



EIS 921 Vol 4

AA018196

Environmental Impact Statement for Bengalla Coal Mine :
prepared for Bengalla Mining Company

NSW DEPT PRIMARY INDUSTRIES



AA018196

BENGALLA

**ENVIRONMENTAL
IMPACT
STATEMENT**

for

**BENGALLA
COAL MINE**

NOVEMBER 1993



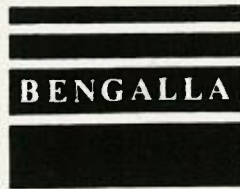
**ENVIROSCIENCES
PTY LIMITED**

622.334099442
ENV

Volume

4

**APPENDICES
7 - 16**



PREPARED FOR:
BENGALLA MINING COMPANY PTY LIMITED

ENVIRONMENTAL
IMPACT
STATEMENT

for

**BENGALLA
COAL MINE**

NOVEMBER 1993



PREPARED BY:
ENVIROSCIENCES PTY LIMITED

622.334099442
ENV

TABLE OF CONTENTS

VOLUME 4

APPENDICES

- APPENDIX 7 : BENGALLA JOINT VENTURE POLICIES
- APPENDIX 8 : PROPERTY OWNERS AND OCCUPIERS
- APPENDIX 9 : AGRICULTURAL INDUSTRIES AND PRODUCTION WITHIN
THE AUTHORISATION AREA OF THE PROPOSED BENGALLA
COAL MINE AND A TWO KILOMETRE RADIUS OF THE
AUTHORISATION AREA
- APPENDIX 10 : ROAD TRANSPORT STUDY FOR BENGALLA COAL DEVELOPMENT
AREA
- APPENDIX 11 : SOCIO ECONOMIC ASSESSMENT
- APPENDIX 12 : ARCHAEOLOGICAL SURVEY
- APPENDIX 13 : BENGALLA MINE PROJECT HERITAGE ASSESSMENT
- APPENDIX 14 : VISUAL IMPACT ASSESSMENT FOR PROPOSED BENGALLA
OPENCUT MINE PROJECT
- APPENDIX 15 : CHEMICAL CHARACTERISTICS OF OVERBURDEN
- APPENDIX 16 : LIGHTING IMPACTS AND RECOMMENDATIONS FOR PROPOSED
BENGALLA MINE

APPENDIX 7
BENGALLA JOINT VENTURE POLICIES

BENGALLA JOINT VENTURE

LAND OWNERSHIP POLICY

COMMITMENT

The Joint Venture commits to this Land Ownership Policy to ensure that the proper interests and reasonable requirements of landowners impacted by the mine, to a degree or in a manner incompatible with the reasonable continued use and occupation of the land, are met by the Joint Venture.

POLICY

1. The Joint Venture recognises that the mine will have predictable impacts on some rural properties to the degree that, for some time, they are not able to be used:
 - * as a residence; or
 - * for agricultural purposes.
2. The Joint Venture recognises that land used for the:
 - * conduct of mining will be sterilised until rehabilitated;
 - * coal preparation and infrastructure will be sterilised during the life of the mine.
3. The environmental assessment will identify the lands referred to in policies 1. and 2.
4. The Joint Venture will enter into agreements with the owners of identified impacted lands to the effect that if the Joint Venture resolves to proceed with the mine it will either:-
 - * lease; or
 - * purchase;the identified land, as may be negotiated with the landowner.
5. Any purchase of land will be for a price and on terms in accordance with conditions set down in prior coal mining development consents and any lease will be on terms that recognise these principles.
6. The Joint Venture will inform landowners of the extent and timing of expected impacts on their properties.

BENGALLA JOINT VENTURE

WATER POLICY

COMMITMENT

The Bengalla Joint Venture recognises the importance of ensuring that the surface and ground water resource available to current and future agricultural, mining, industrial and domestic users in the Hunter Valley is not substantially affected by the development and operation of the Bengalla coal mine.

POLICY

In committing to this policy, the Joint Venture will:

1. Undertake a comprehensive investigation of the existing surface and groundwater systems and their inter-relationships.
2. Design, maintain and operate the mine so that there is no requirement by the mine to discharge mine waters whose contaminants exceed levels determined by the Environmental Protection Authority.
3. Design, construct and operate the mine so as to prevent any escape of contaminated water in all conditions other than when exceptionally high rainfall events occur as determined by the Environmental Protection Authority.
4. Implement and conduct during the life of the mine a water monitoring programme to determine the availability and quality of water before, during and after mining.
5. Maximise the use of contaminated mine water on site in the operation of the coal washery and dust suppression to minimise the use of water from outside the mining area.
6. Design, construct and operate the mine to prevent the entry of rainfall run-off into the mine site.
7. Design, construct and operate the mine to prevent interference with groundwater systems outside the mining area.
8. Design and construct the mine so as not to interfere with catchments outside the mining area.
9. Design and construct the after-mine rehabilitated landform taking into account water catchments.

BENGALLA JOINT VENTURE

LAND USE POLICY

COMMITMENT

The Joint Venture commits to this Land Use Policy in order to ensure that disturbance to agricultural productivity in and around the Bengalla coal mine is minimised during the development and operation of the mine.

POLICY

1. The Bengalla Joint Venture recognises the two major natural economic resources of the Hunter Valley are:
 - * agricultural productivity; and
 - * coal.
2. The Joint Venture seeks to realise and maximise the value of an in-situ coal resource by mining the Bengalla area.
3. In designing, developing and operating the mine there is a requirement to:
 - * minimise the impact on agricultural production;
 - * return mined land to agricultural productivity.
4. The Joint Venture recognises that:
 - * mining is a temporary land use;
 - * stable long term agricultural production is best achieved by landowners;
 - * there is a need for the Joint Venture to become involved in agricultural production.
5. The Joint Venture also recognises the need to:
 - * rehabilitate land to at least its pre-mining capability;
 - * re-establish agricultural land use;
 - * rehabilitate progressively during mining;
 - * re-establish use of the land by landowners.

APPENDIX 8
PROPERTY OWNERS AND OCCUPIERS

LAND OWNERSHIP AND RESIDENCES WITHIN AND ADJACENT TO BENGALLA AUTHORISATION AS AT 15/10/93			
Location	Number in Figure	Land Owner, Property Name, Address, Area.	Occupier
Wholly within Bengalla Authorisation	1	E. E. McLean and others, Wybong Road 249 ha	No residence
	2	Bengalla Mining Company Pty Ltd, Wybong Road 76.08 ha	No residence
	3	D. J. Glover, Wybong Road 58.58 ha	No residence
	4	R. G. & B. Parker, Wybong Road 56.8 ha	No residence
	5	K. J. & E. M. Yore, Wybong Road & Bengalla Road 34.16 ha	No residence
	6	A. Yore, Bengalla Road 2.023 ha	No residence
	7	L. H. Steman, "Valley View" Wybong Road and Bengalla Road 10.12 ha	2 residences a) L. H. & K. E. Steman b) tenant
	8	D. & R. M. McLean, "Karinya" Wybong Road and Logues Lane 9.976 ha	D. K. & R. J. McLean
	9	Bengalla Mining Company Pty Ltd, Logues Lane 10.10 ha	No residence
	10	Bengalla Mining Company Pty Ltd Bengalla Road and Logues Lane 40.03 ha	E. R. Markham
	11	O. J. & J. M. Carter, "Overdene", Bengalla Road 15.8 ha	2 residences a) D. J. & J. M. Carter b) G. J. & K Carter
	12	R. & K. Collins, Bengalla Road 6.973 ha	R. J. Collins
	13	D. J. & J. M. Wild, "Overton", Bengalla Road 43.93 ha	D. J. & J. M. Wild
	14	T. G. & E. A. Sternbeck, Bengalla Road 32.85 ha	T. G. Sternbeck
	15	L. G. & M. E. Daniels, Bengalla Road 175.5 ha	No residence

LAND OWNERSHIP AND RESIDENCES WITHIN AND ADJACENT TO BENGALLA AUTHORISATION AS AT 15/10/93			
Location	Number in Figure	Land Owner, Property Name, Address, Area.	Occupier
Wholly within Bengalla Authorisation	16	G. R. & J. R. Cook, Bengalla Road 10.9 ha	Tenants
	17	R. H. Reynolds, Bengalla Road 132.6 ha	No residence
	18	Bengalla Mining Co. Ltd, "Reneilen", Bengalla Road 19.5 ha	Tenants
	19	Estate Late J. H. Keys, via Bengalla Road 88.73 ha	No residence
Partly within Bengalla Authorisation, North of Hunter River	20	M. J. & M. E. Smith, "Kurrajong", Wybong Road 109.2 ha	No residence
	21	J. B. & H. R. Hofman, Roxburgh Road 86.81 ha	No residence
	22	D. C. & M. M. Koureas, "Dalama Thoroughbred Stud" (a to e) and "Wyndham Arms"(f), Bengalla Road 614.4 ha	6 residences a) Tenants b) " " " c) " " " d) " " " e) " " " f) " " "
	23	H. J. Flemming, "Miami Jersey Stud", Bengalla Road 125.7 ha	H. J. Fleming
	24	R. G. & B. Parker, "Creighton Park" Bengalla Road 127.6 ha	2 residences a) R. G. & B. Parker b) Tenants
	25	K. A. Moffit, "Glendor", Bengalla Road 125 ha	D. L. & V. A. Ackers
	26	G. Ackers, "Texas", Bengalla Road 106.9 ha	Tenants
	27	R. G. & H. D. Thompson, "Koorbor", Bengalla Road 71.41 ha	2 residences a) R. G. & R. S. Thompson b) Tenants
	28	Wybong Dalry Limited, "Wantana", Bengalla Road 126.4 ha	2 residences Wybong Friesian Stud a) D. Munro b) W. Munro
29	R. H. Reynolds, "Bengalla", Bengalla Road 143.5 ha	2 residences a) S. B. & R. H. Reynolds b) Tenants	

LAND OWNERSHIP AND RESIDENCES WITHIN AND ADJACENT TO BENGALLA AUTHORISATION AS AT 15/10/93			
Location	Number in Figure	Land Owner, Property Name, Address, Area.	Occupier
Partly within Bengalla Authorisation, North of Hunter River	30	Late Estate J. H. Keys, Bengalla Road 73.35 ha	Tenant
	31	R. D. & M. Alexander, Logues Lane and Bengalla Road 25.36 ha	No residence
Partly within Bengalla Authorisation, South of Hunter River	86	R. J. & R. L. Quineil 5 Racecourse Road 3.82 ha	J. & R. Quineil
	87	N. H. Boyle, Racecourse Road 5.059 ha	No residence
	88	A. D. L. & C. A. & W. J. & V. S. Hopmans Racecourse Road 8.389 ha	A. D. L. & C. A. & W. J. & V. S. Hopmans
	89	N. B. & M. C. McInerney, Racecourse Road 4.149 ha	N. B. & M. C. McInerney
	90	P. M. Farrell and others, "Farrells Stables", 111 Racecourse Road 4.047 ha	P. M. Farrell
	91	Glenrayley Investment, "Kintaro", Racecourse Road 4.087 ha	C. H. & R. Pryor
	92	J. L. Bowen, Racecourse Road 4.198 ha	Jan Bowen
North of Bengalla Authorisation	32	T. M. Peel, "Broomfield Station" Wybong Road 1267 ha	T. M. Peel
	33	Coal & Allied Operations Pty Ltd Wybong Road 49.91 ha	Tenant
	34	H. J. Camper & J. A. Ellul, Wybong Road 48.95 ha	No residence
	35	G. G. B. Pearce, Wybong Road 48.37 ha	No residence
	36	C. F. & G. P. Bates, Wybong Road 213.7 ha	No residence
	37	Bengalla Mining Co. Ltd Wybong Road 60.71 ha	No residence

LAND OWNERSHIP AND RESIDENCES WITHIN AND ADJACENT TO BENGALLA AUTHORISATION AS AT 15/10/93			
Location	Number in Figure	Land Owner, Property Name, Address, Area.	Occupier
North of Bengalla Authorisation	38	G. J. Scriven, via Wybong Road 252.4 ha	No residence
	39	A. R. Skippen, via Wybong Road 0.1884 ha	A. R. Skippen
	40	A. L. Gardiner, "Hillview" Wybong Road 39.46 ha	A. L. Gardiner
	41	Pastoral Protection Board, Wybong Road 40 ha	No residence
	42	J. Reynolds, Wybong Road 3.908 ha	J. M. Reynolds
	43	Bengalla Mining Co. Ltd "Wirrimbirra", Wybong Road 4.047 ha	Tenant
	44	Bengalla Mining Co. Ltd Wybong Road 25.46 ha	Tenant
	45	Bengalla Mining Co. Ltd Wybong Road 1.214 ha	Tenant
	46	R. & M. Lawrence, Wybong Road 4.518 ha	R. Lawrence
	47	Bengalla Mining Co Pty Ltd, "Windchime", Wybong Road 4.051 ha	Tenants
	48	A. & A. Riley, "The Willows" Wybong Road 40.13 ha	J. & D. L. Riley
	49	Bengalla Mining Co Pty Ltd, "Elouera", Wybong Road 0.2237 ha	Tenants
	50	L. & C. Hamson, Wybong Road 4.639 ha	L. G. & C. J. Hamson
	51	N. & R. Eills, "Berrywood Farm", Wybong Road 4.722 ha	N. J. Eills
52	P. & B. McKinnon, Wybong Road 4.864 ha	P. & B. McKinnon	

LAND OWNERSHIP AND RESIDENCES WITHIN AND ADJACENT TO BENGALLA AUTHORISATION AS AT 15/10/93			
Location	Number in Figure	Land Owner, Property Name, Address, Area.	Occupier
North of Bengalla Authorisation	53	G. Scriven, 'Hilltop Brahman', 213 Wybong Road 9.647 ha	G. Scriven
	54	K. J. & M. A. Thompson Sowerby Street, Muswellbrook 14.3 ha	Under Construction
	55	O. J. O'Keefe and others, 'Seilwood' via Wybong Road 14.3 ha	A. J. O'Keefe
	56	A. F. & S. J. Matthews, 211 Wybong Road 16.39 ha	A. F. & S. J. Matthews
	57	D. & J. Hugo, 'Roselyn', Wybong Road 30.76 ha	D. Hugo
	58	Rosebrook Pty Limited, 'Rosehill Stud', Rosebrook Lane and Wybong Road 1536 ha	2 residences a) T. Blake b) F. Blake
East of Bengalla Authorisation, North of Hunter River	59	J. M. Carter, 'Karooa', Logues Lane 85.85 ha	2 residences a) F. J. Carter b)
	60	Estate of Late G. H. Alexander, 'Thornbro', Logues Lane 57.33 ha	3 residences a) R. N. Alexander b) c)
	61	Jabetin Pty Ltd Logues Lane 22.16 ha	N. Sakno
	62	R. N. Alexander, 'Oak Farm', Logues Lane 21.65 ha	Tenants
	63	C. & V. P. Horne, 'Cricki', Wybong Road 36 ha	2 residences a) C. & V. Horne b) Tenants
	64	M. A. & R. E. McLean, Wybong Road 14.7 ha	2 residences a) M. A. McLean b) Tenant
	65	R. K. & N. V. Googe, Wybong Road 28.7 ha	No residence
	66	J. M. Simpson, Wybong Road 0.1 ha	No residence
	67	R. B. Parkinson, Wybong Road 0.07 ha	No residence

LAND OWNERSHIP AND RESIDENCES WITHIN AND ADJACENT TO BENGALLA AUTHORISATION AS AT 15/10/93			
Location	Number in Figure	Land Owner, Property Name, Address, Area.	Occupier
East of Bengalla Authorisation, North of Hunter River	68	V. C. & N. A. George, 206 Wybong Road 0.07 ha	V. C. George
	69	R. C. Myers, Wybong Road 0.07 ha	R. C. Myers
	70	R. J. Galvin, Wybong Road 0.07 ha	R. J. Galvin
	71	N. B. & J. A. Simpson, Wybong Road 0.07 ha	N. B. Simpson
	72	S. & K. Poverino, Wybong Road 0.07 ha	S. J. Poverino
	73	A. J. Ingram, Wybong Road 0.07 ha	Under Construction
	74	W. W. Clark, Wybong Road 0.07 ha	No residence
	75	B. R. & J. M. Ellis, Wybong Road 0.07 ha	? tenants
	76	L. J. & D. M. Purser, Wybong Road 3.64 ha	L. J. Purser
	77	L. G. & N. F. Castledine, Corner Kayuga Road and Wybong Road 1.958 ha	L. G. & N. F. Castledine
	78	D. L. & F. R. Wicks, 412 Kayuga Road 0.12 ha	D. L. Wicks
	79	W. J. Adnum, 411 Kayuga Road 0.08 ha	W. J. Adnum
	80	W. J. & M. L. Adnum, Kayuga Road 2.633 ha	Tenants
81	C. K. Murray, Kayuga Road 2.056 ha	C. K. Murray	

LAND OWNERSHIP AND RESIDENCES WITHIN AND ADJACENT TO BENGALLA AUTHORISATION AS AT 15/10/83			
Location	Number in Figure	Land Owner, Property Name, Address, Area.	Occupier
East of Bengalla Authorisation, South of Hunter River	82	B. D. & J. Englebrecht, Racecourse Road 4.843 ha	2 residences a) J. N. Englebrecht b) B. D. Englebrecht
	83	B. F. & P. F. Behringer, Racecourse Road 4.065 ha	B. & P. Behringer
	84	I. D. & G. Z. Gothard, "The Willows", Racecourse Road 3.7 ha	I. D Gothard
	85	J. A. & L. J. Lamb, Racecourse Road 3.42 ha	J. A. Lamb
	93	M. J. McGoldrick, Racecourse Road 2.858 ha	M. J. McGoldrick
	94	K. B. & J. A. Barnett, Racecourse Road 2.694 ha	K. B. & J. A. Barnett
	95	D. P. Englebrecht, Racecourse Road 2.883 ha	P. Englebrecht
	96	F. K. Almond and others, Racecourse Road 6.07 ha	No residence
	97	S. W. Barkley, Racecourse Road and Denman Road 6.07 ha	S. Barkley
	98	R. J. & J. M. Duncan, Denman Road 26.45 ha	J. Duncan
	99	Upper Hunter Racing Club Limited, Racecourse Road 43.25 ha	No residence
	100	J. & D. Robinson, Racecourse Road 0.1453 ha	J. Robinson
	101	M. C. & L. J. Dobie, Racecourse Road 0.1264 ha	No residence
	102	J. M. Englebrecht, Racecourse Road 0.1603 ha	Tenant
103	A. M. Boyle, 11 Sheppard Avenue 0.2429 ha	A. & M. Boyle	

LAND OWNERSHIP AND RESIDENCES WITHIN AND ADJACENT TO BENGALLA AUTHORISATION AS AT 15/10/93			
Location	Number in Figure	Land Owner, Property Name, Address, Area.	Occupier
East of Bengalla Authorisation, South of Hunter River	104	A. G. Hill, 10 Sheppard Avenue 0.1987 ha	G. R. Hill
	105	L. V. Cribb, Sheppard Avenue 0.1544 ha	L. V. & P. J. Cribb
	106	Dura - Vinyl Pty Ltd, Sheppard Avenue 0.2055 ha	No residence
	107	J. J. Crosby, 4 Sheppard Avenue 0.4047 ha	J. J. Crosby
	108	R. J. Martin, Sheppard Avenue 0.4047 ha	? tenant
	109	Englebrecht Racing Stables, Sheppard Avenue 0.7153 ha	R. Englebrecht
	110	K. Casben, Sheppard Avenue & Denman Road 19.74 ha	3 residences a) K. & S. Casben b) ? tenant c) ? tenant
	111	M. H. & P. A. Keegan, "Kiambra", Denman Road 11.23 ha	M. H. & P. A. Keegan
South of Bengalla Authorisation, South of Hunter River	112	Domherr Pty Ltd, "Balmoral", Denman Road 84.15 ha	L. Cross
	113	R. N. & F. Webber, Denman Road 581.2 ha	No residence
	114	J. R. Scriven, 12 Denman Road 45.12 ha	J. R. Scriven
	115	Electricity Commission of NSW, several names, Denman Road a) b) "Delhaven Stud" c) "Emoclew" d) "Rouse Lench" e) "Edinglassie" f) g) h) i) "Whites Creek" j)	Edinglassie Estate a) L. & N. Roach/ B. Rankin b) T. Deianey c) M. Stewart/P. Feeney d) e) f) g) h) i) j)
	116	C. L. Ellis, Denman Road 117 ha	C. L. Ellis

LAND OWNERSHIP AND RESIDENCES WITHIN AND ADJACENT TO BENGALLA AUTHORISATION AS AT 15/10/93			
Location	Number in Figure	Land Owner, Property Name, Address, Area.	Occupier
South of Bengalla Authorisation, South of Hunter River	117	Taioma Pty Ltd, Denman Road 35.26 ha	B. C. & J. A. Ensbey
	118	B. W., E. & W. J. Rankin, Denman Road 53.51 ha	B. W. & E. Rankin
	119	B. W. & E. Rankin, Denman Road 40.87 ha	2 residences a) B. W. & E. Rankin b)
	120	J. & E. Zahra, "Killarney", Denman Road 33.18 ha	2 residences a) J. & E. Zahra b)
	121	L. G. Carter and others, "Gia Ginda", Denman Road 34.4 ha	L. G. & B. Carter
	122	J. N. Dimmock, "Greenleaves" Denman Road 30.3 ha	3 residences K, W. & J. N. Dimmock
	123	L. A. & H. E. Latham, Denman Road 32.35 ha	2 residences a) L. A. Latham b) ?
	124	M. G. & L. J. Latham, Denman Road 34.15 ha	M. G. & L. J. Latham
	125	Rosemount Estates Pty Ltd, Denman Road 33.56 ha	Manager's residence
	126	Muswellbrook Polo Club, Denman Road 16.19 ha	No residence
	127	Banugi Pty Ltd, "Corinda Park" Denman Road 51.94 ha	2 residences a) H. R. & Y. J. Barrell b) Oafox Pty Ltd
	128	P. G. & N. N. Richardson, via Denman Road 33.91 ha	P. & N. Richardson
	129	G. M. & R. Gray, "Lilyvale" & "Leahvale" Denman Road 33.99 ha	2 residences a) Duncan b) Duncan
	130	J. E. & D. J. Lowe, Denman Road 83.43 ha	No residence
131	B. E. & M. M. MacPherson, Denman Road 42.17 ha	No residence	

LAND OWNERSHIP AND RESIDENCES WITHIN AND ADJACENT TO BENGALLA AUTHORISATION AS AT 15/10/93			
Location	Number in Figure	Land Owner, Property Name, Address, Area.	Occupier
South of Bengalla Authorisation, North of Hunter River	132	Z. M. Ackers, "Redcliffe", Bengalla Road 117.01 ha	Z. M. Ackers
	133	M. & M. Chudyk, Bengalla Road 21.65 ha	2 residences a) M. T. & L. K. Chudyk b) Chudyk
West of Bengalla Authorisation	134	J. R. & J. Peel, "The Double J. Ranch", Roxburgh Road 174.9 ha	J. R. & J. Peel
	135	L. M. & K. M. F. Cameron, Roxburgh Road 49.09 ha	No residence
	136	P. J. & J. I. Brown, Roxburgh Road 39.96 ha	J. Brown
	137	P. J. Brown, Roxburgh Road 0.690 ha	? tenants
	138	E. A. & M. A. Constable, 317 Roxburgh Road 70.31 ha	E. A. & M. A. Constable
	139	R. J. Betteridge, 316 Roxburgh Road 40 ha	R. J. Betteridge
	140	P. M. & R. H. Peel, "Glengyle", Roxburgh Road 40.48 ha	P. M. & R. H. Peei
	141	K. R. Peel, 312 Roxburgh Road 40.58	K. R. Peel
	142	P. G. & C. M. Lane, "Kurrawalla" Roxburgh Road 41.2 ha	P. G. & C. M. Lane
	143	G. W. & G. M. Collins, Roxburgh Road 40 ha	G. W. & G. M. Collins
	144	Estate of J. H. Keys, via Roxburgh Road 0.2036 ha	No residence
	145	F. W. & P. E. Davey, Roxburgh Road 48.69 ha	F. W. Davey
	146	M. Taylor, Roxburgh Road 68.44 ha	No residence

LAND OWNERSHIP AND RESIDENCES WITHIN AND ADJACENT TO BENGALLA AUTHORISATION AS AT 15/10/83			
Location	Number in Figure	Land Owner, Property Name, Address, Area.	Occupier
West of Bengalla Authorisation	147	N. J. & R. Y. Ellis, Roxburgh Road	? tenants
	148	A. B. & E. J. Hughes Pty Ltd, "Bain-Tree", Roxburgh Road and Wybong Road 37.86 ha	A. B. & E. J. Hughes
	149	M. J. & R. A. Smith, "Allambie" Wybong Road 2.0 ha	M. & R. Smith

APPENDIX 9

**AGRICULTURAL INDUSTRIES AND PRODUCTION
WITHIN THE AUTHORISATION AREA OF THE
PROPOSED BENGALLA COAL MINE AND A
TWO KILOMETRE RADIUS OF THE
AUTHORISATION AREA**

AGRICULTURAL INDUSTRIES AND
PRODUCTION WITHIN THE
AUTHORISATION AREA OF
THE PROPOSED BENGALLA COAL MINE
AND
A TWO KILOMETRE RADIUS OF
THE AUTHORISATION AREA

A REPORT PREPARED FOR ENVIROSCIENCES PTY. LIMITED



NSW AGRICULTURE

Background

The proposed Bengalla coal mine is located in the Muswellbrook shire, west of the town of Muswellbrook in the Upper Hunter Region of New South Wales.

The mine authorisation area covers approximately 1,950 ha. The two kilometre radius (adjoining land) takes a further 4,950 hectares (ha) giving a total area of approximately 6,900 ha.

The agricultural pursuits within each of the two sections is diverse.

For the purpose of this study, a holding occurring both in the authorisation area and the adjoining land and the operation is considered unable to be broken up, all the holding is considered to be in the authorisation area.

If a holding occurs both within the adjoining land and out of the adjoining land an estimation of the value of agricultural within the adjoining land only is included.

Value of agricultural production figures include only product or produce that leaves a holding. For example hay grown on a dairy farm and used on the farm is not given a value whereas hay grown on a dairy farm and sold from off the farm is given a value.

Much of the valuation is based on "average years" particularly as 1991 was a drought year.

The dairy production figures from which milk production figures are calculated are actual 1991 production figures.

Estimates are based on district averages and individual interviews carried out by the authors in March and April 1992.

SUMMARY OF STATISTICS

(Estimates based on district averages and individual interviews)

Within Authorisation Area

Agricultural Enterprise	Number of Establishments	Area (ha)	Value of Production (per annum)
Lucerne Hay (Production for Sale)	12	190	\$399,000
Beef Production	15	1150	\$173,000
Dairying * Milk Sales Dairy Livestock Sales	5	872	\$1,185,500 \$1,066,500 \$119,000
Other Agricultural Enterprises **	3	61	\$38,440
Average Gross Annual Value of Agricultural Production from Authorisation Area			\$1,795,940

* Hay sales from dairy farms included in Lucerne Hay production figures.

** Other Agricultural Enterprises include irrigated wheat, irrigated maize and horse trotting. These are grouped together to protect the privacy of the individual producers. There is only one producer for each enterprise within the authorisation area.

SUMMARY OF STATISTICS (cont.)

Two Kilometre Adjoining Area

Agricultural Enterprise	Number of Establishments	Area (ha)	Value of Production (per annum)
Lucerne Hay Production (for sale)	20	330	\$693,000
Forage Crop Hay (for sale)	5	30	\$45,000
Irrigated Wheat	2	24	\$13,000
Irrigated Sorghum	2	10	\$5,250
Beef Production	36	2,900	\$920,000
Horses (not including Muswellbrook Racetrack, training and spelling)	6	N/A	\$1,295,000
Dairying* Milk Sales Dairy Livestock Sales	5	570	\$1,315,600 \$1,250,000 \$65,600
Other Agricultural Enterprises **	5	670	\$764,250
Average Gross Annual Value of Agricultural Production per annum			\$5,051,100

* Hay sales from dairy farms included in Lucerne Hay production figures.

** Other Agricultural Enterprises include sheep products, turf, cut flowers, irrigated maize and wine grapes. These are grouped together to protect the privacy of the individual producers. There is only one producer for each enterprise in the two kilometre adjoining area.

GROSS VALUE OF PRODUCTION BY INDUSTRY (LAND USE) AND INDUSTRY NOTES

Dairy

There are five dairy producers within the authorisation zone totalling 872 ha and five with significant areas within the two kilometre adjoining land (570 ha). Three dairies had a small portion of one or two paddocks within the very edge of the adjoining land. These farms were not included in the study.

The value of milk production from the five dairies within the authorisation area in 1991 was \$1,066,459 with dairy livestock sales representing a further income of \$118,955. The corresponding figures for the two kilometre adjoining land were \$1,250,163 and \$65,656 respectively.

Value of hay sales from these farms have been included in lucerne hay calculations elsewhere in this study.

A study by Dr Roy Powell, Senior Lecturer in Agricultural Economics at the University of New England for every \$1.00 of dairy farm output, goods and services valued at an additional \$2.66 are created in the region as a result of dairy processing and associated activities. This represents a total value of \$4,338,615 for the authorisation area and \$4,815,898 for the adjoining land (this does not include hay sales from dairy farms).

The study also found that for every 100 jobs in dairy factories and on dairy farms 110 jobs were created in associated regional activities.

The advantage of dairying in the Upper Hunter region was evident during the 1991 drought. The "drought proof" nature of the irrigated dairy production system was shown in production. Muswellbrook milk factory did not suffer greatly during the drought.

In 1991 total milk intake at Muswellbrook factory (105 suppliers) was 45,767,680 litres. The mine authorisation area supplied 2,635,681 litres (or 5.74% of total factory intake) and the adjoining land 3,007,103 litres (6.57% of factory intake).

The total whole milk quota holding by suppliers to Muswellbrook factory in 1991 was 40,689,376 litres of which approximately 87% (35,399,757) was accepted by the NSW Dairy Corporation.

The corresponding quota accepted by NSW Dairy Corporation from authorisation area was 1,818,338 litres (5.14% of factory's) and adjoining land was 1,080,415 (3.05%).

The loss of intake and revenue (farm to factory cartage [2.72 c/l], NSW Dairy Corporation handling allowance [2.01 c/l]) would affect the viability and efficiency of the Muswellbrook factory's operation. The fundamental organisational structure of country dairy factories is based on throughput.

Once the equation is tampered with eg. loss of suppliers, the overhead spread per litre input rises and operational viability is questioned (pers. comm. Mr S Gardiner, Manager Australian Cooperative Foods, Muswellbrook).

Lucerne Hay Production

Lucerne hay production is a major enterprise in the Upper Hunter.

Within the authorisation area, twelve farmers produce irrigated lucerne hay for sale. A large proportion of the hay produced within the authorisation area is used on-farm to meet the requirements of dairy cows, beef cattle and horses. The value of such hay is NOT included in these figures, but is reflected in the value of the milk or beef produced.

An estimated 190 ha of lucerne is grown for commercial hay sale within the authorisation area. Using an average district yield of 15 tonnes per hectare and an average value of \$140 per tonne, the 2,850 tonnes of hay produced has gross value of \$399,000.

Actual figures collated for 1991/92 (a drought year with inflated hay prices) is \$513,000.

Within the two kilometre adjoining land a further 330 ha of lucerne is grown by twenty farmers. A total of 4,950 tonnes of hay are produced for sale at a long term average of \$140/t providing a gross income of \$693,000.

Actual 1991/92 figures are \$749,000.

Hay is sold to the North Coast, Central Coast, Metropolitan and local areas. The market for good quality hay is expanding as demand from horse studs, hobby farms and feedlot type dairies increases.

This area is well suited to lucerne hay production with its freely draining, fertile, alluvial soils and reliable irrigation water supply.

Beef Cattle Production

Beef cattle production is a common agricultural pursuit both within the authorisation area and in the two kilometre adjoining land.

There are several different types of beef enterprises undertaken:

- * Commercial breeding (on improved and unimproved dryland pastures).
- * Fattening (on irrigated and improved dryland pastures).
- * Vealer raising (on river flats with irrigation and improved pastures).
- * Stud stock breeding (insignificant numbers only).

Stud dairy stock, cull dairy stock and bobby calves are included in the dairy production figures. Some agistment of cattle is undertaken but is included here as a value of production from the class of land rather than an agistment fee.

The value of beef production has been estimated from typical enterprises on the various classes of agricultural land.

1. Unimproved Natural Pastures

Average carrying capacity of 1 breeding cow to 3.2 ha (3.75 DSE/ha). The most common enterprise on this land is a straight bred breeding herd producing weaners.

2. Improved Pastures

Natural pastures that have been regularly toppedressed with superphosphate fertiliser and sown with subterranean clovers. Average carrying capacity of 1 breeding cow to 1.6 ha (7.5 DSE/ha).

Vealers can be produced off this land from straight bred cows. Some steer/bullock fattening is also conducted but would produce a similar gross value of production.

3. Irrigated Pastures

High production is possible on irrigated pastures in the study area (1 breeding cow/0.4 ha or 1 steer/0.3 ha [30 DSE]).

Two enterprise types are commonly practiced. Approximately one half of the irrigated pastures are used for steer fattening while vealer production from cross bred cows is conducted on the remaining half of the area.

The following beef production estimates for the study area are:

<u>No of Properties</u>	<u>Ha</u>	<u>Cattle No.</u>	<u>Gross Value/annum</u>
<u>Inside Authorisation Area</u>			
Weaner Production (Unimproved Pastures)			
9 properties	900 ha	280 breeders	\$72,240
Vealers (straight Bred) (Improved Pastures)			
4 properties	200 ha	125 breeders	\$38,750
Vealers (cross bred) (Irrigated Pastures)			
2 properties	30 ha	75 breeders	\$31,725
Steer fattening (Irrigated Pastures)			
2 properties	20 ha	65 steers	\$30,550
Total inside Authorisation 1,150 ha			\$173,265 =====

Two Kilometre Adjoining Land**Weaner production (Unimproved Pastures)**

20 properties	2,000 ha	625 breeders	\$161,250
---------------	----------	--------------	-----------

Vealers (straight bred) (Improved Pastures)

7 properties	350 ha	110 breeders	\$108,500
--------------	--------	--------------	-----------

Vealers (cross bred) (Irrigated Pastures)

9 properties	400 ha	1,000 breeders	\$423,000
--------------	--------	----------------	-----------

Steer Fattening

8 properties	150 ha	480 steers	\$225,600
--------------	--------	------------	-----------

Total within 2,900 ha two kilometre adjoining land			\$918,350
--	--	--	-----------

	=====
--	-------

Irrigated Grain Crops

Only a few farmers in the Muswellbrook area are growing grain crops. Areas sown are obviously dependant on seasonal outlooks on grain prices.

One farmer within the authorisation area grows 10 ha of irrigated maize and 36 ha of irrigated wheat.

In the two kilometre adjoining land, two farmers sow a total of 24 ha of irrigated wheat (gross income of \$13,00 per annum) and 10 ha of irrigated sorghum (gross income of \$5,250 per annum).

Grain crops can be grown successfully in the Muswellbrook area but it is unlikely that large areas will ever be sown. Farmers are generally looking for more intensive alternatives with higher returns per hectare.

Horse Industry

The Upper Hunter Valley has a strong horse industry and the Muswellbrook area is no exception.

A wide cross section of the horse industry is represented within the study area.

Thoroughbred Industry

The thoroughbred industry is represented in the two kilometre adjoining land by four major studs and several smaller owners, as well as the training, racing and spelling facilities at Muswellbrook race course.

The value of racing, spelling and training is outside the terms of reference of the study and is not included in the statistics.

The following gross income is estimated from the thoroughbred studs within the two kilometre adjoining land. There are no thoroughbred studs within the authorisation area.

Agistment fees	:	\$600,000/annum
Stallion Service Fees	:	\$170,000/annum
Yearling Sales	:	\$475,000/annum

\$1,245,000/year
=====

The value of production from the horse industry varies greatly from year to year due to the relatively small numbers of very valuable stock.

The horse studs also diversify into other agricultural enterprises including lucerne hay sales, cattle fattening and breeding, and wine grape production, adding to their net worth in the district (the production from these other enterprises is included under enterprise headings).

Other owners and breeders exist but do not derive a major part of their income from the horse enterprise.

Australian Stock Horse

Within the two kilometre adjoining land, one landholder conducts a stock horse stud. This enterprise has three (3) sources of income:

Stallion Service Fees (3 stallions)
Weaner Sales
Broken in and trained horse sales

Warmblood Horses

One stud breeds and trains warmblood horses within the two kilometre adjoining land. Income is produced each year from sale of weaners and trained stock.

Standardbred (Trotting) Horses

One landholder within the authorisation area conducts a standardbred enterprise.

Gross Horse Industry Income

The total gross yearly income from the horse industry within the authorisation area and the two kilometre adjoining land is \$1,302,000.

Wine Grape Production

Wine grapes are grown within the two kilometre adjoining land by one company. Production has been increased over recent years with 40 ha of Chardonnay only three years old. Production increases are expected and long term plans for future plantings have been developed.

Demand for wine grapes is firm with an increasing proportion of the Hunter Valley vintage coming from the Upper Hunter.

The following table lists the varieties, area and yields from the grapes for the 1990/91 vintage.

<u>Grape Variety</u>	<u>Area Grown</u> ha	<u>Yield</u> t
Chardonnay	44.0	550
Rhine Riesling	1.6	16
Traminer	4.4	60

Turf (Kikuyu)

Turf production is conducted by one grower within the two kilometre adjoining land. He produces 2.4 ha of kikuyu turf on leased land but has purchased more land (within the two kilometre adjoining land) which is currently being prepared for kikuyu turf. Kikuyu turf will be the producers main enterprise though hay and cattle fattening will also be conducted.

The farm currently employs up to six casuals per year as well as full time employment of the farmer.

The owner aims to increase his production to 40,000 square metres of kikuyu turf or nearly 3.5 ha in the next year or so once the new property is prepared.

Wool and Sheep Production

Merino sheep are a major enterprise for one producer in the two kilometre adjoining land. The self replacing Merino flock producing fine wool has been reduced over the last two years due to the downturn in wool but will be retained until wool prices again increase. Production figures quoted are therefore below long term averages.

Sheep enterprises have continued to decline over the last 3 decades in the Upper Hunter. It is unlikely this trend will change.

Most properties running sheep also rely on beef production.

Forage Crop Hay

While the importance of forage crop hay fluctuates with seasonal demand it provides a cash crop alternative for farmers in the area.

Five farmers within the two kilometre adjoining land took advantage of the dry seasonal conditions in 1991 to produce an estimated 450 tonnes of forage crop hay on an area of 30 ha.

The gross value of this production is \$45,000.

Cut Flower Production (Gladioli)

Cut flowers (gladioli) are also produced in the adjoining land. One grower produces 40,000 gladioli bunches from 3.2 hectares.

The gladioli are sold to wholesalers in Sydney, Newcastle, north coast and even western locations like Wellington. There is also local demand for bunches.

The quality of the flowers and the seasonality of production between Queensland and Southern districts amounts to high demand in an area poorly serviced from other growing districts.

Lucerne is grown in rotation to the flowers and used principally for hay. Other forage crops are used as needed for weed and pest control rotations and steer fattening conducted.

The farm currently employs the farmer and his wife as well as one permanent employee and up to two casuals.

General

Income figures have not been included to protect the privacy of individual producers who are able to be identified.

