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3.0 ANALYSIS OF EXISTING ENVIRONMENT

Key points

- MCC's mining operations are located within the Hunter Valley in a locale that has supported coal mining since 1907;
- The proposed No. 1 Open Cut Extension is contained within the existing Consolidated Coal Lease 713;
- The majority of the proposed No. 1 Open Cut Extension area is extensively altered from its natural state through past agricultural activity and mining operations;
- The flora and fauna survey identified 180 species, of which two are threatened (vulnerable) species and 53 species are exotic;
- The roads used for coal transport are described as having a high level of service;
- The main visible feature of MCC's operations are the rehabilitated spoil piles;
- The groundwater in the proposed No. 1 Open Cut Extension is not suitable for potable uses or irrigation;
- Background noise levels were measured at five locations and nightime background noise levels ranged between 29 and 37 dB(A);
- The study area is drained by Sandy and Muscle Creeks;
- The nearest bores to the north and south are located approximately 4 km from the proposed No. 1 Open Cut Extension and the bores are generally used for stock water supplies;
- MCC operates an air quality monitoring network comprising of 15 dust deposition gauges and a high volume air sampler. Measurements from these gauges show MCC generally operates within their EPA limits for dust deposition and concentration;
- An Indigenous and Non - Indigenous heritage study located four Indigenous heritage sites of low archaeological significance and two scarred trees of moderate archaeological significance;
- Over 133 million tonnes of coal were produced in NSW during 1999/2000 of which 80% was produced in the Hunter and Newcastle coalfields;
- $3.01 billion was earned from the export of 72.4 million tonnes of high grade thermal and coking coal through the Port of Newcastle in 1999/2000; and
- Coal mining is a significant employer in the Hunter region. MCC employs 69 permanent employees and on average, 39 contracted and casual employees.

3.1 Methodology

The analysis of the existing environment was undertaken through the preparation of specialist studies. The findings of the specialist studies have been incorporated into the main text of this EIS. The specialist studies are contained in **Volumes 2 and 3** as appendices.

3.2 Regional Setting

The Shire of Muswellbrook covers an area of 3,401 km² being located approximately 130 km north-west of Newcastle. The boundaries of the Muswellbrook shire are delineated by Lake Liddell the east,

Wollemi National Park to the west, Aberdeen to the North and Coricudgy State Forest to the south. Muswellbrook is located at Latitude 32°15´ South, Longitude 150°53´ East, with an elevation of 144.2 metres above sea level.

MCC's mining operations are located 1.6 to 3 km to the east of Muswellbrook and to the north of Coal Road. The land on which the proposed No. 1 Open Cut Extension is situated within the boundaries of CCL 713. With the exception of a portion of Coal Road the No. 1 Open Cut Extension is situated on freehold land owned by MCC.

This land includes an area of existing and former open cut mine operations and the workings in several coal seams of former underground mining operations.

Surrounding land uses include MSC's Waste Management Facility, agricultural activities such as grazing of beef cattle, a light industrial estate, rural-residential areas, the Muswellbrook urban area and St Heliers Correctional Centre.

Major transport links in the form of the Main Northern Railway and the New England Highway pass through Muswellbrook. It has been proposed to construct a highway diversion around the town of Muswellbrook. Several of the route options propose to divert the New England Highway to the east of the town through lands owned by MCC.

3.3 Meteorology

The meteorology of the Muswellbrook region is summarised in the following sections. The Australian Bureau of Meteorology (BOM) collects meteorological data at Jerrys Plains (25km to the south). Data from Jerrys Plains is considered representative of the Muswellbrook area.

The BOM does not currently operate a meteorological station at Muswellbrook, although data has previously been collected from the High School. The meteorological data collected by the coal and electricity generation industry within 10 to 15 km of Muswellbrook is an excellent source of relatively recent data. Most of these meteorological stations have been operating for much less than 20 years whereas the Jerrys Plains meteorological station has been recording weather data since 1884. Accordingly, this data covers a much wider range in respect of maximum and minimums recorded and provides the most reliable long term averages of recorded weather data for the Upper Hunter. Comparisons of this more recent weather data indicates that the data from Jerrys Plains is representative of Muswellbrook. Rainfall is expected to be marginally higher for Muswellbrook and maximum summer temperatures to be slightly lower.

3.3.1 Climate

The regional climate of the Hunter Valley is typically described as warm temperate with seasonal climate variations from hot wet summers to mild dry winters. Short duration, high intensity storms occur in summer, however rainfall is more reliable during February to April and early October. Wind directions

vary from "southerly busters" in summer to north westerlies in winter. (URS 2000). Some frosts and fogs occur between May and October.

3.3.2 Temperature

The Muswellbrook temperature pattern is characterised by hot summers and cool to mild winters. Daily temperature variations can be quite large. The maximum and minimum monthly temperatures recorded at Jerrys Plains are presented in **Table 3.1**. During winter, the average monthly maximum temperature ranges from 17.3°C to 19.4°C and the average monthly minimum temperatures range from 3.7°C to 5.2°C. July is the coolest month with a minimum average of 3.7°C and January is the warmest month with average monthly daytime maximum temperatures reaching 31.7°C. Relative humidity is highest during winter mornings. June has the highest average relative humidity reaching 79% at 9.00 a.m. and 54% at 3.00 p.m. As might be expected, evaporation is related to the prevailing temperature, with the highest evaporation rates in summer months.

TABLE 3.1
CLIMATIC AVERAGES 1884-2001

Month	Temperature (°C)		Mean Relative Humidity (%)		Wind Speed (km/h)	Rainfall (mm)	Mean No. of Raindays
	Max	Min	9am	3pm	3pm		
January	31.7	17.1	67	47	14.1	78.9	7.9
February	30.9	17	72	50	14	70	7.2
March	29	15	71	50	13.3	58.6	7.3
April	25.3	10.8	71	47	12.3	45.3	6.3
May	21.2	7.3	77	52	12.1	41.6	6.5
June	17.9	5.2	79	54	12	46.2	7.4
July	17.3	3.7	8	50	14	44.7	7
August	19.4	4.4	72	45	14.9	36.5	7
September	22.8	6.9	65	43	15.6	41.8	6.6
October	26.2	10.2	60	44	14.6	51.9	7.5
November	29.3	13.1	59	41	15.2	57.9	7.6
December	31.4	15.7	60	42	14.8	66.8	7.5
TOTAL	25.2	10.5	69	47	13.9	640.2	86

Source: BOM Jerrys Plains Meteorological Station.

3.3.3 Rainfall

The annual average rainfall recorded at Jerry's Plains is 640 mm occurring on an average of 86 days. The highest rainfall levels at Jerry's Plains were recorded during January with an average of 79 mm and August recorded the lowest average rainfall with 37 mm.

Rainfall in the Muswellbrook district has a low reliability and is highly variable for any one month. Short periods of sustained heavy rainfall occur periodically in the Hunter Valley, which can be attributable to the tail end of a cyclone passing down the east coast of Australia or from a stationary low pressure trough in the region.

3.3.4 Wind

The typical seasonal wind pattern for the Hunter Valley is dominated by southerlies and south easterlies during summer and more intense north westerlies in winter. Windroses produced from data collected as part of the Air Quality Impact Assessment produced by Holmes Air Sciences are shown in **Figure 3.1**.

3.3.5 Inversions

Temperature inversions occur when relatively dense, cool air bodies are trapped below warmer, lighter air masses. Inversions typically represent still wind conditions at the surface and the air bodies do not readily mix. An inversion inhibits the dispersion of dust and gases, tending to cause higher concentrations at ground level. An inversion can also effectively "trap" sound energy near the ground and lead to an increase in noise levels. Inversions tend to be more prevalent in winter, during cold still nights, and can persist until 11.00 am. Mild temperature inversions are likely to occur on greater than 25% of mornings and evenings in winter.

3.4 Flora and Fauna Habitat

An assessment of flora and fauna was completed for the proposed No. 1 Open Cut Extension by HLA-Envirosciences Pty Limited. This section provides a summary of the flora and fauna assessment. The complete flora and fauna assessment is provided in **Appendix F**.

The flora and fauna assessment incorporated field studies and the results of ecological studies undertaken previously in the Muswellbrook area. This assessment has been prepared in accordance with the requirements of Section 5A of the *EP&A Act 1979*; and the Director-General's Requirements issued by planningNSW. The assessment also considered the legislative aspects of the *Threatened Species Conservation* (*TSC*) *Act 1995*, *SEPP No. 44 – Koala Habitat Protection*, and the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*.

The main objectives of the assessment were:

- To identify the flora and vegetation communities;
- To identify fauna and their habitats;
- Complete targeted surveys for threatened species, populations, ecological communities and critical habitat;

- Review survey findings in accordance with existing legislation; and

- Assess the potential impact of the proposed development in accordance with Section 5A of the *EP&A Act* 1979, *TSC Act* 1995 and *EPBC Act* 1999.

This study failed to identify species of threatened flora during past or the present field investigations. Two threatened fauna species were detected being the Grey-crowned Babbler (Vulnerable) and Eastern False Pipistrelle (Vulnerable). An assessment pursuant to Section 5A of the *EP&A Act 1979* found that there will be no significant impact on threatened species or their habitat either locally or for the Sydney Bioregion.

The majority of the proposed No. 1 Open Cut Extension is extensively altered from its natural state through past agricultural activity and current mining operations. Impacts associated with European occupation include land clearing, pasture improvement and the grazing of cattle. Scattered throughout this landscape are remnants of native vegetation including grassland and dry sclerophyll open woodland (HLA 1998). No critical habitat mapped under the *TSC Act 1995* was identified within the study area.

3.4.1 Flora Assessment

A total of 157 species were identified during the flora survey, which included 106 native and 51 exotic species. A detailed list of flora species identified within the proposed No. 1 Open Cut Extension is provided in **Appendix F**. The proposed No. 1 Open Cut Extension was categorised into five separate flora communities as described below. The locations of the flora communities are shown in **Figure 3.2**.

Rehabilitated Grasslands / Forest

The Rehabilitated Grasslands/Forest flora community has been established throughout the overburden emplacement areas to prevent erosion, improve scenic amenity and restore past land use. To a large extent, this flora community has been created through deliberate plantings of specific grass and tree species, which are capable of withstanding this environment. The Rehabilitated Grasslands/Forest flora community is a grassland - shrubland complex characterised by open expanses of grassland throughout isolated open to dense shrubs which grow to a maximum height of 10 m. This community is restricted to the eastern and western limits of the proposed No. 1 Open Cut Extension and has been artificially created through deliberate plantings and ongoing management. Grazing by the rabbit, feral goat and Eastern Grey Kangaroo is also evident.

Red Gum - Rough-barked Apple Open Forest

The Red Gum - Rough-barked Apple Open Forest flora community is restricted in its occurrence to an isolated remnant within the central western portion of the proposed No. 1 Open Cut Extension. It is characterised by a mixture of grasses and shrubs which grow to a maximum height of 3.5 m. Much of the tree canopy is even-aged suggesting past clearing activities, however regeneration is well advanced and may be resultant from natural rehabilitation. Approximately 3% of the ground's surface within this area is characterised by natural bush rock (sandstone-conglomerate).
Approximately 40% of this community was subject to disturbance including power line maintenance and grazing pressure from feral goats, rabbits and kangaroos.

Narrow-leaved Ironbark Woodland

The Narrow-leaved Ironbark Woodland is the most common flora community occurring throughout moderately flat to steeply sided slopes, within the central and western sections of the proposed No. 1 Open Cut Extension. This flora community has been allowed to persist and naturally regenerate. The Narrow-leaved Ironbark Woodland flora community is a eucalypt - grassland complex characterised by a sparse to open canopy of Narrow-leaved Ironbark, with a well-developed grass - herb understorey amid isolated dense shrub growths.

This community has experienced a range of human induced impacts including selective logging, clearing for agriculture, cattle grazing, subsidence, minor gully erosion and grazing by kangaroos and exotic species such as rabbits and feral goats.

Grassland

The Grassland flora community is representative of a regenerating agricultural landscape that has been excluded from intensive grazing for a number of years. The Grassland community is characterised by an open expanse of grasses and non-woody forbs. The area is void of any trees or shrubs. This community dominates the majority of the western and central portions of the proposed No. 1 Open Cut Extension. Natural regeneration within this community appears to be ongoing due to the absence of cattle grazing and other significant human related impacts. These impacts including selective logging, clearing for agriculture, cattle grazing, subsidence, minor gully erosion and small mammal grazing by kangaroo and exotic species including the rabbit and feral goat.

Aquatic Forbland

The Aquatic Forbland flora community is restricted to open water bodies such as dams and can vary substantially in structure and diversity. This flora community is characterised by either an emergent growth of Cumbungi or submerged growth of Blunt Pondweed, however neither species co-exist within the same environment. Minor salinity may be present within these water bodies, as evidenced by a high-water mark stained by an unknown white compound.

3.4.2 Fauna Assessment

Fauna surveys were conducted within each flora community identified in **Section 3.4.1**. The location where particular fauna survey techniques were employed is illustrated in **Figure 3.3**. These fauna studies found a total of 76 vertebrate fauna species during field investigations. A complete list of fauna species, identified within each flora community, is listed in **Appendix F**.

The most common taxonomic group found were avifauna species, of which 50 species were observed, including two exotic species. Other taxonomic groups observed within the proposed No. 1 Open Cut Extension include reptiles (total of 10 species), mammals (total of 13 species) and amphibians (total of three species).

Birds

Most of the avifauna observed within the proposed No. 1 Open Cut Extension was recorded from the Woodland flora communities. Ecological specialists, including ducks, grebes, herons and other waterfowl were mostly restricted to the aquatic habitats of the proposed No. 1 Open Cut Extension. Exceptions include the common Wood Duck, which was occasionally observed foraging around the Bimbadeen homestead and other suitable foraging grounds.

Nesting activity was evident within the woodlands of the proposed No. 1 Open Cut Extension, including species such as the Currawong, Grey Butcher Bird, Variegated Fairy Wren, White-winged Cough, Spur-winged Plover and Grey-crowned Babbler.

Noisy Friarbirds were observed in the Narrow-leaved Ironbark Woodland flora community. Large numbers of Eastern Rosellas were observed foraging in grasslands. Corellas and Sulphur-crested Cockatoos were also observed as dusk approached.

Mammals

A number of native mammals were observed within the proposed No. 1 Open Cut Extension including the Eastern Grey Kangaroo, Yellow-footed Antechinus, Common Dunnart, Brush-tailed Possum and Echidna. The Eastern Grey Kangaroo was considered to be the most abundant native mammal species and was frequently observed foraging in both the woodlands and grasslands of the proposed No. 1 Open Cut Extension.

Introduced Mammals

Introduced mammal fauna were also observed including the European Rabbit, Feral Goat, Feral Cat and European Fox. Grazing pressure and territory usage by the European Rabbit and Feral Goat have substantially affected selected areas throughout the western section of the proposed No. 1 Open Cut Extension including the Grassland and Woodland flora communities. Predation by the Feral Cat and European Fox was not quantitatively assessed within this study. However, it is considered that this ecological aspect is having a negative impact on the site's native and exotic faunal populations due to the relative low abundance of small to medium sized mammals.

Reptiles

The field survey identified the presence of a number of reptile species. The two most common reptile species encountered were *Egernia modesta* and *Egernia striolata*. Other reptiles observed include the Southern Rainbow Skink (*Carlia tetradactyla), Anomalous leuckartii,* Thick-tailed Gecko (*Underwoodisaurus milii)*, and the Robust Velvet Gecko (*Oedura robusta)*.

Amphibians

Target surveys for amphibians resulted in the identification of three species. The Dwarf Green Tree Frog, Green Tree Frog and Peron's Tree Frog were heard vocalising during humid, wet conditions.

3.4.3 Threatened Species, Populations and Ecological Communities

To assess the likelihood of threatened species of the proposed No. 1 Open Cut Extension, several habitat assessments were undertaken. The *Wildlife Atlas* database (NPWS, 2001), was consulted to acquire any potential occurrence of threatened flora in a 10 km radius of the locality. This method resulted in the identification of 2 threatened flora species and 14 fauna species requiring further investigation to assess whether a section 5A assessment (eight part test) is required. These threatened species are listed in **Table 3.2**.

Eight part tests were conducted for vulnerable species where indicated in **Table 3.2**. An eight part test considers a number of factors to determine if a proposed development will have a significant effect upon the environment of threatened fauna and flora. The results of the eight part tests are detailed in **Appendix F** and any impact on flora and fauna are outlined in **Section 6.2**.

TABLE 3.2
THREATENED SPECIES SUMMARY AND ASSESSMENT REQUIREMENTS
MCC

Species	Conservation Status		Is a Section 5A Assessment Required? (Eight Part-Test)
	TSC Act 1995	*EPBC Act 1999*	
Flora			
Bothriochloa biloba	Vulnerable	Vulnerable	Yes
Olearia cordata	Vulnerable	Vulnerable	No
Fauna			
Green and Golden Bell Frog	Endangered	Vulnerable	Yes
Freckled Duck	Vulnerable	Migratory	No
Square-tailed Kite	Vulnerable	Migratory	Yes
Regent Honeyeater	Endangered	Endangered	No
Grey-crowned Babbler	Vulnerable	-	Yes
Spotted-tailed Quoll	Vulnerable	Vulnerable	Yes
Koala	Vulnerable	-	No
Large-eared Pied Bat	Vulnerable	-	Yes
Eastern False Pipistrelle	Vulnerable	-	Yes
Eastern Little Mastiff Bat	Vulnerable	-	Yes
Little Bent-wing Bat	Vulnerable	-	Yes
Common Bent-wing Bat	Vulnerable	-	Yes
Large-footed Myotis	Vulnerable	-	Yes
Greater Broad-nosed Bat	Vulnerable	-	Yes

3.4.4 SEPP 44 – Koala Habitat Protection

The proposed No. 1 Open Cut Extension was assessed for koala activity and habitat during the fauna survey. No evidence of recent koala activity within close proximity to the proposed No. 1 Open Cut Extension was evident. Given that the evidence collected during the field and desktop survey clearly indicate that there are no current koala populations utilising the proposed No. 1 Open Cut Extension as foraging or core habitat, it is considered that there are no requirements of MCC to provide a koala management plan.

3.5 Weed Control

Weeds are controlled regularly by spraying and by resowing bare areas with pasture. Typical problem weeds on site are Galenia and Castor Oil Bush. A Weed Management Plan has been prepared for the lease areas, which has identified problem areas, species and infestation, and has recommended an action plan to control weeds. Weed control measures are undertaken and reported on an annual basis in the *Annual Environmental Management Report (AEMR)*.

3.6 Feral Animal Control

Monitoring of feral animals and baiting programs are conducted to control wild dogs and foxes. During 2000, a baiting program was undertaken and was considered to be successful. Another baiting program is planned for 2002.

3.7 Fire Management

A fire and emergency system has been developed by MCC for fire prevention, control and general emergency procedures. MCC have appointed a fire officer competent in coordination of fire fighting and equipment maintenance. The main offices and workshop are connected by fire alarm to the Muswellbrook Rural Fire Brigade (RFB) depot. MCC maintains a Caterpillar 777 water cart with a 70 kL water tank fitted out with fire fighting capabilities. The mine site conducts at least two fire simulation sessions on site each year in conjunction with the NSW RFB.

3.8 Soils

RJ Connolly Environmental Management Consulting Pty Ltd conducted a Soil Assessment for the proposed No. 1 Open Cut Extension. This study encompassed soils, land capability and agricultural suitability and is included in **Appendix G**.

3.8.1 Soil Landscapes

The soils in the locality have been mapped by the NSW Soil Conservation Service and appear in the Soil Landscapes of the Singleton 1:250,000 Sheet (Kovac and Lawrie, 1991). Ron Connolly Environmental Management Consulting Pty Ltd used this sheet as a basis for field investigations and refinement of the soil landscape boundaries. The results of this survey are reported in **Appendix G**.

The proposal area was mapped as the Roxburgh Soil Landscape in Soil Landscapes of the Singleton 1:250,000 Sheet. The low and undulating hills, consisting of the Greta Coal Measures sediments display various degrees of weathering of the sandstones, shales, mudstones and conglomerates. The soils derived from this parent material are typically yellow duplex soils.

3.8.2 Soil Descriptions

Soil profiles were assessed in the field using various excavations as well as observations of exposed soil profiles in gully walls. Observation methods were generally as described in the Australian Soil and Land Survey Field Handbook (McDonald et al, 1998).

Soil testing was carried out by the Scone Research Service Centre, which is operated by the DLWC.

The occurrence and distribution of major soil types within the proposed No. 1 Open Cut Extension are shown in **Figure 3.4**. The following is a brief description of each of the main soil classes identified:

Yellow Duplex Soils with mottled subsoil (Dy3.41, Dy2.41)

These soils generally occur in the drainage lines with fine sandy loam topsoils. The topsoil is organically enriched and darker with an average depth of approximately 5 cm. Soils are weakly structured with sandy fabric and have a pH 5.0 - 5.5. An A2 horizon is generally present up to 25 - 30 cm deep and is likely to be conspicuously bleached. B-horizons have typically a medium clay texture with medium structure and ped size to 50 mm with rough ped fabric. The pH range was 5.0 - 5.5 with an acid soil reaction trend. The depth to weathered rock was to 400 cm in the deep gully.

Yellow Duplex Soils, whole coloured subsoils (Dy 2.41)

Yellow Duplex Soils with whole coloured subsoils (solods) occur on the sideslopes where gradients are generally less than 10 %. The A1-horizons are darker coloured and about 5 cm in depth and overlie thick, bleached A2-horizons. The topsoil is typically fine sandy loam texture, weakly structured, with pH 5.5. The B-horizons have medium clay subsoils that are yellow in colour, with medium structure and very firm consistence. The subsoil remains brightly coloured to at least 50 cm with a pH 6.0.

Brown subsoils on the ridgelines (Dy3.41)

Brown duplex soils occur along the ridgelines, especially north of Coal Road. To the south resistant conglomerate subcrops occur giving rise to patches of skeletal soils. The topsoil consists of a thin A1-horizon 0-5 cm depth, with weak structure and pH 5.5. The A2-horizon is 15 cm in thickness, and conspicuously bleached. The B-horizon is whole coloured to depths below 50 cm, with pH 6.0.

