out under strict controls, regulated by an EPA Permission to Construct Works.

8.5 ACOUSTIC ENVIRONMENT

Potential noise impact assessment is made by comparison of calculated received noise levels and derived planning limits.

Received levels from noise generating activities associated with the proposed mine extension

have been calculated using RTA-ENM software. Use of this environmental noise monitoring software is an EPA approved method.

To model received noise levels it is necessary to know: the acoustic power level of all noise generating plant and equipment; the topography between these sources and the receptor locations; the worst case (for noise emission) operating scenario/s. Full details of the modelling methodology employed and calculation of results are provided in an Envirosciences' report: "*Acoustical Assessment of Proposed Extension of Operations of Ellalong Colliery into Bellbird South*", which is included as **Appendix 7** of this document.

The acoustic power level (L_w) of various noise sources associated with the extension, such as ventilation shaft fans, bulldozers and rollers, have been measured on site. All equipment proposed for use is already operated by NWCC.

Topographical information was sourced from Central Mapping Authority (CMA) 1:25,000 topographic maps, and in some areas, from NWCC 1:4000 topographic maps.

Operating scenarios for reject emplacement were provided by NWCC. Shaft ventilation fans are a static source operating 24 hours per day, 7 days per week.

Background noise levels in the receptor areas have been measured. These levels are provided in **Section 4.8** of this EIS.

A planning level of noise sensitive receptors is determined by the relationship between existing background noise levels and recommended acceptable or extreme levels. The planning level is to either prevent the acceptable or extreme limit being exceeded, or to limit the increase in noise level to 5 dB(A) above background.

The procedure of planning level determination is described in Chapters 20 and 21 of the Environmental Noise Control Manual (ENCM). **Tables 20.1 and 21.1** of these chapters are reproduced below as **Tables 8.1 and 8.2** respectively.

TABLE 8.1
RECOMMENDED OUTDOOR BACKGROUND NOISE LEVELS
ENVIRONMENTAL NOISE CONTROL MANUAL
(FIG. 21-1, EPA, 1994)

ROW	Zoning of Noise Receiver Area	Predominant Landuse of Receiver Area	Time Period	L_{90} Background Noise Level dB(A)	
				Acceptable Limit	Extreme Limit
(a)	Rural (approx R1 AS1055)	Residential, church, hospital	Day Night	45 35	50 40
(b)	Residential area (approx R1-R2 AS1055)	Residential, church, hospital, school	Day Night	45 35	50 40
(c)		Shop or commercial office	Day Night	50 40	55 45
(d)		Light industry	Day Night	55 45	60 50
(e)	Residential area on a busy road or near an industrial area of commercial area (approx R2-R3 AS1055)	Residential, church, hospital, school	Day Night	50 40	55 45
(f)		Shop or commercial office	Day Night	55 45	60 50
(g)		Light industry	Day Night	60 50	65 55
(h)	Industrial area (approx R4-R6 AS1055)	Residential, church, hospital, school	Day Night	55 45	60 50
(i)		Shop or commercial office	Day Night	60 50	65 55
(j)		Factory office or factory	Day Night	65 65	70 70
(k)	Passive recreation area	Picnic grounds, public beaches, bush walks, public gardens etc.	Day Night	40 40	50 50

NOTE: From Monday to Saturday, daytime is defined as 7.00 a.m. to 10.00 p.m. and night-time is 10.00 p.m. to 7.00 a.m. On Sundays and Public Holidays, daytime is 8.00 a.m. to 10.00 p.m. and night-time is 10.00 p.m. to 8.00 a.m. Levels applicable to commercial offices in the schedule would also apply to such premises as hotels, motels, clubs, dance halls and theatres.

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TABLE 8.2 RECOMMENDED PLANNING LEVELS ENVIRONMENTAL NOISE CONTROL MANUAL (FIG 20-1, EPA ,1994)	
Existing background noise level at the most sensitive point in an affected residential area.	Recommended maximum noise level, for planning approval purposes, at that point as a result of a proposed new noise source.
A. Background is above relevant acceptable level (from Chapter 21)	- preferably, set maximum planning level 10 dB(A) or more below acceptable level - at least, set maximum planning level 10 dB(A) below existing background level
B. Background is at acceptable level	- set maximum planning level 20 dB(A) below acceptable level
C. Background is below acceptable level by - 1 dB(A) 2 dB(A) 3 dB(A) 4 dB(A) 5 dB(A) 6 dB(A) or more	- set maximum planning level 9 dB(A) below acceptable level 5 dB(A) below acceptable level 3 dB(A) below acceptable level 2 dB(A) below acceptable level 2 dB(A) below acceptable level 5 dB(A) above background level

Planning levels derived as per EPA procedure are provided in the **Table 8.3**.

TABLE 8.3
DERIVED PLANNING LEVELS

Area/location	Background Level		Planning Level.	
	Day	Night	Day	Night
Ellalong	30	30	35	33
Bellbird, Kendall Street	35	31	40	33
Bellbird, Wollombi Road	35	31	40	33
Area 3 emplacement, nearest residence	30	30	35	33
Area 4 emplacement, nearest residence	30	30	35	33
Sandy Creek Road	30	30	35	33

Noise emissions from the majority of operations relate to the planning levels provided in the previous table. However, it is considered that intermittent truck movements (associated with reject emplacement) should be related to the EPA's intermittent or low traffic flow criteria.

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The EPA also have criteria limits that relate specifically to short term construction activities.

EPA criteria limits for intermittent traffic flow noise levels are specified in Chapter 157 of the ENCM. For a new development the criterion limit is an $L_{eq,T}$ of 55 dB(A).

Construction noise limits are set as an allowable exceedence above background noise level. The allowable exceedence is related to the construction activity duration.

Chapter 171 of the ENCM also specifies time restrictions for construction activity which are:

- Monday to Friday, 7.00 a.m. to 6.00 p.m.,
- Saturday, 7.00 a.m. to 1.00 p.m. if inaudible on residential premises, otherwise 8.00 a.m. to 1.00 p.m.
- No construction work to take place on Sundays or Public Holidays.

The level restrictions are:

- Construction period of 4 weeks and under, construction noise (L_{10}) must not exceed the background level by more than 20 dB(A).
- Construction period greater than 4 weeks and not exceeding 26 weeks, construction noise (L_{10}) must not exceed the background level by more than 10 dB(A).

Noise levels calculated for the nearest receptors to the proposed ventilation shaft fan locations are provided in the **Table 8.4**. Also shown in the table are relevant planning levels (night time limits apply for 24 hour operation) and any exceedences that result. No cumulative effect will occur from these sources as only one site will be used at any one time, the selection to be made at a later date.

Reject emplacement by highway truck occurs 24 hours per day also, and the lowest planning levels apply. For the Bimbadeen Road area the lowest background levels occur during daytime hours, at all other receptor locations the night-time planning level applies. **Table 8.5** provides

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the calculated L_{Aeq}, 1 hr for truck emplacement of reject as well as the relevant planning levels and any exceedences that result. All results represent the worst case situation.

TABLE 8.4
VENTILATION SHAFT FANS, NOISE LEVELS AND EXCEEDENCES

Fan Location	Receptor	Received SPL dB(A)	Planning Level dB(A)	Exceedence dB(A)
Cessnock No. 1	Glennie Street	31	33	Nil
Sandy Creek Road	Nearest residence	35	33	2

TABLE 8.5
REJECT EMPLACEMENT BY HIGHWAY TRUCK, NOISE LEVELS AND EXCEEDENCES

Emplacement Area	Receptor Area	Received L_{Aeq}, 1 hour	Planning Level L_{Aeq}, 1 hour	Exceedence L_{Aeq}, 1 hour
1	Bellbird, Kendall Street	31.2	55	Nil
1	Bellbird, Wollombi Road	31.5	55	Nil
1	Bimbadeen Road	31.3	55	Nil
3	Nearest residence	30.5	55	Nil
4	Nearest residence	30.0	55	Nil

Spreading and compacting of reject material in the emplacement areas will occur during daytime hours only. Further, this activity will take place only one day per week. The planning levels derived previously are applicable to a 7 day per week operation, the EPA have indicated in discussion that a higher planning level may apply for this operation considering its short duration. However, the EPA wish to view all aspects of the proposal (re: noise) prior to providing any alternative criteria.

Table 8.6 provides calculated received noise levels for reject spreading and compacting in worst case locations. Also provided are planning levels (may be subject to change) and any exceedences that result.

Construction noise level limits to prevent criteria exceedences at the nearest residences should be made a development consent condition of any proposed construction activities regarding sinking of alternative fan shafts.

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Total acoustic power level limits for construction activities at the Cessnock No. 1 site are 121 dB(A) if construction is less than 4 weeks and 111 dB(A) for construction periods up to 26 weeks.

Total acoustic power level limits for construction activities at Sandy Creek Road are 117 dB(A) if construction is less than 4 weeks and 107 dB(A) for construction periods up to 26 weeks.

TABLE 8.6
SPREADING AND COMPACTING OF REJECT, NOISE LEVELS AND EXCEEDENCES

Emplacement Area	Receptor Area	Received SPL dB(A)	Planning Level dB(A)	Exceedence dB(A)
1	Bellbird, Kendall Street	30	40	Nil
1	Bellbird, Wollombi Road	42	40	2
1	Bimbadeen Road (O'Hearn residence)	40	36	4
3	Nearest residence	25	35	Nil
4	Nearest residence	35	35	Nil

To summarise noise impacts associated with the proposed extension:

- No impacts are predicted for ventilation shaft fans at the Cessnock No. 1 site. Sandy Creek Road ventilation shaft fans result in a minor 2 dB(A) exceedence at the nearest residence. No exceedence is calculated for any other receptor.
- No impacts are predicted for emplacement of reject material by highway trucks.
- No impacts are predicted for the spreading and compaction of reject material except for Wollombi Road, Bellbird and Bimbadeen Road (O'Hearn residence). The impacts predicted for those receptors are 2 dB(A) and 4 dB(A) respectively. It should be noted that these exceedences cannot occur concurrently. These receptors are 1,680 m apart at opposite ends of proposed emplacement Area 1. Worst case noise modelling considered spreading and compacting occurring at the nearest point of the emplacement area (itself 960 m long). Therefore when operations are in proximity to one receptor they are well removed from others. Additionally, an alternative criteria limit may be applicable to these operations as they only occur for 2 days every week.
- No impacts are predicted for construction noise at the Cessnock No. 1 and Sandy Creek Road sites provided the L_w limits specified are adhered to.

All the results provided have been calculated assuming neutral atmospheric conditions apply. Temperature and humidity parameters of 10°C and 90 per cent respectively have been used throughout as these conditions provide the highest received noise levels.

HLA-Envirosciences' acoustic survey report on the proposed extension (**Appendix 7**) provides results for ventilation shaft fan noise receptors during downwind and temperature inversion conditions. These results are considered to be informative but not representative of average conditions.

8.6 SUBSIDENCE

A separate report has been prepared by G.E. Holt and Associates (**Appendix 10**) to determine likely subsidence levels and impacts arising from proposed mining of the Greta Seam by the longwall method of operation in the Bellbird South extension to Ellalong Colliery. It covers prediction of likely subsidence levels in the proposed mining area, assessment of the likely impacts of coal extraction, and suggests measures that might be employed to mitigate the effects of subsidence.