APPENDIX 10

**ROAD TRANSPORT STUDY FOR BENGALLA COAL
DEVELOPMENT AREA**

BENGALLA JOINT VENTURE

**ROAD TRANSPORT STUDY FOR
BENGALLA COAL DEVELOPMENT AREA**

JANUARY 1993

**STAPLETON & HALLAM
3-05B Queen Victoria Building,
455 George Street,
SYDNEY 2000
Telephone: 02 2675300
045 731619**

JOB: H9222

CONTENTS

	Page
1.0 INTRODUCTION	1
1.1 Background	1
1.2 Scope of Report	1
2.0 CURRENT SITUATION	2
2.1 Road Network	2
2.2 Traffic Flows	3
3.0 DESCRIPTION OF PROPOSED MINE OPERATION	10
3.1 General	10
3.2 Schedule of Activities	10
3.3 Traffic Generation and Distribution	11
4.0 TRAFFIC IMPACT OF MINE	14
4.1 Road Network Changes	14
4.2 Impact of Mine Traffic	15
4.3 Temporary Closure of Wybong Road	18
5.0 CONCLUSIONS	20

1.0 INTRODUCTION

1.1 Background

The Bengalla Joint Venture propose to develop the Bengalla Coal Development Area, to produce approximately 7 Mtpa of run-of-mine coal over a period of 21 years. Coal will be washed on site and then transferred from the mine to the Port of Newcastle by rail for the export market.

The development involves the closure of one road - Bengalla Road - and the construction of a new Link Road from Denman Road to Wybong Road. All site access would be off this new road.

Envirosciences Pty Ltd were commissioned by Costain Resources Limited, as manager of the Bengalla Joint Venture, to prepare an Environmental Impact Study of the proposed mining operation. To assess the road traffic and transport implications of the proposed operation, Stapleton & Hallam were commissioned to prepare a Road Transport Study.

1.2 Scope of Report

This report sets out our conclusions on the road transport implications of the proposed development.

The traffic and transport implications of the development have been commented on by Muswellbrook Shire Council and Roads & Traffic Authority (RTA) officers. This report addresses issues raised. For reference, issues raised by the RTA were set out in a letter to Envirosciences Pty Ltd dated 27th November 1992. This letter is reproduced in Appendix A.

This report is set out as follows:

- * Section 2 reviews the current situation in regard to the road network and traffic flows;
- * Section 3 describes the proposed mining operation and estimates the resulting traffic generation;
- * Section 4 assesses the traffic implications of the proposed operation, covering the access roads and intersections as well as the temporary closure of Wybong Road for blasting; and
- * Section 5 summarises conclusions.

2.0 CURRENT SITUATION

2.1 Road Network

Figure 1 outlines the Bengalla Coal Development Area and the adjacent road network. It should be noted that Bengalla Road travels through the centre of this Area. Bengalla Road starts at Wybong Road, at a T-junction. At this point Bengalla Road has a 6.1 m sealed carriageway. Over the 8 km length of this road the carriageway reduces in places to about 4.0 m width. Bengalla Road ends where it meets the Muswellbrook-Ulan Railway. It serves a local access function for the rural properties on either side, numbering about 16. The standard of the road alignment is not high.

As part of the proposed mining operation, it is proposed to close Bengalla Road at Wybong Road. An alternative access will be provided to any landholder affected by this closure.

Bengalla Road meets Wybong Road at the north-eastern corner of the Coal Development Area. Wybong Road extends from Kayuga Road in the East to Sandy Hollow in the West. The speed limit for most of this length is 100 km/hr. At its eastern end it has a sealed carriageway width of 7.0 m. This varies over the section to Roxburgh Road down to about 6.8 m - at Bengalla Road - to about 7.2 m, east of the junction with Roxburgh Road. To the west of Roxburgh Road the carriageway width reduces to about 5.8 m. The horizontal alignment of Wybong Road is constructed to a fair standard. The vertical alignment follows the topography and hence has some uphill sections.

The intersection of Wybong Road with Roxburgh Road is characteristically a minor rural intersection. Roxburgh Road on the approach has a 5.2 m sealed carriageway. From Roxburgh Road to Wybong Road East the sight distance is significantly constrained.

The eastern end of Wybong Road meets Kayuga Road at a T-junction. Sight distance at this intersection is reasonable. The speed limit for both roads at this point is 80 km/hr. On Kayuga Road the sealed carriageway width is 7.0 m, reducing to 4.9 m at the bridge over the Hunter River. One-way operation on this bridge is signposted. At the eastern end of the bridge, Aberdeen Street provides access directly to the New England Highway, or alternatively into the western section of the residential area of Muswellbrook.

The Kayuga Road bridge is the only road bridge over the Hunter River in the immediate vicinity of Muswellbrook. As part of the proposed mining development, it is proposed to construct a new link road from Denman Road in the South to Wybong Road in the North. Denman Road serves as an important link from Muswellbrook to Denman. It starts within Muswellbrook at the signalised intersection with the New England Highway and travels to the West, to Denman. Some 3.0 km west of the Highway intersection it intersects with Thomas Mitchell Drive. Both roads generally have one travel lane per direction. At the intersection a left-slip lane has been constructed for the movement from Denman Road East into Thomas Mitchell Drive. There is no special treatment for either of the right turn movements at this intersection, that is, it functions as an AUSTRoads Type A intersection. The speed limit

at this intersection is 80 km/hr.

Thomas Mitchell Drive provides a link through the adjacent industrial and mining area down to the New England Highway. It provides a shorter path for vehicles travelling between the Highway South and Denman Road West than through Muswellbrook.

The New England Highway provides the arterial link for traffic from the Lower Hunter Valley/Newcastle/Sydney and the Upper Hunter Valley/New England. It is generally constructed to a good standard, with some four lane sections, although a two-lane undivided standard is the norm.

2.2 Traffic Flows

Of the roads in the vicinity of the site, the New England Highway carries the highest traffic flows. Table 2.1 sets out annual average daily traffic flows on the Highway as monitored by the RTA.

TABLE 2.1 Annual Average Daily Traffic Flows on New England Highway - 1988

Location	AADT (veh/day)
200 m south of Sandy Creek Bridge	8,284
East of Maitland Street, Muswellbrook	18,187
South of Sydney Road, Muswellbrook	13,554
At southern Shire boundary	8,633

To provide a basis for assessing the traffic implications of the proposed development, traffic counts were undertaken at a number of locations in the area, in Bengalla Road, Wybong Road, Roxburgh Road and Denman Road. These counts were by means of automatic counters, using rubber tubes. Hourly traffic flows per direction were recorded over the survey period, from 30th October to 6th November 1992.

Table 2.2 summarises the hourly flows on Bengalla Road south of Wybong Road. It indicates an average weekday flow of 192 veh/day, two-way total, with "peak hour" flows of less than 20 veh/hr. The weekend flows are slightly lower, at 170 veh/day for Saturday and 148 veh/day for Sunday, giving an overall average weekly flow of 183 veh/day. These flows are of a very low order, confirming the local access function of Bengalla Road.

TABLE 2.2 CURRENT TRAFFIC FLOWS: 31/10/92 - 6/11/92

BENGALLA ROAD SOUTH OF WYBONG ROAD

PERIOD	WEEKDAY			SATURDAY			SUNDAY		
	NB	SB	Total	NB	SB	Total	NB	SB	Total
0 - 1am	1	1	2	0	0	0	0	0	0
1 - 2	0	0	0	0	0	0	0	3	3
2 - 3	0	0	0	0	0	0	0	0	0
3 - 4	0	0	0	1	1	2	0	0	0
4 - 5	0	0	0	0	1	1	0	0	0
5 - 6	2	1	3	1	0	1	1	0	1
6 - 7	6	3	9	4	2	6	6	0	6
7 - 8	7	6	13	6	3	9	3	1	4
8 - 9	11	7	18	12	3	15	3	8	11
9 - 10	8	11	19	9	4	13	8	4	12
10 - 11	6	3	9	4	6	10	4	4	8
11 - 12	6	3	9	6	7	13	6	2	8
12 - 1pm	3	6	9	2	5	7	6	10	16
1 - 2	6	6	12	5	7	12	6	8	14
2 - 3	4	9	13	11	4	15	7	3	10
3 - 4	6	5	11	4	8	12	2	4	6
4 - 5	5	10	15	4	5	9	6	8	14
5 - 6	5	8	13	5	8	13	3	5	8
6 - 7	6	6	12	4	8	12	1	6	7
7 - 8	5	6	11	2	1	3	4	4	8
8 - 9	3	3	6	1	1	2	0	1	1
9 - 10	2	2	4	2	2	4	3	2	5
10 - 11	2	2	4	2	6	8	2	2	4
11 - 12	0	0	0	3	0	3	1	1	2
24 Hour	94	98	192	88	82	170	72	76	148

Average Weekly Flow = 183

Table 2.3 summarises the hourly flows on Wybong Road east of Roxburgh Road. It indicates an average weekday flow of 715 veh/day, reducing to 675 veh/day and 572 veh/day on the Saturday and Sunday respectively, for an overall average weekly flow of some 690 veh/day. The highest peak hour flows were 60 veh/hr in the 8.00-9.00am period and 64 veh/hr in the 3.00-4.00pm period. While higher than the Bengalla Road flows, these flows are still of a low order.

TABLE 2.3 CURRENT TRAFFIC FLOWS: 31/10/92 - 6/11/92

WYBONG ROAD EAST OF ROXBURGH ROAD

PERIOD	WEEKDAY			SATURDAY			SUNDAY		
	EB	WB	Total	EB	WB	Total	EB	WB	Total
0 - 1am	0	1	1	1	6	7	5	4	9
1 - 2	0	1	1	1	1	2	4	8	12
2 - 3	1	0	1	0	1	1	0	1	1
3 - 4	0	0	0	0	1	1	0	0	0
4 - 5	3	1	4	0	3	3	0	1	1
5 - 6	10	3	13	4	2	6	1	1	2
6 - 7	30	6	36	9	4	13	6	4	10
7 - 8	26	10	36	10	12	22	3	6	9
8 - 9	46	14	60	28	17	45	8	2	10
9 - 10	31	17	48	36	18	54	18	13	31
10 - 11	25	17	42	24	17	41	20	25	45
11 - 12	21	15	36	25	30	55	14	26	40
12 - 1pm	18	17	35	14	45	59	15	26	41
1 - 2	19	21	40	21	21	42	28	32	60
2 - 3	23	26	49	20	31	51	16	27	43
3 - 4	22	42	64	14	33	47	23	18	41
4 - 5	17	44	61	22	33	55	24	16	40
5 - 6	17	42	59	18	19	37	30	10	40
6 - 7	20	25	45	29	12	41	16	16	32
7 - 8	11	15	26	24	10	34	9	5	14
8 - 9	4	14	18	5	11	16	4	15	19
9 - 10	6	9	15	7	5	12	29	23	52
10 - 11	5	8	13	4	8	12	7	8	15
11 - 12	1	11	12	9	10	19	2	5	7
24 Hour	356	359	715	325	350	675	282	290	572

Average Weekly Flow = 689

The automatic count in Wybong Road also covered the type of vehicles. This data is summarised in Table 2.4. This table indicates that the weekday percentage of heavy vehicles is 6%, with slightly higher figures on Sunday, of 7-8%, but lower figures on Saturday, of 3-4%. Heavy vehicle percentages of these magnitudes are relatively low for rural roads. For comparison, a vehicle classification count on the New England Highway north of Muswellbrook in June 1990 gave a figure of 19.1% heavy vehicles on weekdays and about 10% heavy vehicles on the weekend.

TABLE 2.4 VEHICLE CLASSIFICATION COUNT: 31/10/92 - 6/11/92

WYBONG ROAD EAST OF ROXBURGH ROAD

DAY	EASTBOUND				WESTBOUND			
	Car	Bus	Rigid Truck	Artic Truck	Car	Bus	Rigid Truck	Artic Truck
Weekday	94%	1%	0%	5%	94%	1%	1%	4%
Saturday	97%	0%	1%	2%	96%	0%	2%	2%
Sunday	92%	0%	2%	6%	93%	0%	2%	5%

Table 2.5 summarises the hourly flows on Denman Road west of Thomas Mitchell Drive. The average weekday flow was some 2680 veh/day, reducing to just under 2100 veh/day on the Saturday and about 1400 veh/day on the Sunday. The two-way hourly flows are relatively constant over the day, from about 6.00am to about 6.00pm, with a peak of 218 veh/hr in the period 3.00-4.00pm. This period corresponds with the end of the day shift at the nearby industrial/mining developments. The morning peak period is less pronounced. With the Saturday flows, while the total daily flows are lower than the weekday flows, there are still peak periods, in the period 11.00am to 1.00pm, of up to 210 veh/hr. These peaks probably relate to Saturday shopping trips. Over the week, the average weekly traffic flow was 2416 veh/day.

TABLE 2.5 CURRENT TRAFFIC FLOWS: 31/10/92 - 6/11/92

DENMAN ROAD WEST OF THOMAS MITCHELL DRIVE

PERIOD	WEEKDAY			SATURDAY			SUNDAY		
	EB	WB	Total	EB	WB	Total	EB	WB	Total
0 - 1am	8	7	15	12	10	22	17	12	29
1 - 2	4	4	8	5	5	10	6	4	10
2 - 3	3	3	6	2	3	5	2	4	6
3 - 4	3	6	9	13	6	19	0	3	3
4 - 5	8	4	12	4	8	12	2	2	4
5 - 6	20	21	41	10	18	28	3	8	11
6 - 7	94	71	165	45	27	72	19	10	29
7 - 8	98	68	166	32	60	92	12	25	37
8 - 9	110	66	176	101	70	171	19	19	38
9 - 10	102	69	171	75	70	145	33	29	62
10 - 11	103	72	175	127	80	207	43	64	107
11 - 12	98	73	171	88	96	184	46	63	109
12 - 1pm	92	87	179	100	110	210	51	48	99
1 - 2	90	80	170	62	86	148	58	60	118
2 - 3	85	91	176	60	57	117	61	57	118
3 - 4	103	115	218	56	59	115	72	50	122
4 - 5	103	113	216	43	57	100	51	44	95
5 - 6	84	102	186	47	59	106	51	49	100
6 - 7	54	73	127	48	50	98	62	26	88
7 - 8	42	53	95	43	35	78	48	31	79
8 - 9	15	32	47	24	19	43	20	29	49
9 - 10	23	33	56	15	24	39	19	26	45
10 - 11	30	33	63	13	30	43	23	13	36
11 - 12	11	22	33	12	20	32	10	7	17
24 Hour	1383	1298	2681	1037	1059	2096	728	683	1411

Average Weekly Flow = 2416

Peak period intersection turning movements were surveyed in October/November 1992 at two intersections, at Wybong Road/Roxburgh Road and at Denman Road/Thomas Mitchell Drive.

The survey periods covered were 6.30-9.00am and 2.30-5.00pm. At the Denman Road intersection the hours of peak traffic flow were 6.30-7.30am and 3.00-4.00pm, corresponding to the start and finish of the standard 7.00am to 3.00pm day shift at the adjacent industrial/mining developments. The traffic turning movements at these intersections in these peak hours are shown on Figure 2. Also shown on Figure 2 are the turning movements at the Kayuga Road/Wybong Road intersection and in Kayuga Road at the Hunter River Bridge, as counted on 17th July 1991.

Figure 2 indicates moderate turning flows at the Denman Road/Thomas Mitchell Drive intersection, with the highest flows being the left turn from Denman Road East (Muswellbrook) into Thomas Mitchell Drive in the morning and the return right turn movement from Thomas Mitchell Drive to Denman Road East in the afternoon, presumably being commuter movements between Muswellbrook and the industrial/mining areas off Thomas Mitchell Drive. The through movements along Denman Road are not high, at up to about 100 veh/hr.

At the Wybong Road/Roxburgh Road intersection the peak period flows are very light, particularly in the morning. Movements into and out of Roxburgh Road are minimal. Traffic flows build up slightly more over Wybong Road leading to the Kayuga Road intersection, but not to any significant degree. All movements at the Wybong Road/Kayuga Road intersection are light.

To provide a basis for estimating the diversion of existing traffic onto the proposed new link road between Denman Road and Wybong Road, an origin-destination survey was undertaken in the morning peak period at the Denman Road/Thomas Mitchell Drive and Wybong Road/Roxburgh Road intersections. Over the 6.30-9.00am and 2.30-5.00pm periods vehicle number plates were recorded, together with the quarter-hour period in which they passed through. An attempt was then made to match the plates between the two intersections. Over the 2 1/2 hour morning period there were only three vehicles that passed through both intersections. Two of these were eastbound in Wybong Road and turned left from Denman Road into Thomas Mitchell Drive, while the third was initially observed travelling eastbound on Denman Road and then westbound on Wybong Road. In the 2 1/2 hour afternoon period there was only one vehicle that travelled through both intersections.

The potential for existing traffic to use the proposed link road is in proportion to the traffic flows in Wybong Road. In the morning peak hour these are very low, with a two-way flow east of Roxburgh Road of 16 veh/hr. Over the 2 1/2 hour survey period this number was 90 vehicles. (The "peak" flow at this intersection was in the 8.00-9.00am period.) There would be more potential for the use of the link road in the afternoon, with the two-way flow in the 3.00-4.00pm period on Wybong Road being 74 veh/hr. However the lack of number plate matches in the afternoon indicates that the demand would be very low.

As well as providing a direct link from Wybong Road to Denman Road and Thomas Mitchell Drive, the link road would also be of value to drivers between Wybong Road and the New England Highway South. These vehicles would not at present divert down Denman Road to

come back along Thomas Mitchell Drive, to get to the Highway. They would be expected to remain on the Highway through Muswellbrook. However the numbers of such vehicles would be relatively low, given the total traffic flow in Wybong Road.

Based on the survey and making allowance for traffic to/from the Highway South, the assessment in Section 4.2 assumes 2 veh/hr southbound and 1 veh/hr northbound in the 6.30-7.30am period for base traffic on the link road and 3 veh/hr southbound and 7 veh/hr northbound in the 3.00-4.00pm period, again for base traffic on the link road. The latter figures are greater than indicated by the matched sample but have been put at a higher level to take more account of the potential for traffic travelling to/from the Highway South.

These base traffic flows are for existing traffic patterns. If there is another coal mine developed to the north of Wybong Road then the base flows would increase.

3.0 DESCRIPTION OF PROPOSED MINE OPERATION

3.1 General

The mine is to be developed to produce approximately 7 Mtpa of run-of-mine (ROM) coal over a period of 21 years, the duration of the expected lease grant. Coal will be hauled to dump hoppers located on the western and eastern sides of the mine and transferred by overland conveyor to a washing plant situated in the southwest corner of the lease. The washery will be a 1200 tph heavy medium plant with cyclones and spirals for the treatment of finer size fractions. A 200,000 tonne ROM stockpile will be constructed to provide feed to the washing plant. A 500,000 tonne clean coal stockpile will also be established. Washed coal will be loaded onto unit trains on a rail loop off the Ulan/Muswellbrook railway located in the southwest corner of the lease.

All coal transport off the site will be by rail. There will be no road transport of coal, even during any rail strikes.

Figure 3 shows the overall layout of the mine and adjacent roads at about year 21. The office, workshops and a bathhouse are to be located at the southwest corner of the site. The mine requires the closure of Bengalla Road over its entire length from Wybong Road to the railway. A new link road is proposed to be constructed from Denman Road, at a point about 800 m west of the Thomas Mitchell Drive intersection, to join Wybong Road at a point about 1.9 km east of the Roxburgh Road intersection. This link road will incorporate a new bridge over the Hunter River. In addition, the road will be bridged over the railway line. Site access off this link road will be from an intersection at the southwest corner of the site, adjacent to the office/mine facilities.

3.2 Schedule of Activities

The first construction activity for the Bengalla project will be the construction of the link road and associated bridges. This work will be carried out as expeditiously as possible to minimise the use of local roads for the delivery of construction materials and equipment. It is anticipated that this link road will be commissioned within 12 months of the decision to develop Bengalla being made. Some construction work on the dragline and some site facilities may commence prior to the road being fully commissioned. The majority of construction work will occur in the twelve months prior to the production of coal. The link road will be available as access for these works.

Prior to mining commencing, it will be necessary for all land directly affected by mining to have been purchased or for agreements to be entered into with landholders for the Joint Venture to use those properties. For those properties which are not vacated, alternative access will be provided to those properties prior to Bengalla Road being closed. It is anticipated this road closure will occur in the later stages of the construction period.

The rail balloon loop will be built before any coal is transported from the site. Thus, there will be no road transport of coal, either during the early mine development stage or during any rail strikes.

The workforce will be built up over a five year period, with the following total numbers:

Year	Workforce
-1	40
1	120
2	145
3	225
4	258

The workforce of 258 is the number that will be present on any one day. With the mine working a five panel roster, the total workforce will be 300. The shift times and staffing at the full workforce level will be:

Shift Period	Mine Staff			Office Staff
	Roster	3-panel	Day	
11pm to 7am	20	45		6
7am to 3pm	20	45	7	44
3pm to 11pm	20	45		6

Thus, there will be a total of 71 staff for the evening and early morning shifts and 116 staff for the day shift.

3.3 Traffic Generation and Distribution

It should be assumed that all staff arrive in the quarter hour period before the start of a shift and leave within the quarter hour period after the completion of a shift. Movements will probably be relatively "peaked" during these shift change times.

In the traffic analysis, no allowance has been made for staff vacancies or sick leave. Based on the current transport arrangements of staff at the Costain Resources Limited Ravensworth mine, it is expected that mine staff will carpool, with an average of two persons per car, but that office staff will not. It is further assumed that all staff arrive by car. At Ravensworth we understand that there are car pools with considerably more than two vehicle occupants. The assumption provides for some mine staff to not carpool, to balance those with larger than

average carpools. When applied to the staff numbers set out above, at full operation the staff will generate about 40 car trips in the evening and early morning shifts and 80 car trips in the day shift. Total car movements will be double these numbers. Thus, in the 6.30-7.30am period there will be 80 veh/hr into the mine and 40 veh/hr out of the mine. In the 3.00-4.00pm period - the afternoon peak period on the adjacent road network - there will be 80 veh/hr from the mine. A sensitivity test is also done for the 2.45-3.45pm period, adding the 40 veh/hr arriving for the evening shift to the 80 veh/hr leaving at the end of the day shift.

In addition to staff movements, there will be daily supplies and service vehicle trips to the mine. Based on a survey at another coal mine, this is estimated as being up to 20 trips per day, or 40 movements. If they are averaged over the period 7am to 5pm there will be an average of 4 vehicle movements per hour, every hour. These service vehicle and supply movements are all assumed to be to/from Muswellbrook.

With the staff movements, an indication of their routes of approach to the mine can be obtained from a survey of the current residential locations of staff at the Costain Ravensworth mine. From a sample of 348 staff, the following are their residential locations:

Residential Location	Percentage
Singleton & District	45%
Muswellbrook & District	28%
Maitland District	5%
Cessnock District	3%
Branxton District	7%
Aberdeen District	6%
Scone District	3%
Other districts	3%
<u>Total</u>	<u>100%</u>

For the 9% from the North - Scone and Aberdeen - 6% have been assumed to use the Highway, with 3% using Kayuga Road. This might overestimate the usage of the latter, although in reality the numbers are relatively small. For traffic approaching via the Highway, a small proportion has been assumed to use the Kayuga Road/Wybong Road route. The distance to the main site entrance from the Highway/Aberdeen Street intersection would be about 11.0 km via the Highway/Denman Road or 12.6 km via Kayuga Road/Wybong Road. Some drivers might choose the slightly longer rural route, in preference to driving through Muswellbrook, although the latter provides opportunities for shopping and other activities to or from work.

For the 28% Muswellbrook & District traffic, 1% is assumed to travel from Wybong Road West and 2% from Denman Road West, with the balance travelling via Denman Road East, from Muswellbrook. The balance of the traffic would be from the Highway South. The

"Other Districts" has been grouped with this southern group, based on current dwelling locations. All of this traffic is assumed to travel via the Highway South/Thomas Mitchell Drive/Denman Road.

Figure 4 shows the resulting peak hour traffic flows, with the addition of the mine worker and service traffic. The flows include the base traffic through movement along the new link road. No separate allowance has been made for the effect of closing Bengalla Road. The 192 vehicles per weekday currently on Bengalla Road has not been added anywhere else - it is not known where current residents of Bengalla Road would relocate to - nor have adjacent traffic flows been reduced. For instance, the flows at the Wybong Road/Kayuga Road intersection would logically be reduced. The peak hour movements on Bengalla Road average about 12 veh/hr.

4.0 TRAFFIC IMPACT OF MINE

4.1 Road Network Changes

Closure of Bengalla Road

Bengalla Road runs through the centre of the Bengalla Coal Development Area. For the proposed mining operation, it is essential to close Bengalla Road. This road is a local access road, serving about 16 rural properties. The road ends at the railway line. The direct implication of the mining will be that current land use patterns will totally change. Thus, some existing occupiers of the land covered by the mining lease will need to vacate their land. In addition, some properties in near proximity will also need to be vacated. The Bengalla Joint Venture is either in control of these properties or would have purchased or reached agreements with the landholders of these properties before mining began. It would follow that Bengalla Road should remain open until such time as these properties were vacated or an alternative access provided.

The land adjacent to the southern end of Bengalla Road is outside of the mine lease area. This land will still be worked for rural purposes. It will be necessary to connect the new link road to this southern end of Bengalla Road, to enable activities to continue.

In practice, the new link road replaces Bengalla Road as the local access road, and at the same time provides a regional connection. While Bengalla Road currently carries an average of 190 veh/weekday, the new link road will carry about 120 veh/hr in the peak hour, south of the mine entrance, with a substantially lower flow at its northern end.

We conclude that the closure of Bengalla Road and its replacement by the proposed link road would be appropriate.

Construction of New Link Road

The route of the proposed new link road is shown on Figure 3. It would be constructed with a design speed of 80km/hr. At the Denman Road end, it starts about 800 m west of the intersection with Thomas Mitchell Drive. An AUSTRROADS Type C intersection is proposed for Denman Road/Link Road. The option of joining Denman Road at its intersection with Thomas Mitchell Drive was considered. This would ideally have required a large roundabout. In theory, this would better provide for a western bypass of Muswellbrook. A single intersection makes the road network look neater on paper than two offset intersections. In practice, based on the origin/destination survey discussed in Section 2.2, the very low base traffic flows that would divert to the new route would not require the single intersection. The spaced T-junctions would suffice, with the additional benefit of being cheaper and not having the same difficulties with property boundaries and with the proximity to existing dwellings. We conclude that the proposed intersection location is appropriate for the purpose, while retaining benefits for regional traffic, should that traffic increase in the future.

The Link Road would have a two-lane undivided carriageway, with a bridge over the Hunter River and a second bridge over the railway line. The Hunter River bridge will be built approximately one metre above the 1 in 100 year flood level. The road will be built up on either side of the bridge. The railway bridge would provide a safe crossing for vehicles and trains.

At the south-west corner of the site, the Site Access Road would join the Link Road in an AUSTRROADS Type C intersection. Details of the AUSTRROADS intersection layouts are reproduced in Figure 5, taken from AUSTRROADS "Guide to Traffic Engineering Practice Part 5 - Intersections at Grade". This Site Access Road would then feed directly into the mine office and services area, and associated carpark. It would be a two-lane undivided road.

At the north-western end of the Link Road the intersection with Wybong Road would be constructed to an AUSTRROADS Type B standard. Further comment on the design and operation of these intersections is made in Section 4.2.

As is discussed in the following Section, the projected traffic flows on the proposed Link Road would be substantially less than the capacity of the road or its intersections. It would provide an opportunity for future regional traffic flows. Based on current traffic patterns, the usage of the road by current traffic would be very low. One advantage is that when Wybong Road is closed for adjacent blasting, as is further discussed in Section 4.3, there would still be a route between Muswellbrook and Wybong Road West. However the major regional benefit of the road would occur if there was another coal mine developed to the North - Mount Pleasant. The Link Road would provide a direct route without requiring traffic from the Highway South to pass through Muswellbrook. With the estimated distribution of staff for the subject site - 63% assumed residing to the South of Muswellbrook - this would be a benefit. It would also provide an alternative route for heavy vehicles. In summary, the proposed Link Road would provide benefits not only for the Bengalla Mine but also for other development in the area.

4.2 Impact of Mine Traffic

The impact of the mine traffic has been assessed for the peak shift changeover periods. Based on current traffic patterns in the area, these peak hours are 6.30-7.30am and 3.00-4.00pm. Figure 4 reproduces the resulting design peak hour flows at the intersections adjacent to the site, based on the traffic generation and distribution discussed in Section 3.3.

Intersection of Wybong Road Intersections

At the Wybong Road/Roxburgh Road intersection, the current average peak hour delays, based on gap acceptance theory, are minimal, being less than one second. The predicted very low volume of mine traffic added to this intersection would not change this situation and hence

no upgrading works would be required. It is and would remain a Type A intersection.

At the **Wybong Road/Link Road** intersection average peak hour delays would be of a very low order. For the left turn from Wybong Road into the Link Road the flow would not warrant other than Type A treatment. For the right turn from Wybong Road into the Link Road, the predicted volumes only warrant Type A treatment. However, Type B treatment is proposed, as a positive road safety measure. Thus, the probability of right turn traffic affecting the safety of eastbound traffic on Wybong Road would be substantially reduced.

With regard to sight distance requirements, the Roads & Traffic Authority's letter of 27th November 1992 stated that sight distance of 150 metres would be required on all approaches. We concur that this should be the minimum to be achieved but would prefer, if possible, that it be increased to 175 metres, to provide a "safe intersection sight distance" for speeds of 80 km/hr. We note that a distance of 150 metres would provide adequate approach or stopping sight distance for speeds of up to almost 100 km/hr. With the low mine traffic - and other traffic - predicted to use the northern section of the Link Road, the provision of 150 metres sight distance would be reasonable. No problems would occur with the eastern Wybong Road approach. With the western Wybong Road approach, that is eastbound traffic, some benching of Wybong Road might be required to achieve this 150 metre distance. Details can be worked out at the road design stage. Note that the location of this intersection has been designed to maximise sight distance and to minimise the environmental impact of the road construction. In road network terms, we see no significant merit in this intersection being located at the Wybong Road/Roxburgh Road intersection.

At the **Wybong Road/Kayuga Road** intersection the additional traffic from the mine - without reducing flows due to the closure of Bengalla Road - would still see average peak period delays to the right turn movement from Wybong Road into Kayuga Road of less than one second, based on gap acceptance theory. For the right turn from Kayuga Road into Wybong Road Type A treatment - as currently exists - would be satisfactory. Thus, no intersection upgrading works would be required.

Kayuga Road

The additional traffic likely to use Kayuga Road, either to the north of Wybong Road or between the Highway and Wybong Road would be low, with peak period flows of less than 5 veh/hr predicted, based on the assumed residential origins of workers. Thus, there would be no significant impact on the Hunter River bridge. Note: it is proposed that the new link road would be used for the delivery of construction material. Limited use only would be made of other rural roads early in the construction program.

Link Road/Site Access Road

With the predicted peak hour flows, Type A treatment for both the left and right turns is all

that is warranted, based on the AUSTRROADS warrants. However, in the interests of the maximisation of traffic safety, it is proposed to construct a Type C intersection. This would be beneficial not only for mine traffic but would also allow a very significant increase in non-mine through traffic on the Link Road, without the need for additional intersection works at a later date.

The same sight distance considerations applying to the Wybong Road intersection should be applied to this Site Access intersection.

Link Road/Denman Road

With the projected mine traffic, the predicted average peak period delays to the right turn movement into the Link Road are less than one second, for the 6.30-7.30am, 2.45-3.45pm and 3.00-4.00pm periods. With the very low right turn flows out of the Link Road delays would not be an issue. In terms of the AUSTRROADS warrants, a Type B treatment for the right turn into the Link Road would be justified for the morning peak hour but not for the 3.00-4.00pm afternoon peak hour, where Type A would suffice. For the 2.45-3.45pm changeover period, a Type B treatment is indicated. With the proposed Type C, with painted medians, a better than minimum treatment would be provided, to the benefit of traffic safety. For the left turn movement into the Link Road, Type A treatment would be satisfactory.

With sight distance, given the larger traffic flows on Denman Road, in comparison with Wybong Road, we recommend that the minimum sight distance to be provided for each approach would be 175 metres. With the relatively straight alignment of Denman Road at this point, this should not be difficult to achieve.

Denman Road/Thomas Mitchell Drive

With current peak period traffic flows, based on gap acceptance theory the average peak hour delay to right turn movements is about one second. The addition of the mine traffic would see this increase at the most to an average of two seconds. For reference the predicted current delays to the right turn movement out of Thomas Mitchell Drive to travel to Muswellbrook are 0.7 and 1.4 seconds for the morning and afternoon peak hours respectively. The addition of the mine traffic in these periods would see these increase on average to 1.0 and 1.9 seconds respectively. In the 2.45-3.45pm period, with the shift overlapping, the future delay to this right turn movement would be 1.7 seconds, on average. Thus, there would be no traffic efficiency problems at this intersection.

In terms of intersection layout, it currently has a Type B left turn treatment for the movement from Denman Road East into Thomas Mitchell Drive. The right turn treatment from Denman Road West into Thomas Mitchell Drive is Type A. In the current 6.30-7.30am period, a Type B treatment for this movement is marginally required. Type A is adequate for the current afternoon peak period. With the addition of the mine traffic Type B treatment

would be warranted in the afternoon as well as in the morning. Thus, it would be desirable to upgrade the intersection to a Type B right turn treatment.

In theory, a contribution for this work could be requested from the Bengalla Joint Venture for this work. However, with their proposed construction of the Link Road at a higher standard than required just for the mine - a standard that provides for future regional traffic growth - there is a strong argument that the Bengalla Joint Venture has already provided an adequate contribution towards roads in the area. The funding of the work should be discussed further between the RTA and Muswellbrook Council.

Other Denman Road Intersections

We note that the RTA have requested comment on further traffic management required on intersections along Denman Road, including the signalised intersection with the New England Highway. We have reviewed this. Bearing in mind the projected additional peak hour traffic from the mine - a maximum of 25 veh/hr additional in any direction - and the current level of flows, no additional traffic management would be necessary. The Highway traffic signals should be able to cope with this level of increase through the normal vehicle-actuated operation.

4.3 Temporary Closure of Wybong Road

With the mine lease area being very close to Wybong Road, during any blasting near the road, there would need to be short-period road closures. The Bengalla Joint Venture estimate that these closures would last about 10 minutes. The estimated frequency would be two-to-three times over a three week period, and then nothing for about two-to-three months. At the higher end of the figures this would indicate about 18 closures over a 12 month period, averaging one every 20 days.

During the proposed closures, it is proposed that mine staff control traffic. We understand that this is a standard procedure in other areas, such as on Wallaby Scrub Road. While Wybong Road provides a regional access facility, its traffic flows are of a low order. As Table 2.3 indicates, the average two-way weekday flow is 715 veh/day. Between 7.00am and 6.00pm the average two-way hourly flow is 48 veh/hr. In any 10 minute road closure period the traffic would thus average 8 vehicles. While the mine might add the occasional extra vehicle to these current flows, the closure of Bengalla Road could reduce the flow. With eastbound traffic on Wybong Road, if it had a destination in Muswellbrook or to the South, it would be able to divert to the Link Road, subject to appropriate control at the point of closure. This would reduce the impact of the closure.

We understand that the Bengalla Joint Venture will own or will have entered agreements with landholders for all properties on the northern side of Wybong Road opposite the site. Thus, there would not be local access problems during any closure.

The alternatives to the short closures would be to either not mine up to the northern boundary or to construct an alternative bypass road parallel to Wybong Road to the North. Both of these alternatives would be expensive. Cutting off 500 m x 2 km worth of coal would be very inefficient and wasteful. Diverting the road 500 m to the North would be costly, affect more properties and overlay coal reserves in any event. When consideration is taken of the duration of closure and the traffic volume affected, we conclude that the temporary closures would be acceptable.

In terms of requirements for road closures under the Local Government Act, we believe that it would not come under Section 269A. The closure should be regarded as analogous to a closure for road construction or maintenance.

As well as appropriate control at the point of closure, advance warning signs should be erected on a permanent basis, until such time as blasting along that part of the site is finished. These signs should indicate the nature of the closure, approximate delays and alternative routes.

On balance, we consider that the implications of the closures would be satisfactory, subject to satisfactory signposting and closure operation.

5.0 CONCLUSIONS

Traffic Generation and Distribution

1. The proposed mining operation, when fully operating, will employ 116 persons during the day shift and 71 persons during the evening and early morning shifts. It is estimated that this will generate about 80 car trips to the site for the day shift and 40 car trips for the other shifts. Maximum traffic impact will occur at shift change times. In addition to these flows, there would be a small number of delivery and service vehicle movements, estimated at 20 trips or 40 movements over the full day.
2. The distribution of the trips can be estimated from the current residential locations of Ravensworth staff. While only being indicative, this provides guidance. The majority would be expected to reside to the south of Muswellbrook, over 60%, with about 30% in Muswellbrook and 10% to the North.

Road Network Changes

1. It is proposed to close Bengalla Road, which bisects the mine site. This road provides access to adjoining rural properties. These properties would be purchased or have agreements reached with the owners to enable the mine to be built. Property occupiers will need to vacate the site before Bengalla Road is closed or alternative access provided. Access to properties to the south of the authorisation area will be provided along the Link Road or Bengalla Road.
2. A new Link Road will be built between Denman Road - 800 metres west of Thomas Mitchell Drive - and Wybong Road - east of Roxburgh Road. This will provide all access into the mine as well as providing for regional traffic movement. Based on origin/destination surveys, there would be very limited usage of this link in the short term by non-mine traffic. The possible development of a new mine to the North could increase the traffic flows.
3. It is proposed to construct AUSTRROADS Type C intersections at the Denman Road/Link Road and Link Road/Site Access Road intersections, with a Type B intersection at the Link Road/Wybong Road intersection. These intersection standards are in excess of the minimum required and would provide a safe traffic environment. We recommend that minimum sight distances of 150 metres at these intersections be provided, as requested by the Roads & Traffic Authority. Sight distances of 175 metres would be preferred.

Traffic Impact of Proposed Mine

1. The impact of the closure of Bengalla Road will be to remove access to properties adjoining this road. All properties within or close to the mining lease area will owned by

the Bengalla Joint Venture or agreement will have been entered into with landholders. Any properties which access Bengalla Road will be provided with alternative access where necessary. The current average weekday traffic flow in Bengalla Road south of Wybong Road is 192 veh/day. The construction of the new Link Road will provide the opportunity for access to the southern end of Bengalla Road, should existing rural uses in this area continue.

2. The impact on traffic efficiency on the adjacent intersections will be very low, with low levels of delay predicted in the peak periods.
3. The impact on traffic safety will be acceptable, with the high standard of intersections proposed. The design standard of the intersections to be built on the new Link Road is higher than the minimum necessary.
4. At the Denman Road/Thomas Mitchell Drive intersection, upgrading to a Type B right turn treatment for the movement into Thomas Mitchell Drive would be desirable. It is currently warranted with morning peak hour flows. The addition of mine traffic would also warrant this treatment in the afternoon peak period. With the public benefit following from the construction of the new Link Road, to the standard proposed that provides for future regional traffic growth, we do not consider that the mining developer should necessarily be responsible for the upgrading of this intersection. Further discussion needs to be held in this regard.
5. All coal will be transported by rail. There will be no road transport of coal, even during rail strikes.
6. Wybong Road will need to be closed at a maximum frequency of once every 20 days, averaged over the year, with the duration of the closure being about 10 minutes, to enable blasting to safely proceed on the mine site adjacent to the road. Wybong Road currently carries an average two-way weekday traffic flow of 715 veh/day, averaging 48 veh/hr during the day. In any 10 minute period there would be an average of 8 vehicles. Provided that there is adequate control by mining staff of the closure and that signs are erected in Wybong Road advising the public that occasional closures will be experienced, and advising of alternative routes - such as the new Link Road - we consider that the short-period closures would be acceptable.