Mining Areas

Mining areas are those areas where open cut operations have resulted in excavation of overburden material and placement in emplacement areas. These areas may have been subsequently revegetated and have had some topsoil material spread before being revegetated. Some of the area to be disturbed in the current proposal consists of mining areas that have not been rehabilitated but rather form part of currently used infrastructure. This includes haul roads and hardstands around the workshop and stockpiles.

3.8.3 Land Capability

The DLWC has developed a system of agricultural capability classification based on environmental factors, which may limit the use of land (Emery, 1985b). These factors include widespread influences such as climate, land slope, landform and local soil limitations such as soil depth, erodibility, water holding capacity, rockiness, salinity, and the degree of existing erosion. One or a number of the factors in combination may restrict land use and limit land capability.

Based on assessment of these limiting factors, land is classified into eight classes, with the restriction on use, or the likelihood of erosion damage increasing from Class I to Class VIII, as shown in **Table 3.3**.

TABLE 3.3
RURAL LAND CAPABILITY

Land Class	*Land Suitability*	*Land Definition*
Class I	Regular cultivation	No erosion control requirements
Class II	Regular cultivation	Simple requirements such as crop rotation, minor strategic works
Class III	Regular cultivation	Intensive soil conservation measures required such as banks and waterways
Class IV	Grazing, occasional cultivation	Simple practices such as stock control, fertilizer application
Class V	Grazing, occasional cultivation	Intensive soil conservation measures required such as banks, contour ripping
Class VI	Grazing only	Managed to ensure ground cover is maintained
Class VII	Unsuitable for rural production	Green timber maintained to control erosion
Class VIII	Unsuitable for rural production	Should not be cleared, logged or grazed

Land capability has been mapped at a scale of 1:100,000 by the Soil Conservation Service of NSW. At this scale the proposed No. 1 Open Cut Extension is shown as Class V Land, suited to grazing, but requiring intensive soil conservation works to maintain stability.

However, when assessed with detailed topographical and soils information, a more refined pattern can be described, and is shown in **Figure 3.5**. The Class V lands are those where the Yellow Duplex soils are formed in situ from the sedimentary sequence of the Greta Coal Measures with generally good cover of native grasses. Steeper sideslopes and the drainage lines have been grouped as Class VI Land. These areas have poorer cover and active sheet and gully erosion, necessitating only judicious grazing. Class IV Lands are those with moderate slope. There is good ground cover and occasional rocky outcrop making these areas suitable for grazing without constraints other than satisfactory management. The mining areas formed of overburden materials are variously vegetated ranging from rehabilitated land to hardstand and stockpile areas. There lands have been designated as Mining Area, currently removed from agricultural production.

3.8.4 Agricultural Suitability

Agriculture NSW has an alternative system of classification of lands according to five classes of agricultural suitability and shown in **Table 3.4**.

TABLE 3.4
AGRICULTURAL SUITABILITY CLASSIFICATIONS

Class	*Description*
Class 1	Arable land suitable for intensive cultivation where constraints to sustained high levels of agricultural production are minor or absent.
Class 2	Arable land suitable for regular cultivation for crops but not suited to continuous cultivation. It has a moderate to high suitability for agriculture but edaphic (soil factors) or environmental constraints reduce the overall level of production and may reduce the cropping phase to a rotation with sown pastures.
Class 3	Grazing land or land well suited to pasture improvement. It may be cultivated or cropped in rotation with pasture. The overall production level is moderate because of edaphic or environmental constraints. Erosion hazard, soil structural breakdown or other factors including climate may limit the capacity for cultivation and soil conservation or drainage works may be required.
Class 4	Land suitable for grazing but not cultivation. Agriculture is based on native pastures or improved pastures based on minimum tillage techniques. Production may be seasonally high but the overall production level is low as a result of major environmental constraints.
Class 5	Land unsuitable for agriculture or at best only to light grazing. Agricultural production is low or zero as a result of severe constraints, including economic factors, which preclude land improvement.

Figure 3.6 shows agricultural suitability of lands of the study area. The land is largely Class 4 land suitable for grazing, but not cultivation. Constraints include slope, soil structure, rockiness, and the degree of existing erosion. The mining areas comprise the Class 5 land unsuitable for agriculture.

3.8.5 Erosion Status

An erosion survey was conducted of all the Hunter River Catchments in "*Hunter River Catchment Soil Erosion*" (Emery, 1985). The 1:100,000 Sheet Soil Conservation Service (18293/6) generally shows the No. 1 Open Cut Extension proposal area affected by moderate to severe sheet erosion. Grass cover has improved since the early eighties because of reduced grazing pressure. The deep north south trending drainage lines are classified as area of very severe gully erosion approximately 1.5 to 3.0 m deep.

3.9 Spontaneous Combustion

Spontaneous combustion can occur in the Greta Coal Measures, which are mined by MCC. Spontaneous combustion refers to the ability for coal and other carbonaceous materials to heat up through a natural process called oxidation. Once heating has started, and if not controlled, the material may continue to increase in temperature until the carbonaceous material starts to burn. For spontaneous combustion to continue there must be a continuing supply of oxygen (from the atmosphere) and fuel (in the form of carbonaceous material). Spontaneous combustion can occur in exposed coal and shale seams in open cut and underground mines, in stockpiles of product coal and even in overburden or spoil that has been rehabilitated. MCC have developed a spontaneous combustion management plan for the prevention of spontaneous combustion. The issues associated with the management of spontaneous combustion are outlined in **Sections 5.4.3** and **5.5.3**.

Control of spontaneous combustion is based on exclusion of oxygen from coal or carbonaceous material. This can be achieved by utilisation of inert materials (especially clays) to cap coal or carbonaceous material or by removing the coal.

MCC has successfully controlled spontaneous combustion in spoil piles. The No. 1 Open Cut spoil piles were capped with several metres of compacted inert material. MCC has portions of former underground workings affected by subsidence "potholes" and also subject to spontaneous combustion. Air has gained access to these workings by subsidence "potholes", leakage around mine entry seals and the porous nature of geological strata overlying the coal seams. The potholes form when the ground above a section of underground workings collapses. This usually occurs following rainfall events. The collapsed ground creates a hole down to the underground working and allows air to access the coal prone to spontaneous combustion. Several attempts have been made to infill and seal potholes. However, ground fracturing, settlement and the development of new potholes have prevented MCC from achieving complete control of spontaneous combustion. Ongoing monitoring and treatment of areas of spontaneous combustion would involve an open-ended commitment to management of the problem. The preferred method of controlling spontaneous combustion is to remove the coal by mining.

3.10 Acoustic Environment

HLA-Envirosciences Pty Limited conducted a Noise and Vibration Assessment for the proposed No. 1 Open Cut Extension in accordance with the EPA's NSW industrial Noise Policy 2002 (INP). The following section provides a summary of the existing noise conditions at MCC. The complete Noise and Vibration Assessment is included in **Appendix H**.

3.10.1 Meteorological Influences

The atmospheric conditions most relevant to noise assessments are temperature inversions, gentle winds (indicative of possible wind shear) and relative humidity. From long-term weather monitoring data, the existing environment at this location is well classified. Meteorological data is discussed in detail in **Section 3.3**.

The following data is most significant with respect to noise propagation:

- Extremes of relative humidity (RH) are rarely experienced. For modelling purposes, a value of 70% RH was adopted;
- Mild temperature inversions are likely to occur on greater than 25% of mornings and evenings in winter. The EPA default value of +3^{o}C/100m vertical temperature gradient was adopted in the noise model; and
- Winds are predominantly south easterly in summer and north westerly in winter. A wind speed of 3m/s was modelled to determine the noise impact under 'prevailing' conditions.

3.10.2 Ambient Noise levels

Ambient noise monitoring was conducted at five representative residential locations between 11 December 2001 and 18 February 2002. Noise levels were continuously monitored at 15-minute statistical intervals using Acoustic Research Laboratories EL-215 environmental noise loggers in accordance with relevant EPA guidelines and Australian Standard 1055-1997 "*Acoustics - Description and measurement of environmental noise*". Residential locations considered in this assessment are shown in **Figure 3.7** and described in **Table 3.5**. Measurement locations are indicated as *N1* to *N5*. Please not that residences were selected as being representative of the surrounding community and are not a comprehensive listing of all residents. Note that R11 is currently non-residential and R19 is owned by MCC. These locations have not been considered in the assessment of noise and vibration impacts.

TABLE 3.5 NOISE RECEIVER LOCATIONS MUSWELLBROOK	
Location	Ownership / Description
R1	K. Watts
R2	J. French
R3	Reg J. Watts
R4	Reynolds
R5	McKean
R6	V. M. French
R7 (*N1*)	R. G. & G. A. Watts
R8	Aird
R9	Neilsen
R10	R. G. & G. A. Watts
R11	St Heliers Correctional Facility
R12	J. Madden
R13	McMaster
R14	F. Madden
R15 (*N2*)	Collins
R16 (*N3*)	Tuckey
R17 (*N4*)	Colvin
R18	Shephard
R19	Lower Gyarran Cottage (owned by MCC)
R20 (*N5*)	Gordon
R21	Ardee Holdings P/L
R22	M. Bowman
R23	N. Bowman

Table 3.6 presents a summary of the background noise monitoring results (LA_{90} Assessment Background Levels (ABL) and existing LA_{eq}) recorded at the monitoring locations in **Table 3.5**. All values recorded are in decibels with an "A" weighting, dB(A), unless otherwise stated. Shaded cells represent spuriously high noise levels with no obvious explanation. These data have not been included in the totals to allow for the setting of conservatively low noise goals. The Rating Background Level (RBL) is the median of the daily ABL's in each assessment period (day/evening/night), over all valid days in the monitoring period. The existing LA_{eq} in each assessment period (day/evening/night) is the logarithmic average of data measured during the relevant period, defined as follows:

Day:	7* a.m. – 6 p.m.	(*8 a.m. on Sundays and Public Holidays)
Evening:	6 p.m. – 10 p.m.	
Night:	10 p.m. – 7* a.m.	(*8 a.m. on Sundays and Public Holidays)

TABLE 3.6
MEASURED AMBIENT NOISE LEVELS – DECEMBER 2001 TO FEBRUARY 2002

Watts Residence (*N1*)						
Date	Leq(day)	Leq(eve)	Leq(night)	L90(day)	L90(eve)	L90(night)
11-Dec-01	56.2	52.7	46.7	35.4	34.5	32.5
12-Dec-01	52.9	56.7	42.6	35.0	35.5	34.5
13-Dec-01	43.4	42.5	43.3	30.7	32.8	34.0
14-Dec-01	53.6	47.4	46.8	31.2	33.8	32.0
15-Dec-01	45.4	44.4	39.4	31.5	31.3	31.8
16-Dec-01	49.6	50.4	45.6	31.2	33.5	32.0
17-Dec-01	55.2	50.9	46.4	33.0	36.0	32.8
Log Average	**53**	**52**	**45**	**--**	**--**	**--**
Median (RBL)	**--**	**--**	**--**	**32**	**34**	**33**
Collins Residence (*N2*)						
Date	Leq(day)	Leq(eve)	Leq(night)	L90(day)	L90(eve)	L90(night)
11-Dec-01	47.0	48.5	41.3	36.8	38.8	30.5
12-Dec-01	49.6	57.2	43.4	33.5	31.8	29.0
13-Dec-01	54.0	52.9	44.7	31.0	33.3	30.0
14-Dec-01	58.9	55.1	47.9	30.2	45.8	33.0
15-Dec-01	53.0	57.4	52.0	30.5	48.3	29.8
16-Dec-01	47.1	51.7	45.1	31.7	35.3	30.3
17-Dec-01	48.0	51.6	44.9	31.5	36.5	31.3
Log Average	**51**	**54**	**45**	**--**	**--**	**--**
Median (RBL)	**--**	**--**	**--**	**31**	**35**	**30**
Tuckey Residence (*N3*)*						
Date	Leq(day)	Leq(eve)	Leq(night)	L90(day)	L90(eve)	L90(night)
13-Feb-02	44.5	51.6	39.7	33.0	38.0	28.0
14-Feb-02	40.9	47.7	42.4	31.0	36.5	28.5
15-Feb-02	46.9	50.1	39.4	31.0	35.3	28.3
16-Feb-02	49.1	42.4	54.9	32.5	35.5	33.8
17-Feb-02	50.1	49.3	55.1	32.7	37.3	30.5
Log Average	**47**	**49**	**51**	**--**	**--**	**--**
Median (RBL)	**--**	**--**	**--**	**32**	**37**	**29**

TABLE 3.6 MEASURED AMBIENT NOISE LEVELS – DECEMBER 2001 TO FEBRUARY 2002						
Colvin Residence (*N4*)						
Date	Leq(day)	Leq(eve)	Leq(night)	L90(day)	L90(eve)	L90(night)
11-Dec-01	50.1	52.6	46.4	37.5	41.0	35.0
12-Dec-01	44.8	48.2	45.5	36.2	39.5	37.0
13-Dec-01	56.7	64.8	58.7	37.0	41.8	37.0
14-Dec-01	47.7	54.8	46.1	35.7	38.5	35.0
15-Dec-01	47.2	52.1	45.7	34.5	38.8	35.3
16-Dec-01	47.6	49.8	47.4	37.5	38.0	38.0
17-Dec-01	50.1	48.8	45.9	36.0	41.8	38.8
Log Average	**48**	**52**	**46**	**--**	**--**	**--**
Median (RBL)	**--**	**--**	**--**	**36**	**40**	**37**
Gordon Residence (*N5*)						
Date	Leq(day)	Leq(eve)	Leq(night)	L90(day)	L90(eve)	L90(night)
13-Feb-02	55.7	55.9	54.1	42.5	32.5	31.8
14-Feb-02	56.3	57.5	54.7	39.5	33.8	31.0
15-Feb-02	55.7	55.5	53.2	36.7	33.3	32.5
16-Feb-02	55.2	55.2	53.6	37.2	33.8	33.5
17-Feb-02	54.6	51.8	49.4	41.5	31.3	30.5
18-Feb-02	53.1	49.7	50.2	38.5	36.8	36.5
19-Feb-02	55.5	52.6	50.5	43.5	39.0	37.5
Log Average	**55**	**55**	**53**	**--**	**--**	**--**
Median (RBL)	**--**	**--**	**--**	**40**	**33**	**32**

*No data were recorded for 18 and 19 February at the Tuckey residence (*N3*) due to a flat logger battery, so there are only 5 days of data instead of the 7 days normally required under the INP. However, with the night-time noise goal being the governing criterion, the measured background noise level of 29 dB(A) will result in the lowest noise goal that can be derived with the INP and the acquisition of additional data is not considered necessary.

The background levels at R15 (Collins) will be adopted for R17 (Colvin) for the purposes of setting noise criteria. The background noise levels at R17 (Colvin) towards the southern end of Queen Street were significantly higher than those at the northern end of Queen Street at R15 (Collins) and R16 (Tuckey). In the absence of a clear explanation for this difference in background noise levels the lower background noise levels were assigned to the entire length of Queen Street.

Section 3.1.2 of the INP states that an RBL of 30 dB(A) is adopted wherever the measured level is less than 30 dB(A). This adjustment applies only to the night-time RBL at residence R16 (Tuckey).

3.10.3 Noise And Vibration Criteria

Operational Noise Goals

The INP specifies two noise criteria: an *intrusiveness criterion* which limits Leq noise levels from the industrial source to a value of 'background plus 5 dB' and an *amenity criterion* which aims to protect against excessive noise levels where an area is becoming increasingly developed. EPA acceptable industrial noise levels (ANL, as presented in Table 2.1 of the INP) are summarised in **Table 3.7** below. These values, and the measured existing industrial noise levels, are used to establish the amenity criteria by applying modifications to the ANL's. The modifications are shown in **Table 3.8** (reproduced from Table 2.2 of the INP).

TABLE 3.7
EPA RECOMMENDED Leq NOISE LEVELS FROM INDUSTRIAL SOURCES

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended Leq Noise Level, dB(A)	
			Acceptable (ANL)	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
Residence	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
Residence	Urban	Day	60	65
		Evening	50	55
		Night	45	50

Section 2.2.1 of the INP contains guidelines for the selection of noise amenity categories for various land use zones. When considering the proximity of built-up areas and roads, residences 14-17 are in a "suburban" noise amenity area, while the remaining residences are categorised as "rural".

TABLE 3.8 MODIFICATIONS TO ACCOUNT FOR EXISTING INDUSTRIAL NOISE LEVEL	
Total existing Leq noise level from industrial sources, dB(A)	Maximum Leq noise level for noise from new sources alone, dB(A)
≥ ANL +2	If existing noise level is *likely to decrease* in the future: ANL – 10 If existing noise level is *unlikely to decrease* in the future: Existing level – 10
ANL + 1	ANL - 8
ANL	ANL - 8
ANL - 1	ANL - 6
ANL - 2	ANL - 4
ANL - 3	ANL - 3
ANL - 4	ANL - 2
ANL - 5	ANL - 2
ANL - 6	ANL - 1
< ANL - 6	ANL

Operational noise goals calculated in accordance with the INP are shown in **Table 3.9**. Due to the general absence of significant industrial noise at the receiver locations, existing industrial noise levels will be at least 6 dB(A) below the relevant ANL's and the amenity criteria will be equal to the ANL.

TABLE 3.9 EPA CRITERIA FOR OPERATIONAL NOISE LEVELS				
Location	Criterion	Day	Evening	Night
R1	Intrusiveness – dB(A),Leq(15 min)	37	39	38
	Amenity – dB(A),Leq(period)	50	45	40
	Project Specific Noise Goal	**37**	**39**	**38**
R2	Intrusiveness – dB(A),Leq(15 min)	37	39	38
	Amenity – dB(A),Leq(period)	50	45	40
	Project Specific Noise Goal	**37**	**39**	**38**
R3	Intrusiveness – dB(A),Leq(15 min)	37	39	38
	Amenity – dB(A),Leq(period)	50	45	40
	Project Specific Noise Goal	**37**	**39**	**38**
R4	Intrusiveness – dB(A),Leq(15 min)	37	39	38
	Amenity – dB(A),Leq(period)	50	45	40
	Project Specific Noise Goal	**37**	**39**	**38**
R5	Intrusiveness – dB(A),Leq(15 min)	37	39	38
	Amenity – dB(A),Leq(period)	50	45	40
	Project Specific Noise Goal	**37**	**39**	**38**

TABLE 3.9
EPA CRITERIA FOR OPERATIONAL NOISE LEVELS

Location	Criterion	Day	Evening	Night
R6	Intrusiveness – dB(A),Leq(15 min)	37	39	38
	Amenity – dB(A),Leq(period)	50	45	40
	Project Specific Noise Goal	**37**	**39**	**38**
R7 (*N1*)	Intrusiveness – dB(A),Leq(15 min)	37	39	38
	Amenity – dB(A),Leq(period)	50	45	40
	Project Specific Noise Goal	**37**	**39**	**38**
R8	Intrusiveness – dB(A),Leq(15 min)	37	39	38
	Amenity – dB(A),Leq(period)	50	45	40
	Project Specific Noise Goal	**37**	**39**	**38**
R9	Intrusiveness – dB(A),Leq(15 min)	37	39	38
	Amenity – dB(A),Leq(period)	50	45	40
	Project Specific Noise Goal	**37**	**39**	**38**
R10	Intrusiveness – dB(A),Leq(15 min)	37	39	38
	Amenity – dB(A),Leq(period)	50	45	40
	Project Specific Noise Goal	**37**	**39**	**38**
R11	Intrusiveness - dB(A),Leq(15 min)	37	39	38
	Amenity - dB(A),Leq(period)	50	45	40
	Project Specific Noise Goal	**37**	**39**	**38**
R12	Intrusiveness - dB(A),Leq(15 min)	37	39	38
	Amenity - dB(A),Leq(period)	50	45	40
	Project Specific Noise Goal	**37**	**39**	**38**
R13	Intrusiveness - dB(A),Leq(15 min)	37	39	38
	Amenity - dB(A),Leq(period)	50	45	40
	Project Specific Noise Goal	**37**	**39**	**38**
R14	Intrusiveness - dB(A),Leq(15 min)	42	40	40
	Amenity - dB(A),Leq(period)	55	45	40
	Project Specific Noise Goal	**42**	**40**	**40**
R15 (N2)	Intrusiveness - dB(A),Leq(15 min)	37	42	35
	Amenity - dB(A),Leq(period)	55	45	40
	Project Specific Noise Goal	**37**	**42**	**35**
R16 (N3)	Intrusiveness - dB(A),Leq(15 min)	37	42	35
	Amenity - dB(A),Leq(period)	55	45	40
	Project Specific Noise Goal	**37**	**42**	**35**
R17 (N4)	Intrusiveness - dB(A),Leq(15 min)	37	42	35
	Amenity - dB(A),Leq(period)	55	45	40
	Project Specific Noise Goal	**37**	**42**	**35**

TABLE 3.9 EPA CRITERIA FOR OPERATIONAL NOISE LEVELS				
Location	Criterion	Day	Evening	Night
R18	Intrusiveness - dB(A),Leq(15 min)	45	38	37
	Amenity - dB(A),Leq(period)	50	45	40
	Project Specific Noise Goal	**45**	**38**	**37**
R19	Intrusiveness - dB(A),Leq(15 min)	45	38	37
	Amenity - dB(A),Leq(period)	50	45	40
	Project Specific Noise Goal	**45**	**38**	**37**
R20 (N5)	Intrusiveness - dB(A),Leq(15 min)	45	38	37
	Amenity - dB(A),Leq(period)	50	45	40
	Project Specific Noise Goal	**45**	**38**	**37**
R21	Intrusiveness - dB(A),Leq(15 min)	45	38	37
	Amenity - dB(A),Leq(period)	50	45	40
	Project Specific Noise Goal	**45**	**38**	**37**
R22	Intrusiveness - dB(A),Leq(15 min)	45	38	37
	Amenity - dB(A),Leq(period)	50	45	40
	Project Specific Noise Goal	**45**	**38**	**37**
R23	Intrusiveness - dB(A),Leq(15 min)	45	38	37
	Amenity - dB(A),Leq(period)	50	45	40
	Project Specific Noise Goal	**45**	**38**	**37**

The above noise goals are to be satisfied during prevailing conditions of winds and mild temperature inversions. Chapter 4 of the INP also lists several "modifying factor" adjustments to be added to predicted (or measured) noise levels if the noise contains annoyance characteristics such as tones and low frequency content, or if the noise is intermittent in nature.