Particular issues of concern with regard to subsidence are the impact on houses, farm structures and improvements, public roads, water courses and vibration. Vibration is discussed below in **Section 8.7.**

In general, the amount of ground strain and curvature arising from subsidence, rather than the actual amount of vertical subsidence, determines how much surface damage might occur. However the best understood measure is the vertical ground movement, or vertical subsidence because all the other parameters; strain, tilt, position of maximum subsidence, position of inflection point etc. are calculated from this. Hence, this discussion focuses upon maximum vertical subsidence.

The other values can be calculated empirically if the vertical subsidence and depth of mining are known, and also, in the case of Ellalong Colliery, can be extrapolated from measured data.

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Actual subsidence can vary significantly from predictions if unknown geological anomalies cause changes to expected ground movement. Cross-cutting dykes of hard rock, such as occur in the worked out longwall area of Ellalong Colliery can cause marked changes from expected subsidence. If the structures are identified in new mining areas, some allowance can be made. Much effort is expended searching for such structures because they can also have a severe impact on the mining of coal. This reduces the risk to mining, and the consequent risk of large variations in expected subsidence.

8.6.1 Maximum Subsidence Prediction

In New South Wales, the Department of Mineral Resources has produced three booklets detailing empirical methods for predicting subsidence from single seam workings. These are for the Southern, Western and Newcastle Coalfields. The method contained in each booklet is based on the results of a number of subsidence surveys carried out in each of the coalfields. The methods are completely empirical, based on real subsidence monitoring of single seam workings. The early workings at Ellalong Colliery were utilised in preparation of the Newcastle Coalfield Guideline.

The best practical means for prediction for the extension of Ellalong Colliery is to use the empirical methods from the Surface Subsidence Prediction Guidelines updated by recent experiences with multiple longwall panel subsidence, and employing local subsidence experience at Ellalong Colliery.

The proposed longwall workings will be single seam, extracting coal from part of the Greta Seam. The strata sequence above the Greta Seam consists of silty sandstone, sandstone and conglomerate of the marine Branxton Formation, with siltstone, sandstone and shales of the Paxton Formation forming the roof rocks to the Greta Seam. The Branxton Formation varies in thickness across the proposed longwall area, ranging between 350 m and 570 m thick, and it has massive bedding characteristics.

The sequence of strata is considerably thicker than the general strata sequences in the Southern

Coalfield which is characterised by a number of massive sandstone units. This means that the mechanical behaviour manifests as a greater resistance to breaking and caving than the strata around either the Newcastle or Southern Coalfields because of the massive bedding and greater thickness.

The mining height will influence subsidence levels. The mining height in the proposed longwall panels will vary between 3.4 m and 4.5 m depending on coal quality. This compares with 3.5 m to 3.6 m in the existing mine, and it complicates prediction because it is not known where the variation will be. Despite this, the uncertainty can be quantified by considering the end points of subsidence based on maximum working height at shallowest depth of cover, and minimum working height at greatest depth, along with variation in longwall panel width.

The predicted maximum subsidence values have been calculated on the basis of published guidelines for multiple panels. There is a range of values depending on cover depths and mined height and demonstrates the extremes of subsidence influencing factors for each block of panels.

After reviewing data of the actual subsidence measured in previous longwall panels at Ellalong Colliery the predicted maximum subsidence in the proposed extension area at Bellbird South varies from 1.1 m to 1.6 m.

8.6.2 Maximum Strain and Tilt Predictions

Surface strains have been calculated using the empirical formulae provided in the Newcastle Subsidence Guideline. The formulae in this guideline have been selected because the measured strains at Ellalong Colliery more closely approach the values predicted by the Newcastle Guidelines than the Southern Coalfield guideline. This observation also acknowledges the fact that ground strains are lower over Ellalong workings because of the greater depth of workings, and massive nature of the Branxton Formation. The formulae, which are empirically derived from the results of surface surveys over subsided areas, determine maximum values.

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Calculated predictions show overall tensile strain values are in the range 1 mm/m to 1.7 mm/m while compressive strain values are in the range 1.0 mm/m to 2.2 mm/m. Tilt, which is the change in vertical movement over the measured interval, ranges between 3 mm/m and 7 mm/m. Maximum ground curvature radius is around 2 km, but is commonly around 5 km.

8.6.3 Shape of Subsidence Profiles

The subsidence profiles developed at Ellalong are much flatter than the Guidelines would predict because of the massive nature of the cover rocks. While the profile is flatter, particularly in the tensile stress zone away from a mined panel, the actual limit of subsidence is similar for both measured and predicted distances. The zero limit ranges between 200 m and 300 m from the edge of a mined area.

In summary, the measurements at Ellalong Colliery to date indicate that less subsidence, strain and tilt occur over the surface than the best available guideline, the Newcastle Guideline, would predict. Actual subsidence is 300 mm to 400 mm less, strains are up to half predictions, and tilts also up to half predicted values. Goaf edge subsidence, and Inflection Point subsidence are substantially less, yet the limit for subsidence remains similar.

8.6.4 Impact on Land Surface

The land surface varies from the rolling flats adjacent to Quorrobolong Creek to the steep ridges of the Broken Back Range. The creek drops 10 m in elevation across the mining area, and the lowering of sections of the creek by up to 1.6 m will increase ponding along its course. The impact of previous subsidence of the creek has been minimal, and it is expected that lowering of the creek and the surrounding land will have a similar minimum impact. The nature of the strata, coupled with the low strains and tilt mean that there will be negligible impact on water bearing capability of unconsolidated soils. The one water bore in the area is shallow, and no impact is expected.

The impact of subsidence along the Broken Back Range will also be negligible. Although there

are small extremes in topographic relief in the forest covering the range, it is unlikely that there will be any visible effects. On the steeper slopes some ground creep may occur down the slopes, particularly where panels retreat in the same direction as the slope. Surface cracking is unlikely due to the low strains expected at the surface. It is anticipated that Trig Station 2519 Howard will be affected by mining in longwall panel LW 25 as proposed on the conceptual mine plan. After subsidence has occurred, TS 2519 Howard will require reinstatement.

Subsidence will be progressive as mining proceeds. Actual ground movement at any one time will be local in area, and will vary in effect. Measured strain and tilt levels are low, while predicted maxima, based on guidelines that are above predicted values, do approach levels where structural damage to buildings is possible.

8.6.5 Impact on Improvements

Subsidence will be confined to the area immediately above the planned longwall panels, and from approximately 200 m to 300 m beyond the longwall extraction area. Coal extraction will lower the land surface by up to 1.6 m. The amount of surface subsidence predicted for any locality is shown in **Figure 8.6**.

The amount of subsidence beyond the actual mining panels is low at 300 mm or less. This amount, along with the low strain values predicted will cause minimal to no disturbance to structures and improvements, where there are normal strata beneath.

Surface disturbance above the actual mining panels will be low because of the depth and dimensions of workings.

The strain values measured over workings at Ellalong have been less than 1 mm/m tensile or compressive, except around a major dyke. These levels applied to house and farm sheds would result in negligible damage. Long poultry sheds may suffer some distortion because of their length. Tilt values have been measured by the Mine Subsidence Board at greater than

4 mm/m, and these levels would result in minor structural damage such as cornice or wallboard cracking. The damage levels would be low provided tilt did not greatly exceed 4 mm/m.

Other improvements within the mining area which include power lines, concrete culverts, two timber bridges and buried telephone lines, will be minimally affected.

With regard to dams, experience elsewhere on the Ellalong Colliery Holding has shown that extraction can take place under dams without damaging the structure. With at least 30 dams in the Bellbird South area it is possible that some may be damaged by underground workings, and procedures to repair damage promptly are set out in the Company's Subsidence Policy (**Appendix 10**).

Eighteen properties will be directly affected by the proposed longwalls, excluding properties owned by NWCC-Southland, and Aberdare State Forest. The affected properties and their relation to the proposed longwall panels are shown in **Figure 8.5**. The types of structures to be affected on each property are set out in **Table 8.7**.

TABLE 8.7
PROPERTIES PROPOSED TO BE UNDERMINED, BELLBIRD SOUTH

Property No.	Undermined by LW No.	Improvements
7	30-32	Not visible from road
8	29-31	Not visible from road
9	15-17	Nil visible
10	15-18	Metal clad workshop/shed plus 2 small custom orb sheds
11	16-19	Metal roof cottage, 1 small metal shed, 2 large metal sheds
12	17-22	Large iron roof cottage, 2 large metal sheds
13	18-19	Metal roof cottage, metal roof stables, colourbond shed
14	19-22	Weatherboard/iron cottage, 2 metal sheds, 1 galvanised iron shed
15	20-22	Weatherboard/iron cottage, large metal shed, 1 colourbond shed, 2 broiler sheds, feed silos
16	15-16	Nil
17	22	Brick/tile cottage, 2 brick/iron garages

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TABLE 8.7 PROPERTIES PROPOSED TO BE UNDERMINED, BELLBIRD SOUTH		
Property No.	Undermined by LW No.	Improvements
19	34-35	Nil visible
20	22	3 Brick/tile cottages, 1 colourbond garage
28	27-28	Nil visible
29	28	Nil visible
32	31	Brick/tile-metal cottage, 3 broiler sheds
33	31-33	brick/tile cottage, large metal shed
34	32-34	Brick/metal cottage
Note: Visual inspection from public roads.		

Inspection of all surface improvements is a required procedure prior to each longwall panel extraction.

8.6.6 Impact on Archaeological Sites

Mining by underground methods at Ellalong will lower the surface by between 1.1 m to 1.6 m. In the process, the surface can move transversely by small amounts (i.e. millimetres) as well as vertically downward. After mining the ground surface stabilises again.

Virtually all the ground surface remains intact. There are no cave structures known to contain archaeological remains that would be affected by mining, nor are there any cliff faces that might fall, or soil faces that could subside and bury currently visible archaeological sites.

Concern has been previously expressed that erosion caused by subsidence, or loss of relics down cracks opened by subsidence will damage the archaeological record. The incidence of these two events will be so low that consideration of such an event should be discounted. The incidence would be infinitesimally small compared with the ongoing damage caused by farming and grazing. It ought to be remembered that the area has been subjected to intensive surface modification for the last 100 years.

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Underground coal extraction, while lowering the surface, is still going to leave an essentially intact surface. The levels of subsidence are low, as are strain values, above the planned longwall panels which will undermine the sites. These factors will limit any movement of archaeological material from their present positions.

8.6.7 Subsidence Management

Management measures to mitigate the impact of subsidence caused by full seam extraction can be generally incorporated into normal land management programmes for Company owned land. The Company's Subsidence Management Policy (**Appendix 10**) details measures which will prevent and/or remediate erosion or silting which could be caused by subsidence. The principal management measures which may be required include any necessary to regrade grazing areas to alleviate the chance of stock injury in the short term, and regrade the land surface to ensure full productivity. A monitoring system for mining subsidence, described above in **Section 7.9.3**, will enable impacts on watercourses to be detected and prompt action to be taken to grade affected areas to prevent erosion and siltation of Quorrobolong Creek.