APPENDIX 11

**SOCIAL AND ECONOMIC ASSESSMENT FOR THE
BENGALLA MINE PROJECT**

Prepared for:
BENGALLA MINING COMPANY PTY LIMITED

**SOCIAL AND ECONOMIC
ASSESSMENT FOR THE
BENGALLA MINE PROJECT**

ENVIROSCIENCES PTY LIMITED

New South Wales

NEWCASTLE OFFICE & LABORATORY:

PO Box 5348D, Newcastle West 2302

122 Parry St, Newcastle West 2302

Ph (049) 262 600 Fax (049) 264 532

Laboratory: 92 Young St, Carrington 2294

Ph (04) 614 774 Fax (049) 613 271

SYDNEY OFFICE & LABORATORY:

55-65 Grandview St, Pymble 2073

PO Box 1644, Hornsby Northgate 2077

Ph (02) 988 4422 Fax (02) 988 4441

Laboratory: 8/17 King Rd, Hornsby 2077

Ph (02) 476 4699 Fax (02) 476 3568

Queensland

GLADSTONE OFFICE:

PO Box 1753, Gladstone 4680

47 Lord St, Gladstone 4680

Ph (079) 726 120 Fax (079) 726 201

BRISBANE OFFICE:

5 Wolfe St, West End 4101

Ph (07) 844 8563 Fax (07) 846 5459

AUGUST 1993

TABLE OF CONTENTS

	Page No.
1.0 INTRODUCTION	1
2.0 SOCIAL AND ECONOMIC PROFILE OF MUSWELLBROOK	1
2.1 POPULATION	1
2.2 ECONOMIC ACTIVITY	3
2.3 EMPLOYMENT	4
2.4 UNEMPLOYMENT	6
2.5 HOUSING	7
2.6 EDUCATION, HEALTH AND COMMUNITY SERVICES	7
3.0 SOCIAL AND ECONOMIC IMPACT OF THE BENGALLA MINE PROJECT	
3.1 CONSTRUCTION WORKFORCE	9
3.2 OPERATIONAL WORKFORCE	10
3.3 POPULATION	11
3.4 HOUSING	11
3.5 EDUCATION, HEALTH AND COMMUNITY SERVICES	12
3.6 LOCAL, REGIONAL AND NATIONAL ECONOMICS	13
3.7 COMMUNITY CONTRIBUTION	15
4.0 CONCLUSION	15
5.0 REFERENCES	16

LIST OF TABLES

TABLE 1 : UPPER HUNTER SUB-REGION - POPULATION CHANGE 1976-1991

TABLE 2 : UPPER HUNTER SUB-REGION - POPULATION PROJECTIONS (MEDIUM
GROWTH RATE)

TABLE 3 : COAL IN THE HUNTER : TOTAL IMPACTS ON THE REGIONAL ECONOMY
1989/90

TABLE 4 : EMPLOYMENT BY INDUSTRY FOR UPPER HUNTER SUB-REGION

TABLE 5 : EMPLOYMENT - NSW COAL MINES

TABLE 6 : BENGALLA MINE - TOTAL ANNUAL IMPACTS ON THE REGIONAL ECONOMY

1.0 INTRODUCTION

The proposed Bengalla Mine project will be located 3 km west of Muswellbrook in the Upper Hunter Valley in New South Wales. The opencut mine will produce 7 Mtpa of raw coal (5 to 5.5 Mtpa saleable coal) for the export market, and employ a total of 300 personnel.

This report examines the social and economic background of Muswellbrook, and the likely impacts that the mine's development will have on the existing socio-economic conditions.

2.0 SOCIAL AND ECONOMIC PROFILE OF MUSWELLBROOK

The local government area of Muswellbrook has been characterised by a steady population growth since the mid 1970s, attributable mainly to the expansion of the power generation and mining industries. The mining industry has acted as a stimulus in demand for goods and services which has resulted in a broadening of the district's economic base.

2.1 POPULATION

The whole Hunter Region between the years of 1976 and 1981 experienced an increase in population growth as a result of retirement led migration and resource development in power production, mining and smelting operations. The recession of the early 1980s affected the region's industrial developments and caused setbacks in certain sectors such as metals manufacturing, with consequent reduced population growth in the affected areas.

Growth in the Hunter Region as a whole has steadied as a result of resource demand factors in recent years. Muswellbrook local government area displayed significant growth throughout the 1970s and 1980s, but its previously high rate of growth contracted significantly in the 1986 to 1991 intercensal period.

Table 1 shows the population change experienced by Upper Hunter local government areas in the intercensal periods of 1976 to 1981, 1981 to 1986 and 1986 to 1991.

Table 2 shows the Department of Planning medium population projections for the period 1991 to 2006 for the Upper Hunter sub-region and the whole Hunter Region (the latest projections available).

TABLE 1 UPPER HUNTER SUB-REGION - POPULATION CHANGE 1976 - 1991							
Statistical Local Area	Population Change				Average Annual Rate %		
	1976	1981	1986	1991	76/81	81/86	86/91
Merriwa	2,252	2,330	2,353	2,384	0.69	0.20	0.26
Murrurundi	2,357	2,228	2,299	2,368	-1.09	0.64	0.60
Scone	7,382	8,330	9,298	9,375	2.57	2.32	0.17
Muswellbrook	11,520	12,978	14,892	15,117	2.53	2.95	0.30
Singleton	12,359	15,211	17,277	18,583	4.62	2.72	1.51
Sub-region Total	35,870	41,077	46,119	47,827	2.53	2.18	0.74
Total for Whole Hunter Region	422,268	458,772	482,775	513,389	1.73	1.05	1.27

Source: Australia Bureau of Statistics 1976, 1981, 1986 and 1991 Census Data

In the early 1980s it was expected that Muswellbrook would continue to experience a steady rate of population growth, stemming from the industrial, commercial and mining industries expanding and consolidating their positions within the local government area's widening economic base. However, between 1986 and 1991 the actual annual rate of growth dropped dramatically to 0.30 per cent. The Department of Planning predicted an annual growth rate of between 0.64 per cent and 1.01 per cent for the period 1991 to 1996. However, in the light of the recent slowing in growth, this probably overestimates future growth rates.

Muswellbrook has a relatively young population with a high proportion of children including almost 10 per cent under the age of 4 years. Males make up 53 per cent of the population (ABS, 1992).

TABLE 2 UPPER HUNTER SUB-REGION - POPULATION PROJECTIONS (MEDIUM GROWTH RATE)				
Local Government Area	1991	1996	2001	2006
Merriwa	2,400	2,300	2,200	2,100
Murrurundi	2,300	2,200	2,100	2,000
Scone	10,000	10,300	10,600	10,800
Muswellbrook	15,800	16,400	17,000	17,600
Singleton	18,500	19,200	19,900	20,500
Sub-region Total	49,000	50,400	51,800	53,000
Total for Whole Hunter Region	515,200	534,700	551,600	565,800

Source: Population Projections for Non-Metropolitan Local Government Areas in NSW 1991 to 2016, prepared by the Demographic Unit, Department of Planning, 1990.

2.2 ECONOMIC ACTIVITY

The economy of the local government area of Muswellbrook expanded in the 1981 to 1986 intercensal periods. During that time, coal mining activities increased and there was a corresponding expansion of the service industry sector. The manufacturing and wholesale/retail sectors strengthened while agriculture remained steady.

During 1986 to 1991, the wholesale/retail trade and community services and manufacturing sectors strengthened further, but there was a significant decline in construction and in the electricity/gas/water servicing sector. Coal mining and agricultural activities declined to a lesser extent.

Agriculture is still the most visually prominent land use in Muswellbrook, ranging from intensive cultivation on the floodplain to grazing on the valley sides. Beef cattle has just surpassed milk as the most valuable agricultural product in Muswellbrook, closely followed by grapes. Lucerne and pasture hay are valuable crops. In 1989/90 the total value of livestock production was \$21.2M and cropping was valued at \$10.27M, including \$7M in grape production (Australian Bureau of Statistics 1990). Within the Bengalla Mine Authorisation area dairying is the most valuable activity, followed by lucerne hay and beef production (Department of Agriculture 1992).

In 1988/1989 the 17 manufacturing establishments within Muswellbrook had a turnover of \$40.6M and paid \$7.6M in wages and salaries to 342 employees (Australian Bureau of Statistics, 1992).

Three coal mines are currently operating in Muswellbrook. Bayswater No. 2 and Drayton are opencut mines and Muswellbrook No. 2 is a combined opencut and underground mine. The annual raw production from the three mines was over 7.2 Mt in 1991/1992, valued at about \$280M. These three mines currently employ approximately 966 people (Joint Coal Board, pers. comm., August 1993). Dartbrook underground mine, which is predominantly within Muswellbrook local government area, has recently commenced construction.

Table 3 indicates the importance of the coal industry to the Hunter Region as calculated by the Centre for Transport Policy Analysis, University of Wollongong (1991).

TABLE 3 COAL IN THE HUNTER : TOTAL IMPACTS ON THE REGIONAL ECONOMY 1989/90			
	Direct	Flow - On	Total
Output \$ million	424.0	237.44	661.44
Income \$ million	230.0	151.8	381.8
Employment (persons)	11,400	10,944	22,344
Source: Centre for Transport Policy Analysis, University of Wollongong (1991).			

The coal industry is a production industry and thus its effects are directly quantifiable by the use of multipliers (refer Section 3.6). The table indicates the total impact on the regional economy in 1989/1990 when, in output terms, the coal industry was worth \$661M to the Hunter Region, contributing \$382M to regional income, and directly and indirectly employing over 22,000 people.

According to the Centre's research, the coal industry is the third largest contributor to regional output (9.5 per cent), the fourth largest contributor to regional income (8.1 per cent), and the third largest exporter (17 per cent). The industry is also a very important provider of employment (12.8 per cent).

2.3 EMPLOYMENT

All industry sectors throughout the Upper Hunter sub-region expanded in terms of employment levels during the 1981 to 1986 intercensal period, with the exception of agriculture and communication which experienced minor declines in some areas. During the 1986 to 1991 intercensal period employment levels throughout the sub-region tended to expand in the wholesale and retail, manufacturing, and in all the social, financial and business service sectors (Table 4).

In Muswellbrook in 1991, 15.1 per cent of the working population was directly employed in the mining industry, closely followed by 14.6 per cent in the wholesale and retail trade. The next largest areas of employment were community services and electricity, gas and water, both with 10.7 per cent, and agriculture with 9.2 per cent (ABS, 1993).

TABLE 4
EMPLOYMENT BY INDUSTRY FOR UPPER HUNTER SUB-REGION

	Merriwa				Murrurundi				Muswellbrook				Singleton				Scone			
	1981	1986	1991	1991 %	1981	1986	1991	1991 %	1981	1986	1991	1991 %	1981	1986	1991	1991 %	1981	1986	1991	1991 %
Agriculture	450	428	421	42.6	419	442	367	36.2	681	655	616	9.2	735	735	675	8.0	889	864	929	22.3
Mining	39	27	22	2.2	16	11	12	1.2	726	1073	1017	15.1	1148	1731	1689	19.9	144	254	273	6.6
Manufacturing	20	15	28	2.8	22	16	51	5.0	359	364	507	7.5	242	251	320	3.8	398	437	468	11.3
Electricity, Gas, Water	9	12	15	1.5	8	16	21	2.1	656	982	720	10.7	251	388	356	4.2	119	225	176	4.2
Construction	61	35	40	4.0	60	48	48	4.7	616	785	307	4.6	656	470	506	6.0	267	373	223	5.4
Wholesale, Retail Trade	93	98	116	11.7	102	96	92	9.1	653	694	979	14.6	729	1090	1257	14.8	430	501	523	12.6
Transport, Storage	38	27	21	2.1	91	110	58	5.7	200	212	211	3.1	246	276	246	2.9	123	128	108	2.6
Communication	26	21	12	1.2	17	18	25	2.5	79	52	61	0.9	79	54	24	0.3	48	48	33	0.8
Finance, Property Business Services	29	21	25	2.5	27	26	55	5.4	247	327	444	6.6	329	377	516	6.1	126	158	206	5.0
Public Admin. and Defence	61	64	47	4.8	35	38	45	4.4	178	212	209	3.1	1032	998	1055	12.4	124	177	130	3.1
Community Services	98	101	111	11.2	86	104	100	9.9	494	620	717	10.7	604	676	917	10.8	460	505	551	13.3
Recreation, personal and Other Services	45	47	45	4.6	45	45	57	5.6	331	396	430	6.4	271	328	455	5.4	194	234	244	5.9
Not Classifiable	115	10	3	0.3	100	12	0	0	59	52	9	0.1	91	63	27	0.3	35	18	6	0.1
Not Stated		37	83	8.4		29	83	8.2	483	160	489	7.3	615	162	443	5.2	345	113	287	6.9
TOTAL	1083	943	989	100%	1028	1011	1014	100%	5762	6584	6716	100%	7028	7599	8486	100%	3702	4035	4157	100%

Source: Australian Bureau of Statistics Census 1981, 1986 and 1991

The New South Wales coal industry has experienced a number of cycles in the level of employment over the last decade. Following the award restructuring decision of the Coal Industry Tribunal in September 1988 and improved world coal trade conditions, general employment prospects in the industry improved during the early part of 1989. By June 1990 coal industry employment reached a total of 17,313 persons. The decline in employment from 1990 to 1992 related primarily to rationalisation of manning and the closure of several underground mines (Joint Coal Board, 1992). Between June 1990 and June 1992, total employment fell by 1,493 positions, however, there was actually an increase in employment within open cut coal mines during this same period. Table 5 provides an overview of industry employment.

TABLE 5 EMPLOYMENT - NSW COAL MINES				
	June 1989	June 1990	June 1991	June 1992
UNDERGROUND MINES	12,626	12,372	11,425	10,724
Singleton - NW	1,475	1,381	1,231	1,176
Newcastle	4,924	4,871	4,546	4,032
West	1,496	1,543	1,538	1,559
South	4,731	4,577	4,110	3,957
OPEN CUT MINES	4,552	4,941	5,008	5,096
Singleton - NW	4,150	4,541	4,620	4,680
Newcastle	82	81	80	107
West	320	319	308	309
ALL MINES	17,178	17,313	16,443	15,820
Source: NSW Coal Year Book 1990 to 1991 and 1991 to 1992, Joint Coal Board.				

Preliminary figures from the Joint Coal Board indicate that as at June 1993 total employment within New South Wales coal mines had fallen further to 14,480. In the Singleton - North West District, approximately 5,500 were employed in all mines in June 1993. Approximately 966 of these jobs were in the three mines at Muswellbrook.

2.4 UNEMPLOYMENT

According to estimates by the Department of Employment, Education and Training (DEET) there were 696 persons unemployed within the Muswellbrook local government area in the December quarter of 1992 (the latest estimates available), an estimated unemployment rate of 9.2 per cent. In the same quarter, Merriwa had an unemployment rate of 9.1 per cent, Murrurundi 11.0 per cent, Scone 7.3 per cent and Singleton 9.6 per cent (DEET, 1992).

Local labour sources within the district are good, especially within the categories of semi-skilled and unskilled workers, and could provide a source of workers for both the construction and operational phases (Muswellbrook CES Manager, pers. comm.). The local Commonwealth Employment Service (CES) Branch has expressed a willingness to organise suitable Skills Training courses to prepare local unemployed persons for appropriate job opportunities within a new mine development.

There is currently a pool of unemployed experienced underground miners within the Hunter region, resulting from recent underground mine closures. The Northern District of the United Mineworkers Federation of Australia (UMFA) has approximately 800 retrenched workers registered (August, 1993).

The Australian Collieries Staff Association (ACSA) had 140 retrenched technical/professional staff registered in July 1993. Approximately half of these personnel are either resident in the Upper Hunter or would commute from the Lower Hunter (pers. comm ACSA Industrial Officer).

2.5 HOUSING

Rental accommodation in the form of vacant dwellings and residential flat buildings is limited within Muswellbrook.

Muswellbrook Council proposes to develop land at South Muswellbrook and create approximately 200 allotments for future housing requirements.

Temporary accommodation is available in Muswellbrook's caravan parks, hotels and eight motels (with a total 212 units). There are also caravan parks at both Denman and Sandy Hollow, plus a motel in Denman. Temporary accommodation is also available in Singleton's caravan park, hotels and five motels (with a total 210 units), and in Scone's caravan parks and five motels (with a total of 103 units).

2.6 EDUCATION, HEALTH AND COMMUNITY SERVICES

Muswellbrook's two state primary schools with current enrolments of about 600, are predicting a growth rate of about 6 per cent over the next five years, by which time they will be large Class 1 schools. Muswellbrook High, with about 940 students is growing steadily and is predicted to reach about 1,100 in five years. Denman Primary School, with about 200 pupils is fairly stable.

There are also Catholic primary schools in Muswellbrook and Denman, and regional Catholic secondary schools in Singleton and Aberdeen. Scone Grammar caters for both primary and secondary students.

Both the Department of School Education and the Catholic Education Office have advised that a reasonable increase in enrolments as a result of this development could be absorbed. The public schools in Muswellbrook are, however, nearing optimum maximum size.

Muswellbrook has one tertiary establishment, the TAFE College catering for a number of courses.

Muswellbrook's 80 place Pre-School (I and II) and Aberdeen Pre-School are currently meeting the demand for enrolments. There is a strong demand for Family Day Care, and out of school hours care for 5 to 12 year olds is also under-serviced. The 40 place Long Day Care Centre in Muswellbrook has a few vacancies, but the cost of both long day care and pre-school enrolment is a restraining factor. The Pacific Power/Council Day Care Centre planned to open by the end of 1993 in Muswellbrook will provide 22 long day care places for children of Pacific Power employees and 11 general community places.

Health services are provided throughout the whole of the Hunter Region by the Hunter Area Health Service. The Upper Hunter Community Health Team is based in Muswellbrook and provides a comprehensive range of services to the local government areas of Merriwa, Muswellbrook, Murrurundi and Scone.

Denman has a Community Hospital providing basic medical needs and supported by a community based programme. Muswellbrook District Hospital provides an increased range of services, including acute and elective surgery practices.

The Upper Hunter Community Health Team provides information, assistance and counselling with regard to the physical and emotional health of individuals and families located within their jurisdiction, whilst assistance from specialised health care professionals located in the Lower Hunter is at times called upon. The Community Health team's services are just meeting the referrals currently being experienced.

Muswellbrook has a wide range of sporting and recreational facilities. The "traditional" forms of sports currently available to interested persons include soccer, golf, cricket, swimming, rugby union, rugby league, netball, softball, tennis, athletics, squash, basketball, touch football and equestrian activities. There is also provision for such activities as aerobics, gymnastics, dancing and judo, plus a wide range of recreational and service clubs.

There are two youth centres in Muswellbrook and one operating part-time in Denman. One of the Muswellbrook centres runs an after-school programme for 11 to 16 year olds.

3.0 SOCIAL AND ECONOMIC IMPACT OF THE BENGALLA MINE PROJECT

3.1 CONSTRUCTION WORKFORCE

It is estimated that a 24 month period will be required for the construction of buildings and facilities associated with the Bengalla Mine project.

During the 1980s, the Hunter Region demonstrated the capacity to undertake large construction projects such as mines and power stations. Sufficient capacity exists within the Hunter's construction industry to undertake the relevant tasks on the Bengalla project.

The construction workforce is expected to be drawn primarily from the construction industry within the Hunter Valley. The construction workforce for the mine and associated infrastructure will peak at 250, averaging 160 over the 24 month period. In addition, the coal handling and preparation plant will require a construction workforce peaking at 200, averaging 90 over 20 months, and the dragline will require 60 construction workers during 12 months.

Construction firms located within the Hunter Valley have advised that their employees live locally within the region and would be able to commute daily to the Bengalla Mine site. Additional personnel, if required, are usually initially sourced locally. If personnel are employed who require short-term accommodation, sufficient capacity exists within the region in hotels, motels and caravan parks to satisfy their requirements (pers. comm. various Hunter Valley construction companies).

The Bengalla project is proposed at a time when at least one other new mining project is being developed in the area and others are at the planning stage. Additionally, some existing mines in the region are being expanded while the production at others is winding down. As the construction timetables for the different projects are not identical, some construction workers effectively fill more than one job. In other words, a construction worker may complete his involvement in one project and then commence work on another whilst already residing in the district or region.

The Bengalla project has the scope to provide short-term employment for the unemployed, whilst providing job security for those firms and workers permanently employed within the region's construction industry.

3.2 OPERATIONAL WORKFORCE

The project will employ an average workforce of 300 over the productive life of the mine. Seventy (70) of these personnel will be technical/professional staff, and 230 will be mineworkers.

The Bengalla Mine will be able to draw upon a pool of experienced miners, skilled tradesmen and unskilled workers seeking entry into the mining industry.

Past studies in employment characteristics of the Singleton coal mines have revealed that new open cut mining operations obtain their workforce from local sources and by immigration. Gibbs and Wiggers (1982) estimated that 62 per cent of the labour for open cut mines was obtained locally whilst the remaining 38 per cent was via immigration. Eighty per cent of the labour for underground mines was sourced locally at the time of the study. This difference was explained by the variation in the degree of commuting from the Lower Hunter (Cessnock and Maitland in particular) with more experienced underground employees than open cut employees residing in this area.

Since that time, the Shell managed Drayton Opencut Mine began operating in Muswellbrook (1983) and found that only 21 per cent of its workforce migrated to the district as a result of that project proceeding. Improvements to highway conditions and to motor vehicles, and the use of car pooling and mini buses, now makes it possible for mine employees to commute considerable distances to their workplace.

It is expected that the greater part of the Bengalla workforce will be made up of people already resident in the area or people prepared to commute from within the Hunter Region. For these reasons it is anticipated that the 230 mineworkers required for the Bengalla project will be recruited locally from within the region. Half of the 70 required technical/professional staff is also expected to be recruited locally. This means that 35 technical/professional personnel would migrate to the area, and of these up to 20 could choose to live in Muswellbrook while the rest are likely to live in Singleton or Scone.

3.3 POPULATION

It is expected that the Bengalla project will increase the local government area population by a maximum of 80 people. This population increase has been determined by using a base of 20 incoming new workers and assuming that each is married with two dependant children.

In practice, the project is likely to employ a mix of single and married personnel, either with or without children. This possible lower number of dependants would have the effect of reducing the total number of people migrating into the town below 80.

The construction workforce, which will vary in size during the two year construction phase, is most likely to be drawn from the existing construction industry within the Hunter Valley. Any short term increase in population during this period is expected to be small. Because of the short term nature of the work, construction employees do not tend to relocate their families.

The multiplier effects on population attributable to jobs in a new coal mine are spread over the entire Hunter Region. The employment multiplier of 1.39 to 2.31 used by the Association of Coal Related Councils, for example, refers to the overall regional effect (jobs created in the private sector for each job at the coal mine). Effects in the immediate local area (Muswellbrook township and surrounds) are likely to be far less. In the current recessionary conditions, many local businesses are operating at less than full capacity. Those businesses could adequately service/supply the growth in population caused by immigrating mine employees and their families without having to expand. This will suppress the multiplier effect on the local population.

3.4 HOUSING

The Bengalla Mine project will place a demand for both short term rental accommodation and long term permanent residencies.

For the operational phase, accommodation in the form of housing will be required for the 20 workers and their families who migrate to the district. The housing required will be both permanent (purchased) and rental.

Muswellbrook Council has acquired land at South Muswellbrook which is to be developed as a residential estate catering for approximately 200 dwellings.

Under the provisions of State Environmental Planning Policy No. 25 (SEPP No. 25) - Residential Allotment Sizes, there is scope for housing density increases within the already established residential precincts without requiring further expansion of residential areas. SEPP No. 25 facilitates the development of integrated housing and residential flat buildings within existing residential areas.

It is expected that the 20 immigrating workers and their families will be adequately provided with housing in the following ways:

- Residences built on serviced vacant allotments within Muswellbrook and Denman, some of which could cater for multiple dwellings;
- Rental accommodation that is available in Muswellbrook and Denman; and
- Purchase of private residences in Muswellbrook and Denman.

Short term rental accommodation may be required during the construction phase of the project for those workers who cannot commute daily to the site. Sufficient capacity exists within the district and region in the form of motel, hotel, and caravan park accommodation. The owners of Pinaroo Caravan Park, for instance, are willing to provide temporary accommodation and facilities adjacent to their existing caravan park to cater for up to 50 construction workers (J. Blenning, pers. comm.).

3.5 EDUCATION, HEALTH AND COMMUNITY SERVICES

Muswellbrook public schools are expected to be approaching optimum maximum size in a few years time when the commencement of the Bengalla Mine and other planned projects in the area contribute their immigrating workforces' children.

Childcare services such as long day care and occasional care may be further strained by this immigration. Incoming families, separated from their own extended families and friends, tend to need the support of such services. The childcare initiatives supported by the Federal Government which will make available funding for the States for the integration of childcare with existing kindergartens and schools, may be of relevance to Muswellbrook by the time the Bengalla project is operational.

Health facilities should continue to absorb any additional demand resulting from this development.

Recreational and sporting facilities are considered to be adequate to cope with this population influx.

3.6 LOCAL, REGIONAL AND NATIONAL ECONOMIES

The operational phase of the Bengalla project will have favourable income, employment and industrial output impacts upon the local, regional and national economies.

In addition to direct impacts from mining activities, the multiplier effect on employment, income and output in other sectors of the regional economy must be taken into account. Multipliers are parameters which show the total effect (over a time period) of an initial economic change, e.g. the

opening of a new coal mine. Multipliers provide a means of assessing the flow-on effects of a change in economic activity on the regional economy.

An output multiplier indicates the total output effect within the Region (normally measured in value terms) of an initial increase in output sold (e.g. coal from a new mine). An income multiplier indicates the total regional effect on income of an initial increase in income (e.g. wages and salaries of those employed in a new coal project). An employment multiplier indicates the additional regional employment effect of an initial increase in employment (e.g. jobs within a new mine).

The output, income and employment multipliers used for the Bengalla project are presented in Table 6.

TABLE 6 BENGALLA MINE TOTAL ANNUAL IMPACTS ON THE REGIONAL ECONOMY				
	Direct impact	2A Multiplier for Hunter Coal Industry	Flow-on Effect	Total Impact
Output \$ million	296	1.56	166	462
Income \$ million	25	1.66	17	42
Employment (persons)	300	1.98	294	594

The three multipliers have been derived by the Centre for Transport Policy Analysis, University of Wollongong (1991), for the coal mining industry in the Hunter Region. The Centre has used the demo-economic 2A multiplier which is the most commonly used form of multiplier and which gives the most accurate picture of economic activity in a region.

The employment multiplier of 1.98 is in the mid range of the figures (1.39 to 2.31) suggested for use in the New South Wales northern coalfields by the Association of Coal Related Councils as quoted in Department of Minerals and Energy (1991).

The annual output of Bengalla Mine, upon reaching full production, has an estimated value of \$296M and will impact upon other industries in the supply of goods and services which will be primarily sourced from within the Hunter Region.

As a result of a direct annual wages and salary value of \$25M, regional income is expected to be approximately \$42M.

Employment will be created both at the mine and in linkage industries such as transport, maintenance and services. An estimated total 594 additional jobs are expected to be created within the Hunter Region as a result of the 300 jobs created directly by the mine.

The construction and operation of the Bengalla project will have a significant impact on the revenue accruing at the various levels of the public sector, these being:

Local Government

- Rates and charges paid by the Bengalla Mine.
- Rates paid by those employees of the Bengalla Mine not formerly resident in the local government area;
- Rates paid by other new residents attracted to the area by the indirect effects of the Bengalla Mine development on economic activity in the area.

State Government

- Coal royalties paid per tonne of coal sold;
- Rail freight paid to the State Rail Authority for the transport of coal from the mine to the Port of Newcastle;
- Charges paid to the Maritime Services Board for navigation, pilotage and wharfage services;
- Payroll tax levied on the wages of employees whose jobs have been created, directly and indirectly, by the coal mine development;
- Other State taxes and charges.

Federal Government

- Company tax;
- Income tax paid by direct employees of the Bengalla Mine or on income from privately held coal rights;
- Income tax paid by those employees whose jobs have been indirectly created by the coal mine development;
- Excise on exports.

3.7 COMMUNITY CONTRIBUTION

Developments have the potential to increase population and require Council to upgrade services to cope with the increased demand. Areas affected by developments may include roads and bridges, drainage, sewerage supply, water supply, car parking, open space, child care, public infrastructure, and bush fire protection.

Requirements for infrastructure contributions levied must be based on a nexus between a development and that requirement. The Joint Venture will contribute towards community infrastructure which can be reasonably attributed to the requirements of the project and associated workforce.

Muswellbrook Council has prepared a Contributions Plan (Development Control Plan No. 5) under Section 94 of the Environmental Planning and Assessment Act 1979. The document has been adopted as a guide by Council to determine contributions from developers to offset their impact on the community.

4.0 CONCLUSION

The Bengalla Mine project has the potential to provide short-term employment for the construction industry, and 300 permanent jobs at the operational mine.

The project will favourably impact upon the local, regional and national economies, producing significant flow-on effects for income, employment and industrial output.

It is estimated that approximately 20 workers and their families (a total of about 80 people) will immigrate into the Muswellbrook local government area, requiring housing or serviced land, and utilising education, health and other community services. Some of the construction workforce will require short term accommodation.

Although the shire is reasonably well placed to cater for the demands of an increase in population, the Joint Venture will contribute towards community infrastructure which can be reasonably attributed to the requirements of the project workforce and families.

5.0 REFERENCES

- Australian Bureau of Statistics, 1990. Regional Value of Agricultural Commodities Produced NSW, 1989-1990.
- Australian Bureau of Statistics, 1992. Regional Statistics of NSW. Catalogue No. 1304.1.
- Australian Bureau of Statistics, 1992. 1991 Census of Population and Housing (Preliminary Data) State NSW.
- Australian Bureau of Statistics, 1993. Basic Community Profiles. ABS Catalogue No. 2722.1. Muswellbrook, Merriwa, Murrurundi, Singleton LGAs.
- Centre for Transport Policy Analysis, University of Wollongong, 1991. Road Pricing in a Regional Context: The ISC Scheme and Coal Transport in NSW.
- Department of Agriculture 1992. Agricultural Industries and Production within the Authorisation Area of the Proposed Bengalla Coal Mine and a Two km Radius of the Authorisation Area. Prepared for Envirosiences Pty Limited.
- Department of Employment, Education and Training, 1992. Small Area Labour Market - Australia. December Quarter 1992.
- Department of Minerals and Energy, 1991. A Strategic Study of the NSW Northern Coalfields prepared by Coal Resources Development Committee. DME 90/11.
- Department of Planning, NSW. Hunter Regional Environmental Plan, 1989.
- Department of Planning, NSW 1990. Population Projections, Non-Metropolitan Local Government Areas in NSW: 1991 - 2016.
- Envirosiences Pty Ltd, 1992. Muswellbrook Rural Lands Strategy. Prepared for Muswellbrook Shire Council.
- Gibbs, D. and Wiggers, J., 1982. Socio-Economic Implications of Growth in the Hunter Region. 1982 ANZAAS Conference, Sydney.
- Joint Coal Board, 1991. New South Wales Coal Yearbook 1990-1991.
- Joint Coal Board, 1992. New South Wales Coal Statistics 1991-1992.
- Muswellbrook Shire Council. Muswellbrook Local Environmental Plan, 1985.
- Muswellbrook Shire Council, 1992. Muswellbrook Shire Community Profile.

APPENDIX 12
ARCHAEOLOGICAL SURVEY

**PROPOSED BENGALLA COAL MINE,
MUSWELLBROOK NSW:
Summary of Aboriginal Heritage**

January 1993

Prepared for
**Envirosciences Pty Ltd &
Bengalla Joint Venture**

ELIZABETH RICH
1A Angel Road, Strathfield, 2135.

1.0 INTRODUCTION

The Bengalla project area is located on the north side of the Hunter River about 3km west of Muswellbrook in the Hunter valley (see Maps 1 and 2). The Bengalla Joint Venture, managed by Costain Resources Limited, are proposing to develop an open cut coal mine and infrastructure in this area. This report summarises the results of a detailed archaeological survey for this project. The survey was carried out for Envirosiences Pty Ltd on behalf of Bengalla Joint Venture.

The Project Area

The project area is irregularly shaped and is approximately 4.5km east-west and 2km-4km north-south. It covers about 13km².

Most of the project area lies across hilly country above the Hunter flats. A substantial creek flows southwards through the western part of the project area. The other gullies are fairly short. Steep bluffs stand above the Hunter flats.

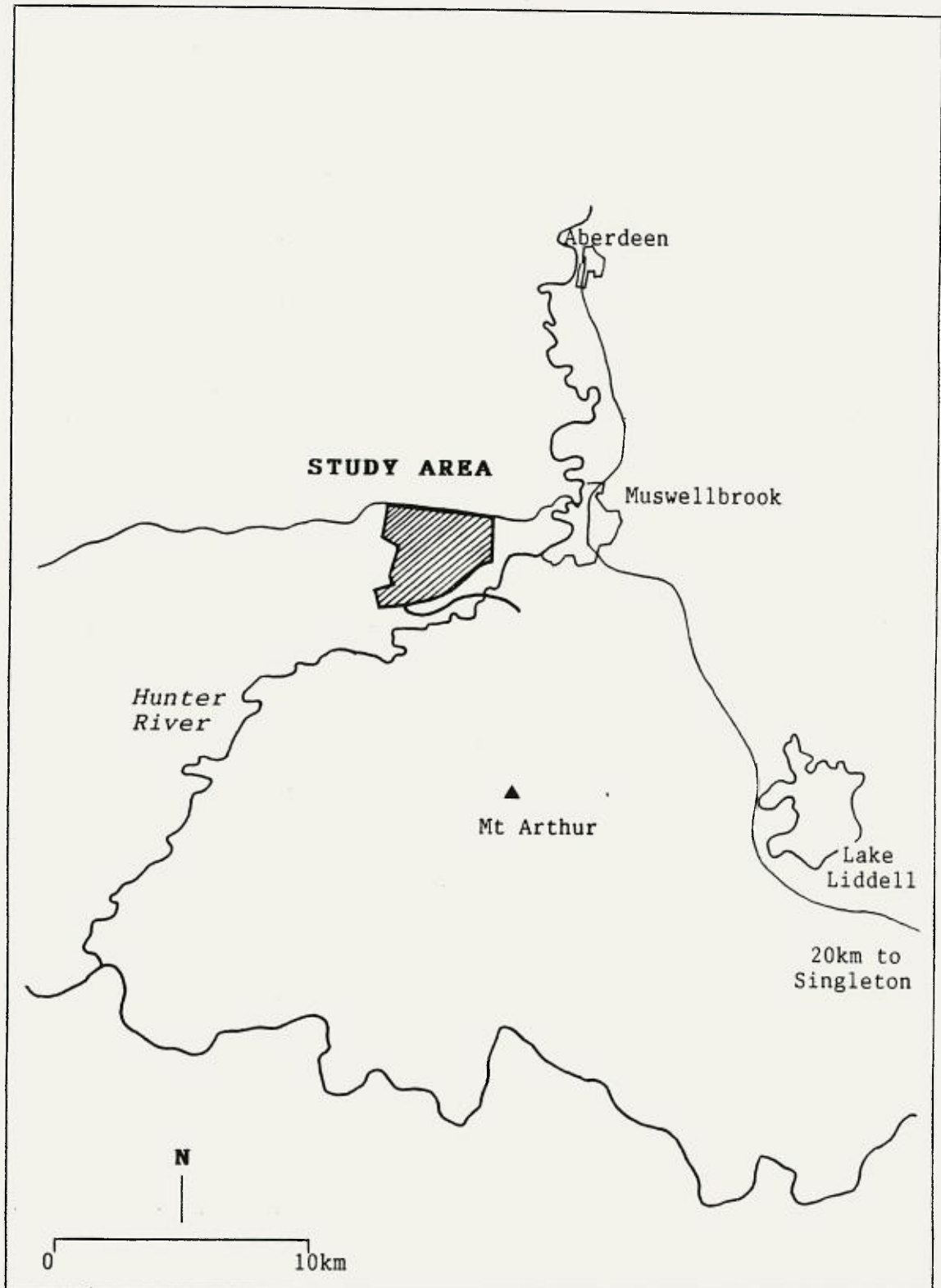
Much of the project area had been ploughed and grazed. The north-western part of the project area is less disturbed and contains more intact sites.

2.0 RESULTS OF THE SURVEY

Aboriginal sites and finds of stone artefacts occur across much of the project area. In all, 39 sites and 17 isolated finds were recorded.

The most important site is a silcrete quarry (extraction) site. This is located on a ridge near the Hunter flats (see Photo 2). The silcrete is distinctive, being whitish in colour and with small pebbles in it. In the past, Aboriginal people carried pieces of this silcrete from the extraction site to all the other sites in the project area. It was an important source of rocks for making stone tools.