Sleep Arousal

To help protect against people waking from their sleep, the EPA recommends that 1-minute L1 noise levels (effectively, the Lmax noise level from impacts, etc) should not exceed the background level by more than 15dB(A). The sleep arousal criterion at each receiver location is equal to the intrusiveness criteria presented in **Table 3.9** plus 10dB(A), and applies to Lmax noise emissions.

Road Traffic Noise

Additional road traffic generated by the proposal, and travelling on public roads, has the potential to increase traffic noise levels at residences along the affected road. Base traffic noise goals given in the EPA *Environmental Criteria for Road Traffic Noise* (ECRTN) are 55 dB(A),Leq(day) and 50 dB(A),Leq(night).

Measured noise levels near the Gordon residence (*N5*, see **Table 3.6**) were 55 dB(A) and 53 dB(A) for day and night, respectively. The logger was placed approximately 3 m from the edge of Muscle Creek Road, which is utilised as part of the MCC coal haul route. Trucking was observed to be active during deployment and retrieval of the logger and, due to the relative consistency of the Leq noise levels, is likely to have been the source of Leq levels during the monitoring period.

The day and night ECRTN criteria will therefore be met at 3 m and 6 m from the road, respectively, based on the same number of truck movements. Even considering an unrealistic case in which truck movements double as a result of the proposed No. 1 Open Cut Extension, the night-time traffic noise criterion will be met at all residences more than 12 m from the haul route. All residences are further from the road than this, so no further assessment of road traffic noise associated with the proposed No. 1 Open Cut Extension is considered necessary.

Blasting – Annoyance Criteria

Noise and vibration levels from blasting are assessable against criteria proposed by the Australian and New Zealand Environment and Conservation Council (ANZECC) in their publication *"Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration – September 1990"*. These criteria are summarised as follows:

- The recommended maximum overpressure level for blasting is 115 dB;
- The level of 115 dB may be exceeded for up to 5% of the total number of blasts over a 12-month period, but should not exceed 120 dB at any time;
- The recommended maximum Peak Particle Velocity (PPV) for blasting is 5 mm/s;
- The PPV level of 5 mm/s may be exceeded for up to 5% of the total number of blasts over a 12-month period, but should not exceed 10 mm/s at any time;

Blasting – Building Damage Criteria

Building damage assessment criteria are nominated in AS 2187.2-1993 *"Explosives – Storage, Transport and Use. Part 2: Use of Explosives"* and summarised in **Table 3.10**.

TABLE 3.10
BLASTING CRITERIA TO LIMIT DAMAGE TO BUILDINGS (AS 2187)

Building Type	Vibration Level (mm/s)	Airblast Level (dB re 20 μPa)
Sensitive (and Heritage)	5	133
Residential	10	133
Commercial/Industrial	25	133

The annoyance (ANZECC) criteria are more stringent than the building damage criteria (**Table 3.10**) and will be taken as the governing criteria.

3.11 Roads and Traffic

TPK & Associates Pty Ltd (TPK) were commissioned by HLA-Envirosciences Pty Limited to undertake a review of the Traffic Impact Assessment (TIA) by Hallam & Associates contained in the *Sandy Creek Colliery EIS (1998)*. This review assessed the status of the TIA relative to present and proposed operating conditions at MCC's No. 1 and No. 2 Open Cut Mines. The review and TIA are included in **Appendix L**. TPK concluded that the Sandy Creek Colliery TIA is appropriate to include as relevant documentation for the consideration of the No. 1 Open Cut Extension proposal. TPK also concluded that a new detailed traffic analysis at this time would only utilise the identical intersection layouts and lower traffic flows for modelling.

3.11.1 Road Network

Coal trucks are loaded at the mine and travel on the private Coal Haul Road to the junction with Muscle Creek Road. Trucks travel along Muscle Creek Road to the New England Highway. At this intersection the road widens and has a left turn slip lane for the movement on the highway southbound. The New England Highway has a left turn deceleration and turning lane into Muscle Creek Road and a sheltered right turn lane and a separate northbound lane. The speed limit on both roads is 100 km/h. The sight distance for traffic in Muscle Creek Road to traffic on the New England Highway is good. These roads are described as having a high level of service.

In the vicinity of Bayswater and Liddell Power Stations the highway widens out and has "high standard grade" separate access ramps for movement to and from these power stations.

Access to the Ravensworth Coal Terminal (RCT) via Pikes Gully Road intersection with the New England Highway has appropriate channelisation for heavy vehicle activity.

3.11.2 Traffic Flows

The NSW RTA monitor traffic flow on most major road networks. A permanent counting station exists on the New England Highway to the south of Muswellbrook and **Table 3.11** shows Annual Average Daily Total (AADT) two way vehicle trip data. **Table 3.11** illustrates this station has been relative stable in terms of traffic volumes.

TABLE 3.11
AADT FOR RTA STATION 05.244
SOUTH OF MUSWELLBROOK

Year	1992	1995	1998	1999	2000
AADT	10707	10255	10114	10311	9948

3.11.3 Muswellbrook New England Highway Bypass

In a route selection study by Maunsell McIntyre Pty Ltd (2000) three options were preferred for a proposed Muswellbrook bypass for the New England Highway. Two of these options intersect MCC property and traverse land known to be subject to potholing. This study summarised that the preferred route, from MCC's perspective and for mine subsidence and economic reasons, would be one that would avoid both pothole zones and all critical undermined areas.

As a result of this latest process, one route will be chosen for a full environmental assessment. If no environmental, cultural or heritage impediment exists to a New England Highway bypass along this route, it will become the preferred option. Public consultation is a key element of the bypass study. Information provided by the RTA at the Planning Focus Meeting for the No. 1 Open Cut Extension proposal was that, in the light of the No. 1 Open Cut Extension proposal, the options available for the By-pass would be re-examined.

The proposed by-pass is totally dependant upon Federal roads funding. $100,000 has been allocated for the 2002/2003 financial year in the Federal budget. These funds will be utilised to produce a Route Investigation Report for a preferred by-pass road alignment which should be available by the end of 2002. This report, once drafted, will be submitted to the Federal Department of Transport and Regional Services for acceptance and approval before going on public display and seeking public comment. The routes that the RTA are currently examining do not impact upon the No. 1 Open Cut Extension proposal.

3.12 Visual and Night Lighting

3.12.1 Visual Aspects

The general landscape around Muswellbrook is dominated by several features which can be classified as Natural, Farming/Agricultural, Mining/Industrial and the Muswellbrook township. The following provides a brief description of these landscapes.

Natural landscape

The natural landscape of the Upper Hunter Valley can be attributed to ancient fluvial action of the Hunter River. This action has resulted in several topographical features evident in the present landscape. These include: flood plains; undulating foothills; and plateaus. A majority of the natural landscape has been subject to human disturbance. Remnant natural vegetation persists in some areas of the Upper Hunter Valley.

Farming/Agricultural Landscape

Farming and Agricultural activities dominate the Upper Hunter Valley landscape. The farming landscape is characterised by cleared paddocks and fields, fencing and stockyards and sheds.

Mining/Industrial Landscape

Open cut coal mining has been operating in the Upper Hunter Valley since the 1940s and has significantly changed the visual environment. The mining and industrial landscape is characterised by open cut voids, rehabilitated mining areas, stockpiles, spoil piles, mining equipment, coal conveyors, rail lines, power stations, and cooling towers. This infrastructure is clearly evident when travelling from Newcastle along the New England Highway to Muswellbrook.

Urban infrastructure

Muswellbrook is the major town in the Upper Hunter and visually consists of low rise urban housing development surrounding a main street commercial and service centre.

Visual Assessment

MCC's operations are located approximately 1.6 km away from the nearest non-company owned residence at Queen Street in Muswellbrook. MCC land has an elevation of approximately 240 m to 260 m. Several locations were visited to assess the existing visual impact of MCC operations. Most of these locations have elevation ranging from 180 m to 220 m.

The view from Queen St towards MCC's operations is impeded by vegetation and topography. **Figure 3.8** illustrates the nearest residents of Queen Street are unable to view current mining operations at MCC.

The visual environment was also assessed from the public road network. Distant views of MCC's operations are visible from the New England Highway. Views from both north and south of Muswellbrook are illustrated in **Figure 3.9** and **Figure 3.10**.

MCC's mining operations are mostly conducted within open cut pits and due to the elevation of surrounding landforms, in-pit operations areas are not visible. MCC's visible infrastructure consists of office buildings, workshops, stockpiles and transport vehicles. This infrastructure is generally not visible from public vantage points. Distant views from McCullys Gap Road of rehabilitated spoil piles are illustrated in **Figure 3.11**.

The main visible features of MCC's operations are the outer faces of rehabilitated spoil piles. These features are visible to the general public from various locations along roads such as the New England Highway, Kayuga Road, McCullys Gap Road and Muscle Creek Road. MCC owns most of the freehold land surrounding its mining operations.

3.12.2 Existing Nightscape

The existing nightscape is one which is influenced by the existing mining and power generation industries and the urban area of Muswellbrook. Traffic on the New England Highway, dependant upon volume, also contributes to the night glow of the area.

3.13 Surface Water Hydrology

HLA-Envirosciences Pty Limited completed a Water Management Study for the proposed No. 1 Open Cut Extension. The following presents a summary of surface water hydrology and groundwater hydrology. A complete Water Management Study is included in **Appendix K**.

3.13.1 Natural Catchments

There are two main natural catchments in the area of mining. These are associated with Muscle Creek and Sandy Creek. Surface drainage to the north of Skeletar Ridge is in a northerly to northwesterly direction towards Sandy Creek. South of Skeletar Ridge, drainage is in a southerly to southwesterly direction towards Muscle Creek.

The No. 1 Open Cut Extension area contains undisturbed land surfaces that drain towards the northwest, however some surface runoff is captured by dams. Drainage is mostly along 1st order channels, however some tracts of 2nd order channels exist in the eastern part of the No. 1 Open Cut Extension. The drainage lines are influenced by bedrock fractures and faults trending NW-SE.

The No. 1 Open Cut Extension area does not encroach on the 100-year flood limit of the Hunter River, as defined by MLEP, or any alluvial lands of the Hunter River and its tributaries.

3.13.2 Mine Catchments

There are eight catchments covering the current operations areas, as shown in **Figure 3.12**. These have been identified by other studies (ERM, 2002). Details of each catchment are listed in **Table 3.12**. Runoff from these catchments forms a part of the mine water balance and is not currently discharged offsite, except by way of licensed discharge under the terms of MCC's current EPL. The mine catchments occur mainly in the Sandy Creek drainage area, however parts of the No. 2 Open Cut, and the pit top facilities, have formed catchments that were previously part of the Muscle Creek drainage area. The No. 2 Open Cut has intersected Skeletar Ridge.

In addition to these catchments, there exists a small catchment to the north of Coal Road. This catchment directly overlies the proposed No. 1 Open Cut Extension. A small holding dam collects sediment-laden water, which is understood to be separate from the mine water reticulation system. This catchment will be eliminated, and converted to spoil and pit base, in the early years of the proposed No. 1 Open Cut Extension.

The central part of the mine area (immediately north of proposed No. 1 Open Cut Extension) consists of an undisturbed catchment which drains to clean water dams located north of the proposed No. 1 Open Cut Extension on MCC property. The water in these dams is not part of the mine's water reticulation system.

The area of catchment QC5 is in the process of being reduced by up to 50% within the next year by the construction of new holding dams and runoff channelling structures. This will reduce future surface water inputs to the mine water balance.

Seven dams are located on or adjacent to the area of the No. 1 Open Cut Extension illustrated by **Figure 3.12**. All seven dams are on MCC property. These dams will need to be drained at various stages of the proposed No. 1 Open Cut Extension.

TABLE 3.12
MINE WATER CATCHMENTS
MCC

Catchment Name	Area (ha)	Operation Type	Surface Types	Main Storage	Surface Area of main storage (ha)
QCA	127.4	No. 2 Open Cut	Spoil and pit base	No. 2 Open Cut pond	1.61
QCB	38.0	South part of No. 1 Open Cut	Spoil and pit base	None	None
QC1	0.13	Dam No. 1 Surface	Dam	Dam 1	0.13
QC2	19.4	Dam No. 2 Catchment	Natural ground	Dam 2	0.36
QC3	178.4	Central area	Rehabilitated spoil and natural ground	Dam 3	0.67
QC4	2.7	Workshop dam catchment	Disturbed area	Workshop dam	0.2
QC5	91.2	Final settling pond catchment	Disturbed area and rehabilitated spoil	Final settling pond	1.01
QC6	40.3	North part of No. 1 Open Cut	Spoil and pit base	No. 1 Open Cut Pond	0.27

3.13.3 Water Flows

No flow gauging data were available for Sandy or Muscle Creeks. These creeks are both ephemeral, however Muscle Creek is observed to flow more frequently than Sandy Creek. These creeks tend to flow only during periods of high rainfall.

The Hunter River flows southwards with average flows of approximately 200 ML/day at the Muswellbrook gauging station.

3.13.4 Water Quality

Surface water quality data were collected from various sources (AGC, 1984; Douglas Partners, 1997b; CH2MHill, 1998; HLA, 1998; and MCC, 2001).

Electrical conductivity (EC) of water samples in Sandy Creek has been monitored regularly in the past by MCC, and varies according to rainfall. During dry conditions, EC of the water can reach as high as 3,000 µS/cm, and in wet conditions can fall to below 500 µS/cm. EC was measured at an average value of approximately 920 µS/cm in 1996 (HLA, 1998), compared to an average of 1,724 µS/cm during 1999 (data supplied by MCC, April 2002). pH is slightly alkaline with a value of 7.9.

Water quality in Muscle Creek (MCC, 2001) is monitored at two locations by MCC on a regular basis (**Figure 3.12**) and is known to vary according to rainfall. During dry conditions, EC of the water can reach as high as 10,000 µS/cm, and in wet conditions can fall to below 1,000 µS/cm. The average EC for the period January 2001 to December 2001 was 1,679 µS/cm at the upstream location and 2,267 µS/cm at the downstream location (data supplied by MCC, April 2002). This compares with average values of 3,833 µS/cm (upstream) and 4,103 µS/cm (downstream), for the period March 1995 to November 1997 (CH2MHill, 1998). pH measurements indicate slightly alkaline water with a value of 7.6.

Water quality of natural runoff from Greta Coal Measures terrain, calculated from nine measurements, indicates a mean of about 380 µS/cm (AGC, 1984).

Water quality of runoff from mine spoil from Greta Coal Measures strata, calculated from four measurements, indicates a mean of about 2,560 µS/cm (AGC, 1984).

Average EC for pit water was reported by MCC as 4,702 µS/cm for the No. 2 Open Cut pond and 4,052 µS/cm for the No. 1 Open Cut pond, for the period January 2001 to December 2001. EC data are available since 1981, and it appears that EC has steadily increased by about 1,000 µS/cm on average, over the last 20 years. pH measurements indicate slightly alkaline water, ranging from 7.5 to 7.7.

3.14 Groundwater Hydrology

The workings of the former No. 2 Underground and St Helliers Colliery are currently being used for water storage, therefore an understanding of the groundwater system is important with respect to the proposed No. 1 Open Cut Extension.

3.14.1 Aquifers

The proposed No. 1 Open Cut Extension is in elevated terrain and no alluvial deposits of high permeability exist. Residual soils are generally too thin to retain groundwater volumes of consequence.

The Coal Measures have negligible intergranular porosity, but fissures, joints, and fractures impart porosity and permeability to the rock mass.

Permeability testing data at the mine site (AGC, 1984; DP, 1997b) for rock strata indicate that the coal seams are the main aquifers in the Coal Measures. Permeability of the coal seams is, on average, two orders of magnitude higher than interburden. The Muswellbrook / St Helliers Seam pairing is the main aquifer in undisturbed ground. Coal Seams are observed to have closely spaced jointing with no preferred orientation (DP, 1997a).

Old workings mostly consist of partial extraction using bord and pillar operations. These workings will act as reservoirs of water. They are essentially voids that release stored water, or accept formation water, according to the permeability of surrounding strata. The workings of the No. 2 Underground and the St Helliers Colliery are considered to be well connected. Movement of water within these workings will be by pipe flow.

An open borehole that is called the Cross-Workings Drainage Hole exists in the mine area as illustrated in **Figure 3.13**. This borehole was drilled in 1991 in the northern (down-dip) part of the St Helliers Colliery within the lower levels of the workings. Its purpose was to drain any water in the Muswellbrook / St Helliers Seams of the St Helliers Colliery into the underlying Lewis Seam workings of the No. 2 Underground. Mine water make for the No. 2 Underground at this time was estimated by mine staff as approximately 0.3 ML/day, and it was thought by mine staff that most of the inflow was from water stored in overlying workings. This borehole provides a good hydraulic connection between the two sets of workings.

Water level data collected by DP (1997b) indicates that coal-fired rock will provide enhanced rainfall infiltration. The rock may behave similarly to a coarse unconsolidated gravel with characteristics of high storage and high permeability.

The contact between the Gyarran Volcanics and Greta Coal Measures has been identified as a palaeosol horizon, which may be permeable, and may form a groundwater pathway below the pit floors (DP, 1997a). It is reported that significant water inflows occurred in the past, at points where the interface was encountered, and that at some locations, intersections of the interface with faults exhibited open voids (DP, 1997a, from mine staff).

There are large areas where old and young mine spoil is emplaced. Spoil is known to be heterogeneous due to the range of grain / boulder sizes in its constituents, and is known to be anisotropic according to the method of emplacement (Hawkins, 1994). The spoil has been generally laid in north-south strips in the No. 1 Open Cut and in east-west strips in the No. 2 Open Cut. In both cases, water flowing towards the open pits, from within the spoil, will be travelling normal to the strip direction.

3.14.2 Aquifer Parameters

Overall, the coal seams exhibit permeabilities ranging from about 2 m/day near the surface to about 0.001 m/day at a depth of 130 m. Overburden permeabilities range from about 0.01 m/day at the surface to

about 0.0001 m/day at a depth of 100 m. These data indicate a marked contrast between coal seams and overburden.

Two tests conducted in cindered coal (metamorphosed by diorite sills) indicate that cindered coal exhibits similar characteristics to overburden. Pockets of cindered coal in the proposed No. 1 Open Cut Extension area are assumed to be localised.

The igneous sills in the proposed No. 1 Open Cut Extension area are composed of very high strength, slightly weathered, unbroken diorite (DP, 1997b). AGC (1984) provide test measurements for two sills in the Muswellbrook area with permeabilities slightly higher than the coal seams. The data presented are 1.5 m/day for a sill at a depth of 80 m, and 1.4 m/day for a sill at a depth of 50 m. The structure of the tested sills is not described.

Experience with similar spoil at other mines in the Hunter Valley, and results of research (Hawkins, 1994), indicate that a reasonable estimate of horizontal permeability of open cut mine spoil at the MCC's operations is 1 m/day considering the direction of flow in the spoil at the open cuts, and the measured surface of the water table in spoil in the No. 1 Open Cut (DP, 1997b). A reasonable estimate of storativity for mine spoil is 15%.

3.14.3 Groundwater Levels and Flow

There are several features of note in the groundwater level surface:

- Water levels indicate a westerly to northwesterly flow direction, from groundwater highs under Skeletar Ridge and Bells Mountain to the east, towards the discharge zone along Sandy Creek;
- The St Helliers Colliery is seen as a depression with about 40 m of drawdown;
- The No. 2 Open Cut is seen as a depression with about 60 m of drawdown;
- The No. 1 Open Cut shows negligible drawdown, however there is an east-west trending low anomaly running through the open cut, which may indicate drainage into a lineament, possibly representing an igneous intrusion into the fault discussed previously. The anomaly is more apparent to the west of the open cut, where underground mining of the No. 1 Underground may have come close to the lineament. The contours reflect the use of the pit for water storage; and
- The No. 1 Underground is not conspicuous as a depression in the water table. It may have already undergone substantial refilling with groundwater by this time. A pothole subsidence area west of the No. 1 Open Cut, overlying the No. 1 Underground, appears to maintain a groundwater mound in the Coal Measures, probably by leakage from water perched in sediments and rubble within the potholes.

Water level measurements collected since 1981 indicate that the regional flow field has remained unchanged, however drawdown around the No. 2 Open Cut has increased.

The water level in the No. 2 Underground workings in the Lewis Seam is currently (February 2002) being maintained at an elevation of approximately 154 m AHD. The elevation of the base of the buried portal in the No. 1 Open Cut highwall is approximately 168 m AHD, however the Lewis Seam falls rapidly a short way into the headings, due to faulting.

Figure 3.14 is a hydrogeological cross-section oriented northeast – southwest, through the proposed No. 1 Open Cut Extension area and both open cut pits. It shows the relative water levels within the workings at the end of 2001.

3.14.4 Groundwater Quality

Water quality analysis of samples from 12 wells intersecting unworked Greta Coal Measures (AGC, 1984; DP, 1997b) indicate a mean EC of 5,535 µS/cm and mean pH of 7.6. The water is not suitable for potable uses or irrigation, and is generally only useful for stock consumption (excluding poultry). In contrast, the average EC from six measurements of groundwater in the overlying Whittingham Coal Measures at the Bengalla lease (MMA, 1993) was 3,230 µS/cm. This indicates the relatively higher salinities of the Greta Coal Measures compared to overlying Permian formations.

The results indicate that the groundwater in the Greta Coal Measures on the site is dominated by sulphate and chloride, whereas the groundwater in the overlying Whittingham Coal Measures is bicarbonate, and weakly sulphidic (MMA, 1993).

One set of chemical analytical data is available for groundwater within mine spoil (DP, 1997b). The data indicate a character similar to pit water.