The most productive land is the alluvial land surrounding Quorrobolong Creek. The land is used primarily for grazing, and sometimes for cropping. Both land uses may require minor regrading of any ponded areas resulting from subsidence. The extent of regrading will depend on the land use.

Pelton/Ellalong Colliery has in place a subsidence policy to assist private land owners where the provisions of the Mine Subsidence Compensation Act do not apply. With the mechanistic framework for covering the cost of any rehabilitation in place, land surface repair can be carried out by agreement with the land owner, Pelton/Ellalong Colliery and the Mine Subsidence Board.

The actual amount and timing of likely subsidence at any point on the surface can be determined accurately from the location of workings, and the delay before surface effects appear. Consequently, any areas containing structures that might be adversely affected by

subsidence can be visually monitored, and remedial action quickly undertaken if required.

8.7 VIBRATION

8.7.1 Introduction

Over the years, Ellalong Colliery and the Mines Subsidence Board have monitored a number of ground vibration events at various locations in Ellalong resulting from the current mining activity. An independent report on ground vibration at Ellalong Colliery has been carried out by Renzo Tonin and Associates (**Appendix 10**). An important conclusion of the report was that the vibration data were shown to scale in a manner consistent with ground vibrations associated with subsidence.

It is possible to derive from the data a set of scaling laws which are assumed to apply to this regional generally. The scaling laws assist in predicting vibration levels at given distances provided that the magnitude of the events (equivalent to the Richter strength of an earthquake) and the epicentre of the vibrations are known.

The difficulty is that the magnitude and epicentre are not known and cannot be determined with any degree of accuracy. The approach taken is to assume that the magnitudes previously measured are likely to occur again within the subject region of mining considered here. The epicentre is assumed to be located anywhere in the subject region. For this site, however, the exact location of the epicentre is not a critical factor because there is no predominance of housing development in any one region on the site.

Based on conservative assumptions, it is possible to determine a range in vibration levels which can be expected if a vibration history similar to that experienced in the current workings is repeated here. These assumptions are conservative as the cantilever surcharging (cover depth) is 100 m less for Longwalls 13, 14, 15 and 16, compared with the current workings at Ellalong and hence it is less likely that the same magnitude of events would be expected. However, for Longwall 17 onwards, the same magnitude of events may occur.

8.7.2 Description of Structures and Susceptibility to Damage

Houses in the region range from new residences to others which are possibly more than 50 years old. Construction materials include timber frame clad with weatherboard or compressed fibre cement sheeting. A significant proportion which are brick veneer or possibly full brick construction. Practically all houses are single storey constructions. Some structures are chicken sheds.

Troublesome soft clays, or sands having a small clay content are not expected to be prevalent in this area. By comparison with other houses in the Ellalong area, foundations are expected to be strip or pad footings in buildings of more recent origin and brick or timber posts in some of the older houses. It is expected that the newer buildings are constructed on reinforced concrete raft slabs.

Visual inspections show that some house have corrugated iron or metal deck roofing and others are tiled.

Past experience with inspection of damage to houses in Ellalong from the current workings shows no consistent pattern which would categorise one particular form of construction as being more prone to reports of defects than another.

Neither does it appear on the evidence that a particular type of construction is more or less likely to suffer from a particular type of defect. For example, no pattern emerges in the case of ceiling defects which would distinguish metal roof from tiled roof construction.

Vibration generally causes damage to structures by the action of differential movement in the structure. The upper part of a structure usually moves more than the foundation. If the upper part twists about the foundation, this racking motion produces characteristic shear stresses and failures particularly in cornices and ceilings.

8.7.3 Vibration Damage Criteria

There are no standards anywhere in the world that relate specifically to ground vibration caused by subsidence-induced strata failure. However, based on a review of overseas standards and typical vibration traces from previous events at Ellalong Colliery, it is concluded that a level of 5 mm/s peak vibration is a conservatively low level below which damage due to vibration is unlikely to occur.

8.7.4 Predicted Impacts in Extended Mining Area

If vibration occurs and the level of damage is similar to that experienced at Ellalong at present, then the type of damage one can expect will generally be cracks in cornices and wall junctions and the like which are more cosmetic than structural problems. The probability of vibration causing structural damage is extremely remote and even if it were to occur, would at most only amount to minor damage consisting of visible cracks in structural members such as masonry walls, beams, columns, slabs, etc. In such an event, this would affect at most two or three houses in this way.

In all cases, the Mines Subsidence Board has mechanisms for compensating damage caused by ground tremors resulting from tensile failures.

It is stressed that there is no mechanism by which it can be predicted that vibration history will repeat itself. In fact it is quite possible that no vibration will occur at all.

8.8 WATER MANAGEMENT

Underground mining activities in Bellbird South are not expected to constitute a source of environmental impact in terms of water management, of any differing magnitude in terms of quantity or quality to the present mining operations. At the present time, development of Longwall 13, the first panel within the sublease area and the closest planned panel to Cessnock No. 1 workings for a number of years, is taking place. There has been no observed increase

in water make in these workings. The total pumping rate from the mine over the past eight months of 0.8 ML/d is well within the capacity of the current Water Management Plan which is 1.2 ML/d. Moreover, mining for the next 7 years will be moving in a direction away from the Cessnock No. 1 workings.

No difference in water quality is indicated by available data (refer to **Appendix 5**). Consequently, the existing Water Management Plan, as described in **Section 5.2.6**, is expected to function to prevent adverse environmental impacts due to dewatering of workings by ongoing pumping in the longwall panels in early years.

Groundwater consultants are at present investigating future underground water conditions, including water makes and water quality. Preliminary data suggest that little or no change in water make is likely while the planned mining in the southern part of Bellbird South takes place over the next 7 years (refer to **Appendix 8**). Should any unexpected water conditions occur, the Water Management Plan would be modified to prevent adverse environmental impacts. A comprehensive geohydrological study is being carried out to determine likely water makes in conceptual Longwall panels 23 to 28. If increased water make is predicted beyond the capacity of the present Water Management Plan, then a new Water Management Plan will be designed to ensure no adverse impacts occur.

A source of potential environmental impact in terms of water management would be the dewatering of Cessnock No. 1 workings, should the decision be taken to pursue this option. A number of alternatives for disposal of an estimated 2,500 ML of moderately saline water have been (and are being) considered. Following concerns raised by several government bodies, disposal by land application is now not favoured. The options of re-injection into other abandoned underground mine workings, and treatment prior to disposal, are still under consideration. A decision is not required in the short term, from the operational point of view, and will not be made until the results of the geohydrological investigation are available.

It is noted that Emplacement Area 1 occupies approximately 9.6 per cent of the northern catchment. The effect of this small reduction in clean catchment on the water quality in the

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event of a wet weather discharge, as per the Water Management Plan, is slight at the northern boundary of the colliery and nil at Lomas Lane.

Given that all data available at present suggest that water make and quality from extended mining operations for mining in the southern longwall blocks, will be well within the design parameters of the current Water Management System, it is not anticipated that any new water storages will need to be constructed. Further, it is expected that there will be no alteration to impact upon the downstream water quality associated with any discharges which may be made into Black Creek. However, the results of the geohydrological study will be used to design water management strategies for the mining of the northern longwall blocks.

Appendix 5 sets out details of current groundwater chemistry and the EPA licence regulates discharges of this water.

Subject to unexpected changes in water makes and/or mine planning, storage and disposal of contaminated groundwater will continue as at present under the Water Management Plan, at least for southern longwall panels. New systems will be designed should geohydrological studies indicate that they will be required. The effect upon Black Creek will remain at current levels.

There is no provision under existing EPA licence arrangements for discharge of mine water into the Wollombi Brook catchment. It is not planned that this situation will change.

8.9 REJECT DISPOSAL

An area of approximately 90 ha in total of Company owned surface land will be significantly impacted over the life of the proposed development, as a result of the creation of reject emplacements. However, at any given time, it is anticipated that a maximum area of approximately 33 ha only will be impacted by the active creation of an emplacement.

Short term impacts will be considerable, involving removal of vegetation, stripping and stockpiling of surface soil, re-routing of drainage patterns, creation of new drainage systems and features, construction of temporary bunds to screen construction operations, and construction of dams and ponds for leachate control. Further, washery reject material will be spread over the site and compacted into thin layers. Bactericide and lime may be added to the reject material, and the final contoured surface will be capped with clay. Stockpiled soil will be spread over to form the final surface for rehabilitation of vegetation.

The design of the washery reject emplacements set out above in **Section 7.6** ensures that shallow ground and surface waters will not be impacted by leachate or runoff from the emplacements and that erosion will be prevented. **Figures 7.2** and **7.3** show the protective dams and diversion drains proposed for the water management of the emplacements. The deep underground environment will be impacted by the draining or pumping of leachate into abandoned Pelton underground mine workings.

The final result of the rehabilitation of the emplacements will be an undulating landscape supporting native vegetation similar to surrounding areas and capable of supporting a variety of compatible land uses.

8.10 TRAFFIC

8.10.1 Roads

Apart from the privately owned access road connecting Cessnock No. 1 Shafts with Ellalong Road, it is anticipated that existing road traffic usage patterns and volume may be altered but will not be adversely impacted by the proposed development. Road haulage volumes will be maintained at current levels, and since the workforce levels and source will remain unchanged, usage of roads for transport of workers to and from the mine site will not change in volume, apart from a limited period during proposed construction of new surface facilities at Cessnock No. 1 Shafts or alternative sites. However, the impact upon public roads by these construction activities will be short term. Moderate impacts will be associated with the usage of these

surface facilities once constructed: traffic volumes will increase at times of shift changeovers, and minor increases due to visitors will occur during business hours.

Should the planned use of Cessnock No. 1 Shafts or another shaft in the vicinity for manriding take place (with the development of Longwall Blocks in the northern area) Ellalong Drift access for manriding will decrease. A net impact above existing traffic levels will not occur as workforce levels will remain static. However, the road surface will be affected to some degree by turning traffic. Use of manriding facilities at Cessnock No. 1 site would result in decreased traffic from Cessnock to Dry Creek Road and decreased traffic through Ellalong.

A source of impact upon road traffic could occur in relation to the washery reject emplacements, as approximately 47 trucks per day will possibly cross Wollombi and/or Paxton Roads to transport reject material between Pelton Washery and Emplacement Areas 3 and 4. This crossing would replace the existing crossing over Wollombi Road which is used for transporting reject material to the Aberdare Extended emplacement.

8.10.2 Railway

Volumes of coal hauled by rail will remain at current existing levels. Hence no net impact upon rail traffic will occur as a result of the proposed development.

8.11 SOCIAL AND ECONOMIC

8.11.1 Social Impacts

The proposed Colliery extension will not generate further permanent employment as the current mine workforce will be used to produce from existing and extended mine areas. Indirect employment in linkage industries will be little changed from present levels.

The main benefit of the proposed mine extension will be in ensuring employment levels are maintained and the mine continues to operate. The Ellalong/Pelton Mine is a major employer,

with a total workforce of 360 personnel of whom 284 reside in the Cessnock local government area (refer **Section 6.4.4**). It is the only mine still in operation in the Cessnock area.

By maintaining direct employment, the mine will provide continued employment support in ancillary operations such as transport, maintenance and services.