Map 1: Locality Map



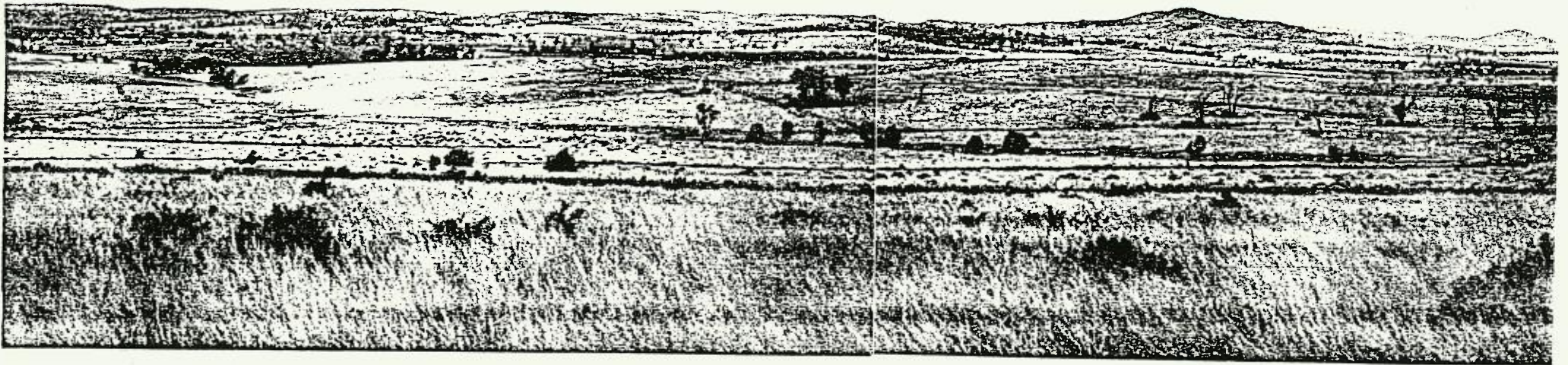
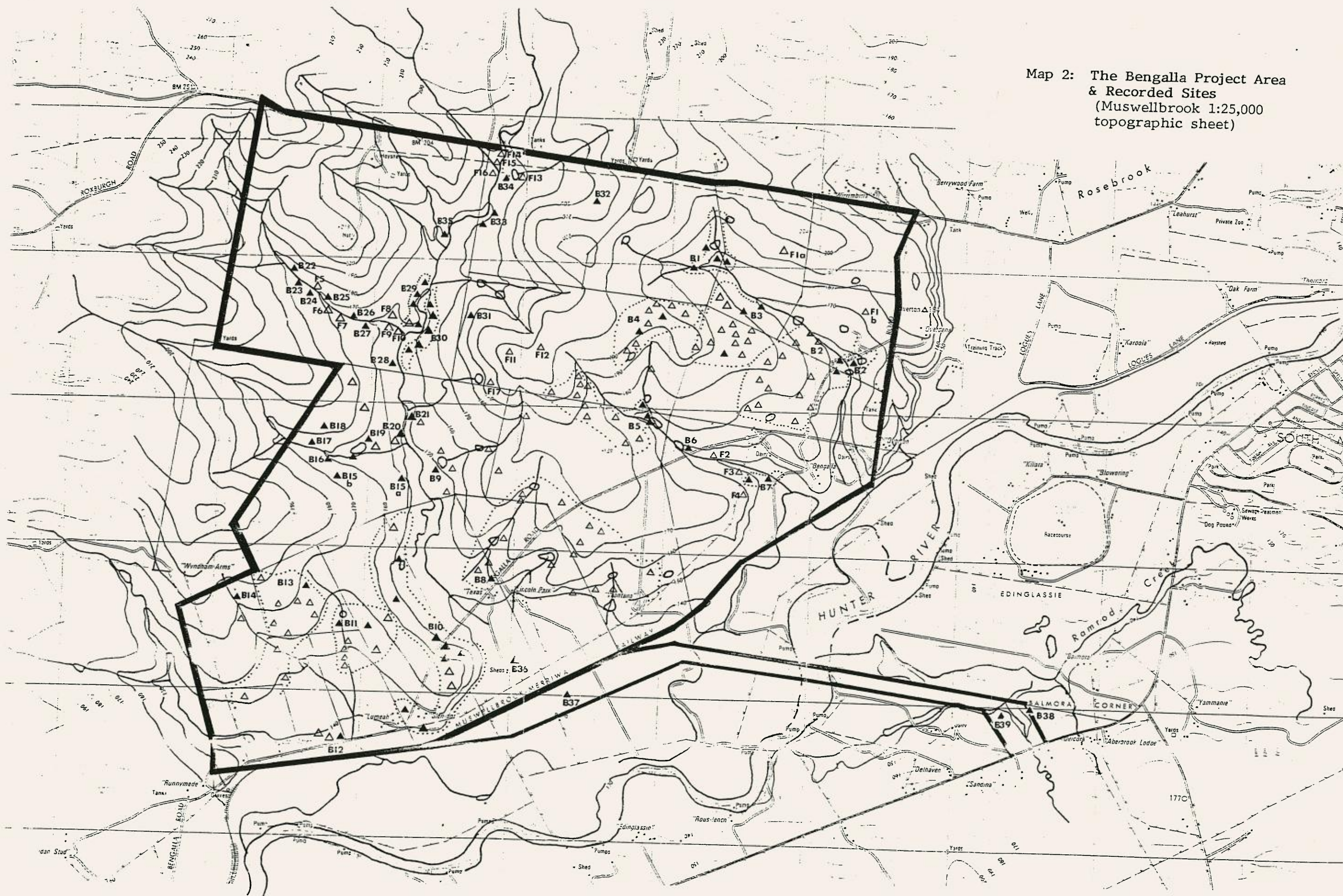


Photo 1: General view in the project area. Taken from a hill high on the northern edge of the project area and facing south-east. Site B1 is located along the gully in the centre-left of the photo. Site B3 is located along the gully in the far left. Sites B2 finds and B3 finds occur on the hill slope beyond the gully. Site B4 occurs on the ridge top in the right midground of the photo.

Map 2: The Bengalla Project Area
& Recorded Sites
(Muswellbrook 1:25,000
topographic sheet)



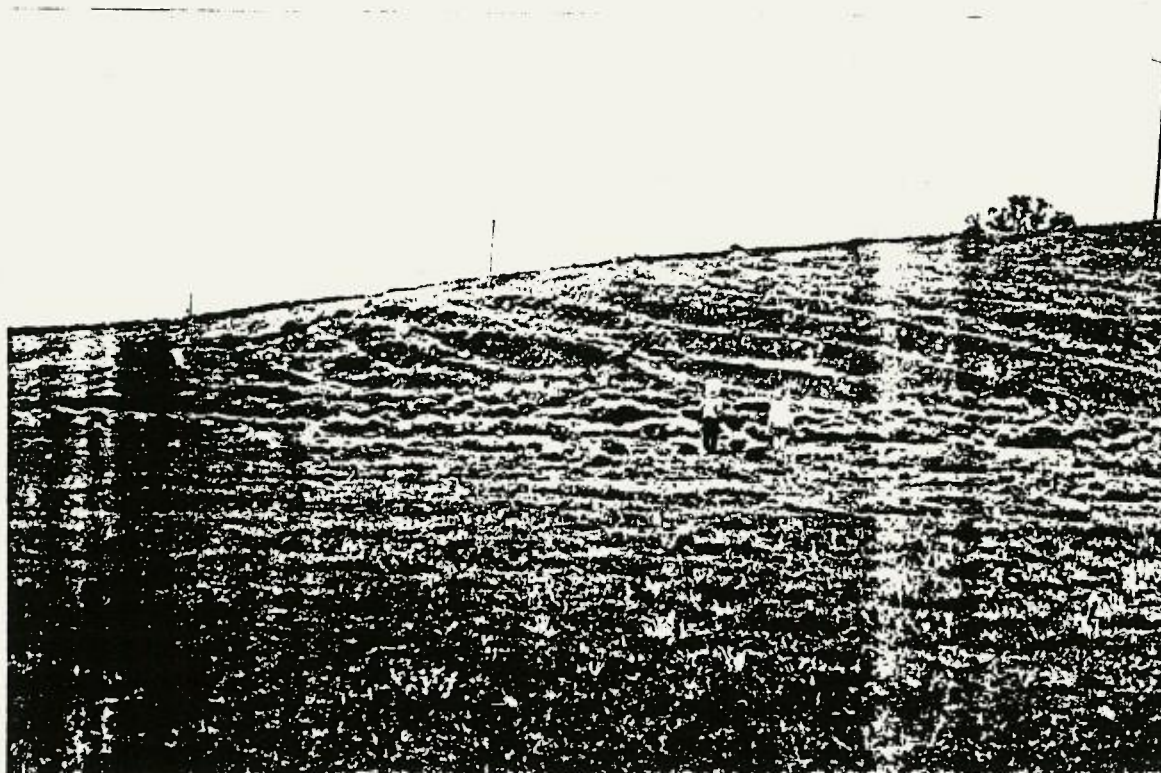


Photo 2: Part of the silcrete extraction site. Silcrete artefacts and cobbles occur on the hill slope and can be seen in the eroded areas.

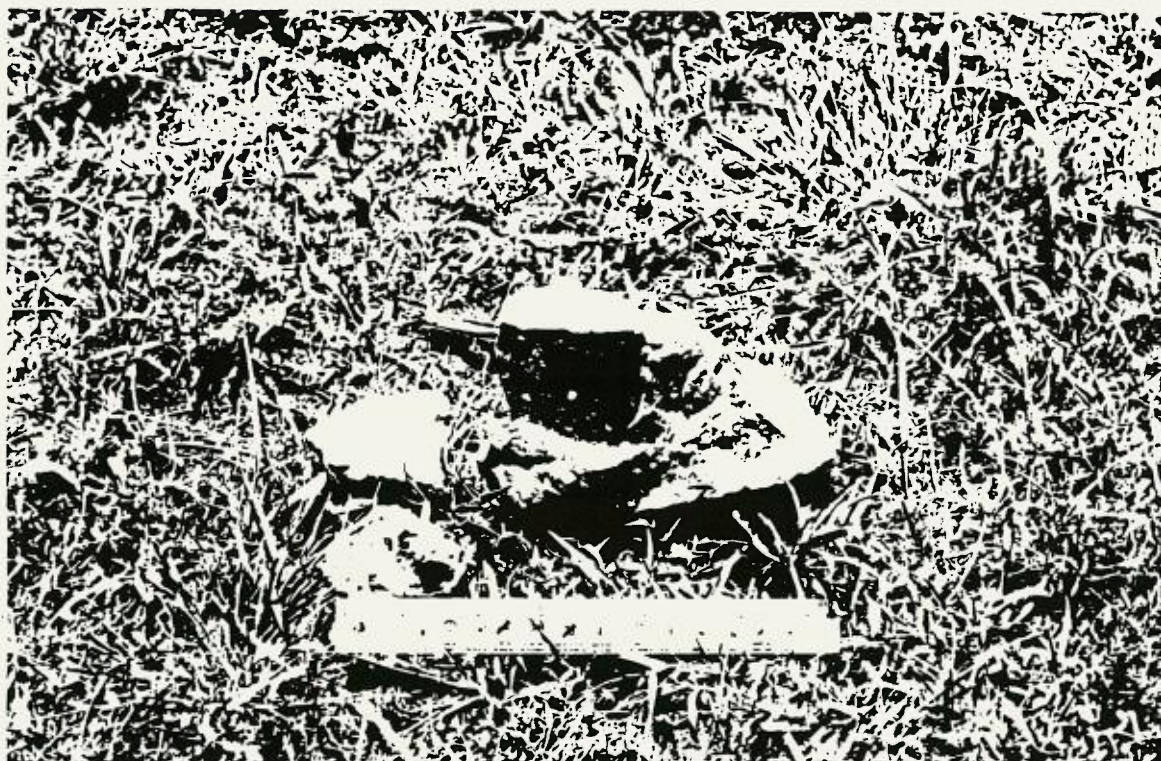


Photo 3: Examples of silcrete artefacts. The ruler is in 1cm intervals.

2.1 SITES IN THE LANDSCAPE

Sites were found on all land units within the project area - along the main creek, along some gullies, on rises and bluffs above the Hunter flats and on slopes and ridge tops. Artefacts were also found on the Hunter flats but these may have been washed there during floods. The locations of some of the sites are shown on Figures 1 and 2.

During the survey, notes were made about all the areas where we could see the ground and so be able to find artefacts. These areas are called "exposures". Figure 3 shows the total area in hectares of all the exposures seen during the survey. It shows that we were able to see the most ground on the hill slopes and ridges.

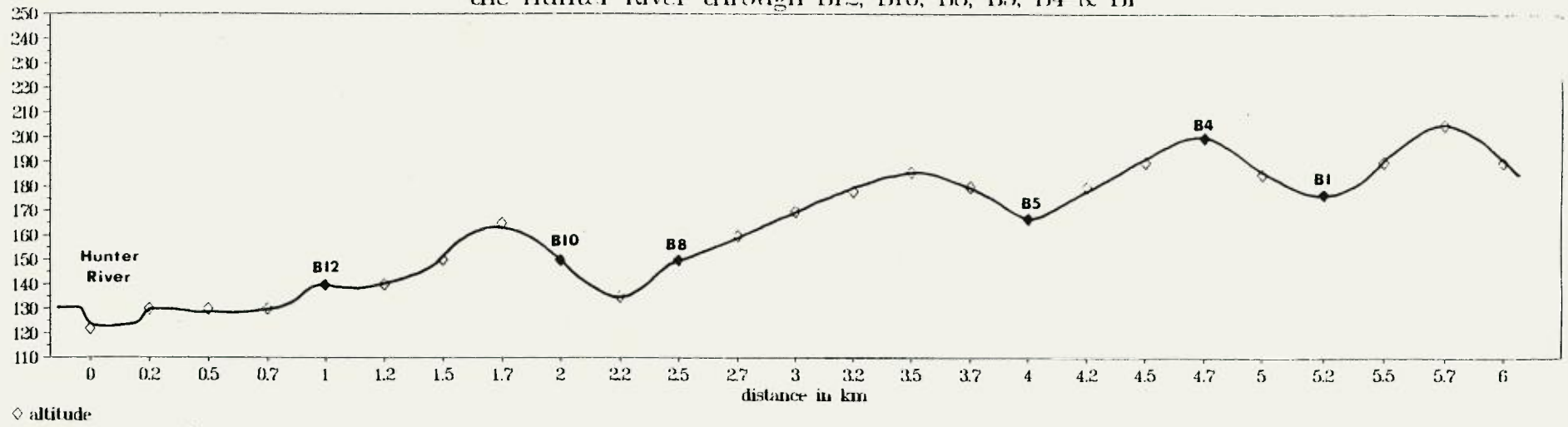
Figure 4 shows the total number of artefacts recorded during the survey. The gullies and the main creek have the most artefacts. The slopes and ridges do not have as many artefacts. The main creek, the gullies and the low rises above the Hunter flats had the highest artefact density (see Table 1). The bluffs above the Hunter flats, and slopes and ridges, had the lowest artefact densities.

Table 1: Artefact Density

No.	Land Unit	Artefact Density /hectare
1	the Hunter flats	2/ha
2	low rises above the Hunter flats	102/ha
3	bluffs above the Hunter flats	4/ha
4	gullies close to the Hunter flats	35/ha
5	other gullies	96/ha
6	main creek	354/ha
7	slopes & ridges	9/ha
8	silcrete extraction site	47/ha*

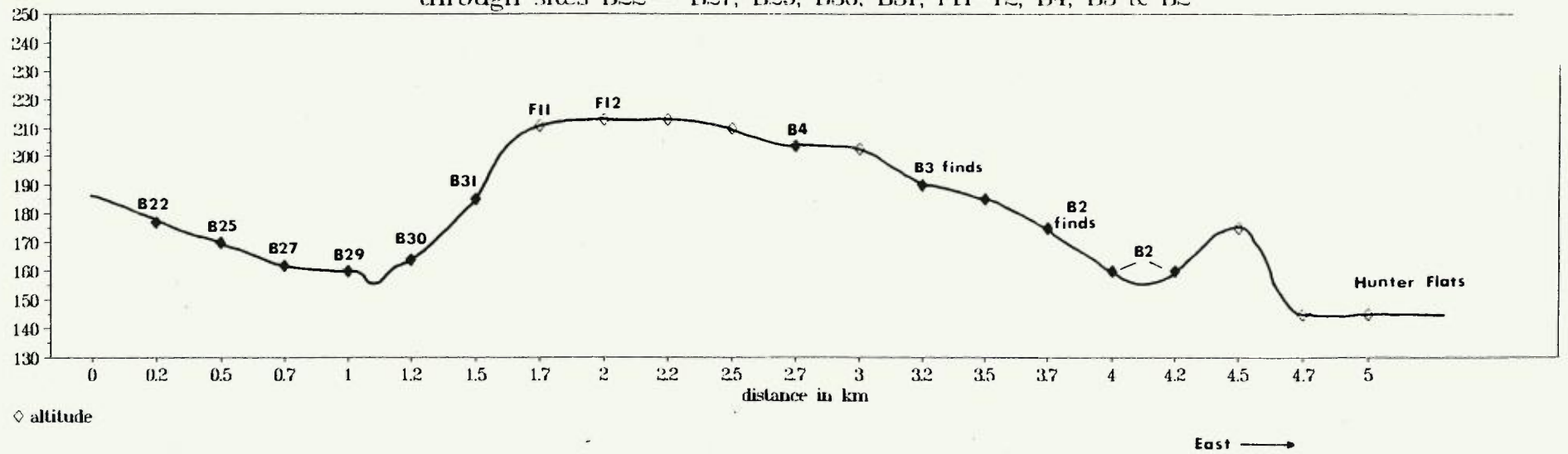
* many artefacts were seen but not all were recorded so the extraction site has a higher density of artefacts than this.

Fig 1: Cross Section through the Bengalla Project Area:
the Hunter River through B12, B10, B8, B5, B4 & B1



©
M
A
X

Fig 2: Cross Section through the Bengalla Project Area from west to east through sites B22 - B27, B29, B30, B31, F11-12, B4, B3 & B2



©
M
A
X

Fig 3: Extent of Ground Visibility in hectares

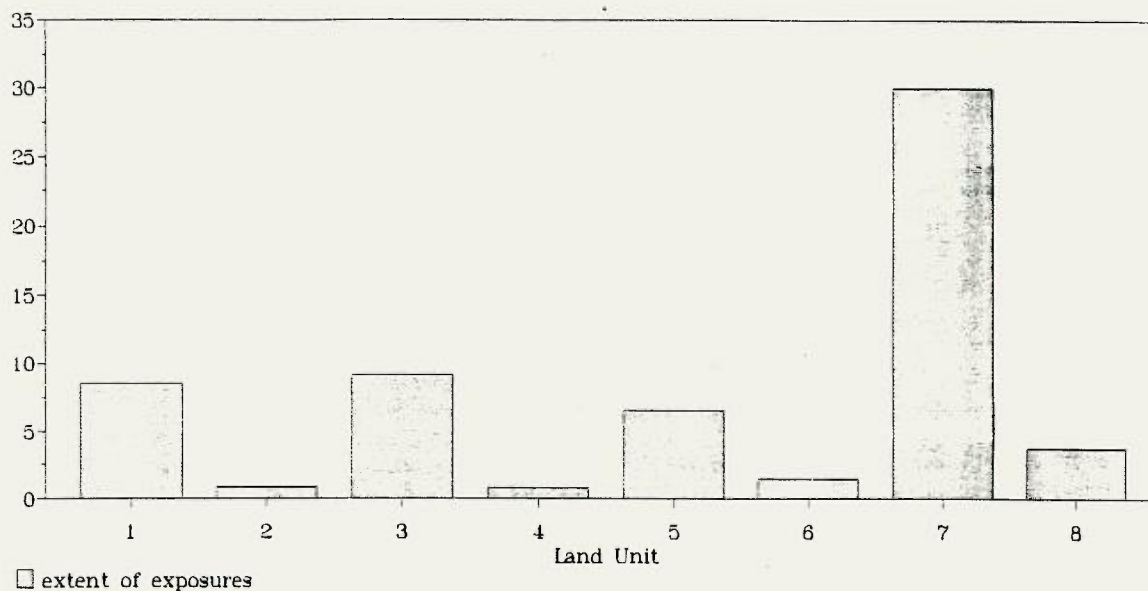
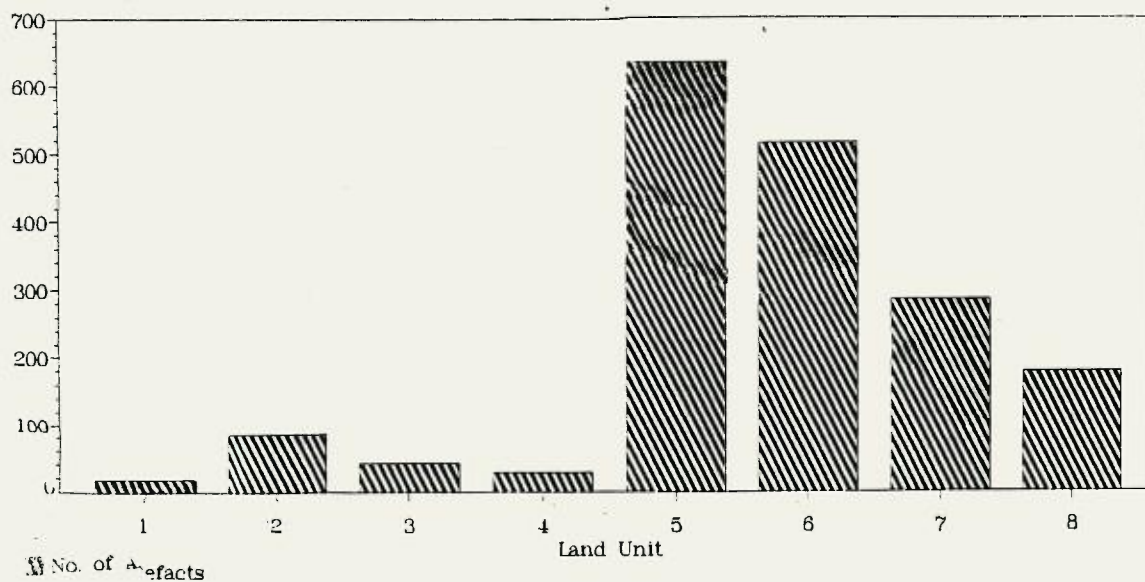


Fig 4: Frequency of Artefacts on Each Land Unit



Many of the sites and finds had been ploughed in the past. However, an area in the north-west part of the lease has more trees and may not have been ploughed. The sites in this area are much less disturbed.

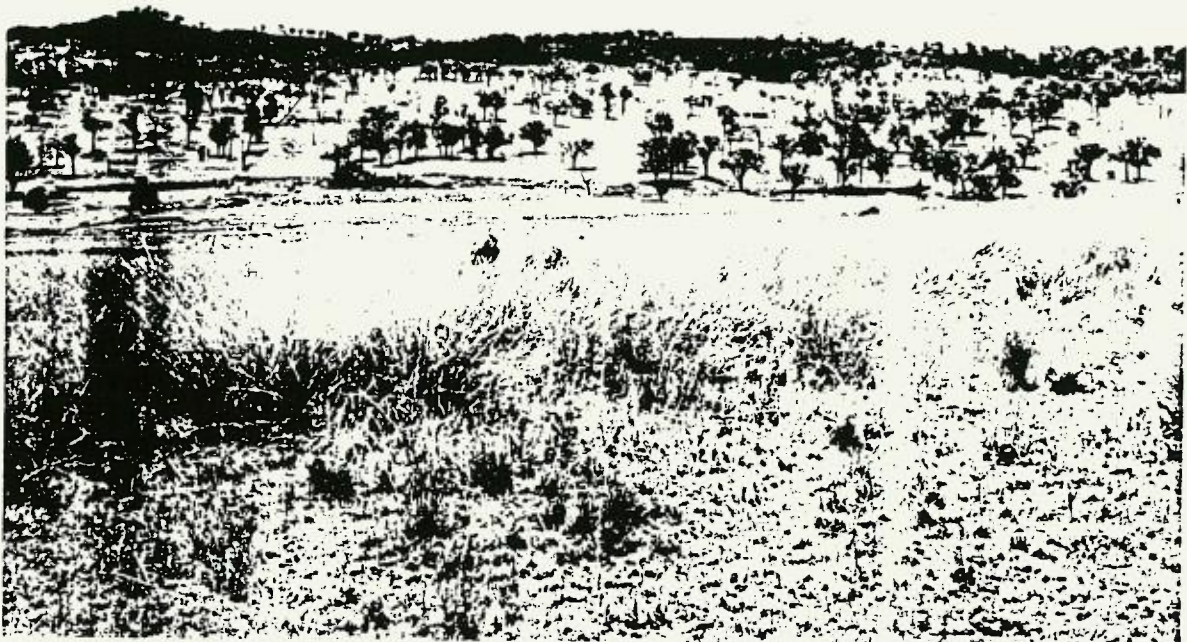


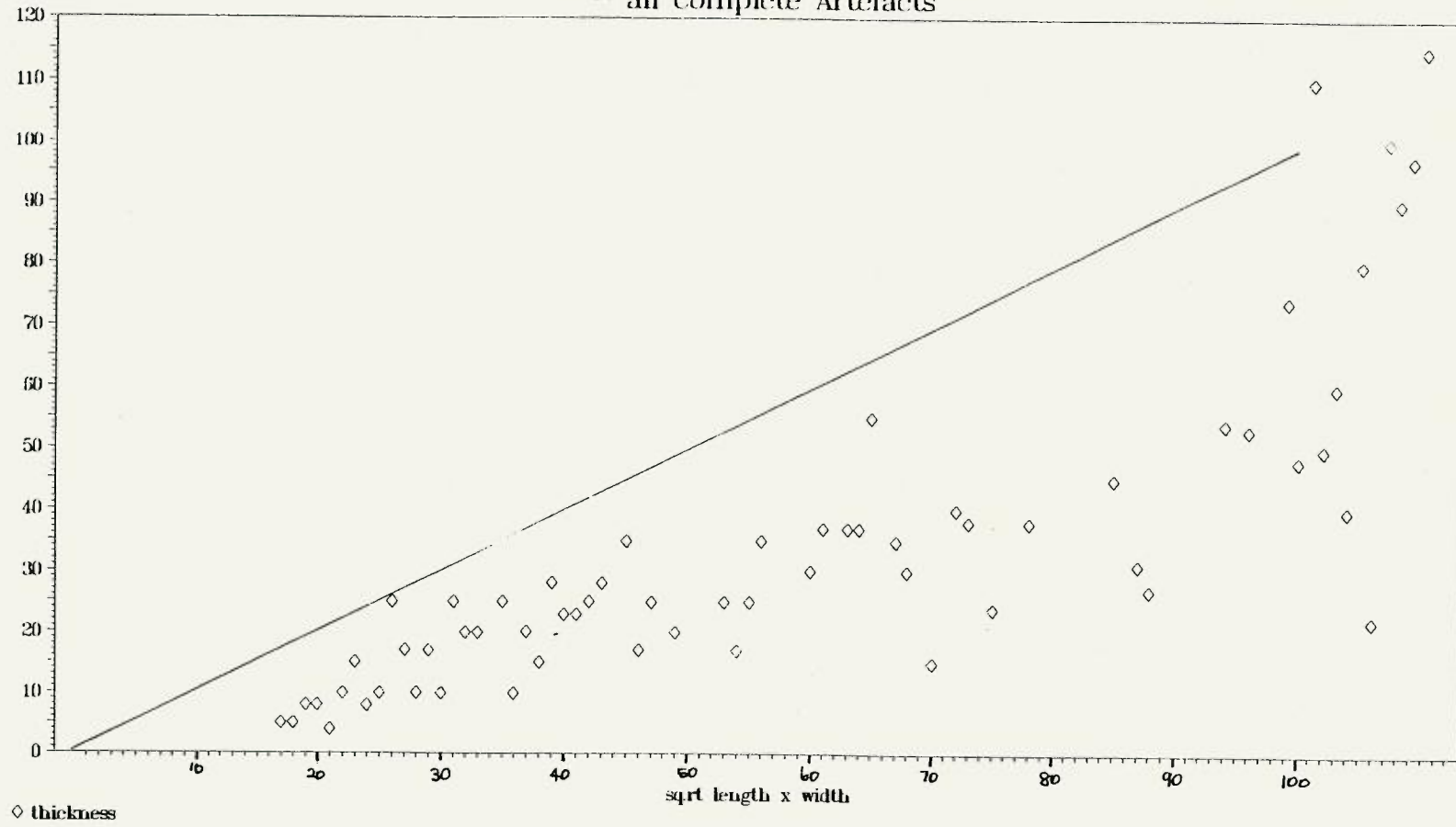
Photo 4: The north-western part of the coal lease. Sites were found along the creek and along the gully flowing into the creek on the right-hand side of the photo.

2.2 THE STONE ARTEFACTS

A variety of stone artefacts were found. On the extraction site the artefacts occur in all shapes and sizes, and include large cores, big flakes, big tools, smaller flakes and pieces and a petrified wood backed blade knapping floor (cluster).

Artefacts recorded on this site are shown on Fig 5. This is a graph designed to show the size of artefacts. The x-axis (along the bottom) is a measure of how big the artefacts are; artefacts on the right side are big, and those on the left side are small. The y-axis (going up the page) shows the thickness of the artefacts. Fig 5 shows that a very wide range of artefact sizes and shapes are present on the extraction site. Graphs showing the artefacts at other sites in the project area look a bit different.

Fig 5: Site B10 Extraction Site
- all Complete Artefacts



It is thought that three stone industries are present in the area. These are:

1. A large-tool industry;
2. A small flake tool industry; and
3. The microblade industry.

Graphs for these three stone industries look different from each other and different from the graph for the extraction site (compare Figures 5, 6, 7 and 8). The large-tool industry includes large retouched flakes, pebble tools, axes, hammerstones (see Figure 6) and a broken grindstone. The small flake tool industry is based on small retouched flakes (see Figure 6), and the microblade industry was given over to the production of backed blades (see Figure 8).

Most sites have artefacts from two or three of these stone industries. Figure 7 includes some large tools although the artefacts at these sites belonged mostly to the small flake tool industry. There are some sites that have predominantly (or only) the microblade industry. Figure 8 shows site B30 which is located along the main creek and this site appears to have been devoted entirely to the production of backed blades.

The various stone industries tend to be found on different land units. The microblade industry is concentrated along the main creek and around the confluences of minor gullies. Small flake tool assemblages tend to occur along minor gullies and on hill slopes and ridges. Artefacts of the large tool industry are found on most land units, but occur most frequently on all land units close to the Hunter flats, and on slopes and ridges away from the flats. Large tools occur only rarely along the main creek and infrequently along gullies.

These differences in the distribution of the various stone industries reflect differences in past Aboriginal behaviour. There were rules about what kinds of stone working or stone tools were used (or left behind) in the landscape.

When stone tools are used, bits of blood, hair, or plant fibres can get stuck on the edges. It is possible to analyse these residues and find out what the tools might have actually been used for. If we knew what

Fig 6: Large Tools

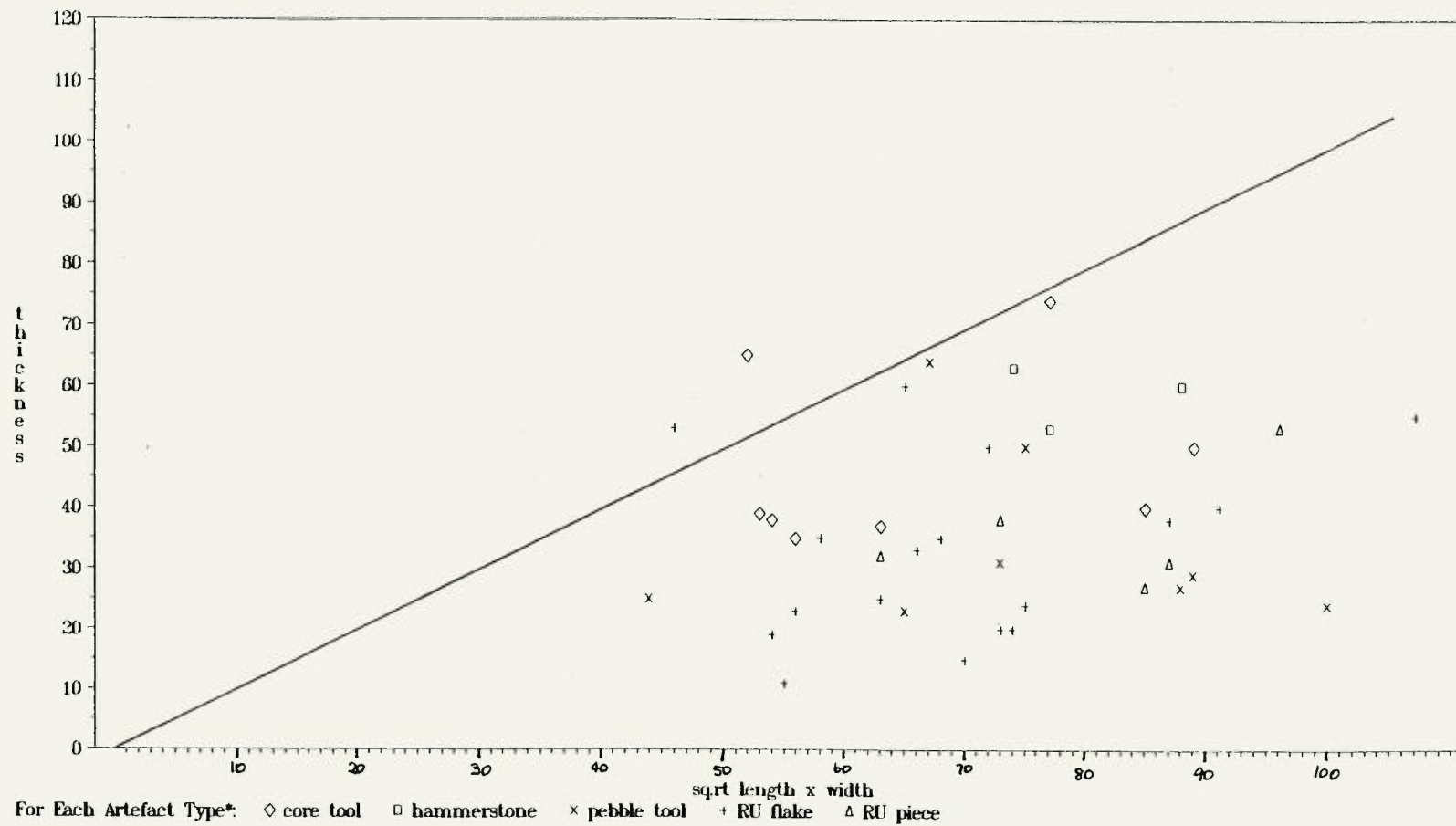


Fig 7: Sites along the West Tributary Gullies -
 B16-B19 and B23-B26

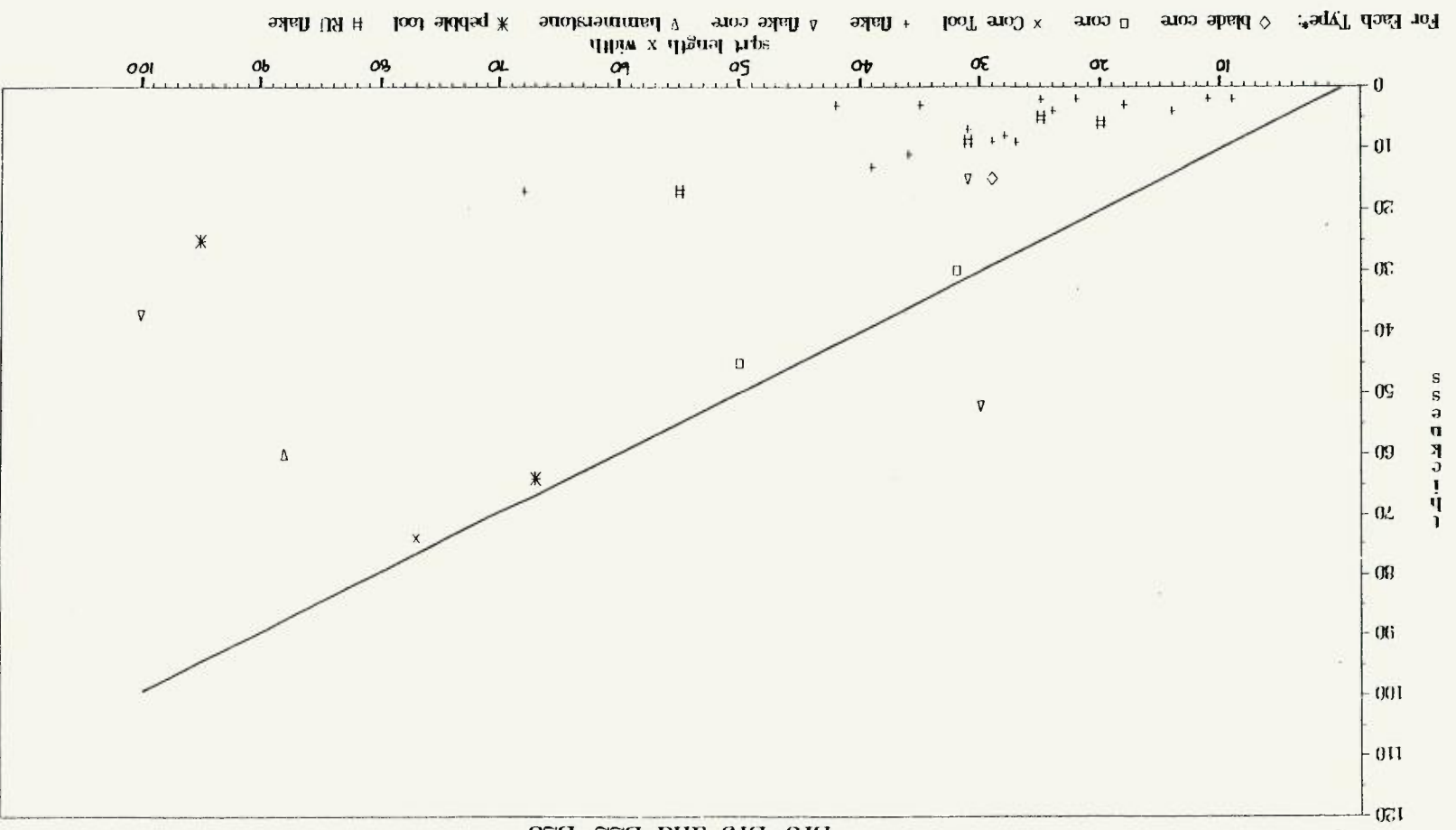
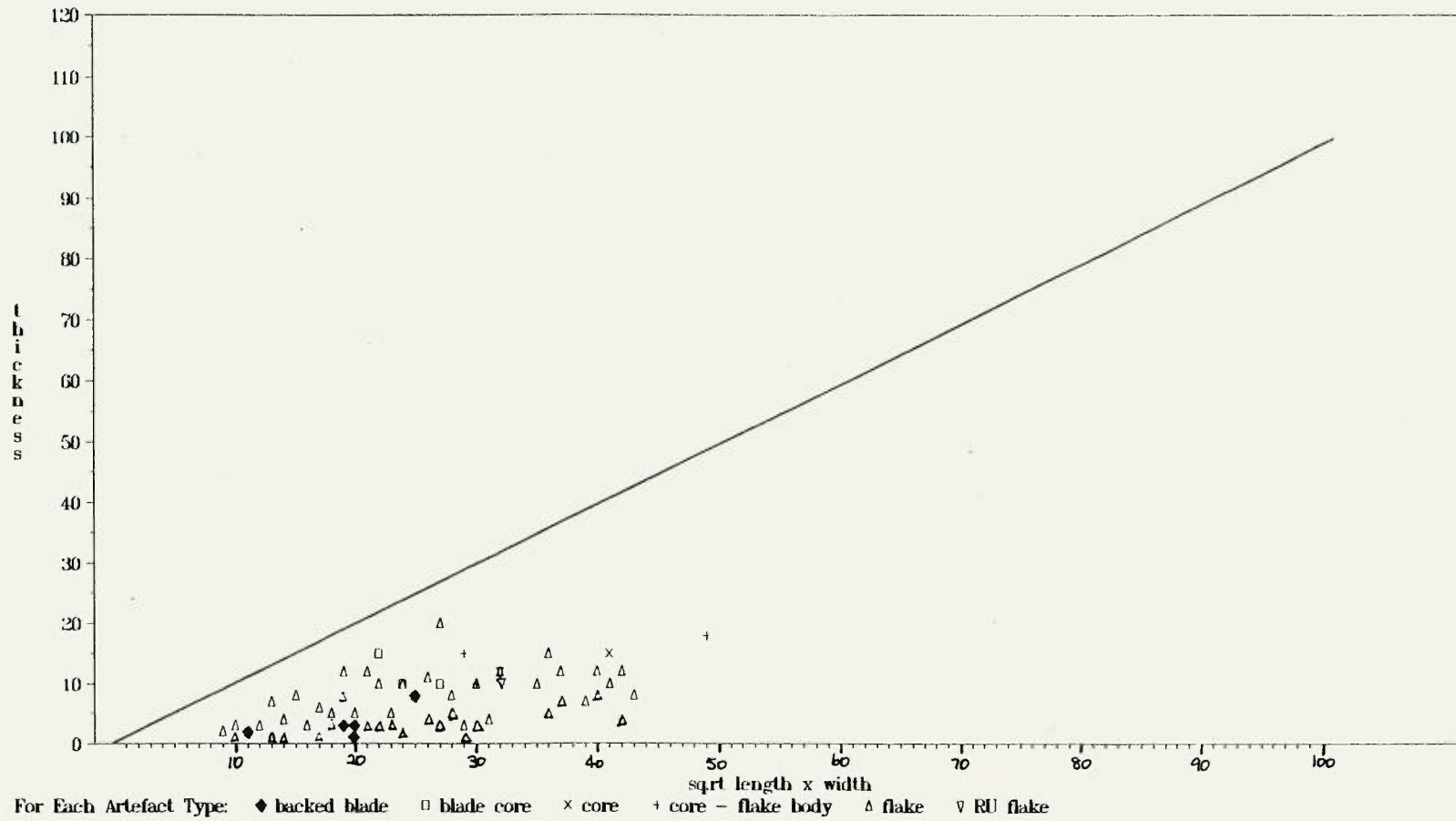


Fig 8: The Microblade Site B30



jobs had been carried out in the project area it would be possible to start to understand why different stone tools and industries were found in different parts of the landscape.