3.14.5 Groundwater Use

Previous studies have identified a number of DLWC registered water bores in the region of the mine:

- All registered bores within a 3 km radius of the No. 1 Open Cut are located along the Hunter River, within alluvium. A majority of the wells were constructed of timber between 1912 and 1964 and may no longer be in operation (DP, 1997b). All these bores are distant from the proposed No. 1 Open Cut Extension;

- The nearest bores to the south are located 4 km from the proposed No. 1 Open Cut Extension, in alluvium along Muscle Creek. There are 3 bores within an area of about 1 km^2 (RCA, 1998); and

- The nearest bores to the north are located 4.5 km or more from the proposed No. 1 Open Cut Extension, in alluvium along Sandy Creek. There are several bores located along 5 km of the reach of the creek (HLA, 1998).

The bores are generally used only for stock water supplies. There are no DLWC registered water bores likely to be impacted near the proposed No. 1 Open Cut Extension.

3.15 Air Quality

An Air Quality Assessment was completed for the proposed No. 1 Open Cut Extension by Holmes Air Sciences Pty Limited. This section provides a summary of the existing air quality in the vicinity of MCC's operations. The complete Air Quality Assessment is included in **Appendix E**.

MCC operates a High Volume Air Sampler (HAVS) measuring 24-hour average concentrations of Total Suspended Particulate (TSP) matter and an air quality monitoring network comprising 15 dust deposition gauges, which measure monthly average dust fallout levels. The locations of the monitoring sites is shown in **Figure 3.15**.

3.15.1 TSP and PM_{10} Background Concentration

The TSP data are summarised in **Table 3.13**. The maximum 24-hour concentration measured to date has been 92.6 $\mu g/m^3$ (measured on 18 January 2002). The data include a period of intensive monitoring in January 2002 in which attempts were made to quantify the effects of blasting and it may be noted that the measurement of 92.6 $\mu g/m^3$ included the effects of blasting. Some of these readings show elevated levels. The average of data collected to date has been 46.6 $\mu g/m^3$. The average of data excluding the blast monitoring results is 43.0 $\mu g/m^3$. The difference between the two is 8.4%. The later value is probably more representative of background levels, but conservatively, the value of 47 $\mu g/m^3$ has been adopted as the background for the purpose of assessment.

Currently there is no 24-hour criterion for 24-hour TSP concentrations. The 24-hour criteria for TSP have been replaced by criteria for particles with aerodynamic diameters of less than 10 microns (PM_{10}). However, it may be useful to note that the former US EPA Primary Standard for TSP was 260 $\mu g/m^3$ and the Secondary Standard was 150 $\mu g/m^3$. The US EPA Primary Standards are set to protect the community against health effects and the Secondary Standards are set to protect the community against all other effects (including nuisance effects) with an adequate margin of safety. The available data set, while limited in the period which it covers, suggests that TSP levels in the area are likely to comply with these two standards.

TABLE 3.13
TSP CONCENTRATIONS (24-HOUR AVERAGE) AT TSP1 (SEE FIGURE 3.15)

01-Aug-01	14.6
03-Aug-01	13.7
10-Aug-01	20.7
15-Aug-01	13.7
23-Aug-01	42.6
20-Sep-01	59.0
08-Oct-01	41.0
10-Oct-01	4.9
02-Nov-01	47.0
06-Nov-01	59.1
14-Nov-01	60.7

TABLE 3.13 TSP CONCENTRATIONS (24-HOUR AVERAGE) AT TSP1 (SEE FIGURE 3.15)	
28-Nov-01	44.1
16-Jan-02	71.2
17-Jan-02	85.4
18-Jan-02	92.6
19-Jan-02	56.0
20-Jan-02	20.8
21-Jan-02	29.2
22-Jan-02	37.0
23-Jan-02	78.6
24-Jan-02	59.5
25-Jan-02	45.4
26-Jan-02	30.4
27-Jan-02	39.6
28-Jan-02	68.2
11-Feb-02	42.6
12-Feb-02	37.4
13-Feb-02	45.9
14-Feb-02	47.5
15-Feb-02	49.2
16-Feb-02	38.2
17-Feb-02	52.4
01-Mar-02	35.2
04-Mar-02	39.9
05-Mar-02	39.6
07-Mar-02	55.1
08-Mar-02	42.0
12-Mar-02	89.1
13-Mar-02	51.7
20-Mar-02	76.5
21-Mar-02	72.7
25-Mar-02	21.8
26-Mar-02	31.7
Average	45.4

As a general rule, long-term average PM_{10} concentrations are 40% of the corresponding TSP concentration. This is true in areas where mining is the main source of particles, however it may not be true in urban areas where combustion sources (motor vehicle emissions etc) are the dominant source and is not necessarily valid for short-term averages. In addition it may not be true when bushfire smoke is present. Based on the assumption that 40% of the TSP is PM_{10} the long-term PM_{10} concentration is estimated to be 18.6 $\mu g/m^3$, which is below the NSW EPA's annual reporting goal of 30 $\mu g/m^3$.

3.15.2 Deposition

Dust deposition has been measured at up to 15 sites at MCC since 1988 as shown in **Table 3.14**. The number of sites has varied throughout this time as the mine has developed and different areas have needed to be monitored. The current location of monitors is shown in **Figure 3.15**. The annual average dust deposition rates have varied from 8.8 g/m^2/month at Site 15 in 1989 to 0.5 g/m^2/month at Site 18 in 2000.

Highlighted Gauges (7, 18, 19 and 24) are close to residences.

TABLE 3.14
ANNUAL AVERAGE DUST DEPOSITION DATA (INSOLUBLE SOLIDS) (g/m^2/MONTH)
MCC MONITORING PROGRAMME

Year	Site 2	**Site 7**	Site 10	Site 14	Site 15	Site 16	Site 17	**Site 18**	**Site 19**	Site 20	Site 22	Site 23	**Site 24**	Site 26	Site 27
1988	1.2	***1.2***	2.2	-	4.7	0.8	-	-	-	-	-	-	-	-	-
1989	1.4	***1.6***	1.4	-	8.8	1.5	-	-	-	-	-	-	-	-	-
1990	0.6	***0.8***	2.3	-	5.5	1.7	-	-	-	-	-	-	-	-	-
1991	1.7	***1.5***	5.2	-	1.7	2.4	-	-	-	-	-	-	-	-	-
1992	2.0	***1.8***	6.1	-	1.3	2.5	-	-	-	-	-	-	-	-	-
1993	2.8	***1.6***	3.4	-	1.3	2.7	-	-	-	-	-	-	-	-	-
1994	1.9	***1.0***	2.3	0.7	2.9	2.5	1.8	-	-	-	-	-	-	-	-
1995	1.9	***1.0***	2.2	0.9	2.1	1.3	1.2	***0.9***	***0.9***	1.2	-	-	-	-	-
1996	1.5	***1.0***	3.0	1.0	2.0	1.5	1.1	***1.0***	***1.2***	1.7	1.1	0.8	***2.3***	3.6	1.0
1997	2.5	***0.8***	3.1	1.1	3.1	2.8	2.2	***1.1***	***1.3***	1.2	1.0	1.6	***2.6***	2.1	1.0
1998	1.8	***0.9***	2.0	1.5	2.5	3.3	1.7	***0.8***	***5.6****	1.2	1.1	1.6	***2.2***	0.7	1.3
1999	2.5	***1.1***	2.3	0.9	3.1	2.9	3.0	***0.9***	***1.2***	1.3	0.9	0.8	***1.4***	0.9	1.5
2000	1.9	***1.0***	1.7	1.1	2.1	1.7	1.4	***0.5***	***3.0****	2.0	1.1	1.0	***1.0***	2.5	4.2
2001	1.1	***0.7***	1.7	-	3.7	1.5	1.5	***1.4***	***0.9***	1.4	1.4	0.8	***1.9***	2.3	1.5

Note: *Affected by bird droppings for five months out of twelve.

**Affected by insects, clay transported by birds and bird droppings.

As shown in **Table 3.14** the dust deposition gauges close to residences have recorded deposition levels below the NSW EPA's goal of 4 g/m^2/month, except Gauge 19, which recorded an annual average dust deposition level of 5.6 g/m^2/month in 1998 due to bird droppings in the gauge. Thus none of the sites close to residences have recorded elevated dust deposition levels. The data indicates that an increment in dust fallout of 2 g/m^2/month could be accommodated without a noticeable deterioration in air quality.

3.16 Indigenous and Non-Indigenous Heritage

An Indigenous and Non-Indigenous Heritage Assessment was completed for the proposed No. 1 Open Cut Extension area by HLA-Envirosciences Pty Limited. The survey team included members of the Upper Hunter Wonnarua Council, the Wanaruah Local Aboriginal Land Council and HLA-Envirosciences Pty Limited. This section provides a summary of these studies. The complete Indigenous and Non-Indigenous Heritage Assessment is included in **Appendix I**. Victor Perry of the Upper Hunter Wonnarua Council has prepared a Cultural Heritage Assessment to identify the concerns of the Aboriginal community regarding the development and this assessment is included in **Appendix J**.

The Indigenous and Non-Indigenous Heritage Assessment incorporated field surveys and a review of archaeological, historical and environmental information to place the proposed No. 1 Open Cut Extension in local context. The main aims of the study were:

- To identify and record the extent and nature of archaeological material of human occupation and land use within the limits of the No. 1 Open Cut Extension area;
- To identify areas of archaeological potential within the proposed No. 1 Open Cut Extension that may contain additional material evidence;
- To assess the significance of the archaeological resource identified;
- To consult with the relevant local Aboriginal communities;
- To assess the impacts of the proposed mine development on the known archaeological material within the proposed No. 1 Open Cut Extension and areas of archaeological potential;
- To provide details of any archaeological sites or relics in accordance with statutory requirements, specifically those of the NSW NPWS and the NSW Heritage Office; and
- To present recommendations for the management of and/or mitigation of development impact to the archaeological resource identified.

The survey recorded a total of eight Indigenous artefacts and two scarred trees. The No. 1 Open Cut Extension area has been subject to considerable disturbance, since European settlers arrived in the Hunter Valley in the 1820s. Disturbance has been caused by three main activities:

- Pastoral grazing;
- Domestic construction; and
- Coal mining.

Until 1944, pastoral activity was the dominant activity throughout the lease area. Pastoral grazing accelerates natural erosion rates and has been known to impact on and destroy archaeological material

The construction of, at least, two domestic residences has also impacted on the proposed No. 1 Open Cut Extension area. Both structures have access roads (high-level, localised disturbance), that required the clearance of native vegetation (low-scale, generalized disturbance).

Areas within the proposed No. 1 Open Cut Extension have been subject to both underground and open cut mining and associated infrastructure. Extension A has experienced a number of impacts from subsidence of underground workings. Any archaeological materials once contained within this area have most likely experienced post-depositional movement, by either falling into the underground workings or from the movement associated with subsidence. Essentially, subsidence impacts within the proposed No. 1 Open Cut Extension are contained within the subsidence exclusion zone currently defined by MCC and illustrated by **Figure 3.16.**

Areas that have experienced open cut mining have resulted in the destruction of any archaeological sites. Additionally, the associated mining activity has led to the construction of a number of access roads within the area, most notably the Coal Road**. Figure 3.17** shows disturbance to the No. 1 Open Cut Extension area mapped according to zones as described in **Table 3.15.**

TABLE 3.15
ZONES OF DISTURBANCE
NO. 1 OPEN CUT EXTENSION

Disturbance Zone	Description (as relating to the proposed No. 1 Open Cut Extension)
High	Areas which have been mined currently or in the past. Sites or areas of archaeological potential in this zone would be destroyed.
Moderate-High	This zone contains the subsidence exclusion area where parts of the surface soils have already collapsed due to mining underneath. Although some of the surface is intact, its structure is unstable due to this area being thoroughly mined beneath.
Moderate	During the field survey, areas of moderate disturbance were determined as being those of high erosion, construction areas and those disturbed to a lesser extent from mining and pastoralism.
Low	There were no almost or completely undisturbed areas noticed during the survey of the proposed No. 1 Open Cut Extension.

Four landform units (LFUs) were defined as occurring within the study area, based on morphological type, slope, dimensions and geomorphological agents of landform elements throughout the study area. LFUs are used in archaeological surveys to divide the landscape into standardised elements that can be used for comparative analyses. The four LFUs used in assessing the No. 1 Open Cut Extension are illustrated in **Figure 3.18**.

A total of 31 intensive pedestrian survey units or archaeological survey units (ASU) were conducted across the proposed No. 1 Open Cut Extension area. The ASU are illustrated in **Figure 3.19**.

3.16.1 Indigenous Heritage

A total of four sites were located during the field survey of the proposed No. 1. Open Cut Extension area. **Table 3.16** identifies the recorded sites, site type and positioning within the proposed No. 1 Open Cut Extension. Site locations are illustrated in **Figure 3.18**. Each site is discussed individually below.

TABLE 3.16
ARCHAEOLOGICAL SITE DESCRIPTIONS

SITE NO	SITE TYPE	ASU	LFU	AMGE	AMGN	DIMENSIONS	% EXPOSURE	% VISIBILITY	CONDITION / POTENTIAL
M1	Artefact Scatter	1	2	304327	6429316	3m by 3m	10	60	Highly disturbed.
M2	Isolated Find	2	2	304546	6429286	1m by 1m	30	70	Highly disturbed.
M3	Artefact Scatter	15	4	305006	6429742	2m by 2m	30	70	Highly disturbed.
M4	Artefact Scatter	13	1	305091	6429633	15m by 5m	20	60	Disturbed.
M5	Scarred Tree	1	2	304487	6429332	5m by 5m	15	60	Fair.
M6	Scarred Tree	5	4	304564	6429578	5m by 5m	30	60	Fair.

M-1: Artefact Scatter

This site was recorded in ASU 1 and in LFU 2 (hillslope). It consists of two stone artefacts - one silcrete flaked piece (3-4 cm) and one mudstone flaked piece (1-5cm) – located within a 3 m^2 area.

The site was located near the western limit of Extension A. The degree of slope at the site was approximately 1%, and the site was located approximately 80 m from a watercourse (LFU 4). The immediate area has been highly disturbed by previous geotechnical test pits, and the artefacts are obviously no longer in situ as they are located within a rectangular trench resulting from subsurface testing. This portion of the proposed No. 1 Open Cut Extension is currently utilised for grazing activity, which has accelerated the clearance of vegetation in this portion of the proposed No. 1 Open Cut Extension. As a result, much of the area is covered by a moderate to dense grass cover, with the only remnant vegetation more indicative of regrowth rather than native vegetation.

Although there is no surface indication of additional subsurface materials at this locality, the surrounding area is considered to be of moderate archaeological potential. As it is considered likely that the subsurface geotechnical testing exposed the recorded artefacts at this site, additional archaeological materials may be found in the subsurface context surrounding the site.

M-2: Isolated Find

This site was recorded in ASU 2 and in LFU 2 (hillslope). This site consists of a single artefact – one mudstone flaked piece (2-3 cm).

The site is located within a ridge crest, with the degree of slope less than 1%. The site is located near the borrow pit of the subsidence zone, where soil to the west of the mine subsidence exclusion zone has been removed to stabilize the collapsing earth. The artefact is directly associated with the spoil heap resulting from the excavation of the borrow pit, being on the fringes of the mound, and was most likely deposited here from the earthwork excavation. Vegetation surrounding the site has been essentially cleared, although there is a patch of regrowth vegetation to the northwest.

There is no surface indication of additional subsurface materials at this locality. Based on the high level of disturbance in this locality, the area is considered to be of low archaeological sensitivity as any materials located here have most likely been destroyed or severely damaged.

M-3: Artefact Scatter

This site was recorded in ASU 15 and in LFU 4 (lower order drainage channel). The site contains two artefacts – a silcrete flaked piece (2-3 cm) and a broken silcrete fragment (2-3 cm).

The artefacts are positioned on the edge of the drainage cutting, atop the steep sidewalls of the channel. The area surrounding the site is therefore very disturbed, being contained within a drainage channel cut into the hillslope. It is likely that the artefacts were deposited in their current location through post-depositional movement, specifically through the movement from the upper hillslope areas through water movement (sheetwash erosion).

There is no surface indication of additional subsurface materials at this locality. Based on the high level of disturbance in this locality, the area is considered to be of low archaeological sensitivity as any materials located here have most likely been destroyed or severely damaged. However, the artefacts located are considered to be indicative of land use of the upper hillslope and ridge landform units, which are defined to be of moderate archaeological sensitivity.

M-4: Artefact Scatter

This site was recorded in ASU 13 and in LFU 1 (ridge crest). This site contains three artefacts - 1 mudstone flake (2-3 cm), 1 mudstone flaked portion (2-3 cm) and 1 silcrete flaked piece (1-2 cm).

The site is located within the limits of a vehicle access track to the north of Bimbadeen homestead, on a ridge crest with a degree of slope less than 1%. The original vegetation of the crest has been wholly cleared for the construction of a nearby domestic structure and for the access track that passes through the site. This construction activity has left the site highly disturbed, and accordingly, visibility within the track is quite high (80%). This visibility is only reduced by a light grass cover and by localised patches underlying conglomerate pebbles, exposed by the construction of the road. Beyond the cleared limits of the vehicle access track, a moderate to dense grass cover covers the crest and reduces general visibility to below 20%.

There is no surface indication of additional subsurface materials at this locality. Based on the high level of disturbance due to the local construction (vehicle access track, associated domestic structure) in this locality, this area of the ridge crest is considered to be of low archaeological sensitivity. However, the artefacts located are considered to be indicative of land use of this ridge crest, and areas beyond this central area of disturbance are considered to be of moderate archaeological sensitivity.

M-5: Scarred Tree

This site was recorded in ASU 1 and in LFU 2 (hillslope). The site is located within Extension A of the study area on a gently inclined hillslope (2% degree of slope). The original vegetation of the area has been predominantly cleared for the pastoral and mining use of the land. A large gully passes approximately 20 m to the east of the tree, constructed to funnel the drainage of excess construction into the nearby small dam. Visibility surrounding the tree is moderate to low, with the dense grass cover of the area the primary constraint. Exposures in this area are approximately 15%, with visibility within those exposures approximately 60%.

The tree is a large gum, approximately 25m high in total. The trunk forks approximately 150 cm from the ground into two main branches, from which there are numerous smaller branches. One scar was identified on the main east branch of the trunk. The scar is located on the northern face of the trunk and is elliptical in shape, tapering at the top and base of the scar. It is located 173 cm above ground level, and its dimensions are:

- 195 cm high;
- 15 cm wide; and
- 7 cm in depth.

There has been some minor damage to the base of the scar, resulting from the weathering of the bark. No associated archaeological materials were identified in the immediate area.

Additionally, the health of the tree appears to have been negatively affected by subsidence, with heat from underground spontaneous combustion emerging from cracking. However, subsequent discussions with an arboreal specialist indicated that the tree requires professional assessment to determine the status of its health and its' chance of regrowth.

M-6: Scarred Tree

This site was recorded in ASU 5 and in LFU 4 (lower order stream). The site is essentially positioned on the boundary of the study area within Extension A, being found approximately 40 m from the wall of a large dam. The tree is the only remaining vegetation within a small fenced paddock at this location, with the surrounding vegetation wholly cleared. This has increased average visibility surrounding the tree to approximately 30%, although the moderate grass cover of the paddock is the primary restraining factor to visibility.

The tree is large Ironbark, approximately 30 m high in total. The trunk forks approximately 15 m from the ground into a number of smaller branches. Two scars were identified on the main trunk of the tree, positioned one above the other in a vertical line on its' eastern face. Approximately 50 cm separates the two scars. The dimensions for the scars are as follow:

Scar 1 (base scar):	130 cm above ground 122 cm total length 23 cm total width 6.5 cm deep
Scar 2 (top scar):	340 cm above ground 110 cm total length 20 cm total width Depth unknown

Both scars are elliptical in shape, tapering at the top and base of the scars. Both have minor bark damage around the scar, from the natural weathering of the tree. The area of damage for each scar is approximately 80 cm for Scar 1 (below base of scar) and approximately 60 cm for Scar 2 (below base of scar). The tree was dead at the time of survey.

No associated archaeological materials were identified in the immediate area.

Table 3.17 presents a summary of the material recorded in all sites.

TABLE 3.17
SITE CONTENT
MCC ARCHAEOLOGICAL SURVEY - 2001

Site No.	LFU	Silcrete			Mudstone			Totals
		F	FP	C	F	FP	C	
M-1	2		1			1		**2**
M-2	2					1		**1**
M-3	4		1			1		**2**
M-4	1		1		1	1		**3**
Totals			**3**		**1**	**4**		**8**

Key to table: F = flake; FP = flaked piece; C = core.

3.16.2 Significance Assessment - Indigenous

An assessment of significance is undertaken to explain why a particular site is important and to enable the appropriate site management to be determined. Cultural significance is defined in the *Australian ICOMOS Charter for the conservation of places of Cultural Significance* (the *Burra Charter*) as meaning "aesthetic, historic, scientific or social value for past, present or future generations" (Article 1.1). Cultural significance may be derived from the fabric of a place, association with a place, or the research potential of a place. The significance of a place is not fixed for all time, and what is of significance to us now may change as similar items are located, more historical research is undertaken and community tastes change.

The NSW NPWS *Aboriginal Cultural Heritage Standards and Guidelines Kit* emphasizes two streams of significance assessment:

- Aboriginal Cultural significance; and,
- Archaeological/scientific significance.

The cultural significance has been assessed separately by the appropriate Aboriginal community – the Upper Hunter Wonnarua Council.

In order to further clarify the archaeological potential of the sites, two aspects effecting the archaeological potential of sites are addressed separately in **Table 3.18**: site integrity and research potential.

It has been noted that the "…intactness of a site, the quality of its information, and its potential for the interpretation of activities or symbology depends upon its integrity. Even a typical flaked stone artefact site of small size takes on special importance if it is in a good state of preservation. A deposit or a surface may have stratigraphic or spatial integrity. The idea of integrity also includes the state of preservation, such as stencil shelter or the condition of bones in a burial" (Witter, 1995:3).
Witter provides the following categories used in defining levels of integrity. These have been used in the archaeological assessment for this study.