Some temporary jobs may be generated by the upgrading of surface facilities. These will be short term and would most likely be filled from within the region from the pool of experienced workers available.

8.11.2 Housing

Since there will be little or no change in long term employment numbers at the mine, no increased demanding for housing in the Cessnock area is anticipated.

Those employees who currently commute to the mine site from outside the Cessnock area (less than 25 per cent of the total employees) are expected to continue the practice.

It is not anticipated that any temporary workers would choose to move into the Cessnock area if they were not already resident.

8.11.3 Community Services

A comprehensive range of community services and facilities is provided in Cessnock and within the region. The proposed mine extension will not create additional demand on such services as health, education and childcare, or on recreational, sporting or other community facilities.

8.11.4 Economic Impact

The capital input of $7M to $10M which may be invested in upgrading surface facilities would

have a positive economic impact. A significant proportion of this investment would flow into the regional economy through payments to local contractors, construction workers and suppliers of services and equipment.

Continued employment of the current mine workforce, which will be provided by the proposed extension, will continue to contribute valuable wages income to the Cessnock area, much of which will be spent locally.

In addition to the direct economic benefits to the Cessnock area and surrounding region, the New South Wales Government will continue to receive income from the mine's operations via coal royalties, rail freight payments, port charges and various taxes.

The Ellalong/Pelton Mine generates approximately $A90 million per year in export revenue, according to the 1994 New South Wales Coal Industry profile (Department of Mineral Resources 1994).

8.12 VISUAL AMENITY

Reject Emplacement Areas

Reject emplacement areas will be constructed in such a way as to minimise visual impacts upon residents in the vicinity and upon travellers upon roads surrounding the affected areas.

Proposed emplacement Area 1 will be more visible to residents than Areas 3 and 4. Construction of these emplacements will be staged in such a way as to minimise visual impacts to residents.

Future more detailed plans for reject emplacement area construction will incorporate bund construction and maintenance of buffer zones by maintaining existing vegetation where appropriate as well as tree planting to screen the emplacement areas in the line of sight from adjacent houses, and to reduce acoustic impacts.

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Cessnock No. 1 Colliery

Any redevelopment of this site will result in improved visual amenity with restoration of heritage buildings and landscape and possible demolition of buildings currently in a derelict condition.

Night Lighting

The reject emplacement areas and the redeveloped Cessnock No. 1 Colliery site will be impacted in twilight and night times due to bright lights from fixed infrastructure components at Cessnock No. 1 and moving lights on dump trucks in the emplacement areas.

The current mine infrastructure area, washery, stockpile and coal loading facilities are all sources of light which will remain at current levels of lighting. No complaints have been received regarding night lighting in existing operations. No residents are currently adversely affected by infrastructure lighting.

Minor night lighting impacts in relation to the reject emplacement areas in terms of moving and possibly stationary lighting could be experienced by travellers upon Wollombi, Paxton and Mount View Roads.

Screening measures described above will lessen night lighting impacts and will be fully addressed when more detailed plans for the creation of each reject emplacement area are drawn up.

Proposed activities at the abandoned Cessnock No. 1 Colliery site would require night lighting but this area is distant from residences and from the Ellalong Road. The lighting levels which could be experienced at the Cessnock No. 1 site are expected to be equivalent to current lighting levels at the Ellalong No. 2 Shaft.

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Sandy Creek Road

Minor visual impacts caused by the construction of the fan installation and night lighting will occur should the Sandy Creek Road site be pursued.

8.13 SOIL EROSION AND SEDIMENTATION

The proposed development is not expected to result in environmental impacts in terms of soil erosion and sedimentation. All the activities which could possibly cause such impacts have been designed so as to:

- prevent the occurrence of soil erosion or sedimentation;
- incorporate monitoring of potential locations and causes of soil erosion and sedimentation;
- provide for immediate measures to be implemented to remedy any soil erosion or sedimentation which may have occurred.

All disturbed areas, particularly reject emplacement areas, will be designed to ensure full containment of runoff and incorporate thorough drainage networks to adequately capture and remove all water inputs.

Soil erosion and sedimentation are specifically addressed in planning for the following:

- creation of reject emplacements (refer to **Sections 7.6** and **8.9**); and
- mining subsidence (refer **Section 8.6**).

Any future plans to conduct surface improvement works at the site of Cessnock No. 1 Colliery, other possible shaft sites and Sandy Creek Road will be designed to incorporate measures to prevent soil erosion and sedimentation of watercourses. These measures will involve rapid actions designed to stabilise areas which become exposed or disturbed.

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8.14 CULTURAL AND HERITAGE SIGNIFICANCE

The cultural significance of all archaeological sites was assessed in the survey carried out for this EIS. The basis of assessment was the ICOMOS "*Charter for the Conservation of Places of Cultural Significance*" (the Burra Charter).

Prior to the development of any of the proposed surface facility sites, namely Sandy Creek Road, shaft site, Cessnock No. 1 Colliery, access roads and each emplacement area, additional archaeological surveys of these sites will be carried out.

8.14.1 European Heritage

The site EL-2, a scarred tree, has been assessed as not significant or of low significance. The railway line formations are seen as being significant for their association with the mining industry and as part of the well known South Maitland Railway System. The construction of the lines however was not a major technological feat nor was there anything particularly unique about the technology used or method of working. However, the South Maitland Railway as a whole was one of the largest private railways in Australia as well as playing a significant role in the development of the South Maitland Coalfields and the towns of Cessnock and Kurri Kurri by providing transport facilities.

The South Maitland Railway had also considerable community esteem as one of the last steam railways in Australia.

The two railway line formations as part of the South Maitland system share in this overall significance. However the integrity of these sites must be seen as compromised by the removal of all track signalling and other railway facilities from the lines leaving only the track formation.

In the case of the Kalingo Junction to Millfield and Paxton line, the integrity is even more compromised by the formation being cut by the Ellalong to Pelton coal conveyor.

While the two railway formations would qualify as being a significant heritage item, that significance is diminished by their low integrity.

The Cessnock No. 1 Colliery was part of the "1920s" group of collieries that opened the southern seams of the South Maitland Coalfields.

Prior to the implementation of any plans to re-open the surface facilities at Cessnock No. 1 Colliery, a Heritage Impact Assessment would be conducted and a Heritage Impact Statement prepared. If such an assessment indicates that the site is of sufficient heritage significance, a plan for the management of heritage items at this site would be developed. Such a plan would identify all the significant elements of the Colliery, their condition and appropriate management strategies for the protection of sites and areas of significance within the Colliery site consistent with the long term goal of reopening the shaft. Both the Heritage Impact Statement and any Heritage Management Plan would be submitted to the Heritage Council for approval.

8.14.2 Aboriginal Heritage

The isolated find EL-1 has been assessed as being of low significance.

This site would be affected by the deposition of washery reject material on proposed emplacement Area 3, and it is also likely that more sites may be located in the area due to changes in ground surface visibility.

It is planned that as each emplacement area is scheduled for utilisation, it will be resurveyed for archaeological sites at lease six months prior to utilisation. Should activities be planned which would result in the destruction of any identified Aboriginal site, the Company would apply to the National Parks and Wildlife Service for Consent to Destroy.

Although previous experience at Ellalong Colliery is that mining has not resulted in erosion problems at the surface, the effects of mining subsidence may include erosion on creek banks. This has the potential to affect archaeological sites. The Company's policy on subsidence, and

its monitoring network, will ensure that the risk of damage to archaeological relics caused by erosion is minimised. Stabilisation measures will be discussed with the Hunter Regional Archaeologist, National Parks and Wildlife Service, as required.

8.15 LAND OWNERSHIP AND RESIDENCE

In the long term, land in the rehabilitated emplacement areas will be returned to the previous land use or possibly sold by the Company for the purpose of private purchase of small rural acreages.

Should any significant subsidence impacts to improvements occur, the Mine Subsidence Compensation Act (1962) allows for the repair or, in extreme cases purchase of damaged houses by the Mine Subsidence Board, if appropriate. Other impacts may be dealt with under the Company's Subsidence Policy (**Appendix 10**).

In the remotely possible event of damage to homes as a result of subsidence and/or vibration necessitating the carrying out of major repairs, residents may be required to vacate their homes for short periods during such work. These matters are covered by the Mine Subsidence Board.

8.16 LAND USE

Temporary impacts upon land use in the emplacement areas will occur during the period of the creation and rehabilitation of the emplacements. The rehabilitated land will be returned to original land use or made available to private purchasers for appropriate rural land uses, should local government zoning be compatible.

Where surface facilities are proposed to be constructed, minor impacts upon existing land use may occur.

8.17 CUMULATIVE IMPACTS

The proposed development is not a "new development" but a plan to continue an existing coal mining operation in a manner similar to current operations. Further, Ellalong Colliery is the only currently operating coal mine in the Cessnock area.

The proposed water monitoring programme will be designed to enable any contribution to cumulative impacts in Black Creek, caused by the Pelton/Ellalong Colliery operations, to be identified. The monitoring data will also enable the mine water discharges to be distinguished from other sources of pollution which include the Cessnock Sewage Treatment Works, runoff from agricultural land, stormwater runoff from built-up areas and discharges from EPA licensed premises.

A study is currently being undertaken by the Hunter Water Corporation, Hunter Catchment Management Trust, and the Department of Land and Water Conservation, which is examining the issue of cumulative impacts in the Black Creek catchment. The Company is also a participant in this study and provides background data.

8.18 WASTE DISPOSAL

Wastes generated by the proposed development will generally be of the same nature and volume as wastes generated by the current operations and will be disposed of in the same manner. **Section 5.2.11** details these arrangements.

The only exceptions are the construction period which may occur if the surface facilities at Cessnock No. 1 abandoned pit top are demolished or restored and new facilities constructed, with the possible upgrading of the access road at the site and the holing into Cessnock No. 1 Shafts, and with the possible construction of shafts and fan(s) at Sandy Creek Road or near the Cessnock No. 1 site. Construction wastes generated by these activities will be disposed of in the following manner:

- recyclable materials will be retrieved and recycled;

- non-recyclable materials will be removed by licensed contractors and utilised for landfill.

By planning the manner of dealing with this waste, recycling and re-use of waste materials will be maximised. These measures will ensure that the environmental impacts of wastes caused by these construction activities will be minimal.

8.19 REHABILITATION

Rehabilitation procedures in regard to coarse washery reject emplacement must be approved by the Department of Mineral Resources, under the Coal Mines Regulation Act, 1982.

In the long term, the impact of the reject emplacements will be minor. The rehabilitated surfaces will be restored to at least pre-existing land capability and visual amenity ratings. The rehabilitation of emplacements will be integrated into the overall scheme of rehabilitation to accompany the future final cessation of mining activities at Pelton/Ellalong and the decommissioning of the mine.

When the mining operation ceases at Pelton/Ellalong, a Management Plan for discontinuance or abandonment will be implemented. This is a condition of the issuing of a Coal Lease under the Mining Act 1992 and the Coal Mines Regulation Act 1982.

It is anticipated that the long term rehabilitated land surface will be suitable for small rural acreage land use zoning.

8.20 HEALTH

As the proposed development constitutes a continuation of existing Colliery operations at similar levels, no adverse health impacts are expected. Continuing compliance with EPA licence conditions will ensure no adverse impacts upon health occur as a result of the proposed development.