3.0 THE PROPOSED DEVELOPMENT

The layout of the proposed development is shown on Map 3. The open cut pit would be located in the north-eastern part of the area, mining progressively from east to west. The coal would be taken from the pit to a crushing plant and then to a raw stockpile adjacent to the washery in the south-west part of the project area. The coal would be processed at the washery and stockpiled. From the stockpile the coal would be loaded into rail cars and taken, via a rail loop, along the existing Muswellbrook-Merriwa railway.

An office and workshop complex would be located in the south-west part of the area. Two new roads would be constructed; one from the complex to Roxburgh Road, and the other from the complex to Denman Road.

The proposed mine would destroy Aboriginal sites and finds from an extensive area (see Table 2). At the time of the archaeological study the proposed development had been designed at an indicative level only, and precise details on impact on sites around the margins of proposed works would need to be reassessed once the development has been pegged out on the ground.

The sites and finds which would probably be effected have already been substantially disturbed by previous land uses. At this stage it appears that some similar sites along the main creek, gullies draining into the creek from the west, and on slopes above the creek would not be effected. These sites and finds occur in the north-west part of the lease area and include the least damaged sites. The three stone industries are present in this area.

The silcrete extraction site B10 would be partly destroyed by construction of conveyors and a road.

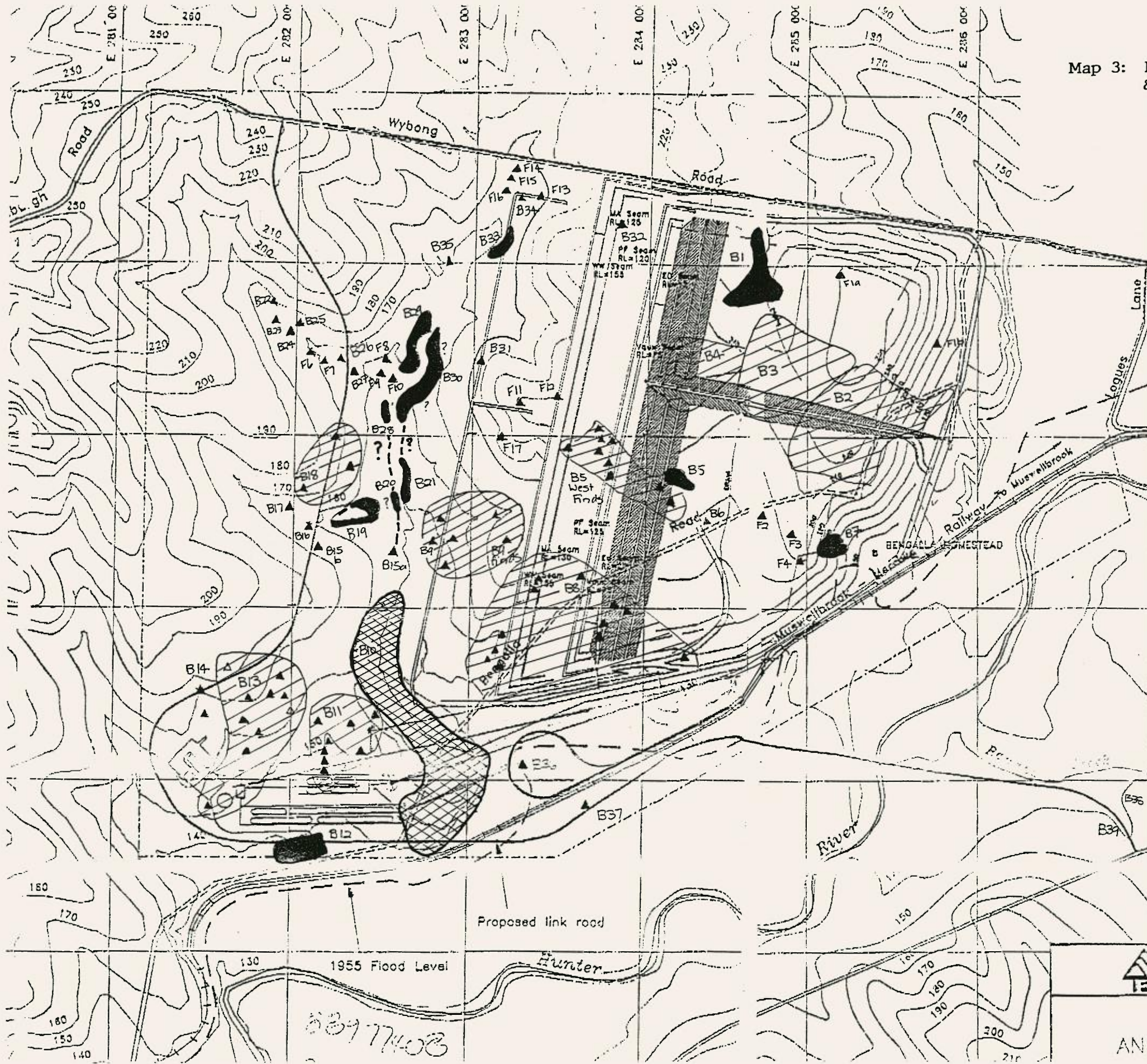
On the whole it is considered that the destruction of the Aboriginal sites and finds is not desirable, but they are not of enough archaeological importance to prevent the proposed mine from proceeding. However, the destruction of sites would need to be offset by mitigative measures.

Three measures should be adopted to reduce the impact of the proposed mine. These measures are:

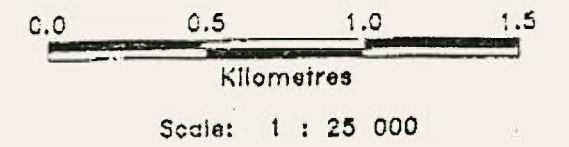
1. Salvage of the sites and finds before their destruction.
2. Protection of sites (eg, by fencing) which would be located close to the mine and other works.
3. Set aside a conservation zone which includes the silcrete extraction site B10 and areas in the north-west of the coal lease which are relatively undisturbed and beyond the limit of open cut mining. The final design of the access road from Roxburgh Road should take the need to conserve these sites into account. The Bengalla Joint Venture should enter into a conservation agreement with the National Parks and Wildlife Service.

Table 2: Indicative Impact of the Proposed Development – Land Units & Sites in the Project Area

Land Unit	Total Destruction	Partial Destruction	Not Effected
Hunter flats	B36, B37		
rise above flats		B12, B39	B38
bluffs	B8, B8 finds F4	B8 finds	
gullies within 0.5km of Hunter flats	B1, F2, F3		
gullies generally	B1, B5, B6, B7 B2 part, B3 part B9?, B12, B14 ?B26, ?B27, ?B16	B11	B17, B18, B19 B22, B23, B24 B25, F5-F10
main creek	B33, B34, F13		B20, B21, B28, B29 B30, B35
slopes & ridges	F1a, F1b, B2 part B3 part, B4, B5 west finds B15b, ?F11, ?F12	B9 finds B13 finds B18 finds	B15a,
Raw Material Source		B10	



Map 3: Recorded Sites & Finds
& Layout of the Proposed Development
(1:25,000 scale sheet
Envirosiences Pty Ltd)



NOTES: ALL LEVELS ARE IN METRES UNLESS NOTED OTHERWISE.
GRID USED - INTEGRATED SURVEY GRID



ENVIROSCIENCES PTY LIMITED

MINING AREA
AND INFRASTRUCTURE

FIGURE 1

83977408

APPENDIX 13

BENGALLA MINE PROJECT HERITAGE ASSESSMENT

BENGALLA AUTHORISATION AREA

HERITAGE ASSESSMENT

FOR

ENVIROSCIENCES PTY LTD

ON BEHALF OF

COSTAIN RESOURCES LIMITED

FINAL REPORT

FEBRUARY 1993

JOB NO. 3507

SUTERS ARCHITECTS SNELL

TABLE OF CONTENTS

	PAGE
1. INTRODUCTION	1
1.1 BACKGROUND	
1.2 STUDY PROCESS	
1.3 SCOPE OF WORKS	
1.4 REPORT FORMAT	
1.5 EXISTING HERITAGE SCHEDULES AND LISTS	
2. HISTORICAL OVERVIEW OF BENGALLA LOCALITY	3
2.1 LANDHOLDINGS IN AND AROUND THE AUTHORISATION AREA	
2.2 LANDHOLDINGS SOUTH EAST OF THE HUNTER RIVER	
3. DESCRIPTION OF HERITAGE ITEMS IN OR ADJACENT TO THE BENGALLA MINE AUTHORISATION AREA	4
3.1 ITEMS WITHIN THE AUTHORISATION AREA	
3.1.1 OVERTON (C1912)	
3.1.2 OVERDENE (C1830)	
3.1.3 BENGALLA (1877)	
3.1.4 OTHER ITEMS	
3.2 ITEMS WITHIN CLOSE PROXIMITY TO THE BENGALLA MINE AUTHORISATION AREA	
3.2.1 KEYS FAMILY PRIVATE CEMETERY	
3.2.2 EDINGLASSIE HOMESTEAD GROUP (C1880, C1895)	
3.2.3 ROUSE LENCH HOMESTEAD GROUP	
3.2.4 BALMORAL (1857-9)	
3.2.5 SKELLATAR (1883)	
4. STATEMENTS OF SIGNIFICANCE	6
4.1 INDIVIDUAL STATEMENTS OF SIGNIFICANCE	
4.2 CONCLUSIONS REGARDING SIGNIFICANCE	
5. POTENTIAL THREATS TO HERITAGE RESULTING FROM THE BENGALLA MINING PROJECT	8
5.1 DAMAGE FROM DUST EMISSIONS	
5.2 DAMAGE DUE TO VIBRATION FROM MINING ACTIVITIES	
5.3 DETERIORATION DUE TO LACK OF OCCUPANCY	
5.4 IMPACT ON VIEWS	
5.5 IMPACT OF IMMEDIATE CURTILAGE	
5.6 LOSS OF IMPORTANT HISTORICAL AND FAMILY ASSOCIATIONS	
5.7 LOSS DUE TO PERMANENT REMOVAL	
6. RECOMMENDATIONS FOR THE PROTECTION OF HERITAGE ITEMS WITHIN OR ADJACENT TO THE PROPOSED BENGALLA MINE.	11
6.1 ITEMS WITHIN OR IMMEDIATELY ADJACENT TO THE MINE	
6.1.1 RECORDING OF EXISTING ITEMS	
6.1.2 'MOTHBALLING' OF EACH PROPERTY	
6.1.3 MONITORING OF CONDITION	
6.1.4 FUTURE RESTORATION	
6.2 ITEMS REMOTE FROM THE PROPOSED BENGALLA MINE	

A APPENDICES

- A1 APPENDIX NO. 1 - HISTORICAL OVERVIEW
- A2 APPENDIX NO. 2 - INVENTORY SHEETS
 - . OVERTON
 - . OVERDENE
 - . BENGALLA
 - . KEYS FAMILY PRIVATE CEMETERY
 - . EDINGLASSIE
 - . ROUSE LENCH
 - . BALMORAL
 - . SKELLATAR

- A3 APPENDIX NO. 3 - BURRA CHARTER

LIST OF DIAGRAMS

- 1.1 STUDY AREA
- 2.1 LAND GRANTS
- 3.1 LOCATION OF HERITAGE ITEMS

EXECUTIVE SUMMARY

This study has been prepared as part of the preparation of an Environmental Impact Statement for a proposed mine by the Bengalla Joint Venture at Bengalla immediately west of Muswellbrook NSW.

The study aims to review the historical evidence and evidence "on the ground" to determine the extent and significance of any heritage items in the area. These are then reviewed in the context of the mining activity proposed for the site, to determine the implications of mining on heritage items within the locality. Finally recommendations are made with respect to actions and safeguards to protect any heritage items identified.

The study has identified a number of Heritage Items in the locality having significance at the regional level.

This investigation supports the findings of previous assessments that 'Balmoral', Edlinglassie, Rouse Lench, Skellatar and the Keys family cemetery are of Regional Significance. These items are outside the Bengalla Authorisation but within an area that could be affected in some way by mining activity.

In addition, however, this study has assessed three further items within the mine authorisation area, and has recommended that two items, 'Bengalla' and Overdene' should also be considered of regional significance. 'Overton', a more recent (c1912) weatherboard dwelling is not considered significant.

Potential impacts on these items from mining activity could include:

- Dust deposition leading to staining or deterioration of external finishes;
- Ground vibration and overpressure from blasting;
- Deterioration resulting from lack of occupancy;
- Impacts on views;
- Impact on immediate curtilage;
- Loss of historical and family associations; (particularly Bengalla).

The impacts on items south east of the Hunter River (Balmoral, Edlinglassie, Rouse Lench and Skellatar) have been assessed as not being significant (refer to noise and blasting studies, Air Quality Studies, and Visual Impact and Landscape Assessment Studies).

The items, subject to the most significant impacts will be 'Bengalla' and 'Overdene' which are both in close proximity to the early stages of mine development.

The most important impact will be the effects of blasting, with ground vibrations predicted to be up to ten times the recommended standard of 2mm/sec for 'Bengalla', and six times the standard for 'Overdene'.

Dust emissions will also have a significant impact.

From a conservation viewpoint, it is considered desirable that every attempt should be made to retain these items in situ.

Whilst, the potential impacts from vibration are high, 'mothballing' of Bengalla and 'Overdene' is considered feasible, with restoration and reuse being carried out at a later time, once impacts are within acceptable limits.

Recommendations are therefore made to record, 'mothball', monitor and later restore both 'Bengalla' and 'Overdene'.

This will require further investigation, to determine the extent of works required to stabilise these items and to prevent irreparable damage during mining activities. A programme of ongoing maintenance will also be required to prevent deterioration during this period. Finally, documentation will be required for restoration works, based on the 'recording' carried out prior to mining.

1. INTRODUCTION

1.1 BACKGROUND

This assessment has been carried out as part of the process of preparing an Environmental Impact Statement being managed by Envirosciences Pty Ltd for the proposed Bengalla mine proposed to be developed by the Bengalla Joint Venture.

The authorisation area includes or is adjacent to a number of properties that have been identified as having Regional Heritage significance.

The objectives of this assessment are to:-

- Review the historical evidence to determine whether the properties individually or collectively are representative of local, regional, or state historical themes to determine whether any important associations exist, or whether there is anything unique about them;
- To examine the current extent, character and condition of the items;
- To prepare a statement of heritage significance for each item;
- To review possible threats to the items as a result of the proposed mining; &
- To make recommendations for future management of the items.

The work has been managed by Envirosciences Pty Ltd and is carried out concurrently with other assessments of aboriginal archaeology, visual/landscape, dust emissions, noise and vibration impacts.

1.2 STUDY PROCESS

In order to minimise inconvenience to the many landholders involved the fieldwork was focussed on areas which through research were identified as having potential significance.

Historical research was carried out by Dr John Turner to build up a picture of the history of each site from primary to secondary documentary and oral sources.

This identified changes in ownership from original land grants through to more recent subdivision of the land, enabled associations with persons of prominence to be established, and provided some insight into other activities on the land they may require investigation.

This work was followed up with field inspections of the most significant items directly affected by the mining proposal, to record the items and make an assessment to their current condition.

Following further research and investigation to "fill in the gaps", statements of significance were prepared, and an assessment of potential impacts was carried out.

1.3 SCOPE OF WORK

The assessment was focussed particularly on items with existing listings or entries in current heritage registers and planning schedules.

Priority was given to those in close proximity to the proposed mine, ie: those within the authorisation area. Others have been identified where they are possibly in some way affected by the proposal.

The assessment was directed towards European heritage, with visual landscape issues and aboriginal archaeology subject to separate investigation. Refer Visual Impact and Landscape Studies - O'Hanlon Design Pty Ltd and Archaeological Survey - Elizabeth Rich.

Fieldwork was carried out only where there was evidence of remains of potential significance. No archaeological assessments were carried out.

1.4 REPORT FORMAT

Section 1 of the report outlines background to the study, and provides information on the current framework for heritage conservation affecting items in the locality.

Section 2 provides a brief outline of the history of the locality including the development of each estate from the time of the initial grants. This is supported by the more detailed historical assessment included in Appendix No. A1.

Section 3 provides a description of each of the major items within the study area, which summarises the more detailed inventories included in Appendix No. A2.

Section 4 outlines the significance of each item and the area as a whole which has been framed taking into account the historic themes outlined in the pilot

version of the State Heritage Inventory programme, and the statements of significance included in Appendix No. A2.

Section 5 discusses potential threats to Heritage Items resulting from the proposed mine, whilst section 6, makes recommendations for the protection of heritage items in the vicinity of the proposed mine.

1.5 EXISTING HERITAGE SCHEDULES AND LISTS

The principal schedules and lists of relevance to this assessment are:

- Heritage Act - Register of Heritage Orders
- Hunter Regional Plan - Heritage Schedules
- Local Environmental Plan - Heritage Schedule
- National Trust Register

1.5.1 HERITAGE ACT

Permanent conservation orders

Edlinglassie - Denman Road

1.5.2 HUNTER REGIONAL PLAN - HERITAGE

Current items include:-

Schedule 2 - Item of Regional Significance

Keys Family private cemetery - Bengalla Road

Balmoral - Denman Road

Edlinglassie - Denman Road

Rouse Lench - Denman Road

Skellatar - Tindale Street

Schedule 3 - Items of Local Significance

Overdene - Bengalla Road

Schedule 4 - Item requiring further investigation

Bengalla - Bengalla Road

1.5.3 LOCAL ENVIRONMENTAL PLAN

There are currently no heritage provisions and no heritage schedule in the Muswellbrook Local Environmental Plan.

1.5.4 NATIONAL TRUST REGISTER

Bengalla - Bengalla Road

Overdene - Bengalla Road

Balmoral - Denman Road

Edlinglassie & Rouse Lench - Denman Road

2. HISTORICAL OVERVIEW OF BENGALLA LOCALITY

Settlement and development of the Bengalla locality reflected trends in the rest of the Hunter River Catchments.

Land grants were taken up in the mid 1820's by prominent citizens of the day, rewarded for service to the Crown. The pattern adopted here as elsewhere in the Hunter was for the fertile land along the river to be taken up as grants, with areas around the grants leased until land was improved.

Land grants were issued in 640 acre parcels to a maximum of 2560 acres.

2.1 LANDHOLDINGS IN AND AROUND THE AUTHORISATION AREA

The most significant grants north west of the Hunter River were issued to DCF Scott (2560ac), Francis Allman (2560 ac) JK McDougall (1280 ac) and Samuel Wright (100 acres). Others with significant landholdings which show up on the parish maps include George Blunt, JE Ireland, John Soles, RT Keys and JH Keys.

Allman Scott and Wright acquired fertile river frontage. Activities in the early 19th century included sheep and cattle, wheat and viticulture. By the end of the Century both properties had changed hands. The Keys family (JH Keys and RT Keys) took control of Bengalla, and acquired further land in the area. By 1911 they controlled over 20,000 acres. The current 'Bengalla' homestead was constructed in 1877.

'Overton' passed through a succession of owners including the McDougalls, and Nowlands and came into the possession of George Blunt in the 1870's. The date of construction of the stone cottage now known as 'Overdene' is uncertain, but is believed to have been constructed for the Nowlands in the 1860's.

Both Keys and Blunt were significant in taking on board improvements in farm technology. Both had sophisticated irrigation systems which allowed them to achieve excellent lucerne yields.

The nature of farm activities reflected the pattern elsewhere in the Hunter. However, Keys was important as a prime proponent of live cattle exports, whilst Blunt concentrated on Sheep breeding. Later both were to move into Dairying with a creamery erected at 'Overton'.

The advent of the Closer Settlement Act resulted in the fragmentation of both Bengalla and Overton estates.

'Bengalla' continued as a middle sized estate and has remained in the hands of descendants of the Keys family. The 'Overton' estate, however, was almost completely dismantled and fragmented into smaller parcels.

It was following the subdivision of the land in 1912 that the house now known as 'Overton' was probably constructed.

The construction of the railway through the land in 1915 allowed the development of resources in the area. The Overton Coillery Company was formed in 1921 and operated for a brief period from 1922 to 1925.

2.2 LANDHOLDINGS SOUTH OF THE HUNTER RIVER

Original grantees south east of the Hunter River included Francis Forbes and George Forbes and Marcus Macartney.

By mid century substantial estates were being developed, 'Balmoral' by William Bowman (1857) and 'Edinglassie' by James White (1880). Bowmans twin sons Edward and Andrew built nearby 'Skellatar' (1883).

These residences were all associated with prominent architects of the period, including Horbury Hunt, Reuss and Brown, and Blackett.

Their owners were men of prominence and wealth. William Bowman has significant associations with the area, being a magistrate, the first mayor of Muswellbrook, and MLA for Northumberland. Skellatar is an example of inherited wealth.

'Rouse Lench' is located within the Edinglassie estate approximately 600 metres East of 'Edinglassie', and is the earlier homestead, used prior to the construction of 'Edinglassie'.

3. DESCRIPTION OF HERITAGE ITEMS IN OR ADJACENT TO THE BENGALLA MINE AUTHORISATION AREA

Existing heritage items within the vicinity of the Bengalla mine Authorisation Area are shown in diagram No. 3.1 and include:

Items within the Authorisation

- Overton - Homestead
- Overdene - Homestead (unoccupied)
- Bengalla - Homestead group including curtilage

Other activities known to have been associated with the above but which no longer exist include:

- former colliery and spur line - Overton Colliery Co.
- former creamery
- former school (Clanricard)
- former shearing sheds
- former irrigation equipment
- former blacksmiths shop
- viticultural activities

Items within close proximity to the Authorisation

- Keys family private cemetery
- Edinglassie - homestead group
- Rouse Lench - homestead group
- Balmoral - homestead group
- Skellatar - homestead
- Old Bengalla Site - no above ground remains

More detailed information on each of the major items is included in Appendix No. 2 to this report, which includes an Inventory form based on the State Heritage Inventory programme (version 1.0) developed by the Department of Planning Heritage Branch.

Sections 3.1 and 3.2 give a brief description of each of the items noted above.

Property reference numbers included for each property are those adopted by Envirosciences Pty Ltd.

3.1 ITEMS WITHIN THE AUTHORISATION

3.1.1 OVERTON (c1912) Property No. 13

'Overton' is a single storey weatherboard Federation residence constructed c1912 following the fragmentation of the 'Overton' estate.

'Overton' is in a good state of repair having recently been sympathetically refurbished. The building appears

to be structurally sound, and most original interior and exterior finishes are intact.

3.1.2 OVERDENE (c1860) Property No. 11

'Overdene' was originally known as 'Overton' and was the principal residence associated within the 'Overton' estate.

It is a single storey Colonial Georgian stone residence constructed with coursed random sandstone, with brick chimneys. The original timber shingle roof has been replaced with corrugated iron. The building measures 9.5 x 12.5 metres.

'Overdene' is in an extremely poor state of repair, however the basic structure is sound, and key components such as windows and doors are still intact.

Internally plasterwork is deteriorating, ceilings have collapsed, and some joinery has been removed. The original western wing has been demolished, verandahs have collapsed, and verandah flooring has deteriorated.

The building was subject to a proposal for restoration in 1989, and received an offer for funding from the NSW Heritage Council. The estimated cost of basic restoration works at the time was \$21,200.

'Overdene' is now at a critical point where accelerated deterioration is possible if remedial works are not carried out to stabilise the condition of the building.

3.1.3 BENGALLA (c1877) Property No. 29

'Bengalla' is a large single storey brick residence with a corrugated iron roof. The building was constructed in several stages. The earliest stage 1877 was in the colonial Georgian style with split timber shingled roof. This was substantially extended in 1895 with an eastern wing with Gothic revival detail added, and the service wing extended.

More recent additions include a garage, bathroom and laundry, and extensive pergola structures.

The building is in sound condition, with evidence of foundation movement, resulting in cracking of brickwork. This is possibly a result of differential movement between the original building and later additions.

Original internal finishes and details are substantially intact and in good condition although finishes in the service wing are starting to deteriorate.

3.1.4 OTHER ITEMS

There is no above ground evidence left of most items referred to in the historical analysis with the exception of the former shearing shed which at the time of the fieldwork was under demolition.

The location of these items where known is indicated in diagram 3.1.

3.2 ITEMS WITHIN CLOSE PROXIMITY TO THE BENGALLA MINE AUTHORISATION AREA

Of the items in the immediate vicinity of the proposed mine, only one, the Keys family private cemetery is located north west of the Hunter River.

All other items are on the opposite (south east) side of the River and range from 600 metres to 2.5 km from the boundary of the authorisation boundary.

Details of each of these items is included below:

3.2.1 KEYS FAMILY PRIVATE CEMETERY Property No. 132

The Keys family cemetery is a small area approx. 20m x 40m located approximately 350 metres south of the authorisation area. The Cemetery is fenced with a post and wire fence, and located about 25 metres south of the Bengalla road just to the south east of 'Runnymede' homestead.

The area includes a variety of grave markers in sandstone and marble. Condition ranges from excellent to poor. Some (mainly sandstone) markers are in a deteriorating condition.

The site is located in close proximity to the original Keys homestead known from 1877 as 'old Bengalla'. There are no above ground remains of the old cottage.

3.2.2 EDINGLASSIE HOMESTEAD GROUP (c1880 AND c1895) Property No. 115

'Edinglassie' is an impressive late Victorian residence constructed in the period 1880 to 1895.

It is a two storey sandstone building with hipped corrugated iron roof containing 14 principal rooms and located approximately 900 metres south of the authorisation area boundary.

The group includes the main building, a 2 storey service wing, timber stables building, meathouse, killing shed and dovecote.

The well defined curtilage includes significant vegetation.

The main building is in excellent condition with most

original internal and external finishes intact.

3.2.3 ROUSE LENCH HOMESTEAD GROUP Property No. 115

'Rouse Lench' is a single storey building in the Colonial Georgian style with skillion verandah extending from the main roof.

It is located approximately 1.4km south east of the Authorisation Area boundary. Full historical details are not known, but the building is known to be the earlier stage of development of Edinglassie.

3.2.4 BALMORAL (1857-1859) Property No. 112

'Balmoral' is an impressive two storey brick residence in the Colonial Georgian style and is located approximately 1.4 km south east of the Authorisation boundary. It was designed by Reuss and Brown and built by Bringeman and Dewar. The building has a hipped roof with dormer windows, a two storey verandah, and two storey service wing. Details include six pane windows, cedar joinery, six panel doors and stone quoins.

Balmoral is in excellent condition and is relatively unmodified.

3.2.5 SKELLATAR (1883)

'Skellatar' is a two storey late Victorian residence designed by Blckett and located approximately 2.4 km east of the Bengalla Authorisation area. The building is constructed of brick and has a hipped slate roof. It has two storey verandahs with cast iron supporting columns and decorative lacework and bullnosed corrugated iron roofing. It also includes a brick ballroom. Most detail including interior joinery is intact.

4. STATEMENTS OF SIGNIFICANCE

4.1 INDIVIDUAL STATEMENTS OF SIGNIFICANCE

The following statements are reproduced from the inventory forms included in Appendix No. A2 and outline the most important factors affecting the significance of each item.

4.1.1 BENGALLA

The building has associations with prominent district citizens including JH Keys, pioneer in cattle, dairying and farm management.

The land has important associations with prominent citizens including Capt. Samuel Wright and Capt. 'D.C.F. Scott.

Buildings and curtilage are good examples of successful pastoral properties of the late 19th Century.

Good intact example of the Victorian style, currently complete with family furnishings, photographs and archives which facilitate interpretation of the life style of occupants.

4.1.2 OVERDENE

The land has significant associations with Capt. F. Allman and J.K. McDougal - prominent citizens in NSW.

The building has significant associations with George Blunt, successful construction contractor associated with important projects such as the railway line and Waika Waterworks.

A good example of the colonial Georgian style located in a prominent position.

Important associations with pastoral development, advances in irrigation technology in the region and early attempts at coal mining in the area.

4.1.3 OVERTON

Example of the scale of activity and pattern of settlement that developed following the Closer Settlement Act.

Has associations with original more extensive 'Overton' property owned by the Blunt Family at the time of subdivision.

Represents the fragmentation of 'Overton' landholding.

Good example of a timber farm house - common in this

period - largely intact.

4.1.4 KEYS FAMILY CEMETERY

Important associations with the Keys Family who were prominent in local affairs.

Significant associations with "Bengalla".

Facilitates interpretation of the lifestyle of prominent local citizens in conjunction with other items in the area including site of "Old Bengalla".

Good example of family cemetery in good condition.

Enjoys important relationship with landscape.

4.1.5 EDINGLASSIE

Exemplifies the wealth associated with the development of prime rural resources in the Upper Hunter.

Important associations with James White and the White Family who were prominent in the Upper Hunter and other regions.

Important associations with Horbury Hunt a prominent Australian Architect.

Excellent example of a late Victorian farm group with detail substantially intact.

Facilitates interpretation of the lifestyle of wealthy landowners in late 19th Century.

Well known historic home in the area.

Has important associations with other properties in the locality and region which collectively demonstrates the importance of pastoral/farming themes to the region.

4.1.6 ROUSE LENCH

Represents the early phase of development of Edinglassie.

4.1.7 BALMORAL

Important associations with William Bowman. Significant local citizen, Mayor, and MLA.

Designed by Reuss and Brown - prominent architects.

Excellent example of Georgian style in excellent condition.

Facilitates interpretation of the lifestyle of the wealthy landed gentry in the mid to late 19th Century.

Well known historic home in the area.

Has important associations with other historic properties in the area (particularly "Skellatar") which collectively demonstrate the importance of pastoral/farming themes to the region.

4.1.8 SKELLATAR

Important associations with Bowman Family who were prominent in the region.

Designed by Blackett - a prominent Australian architect.

Has important associations with other historic homes in the area (particularly "Balmoral") which collectively demonstrate the importance of pastoral/agricultural themes to the region.

4.2 CONCLUSIONS REGARDING SIGNIFICANCE

The assessment carried out as a result of this study supports the inclusion of Balmoral, Edinglassie, Rouse Lench, Skellatar and the Keys family cemetery in schedule 2 of the Regional Environmental Plan.

It is suggested, however, that based on the evidence available as a result of this study, the following items should also be regarded as being of regional significance, and therefore included within schedule 2 of the Regional Environmental Plan. (ie. of Regional Significance).

- Bengalla - Bengalla Road
- Overdene - Bengalla Road

The reasons for these recommendations are included within the statements of significance for each item.

'Overton', whilst a good example of an early 20th Century farmhouse developed following the Closer Settlement Act, is not considered to be of sufficient significance to include in a Regional or Local heritage schedule. However, its associations with 'Overdene', and good condition would make conservation desirable.

5. POTENTIAL THREATS TO HERITAGE RESULTING FROM THE BENGALLA MINING PROJECT

Potential threats to heritage in the vicinity of the proposed mine are likely to include the following:

- Damage resulting from dust emissions;
- Damage due to vibration from blasting, vehicles and equipment;
- Deterioration due to lack of occupancy during the life of the mine;
- Impact on views;
- Impact on the immediate curtilage as a result of mining activity;
- Loss of important associations due to removal of current occupants; &
- Loss due to permanent removal

5.1 DAMAGE FROM DUST EMISSIONS

Dust impacts have been assessed within the Air Quality Studies prepared by Nigel Homes & Associates for the Mine Project.

Potential affects resulting from mine operations could include:

- Staining of external surfaces;
- Deterioration of external finishes through chemical attack, corrosion etc. (particularly in solution).

It is not expected that the composition of dust that will deposit on 'Overdene' and Bengalla is likely to result in chemical attack of external finishes. However, the external components of items within the Authorisation should be cleaned as part of an ongoing maintenance programme to avoid damage.

5.2 DAMAGE DUE TO VIBRATION FROM MINING ACTIVITIES

Refer also to the separate sub-consultancy on this issue prepared by Caleb Smith Consulting Pty Ltd "Noise and Blasting Studies".

During the life of the mine, nearby properties will be affected by vibration from several sources including:

- Mine blasting;
- Mining vehicles
- Equipment and machinery

5.2.1 MINING VEHICLES EQUIPMENT AND MACHINERY

Bengalla homestead is located a minimum of 310 metres from the mining pit, and mine operations associated with

the removal of spoil will be in excess of 50 metres from the homestead. No adverse impacts are therefore expected from vibration from mining vehicles, plant and machinery.

Mine Roads and other infrastructure are well away from Bengalla, Overton and Overdene, and no adverse impacts are anticipated.

5.2.2 BLAST GROUND VIBRATION

Australian Standard 2187 Part 2 - SAA Explosives Code establishes a limit of 2.0mm/sec for historic buildings.

It has been predicted in the Noise & Blasting Studies that Bengalla, Overton and Overdene will be subject to ground vibration from blasting greater than the recommended limit.

In the early life of the mine, ground vibrations are expected to exceed the 2mm/sec limit at Bengalla, Overton and Overdene. Predicted levels are 15-20mm/sec for Bengalla, and 12mm/sec for Overdene.

This would reduce to 2mm/sec once a distance of 1600m from the mine was achieved.

Levels at all other heritage items are predicted to be below the required standard.

Overton, being a timber framed weatherboard structure will be less likely to suffer irreparable damage than Overdene and Bengalla.

Both Overdene and Bengalla are masonry structures, already showing signs of foundation movement.

5.2.3 BLAST OVERPRESSURE

Criteria for over pressure from blasting are included in the Noise Control Manual issued by the EPA. These are based on comfort criteria and vary with time and day of week.

The maximum allowable over pressure is 115dB (linear) for Monday to Saturday 9.00am to 3.00pm. Lesser limits apply for early mornings, Sundays and public holidays.

Over pressure levels have been calculated by Caleb Smith Consultant Pty Ltd in the Noise and Blasting Studies. These are expected to exceed this limit in the early life of the mine at the three properties close to the mine with levels at Bengalla expected to be 130 dB, and Overdene 125db.

Levels at properties south of the Hunter River are predicted to be within the allowable criteria and no adverse impacts are predicted. However, the

potential impact of focussing of overpressure due to climatic conditions (wind direction or temperature inversions) should be considered in the mine plan.

5.2.4 POTENTIAL IMPACTS

The possible results of an extended period of exposure to blasting at the levels predicted for 'Bengalla' and 'Overdene' could include:

- further foundation settlement;
- cracking of stone and brick masonry;
- damage to structures such as chimneys;
- loss of plaster on internal walls;
- damage to ceilings and cornices;
- weakening of structural connections;
- failure of structural elements and framing already subject to damage or stress;
- damage to joinery items such as window and doors;
- damage to roof elements permitting water damage;
- failure of mortar beds between masonry units
- failure of random rubble walls.

The magnitude of impact from these potential sources will require further evaluation by a suitably experienced structural engineer.

5.3 DETERIORATION DUE TO LACK OF OCCUPANCY

Exposure to dust, noise and vibration will probably necessitate the relocation of the current occupants of "Overton" and "Bengalla".

Whilst "Overdene" is currently unoccupied, it is in close proximity to two other residences which are occupied.

The removal of occupants leaves each building subject to possible deterioration which is less likely to otherwise occur.

These include:

- lack of regular inspection;
- lack of regular maintenance when required (particularly maintenance to prevent weather exposure);
- exposure to vandalism and loss (such as fire);
- exposure to theft and loss of internal detail

Occupation of a building, particularly as a residence, means that maintenance issues such as water damage, white ant infestations, etc are usually quickly identified and attended to. There is also less risk of acts of vandalism and theft of significant detail and components such as joinery items, hardware and fireplaces. These acts are sometimes also associated with arson.

5.4 IMPACT ON VIEWS

Refer also to the separate sub-consultancy on this issue prepared by O'Hanlon Design Pty Ltd (Visual Impact and Landscape Assessment).

The impacts on views from the principal spaces within Bengalla, Overdene and Overton will be negligible as the buildings have been oriented away from the proposed mine.

Bengalla, however, is close to the initial box cut. The Curtilage of this property will be directly affected by mining operations. This issue is discussed further in Section 5.5.

'Edinglassie', 'Balmoral' and 'Rouse Lench' each enjoy expansive views over the river flats towards the site. The extent to which these are affected is discussed in the Visual Assessment carried out by O'Hanlon Design Pty Ltd.

5.5 IMPACT ON IMMEDIATE CURTLAGE

Of the properties which were subject to this assessment 'Bengalla' is closest. The curtilage of other items is unaffected.

Initial mine plans indicate that the edge of the box cut will extend to within 310 metres of the residence, or 290 metres of the northern fence defining its curtilage.

The area between the box cut and residence will be affected by works associated with the relocation of spoil on the site and recontouring. This work will extend to within 60 metres of the curtilage and should have no significant impact.

5.6 LOSS OF IMPORTANT HISTORICAL AND FAMILY ASSOCIATIONS

Both "Overton" and "Overdene" have changed hands several times and have nothing left which is considered to reinforce interpretation of their history.

'Bengalla' however, is still occupied by a descendant of the Keys family. The building still contains family possessions including furniture, personal effects and family documents and archives. These add another dimension to interpretation of the history of the property itself, and provide details about other activities in the locality.

The relocation of current occupiers will see these possessions and documents removed and possibly dispersed or disposed of.

5.7 LOSS DUE TO PERMANENT REMOVAL

A further threat which exists is the permanent loss or destruction of items of significance due to location within the area affected by the box cut and surrounding infrastructure.

None of the principal items investigated are directly threatened by loss, and there is no evidence to suggest that other significant remains are likely to be interfered with as a result of the proposal.

6. RECOMMENDATIONS FOR THE PROTECTION OF HERITAGE ITEMS IN OR ADJACENT TO THE PROPOSED BENGALLA MINE

In making recommendations regarding the heritage items discussed in this report, consideration has been given to the Burra Charter and associated guidelines issued by ICOMOS. These are included in Appendix No. A3.

The conservation philosophy adopted is that all items regarded as having Regional or State significance should be retained in situ.

The level of impacts predicted establishes two major levels of measures to respond to the following scenarios:

- Items immediately next to the box cut; and
- Items remote from the box cut

6.1 ITEMS IMMEDIATELY ADJACENT TO THE MINE

There will be a need to vacate all residences within the immediate vicinity of the proposed mine. In particular "Overton, "Overdene" and "Bengalla" will be affected by noise and vibration levels which exceed accepted standards. At a later stage, the Keys family cemetery could also be subject to similar impacts.

These items will be subject to vibration from mining activities greater than the recommended standard. Whilst it is impossible to predict the consequences of this exposure over an extended time period, the possible results are noted in Section 5.2. Mining will probably result in damage to each of the properties.

Whilst "Overton" could be considered for removal to another site, "Overdene" and "Bengalla" and the Keys family cemetery have significant associations with their respective sites that would make relocation undesirable given the objectives of the Burra Charter.