Excellent Disturbance erosion or development is minimal. (Low disturbance)

Good Relatively undisturbed deposits or partially disturbed with an obvious in situ deposit. (Low disturbance)

Fair Some disturbance but the degree of disturbance is difficult to assess. (Moderate disturbance)

Poor Clearly mostly destroyed or disturbed by erosion or development. (Moderate-High disturbance).

Very poor Sites totally disturbed or clearly not in situ. (High disturbance)

Destroyed A known site that is clearly no longer there. (High disturbance)

Archaeological significance assessment also comes from bringing together and comparing the work done and knowledge available for the region. The potential to assess the significance of a site increases depending upon the information available for a region. Therefore the category of 'representativeness' has also been included in the assessment for the study. This is usually based on the regional context. "The regional context indicates what is usually found in the region, and includes explanations for what it means. It also provides a background for what is rare, outstanding, or surprising for the region" (Witter, 1995:3). Drawing on the archaeological background knowledge and results of previous work in the region and assessment of whether a site is rare or representative has been made.

The significance assessment **Table 3.18** also includes comments on the potential of a site to contain archaeological material. The extent of the deposit affects the research potential of the site. All sites have some potential to add to the knowledge base and therefore, the useable research data, for an area. However, sites with the potential for a depth of deposit have a higher research potential as they could provide information to further studies of activity areas and possibly provide dateable material to expand site chronologies.

TABLE 3.18
SIGNIFICANCE ASSESSMENT
MCC

Site	Site Type	Representative-ness	Integrity / Condition	Research Potential	Overall Significance
M-1	Artefact Scatter	Representative	*Poor.* Disturbed by grazing and geotechnical test-pit. Likely post-depositional movement.	*Moderate.* Small surface assemblage. Potential for sub-surface deposit.	Low
M-2	Isolated Find	Representative	*Very poor.* Very disturbed by earthworks. Likely post-depositional movement.	*Low.* Isolated Find with no indication of sub-surface deposit.	Low
M-3	Artefact Scatter	Representative	*Poor.* Disturbed by grazing and vehicles.	*Low.* Small surface assemblage. No indication of sub-surface deposit.	Low
M-4	Artefact Scatter	Representative	*Poor.* Disturbed by drainage channel construction and erosion.	*Low.* Small surface assemblage. No indication of sub-surface deposit.	Low
M-5	Scarred Tree	Rare	*Fair.* Tree potentially dead in current position.	*Moderate.* Tree	Moderate
M-6	Scarred Tree	Rare	*Fair.* Tree potentially dead in current position.	*Moderate.* Tree	Moderate

3.16.3 Non Indigenous Heritage Assessment

No. 1 Open Cut Extension Study Area

Three non-Indigenous items of potential heritage significance were observed during the field survey, as identified below:

- Domestic Structure,
- Road and Culvert, and
- Stockyards.

Analysis of the fabrics utilised in their construction as the construction techniques indicated that these items may have been over 50 years in age, and therefore classified as relics under Section 139 of the NSW *Heritage Act* (1977 as amended 1998).

However, subsequent historical research indicated that none of the above items were over 50 years in age, as they all dated to Alan Cowley's occupation of the land (post-1954). The below history is derived from oral sources within Muswellbrook.

This section of the study area was originally part of a 3000 acre holding that extended from Muscle Creek Road across the ridge line of the study area. It also included the Bimbadeen Homestead. This land was owned by the Bowman family, who subdivided it in 1954 for sale. At this time, Cowley bought this section of land and within two years had constructed a stockman's hut (slab construction, corrugated iron roof) and a nearby stockyards. These two items were observed during the survey. The road and culvert items also noted during the survey post-date the construction of the stockman's hut, and most likely date to the 1960s.

As none of the above items are over 50 years in age, they will no longer be considered in this assessment.

Muswellbrook Brickworks

The Muswellbrook Brickworks are located to the northwest of the study area, removed from the MCC proposed development area by approximately 400m. They are accessed from Coal Road, to the west of the study area.

The Brickworks reportedly date to 1949, when it was established by Muswellbrook Industries to exploit the clay deposits of the Muswellbrook Coal Company open cut mine. The kilns have a total capacity of 180,000 bricks. The Brickworks were briefly closed in 1975, but were then reopened by O.J. O'Brien. The original fabric of the Brickworks has remained intact since its construction, including the three draft kilns and associated timber buildings. However, the conditions of the kilns have been described as requiring some repair to the roofs. The Brickworks also have several brick presses dating to the 1860s, which were imported from England. At the time of the 1996 MSC Heritage Study these machines were being restored for the production of bricks for heritage buildings that were built with these bricks.

When the 1996 recording of the item was made, the Brickworks were still operational, with three of the draft kilns actively firing coal. The Brickworks ceased operation in late 1997 (Mark Howes, pers. comm.).

The historic themes identified in the heritage assessment of the Brickworks are: Booms and Busts, Industrialisation and Decentralisation, and Technology. The Brickworks also reflect on the local themes of: The Economic Cycle of Muswellbrook, Coal Mining in the Muswellbrook District, and The Manufacture of Bricks in the Muswellbrook Area.

3.16.4 Areas of Archaeological Potential

The assessment of areas of archaeological potential within the study area has been based on the juxtaposition of archaeological patterning, landscape analysis and the levels of disturbance throughout the area.

In recent history, the study area has since been disturbed by pastoral, mining and residential development. However, as these activities have generally been focussed in a low number of areas within the MCC landscape (such as at Bimbadeen and the mine infrastructure area), the remaining sections of the study area are only moderately disturbed. Although the widespread land clearance and grazing within the study area may have resulted in the post-depositional movement and disturbance of archaeological materials, it is considered likely that the majority of extant sites have survived these impacts. Conversely, areas of high disturbance are considered to be of low archaeological sensitivity as the subsequent impacts in these areas have most likely destroyed, severely damaged or moved any existing archaeological materials.

Therefore, the majority of the study area has been defined to be of moderate archaeological sensitivity as they may be additional archaeological materials within these areas. This area of moderate archaeological sensitivity is directly correlated with the area of moderate disturbance only illustrated on **Figure 3.17**.

However, no specific potential archaeological deposits (PADs) within the study area have been identified by this assessment. However, much of the area has been defined to be of moderate archaeological sensitivity due to the assessment of the archaeological patterning of the area and assessment of the level of disturbance throughout the study area have concluded that much of the study area should be considered to be of moderate archaeological sensitivity.

No areas of non-Indigenous archaeological potential were identified within the study area, as a result of both desktop and field assessments.

3.17 Social Environment

3.17.1 Regional Setting

The Hunter Region is of great significance to NSW. Not only does it contain a substantial part of the State's coal resource it also contributes greatly to power generation, metal manufacturing and agricultural productivity. The regional population has grown steadily since the post war period and now accounts for approximately 10% of the State's population. The Hunter is second to Sydney as the State's most populated region.

Muswellbrook Shire is located within the Hunter Region. It has sound agricultural, industrial, resource and commercial bases, and provides a wide range of community, social and recreational activities and services. It has a rich history, which helps support a growing tourism market.

3.17.2 Population and Growth

At the 1996 census Muswellbrook Shire had a population of 15,562. This represented 2.9% of the Hunter's population and 0.25% of the State's population. Compared to the rest of the Hunter and NSW, the MLEP has a higher percentage of minors aged 0-17 years, and a higher proportion of young adults aged 25-39 years. This suggests that Muswellbrook Shire has a young population with families moving into the area to take advantage of job opportunities as they arise, mainly in the resource sector. It also suggests that many people leave the area upon retirement, probably seeking coastal settlement with a milder climate.

Muswellbrook LGA's population growth between 1991 and 1996 was 0.6% per year, which is significantly lower than the regional and State average of 1%. The Department of Urban Affairs and Planning (now planningNSW) projects that the population of Muswellbrook Shire in 2021 will be 16,700.

3.17.3 Housing Structure

In 1996 32.2% or 1,869 of dwellings in Muswellbrook were fully owned by its occupants and 23.9% or 1,340 were being purchased while 27.4% or 1,594 were being rented. The 1996 census revealed there were 7.9% or 460 unoccupied private dwellings.

Approximately 85% or 4,943 of all private dwellings in Muswellbrook Shire were separate houses. This is higher than the Hunter average of 81% and far greater than the State figure of 70.2%. Of all the dwellings, 9.3% are flats, units, town houses, terraces or apartments. The average occupancy rate for Muswellbrook was 2.6 people per dwelling. This rate is higher than the Hunter at 2.3 people and 2.4 for NSW.

3.17.4 Employment

In 1996 56.6% of all residents of the Muswellbrook Shire, of age 15 years and over were employed. This figure is higher than the Hunter at 50% and NSW at 54%. Unemployment at this time was 9.2%, better than the Hunter region at 11.3%, but above the NSW average of 8.8%.

The latest unemployment figures obtained from the Department of Employment, Workplace Relations and Small Business (DEWRSB) are for the December quarter 2001. These figures show that a total of 518 people in the Muswellbrook Shire were unemployed, representing an unemployment rate of 7.0 %. Over the previous four quarters unemployment rates were 5.8%, 5.1%, 5.3% and 5.8%. The latest figures show that Muswellbrook has a higher unemployment rate than the national average for the same quarter of 6.6% and the State at 6.2% respectively. Employment in Muswellbrook exhibited a trend that also occurred in NSW and nationally over the past 5 quarters. This trend saw unemployment rates generally decline throughout 2000 and increase throughout 2001.

DEWSRB indicated that the Muswellbrook labour force is made up of 7,413 people. Mining is a significant source of local employment, employing 1,065 people, representing 16.3% of the workforce (1996 figures). A quarter of all males employed work in mining. These figures are significantly higher than Hunter and NSW averages.

The next largest source of employment in Muswellbrook Shire was retail trading which employed 11.8% of all workers. Other significant employment industries were agriculture, forestry and fishing which employed 10%, manufacturing employed 8 %, electricity gas and water supply employed 7.2% and construction 6.6%.

3.17.5 Income

In 1996, Muswellbrook Shire households generally had higher weekly household incomes than the Hunter and NSW. The income level of $1,000 - $1,499 per week was the most common amount earned, at 17.9 %of households. This is significantly more than the Hunter and State averages. There were also more households, on average, in Muswellbrook with weekly income levels of $1,500 and greater, and less with lower incomes (the $120 - $700 levels).

3.17.6 Services

The Muswellbrook is well serviced by recreational, community and health facilities, as well as commercial and professional services.

Child Care

There are a number of childcare centres operating in the area. There is a childcare centre and a pre-school in Muswellbrook. Overall, these provide extensive facilities for those children aged 3 to 5.

The Upper Hunter Family Day Care, whilst being based in Scone, services Scone, Muswellbrook, Merriwa, Denman and Murrurundi. More than 400 families in the region use this service. Family Day Care advises it is well able to meet existing demands, and any future increases. Family Day Care generally covers the gap in servicing the 0 to 3 years age group that the pre-school/kindergartens do not cover.

There is out of school hours care (OOSH) service available at Muswellbrook. Nine playgroups are conducted in Muswellbrook. Muswellbrook hospital has an early childhood centre. Other children's services available are a Children's Mobile Outreach Service, Early Intervention Centre, Nursing Mothers Association and Upper Hunter Peer Link Children's Services.

Education

There are two public and two private primary schools in Muswellbrook, as well one State high school. St Josephs High School is located at nearby Aberdeen.

The Hunter Institute of Technical and Further Education (TAFE) maintains a campus at Muswellbrook. The Muswellbrook Campus also offers a TAFE Outreach Service. Classes in adult literacy and numeracy are conducted at Muswellbrook and adult education services are provided. Upper Hunter Community Training Inc is situated in Muswellbrook.

Recreation

Muswellbrook provides an excellent range of recreational, sporting and cultural activities including the following:

- Scouts, Guides, Brownies and Cubs;
- All major sports including golf, tennis, swimming, rugby league, rugby union, soccer, netball, squash, hockey, fishing, cricket, basketball and athletics;
- Arts and crafts, music and dance; and
- Youth clubs, licensed clubs, hotels and restaurants.

Health

Muswellbrook has a 42-bed hospital with an 18-bed nursing home attached to the hospital. The hospital provides medical, anaesthetic, surgical, obstetric and emergency services.

A range of community health services and visiting health professionals support the hospitals. The community health service provides an Early Childhood Clinic, Community Nurses, Dietary Advice, Family Planning and Antenatal Classes.

In addition to the hospital the following health care is provided in the area:

- Ambulance station;
- Medical practices;
- Dental practices;
- Chiropractic, massage, osteopath, speech pathology, optometrist, podiatrist, physiotherapy and acupuncture services; and
- Counselling services.

Other Services

Other community services that are provided in Muswellbrook include:

- A wide range of aged care services including aged and disabled support project, Home and Community Care (HACC) nurses, meals on wheels, respite care, day care centre, senior citizens club and home care, aged hostel and nursing homes;
- Community transport;
- Service Clubs (e.g. Apex, Lions, Rotary, Inner Wheel, Legacy, Probus and Quota); and
- Police, Court Houses, Fire Brigade, SES.

Commercial and Professional

Muswellbrook is the main commercial centre within the area. It contains a large, modern shopping mall, supermarkets, and a wide range of professional, banking and other commercial services.

3.18 Economic Environment

3.18.1 Regional Economy

The Hunter Region's 10% of NSW population is matched by the fact that the region also produces 10% of the State's manufacturing output with a value added component of $5.5 billion. Approximately 28% of NSW shipping export income is generated through the Port of Newcastle. Whilst coal represents the bulk of exports, wheat and aluminium are also exported from the port around Australia and overseas.

Coal represents approximately 74% of NSW mining income. In 1999-2000, $3.1 billion was earned from the export of 72.4 million tonnes of high grade thermal and coking coal. This represents a decrease of 4 million tonnes over the previous year, which is the first significant decrease in exports for 10 years. Overall 133 million tonnes of coal was produced in NSW in 1999-2000 increasing from 131 million tonnes in 1998-1999. 80% is produced in the Hunter and Newcastle coalfields (106 million tonnes). (1999, 2000 and 2001 Coal Industry Profile).

Table 3.20 gives a breakdown of goods exported through the Port of Newcastle for the years 1997-2000.

TABLE 3.20 HUNTER EXPORTS - PORT OF NEWCASTLE						
	Tonnes 1997-98	% Total Exports	Tonnes 1998-99	% Total Exports	Tonnes 1999 – 2000	% Total Exports
Aluminium	241,836	0.3	220,076	0.3	226,403	0.3
Iron and Steel	614,545	0.9	442,219	0.6	99,342	0.1
Concentrates	312,095	0.4	308,956	0.4	320,759	0.5
Grain	2,078,389	3.0	1,116,469	1.6	1,409,632	2.1
Woodchips	352,687	0.5	304,842	0.4	182,408	0.3
Sands	88,985	0.1	83,311	0.1	54,461	0.1
Coal	65,309,315	94.0	68,207,181	95.5	64,425,353	95.6
Other	150,045	0.2	201,711	0.3	274,763	0.4
Coastal	307,716	0.4	450,780	0.6	337,129	0.5
Total	**69,503,186**		**71,392,573**		**68,403,868**	

Primary production for the Hunter Region is shown in **Table 3.21**.

TABLE 3.21 HUNTER PRIMARY PRODUCTION 1995/96 TO 1998/99				
Commodity	1995/96	1996/97	1997/98	1998/99
Hay (tonnes)	76,600	69,200	77,800	74,400
Wheat (tonnes)	40,200	85,200	58,200	45,300
Sorghum (tonnes)	48,200	53,500	34,700	99,500
Barley (tonnes)	11,900	16,600	13,800	9,900
Grapes for Wine (tonnes)	18,700	24,500	19,000	29,600
Sunflower Oil Seeds (tonnes)	5,800	4,900	4,000	13,500
Potatoes (tonnes)	3,200	3,100	4,900	Not Available
Sheep/Lamb (No.)	478,000	488,600	572,200	426,100
Beef Cattle (No.)	541,100	545,400	519,200	473,700
Milk Cattle (No.)	65,600	68,400	73,600	65,800
Chickens – Meat (No.)	12,404,100	11,723,300	10,880,300	11,308,00
Chickens – Eggs (No.)	444,400	461,500	346,00	274,300

Other important regional economic statistics include:

- Aluminium smelters at Kurri Kurri and Tomago produce 40% of Australia's aluminium. 85% of this local product is exported, mostly to Asian destinations;

- In 1998 expenditure generated by tourism in the Hunter was $709 million;

- 80% of the State's electricity is produced in the region;

- Agricultural production for the 1995-96 season was valued at $342 million. The most important economic contribution was made by poultry production ($100 million), milk production ($88 million) and beef cattle ($73 million); and

- 39 million litres of wine worth more than $270 million is produced annually. 8 million litres of wine is exported each year to Europe (39%), USA (26%) and Asia (22%). This generates $43 million annually in export revenue. (Source: Hunter Valley Research Foundation, 1999 and NSW Tourism, 2001).

3.18.2 Local Economy

In the Muswellbrook area there are five active mines surrounding the township. Four of these mines are open cut, being, Mt Arthur Coal, Bengalla, Drayton and Muswellbrook No. 2 Open Cut. Dartbrook is an underground mine.

The coal mines situated within the Muswellbrook Shire produced 16.2 million tonnes of raw coal in 1997-98, of which 14.64 million tonnes was saleable. 1998-99 production levels increased to 17.55 million tonnes raw and 15.6 million tonnes saleable. During 1998-99 the Bengalla open cut mine commenced production. The latest reported production figures (1999-00) showed a further increase to 18.5 million tonnes of raw coal of which 16.47 million tonnes was saleable

The overall trend in the Hunter coalfields has seen a decline in the number of mine employees from 6,358 in 1997 to 4,770 in 2000. The mines in the Muswellbrook area had a peak workforce of 1,233 in 1997. In 1998 the number of employees dropped to 1030, to pick up to 1153 in 1999. The opening of the Bengalla Mine was the main reason for the local increase. The 2000 employment level for these mines was 1104.

A survey of four mining operations in the Muswellbrook area was conducted in 1999 (Mining Industry and Employee Survey, 1999). At that time there were 795 full time employees at these mines made up of 303 employees at Bayswater, 91 at Bengalla, 245 at Drayton and 156 at MCC. The survey established the average income of mine employees at between $70,000 and $80,000 per annum.

Of the employees of these mines 48% resided in Muswellbrook, 14% in Singleton, 12% in Scone, 8% in Denman, 6% in Aberdeen and 12% across other localities including Maitland (2%), Cessnock (1%) and Newcastle (1%).

The survey also made the following findings in respect of the workforce at these mines:

- The mine workers were largely employed full time, having worked for their respective employers for over 10 years and, in the industry, for an average of 15 years;

- 51% had a mortgage;
- Employees had resided in their current townships, on average, for 22 years;
- 23% were educated to Year 10 level with 65% possessing a certificate, degree or diploma; and
- Household expenditure, after tax, was estimated at approximately $40 million. A breakdown of the expenditure pattern appears in **Table 3.22**.

TABLE 3.22
HOUSEHOLD EXPENDITURE LOCATIONS 1999
(BAYSWATER, BENGALLA, DRAYTON AND MCC MINES)

Location	Annual Household Expenditure ($million)
Muswellbrook	19.59
Singleton	4.76
Scone	4.28
Newcastle	3.51
Maitland	2.46
Denman	1.63
Aberdeen	0.92
Sydney	0.74
Cessnock	0.38
Other	1.74
Total	40.01

NSW Tourism provides information concerning tourist visitation, number of nights stayed and expenditure for each local government area. The figures for Muswellbrook appear below in **Table 3.23**. This table shows that the tourist industry in Muswellbrook in 1996/97 was worth an estimated $28 million. These are quite significant totals in the local economy of each area. The amount of expenditure for Muswellbrook increased by 33 % over the three-year period.

Figures available for Muswellbrook Shire indicate that the direct takings for accommodation in the Shire in 1996/97 were $2.536 million and the average room occupancy rate was 56.6 %.

TABLE 3.23
TOURIST VISITATION INFORMATION
MUSWELLBROOK SHIRE

	Visits ('000)			Nights ('000)			Expenditure ($ million)		
	94/95	95/96	96/97	94/95	95/96	96/97	94/95	95/96	96/97
Muswellbrook	120	139	146	309	355	400	21	25	28

The agricultural industry is an important element in the economy of the area. The information relating to agricultural activity for the Shire in the 1995/96 season is shown in **Table 3.24**.

TABLE 3.24
AGRICULTURAL ACTIVITY
MUSWELLBROOK SHIRE 1995/96

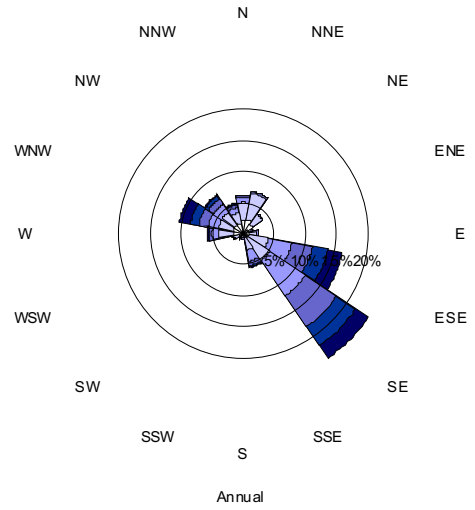
	Establishments with Agricultural Activity (No).	Total Area of Establishments (Hectares)	Gross Value of Agricultural Commodities Produced ($,000)
Muswellbrook	288	124,190	$27,504

Figures available for Muswellbrook indicate that the value of agricultural commodities was made up of:

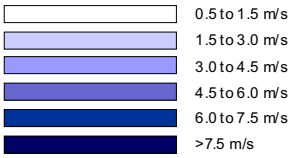
- Crops - $7.115 million (including pastures and grasses $3.060 million and fruit (including grapes) $3.159 million);
- Livestock Slaughter - $6.997 million; and
- Livestock products - $13.391 million.