8.21 HAZARDS

The need for reject dump trucks to cross Wollombi Road is a source of potential traffic hazard. Adequate precautions, similar to the existing Wollombi Road Crossing for Aberdare Extended emplacement, including stop signs, will prevent such a hazard arising.

Fuel and explosive storage will remain under currently existing regulation.

Bushfire risks from spontaneous combustion of coal in stockpiles, and washery reject material, will be minimised by thorough monitoring of these sites to detect early indicators of spontaneous combustion.

8.22 SUMMARY OF IMPACTS

Table 8.8 briefly summarises the expected impacts of the proposed development. This table must be read in conjunction with the relevant text sections, appendices and figures referred to therein. The table should not be used as a reference in isolation from the more detailed information or particular issues provided throughout the document.

TABLE 8.8
(This table must be read in conjunction with the relevant text sections, appendices and figures referred to therein.
The table should not be used as a reference in isolation from the more detailed information or particular issues provided throughout the document.)

Environmental/ Social Feature Impacted	Source of Impact	Nature of Impact	Area Affected and Comments	
Topography	Subsidence	Increase ponding in Creeks. Ground creep, on steep slopes Lowering of surface relief	Quorrobolong Creek Broken Back Range Bellbird South	Section 8.6.1, 8.6.4, 8.6.5, 8.6.7, Appendix 10
	Reject emplacement	Creation of artificial surfaces 3 m to 20 m greater in elevation	Delineated emplacement areas Short term impact	Section 8.9, Figures 1.2, 8.1
Soils	Subsidence	Change water bearing capacity of unconsolidated soils; erosion	Alluvial flats, Bellbird South	Section 8.6.4
	Reject emplacement	Removal of topsoil, stockpiling and re-application with growing medium	Delineated emplacement areas	Section 8.9
Flora and Fauna	Washery reject emplacement	Removal of existing vegetation and later revegetation	Delineated emplacement areas	Section 8.3, Appendix 9
Air Quality	Coal Preparation Plant, coal stockpiles, coal haulage, overland conveyor	Nil to marginal increase if coal production increases to maximum capacity	Pelton Colliery, Bellbird South	Section 8.4
	Surface works, shaft areas	Construction of buildings and road works; demolition of buildings	Cessnock No. 1 Shafts/ alternative shaft sites	Section 8.4
	Washery reject emplacement	Removal of vegetation and topsoil, haulage of reject material; spreading of reject material and topsoil	Delineated emplacement areas	Section 8.4
Acoustic Environment	Fans, reject emplacment, reject spreading and com paction	Exceedences of nil to 4 dB(a)	Based on conservative modelling	Tables 8.4, 8.5, 8.6, Section 8.5, Appendix 7

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TABLE 8.8 (Continued)
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The table should not be used as a reference in isolation from the more detailed information or particular issues provided throughout the document.)

Environmental/ Social Feature Impacted	Source of Impact	Nature of Impact	Area Affected and Comments	
Surface Improvements	Subsidence	Disturbance to structures and improvements	Areas beyond actual mining panels where underlain by normal strata	Section 8.6.5 and Appendix 10
	Subsidence	Disturbance/damage to house and farm sheds	Areas above actual mining panels	
		Distortion of long poultry sheds	Above mining panels	
	Subsidence	Power lines, concrete culverts, two timber bridges, buried telephone lines	Impact diminishes with distance from source.	Appendix 10
	Vibration	Cracks in cornices and wall junctions	Refer Table V, cosmetic rather than structural	Section 8.7.4
Water Quality (groundwater and surface water)	Water make from seam during mining	Disposal of saline water within existing Water Management System		
	Possible dewatering of Cessnock No. 1 Shafts	Disposal of moderately saline minewater		
	Washery reject emplacement	Leachate or runoff from reject material		Section 7.6, Figures 7.2 and 7.3
	Tailings emplacement into underground abandoned workings	Groundwater effects	Deep (seam level) aquifers	Figure 7.5

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TABLE 8.8 (Continued)
(This table must be read in conjunction with the relevant text sections, appendices and figures referred to therein.
The table should not be used as a reference in isolation from the more detailed information or particular issues provided throughout the document.)

Environmental/ Social Feature Impacted	Source of Impact	Nature of Impact	Area Affected and Comments	
Traffic	Construction activities	Increased usage of roads to access construction sites	Roadways between main roads and construction sites	
	Use of new surface facilities	Increase in traffic - volumes at shift changeover times	Roadways between main roads and Cessnock No. 1 site	Section 8.10.1
	Emplacement of washery reject	Up to 47 trucks per day to possibly cross Wollombi and/or Congewoi Road	Where private haul roads cross these roads	
Employment	Avoid closure of Ellalong Colliery	Maintain employment of 360 personnel; maintain ancillary employment	Cessnock and surrounding region	Section 8.11
	Construction activities	Provision of temporary employment	-	
Economies: local, regional and national	Capital input	Payments to contractors, construction workers and suppliers of services and equipment		Section 8.11
	Continued employment of current workforce	Wages input into local and regional economies		
	Coal royalties, rail freight payments, port charges, taxes	Input into New South Wales economy		
	Export revenue	≈$90 million per annum		

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TABLE 8.8 (Continued)
(This table must be read in conjunction with the relevant text sections, appendices and figures referred to therein.
The table should not be used as a reference in isolation from the more detailed information or particular issues provided throughout the document.)

Environmental/ Social Feature Impacted	Source of Impact	Nature of Impact	Area Affected and Comments	
Visual amenity	Reject emplacement	Removal of vegetation and topsoil, emplacement of reject material, creation of artificially contoured and rehabilitated surface	Areas surrounding and overlooking Reject Emplacement Areas, 1, 3, 4; impact will be staged and short to medium term duration	Section 7.6.1, 7.6.2
	Cessnock No. 1 Colliery restoration	Restoration of heritage buildings; removal of derelict buildings	Cessnock No. 1 Colliery site	Section 8.12
	Night lighting	Increased lighting in twilight and night hours from fixed infrastructure and moving dump trucks	Surrounding and overlooking Cessnock No. 1 site and emplacement areas and adjacent roads	Section 8.12
Post-contact heritage	Re-use of Cessnock No. 1 Colliery site	Restoration of heritage buildings; removal of derelict buildings	Colliery site	Section 8.14.1, Appendix 6
Aboriginal heritage	Washery reject emplacement	Disturbance and loss of heritage items	Reject emplacement areas	Section 8.14.2, Appendix 6
	Mining-induced subsidence	Possible loss of items due to erosion or surface cracking	Areas affected by subsidence	
Land ownership and residence	Mining subsidence or vibration	Damage to homes	Areas affected by subsidence	Section 8.6.5, Appendix 10
Land use	Washery reject emplacement	Creation and rehabilitation of emplacements (short to medium term)	Washery reject emplacement areas	Section 7.6, 8.9
Waste generation	Construction activities	Construction wastes: recyclable and non-recyclable	Possible surface facility construction sites	Section 8.18

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SECTION 9 : MEASURES TO MITIGATE ADVERSE EFFECTS

9.1 APPROACH

The general approach underpinning the planning and design of all aspects of the proposed development has been to incorporate measures to prevent or minimise potential adverse impacts of the development. The result is that few significant adverse effects are likely to occur. Where such adverse effects are unavoidable, measures have been designed to mitigate or ameliorate them to the greatest extent practicable. The appropriate measures have been outlined at various points in this document as an integral part of the discussion of the sources of the relevant effects, and are summarised in **Table 9.1**, below.

TABLE 9.1
MEASURES TO MITIGATE ADVERSE EFFECTS

Feature Affected	Adverse Effect Identified	Measures to Mitigate
Topography	Ponding in creeks	Monitoring programme, grading/earthworks
	Ground creep (steep slopes)	Monitoring programme
	Surface subsidence	Subsidence Policy (**Appendix 10**)
	Artificial surface created	Effective drainage systems designed and installed
Soils	Change in water-bearing capacity of unconsolidated soils	Monitoring, earthworks
	Removal of topsoil, stockpiling and re-application (emplacement areas)	Treating with gypsum and lime, fertilisation and revegetation if not being respread within 3 months; restriction of depth of topsoil dumps
	Erosion	Monitoring, earthworks; drainage construction
Flora and Fauna	Removal of vegetation, later revegetation (emplacement areas)	Speedy revegetation and rehabilitation to original conditions Screening of constructions with vegetation Restrict constructions to already cleared land where possible Construction and revegetation of drainage systems to simulate natural watercourse; careful selection of species for revegetation

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TABLE 9.1
MEASURES TO MITIGATE ADVERSE EFFECTS

Feature Affected	Adverse Effect Identified	Measures to Mitigate
Air Quality	Increased dust levels caused by various activities	monitoring; maintaining stockpiles and reject dumps in moist condition; watering roadways; limiting vehicle speeds on unsealed roads; prompt compaction of reject material; covering conveyors; Air Quality Management System (Environmental Management Plan); sealing of access road; Ministerial controls and EPA permission for construction of Washery Reject Emplacement; covering loads.
Acoustic Environment	Increased noise levels caused by various activities	horizontal orientation of fan outlets; staggering of spreading and compaction of reject; restriction of spreading and compaction of reject to daytime hours only; restriction of reject spreading and compaction to two days per week; bunding/ screening of reject emplacement areas; maintenance of all equipment particularly exhaust and muffler systems; grading of roadways.
Surface Improvement	Damage due to subsidence and vibration	Monitoring; subsidence policy. Mine Subsidence Board procedures for assessment and payment of claims.
Archaeological Sites	Loss of relics (erosion or cracking of surface; removal of surface soil)	surveys, monitoring, consultation
Water Quality	Saline water production and disposal contaminated leachate and runoff generation tailings emplacement underground	Water Management Plan; groundwater monitoring programme drainage systems; Water Management Plan; water monitoring groundwater monitoring in seams
Traffic Flows and Volumes	increased volumes entering and crossing of public roadways	nil available installation of stop signs and speed limits on private roads
Visual Amenity	creation of washery reject emplacement night lighting	staging of construction and prompt rehabilitation; bunding; screening screening, bunding; restriction of lighting to necessary levels only

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TABLE 9.1 MEASURES TO MITIGATE ADVERSE EFFECTS		
Feature Affected	Adverse Effect Identified	Measures to Mitigate
Land Use	creation of washery reject emplacements	prompt rehabilitation to pre-disturbance land capability
Waste Disposal Requirements	generation of construction wastes	re-use and recycling; disposal by licensed contractors

Some adverse effects, however, require special plans or policies to be implemented in order to ensure adequate mitigation. These measures are outlined below.

9.2 MEASURES

9.2.1 Subsidence Policy

The Mine Subsidence Board provides procedures for the assessment and payment of claims to compensate damage due to mining induced subsidence or vibration. The Newcastle Wallsend Coal Company has developed a Subsidence Management Policy for Private Lands, Ellalong/Pelton Colliery.