The suggested ameliorative measures for these items are therefore based on the following philosophy:

- Accurately record the existing heritage items;
- Minimise the impact of mining activities on the immediate curtilage - establish a zone within which no mining activities can take place;
- "Mothball" each property to prevent deterioration due to known and controllable factors;
- provide permanent or temporary reinforcement to minimise damage from vibration;
- carry out regular monitoring of the condition of each item;
- Install fire detection and security systems;
- carry out regular maintenance;

- Restore each item for occupation once impacts are within accepted standards

Detailed plans of management should be prepared for both 'Overdene' and 'Bengalla' to address these issues.

6.1.1 RECORDING OF EXISTING ITEMS

Prior to existing occupants vacating the sites the following actions should be taken:

Survey of site within defined curtilage to record all visible evidence including:

- buildings, outbuildings and other structures
- pavings
- vegetation including significant trees
- fencing
- water tanks and cisterns
- sites of demolished buildings

Prepare measured drawings of all existing buildings including:

- Floor plans at 1:50
- Elevations at 1:50
- Internal elevations at 1:50
- Reflected ceiling plans at 1:50
- Sections at 1:20
- Details at 1:10
- Schedule of windows, doors, joinery, internal finishes, fireplaces and other significant fittings

Carry out a photographic inventory of all internal and external surfaces (with existing furniture and decorations in place for Bengalla).

Collate of existing documentary evidence for each property including written documents, photographs, etc.

Structural engineering investigation to determine condition of footings and likely consequences of exposure to blasting.

6.1.2 "MOTHBALLING" OF EACH PROPERTY

The objective of this exercise should be to:

- Prevent unauthorised entry, vandalism and theft;
- Prevent deterioration
- Minimise damage from mining operations; and
- Allow regular inspections by mine staff

The scope of these works will require further structural

engineering input but would include:

- Underpinning or reinforcement of footings and walls if recommended by Structural engineering investigation.
- Installation of security fencing fire detection and security systems;
- Boarding up of windows;
- Securing door openings;
- Preventing the entry of vermin (birds, rats and wild animals);
- Strengthening of structure and finishes likely to be subject to damage (for example propping of ceilings cornices and decorative plaster);
- Disconnect electrical services;
- Maintain a source of water supply for fire fighting

6.1.3 MONITORING OF CONDITION

It is essential to carry out regular monitoring of the condition of the buildings to ensure that action is taken to minimise the risk of damage, deterioration or loss.

The major issues involved are:

- regular monitoring of the impact of vibration on structural condition or the integrity of internal finishes;
- regular inspection to ensure weathertightness and avoid deterioration due to water penetration;
- regular white ant and vermin inspections;
- regular inspection of security - It is recommended that an electronic security and fire detection system be installed
- regular cleaning of external surfaces particularly brick and stone.

These should be carried out in accordance with a pre-determined monitoring programme. Where issues are identified, a maintenance or works programme should be carried out to ensure unnecessary or rapid deterioration does not occur.

Maintenance of grounds and vegetation.

6.1.4 FUTURE RESTORATION

It is recommended that arrangements be made to facilitate the future restoration of "Bengalla" and "Overdene". Restoration works would include:

- Structural works including repairing footings, masonry, brickwork and structural timbers;
- Repairs to detailed timber and joinery;
- Repairs to internal finishes including hard plaster, ceilings, joinery, floors and details such as fire places;
- Painting and decorating
- Reconnection of services

- Refitting of kitchens, bathrooms and laundries;
- Restoration of the curtilage of the buildings including fencing and landscaping; &
- The collation of a historical record of each site and provision of a historical marker

6.2 ITEMS REMOTE FROM THE PROPOSED BENGALLA MINE

Potential Impacts affecting these properties from a conservation viewpoint are:

- dust emissions; and
- visual impact.

These are discussed within the respective subconsultant reports. Vibration is predicted to be within the limit established by Australian Standard 2187 Part 2 - SAA Explosives Code.

It would be desirable to carry out further investigations of the condition of ceilings in properties within 2km to ensure that they are in sound condition. The possible effects of focussing of overpressure due to unfavourable wind or climatic conditions such as temperature inversions will require evaluation.

LIST OF SOURCES

1. MAPPING

- Maps of Early Land Grants
Archives office of NSW
D.2. 1086 (c1829) AO Maps 2775 (4 Sheets)
- Parish of Clanricard Maps
Dated 1911, 1938, and 1979
Dept. of Conservation and Land Management
- Railway Line Survey Maps (c1915)
Stage Rail Authority - Archives Section
- Parish of Vaux Map - current edition
Dept. of Conservation and Land Management
- Bengalla Estate Sale Poster
Incorporating map and information 25/5/1911
AMC 30/290
- Overton Estate Sale Poster
Incorporates map and information
22/5/1912

2. OTHER SOURCES

- 1841 Census information compiled by Robert Tickle, Muswellbrook.
- National Trust of Australia (NSW) recording sheets for Bengalla, Overdene, Overton, Balmoral, Edinglassie, Rouse Lench and Skellatar.
- Berry Stephen - "Overdene" Homestead
Proposal for restoration undated c. 1989
(Includes assessment, plans and historical photos).

3. PUBLICATIONS

- Bengalla, Muswellbrook, NSW
Article and photographs
Sale brochure held by Muswellbrook Historical Society.
- Ashford, H; & Asford MacDougall
"MAC Bridge - The Man and His Recollections"
1983 pp 73-76 "Kayuga Coal Mine" reproduced
from "Muswellbrook Chronicle" Friday 8 March
1963 "Early Coal Mining Ventures".

APPENDIX 14

**VISUAL IMPACT ASSESSMENT FOR PROPOSED
BENGALLA OPENCUT MINE PROJECT**

VISUAL IMPACT ASSESSMENT

for

PROPOSED BENGALLA
OPEN CUT COAL MINE PROJECT

in the

UPPER HUNTER VALLEY
NEAR MUSWELLBROOK

O'HANLON DESIGN PTY LIMITED

LANDSCAPE ARCHITECTS

3 RYDE ROAD

HUNTERS HILL NSW 2110

PHONE: 816 5883 FAX: 816 4179

REF NO: 376

FEBRUARY 1993

CONTENTS

CHAPTER:

- 1.0 INTRODUCTION
 - 1.1 Preamble
 - 1.2 Objectives
 - 1.3 Methodology
- 2.0 LANDSCAPE ASSESSMENT
 - 2.1 Location
 - 2.2 Regional Visual Character
 - 2.3 Local Visual Character
 - 2.4 Landscape Units
 - 2.4.1 Ridgelines
 - 2.4.2 Undulating Side Slopes & Foothills
 - 2.4.3 Alluvial Floodplain
 - 2.4.4 Waterbodies
 - 2.4.5 Rural Homesteads
 - 2.5 Visual Quality Assessment
- 3.0 LANDSCAPE MANAGEMENT ZONES
 - 3.1 Viewpoints
 - 3.2 Sensitivity Levels
 - 3.3 Landscape Management Zones
 - 3.3.1 Zone A (High concern for visual resource)
 - 3.3.2 Zone B (Moderate concern for visual resource)
 - 3.3.3 Zone C (Low concern for visual resource)
- 4.0 PROPOSED DEVELOPMENT
 - 4.1 Open Cut Area
 - 4.2 Industrial Area
 - 4.3 Transport Utilities
- 5.0 VISUAL IMPACT ASSESSMENT
 - 5.1 Open Cut Area
 - 5.2 Industrial Area
 - 5.3 Transport Utilities
 - 5.4 Muswellbrook and South Muswellbrook
 - 5.5 Historic and Rural Homesteads
 - 5.6 Night Lighting
- 6.0 RECOMMENDATIONS TO REDUCE VISUAL IMPACT
 - 6.1 Travel Routes
 - 6.1.1 Denman Road
 - 6.1.2 Wybong Road, Roxburgh Road
 - 6.1.3 Bengalla Road / Proposed Link Road
 - 6.1.4 Ayredale Road, Edderton Road
 - 6.2 Urban Areas
 - 6.3 Rural Homesteads
 - 6.4 Open Cut Area
 - 6.5 Industrial Area
 - 6.6 Revised Visual Impacts
- 7.0 CONCLUSION

LIST OF FIGURES

FIGURE:

- 1.1 Study Methodology
- 1.2 Location Plan

- 2.1 Landscape Units and Visual Quality Assessment
- 2.2 Visual Quality Assessment - Bengalla Study Area

- 3.1 Viewpoints and Management Zones
- 3.2 Viewpoints of Muswellbrook and South Muswellbrook
- 3.3 Distance Definition for Landscape Assessment
- 3.4 Sensitivity Levels

- 4.1 Progression of Proposed Ridgeline
- 4.2 Proposed Development

- 5.1 Discussion of Landscape Components for Open Cut Area
- 5.2 North and West Viewpoints
- 5.3 Eastern Viewpoints
- 5.4 Southern Viewpoints
- 5.5 Discussion of Landscape Components for Industrial Area
- 5.6 Discussion of Landscape Components for Transport Utilities
- 5.7 Impact Description for Two Viewpoints of Muswellbrook and South Muswellbrook
- 5.8 Visual Impact Ratings for Rural Properties

- 6.1 Proposed Ameliorative Measures to Reduce Visual Impact
- 6.2 North and West Viewpoints
- 6.3 Southern Viewpoints

1.1 PREAMBLE

It is proposed to establish an open cut coal mine operation in the Bengalla Coal Development Area, located to the west of the Muswellbrook township in the Upper Hunter Valley, NSW.

This visual impact assessment, prepared as part of the Environmental Impact Statement, has been divided into seven sections:

- 1) Introduction
- 2) Landscape Assessment
- 3) Landscape Management Zones
- 4) Proposed Development
- 5) Visual Impact Assessment
- 6) Recommendations to reduce Impact
- 7) Conclusion.

1.2 OBJECTIVES

The main objectives of this report are:

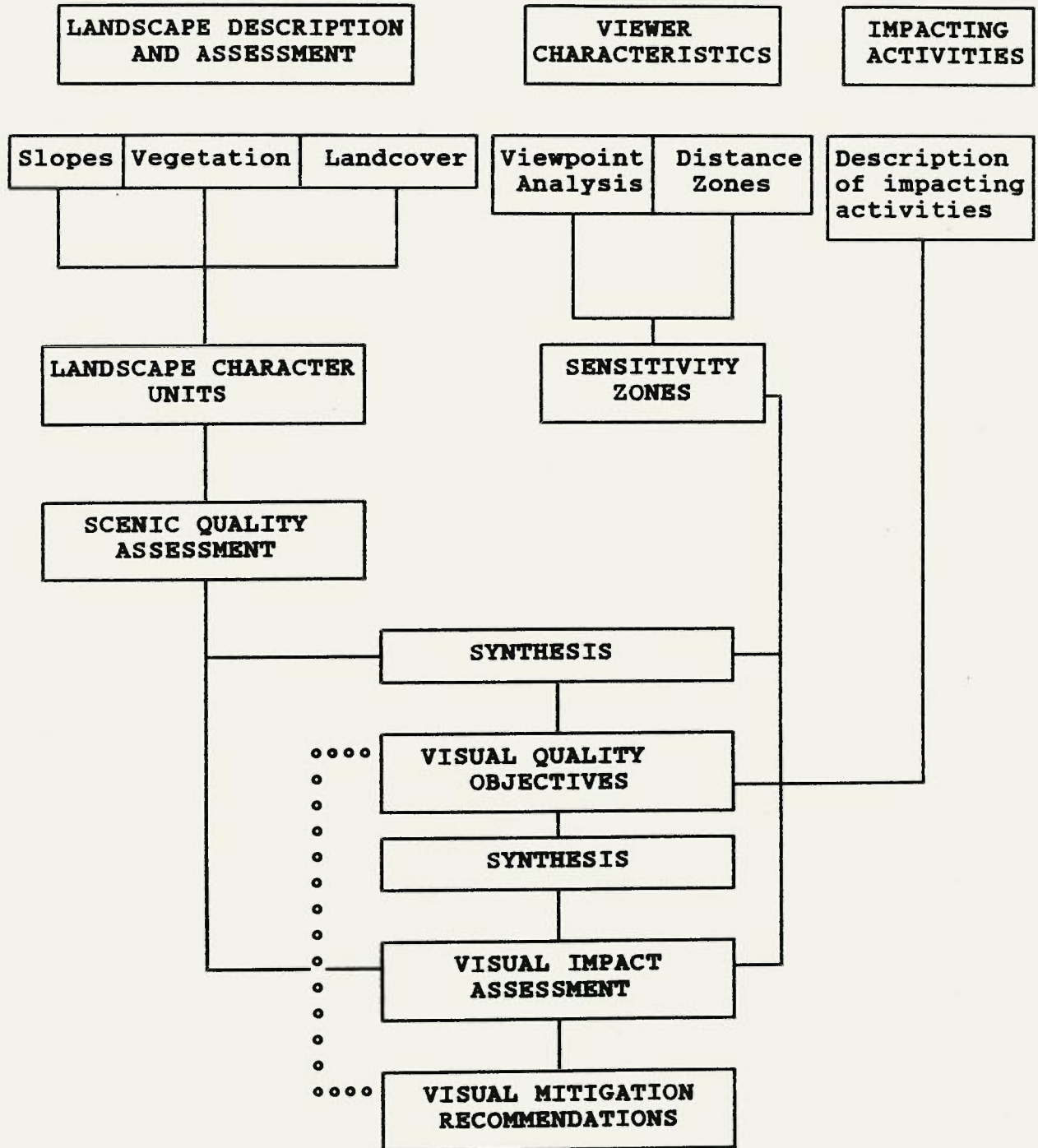
1. To describe the visual character of the regional and local landscape, and evaluate the visual quality of the Bengalla Coal Development Area;
2. To assess the visual impact of the proposed mine facilities, open cut area and other utilities on the landscape character and relevant properties; and
3. To provide recommendations and ameliorative measures to reduce the visual impact of the proposed mine.

1.3 METHODOLOGY

The methodology used for this visual assessment is shown in Figure 1.1. This methodology is based on the model developed by the Forest Commission of Victoria and the landscape assessment techniques of the U.S Department of Agriculture.

Figure 1.1 -

STUDY METHODOLOGY



2.1 LOCATION

The Bengalla Coal Development Area hereafter referred to as the Study Area, is approximately 19km² in area and lies 3km west of the centre of the township of Muswellbrook in the Upper Hunter Valley.

The Study Area is bounded by Wybong Road to the north, Logues Lane to the east, the ridgeline east of Roxburgh Road to the west, with its southern boundary lying approximately between the Muswellbrook-Ulan Railway and the Hunter River, as shown in Figure 1.2.

The mine proposal contains two major components - the open cut area in the east, and the industrial area with associated infrastructure in the south west of the Study Area.

2.2 REGIONAL VISUAL CHARACTER

Since early settlement, much of the Upper Hunter has been cleared for grazing, agriculture, and timber. The existing landscape bears the imprint of these past activities, with cleared and lightly timbered undulating ridges and slopes forming a major landscape type.

Extensive forested landscapes are not common through the settled areas of the region. Exceptions are the heavily forested mountains to the north east and north west of the study area.

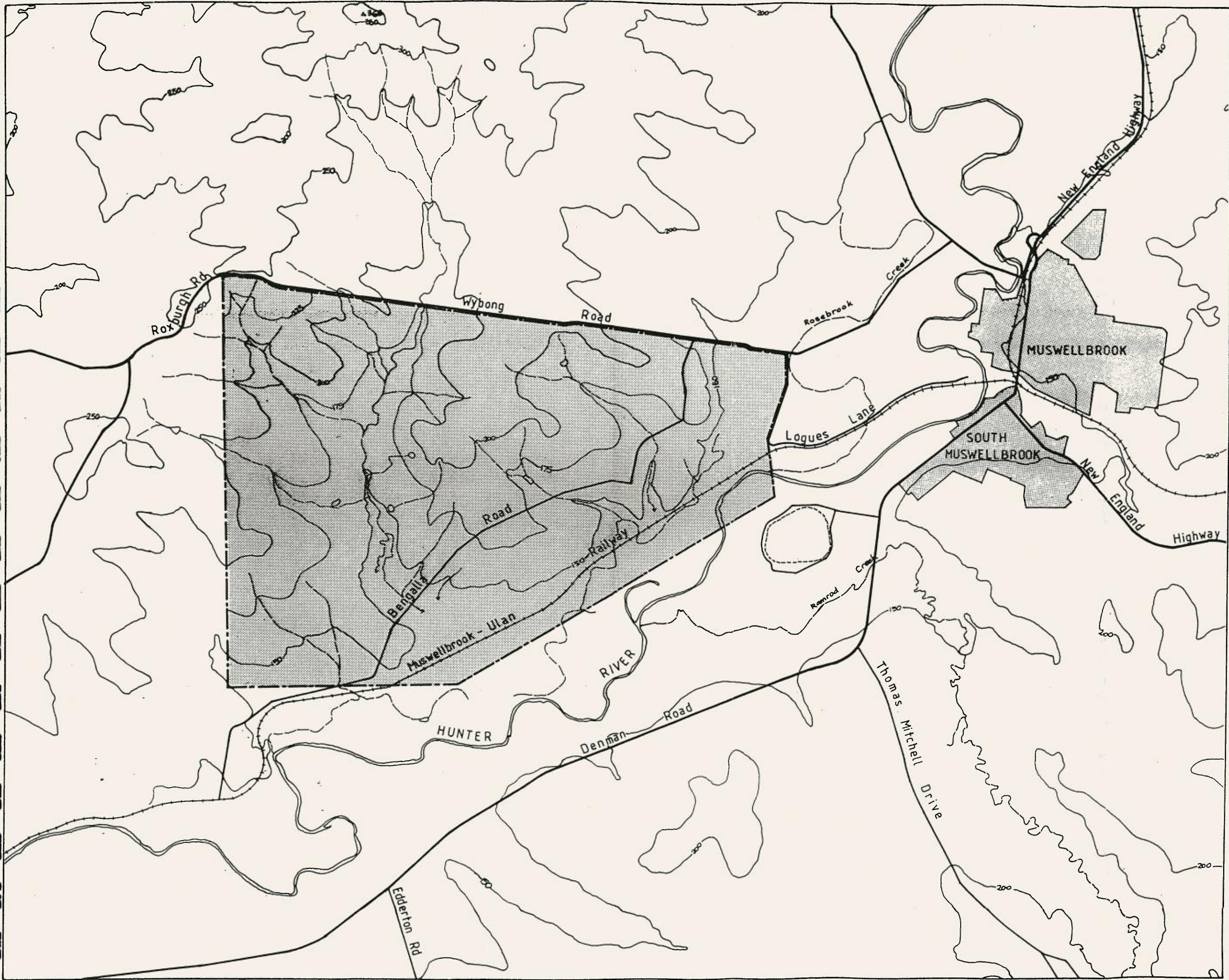
Coal mining has played an important part in the development and growth of the Hunter Region, as it contains the largest proportion of coal resources in NSW. As stated in the Background Report to the Hunter Regional Environmental Plan (REP) 1989, the "*considerable growth of modern open-cut mining in the Upper Hunter is transforming the landscape and livelihood of this district*". Large coal mines, leases and infrastructure form an integral part of the existing regional visual character.

2.3 LOCAL VISUAL CHARACTER


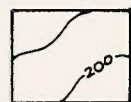

The Study Area is located in the floodplain and lower slopes of the Muswellbrook valley, with the Hunter River meandering eastwards south of the Area and intersecting its south-eastern corner.

The visual catchment of the Area is determined by the surrounding topographical features which limit the extent of views. The boundaries are created by an enframing series of rolling hills and mountain ranges, with Mt. Arthur, 8 kilometres to the south, forming a distant focal point.

The Study Area has been cleared for cultivation, grazing and settlement and is visually harmonious within its rural setting, with no discordant structures apparent. The three ridges projecting south from the northern boundaries of the Area are scattered with eucalypt trees. The undulating foothills are lightly timbered, with the drainage lines more heavily wooded.



legend

-  BENGALLA COAL DEVELOPMENT AREA
-  Contour Interval of Study Area 25 metres
-  Waterbodies and drainage lines for Study Area



**BENGALLA
VISUAL
STUDY**

figure 1.2
LOCATION PLAN

scale 1:33,333

On the southern and eastern boundaries, the alluvial floodplain supports farming and homesteads. The Muswellbrook-Merriwa Railway runs south-west/north-east through the floodplain.

2.4 LANDSCAPE UNITS

The division of the Study Area into landscape units is based on the combination of landuse, vegetation cover and topography as shown on Figure 2.1. Visual characteristics are homogeneous within each unit but not between units.

The units are as follows:

2.4.1 RIDGELINES

The three ridgelines of the Study Area form a generally cleared or lightly timbered landscape unit.

When viewed from the south, this landscape unit forms part of an overlapping series of ridgelines on the horizon. It provides an important visual backdrop to the fore- and middle-ground views. The degree of slope ranges from 1% to 10%. The most elevated points are 200m AHD to a maximum of 240m AHD, which are approximately 100 metres above the Hunter River floodplain.

Landscape Components

Form is the most dominant visual element in this landscape unit. From certain viewing points, the ridgelines may be silhouetted against the sky, where line becomes the dominant component. Texture and colour are fairly homogeneous throughout this unit, derived mainly from the grasslands and scattered tree cover, the latter providing some contrast.

Man-made components of this unit include Wybong Road, which is the most prominent line component of the built elements; but is overall subordinate to the strong natural form of the ridgelines.

2.4.2 UNDULATING SIDE SLOPES AND FOOTHILLS

This landscape unit is the predominant unit of the Study Area. With slopes ranging from 1% to 10%, its main feature is its undulating topography, dissected by drainage lines. The slopes associated with the western ridgeline are generally steeper with a higher tree cover.

Landscape Components

Form is the most dominant feature, and with the variation in slope and orientation, provides a distinctive visual element of the Study Area. The lines derived from the undulating nature of the foothills is a less important component of the landscape.

Colour and texture are derived from the vegetation, namely grasses and scattered forest. The density of the forest cover increases in the more moist drainage lines particularly in the west of the area. This provides a pleasant textural and form contrast to the pasture grasses.

Man-made components of this unit include Bengalla Road and its access roads servicing farms and homesteads. On a relative scale these are secondary to the natural features of this unit.

2.4.3 ALLUVIAL FLOODPLAIN

The alluvial floodplain supports the major agricultural activities of the Study Area. The various crops form a continuous land cover on both sides of the Hunter River.

Landscape Components

Form plays a minor role although features such as rows of trees and buildings provide some contrast. Line is more prominent both as a horizontal feature and in the crop layout, where its patchwork pattern creates a picturesque effect.

Cultural components include Bengalla Road, the Muswellbrook-Ulan Railway, homesteads and associated outbuildings, and exotic plantings of private and public areas. These all provide visual interest and focal points particularly when viewed from the roadways as foreground elements.

2.4.4 WATERBODIES

The few waterbodies of the Study Area consist of the approximately one kilometre section of the Hunter River in the south-eastern corner and intermittent tributaries and small dams found throughout the foothills.

Landscape Components

Form is not a dominant component, although the higher density of trees in the drainage lines and along the river provides a significant contrast to the water bodies.

Colour, reflections and surface texture of the waterbodies can alter, dependant on weather conditions and time of day. These can create pleasant ephemeral effects for viewers.

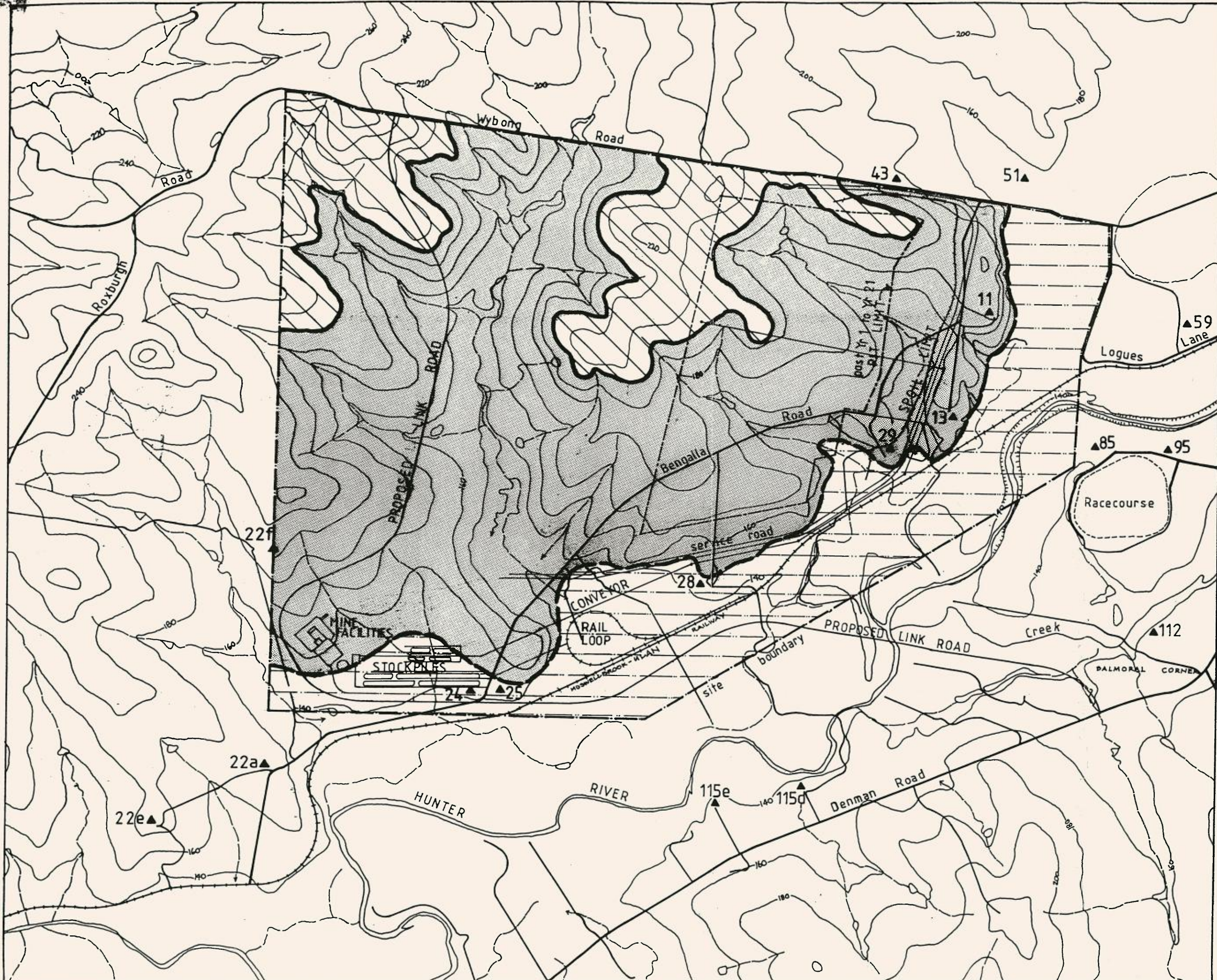
2.4.5 RURAL HOMESTEADS

There are a number of homesteads and farms situated within the Study Area which can be accessed from Bengalla Road and Denman Road. Refer to Appendix A for property names. These include Properties numbered 11, 13, 22f, 24, 25 and 29.



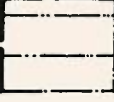
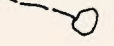

The homestead, Property 11, in the north east of the Area has been classified as a Schedule 3 Item of Local Environmental Heritage by the Hunter REP - Heritage 1989. Schedule 3 items are *"numerically well represented in the region but have a special quality and interest to the local area. They contribute to the individuality and character of an area and are irreplaceable parts of its environmental heritage."*

The homestead, Property 29, has been classified as a Schedule 4 Item Requiring Further Investigation reflecting its potential heritage value.

The heritage assessment contained within the accompanying EIS contains further recommendations regarding the significance of some of these properties.



Legend

-  RIDGELINE - moderate visual quality
-  UNDULATING FOOTHILLS - moderate - high visual quality
-  ALLUVIAL FLOODPLAIN - moderate - high visual quality
-  WATERBODY & drainage line - moderate visual quality
-  RURAL HOMESTEADS - moderate - high visual quality
Property numbers as shown.

NB. Components of proposed mine shown for reference.



BENGALLA VISUAL STUDY

figure 2.1

LANDSCAPE UNITS & VISUAL QUALITY ASSESSMENT

scale 1:25,000

2.5 VISUAL QUALITY ASSESSMENT

The basic premise of visual quality assessment is that all landscapes have some value, but those with the most variety or diversity have the greatest potential for high scenic value. The scenic resource values are based on Williamson's findings for landscape dimension - scenic quality dimensions.

Scenic quality increases as:

- . Topographic ruggedness and relative relief increase.
- . Presence of waterforms, water edge, and water areas increase.
- . Patterns of grasslands and forest become more diverse.
- . Natural and agricultural landscapes increase and man-made landscapes decrease.
- . Land use compatibility increases and land use edge diversity decreases.

Source: Williamson, Dennis. Scenic Perceptions of Australian Landscapes, *LANDSCAPE AUSTRALIA*, 1979 vol.2.

The visual quality of each landscape unit of the Study Area has been ranked into one of three classes - high, moderate, low - as shown in Figure 2.2. This will also enable the sensitivity levels and visual impact assessment to be determined.

Figure 2.2 VISUAL QUALITY ASSESSMENT - BENGALLA STUDY AREA

LANDSCAPE UNIT	SCENIC QUALITY CRITERIA				VISUAL QUALITY RATING
	PROPORTIONAL PROMINENCE OF-				
	Diversity	Landform	Vegetation	Water	
Ridgeline	moderate	high	moderate	-	moderate
Undulating foothills	high	high	moderate	-	mod-high
Alluvial floodplain	high	moderate	high	mod.	mod-high
Waterbodies	moderate	-	moderate	high	moderate
Rural Homesteads	high	moderate	high	-	mod-high

3.0 LANDSCAPE MANAGEMENT ZONES

The derivation of landscape management zones is based on prominent viewpoints of the Area and areas of ranked sensitivity of viewers' concern.

3.1 VIEWPOINTS

The selection of viewpoints are specific to the project and are determined by angle and elevation of the view, distance to the object, the sensitivity of the view to the viewer, and number and type of existing viewers.

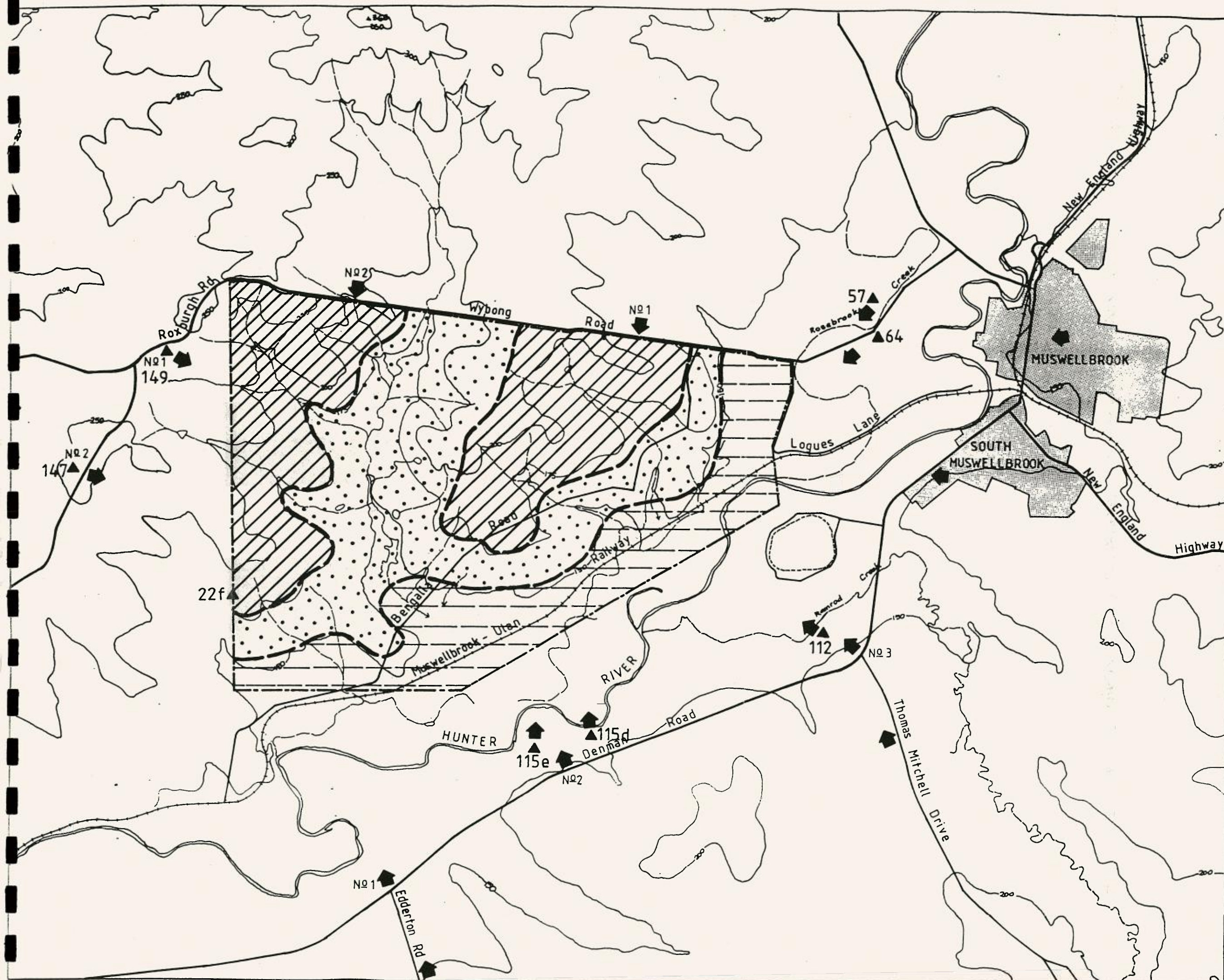
To determine the full extent of the visual impact of the mine, viewpoints offering elevated and/or prominent views of the Study Area have been selected. These are shown in Figures 2.1, 3.1 and 3.2.

These viewpoints are:

1. Wybong Road
 - No. 1 1.6km west of Logues Lane intersection (RL 185m).
 - No. 2 4.4km west of Logues Lane intersection (RL 200m).
2. Roxburgh Road
 - No. 1 Near Property 149 (RL 245m).
 - No. 2 300m south of Property 148 (RL 260m).
3. Denman Road
 - No. 1 Intersection with Edderton Road (RL 140m).
 - No. 2 2.2kms east of Edderton Road intersection (RL 154m).
 - No. 3 Balmoral Corner, intersection with Thomas Mitchell Drive (RL 155m).
4. Edderton Road - 1.0km south of Denman Road intersection (RL 155m).
5. Thomas Mitchell Drive - 1.0km south of Denman Road intersection (RL 180m).
6. South Muswellbrook township
 - i) Tobruk Avenue (RL 170m).
 - ii) Jarrah Place (RL 200m).
7. Muswellbrook township
 - i) William Street (RL 170m).
 - ii) Flanders Street (RL 175m).
 - iii) Cabernet Street (RL 200m).

The following properties have been listed as Schedule 2 Items of Regional Significance by the Hunter REP - Heritage 1989. Although these properties are situated outside the Study Area on Denman Road, the nature of any visual impact caused by the mine needs to be assessed due to their high heritage value.

8. Property 115e
9. Property 115d
10. Property 112

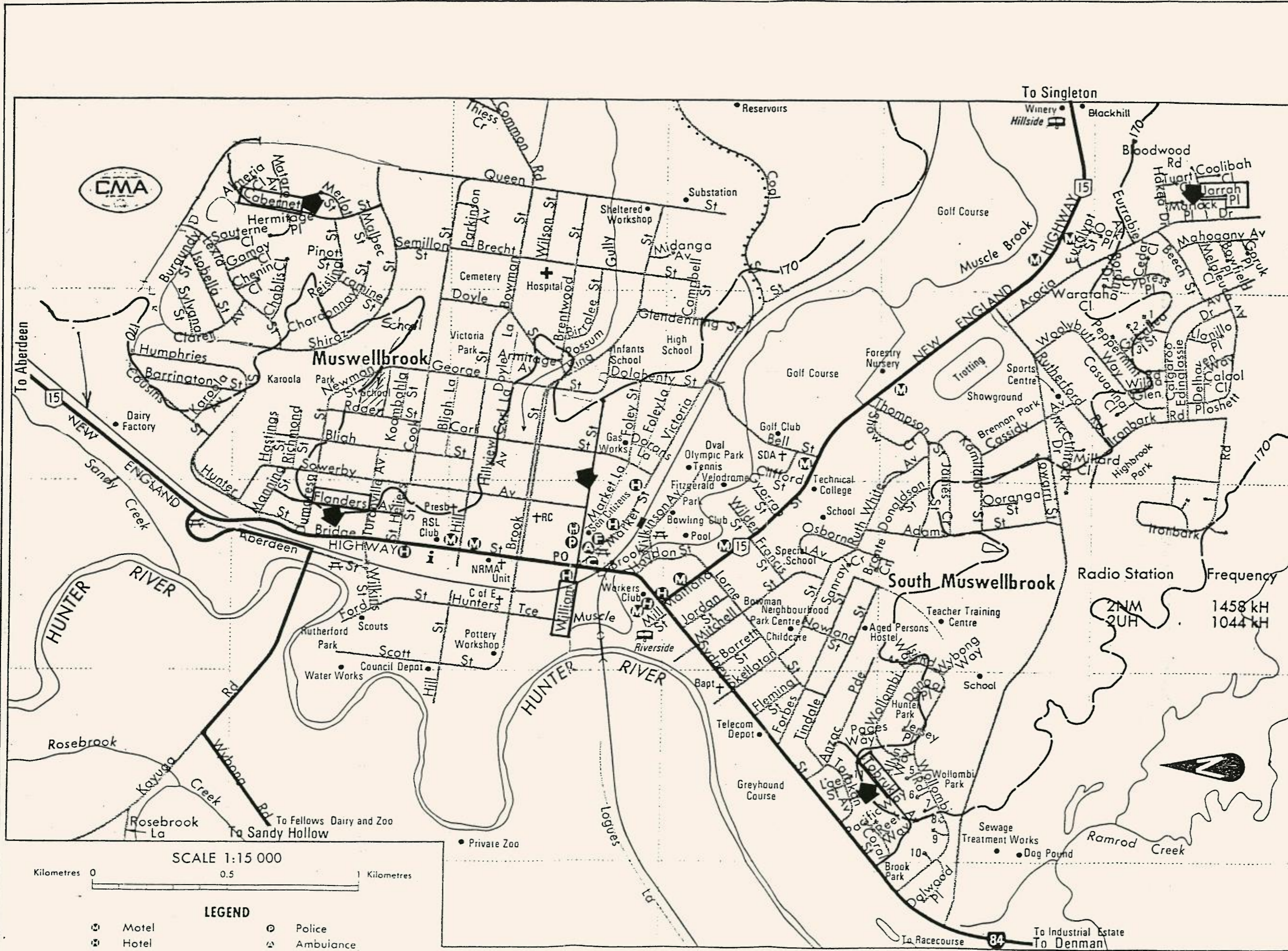


Legend

- VIEWPOINTS -
 Wybong Road
 Roxburgh Road near
 Property 149
 Property 147
 Denman Road
 Edderton Road
 Thomas Mitchell Drive
 South Muswellbrook
 Muswellbrook
 Refer Figure 3.2
- Property 115e
 Property 115d
 Property 112
 Property 22f
 Properties 57, 64
MANAGEMENT ZONES-
- ZONE A
 High Concern
- ZONE B
 Moderate Concern
- ZONE C
 Low Concern

**BENGALLA
VISUAL
STUDY**

figure 3.1
**VIEWPOINTS &
 MANAGEMENT
 ZONES**
 scale 1:33,333



legend

- VIEWPOINTS -
- MUSWELLBROOK
- Flanders Street
- William Street
- Cabernet Street

- SOUTH MUSWELLBROOK
- Tobruk Avenue
- Jarrah Place

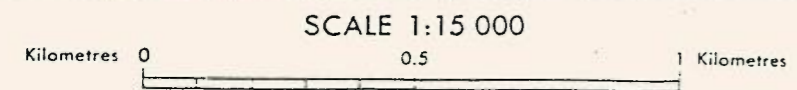
— RL 170m Contour



**BENGALLA
VISUAL
STUDY**

**FIGURE 3.2
VIEWPOINTS OF
MUSWELLBROOK and
SOUTH MUSWELLBROOK**

scale 1:15,000



SCALE 1:15 000

LEGEND

- | | |
|---------------------|----------------|
| ☉ Motel | Ⓜ Police |
| 🏨 Hotel | 🚑 Ambulance |
| 🏠 Caravan Park | 🔥 Fire Station |
| 🏛️ Council Chambers | 🌳 Picnic Area |

Other properties include those found within the Study Area such as Property 11 (Schedule 3 heritage Item) and Property 29 (Schedule 4 Item); and views obtainable from properties to the south west, west and north of the Study Area have also been examined.