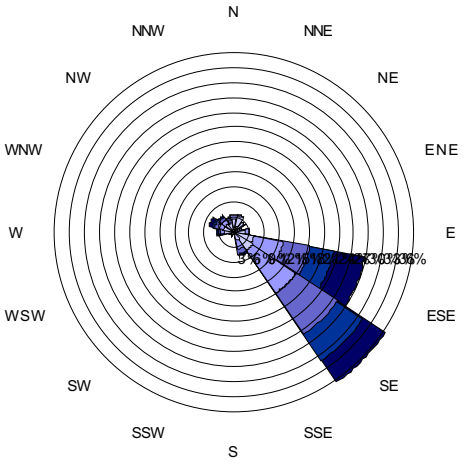
Average weekly household expenditure for the Muswellbrook Shire in 1997 was $665 whilst the State average was $674.32.

Annual and Seasonal Windroses for Mt Arthur North Meteorological Station for 1999/2000

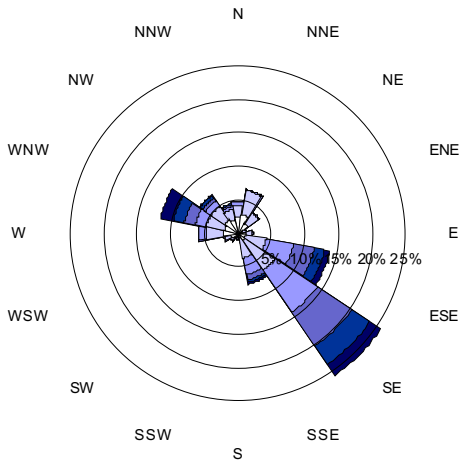


Annual

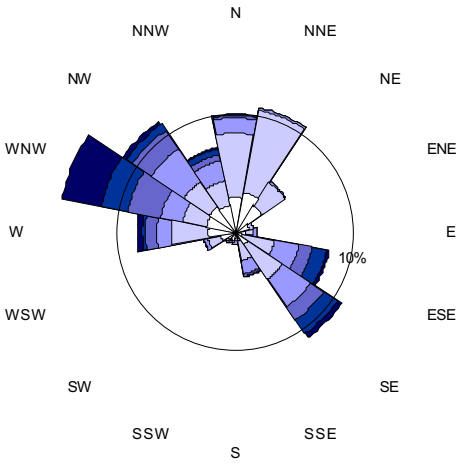




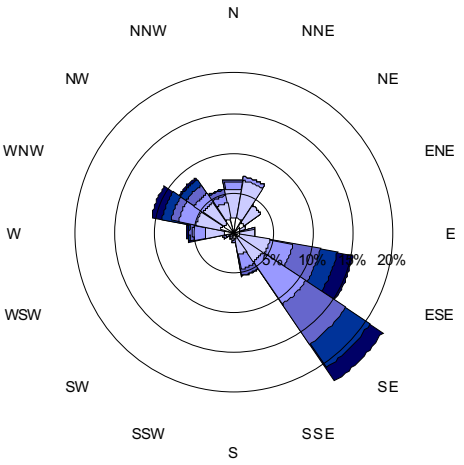
Summer



Autumn



Winter



Spring

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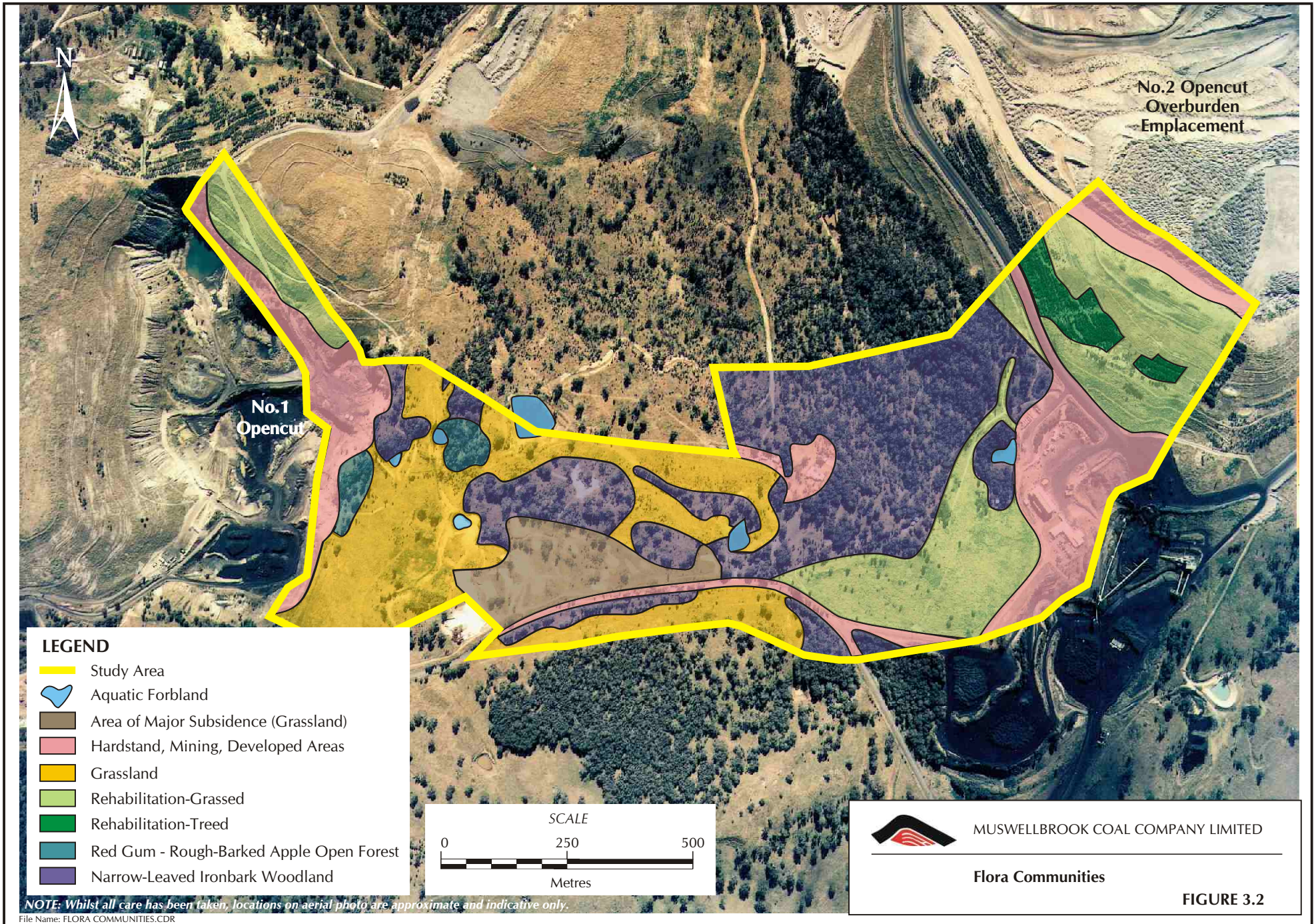
Warabrook, NSW
(02) 4968-0044