This Policy is attached to this document in **Appendix 10.** It outlines the meanings of "subsidence", "improvements", and addresses actions NWCC intends to take to minimise the impact of subsidence on residences, agricultural land and watercourses that may be affected by mining at Ellalong. The Company also gives undertakings in respect of steps to be taken in the event of interruption of water supplies due to subsidence, and to overcome the sterilisation of lands due to ponding. The Policy will be provided to all potentially affected landowners. In the event of dissatisfaction with the NWCC Subsidence Policy, amelioration and compensation of the kind of damage outlined above may be achieved through the Mining Act, which provides for compensation via the Mining Warden.

In addition to the provisions of the Mine Subsidence Board and the company's Subsidence Policy, the company also recognises the possibility of mining-induced subsidence affecting

roads in Aberdare State Forest. Should damage occur, appropriate restoration and drainage reconstruction of road surfaces will be undertaken.

9.2.2 Water Management Plan

Ellalong/Pelton Colliery currently operates under a Water Management Plan which was prepared by Graham A. Brown and Associates. The Plan is described in **Sections 5.2.6** and **7.8**.

Current indications are that the proposed extension of operations will not result in any water impacts which cannot be handled within the existing Water Management Plan while mining in the southern area (likely to be for some 7 years duration). However, geohydrological investigations of the likely water make during the proposed mining operations in the northern area are currently in progress. Should these investigations indicate, or should actual mining conditions encounter, significantly greater water impacts than under current operations, the Water Management Plan would be modified or redesigned to ensure that EPA requirements and licence conditions continue to be satisfied and that downstream water quality in Black Creek is maintained. The company's intention is that any upgrading of the Water Management Plan would occur only after full consultation with the relevant government and statutory authorities (the EPA, DMR, Department of Land and Water Conservation and the Hunter Catchment Management Trust) and the Black Creek Salinity Management Committee.

9.2.3 Noise

Noise control has been applied to the existing ventilation shaft fans at Hunter Street, Ellalong. Reduction of noise levels was achieved by directing the fan outlets horizontally and away from the nearest receptors. Previously the fan outlets were angled up at about 60 degrees from horizontal, propagating sound more evenly in all directions.

The fan acoustic power level used to calculate received noise levels, as presented in this EIS, was measured when the fan outlet was in its original orientation. Should a fan installation at

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Cessnock No. 1 Colliery, or nearby, be carried out the outlet would be directed away from Glennie Street, Ellalong. This should result in lower received noise levels than have been predicted. Similarly, any fan installation near Sandy Creek Road would have the outlet directed away from the nearest residence.

All plant and equipment operated by NWCC and any contractors on the emplacement sites are operated in good mechanical condition. All exhaust and muffler systems are and will be maintained to prevent excessive noise emissions.

NWCC will ensure all reject emplacement access roads are evenly graded to prevent truck body "crash" over bumps. Spreading and compacting operations occur separately. A dozer spreads reject one day, and the reject is compacted by a roller the following day. Allocating this work over a 2 day period avoids the cumulative effect of the dozer and roller operating simultaneously.

NWCC's regular noise monitoring programme indicates no criteria limits are being exceeded by current operations. NWCC intend to employ the best available technology economically achievable at all times to ensure they continue to meet noise requirements.

9.2.4 Reject Emplacement

Prior to the disturbance of each reject disposal site, a site-specific rehabilitation management plan will be developed. The need for detailed surveys of soil, archaeology, flora and fauna will be evaluated at that time and where deemed necessary, such surveys will be carried out. NPWS and Department of Land and Water Conservation would be consulted to ensure that any studies carried out meet the relevant organisations' requirements.

Adverse effects of the emplacement of washery reject material will be mitigated primarily by the staging of construction (to allow a range of vegetation stand ages), prompt rehabilitation and employment of screening measures to mitigate visual and noise impacts. Dust control measures will include watering of roadways, maintenance of moist condition of reject material

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during transport and spreading, revegetation of soil stockpiles if longer-term stockpiling becomes necessary, spraying of stockpiles with water and maintenance of low speed limits to reduce the creation of airborne particulate matter. Dry weather daily watering of roads and reject dumps will take place along the lines of current practices. To minimise the potential dust impact, reject emplacement and rehabilitation will occur in stages so that large areas are not exposed. The planning and implementation of these and all other activities associated with the creation of washery reject emplacements will be ensured by the operation of procedures under the Coal Mines Regulation Act.

The production of leachate will be minimised and controlled, on a long term basis, by means of:

- treating reject material with slow-release bactericide (or other appropriate treatment);
- capping spread reject with a layer of non-dispersing clay or treated clay;
- covering the capping layer with an appropriate depth of topsoil;
- revegetation to ensure the long term regeneration of pre-mining habitats;

The measures will minimise leachate formation by ensuring that:

- surface rain water flows over the capped area and not through the reject in rehabilitated areas;
- any leachate that forms is of acceptable quality.

Further measures to control leachate will include:

- maintenance of protection dam(s) at the low point of Area 1 until final rehabilitation;
- direction of any potential leachate from Areas 3 and 4 to old underground workings by vertical boreholes;

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Further, perimeter drains or dams may be constructed to simulate natural watercourses with appropriate vegetation. This would provide an enhanced habitat for post-mining land use.

It is proposed to return all coarse reject emplacement areas to native bushland. Following these procedures relevant to revegetation outlined in **Section 7.6.2**, all prepared emplacement areas will be directly tree seeded with a mixture of local native tree and shrub species. Where possible, seed will be collected locally. This will rapidly return those areas to natural bushland. Activities will include:

- cultivate each emplacement area along the contour;
- immediately following cultivation, apply correctly prepared local native tree and shrub seed to the prepared surface;
- **Table 9.2** sets out the tree and shrub species to be applied; and the rates of application of individual species.

TABLE 9.2
REVEGETATION TREE AND SHRUB SPECIES

Species	Sowing Rate (kg/ha)
Acacia dealbata	0.3
A. falcata	0.3
A. ulicifolia	0.2
Callistemon linearis	0.05
Casuarina glauca	0.2
C. torulosa	0.2
Dodonea triquestra	0.05
Eucalyptus capitellata	0.2
E. fibrosa var. fibrosa	0.2
E. globoidea	0.2
E. maculata	0.5
E. microcorys	0.2
E. moluccana	0.4
E. punctata	0.2
E. tereticornis	0.4
E. umbra var. umbra	0.1
Leptospermum flavescens	0.1
Melaleuca nodosa	0.1
Syncarpia glomulifora	0.1

Fertiliser (Starter 15) will be applied to tree sown areas at 100 kg/ha.

Capping material should be free of weed and grass propagules. Ideally, capping material should be stripped following clearing and immediately respread. No soil materials will be imported to the site.

Sown areas will be monitored and resown or planted (with seedlings of same species) if suitable tree cover fails to establish within 12 months. Suitable cover shall constitute 400 stems (trees and shrubs) per hectare or greater. Weeds will be removed as required.

The first sown areas should be assessed after 12 months and sowing rates altered if necessary to encourage increased species diversity.

Generally, the procedures to be adopted at all stages of the formation and rehabilitation of reject emplacements have been determined as being conducive to ensuring long-term stability of reject emplacement areas.

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SECTION 10 : JUSTIFICATION OF THE DEVELOPMENT

10.1 GENERAL

The proposal to extend the operations of Ellalong Colliery into the Bellbird South area has arisen as a consequence of problems encountered in the existing Ellalong Colliery workings which have rendered further mining in this area, with existing technology, impossible in the short term.

NWCC received development consent to mine a sub-lease area within Consolidated Mining Lease No. 2, a plan which will enable mining operations to continue for about two more years although development driveage outside the sublease would be required earlier. However, upon completion of mining in the sub-lease, there are compelling reasons why NWCC should continue its underground operations into the remainder of Consolidated Mining Lease No. 2. The development will result in a major economic benefit being achieved in a manner which minimises adverse environmental effects.

10.2 BIO-PHYSICAL ISSUES

The biophysical impacts have been considered and reported upon by specialists in the appropriate disciplines. Full reports are presented as appendices and have been summarised in the various sections of this document. The prediction of the biophysical impacts is assisted and supported by the monitoring records of the conduct of Pelton Colliery since 1916 and the detailed knowledge of the mining conditions acquired during the conduct of mining at Ellalong since 1978.

Mining Method

The Greta Seam reserves in CML No. 2 are present at depths which necessitate extraction using underground mining methods. A major environmental advantage of underground mining in comparison with open cut mining is the relatively minor nature of disturbance of surface features.

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As a result, bio-physical effects of the proposed development are minimal whilst the longwall mining method to be utilised will allow a high level of efficiency in coal resource utilisation through maximisation of productivity and safety.

Flora and Fauna

The report of HLA-Envirosciences (**Appendix 9**) concludes that the project will not have an impact on the habitat of endangered flora and fauna.

Subsidence

Some surface subsidence is an unavoidable consequence of underground mining, if an economically viable proportion of the resource is to be recovered. At the proposed extension to Ellalong Colliery, both the mining method utilised and the design of the mine plan will minimise subsidence effects of the mining operation. Further, the considerable depth below the surface of the Greta Seam in the CML No. 2 area proposed for mining will contribute to minimising the surface effects of subsidence.

Any subsidence effects which do occur and impact upon the environment can be successfully mitigated to maintain or permit regeneration of habitats. Human impacts will be remediated under the Mine Subsidence Act and the Company's Subsidence Policy (refer **Appendix 10).**

Air Quality

Effective dust suppression measures will be continued and so adverse biological effects will be avoided. Air quality monitoring will continue.

Vibration

Predicted vibration levels are unlikely to give rise to serious adverse impacts. Any adverse impacts which do occur will be remediated under the Mine Subsidence Act, which is

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administered by the Mine Subsidence Board. Vibration monitoring will continue.

Water

Water management will be planned to avoid or rapidly respond to and remedy any erosion or silting occurrences and thus avoid environmental impacts. Water quality will be carefully controlled to maintain predetermined acceptable levels and thus not to threaten biological systems.

Noise

The report compiled by HLA-Envirosciences (**Appendix 7**) concludes that no impacts will occur as a result of operation of ventilation shaft fans at Cessnock No. 1 site or emplacement of reject material by highway trucks. Minor impacts are predicted for spreading and compaction of reject material at Wollombi Road, Bellbird and Bimbadeen Road only, and for the operation of ventilation fans at Sandy Creek Road. No impacts are predicted for construction noise at Cessnock No. 1 site. All predictions are based upon modelling for worst case situations.

Soil

The Company has established that sufficient topdressing material is available in the emplacement areas for rehabilitation purposes. The rehabilitation process will ensure the stabilisation of the emplacement areas thereby preventing erosion.

10.3 ECONOMIC CONSIDERATION

Historically, underground coal mining has been an essential part of the Australian economy. Today, underground coal mining is a major contributor to the economic life of Australia.

The mining of coal for both domestic consumption and export for electricity generation and

metallurgical use is essential to the maintenance and growth of the Australian economy.

Technological changes mean that the amount of coal produced from underground operations is expected to increase in the future.

Continuation of mining of the Ellalong Extension into Bellbird South, into deeper coal reserves with an increased working section height, is expected to encourage the development of technical skills which would constitute an economic and technical asset to the Cessnock area and beyond. The presence of such skilled workers and technology will aid future efficient exploitation of coal resources in other areas of the Hunter Valley and hence provide economic benefits on a wider scale.