3.2 SENSITIVITY LEVELS

Sensitivity levels are a measure of people's concern for the scenic quality of an area. They are based upon the visual quality of the landscape unit, the distance from and type of travel route, and the number and type of potential viewers.

The distance definition, as set out in Figure 3.3, shows that the Study Area is viewed mainly as a foreground or middleground component from the adjacent travel routes and urban areas.

Major roads and primary use areas carry a higher number of viewers than secondary roads and use areas. Generally, tourists and residents have a higher concern for visual quality than commuters. Residents have a high concern for the scenic quality of their visual catchment, particularly if it is threatened by perceived detrimental changes. Given the high level of mining activity in the region commuter traffic may have a lower level of concern as a proportion of the commuter traffic may be mining related.

Figure 3.3 - DISTANCE DEFINITION FOR LANDSCAPE ASSESSMENT

	Foreground	Middleground	Background
Distance	0 - 400/800m	400/800m - 5.0/8.0km	5/8km-infinity
Sight Capacity	detail	detail and general	general - no detail
Object Viewed	rock outcrop	entire ridge	system of ridges
Visual Characteristics	species of individual plants	textures (palms and hardwoods)	patterns (light & dark)

SOURCE: Forest Commission, Victoria, 1981 - *Visual Absorption Capability in the Blue Range Study Area.*

Based on these principles, a three-tiered hierarchy of the travel routes and urban areas is evident surrounding and within the Study Area.

- Level 1 - the townships of Muswellbrook and South Muswellbrook.
- Level 2 - Denman Road, connecting Denman, adjacent mining and outlying areas with Muswellbrook and the New England Highway with moderate volumes of traffic.
- Level 3 - Wybong and Roxburgh Roads. These roads connect Muswellbrook with the towns situated to the west with light and very light traffic respectively.

Level 3 - Bengalla Road, which branches off Wybong Road through the Study Area. Used mainly by local residents. Very light traffic.

Bengalla Road users would experience the highest sensitivity to visual impacts, but its lower number of users reduces the overall sensitivity rating. The proposed re-routing of Bengalla Road shown in Figure 2.1 and its projected traffic volume (refer accompanying Traffic Study) may raise its sensitivity level.

The users of the main regional route, the New England Highway, would not be visually impacted by the proposed mine activities. The Muswellbrook-Ulan railway would be only nominally affected as it is a dedicated freight line.

The roads to the south of the Area would generally have good views of the open cut and infrastructure areas. The westerly aspect of Muswellbrook and South Muswellbrook would provide some of its residents with clear views of the mine in the early years of operation. Anticipated sensitivity levels are indicated in Figure 3.4.

Figure 3.4 - SENSITIVITY LEVELS (continued over)

TRAVEL ROUTE	FOREGROUND	MIDDLEGROUND	BACKGROUND
Urban Areas LEVEL 1	Floodplain east of study area.	Open Cut Area <4kms	Surrounding terrain of Study Area, incl. Mt. Arthur and Mt. Pleasant
		Industrial zone as distant middle-ground feature.	
SENSITIVITY LEVELS	moderate concern	high concern	moderate concern
Denman Road LEVEL 2	Floodplain south of Study Area.	Open Cut Area	Ridgelines beyond Study Area to the north
		Industrial zone as close (2km) middleground	
SENSITIVITY LEVELS	moderate concern	high to moderate concern	low concern
Wybong Road LEVEL 3	Open cut area	Remainder of Study Area, Industrial Zone <4km	Ridgelines south of Denman Road Mt Arthur
	Northern section of Study Area		
SENSITIVITY LEVELS	high concern	moderate concern	low concern

The proposed mine involves a complex series of activities during the mining and processing operations. This chapter outlines the most relevant aspects of the proposed operations.

4.1 OPEN CUT AREA

The proposed mine has an expected lease grant of 21 years. At the time of writing the open cut activities have been documented in stages, namely Years 1, 7, 14 and 21 as shown in Figure 4.1.

At each seven year stage the approximately 60 metre wide open cut area would progress westwards approximately 500m. The mine would advance at approximately 60m per year. The proposed maximum disturbed benched and cut surface from west to east would be between 750m and 1000m. Initially the cut strip would be approximately 1500m length, but by Year 7 its eventual length would be approximately 2500m.

Mining would progress down the dip of the coal seams. The floor of the mine would reduce from 112m AHD in Year 1 to 22m AHD in Year 21. The western side of the mine would have a stepped profile.

During the early years the spoil piles from the worked sections of the mine would be clearly visible, as would the 35m high dragline. The rehabilitation of the spoil would form the basis of the proposed ridgeline to be constructed parallel with the existing central ridgeline, with its highest RL over 240m.

As the mine progresses westwards the ramp containing the main conveyor belt would intersect through the new ridge to the coal seam RL's; over 140 metres depth by Year 21. At Year 7 the ramp length would be 700m; Year 14 length 1100m and by Year 21 total length would be 1500m. It is proposed to align this ramp in an east-west direction, directed at South Muswellbrook. The eastern end of the ramp would curve to the south east for approximately 200m, as shown in Figure 4.2.

4.2 INDUSTRIAL AREA

The industrial area or infrastructure area contains the coal washery (24 hour operation), ROM and product stockpiles, rail loop, office, workshops and stores, bathhouse and vehicle service facilities.

The intention is to create a pair of Run-Of-Mine (ROM) or raw 100,000t stockpiles with associated luffing stackers (approximate height 22m) to feed the coal washery, and two 250,000t product stockpiles for transportation to market. Approximate dimensions are 300m x 100m x 17m height, and 800m x 100m x 17m height for the raw and product stockpiles respectively.

The approximate heights of the proposed structures are as follows: coal washery plant (31m), crushing plants (12-16m), 400t and 600t surge bins (27m and 32m), by-pass and 3 way transfer stations (14m and 17m), and transfer station (12m). Conveyor belts link these structures e.g. open cut area to the ROM stockpiles (6.0km length); ROM stockpiles to the 3 way transfer station (350m); product stockpile to rail loop (700m).

The proposed dam, located approximately 1.3km north of the stockpiles, would be the main source of water for the coal washery. A series of small ponds are proposed to hold the water from the open cut for use in the infrastructure area.

The workshop, stores, offices, bathhouse and carpark areas would be located northwest of the stockpiles. Building heights vary from 5.5m (offices) to 17.5m (workshop).

The proposed unidirectional rail loop at the eastern end of the stockpiles connects with the Muswellbrook-Ulan Railway; associated facilities include the train load out bin (approximately 39m high), loading facilities and conveyor belt linking with the product stockpile.

4.3 TRANSPORT UTILITIES

The proposed link road, to replace Bengalla Road, would connect Denman Road with the western end of Wybong Road as shown in Figure 4.2. A temporary service road would be built to the west of each stage of the open cut area along its entire length to provide mining access.

A new bridge to comply with railway standard clearance requirements is proposed to be built over the rail line, south east of the proposed rail loop. The minimum vertical clearance required is 6.1m. A new bridge is also proposed for the new link road where it would cross over the Hunter River, and the associated road would be built up to approximately 3-4 metres.

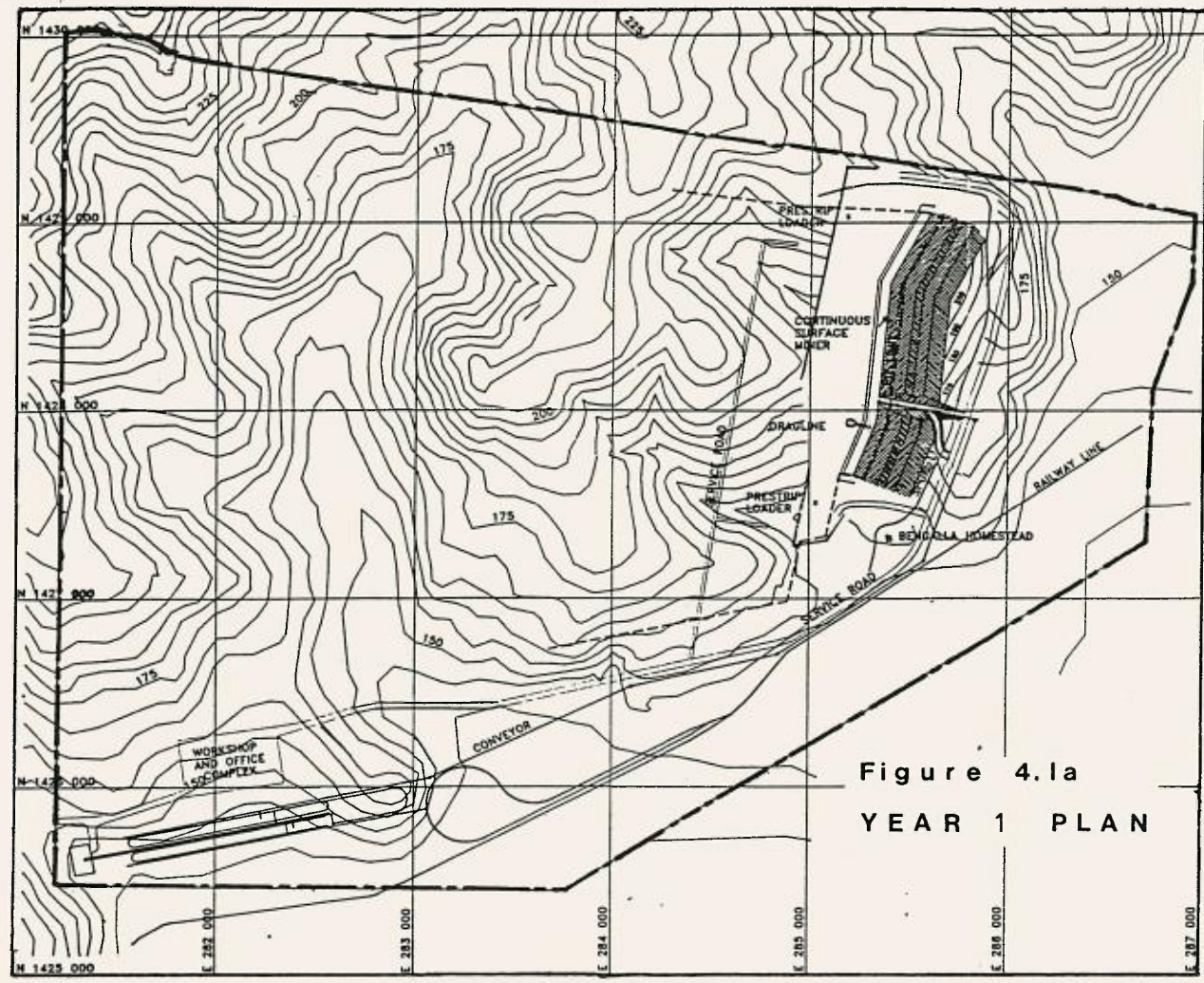


Figure 4.1a
YEAR 1 PLAN

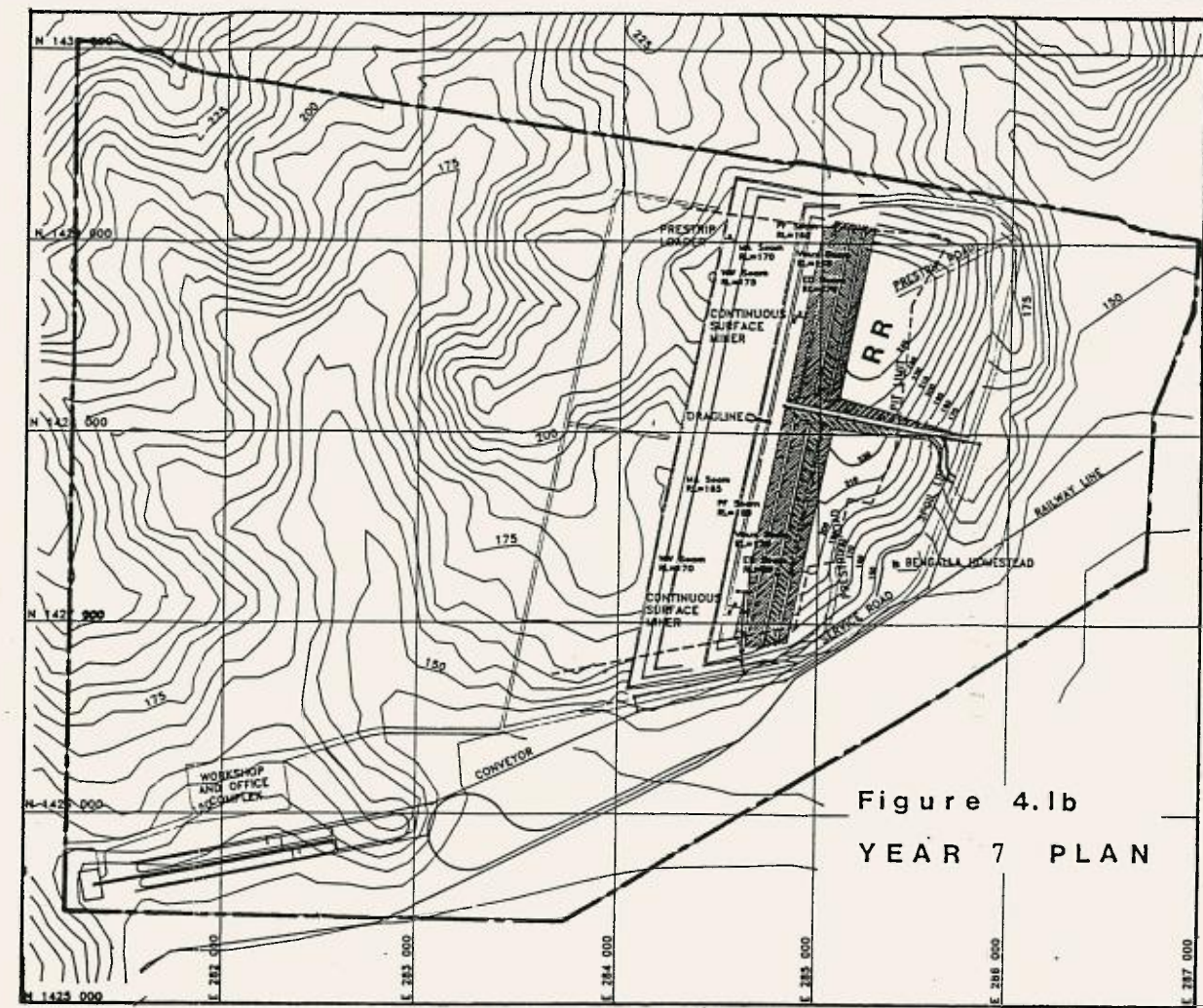


Figure 4.1b
YEAR 7 PLAN

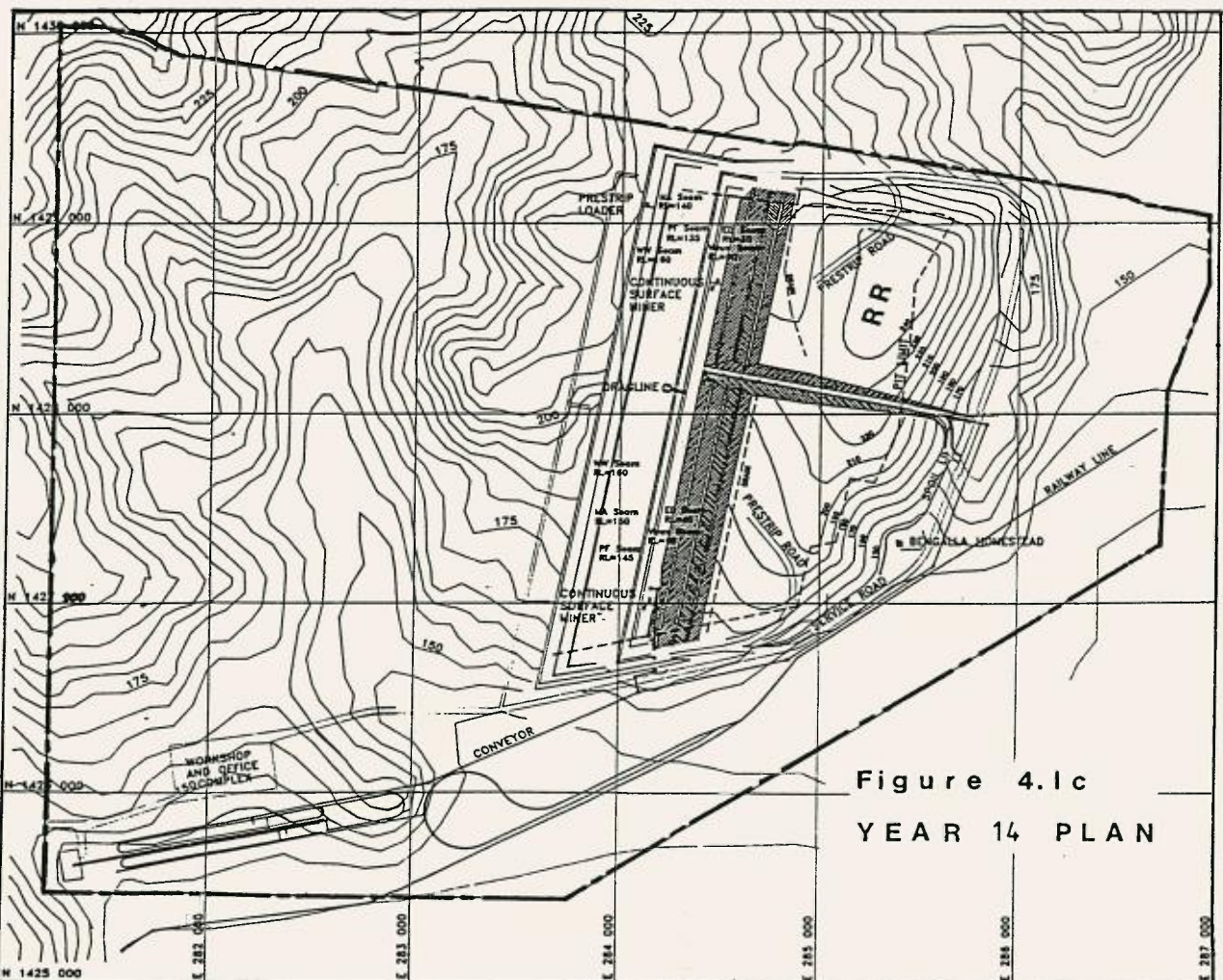


Figure 4.1c
YEAR 14 PLAN

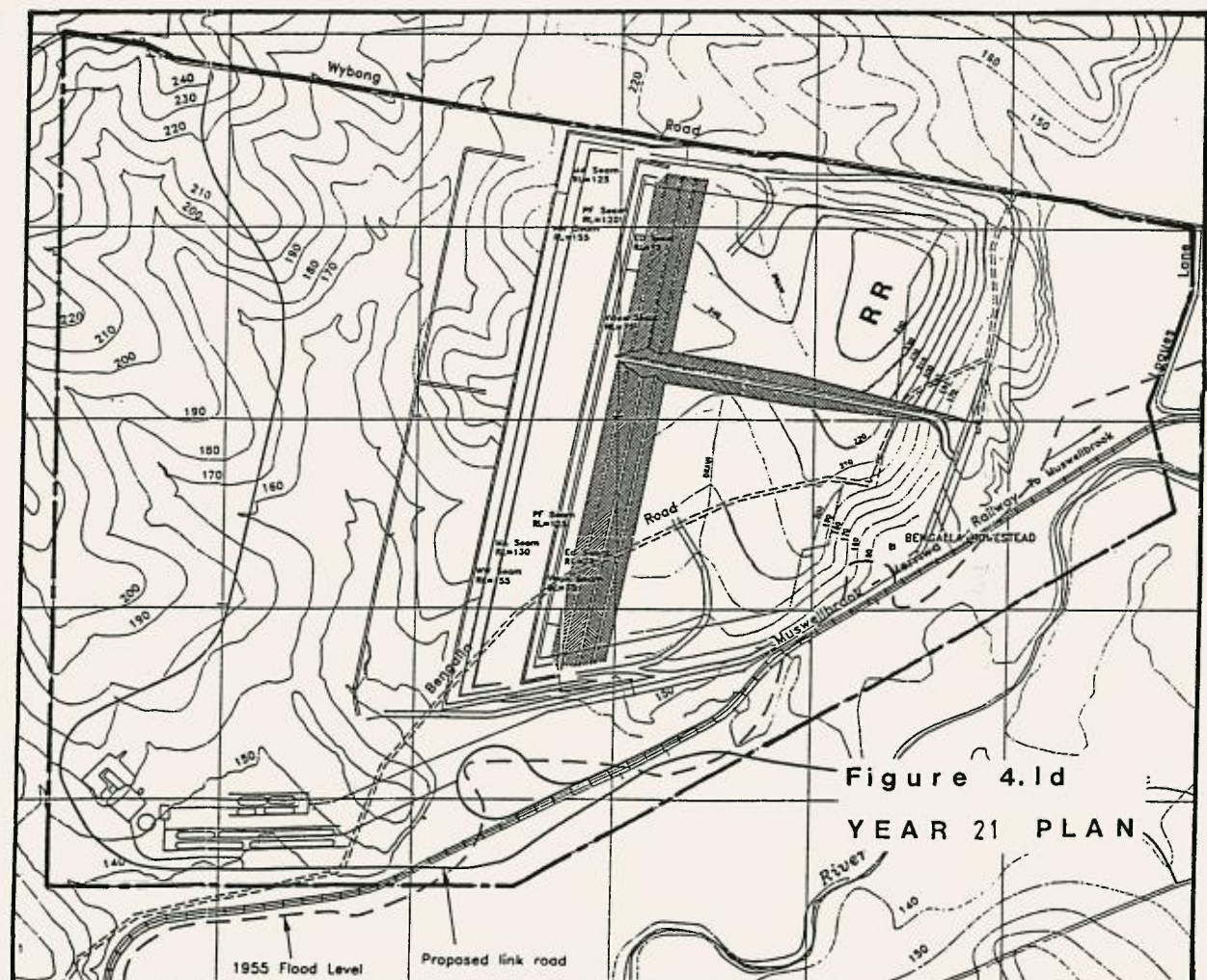


Figure 4.1d
YEAR 21 PLAN

legend



OPEN CUT AREA

RR REHABILITATED RIDGELINE (proposed)

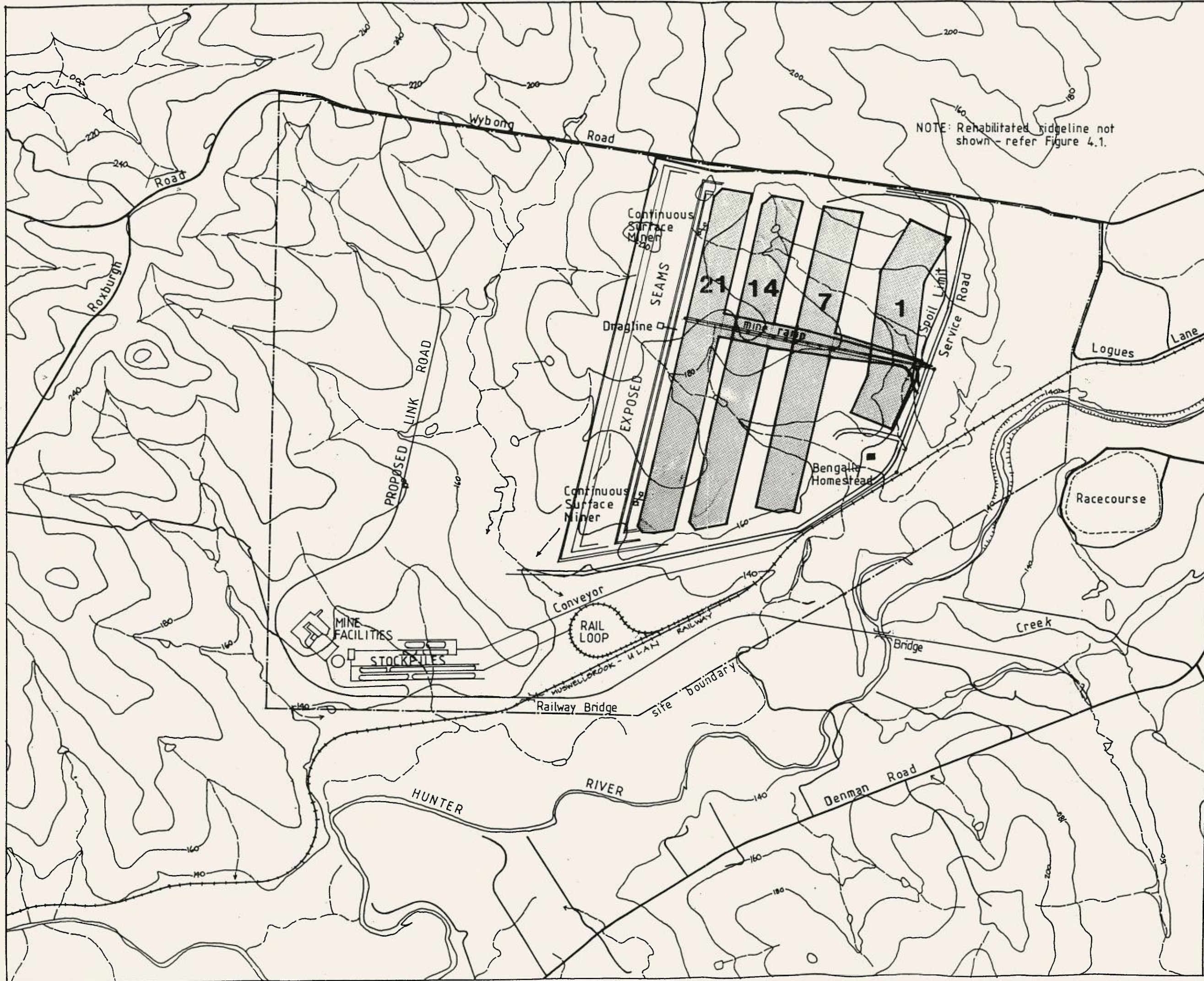
NOTE:
Plans to be updated to show curve in ramp as in Year 21 plan.
— Refer to Fig.4.1d or Fig.4.2 for layout of Industrial Area, proposed link road and curved eastern end of ramp.

source: Envirosiences Pty Ltd

BENGALLA
VISUAL
STUDY

Figure 4.1
PROGRESSION OF
PROPOSED RIDGELINE





Legend

- 7 OPEN CUT AREA
- 7 PROPOSED YEAR OF OPERATION
- 7 EXPOSED SEAMS AT EACH STAGE AS PART OF OPEN CUT (refer also to Figure 4.1)

BENGALLA VISUAL STUDY

Figure 4.2

PROPOSED DEVELOPMENT

source: Envirosciences Pty Ltd
scale 1:25,000

The assessment of the degree of visual impact of the proposed mine is based on the perceived severity of the facilities within the landscape from selected viewpoints and the number of viewers expected to experience the visual changes.

The complexity of the number and types of structures involved in the mining, processing and transporting of the coal requires that attention be directed at the proposed structures as groups of elements rather than as individual items.

The assessment is made more complex by the constantly changing nature of the proposed development over the 21 year period, particularly the open cut area. Hence the visual impact has been assessed at each stage, ie. at years 1, 7, 14 and 21.

Factors included in the assessment are as follows:

- (a) selection of viewpoints which offer prominent or potentially prominent views from the north, south, east and west of the Study Area. These viewpoints do not represent all possible views attainable from each direction; the visual impact would vary according to the stage of operation, viewing position and specific site conditions.
- (b) the proposed ridgeline which would be the most significant single rehabilitation measure of the project, and other proposed landform changes as shown in Figure 4.1. These have been assessed as grassed landforms only in assessments noted as "No Ameliorative Measures" Figures 5.2, 5.3, and 5.4. Hence these ratings are for maximum visual impact. Ameliorative measures such as general tree cover have been included for assessment in Figures 6.2 and 6.3.
- (c) consideration of the various landscape components in relation to the visual impact.

Visual impact ratings are ranked in decreasing order of severity as follows: Severe, High, Moderate, Low and Nil.

5.1 OPEN CUT AREA

The open cut area is the most complex of the mine elements to assess due to its dynamic nature. This is reflected in the impact ratings for each viewpoint which may decrease or increase over time due to the westwards shift of the open cut and/or the proposed topographical changes, thus allowing or impeding views to the cut area.

The most severe impact would be during the initial years, prior to the construction of the rehabilitated ridgeline. The spoil piles, open cut area and machinery would be clearly visible from many viewpoints.

Figure 5.1 outlines the discussion of the landscape components as background data for the assessment.

Figure 5.1 -Discussion of Landscape Components for Open Cut Area.

LANDSCAPE COMPONENTS	GENERAL DESCRIPTION OF IMPACT WHERE VISIBLE
Form	Major changes to topography - extensive excavation to depth and length and construction of new ridgeline Introduction of incompatible industrial structures to rural landscapes.
Line	The edge of the worked surfaces, dragline, and ramp would provide strong horizontal and vertical elements to surrounding undulating landform.
Colour	Exposure of coal seams, associated geological strata and spoil heaps, would provide a severe contrast to green pastoral grasslands.
Scale Contrast	The extent of the open cut at each stage would be a significant element of the visual catchment area.
Spatial Dominance	The open cut area would be perceived as a prominent spatial element of the local landscape.

A. VIEWPOINTS FROM NORTH OF OPEN CUT AREA.

From Figure 5.2 the two viewpoints of Wybong Road experience significantly different impacts, based on proximity to the open cut area and existing topography.

Excluding proposed ameliorative measures, Viewpoint No.1 would be severely impacted by the magnitude of the open cut as a prominent foreground feature until Year 14, where the westward shift of the cut reduces the impact. By Year 21 the proposed ridgeline becomes most dominant.

From Viewpoint No.2 the existing ridge (RL200 to 220m) hinders views to the cut area over the 21 year operation period and impact is minimal.

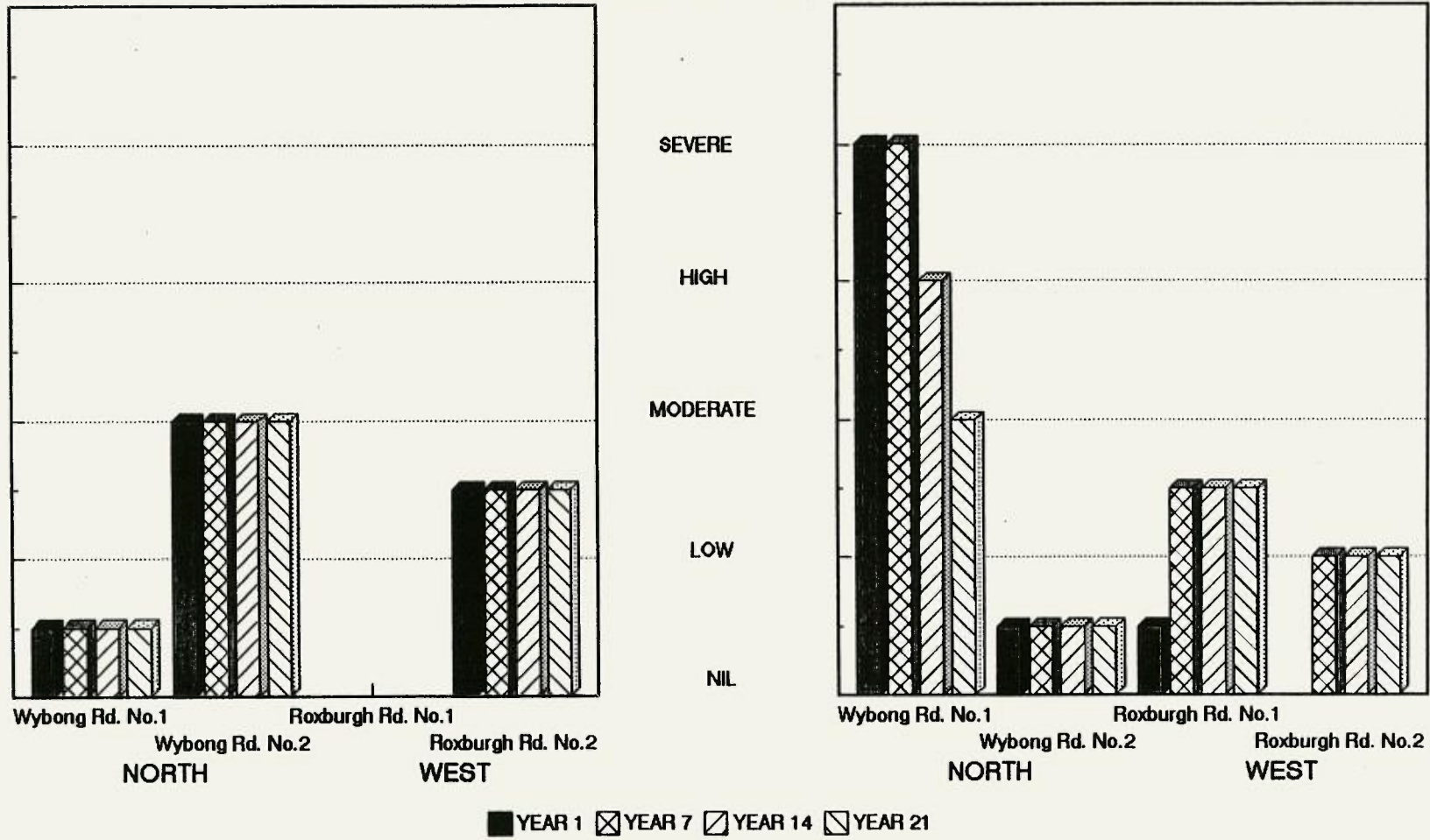
B. VIEWPOINTS FROM EAST OF OPEN CUT AREA.

These include 3 viewpoints from Muswellbrook and 2 view points from South Muswellbrook; their impacts are shown in Figure 5.3.

The residents of Muswellbrook and South Muswellbrook would view the cut area along its length as a prominent middleground feature but as the ridgeline is constructed, views of the open cut area from the east would be significantly reduced. The most severe impact would occur when the slopes are first stripped and while the spoil mound develops sufficiently for the ridgeline to be built. The bare earth mound is proposed to be vegetated after the first 12 months.

The visual impact of the ridgeline with the intersecting ramp and conveyor is largely dependant on the modelling and revegetation of the ridge and slopes to achieve a natural effect. The curved end of the ramp would lessen the severity of the ramp length but it would be most prominent from the viewpoints of William Street, Muswellbrook and Tobruk Avenue, South Muswellbrook.

VISUAL IMPACT



INDUSTRIAL AREA

OPEN CUT AREA

NO AMELIORATIVE MEASURES

FIGURE 5.2 NORTH and WEST VIEWPOINTS

VISUAL IMPACT

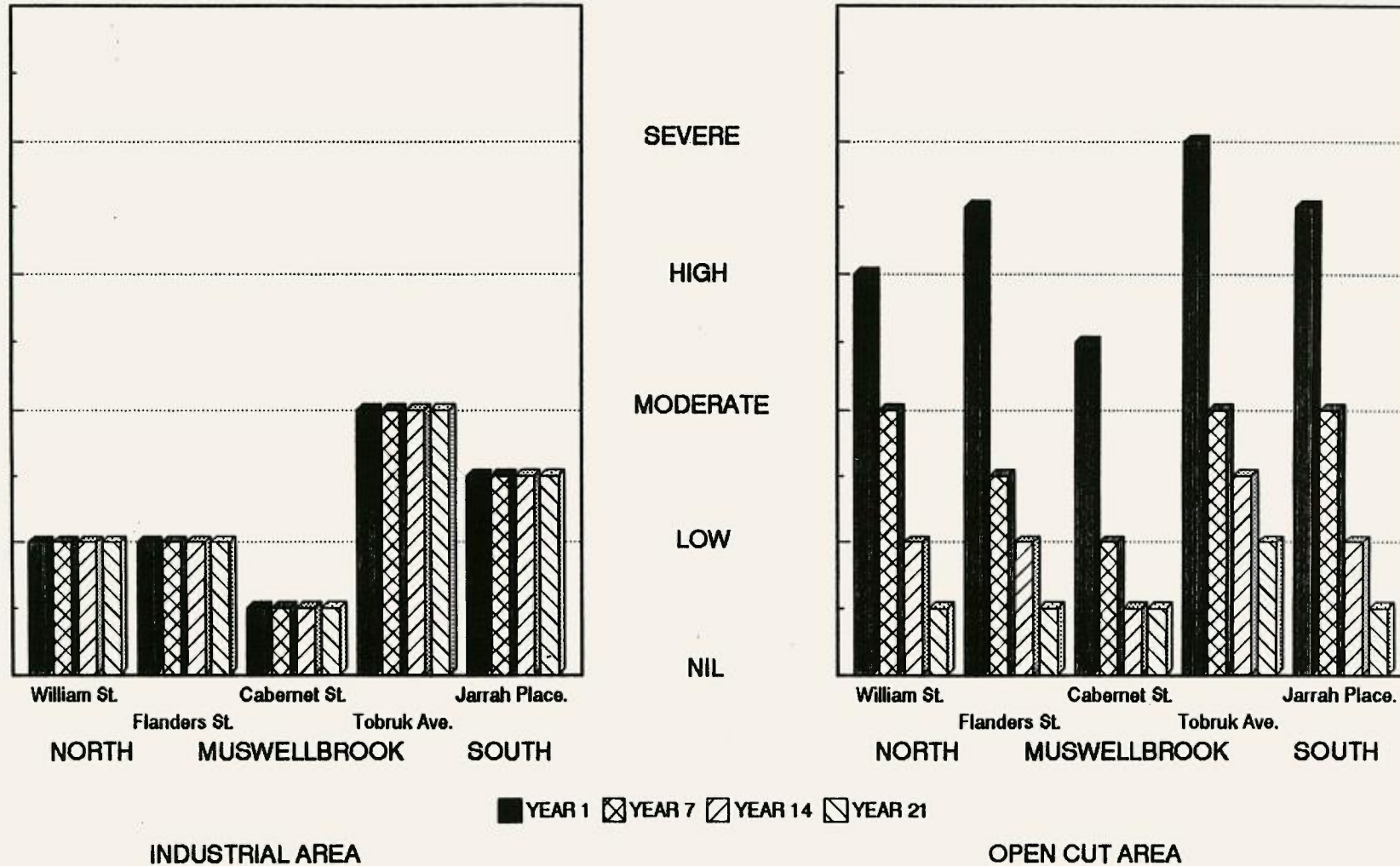


FIGURE 5.3 EASTERN VIEWPOINTS

The proposed ridgeline system would be perceived as a prominent massive middleground element from the township, and its formation, silhouetted shape and treatment would be most significant in its final visual impact.