ANNUAL AND SEASONAL WIND ROSES FOR MT ARTHUR METEOROLOGICAL STATION 1999/2000

FIGURE **3.1**

DRAWN	PROJECT - TASK NUMBER	APPROVED	DATE
	U888		February 2002

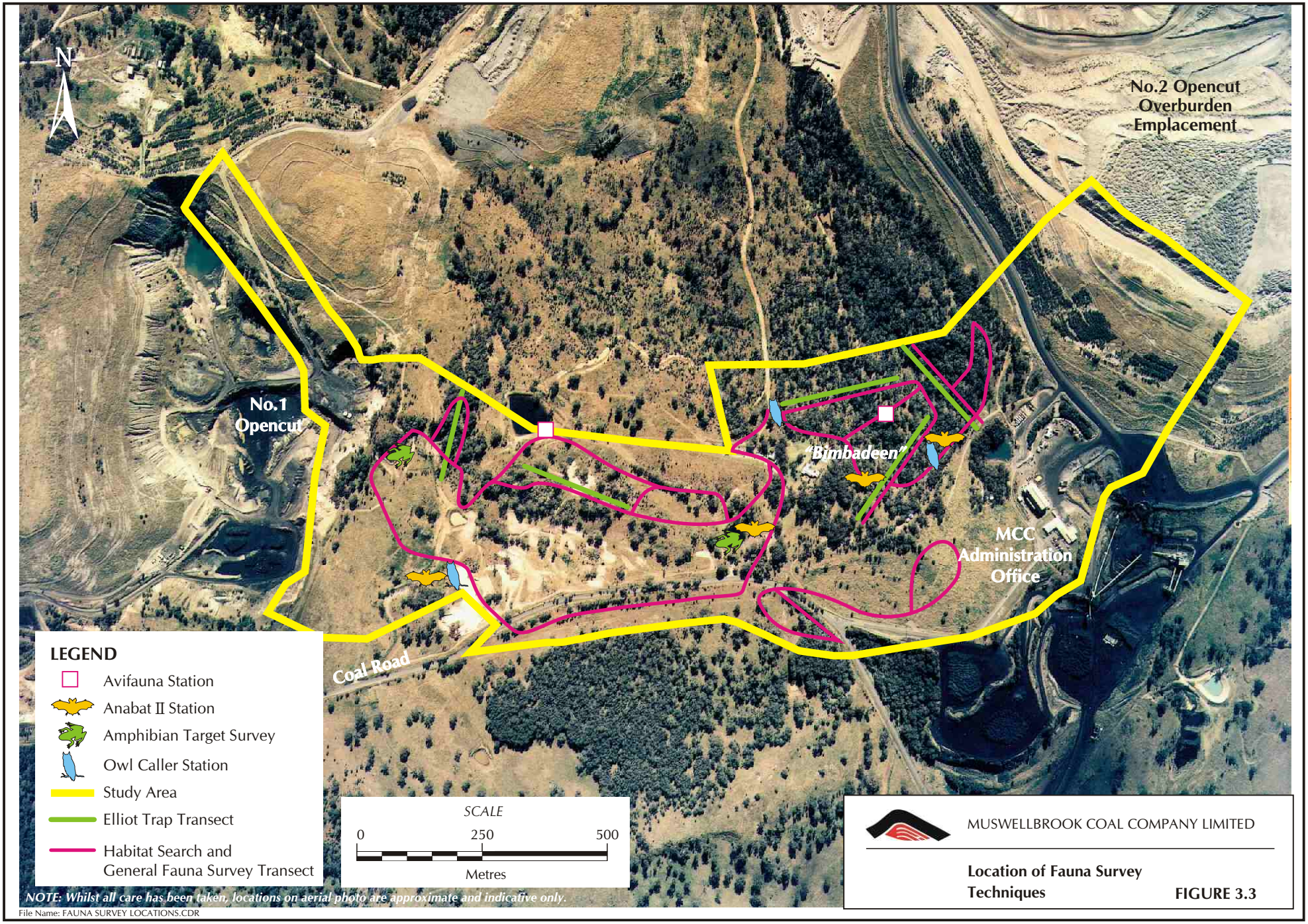


MUSWELLBROOK COAL COMPANY LIMITED

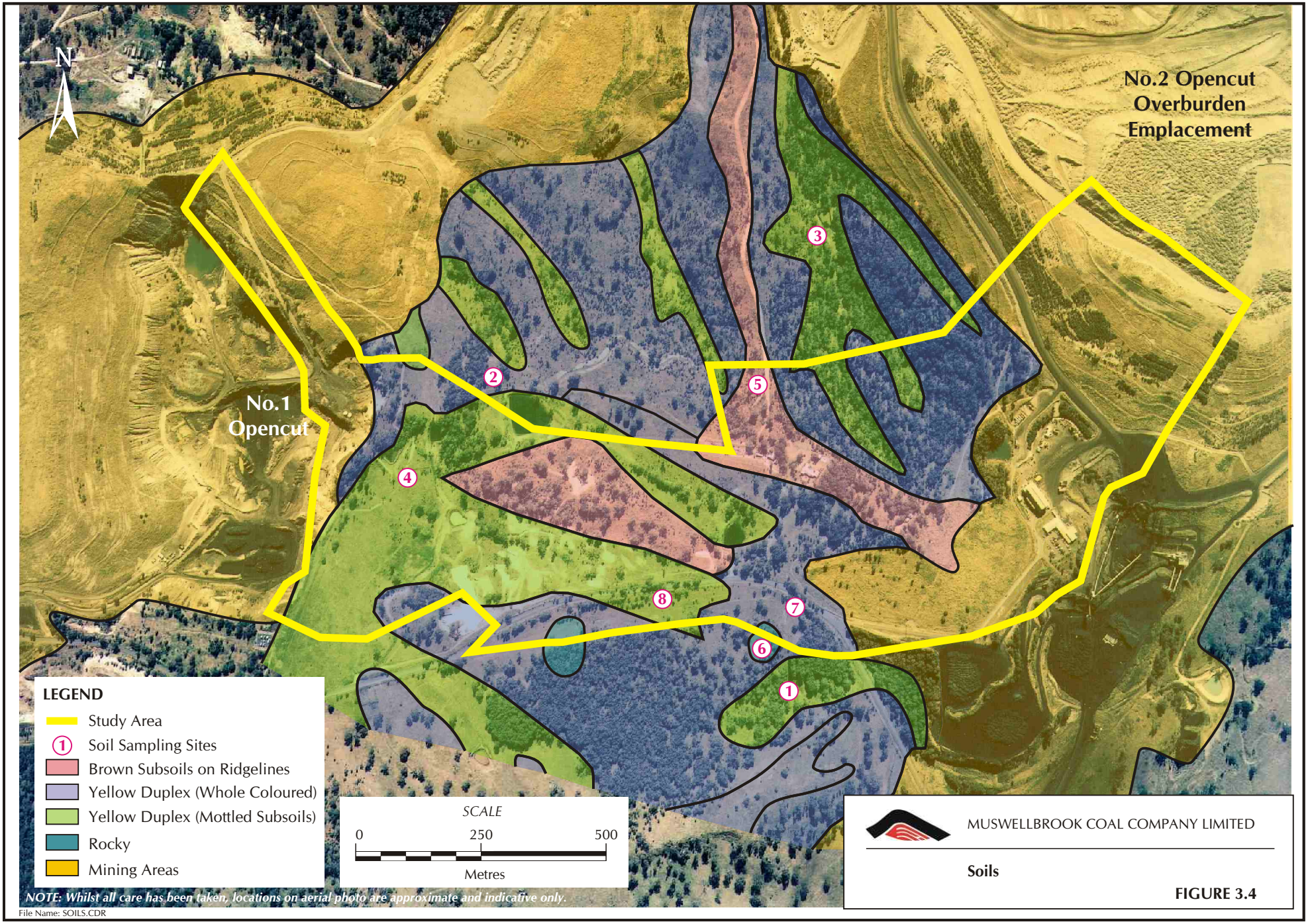
Flora Communities

FIGURE 3.2

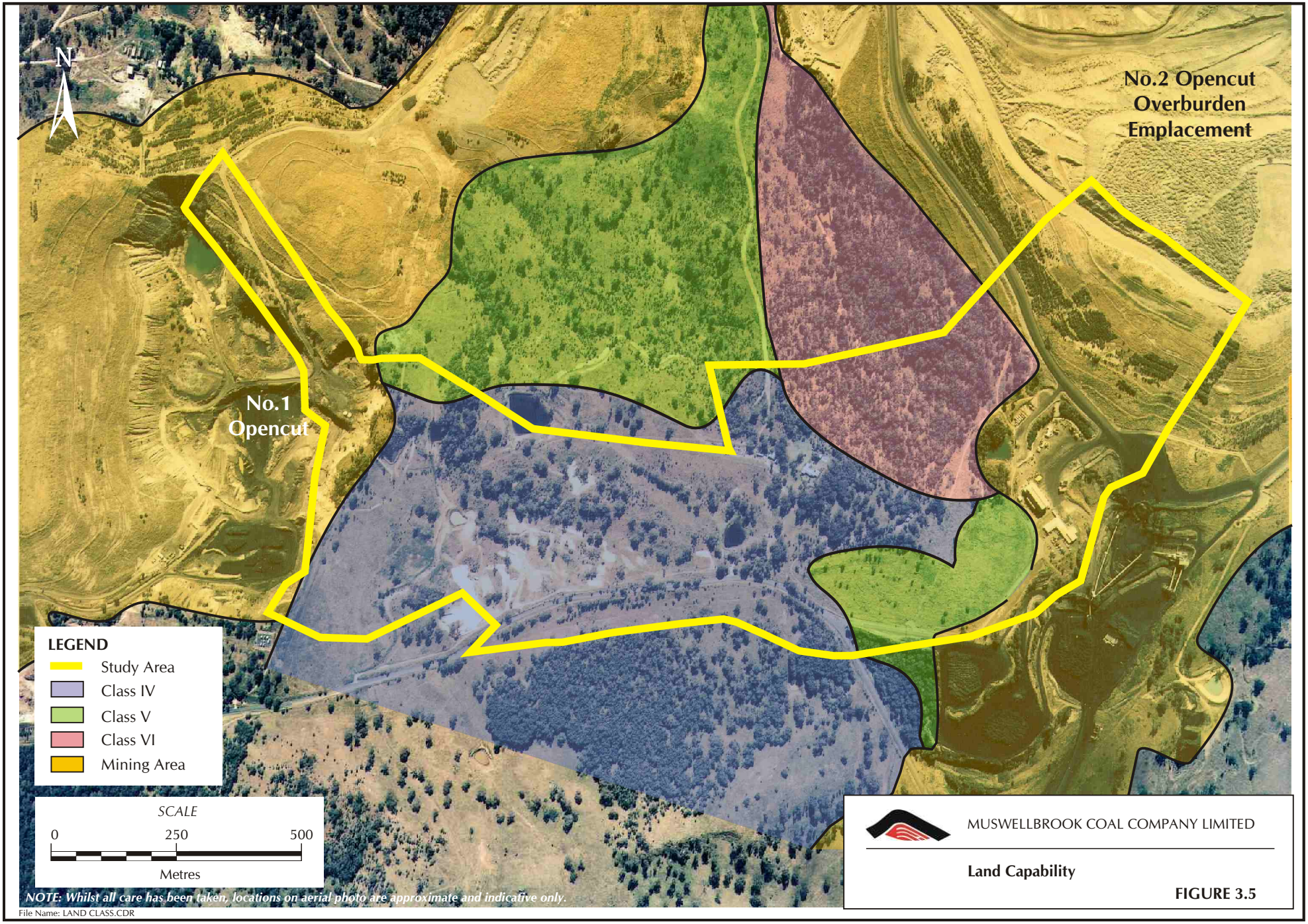
File Name: FLORA COMMUNITIES.CDR

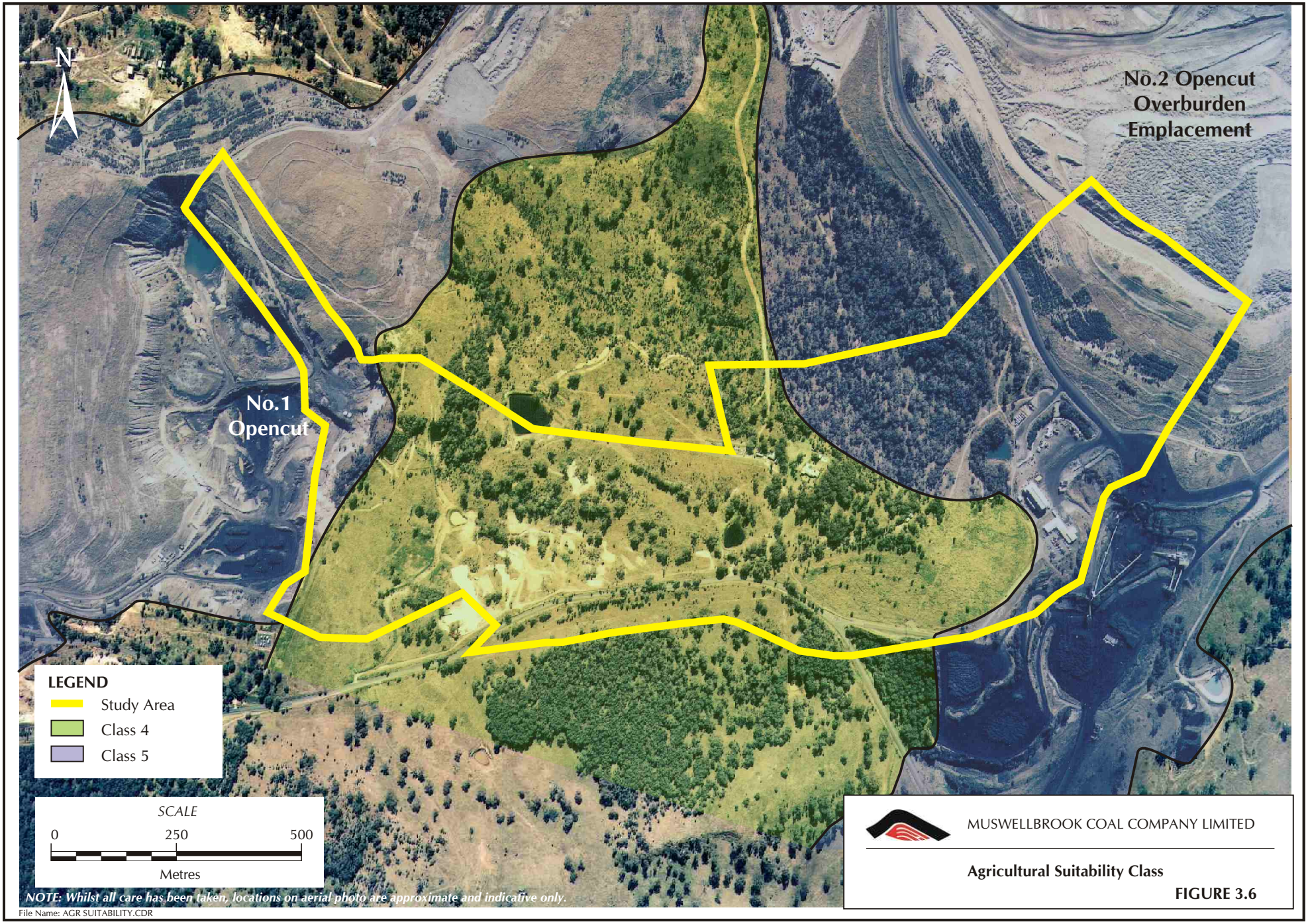


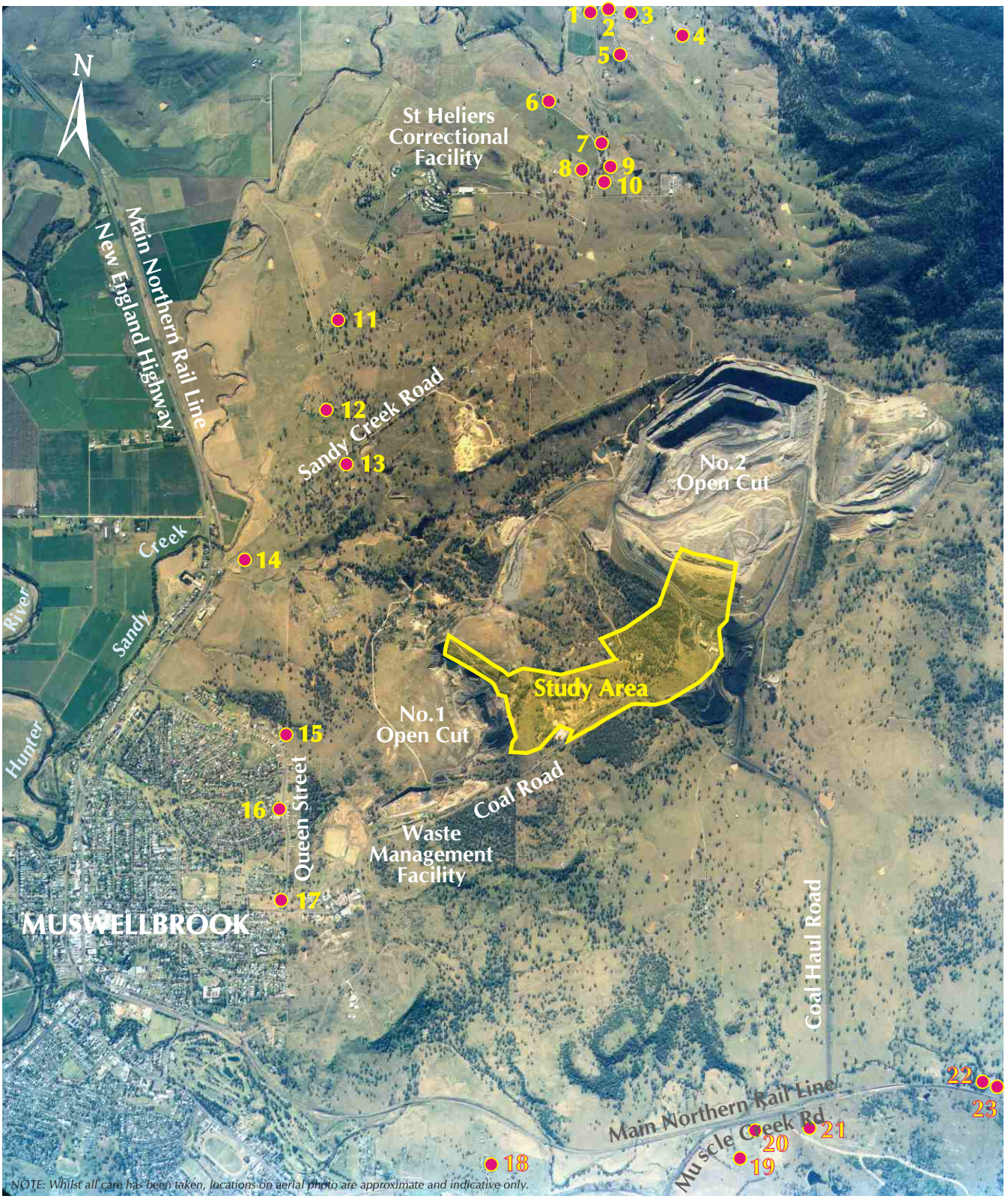
File Name: FAUNA SURVEY LOCATIONS.CDR



File Name: SOILS.CDR


N
No.2 Opencut Overburden Emplacement
No.1 Opencut
LEGEND
Study Area
Class IV
Class V
Class VI
Mining Area
SCALE
0
250
500
Metres
NOTE: Whilst all care has been taken, locations on aerial photo are approximate and indicative only.
File Name: LAND CLASS.CDR
MUSWELLBROOK COAL COMPANY LIMITED
Land Capability
FIGURE 3.5


N
No.2 Opencut
Overburden
Emplacement
No.1
Opencut
LEGEND
Study Area
Class 4
Class 5
SCALE
0
250
500
Metres
NOTE: Whilst all care has been taken, locations on aerial photo are approximate and indicative only.
MUSWELLBROOK COAL COMPANY LIMITED
Agricultural Suitability Class
FIGURE 3.6
File Name: AGR SUITABILITY.CDR



LEGEND

8 ● Denotes Residence

SCALE

0 1 2

Kilometres

File Name: RESIDENCES.CDR

MUSWELLBROOK COAL COMPANY LIMITED

Residences

FIGURE 3.7

FIGURE 3.8. View of MCC operations from Queen Street.

FIGURE 3.9. View of MCC from 3 km north of Muswellbrook.
Photo taken from the New England Highway.

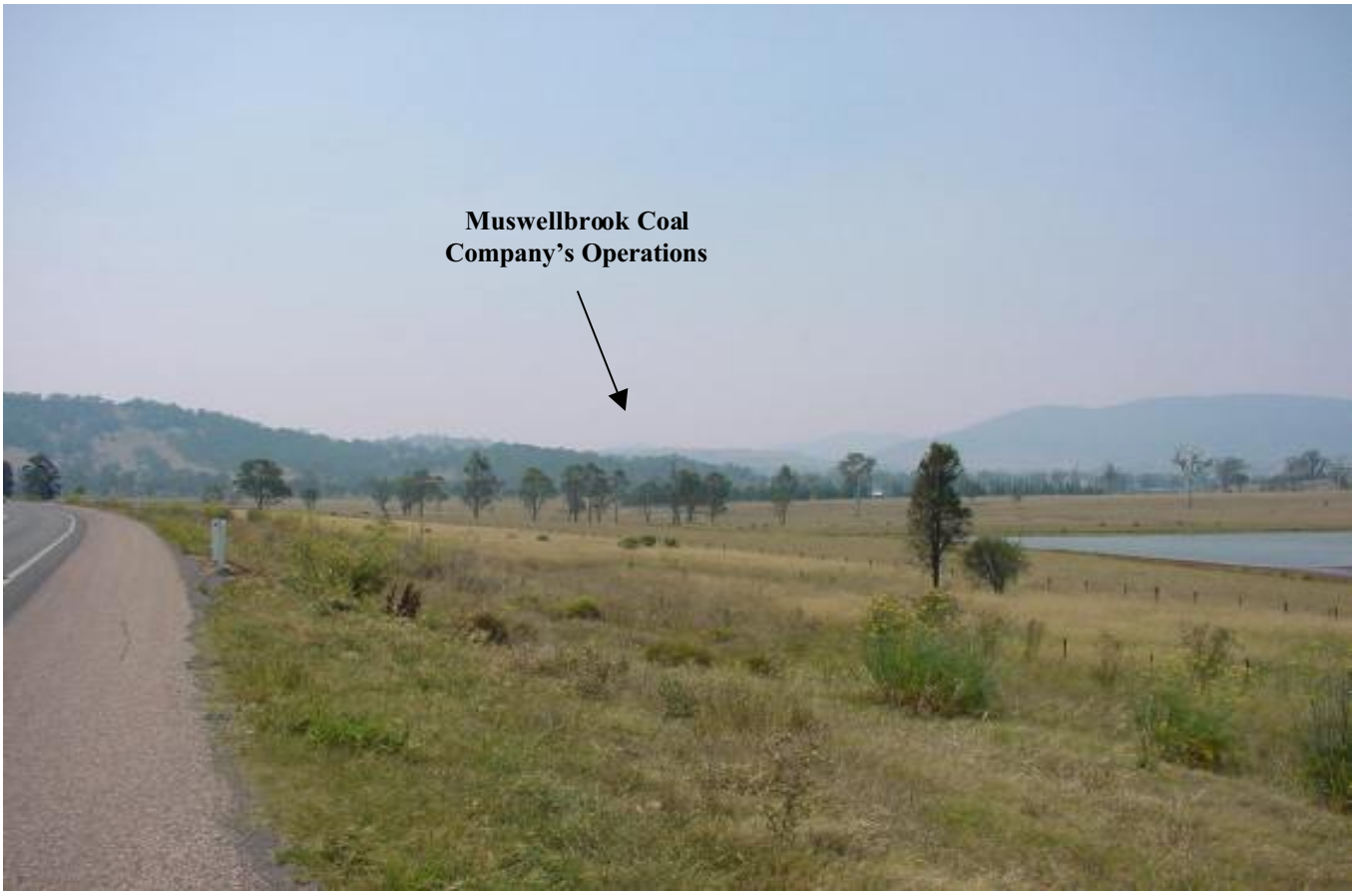
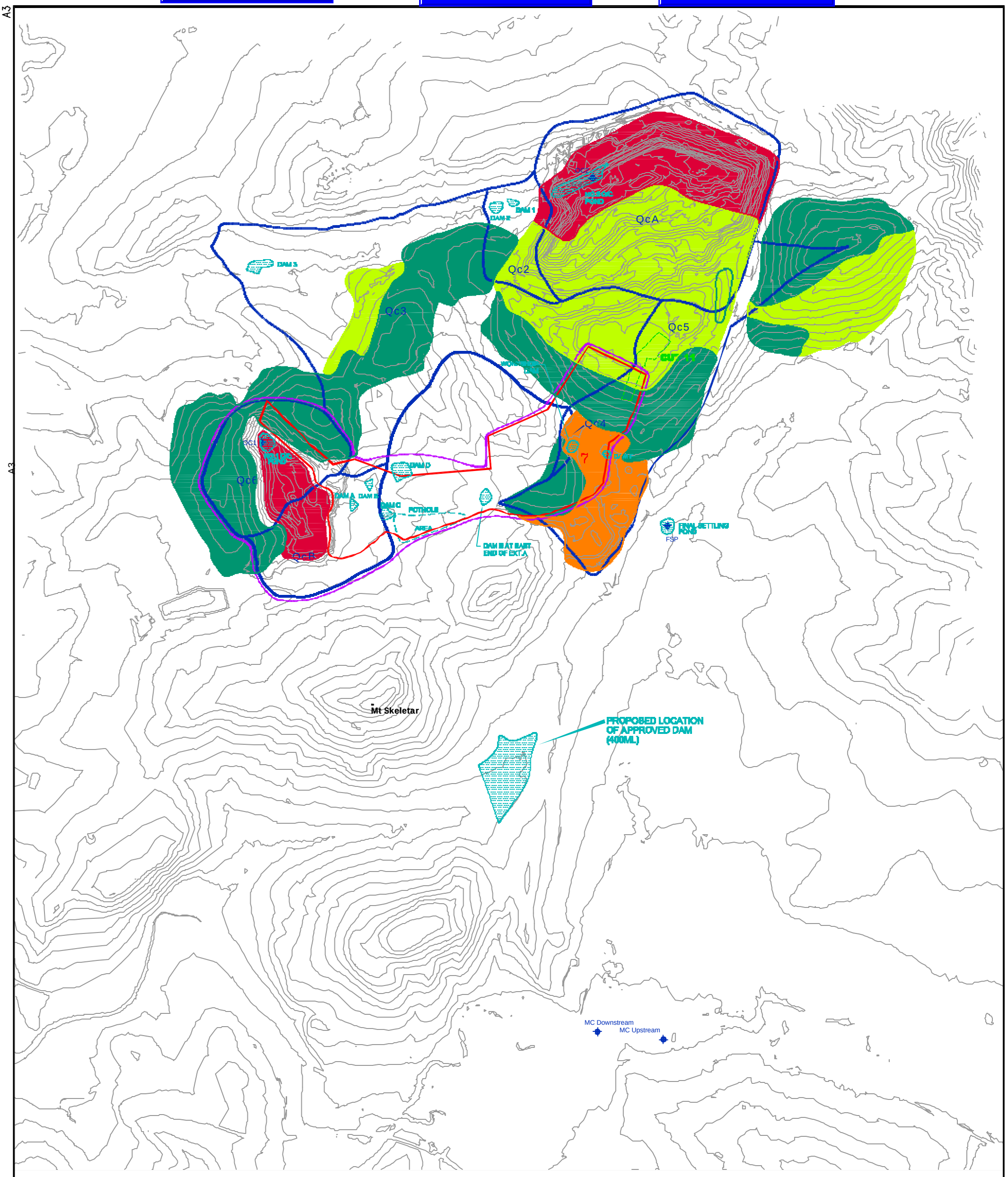


FIGURE 3.10. View towards MCC's operations from New England Highway 5 km south of Muswellbrook.

FIGURE 3.11. View towards MCC's operations from Sandy Creek Road.



LEGEND

- PROPOSED EXTENSION
- CURRENT CATCHMENT BOUNDARIES
- NEW CATCHMENTS CREATED BY PROPOSAL
- MCC WATER MONITORING SITES
- ACTIVE MINING AREA
- REHABILITATED SPOIL
- UNREHABILITATED SPOIL
- INFRASTRUCTURE

0 0.5 1.0
metres

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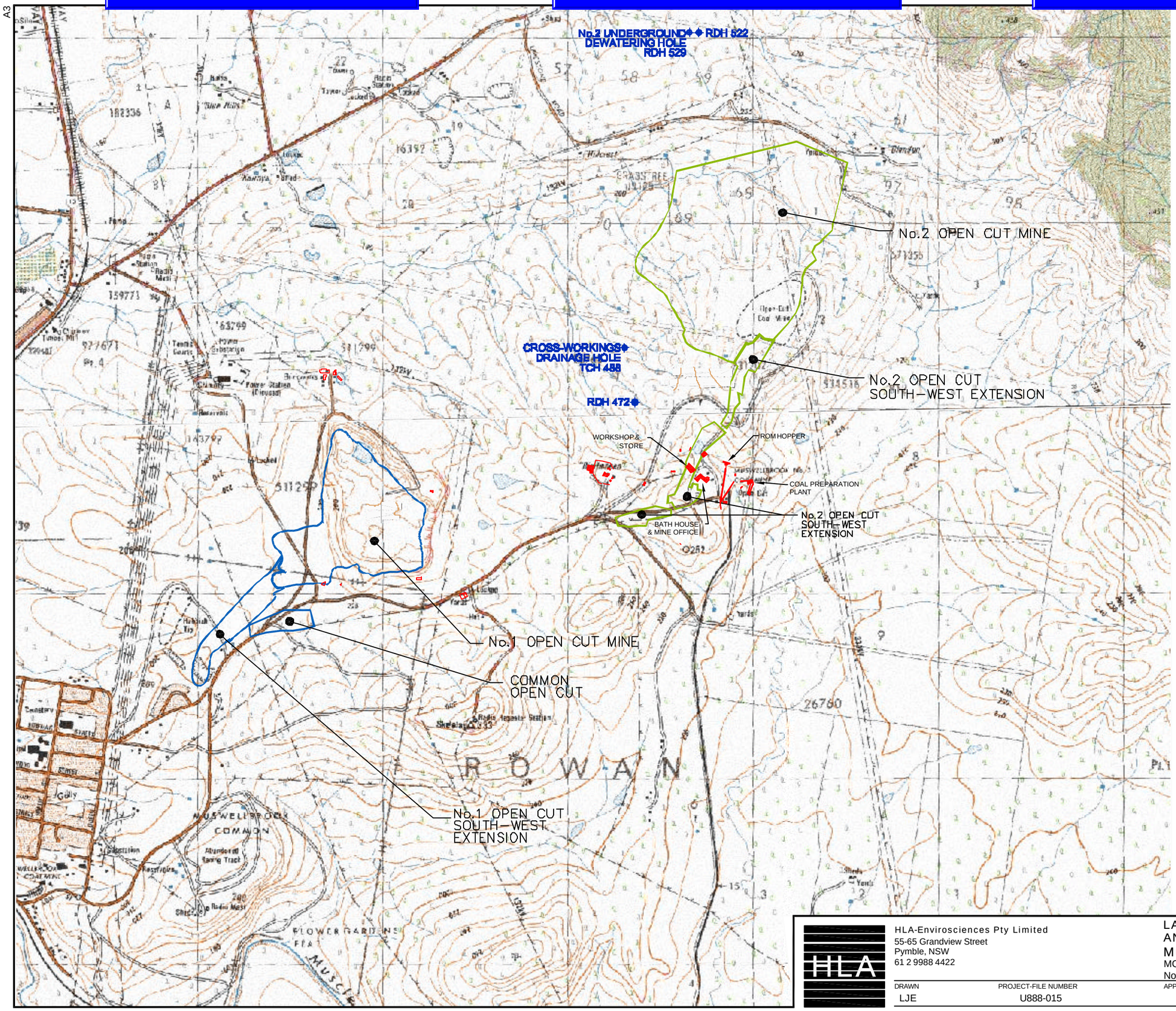
61 2 9988 4422

MINE CATCHMENTS AND MCC WATER MONITORING LOCATIONS
Muswellbrook Coal Company Ltd
MCC Environmental Impact Statement
No.1 Open Cut Extension, Muswellbrook NSW

FIGURE 3.12

DRAWN	PROJECT-FILE NUMBER	APPROVED	DATE	REVISED DATE
LJE	U888-014		June 2002	

A3



LEGEND

- SITE INFRASTRUCTURE
- MINE BORES

N

0 0.5 1.0
metres

HLA

HLA-Envirosciences Pty Limited
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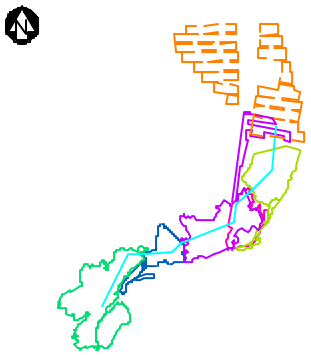
Pymble, NSW
61 2 9988 4422

LAYOUT OF CURRENT OPERATIONS AND INFRASTRUCTURE
Muswellbrook Coal Company Ltd
MCC Environmental Impact Statement
No.1 Open Cut Extension, Muswellbrook NSW