The proposed extended Ellalong mining operation will generate approximately $90M per annum in export revenue and provide significant inputs into the local economy, and any capital input associated with the possible upgrading of surface facilities at Cessnock No. 1 site would have a positive economic impact at the local and regional level.

10.4 SOCIAL CONSIDERATION

Social and economic considerations related to the proposal are discussed in **Sections 6.4** and **8.11.**

Directly and indirectly, coal mining provides employment for many people. In the Cessnock area in particular, Ellalong Colliery which employs 360 people, is the only remaining coal mine in operation. Closure of the mine would undoubtedly lead to unemployment and loss of a skilled workforce from the area, as well as affecting employment in linkage industries.

By maintaining direct employment, the mine will provide continued employment support in ancillary operations such as transport, maintenance and services. The Cessnock local government area is already equipped with all levels of school and technical education facilities as well as child care, sporting, recreational and cultural facilities and organisations. As the

proposal will not increase the local population, demand for these services and facilities will remain at current levels and existing facilities will continue to satisfy the demand for these services.

10.5 ECOLOGICAL SUSTAINABILITY

10.5.1 General

In 1990, the Commonwealth Government adopted the definition of ecologically sustainable development as "*using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased*" (National Strategy for Ecologically Sustainable Development, AGPS, 1992, p6). Thus, the concept of ecologically sustainable development embraces the two objectives, of meeting the needs of Australians today, as well as conserving ecosystems for the benefit of future generations (Bates 1992, p6).

The objective of conserving ecosystems for the benefit of future generations means the development of resources in a way which maintains and, where possible, improves their range, variety and quality. The objective of meeting the needs of Australians today involves utilising resources to develop industry and create employment.

In **Section 5** of the National Strategy for Ecologically Sustainable Development, the following were identified as being means of improving opportunities for ecologically sustainable minerals and energy development:

- enhanced decision making;
- achieving a high standard of environmental and occupational health and safety performance;
- strengthening the geoscientific information base;
- optimising the economic return to the community from mining;
- improved consultative mechanisms.

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Generally, the environmental impacts of the mining industry have not been as broadscale as those of some other land uses, such as agricultural or urban developments. Underground coal mining would be a particular example of this. The environmental effects of underground mining are generally confined to relatively small areas. Underground coal mining at Ellalong is generally consistent with multiple land use of the broader area, including conservation. The impact of coal mining at an extended Ellalong Colliery will be temporary, and is consistent with sequential land use of the area, following rehabilitation.

The Newcastle Wallsend Coal Company's commitment to active environmental management facilitates the ecological sustainability of its current and proposed mining operations at Ellalong. Considerable financial resources are devoted to environmental management by NWCC. Coupled with the natural dynamism of ecosystems, and the restorative capacity of nature over time, this approach supports and fosters ecological sustainability of the Company's operations. The minute residual of irreversible mining impact must be balanced against the numerous positive impacts of the proposed mining operation (Sharp-Paul 1994).

The proposal to extend Ellalong Colliery operations into Bellbird South has been developed with ecological sustainability principles taking high priority. Environmental management has been treated as an integral component of the design of all aspects of the proposed development, consistent with the high level of NWCC's commitment to environmentally sound practices. As a result, the objectives of enhanced decision making, high standards of environmental performance, a strengthened geoscientific information base and improved consultative mechanisms are direct results. Optimal economic return will flow-on as a result.

Meeting Needs of Australians Today

Clearly, the proposed development will meet the needs of Australians today on a number of levels. On a **National level,** earning of some $90M per annum in export income, maintenance of coal markets, provision of employment, and continuing development of coal extraction technology will be benefits which flow from the development.

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On a **State level,** revenues generated by the mining operation in the form of coal royalties, rail freight payments, port charges and various taxes will benefit the State of New South Wales.

On a **regional level,** the proposed development will prevent the premature closure of Ellalong Colliery and so provide an opportunity for the highly skilled workforce to remain within the Hunter Valley, a major coal mining region, for a further 21 years. The experience gained in mining the Greta Seam at depth utilising the longwall technology proposed will be valuable for other coal mining operations in the Hunter Valley in the future, which may face similar challenges.

On a **local level,** the maintenance of employment will sustain the local economies which are otherwise in danger of becoming depressed due to loss of income and possible loss of human resources as the Ellalong Colliery is the only coal mine operating in the Cessnock area.

The Company, in proposing this development has actively pursued strategies to inform and liaise with governments, statutory bodies and community members and has given priority to publication of details of the mining proposal. The Mindaribba Local Aboriginal Land Council has been consulted during the environmental impact assessment process.

Conserving Ecosystems for the Benefit of Future Generations

Any interpretation of this objective in relation to an underground coal mining development must consider the fact that coal is a non-renewable resource. Rather than strictly being able to maintain or improve the range, variety and quality of coal resources, the responsibility of the mining industry may be viewed as being to maximise resource recovery and ensure resource utilisation for sustainable purposes. The requirement of minimising or eliminating adverse environmental impacts of any mining development ensures the conservation of ecosystems for the benefit of future generations and underpins the whole concept and purpose of environmental impact assessment as an essential accompaniment to the proposed development.

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Underground coal mining using longwall technology permits a highly efficient resource recovery to occur with minimal disturbance to ecosystems.

The possible use of abandoned surface facilities and the utilisation of operating surface infrastructure which would otherwise become redundant, also contribute to minimising the disturbance of ecosystems and hence facilitate the conservation of ecosystems for future generations.

The fact that the bulk of the coal produced from the proposed extended Ellalong Colliery will be transported to the port of Newcastle by rail also entails ecological benefits in comparison to truck haulage.

10.5.2 The Precautionary Principle

The Precautionary Principle as set out in Schedule 2 of the Environmental Planning and Assessment Regulation 1994, states "*if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation*".

Adherence to this principle ensures that any substance or activity which can be identified as constituting a threat to the environment will be the subject of measures to prevent it from adversely affecting the environment. Lack of conclusive scientific proof linking the particular substance or activity with environmental damage will not impede the process of preventative measures being implemented in advance of any effect occurring.

The EIS prepared by HLA-Envirosciences Pty Limited has thoroughly considered and outlined all possible harmful effects of the proposed activity on the environment. All potentially harmful effects identified have been systematically evaluated and will be the subject of Management Plans incorporating monitoring and mitigation, as an integral aspect of the proposed development's Environmental Management Plan.

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For the proposed development, none of the identified sources of possible threat to the environment is a subject of a lack of scientific certainty apart from water volumes. In any case, these possible sources of threat will be pro-actively managed so as to prevent any of them from being able to adversely affect the environment. Water quantity is the subject of special investigations which will enable measures to adequately prevent environmental degradation to be implemented.

Mining operations at Ellalong have been in existence for some years and are currently dealing effectively with all possible sources of threat to the environment. The proposed development, being a continuation of existing operations, is not expected to give rise to any new threats and thus it can be confidently predicted that no potential threats will be permitted to adversely affect the environment in the proposed development.

10.5.3 Inter-Generational Equity

This principle is defined in Schedule 2 of the Environmental Planning and Assessment Regulation as follows: *"the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations".*

In terms of the proposed development, the environment can be viewed in two parts: the underground coal reserves, and the surface environment.

Underground Environment

For economic reasons, the Company will maintain the most effective resource recovery maximisation measures. Technology utilised and the mining plan itself are carefully selected to ensure maximisation of resource recovery. Resources utilised in recovering the coal resource are also utilised at maximum achievable efficiency. Waste reduction and recycling are also incorporated as part of the Environmental Management Plan.

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The concept of inter-generational equity has historically been embodied in the criteria set by the Department of Mineral Resources for approval of both conceptual mine plans and operational procedures in mining operations. The objective of the DMR has always been to ensure the maximum recovery of the coal resource achievable given the constraints of safety, technology and quality. Mining has also always been prohibited in areas where the activity would prevent the utilisation of other important resources regarded as having higher priority.

This approach incorporates inter-generational equity as far as this can be achieved for a non-renewable resource such as coal. When such resources are extracted it is essential that maximum recovery and minimum wastage occur. It is important to utilise the best technology and practices to ensure this objective is achieved. When such practices are implemented, the resources left in the ground for the benefit of future generations, are maximised. In future, higher prices and improved technology may render the vast resources of currently uneconomic coal, economically viable. Thus the decision to mine by the longwall method, and to orient longwall panels parallel to the dominant stress direction, designed to ensure efficient mining and hence maximum resource recovery, also ensures the maximisation of inter-generational equity.

It is planned to commence mining the Bellbird South coal in areas where the seam is thinner, and to move over time into areas where the seam thickness is increasing. It is hoped that this will allow for the development, over time, of mining equipment which is capable of extracting greater working sections and hence to maximise resource recovery.

Rehabilitation of all sites affected by the coal mining operations, particularly reject emplacements and other disturbed sites, has been subject to considerable planning and is an area of high awareness on the part of the Company. Surface land rehabilitation objectives include the restoration of such land so that its ongoing maintenance needs are consistent with those of equivalent unmined lands in the area.

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Surface Environment

The Environmental Impact Assessment process and the development of a comprehensive Environmental Management Plan for the proposed development will give effect to the objective of conserving ecosystems and maintaining the health, diversity and productivity of the surface environment. In fact, some aspects of the planned development will increase the productivity of the surface environment. This is likely to occur in the long term in the reject emplacement areas. The requirements of legislation and statutory authorities will provide a framework to ensure the adequacy and effectiveness of all measures designed to maintain environmental health, diversity and productivity.

10.5.4 Biological Diversity and Ecological Integrity

The proposed extension of mining operations into Bellbird South is consistent with the preservation and promotion of biological diversity in the Bellbird South area. It should be noted that this area has already been significantly affected by grazing and other activities which have diminished biological diversity.

The area of land surface to be disturbed by the proposed operation is comparatively small. Those areas which are disturbed will be carefully rehabilitated, using advanced rehabilitation techniques, to restore original species to the greatest degree possible. NWCC's previous experience in successful site rehabilitation will provide valuable knowledge to ensure the success of this phase of the mining operation.

The studies conducted indicate that no rare or endangered species will be impacted adversely by the proposed development.

10.5.5 Valuation and Pricing

The National Strategy for Ecologically Sustainable Development includes "*optimising the economic return to the community from mining*" as an important element in achieving

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ecologically sustainable minerals and energy development. One way of optimising economic returns to the community is to optimise the valuation and pricing of the resources being mined.

NWCC is currently producing coal from Ellalong at a loss due to mining problems encountered. It is expected that the transfer of operations to the Bellbird South area will return the mine to profitability. The price obtained for Ellalong coal is the maximum obtainable given the quality of the coal and its end use. An important means of maximising the valuation of Greta Seam coal is to use the coal produced from Ellalong as a component in coal blends made up from coal either produced at other collieries of the Oakbridge Group, or purchased especially for blending purposes. This allows the Greta Seam to be utilised for its optimised quality characteristics and priced accordingly. The comparatively high sulphur content of the Ellalong washed product is a determining factor in the valuation and pricing of the product coal. The Company maintains an "optimisation model" which is utilised on a daily basis to manipulate the coal washing process to achieve maximum yields within required coal quality parameters, and hence maximise the price obtained for the coal resource.