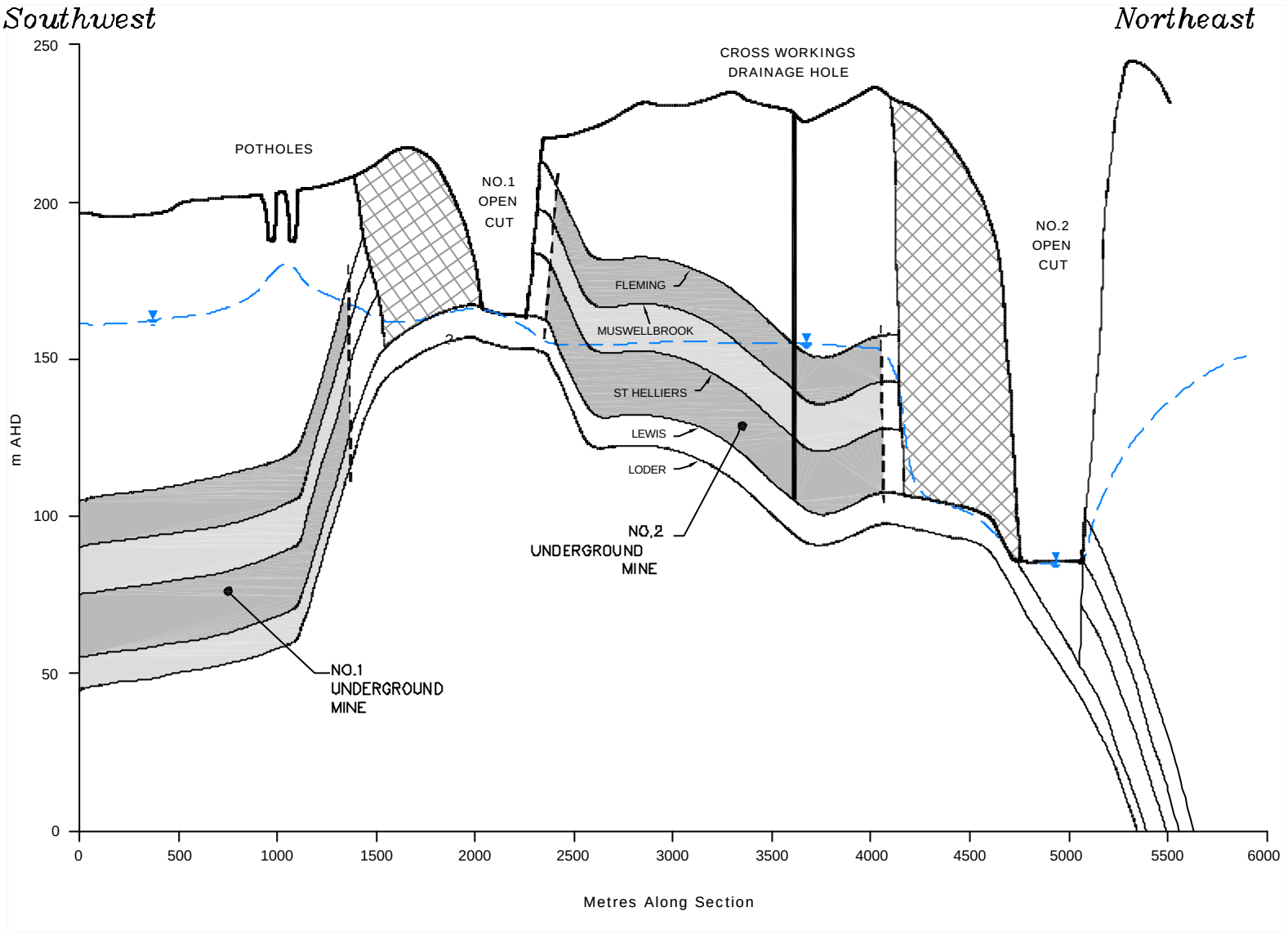
FIGURE **3.13**

DRAWN	PROJECT-FILE NUMBER	APPROVED	DATE	REVISED DATE
LJE	U888-015		June 2002	



LEGEND

- CROSS SECTION LOCATION
- INFERRED COMPOSITE POTENTIOMETRIC SURFACE IN HARD ROCK



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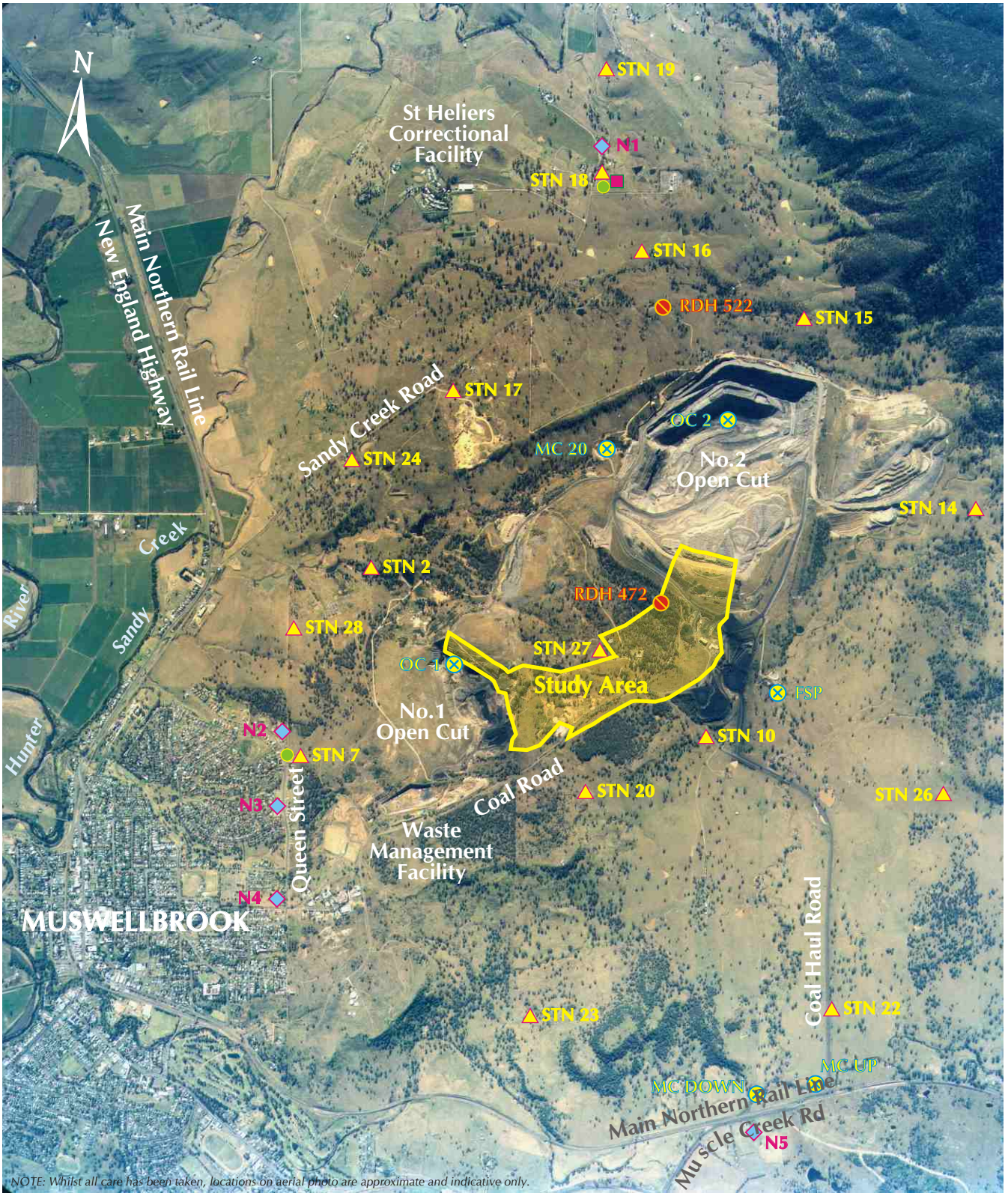
HYDROGEOLOGICAL CROSS SECTION
Muswellbrook Coal Company Ltd
MCC Environmental Impact Statement
No.1 Open Cut Extension, Muswellbrook NSW

FIGURE **3.14**

DRAWN	PROJECT-FILE NAME	APPROVED	DATE	REVISED DATE
LJE	U888-016		June 2002	



LEGEND

- Dust Deposition Gauge
- Blast Monitor
- TSP Dust Monitor
- Noise Measurement Locations
- Surface Water Monitoring Location
- Groundwater Monitoring Borehole

SCALE

0 1 2

Kilometres

MUSWELLBROOK COAL COMPANY LIMITED

Monitoring Locations

FIGURE 3.15

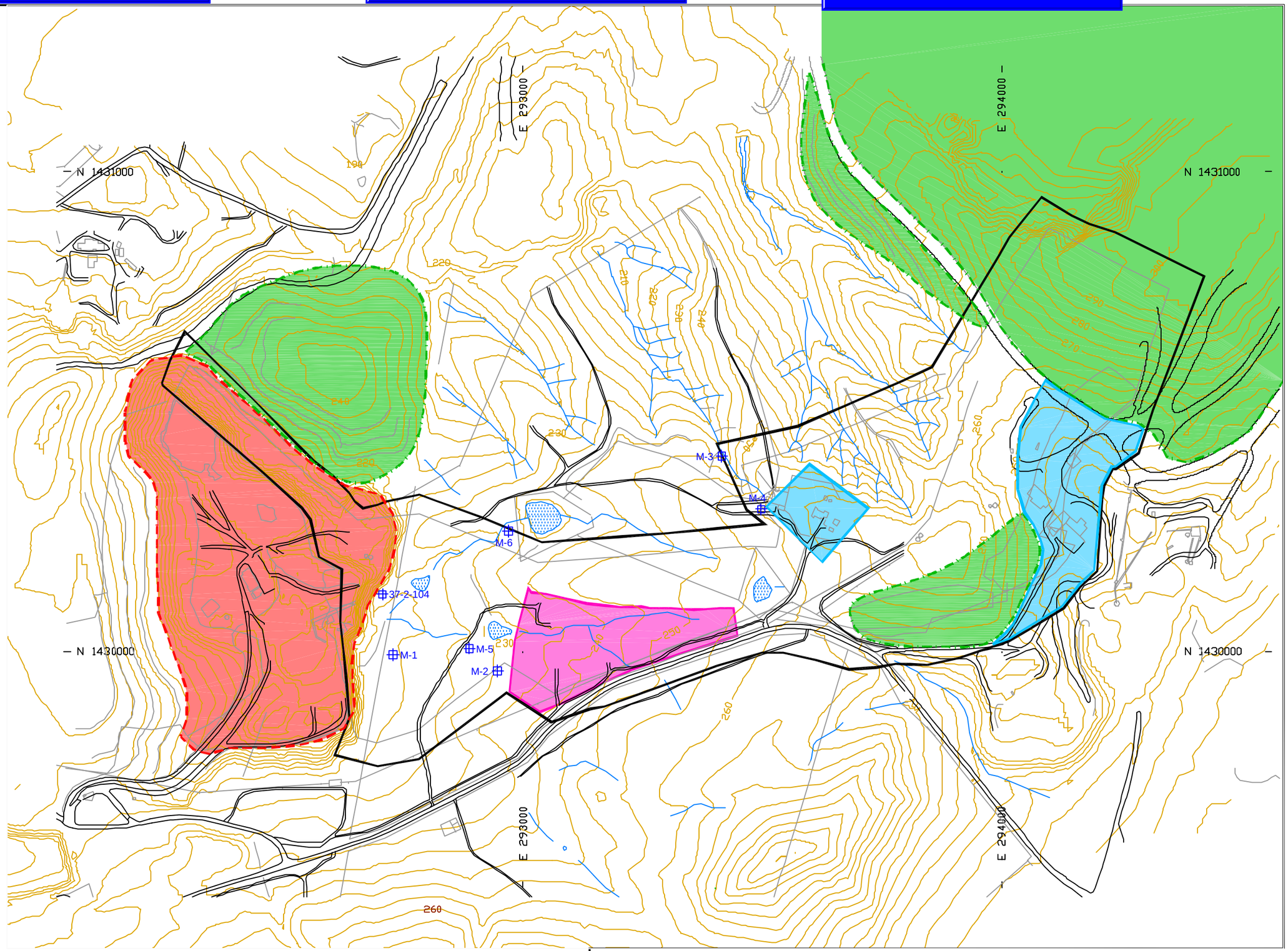
File Name: DUST LOCATIONS.CDR

A3

LEGEND

- ARCHAEOLOGICAL SITE
- DAMS
- REHABILITATION AREA
- OPEN CUT MINING PIT
- SUBSIDENCE EXCLUSION ZONE
- INFRASTRUCTURE AREAS

0 100 200 300 400
metres



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PREVIOUS LANDUSE IMPACTS
Muswellbrook Coal Company Ltd
MCC Environmental Impact Statement
Muswellbrook Coal Mine, NSW

FIGURE 3.16

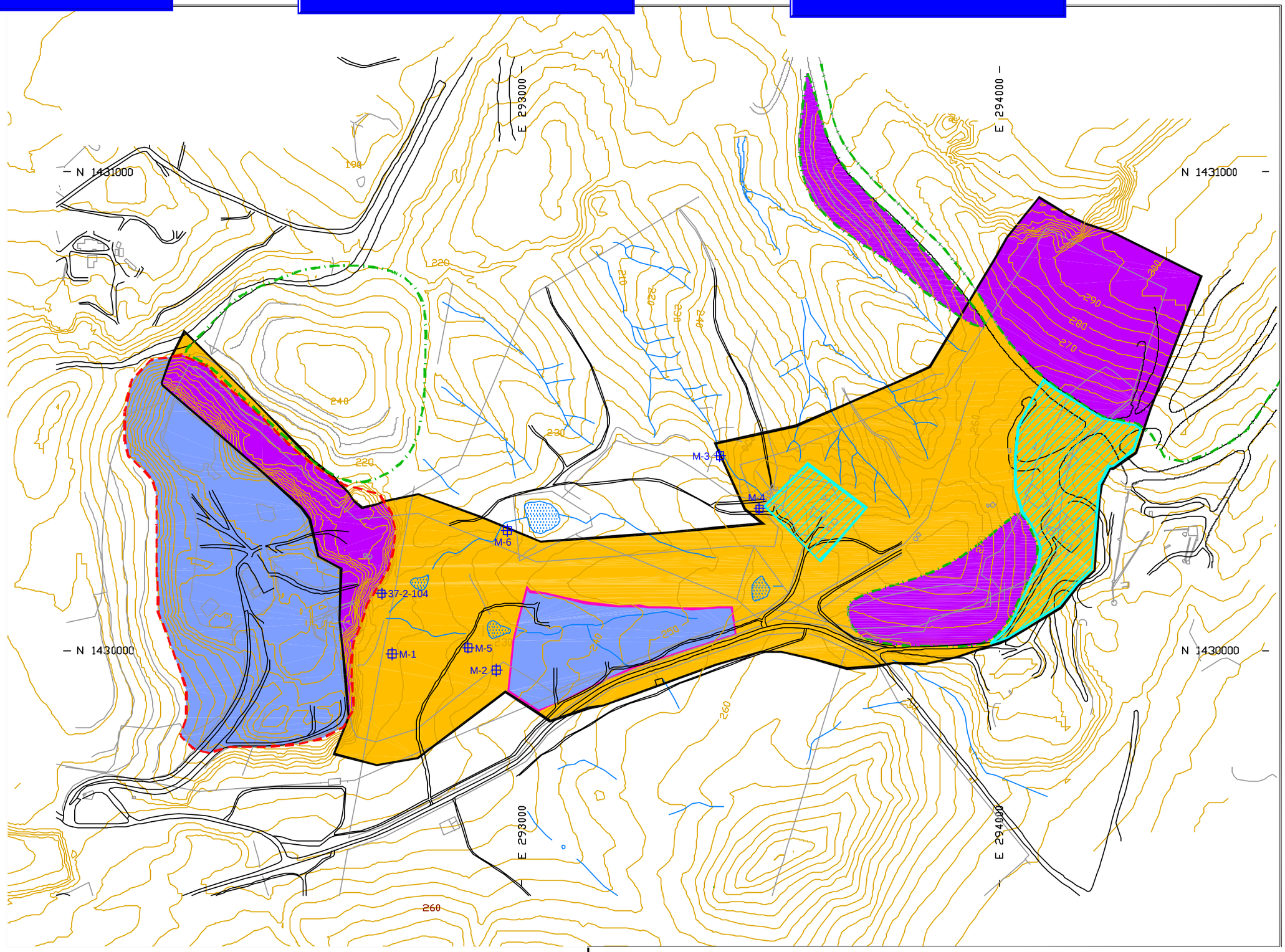
DRAWN	PROJECT-FILE NUMBER	APPROVED	DATE	REVISED DATE
LJE	U888-017		June 2002	

A3

LEGEND

- ARCHAEOLOGICAL SITE
- DAMS
- REHABILITATION AREA
- OPEN CUT MINING PIT
- SUBSIDENCE EXCLUSION ZONE
- INFRASTRUCTURE AREAS
- AREA OF HIGH DISTURBANCE
- AREA OF MODERATE TO HIGH DISTURBANCE
- AREA OF MODERATE DISTURBANCE

0 100 200 300 400
metres



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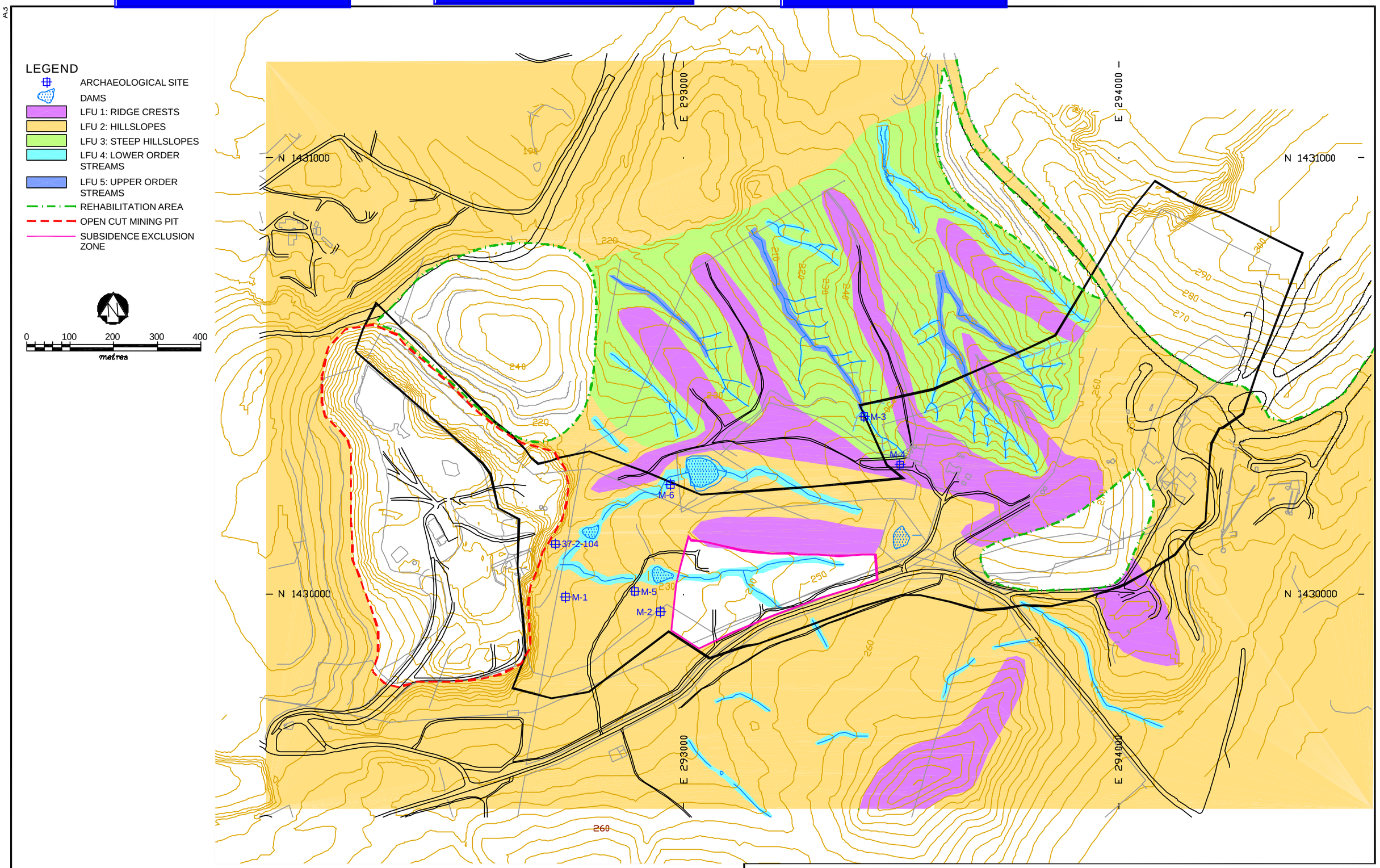
DISTURBANCE ZONES
Muswellbrook Coal Company Ltd
MCC Environmental Impact Statement
Muswellbrook Coal Mine, NSW

FIGURE 3.17

DRAWN	PROJECT-FILE NUMBER	APPROVED	DATE	REVISED DATE
LJE	U888-018		June 2002	



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Pymble, NSW
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LANDFORM UNITS
Muswellbrook Coal Company Ltd
MCC Environmental Impact Statement
Muswellbrook Coal Mine, NSW

FIGURE 3.18

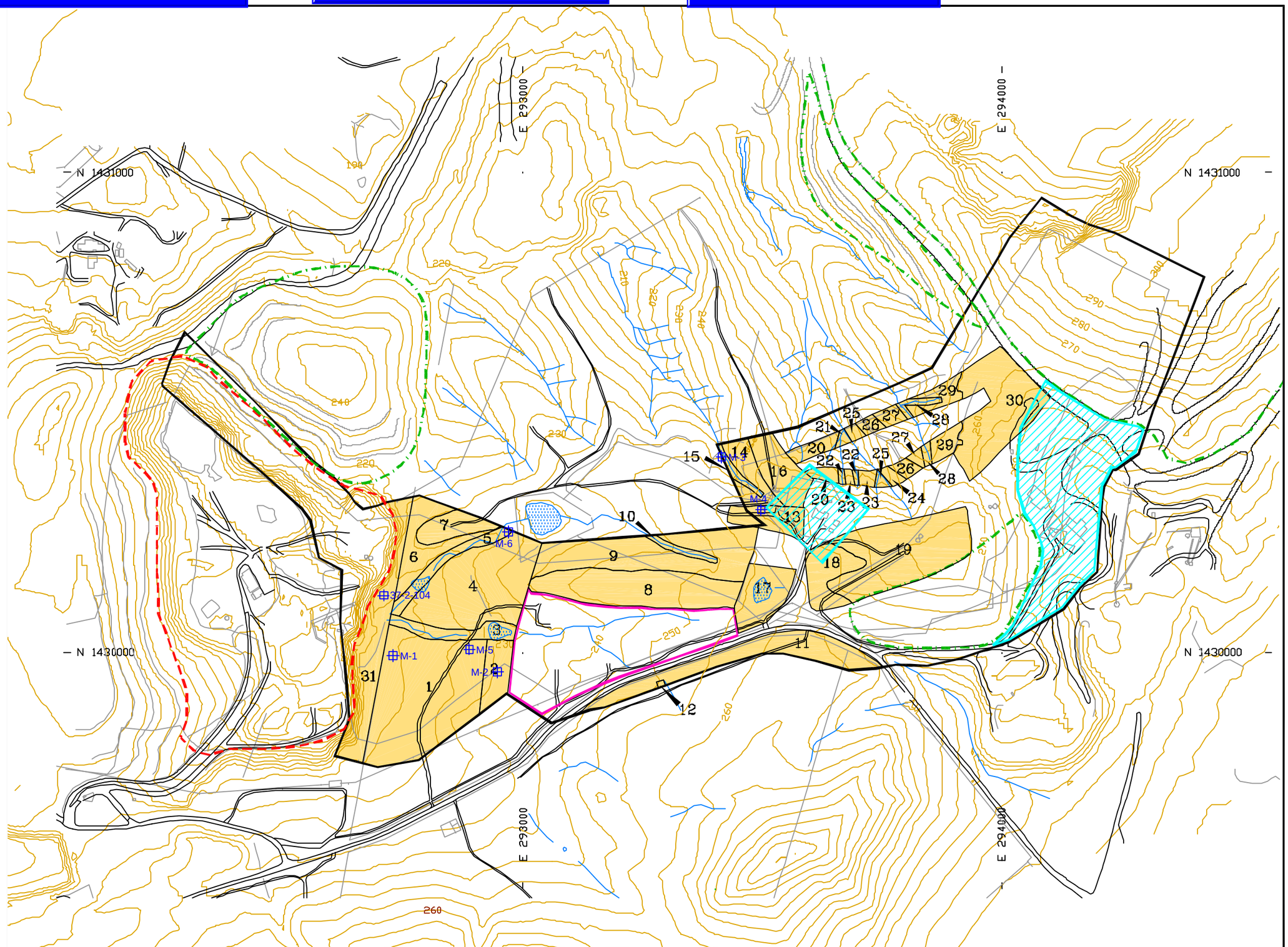
DRAWN	PROJECT-FILE NUMBER	APPROVED	DATE	REVISED DATE
LJE	U888-019		June 2002	

A3

LEGEND

- ARCHAEOLOGICAL SITE
- DAMS
- ARCHAEOLOGICAL SURVEY UNITS
- REHABILITATION AREA
- OPEN CUT MINING PIT
- SUBSIDENCE EXCLUSION ZONE
- INFRASTRUCTURE AREAS

0 100 200 300 400
metres



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ARCHAEOLOGICAL SURVEY UNITS

Muswellbrook Coal Company Ltd
MCC Environmental Impact Statement
Muswellbrook Coal Mine, NSW

FIGURE **3.19**

DRAWN	PROJECT-FILE NUMBER	APPROVED	DATE	REVISED DATE
LJE	U888-020		June 2002	