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SECTION 11 : ENERGY STATEMENT

11.1 ENERGY REQUIREMENTS

The proposed Bellbird South project will produce energy in the form of coal for export. In producing the product coal, energy will be consumed, mainly in the form of electricity to power conveyors, man riding winders, washery and other fixed equipment and petroleum product to power trucks and other mobile equipment.

For an annual saleable coal production of 1.7 Mt and a total coal recovery from the project of an estimated 29 Mt and assuming a specific energy value of 32.0 MJ/kg for the saleable product, the total energy output during the projected life of the operation would be 9.3×10^{11} MJ.

The estimated petroleum product use by mine machinery would be 609,000 L per annum, which is equivalent to an annual consumption of 2.47×10^7 MJ.

Estimates of electricity use include consumption both underground and on the surface. Total annual electricity use is estimated at 2.6×10^7 kWh, equivalent to 9.4×10^7 MJ.

Bellbird South will be a net producer of energy, with a total energy production of 9.3×10^{11} MJ. The total energy input to win this coal will be 21.2×10^8 MJ, or 0.23 per cent of the total energy output.

11.2 MEASURES TO CONSERVE ENERGY

Existing equipment designed for energy efficiency will be used for the Bellbird South project. Energy efficient features include the use of electric conveyors rather than trucks and minimum rehandling of materials. In addition, power factor correction on capacitators will allow the Colliery to keep the maximum energy demand (kVA) to a minimum. If this maximum demand is kept low, energy saving benefits and reduction in energy costs result.

11.2

The use of the existing infrastructure including the Colliery's coal preparation plant, washery facilities and transport system will allow the continuation of a viable and efficient operation.

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SECTION 12 : ALTERNATIVES TO THE DEVELOPMENT

12.1 ALTERNATIVES TO THE DEVELOPMENT

The Environment Planning and Assessment Act 1979 requires a proponent to consider feasible project alternatives and give reasons for adopting the preferred option.

The options of mining in other parts of the present Ellalong mining lease, altering the scale of operations and the possibility of new entries have been considered.

High seam gas levels have made it difficult to safely and economically mine the southern workings of Ellalong Colliery with present technology. Hence, this area is being abandoned for the time being. Large faulting and unknown gas levels in the eastern and western parts of the lease make mining in these areas not viable in the short term either. It may be possible to successfully mine these areas at a later time if a technologically sound method of dealing with the gas levels can be developed.

There is no current plan to change the existing scale of mining operations, however options of scaling up or scaling down the operation of the mine have been considered. This alternative is under continual review and depending on economics, a changed scale of operations may occur in the future. Should such a change result in the need to significantly upgrade infrastructure, it would be subject to a separate development application.

The possibility of sinking new entries instead of re-using (dewatering) the Cessnock No. 1 shafts is being considered. No decision has been made as to which option is favoured, pending the outcome of geohydrological and ventilation studies currently underway.

If the mine was to be worked as a first workings only or partial extraction operation, subsidence and vibration effects would be reduced. Due to the very high development costs associated with deep mining in the Greta Seam, this alternative is not being pursued. In addition, the mine would be uneconomic because a much larger percentage of the resource would not be mined. The only resource efficient and cost effective mining technique is longwall extraction.

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The Company perceives its development to be an optimal proposal involving a high degree of environmental acceptability blended with careful consideration of good mining practice and cost-effectiveness.

12.2 CONSEQUENCES OF NOT PROCEEDING

If the Bellbird South development does not proceed then the mine would almost certainly close, resulting in the loss of 360 direct jobs. In addition, foreign exchange earnings from the sale of coal will not be achieved and an annual direct expenditure of approximately $90M in local, regional and national economies will be lost. Further losses to the economy would result from the loss of indirect and induced employment and expenditure.

The proposed project minimises environmental impact because the majority of mining development occurs underground. If the development does not proceed, the area will remain substantially the same. This would result in reduced environmental impacts such as noise and subsidence as described in other sections of this document. However, the substantial economic benefits of such a development would be lost to the local community, the state and the nation.

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SECTION 13 : CONCLUSIONS AND SUMMARY

13.1 CONCLUSIONS AND SUMMARY

This Environmental Impact Statement (EIS) supports a Development Application (DA) by The Newcastle Wallsend Coal Company Pty Limited, for an extension of its existing Ellalong underground mining operations into Bellbird South. The development is being proposed in order to prevent premature closure of the Colliery and would extend the life of the mine for 21 years. The DA will be determined by the Department of Urban Affairs and Planning under State Environmental Planning Policy No. 34 : Major Employment-Generating Industrial Developments.

A variety of approvals is required for the various elements of the proposed development, these being the underground mining operation, construction of associated surface infrastructure, creating of washery reject emplacements, pollution control systems, and extraction of coal by the longwall mining method.

The coal to be mined occurs in the Greta Seam and the major product is a high volatile, low ash, bituminous coal suitable for export and local use as coking coal.

This EIS describes in detail the existing environment of the area to be affected by the proposed development. The environment is one which has been extensively modified by post-contact land uses and supports no threatened or endangered species. Furthermore, because the proposed mining activity is underground, a relatively small surface area only will be affected, apart from the very minor effects of mining-induced subsidence.

There will be few changes made to the existing mining operation, as described in detail in this document, apart from the relocation of the actual underground mining activity. All the major parameters: mining method, coal handling and preparation, coal storage, production and transportation and mine infrastructure will remain largely unchanged. Some changes to water management practices are conceivable but are not considered likely, on indications currently available. Environmental monitoring programmes will be modified where required to apply them to the proposed development. The mine workforce, working hours and waste

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management systems will be unchanged. Reject handling and disposal will continue as at present for the next several years: thereafter, reject disposal will be in the form of the creation of emplacements upon existing land surfaces which will result in new land contours being created. These areas will be fully rehabilitated with native vegetation and returned to compatible land uses.

Existing land uses, zonings and property ownership are not incompatible with the proposed development and associated activities. No significant items of Aboriginal or post-contact heritage will be impacted by the proposed development, apart perhaps from the restoration (or, if necessary, demolition), of abandoned buildings at Cessnock No. 1 Colliery.

Some significant impacts upon the environment have been identified and quantified and their likelihood of occurrence assessed. Generally, though, these are shorter term effects. However, impacts upon the acoustic environment, subsidence and vibration, and particularly water management and reject disposal are likely to require pro-active management policies. Consequently, specialist studies have been undertaken in order to quantify the likely level of such impacts and to assist the Company in developing policies and plans of management which can successfully mitigate or ameliorate these impacts. Where this cannot be achieved, compensation policies of both the Mine Subsidence Board and NWCC may be applicable.

Strong arguments can be raised, in social and economic terms, and in view of the minor nature and extent of predicted adverse environmental impacts, in favour of the proposed development. Moreover, consideration of bio-physical issues and ecological sustainability have not raised any obstacles to the development proposal. Rather, consideration of these concepts has assisted in the development of policies and plans of management described above. The Company's commitment to ongoing geohydrological investigations reflect the operation of the precautionary principle in relation to the proposed development.

In conclusion, the proposed extension of Ellalong Colliery's underground mining into Bellbird South will result in few significant adverse environmental impacts. Those which do occur will be confined in many cases to small areas, will be of short to medium term duration, and will

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be addressed by strategies designed to ameliorate them. A valuable natural resource will be effectively utilised at a relatively minuscule environmental cost. At the end of the life of the mine, the mine will be decommissioned and all surface sites rehabilitated and returned to a condition at least as good as, if not better than that which existed prior to the commencement of coal mining at Pelton/Ellalong.

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SECTION 14 : REFERENCES

14.1 REFERENCES

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GLOSSARY

GLOSSARY

Bund

A wall or low embankment of soil surrounding an area to prevent ingress or egress of liquids or to deflect.

Cyclone

A plant item designed to separate suspended particles of differing size or density by centrifugal force.

Density

Ratio of a substance mass to its volume.

Dust

Solid particles or particulates which have become airborne.
Total dust - all dust which is airborne
Respirable dust - the size fractions of total dust which enters a person's air tracts in breathing.

Evapotranspiration

Evaporation due to movement of water through vegetation.

Groundwater

Water occurring in interconnecting pores within soil or rocks, beneath the water table.

Permeability

A measure of the rate at which fluids can move through rock or soil.

Permian

Geological time period from 280 to 230 million years ago.

pH

A value representing the acidity or alkalinity a solution. Water is pH neutral at pH 7. Acids have a pH less than 7, the lower the number the stronger the acid (minimum 0). Alkalis have a pH greater than 7, the higher the number the stronger the alkali (maximum 14).

Piezometer

A device for measuring changes in water level or water pressure.

Potable

Water which has been treated to a quality suitable for human consumption.

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Prefixes

Prefixes are used to form names for symbols of multiples of SI units.

SI PREFIXES		
Factor by which the unit is multiplied	Prefix	
	Name	Symbol
10^{18}	exa	E
10^{15}	peta	P
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10	deka	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
Source: AS 1000-1979		

Water Table

Level below which the ground is saturated with water.

ABBREVIATIONS

ABBREVIATIONS

ABS	Australian Bureau of Statistics
AHD	Australian Height Datum
ARI	Average Recurrence Interval
AS	Australian Standard
CaLM	Department of Conservation and Land Management
°	angular measurement in degrees
°C	degrees Celsius (Centigrade)
dB(A)	decibel, "A" weighted sound pressure level
$dB(L_{10})$	Sound pressure level exceeded for 10 per cent of time in decibels
$dB(_{LEq.T})$	Equivalent continuous traffic generate sound pressure level in decibels
DDH	Diamond Drill Hole
DEET	Department of Education, Employment and Training
DMR	Department of Mineral Resources
DWR	Department of Water Resources
EC	Electrical Conductivity
e.g.	for example
EIS	Environmental Impact Statement
EPA	Environment Protection Agency
EP&A	Environmental Planning and Assessment Act 1979
ESP	Exchangeable Sodium Percentage
g	gram
$g/m^2/mth$	grams per square metre per month
H_2S	Hydrogen Sulphide
ha	hectare
h/d	hours per day
km	kilometre
kW	kilowatt
L	litre
L_{10}	noise level exceeded 10% of time
L_{eq}	equivalent continuous noise level
<	less than
Ltd	Limited
Mg	Magnesium
ML	megalitre (1,000,000 litres)
ML/d	megalitres per day
Mt	Million tonnes
Mtpa	Million tonnes per annum
m	metre
m^2	square metres
m^3	cubic metres
m^3/h	cubic metres per hour
mg/L	milligram per litre

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ABBREVIATIONS (cont.)

mm	millimetres
mm/h	millimetres per hour
m/s	metres per second
MW	Megawatts
μm	microns
Na	Sodium
per com	personal communication
%	per cent
pH	Measure of hydrogen ion concentration on a logarithmic scale
ppm	parts per million
Pty	Proprietary
ROM	Run of Mine
RTA	Roads and Traffic Authority
μS/cm	micro Siemens per centimetre
SAR	Sodium Absorption Ratio
SO_2	Sulphur Dioxide
SPCC	State Pollution Control Commission (now Environment Protection Authority)
SRA	State Rail Authority
t	tonne
tpa	tonnes per annum
tph	tonnes per hour
TSP	Total Suspended Particulates
y	year

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