C. VIEWPOINTS FROM SOUTH OF OPEN CUT AREA.

Three viewpoints have been selected from Denman Road and one each from Edderton Road and Thomas Mitchell Drive. Their relative impacts are shown in Figure 5.4.

Denman Road users and residents would experience a foreshortened view of the open cut area and associated machinery. The 35m high dragline would be a conspicuous element in the initial years, however as the mine progresses and the dragline works at greater depths silhouetting against the skyline or hillside would reduce progressively until it was not visible.

The length of the cut after Year 7 increases its proximity to Denman Road as a close middleground feature particularly for Viewpoints No. 1 and 2, where impact increases from high to severe. From these viewpoints the proposed ridgeline does not screen views to the cut area, although from viewpoint No. 3 the ridgeline would screen the northern part of the cut leaving the southern end of the cut visible with a corresponding reduced impact.

From the Edderton Road viewpoint (RL150m) the open cut area may not be clearly visible at first but as the cut progresses westwards the depth and length of the cut would become more apparent as a middleground feature. The Ayredale Road viewpoint on Thomas Mitchell Drive (RL180m) provides a more elevated position where the initial years of the open cut would have the most impact. As the cut area moves westwards after Year 7 the existing roadside vegetation adjacent to this viewpoint would significantly screen views to the cut area.

D. VIEWPOINTS FROM WEST OF OPEN CUT AREA.

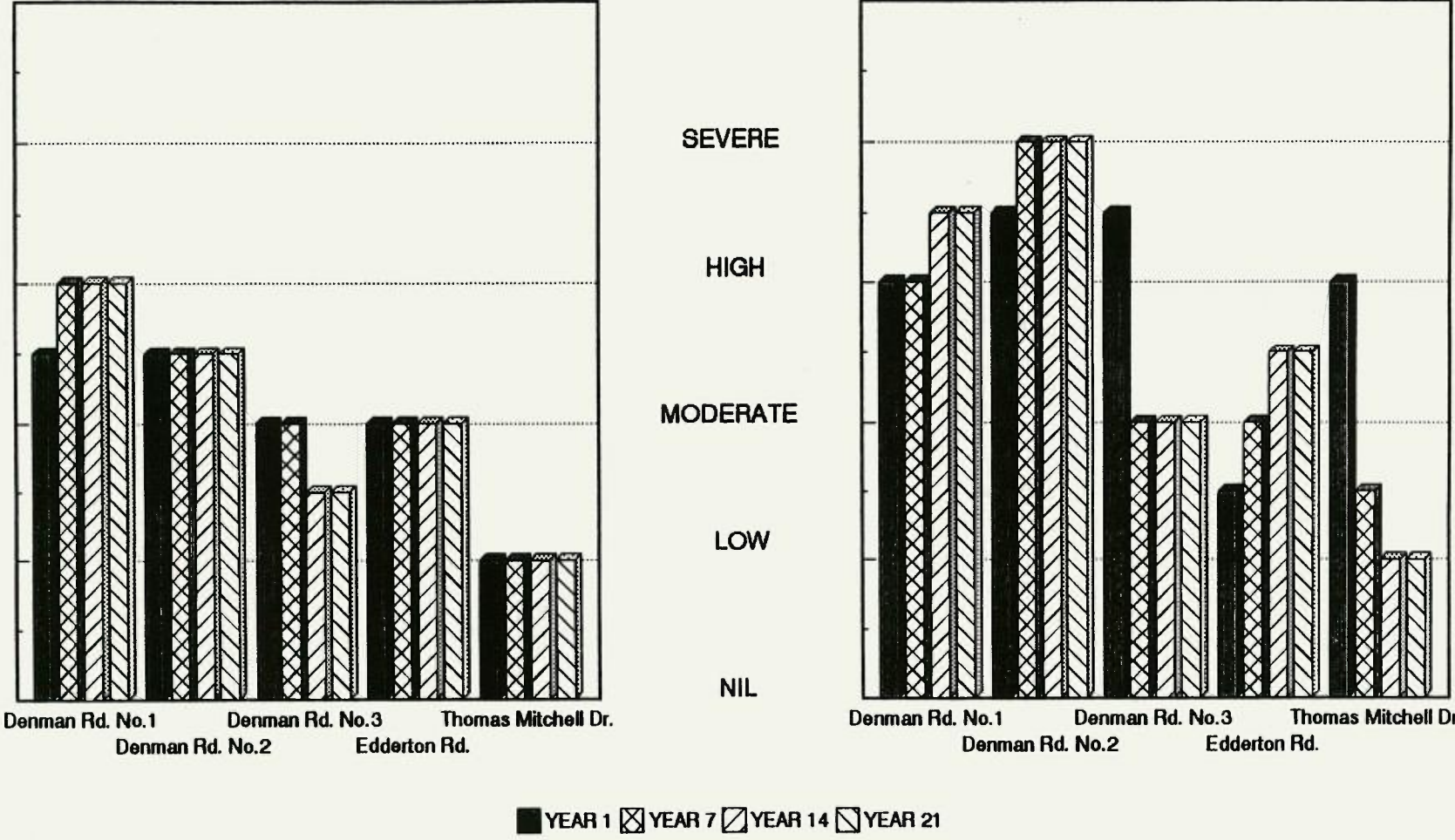
Two viewpoints from Roxburgh Road have been assessed; refer to Figure 5.2 for level of impacts. The existing ridgeline effectively blocks the open cut area from both viewpoints. Assessments in Figure 5.2 are worst case ratings as there is significant existing vegetation which totally screens the development from many viewpoints.

The impact of the open cut area is most severe from the east, north and south during the early years of operation. The construction of the proposed ridgeline significantly reduces the impact from the east, so after Year 7 the most severe impact would be experienced from the north and the south.

5.2 INDUSTRIAL AREA.

The industrial area would experience minimal changes over time once the structures and buildings have been built. The stockpiling of excess coal adjacent to the proposed stockpiles would be the most significant occasional occurrence; however its impact would probably be visually absorbed by the stockpiles.

VISUAL IMPACT



INDUSTRIAL AREA

OPEN CUT AREA

NO AMELIORATIVE MEASURES

FIGURE 5.4 SOUTHERN VIEWPOINTS

The proposed siting of the industrial area at the base of the foothills reduces its overall impact and the possibility of silhouetting against the skyline. However the rail loop, structures and stockpiles are spread over a 2.5 kilometre area.

The most visually critical individual structures of the industrial area are the proposed product stockpiles, for their considerable dimensions and dark colour contrast, and the rail load out bin adjacent to the rail loop. The impact on each landscape component is discussed in Figure 5.5.

Figure 5.5 - Discussion of Landscape Components for Industrial Area.

LANDSCAPE COMPONENTS	GENERAL DESCRIPTION OF IMPACT WHERE VISIBLE
Form	Bulkiness of infrastructure & dimensions of stockpiles would have a significant visual impact.
Line	Most prominent with long horizontal features of stockpiles and rail loop, combined with vertical elements of buildings etc.
Colour	Impact dependant on external colours used on buildings and other structures. Stockpiles of dark coal would be most conspicuous.
Scale Contrast	Elements such as stockpiles and taller buildings/structures, provide significant contrast to the surrounding rural environment.
Spatial dominance	The net effect of several discordant buildings, structures and stockpiles over a wide area forms a disjointed collection of very high spatial dominance in the lower foothills/floodplain unit.

A. VIEWPOINTS FROM NORTH OF INDUSTRIAL AREA.

A very low to moderate impact is experienced from the two viewpoints of Wybong Road as shown in Figure 5.2. The existing and proposed ridges would obscure most views from Viewpoint No. 1; Viewpoint No. 2 would offer views down the valley to the industrial area as a middleground feature with a moderate to low impact.

B. VIEWPOINTS FROM EAST OF INDUSTRIAL AREA.

The five viewpoints from Muswellbrook & South Muswellbrook would be impacted at a low to moderate level by the industrial area.

The existing low ridge (RL 160m) and the top of the proposed ridgeline would screen the bulkiness of some structures, but the tops of the taller structures would be visible. However, the rail loop, load out bin and associated facilities would be visible from South Muswellbrook and to a lesser extent from Muswellbrook.

The overall impression would be massed but not clearly distinguishable components in the distant middleground to background.

C. VIEWPOINTS FROM SOUTH OF INDUSTRIAL AREA.

From Denman Road Viewpoint No.1 and Edderton Road the industrial area would be visible along its entire length as a prominent close middleground feature. Viewpoint No. 2 provides foreshortened views of the industrial complex which is closer at this point. From the third viewpoint the impact is reduced with increased distance from the complex and the partial screening by the new ridge. Generally the stockpiles would screen the infrastructure facilities on the northern side when viewed from the south and southeast, however the heights of some of the structures would project above the stockpiles.

From the Thomas Mitchell Drive viewpoint the existing roadside vegetation would filter the westerly views to the complex, minimising the impact.

D. VIEWPOINTS FROM WEST OF INDUSTRIAL AREA.

The existing ridge (RL200-220m) blocks views to the western section of the industrial complex from Roxburgh Road Viewpoint No. 1. From Viewpoint No. 2 the tops of the taller structures would be visible down the valley. Generally the hillier topography to the west of the Study Area provides glimpses of the complex.

The proposed link road, to the immediate west of the complex, would experience foreground views of the entire industrial area. The impact would be severe but this rating would be reduced with a possible low traffic volume.

The impact of the industrial area is highest from the south and the west where it would be viewed as a close middleground and foreground feature respectively. With increased distance and the existing and proposed ridgelines the views from the north and the east are less impacted.

5.3 TRANSPORT UTILITIES

The proposed link road, mine access roads and associated bridges have a generally low impact. The new railway bridge would have the most significant impact but would be visually absorbed by the infrastructure in the background. Hence the scale of these utilities in relation to the proposed mining structures is of minor importance.

Figure 5.6 - Discussion of Landscape Components for Transport Utilities.

LANDSCAPE COMPONENTS	GENERAL DESCRIPTION OF IMPACT WHERE VISIBLE
Form	Form of bridges would be apparent but not significant.
Line	Roads would provide strong lineal features of the landscape.
Colour	Dependant on final colours for bridge but overall colours would relate to colours of existing built elements.
Scale Contrast	Relative to other proposed mine features the bridges would not provide significant scale contrast.
Spatial Dominance	The high level railway bridge would provide some spatial dominance within the floodplain and as a foreground feature.

5.4 MUSWELLBROOK AND SOUTH MUSWELLBROOK

The residential areas of Muswellbrook and South Muswellbrook would experience the most visual impact from the proposed mine in terms of viewer numbers. The views and impacts of the proposed mine from other streets or properties may vary significantly to the five viewpoints selected and assessed, based on the aspect, proximity and elevation of the viewpoint relative to the proposed mine as well as localised factors of the viewing position such as vegetation and site structures. The existing topography and proposed ridge system would also play a significant role in the extent of views obtained from the east.

Generally those residents facing west on higher elevations (say above RL 170m) would have a greater potential to be impacted by the proposed mine than properties which do not share these criteria. Figure 5.4 describes the impact from two prominent viewpoints.

Figure 5.7 - Impact Description for Two Viewpoints of Muswellbrook and South Muswellbrook.

VIEWING POSITION	DESCRIPTION OF IMPACT
Flanders St (RL 175m) between Dumaresq & Turaville St MUSWELLBROOK	Open cut area as clearly visible middleground feature to the west, in early stages. Elevated viewpoint position on RL 170m. Length of open cut visible. Proposed ridgeline would become a prominent middleground feature when built screening the open cut behind. Industrial area as distant middleground feature - components would appear as massed industrial elements.
Tobruk Ave (RL 170m) SOUTH MUSWELLBROOK	Western views onto open cut area along its length as prominent middleground element, in early stages. Proposed ridgeline would form new skyline for viewers from RL 160m and lower viewing positions. Industrial area as distant middleground feature - components would appear as massed industrial elements.

5.5 HISTORIC AND RURAL HOMESTEADS

This analysis is based on the perceived global impact of the mine from the properties most affected. Selected views may be of lesser or greater significance depending on the localised factors of the viewing position - ie: location, aspect, topography, vegetation and site conditions. Impacts have been assessed from adjacent roads and from some of the properties. Topographical information such as maps and sections have been used to determine lines of sight.

As Regional Heritage Items the views obtainable from the homesteads on Property numbers 115e, 115d and 112 have been evaluated. Property No. 11 has been included as a local heritage item and Property No. 29 as a Schedule 4 Item. Rural homesteads which have extensive and/or typical views of the proposed mine have been selected, one from each of the south-west, west and north areas relative to the mine site. These are outlined in Figure 5.8.

In addition, a brief outline of the impacts for the remaining residences to be found within and around the Study Area are as follows:

1. Northern properties with similar visual impacts to Property No. 43 include Property 149, Property 51, Property 59, Property 64 and Property 57, as their views to the open cut and industrial areas would be screened by the proposed ridgeline over time ie. severe to low.

2. Low to moderate impact for properties east of open cut area, Properties 85 and 95 where the existing and proposed ridges screen westerly views to open cut area. Foreshortened views of industrial area in middleground (low - moderate impact).
3. The views from the residences on/adjacent to Wybong, Denman and Edderton Roads and Thomas Mitchell Drive generally correspond to the views obtainable from these roads to the open cut and industrial areas.
4. Severe impact for Property 22f with south easterly superior views of the proposed industrial area as a close middleground feature from various positions of the property.
5. Moderate to high impact for Properties 143 and 145 on either side of the road from Roxburgh Road leading to Property 22f. Views are focused along the valley to the proposed industrial area as a middleground feature. Impact is moderated by the existing vegetation of the valley depending on viewing position.
6. Severe impact for Properties 24 and 25 situated from 50 - 200m south of the proposed product stockpiles and industrial area.
7. Property 29 homestead situated 200m from proposed southern end of Year 1 cut area. Impact would be severe for the early years prior to construction of ridgeline. Its screening effectiveness from the cut area would be established by Year 7 but the access road and conveyor belt would be 100-200m on the eastern side of property. Depending on density of screening the impact would vary from low to moderate.

5.6 NIGHT LIGHTING

The visual impact of night lighting will be assessed by a separate specialist consultant for the EIS. Consideration should be given to the effect of proposed ameliorative measures on Night Lighting Impact Assessments.

5.7 HISTORIC AND RURAL HOMESTEADS

Figure 5.8 - Visual Impact Ratings for Rural Properties
(NO AMELIORATIVE MEASURES - MAXIMUM IMPACT).

Note: OCA = Open Cut Area; IA = Industrial Area
Schedule to Property Numbers in Appendix A.

PROPERTY NUMBER HOMESTEADS	DESCRIPTION OF IMPACT	OVERALL IMPACT
Property 115e (south)	Open cut area 2kms & industrial area 1.2km to north - both clearly visible as prominent middleground elements from various viewing positions of the property including the house for duration of mine life.	OCA & IA: Severe (Yrs 1-21)
Property 115d (south)	Situated 400m to east of Property 115e with similar impacts.	OCA & IA: Severe (Yrs 1-21)
Property 112 (south east)	Open cut area clearly visible in early stages (<2kms in north west) and industrial area 4kms to west. Stockpiles and infrastructure seen as foreshortened complex.	OCA-severe (Yr 1) to low(Yr 21) IA-mod (Yrs 1-21)
Property 11 (east)	Elevated position 500m east from open cut gives views during initial years prior to new ridge which would screen mine areas once built to >RL 200m. No views to industrial area.	OCA-severe (Yr 1) to low (Yr 21) IA-no impact
Properties 22a and 22e (south west)	Overlooks industrial area in foreground. Middleground views of open cut during later stages from Property 22e.	OCA-mod (Yrs 7-21) IA-high to severe (Yrs 1-21)
Property 147 (west)	Open cut may be visible on west facing slopes. Taller structures of industrial area visible as middleground feature, existing ridge obscures part of the view.	OCA-low (Yrs 7-21) IA-low (Yrs 1-21)
Property 43 (north east)	Overlooks open cut area down its length in early years. Proposed ridge obscures views to open cut and industrial areas after Year 7.	OCA-severe (Yr 1) to low(7-21) IA-none

Visual mitigation measures can broadly be divided into two categories:

- 1) Point Source measures - provision of screening and other measures at the source of visual impact i.e. at or adjacent to the proposed mine activity areas.
- 2) Viewer position measures - provision of visual mitigation measures from viewing positions such as travel routes and residences.

These mitigation measures may include one or more of the following treatments:

- * forward tree planting
- * massed tree planting
- * amenity and specimen planting
- * earthworks and bunding
- * other rehabilitation techniques

Time is a critical factor in the establishment of meaningful and effective tree screening, which stresses the importance of the forward tree planting measures.

All proposed bunding should be an extension of the contouring of the existing land surface relative to its intended size. The proposed rehabilitated ridgeline is of most importance due to its massive scale and anticipated prominence within the local and regional landscape.

Generally the remodelled landforms should be undulating with drainage lines and similar slope ranges to the existing topography. The ridgeline should undulate, slope should vary and drainage lines should meander rather than conform to strict engineering lines.

Revegetation programmes should be carried out to replicate existing vegetation patterns and species eg. denser growth along drainage lines, scattered tree cover for ridges/slopes.

The overall aim would be to achieve a similar visual quality and naturalness in appearance of the proposed ridgeline to other elements within its visual catchment.

The principles of the recommendations for the ridgeline treatment can be applied to other earthworks and bunding proposals for the Study Area.

6.1 TRAVEL ROUTES

6.1.1 Denman Road

Both the industrial and the open cut areas would be viewed as prominent middleground features from Denman Road. The proximity and extent of the industrial area is of particular concern and screening would reduce but not eliminate the views. An approximately 1 kilometre stretch of road is currently lined with poplar trees. If possible continue this roadside planting for another 8km of Denman Road, using native species with a columnar or pyramidal form, such as Casuarina. However as a minimum, the

most impacted section of the road totalling 3-4 kilometres should be planted as described. This would reduce the impact at the most critical points of the road. Planting should take place well in advance of the commencement of operation to allow some screening growth to occur.

6.1.2 Wybong Road, Roxburgh Road

The open cut area would feature prominently as a foreground element for users of Wybong Road. The removal of the easternmost ridge (AHD 204m) of the Area parallel to Wybong Road would remove a naturally existing visual buffer for that section of the road.

Some intermittent mounding to the east of the central ridge may be successful. However such mounding should be within the existing slope range and considered carefully to match existing drainage and topographical features.

Roadside planting of trees and shrubs, along the south edge of the road, should be installed as part of the forward tree planting scheme. Direct seeding of grasses, shrubs and trees should be carried out as soon as possible.

Due to its existing heavy tree cover, large sections of Roxburgh Road would be minimally impacted from the proposed mine. Recommendations include selective roadside planting for the northern section of road and where the topography provides possible views of the industrial area.

6.1.3 Bengalla Road / Proposed Link Road

The proposed link road to replace Bengalla Road would provide its users with unrestricted views of both the open cut and industrial areas as immediate foreground elements at the closer viewpoints.

It is recommended that a limited amount of intermittent low mounding be constructed to block the most conspicuous views, supplemented with direct seeding. Extensive roadside planting with a minimum two rows of trees, or more if space allows, should be placed along the road at the closer viewpoints.

6.1.4 Thomas Mitchell Drive, Edderton Road

As the road user approaches the Denman Road intersection when travelling north on Thomas Mitchell Drive, the open cut area would be visible as a middleground element to the west, particularly when passing over more elevated sections of the road. From the assessed viewpoint the existing vegetation screens the more westerly views of the Study Area. However further south it may not be possible to significantly control the impact of the mine due to the orientation and elevation of the road.

Similar constraints apply to Edderton Road and its commanding views of the industrial area in particular, and the open cut area as a middleground feature. The most prominent would be obtained in the 2.0km stretch of road approaching the Denman Road intersection.

The establishment of a dense overhead canopy along these stretches of road with appropriate street trees would provide an immediate focus and lessen the impact of the views but requires many years for an effective result.

6.2 URBAN AREAS

The most significant visual impact would result from the open cut area as a prominent middleground feature during the early years of the mine life. The industrial area would form a distant middleground to background feature from Muswellbrook and South Muswellbrook.

It would be impractical to completely screen the open cut area. Amenity planting along the most affected streets on the western edge would enhance the streetscape and filter direct views to the mine areas. Forward tree planting would need to be introduced for those properties at higher elevations such as the High School.

It is also recommended that mitigation measures be carried out at the source of the impact such as an extensive forward tree programme on the eastern side of the proposed ridgeline. This would reduce the initial harsh impact of the stripped area.

The construction of the proposed ridgeline by Year 7 would obscure the views of the open cut area from the east. The final contours of the ridge and slopes of the proposed ramp would determine the degree of naturalness and their level of visual quality. The massive form of the ridge may appear unnatural in its environs and an effective tree planting programme could be carried out to soften the effect.

The establishment of the forward and massed tree programme would reduce the visual impact of the mine and the ridgeline to the residents. Best results would be achieved by specimen or selective planting on individual properties in strategic positions to screen views to the mine. The effect of individual specimen screening is not assessed as part of this study.

6.3 RURAL HOMESTEADS

The existing rural homesteads as discussed would be visually impacted to varying degrees. The visual impact would be lessened by tree planting depending on viewer position and extent of planting.

It is recommended that screen planting of trees and shrubs be installed particularly for the residences in close proximity to the open cut and industrial areas and those residences evaluated as having moderate and higher impacts. Indigenous native species are preferred, as well as plant species which are compatible with the cultural plantings of the homesteads.

6.4 OPEN CUT AREA

Temporary and permanent mitigation measures would be required to screen the open cut area. The proposed construction of the rehabilitated ridgeline is the major permanent screening device. It would be during the ridge's construction that the open cut area would be most visible and have the most visual impact.

Large groves of trees strategically placed adjacent to the excavation area and loading machinery would soften their impact; this should be carried out as part of the proposed forward tree planting programme. This forward tree planting programme should be implemented so as to screen the urban areas as a priority objective.

Extensive massed planting should be carried out for the new ridge to replicate the denser forested slopes to the west of the Area. Hydroseeding and hydromulching of the re-formed landscape using non-invasive local grasses and plant species should form part of the rehabilitation programme.

As mining progresses westwards, massed tree planting on the spent eastern sections of the mine may also be a valuable asset in wind speed reduction.

6.5 INDUSTRIAL AREA

Careful selection of colours, materials and design of the built structures should form part of the planning process. It is recommended that olive greens and green-greys be used for the buildings to blend in with the pastoral environment. A combination of these colours is preferable to a single colour scheme being used.

One recommendation to lessen the impact of the night lighting would be to apply darker colours and materials to those sections of structures or elements that are likely to be lit.

It is recommended that architectural forms and building materials for the proposed buildings reflect the local rural architecture, i.e. homesteads, farmhouses, sheds, silos, etc.

To improve the working environment amenity planting could be installed within the complex. Plant selection would be based on colour (foliage and/or flowers), form, texture and height.

Massed planting with low branching habits on the boundary of the industrial area would filter ground level views into the complex e.g. from Denman Road. This planting would also improve the aesthetic appearance when viewed from more elevated positions although it would not provide an effective screen for all built structures.

6.6 REVISED VISUAL IMPACTS

Figure 6.2 and 6.3 provide revised listings of predicted visual impacts for selected view points, following the successful implementation of their respective ameliorative measures outlined in Figure 6.1.

The revised impact ratings are dependant on the mature tree heights having been reached. ie. mature growth and healthy foliage development. These are the minimum impact ratings for the amelioration of the visual impact of the proposed mine.

The realistic value of the ratings would lie somewhere between these maximum and minimum impact ratings, dependant on the year of mine operation, height of vegetative growth and success rate of the forward tree planting.

This emphasises the need for a forward tree planting programme to be carried out as soon as practical with special reference to the screening of the open cut area. As the open cut progresses, the trees would mature further providing more extensive screening in conjunction with the new ridge. The lead time would be dependant on species but it is unlikely to be less than 3-4 years.

Where possible, the aim of the screening should be to completely screen the mine but for many of the roadways and residences a reduction in the original visual impact is the only realistic alternative.

Figure 6.1 - Proposed Ameliorative Measures to Reduce Visual Impacts.

VIEWPOINT	DISTANCE DEFINITION	DESCRIPTION OF MEASURES
Denman Road	Open cut area (OCA) and Industrial Area (IA) middle-ground	<ul style="list-style-type: none"> * Forward tree planting (FTP) on road side * FTP on highest RL's south of OCA and IA * FTP on site boundary of IA
Wybong Road	OCA- foreground IA-middleground	<ul style="list-style-type: none"> * Bunding possible limited adjacent to road side * Direct seeding * Massed & forward tree planting * FTP on eastern side
Roxburgh Road	IA-middleground	<ul style="list-style-type: none"> * FTP on roadside

cont. over

VIEWPOINT	DISTANCE DEFINITION	DESCRIPTION OF MEASURES
Bengalla Road (proposed link road)	OCA- foreground IA-foreground	<ul style="list-style-type: none"> * Bunding possible limited adjacent to road side * Direct seeding * FTP on mine side of road
Thomas Mitchell Drive, Edderton Road	OCA - middle-ground IA-middleground	<ul style="list-style-type: none"> * FTP on roadside to create canopy cover * Massed planting at intersection north side
Muswell-brook South Muswell-brook	OCA - middle-ground IA - distant middleground	<ul style="list-style-type: none"> * Massed FTP on ridges to east of IA and OCA * Appropriate binding to replicate existing landforms. * FTP and amenity planting on individual properties and streets where appropriate
Rural Homesteads and Properties	OCA- fore and middleground IA- fore and middleground	<ul style="list-style-type: none"> * FTP and amenity planting adjacent to individual properties * Roadside FTP & bunding on roadways * FTP and massed planting on ridges & slopes

VISUAL IMPACT

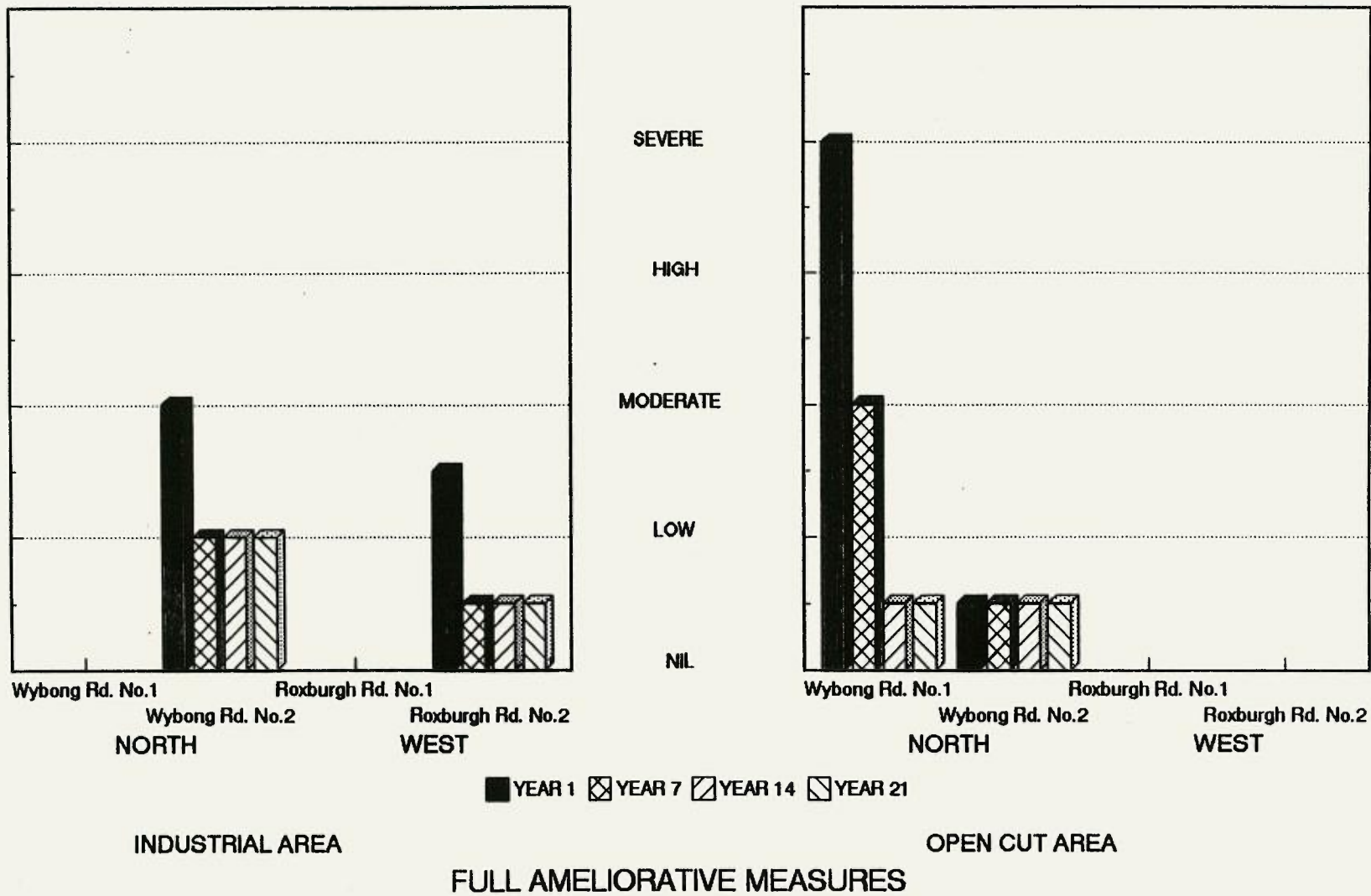
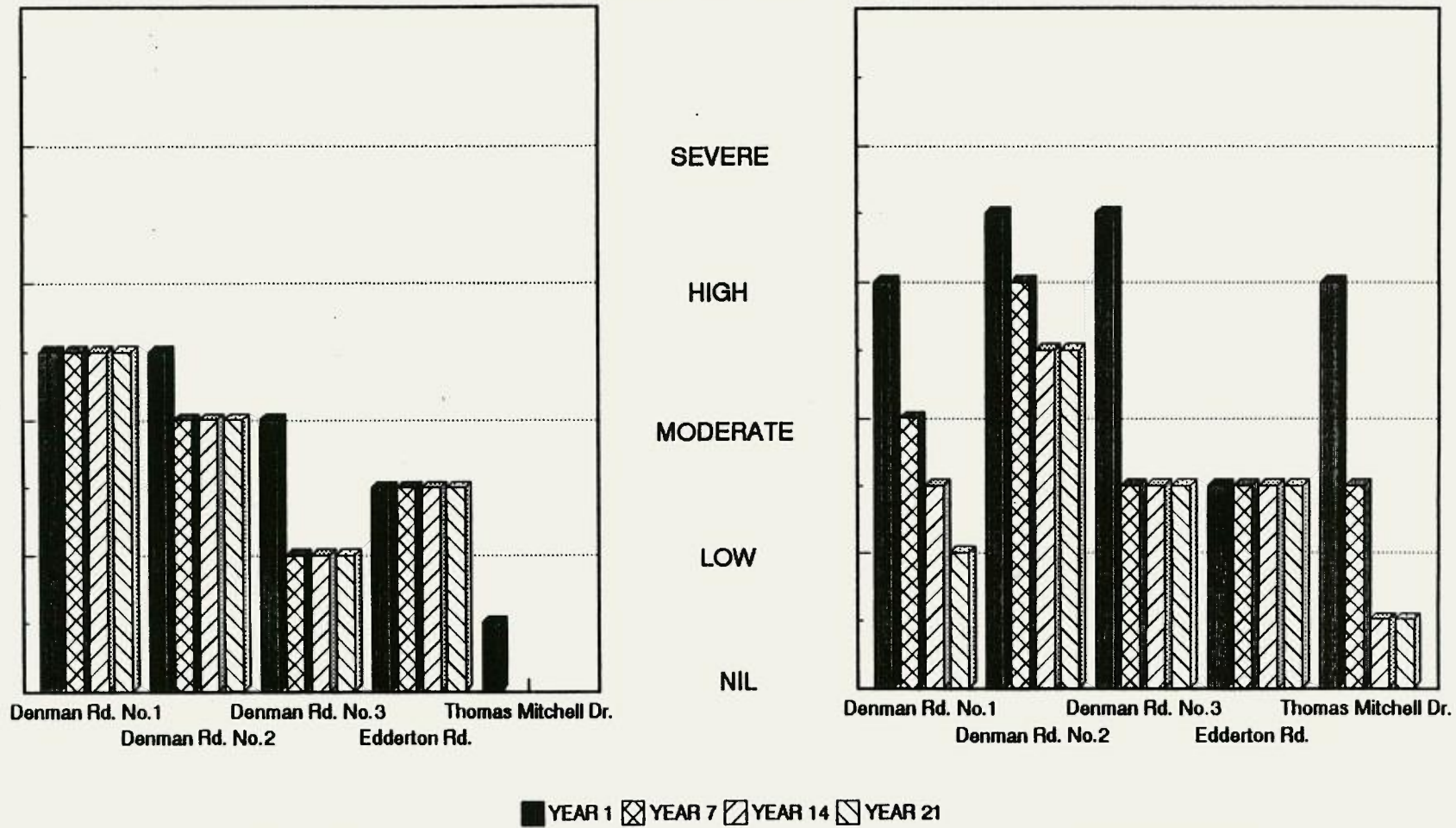


FIGURE 6.2 NORTH and WEST VIEWPOINTS

VISUAL IMPACT



INDUSTRIAL AREA

OPEN CUT AREA

FULL AMELIORATIVE MEASURES

FIGURE 6.3 SOUTHERN VIEWPOINTS

The proposed mine has the potential to visually impact the landscape character of the Muswellbrook valley for the duration of the mine life and well into the future. With the implementation of all the recommendations set out in this report, the visual impact could be reduced.

The landscape assessment of the five landscape units of the Development Area found all units to have moderate to high visual quality. The Area is visually harmonious within its predominantly rural and agricultural environs, with no discordant structures apparent.

The derivation of the landscape management zones indicated the open cut area is proposed to be located within the zone of high concern for visual resource, and the industrial area and new rail bridge are within the zone of moderate concern for visual resource. These zones of higher concern reflect their relative inability to absorb change without significant effect.

The proposed open cut area was found to have the most visual impact of the mining components given its large scale and severe changes to the existing landform particularly visible during the initial years of operation.

The massed effect and nature of the structures of the industrial area has a significant visual impact, particularly the anticipated dimensions of the product stockpiles and the heights of the structures exceeding 20 metres.

Denman Road and the elevated west facing residential portions of Muswellbrook and South Muswellbrook provide the viewer with the most prominent vantage points. The residents of those areas would view a significant portion of the open cut and industrial areas on a permanent daily basis. The screening benefits of the new ridgeline would not be significant until around Year 7.

Recommendations to reduce the visual impact of the mine include point source and viewer position ameliorative measures. These could consist of various planting strategies, bunding and rehabilitation techniques, as well as pre-planning and design of the mine structures to increase visual compatibility within the valley.

The treatment of the proposed ridgeline would be of most significance for its degree of visual impact during the mine life and in the long term. All efforts should be made to recreate existing appropriate landforms and vegetation patterns for the ridgeline to visually blend the proposed ameliorative measures with the existing landscape character.

The implementation of a comprehensive forward tree planting programme would be critical in successfully reducing the wide ranging visual impact of the proposed Bengalla open cut coal mine for the local community and other viewers. Adequate lead time must be allowed to install and assess the success of the proposed tree planting programme. The reduction of the significant visual impacts of the proposal could only be achieved with a comprehensive and carefully implemented planting and bunding programme.

APPENDIX A.

Schedule of Property Names and Numbers:

Property Number	Property Name
11 13	`Overdene' `Overton'
22a 22e 22f 24 25 29	`Runnymede' `Coldon Stud' `Wyndham Arms' `Lumeah' `Glen-dor' `Bengalla'
43	`Wirrimbirra'
51 57 59	`Berrywood Farm' `Roselyn' `Karoola'
64	`Leahurst'
85	`Killara'
95	`Blowering'
112 115d 115e	`Balmoral' `Rous-lench' `Edinglassie'
147 148 149	`Amaroo' `Cleveland Park' `Allambie'

APPENDIX 15
CHEMICAL CHARACTERISTICS OF
BENGALLA OVERBURDEN

1.0 INTRODUCTION

Overburden comprises all the rock above and between the coal seams to be mined. In the Bengalla area, overburden consists mainly of sandstone, siltstone and claystone, with minor tuff, conglomerate and inferior coal. Sandstone occurs as thick units (channel sands) and as thinner beds within interbedded units of sandstone, siltstone and claystone (overbank sediments). As well as occurring in interbedded units, siltstone and claystone can also form discrete units. The depth of weathering is about 25 m.

During open cut mining, large quantities of overburden are fragmented and removed from the pit and emplaced in spoil dumps in reverse and mixed stratigraphic order. Heaps of fresh rock are created and exposed to weathering. As air and water penetrate the spoil, soluble salts and sulphides may be leached and carried from the site in surface water and groundwater.

A knowledge of the chemical characteristics of the rock types in overburden will assist in planning water management of the site, in the placement of spoil, and in establishing a self-sustaining vegetation cover on the shaped spoil. A description of the geochemical consequences of disturbing overburden is given by the SPCC (1983). In the Upper Hunter Valley, three chemical conditions which may arise from the weathering of fresh overburden and result in environmental degradation are:

- acidity
- high salinity
- sodicity

In addition to the above, most spoils are usually deficient in many of the essential plant nutrients. Experience in the Hunter Valley has indicated it is almost impossible to establish a plant cover on spoil material without adding fertilisers, especially phosphorus (P) and nitrogen (N) rich fertilisers. However, amelioration (fertiliser application) techniques are now so well developed on coal mine sites in the Hunter Valley that nutrient deficiencies are not considered a major spoil chemical problem.

It is important to realise that the chemical characteristics of exposed spoil are not static but may change as weathering and leaching occurs. As an example, surface salinity levels of spoil may decline over time. This is important in that initial decisions based on spoil chemical characteristics are generally taken from unweathered samples of drill core.

In addition, surface spoil material is rarely homogenous and frequently contains a mixture of various strata. Extremes of chemical conditions may exist only centimetres apart on the spoil surface or within the rooting zone of plants. Consequently, chemical characterisation of core samples is only an aid in decision making and results must be kept in perspective. Decisions on selective placement of strata must consider the effects of weathering, mixing, ultimate land use, the relative cost of ameliorative techniques and vegetation tolerances.

2.0 SAMPLING

The stratigraphic section to be mined in the first 20 years of the Bengalla project extends from the Edderton Seam to the upper split of the Warkworth Seam. The Edderton Seam will form the basal seam in the open cut mine and will be the first seam mined in the initial box cut. The Warkworth 1 Seam, the uppermost seam to be mined, subcrops in the western part of the mining area and will not be mined until after Year 10.

Two representative cored drill holes from the Joint Venture's recent drilling programme were chosen for sampling: D108AF03 (F3) in the proposed box cut, and D111AC07 (C7) in the western part of the proposed mining area. F3 intersected the first strata that will be uncovered and represents the lower part of the mining sequence. C7 penetrated almost all the stratigraphic section that will be mined, except for the sequence from the Warkworth 2 Seam and above, which only occurs in the far western part of the proposed mining area. Overburden from the lower part of the mining sequence, from the Bayswater Seam to the Edderton Seam, was sampled in both drill holes, whereas overburden from almost the full mining sequence was sampled in C7. The locations of the sampled drill holes are shown in Figure 3.4 of the Environmental Impact Statement. The stratigraphic location and depth of the samples is given in Tables 1 and 2.

In both drill holes, one or more samples were taken from each interseam interval. The most abundant rock type or facies in each interseam interval was generally sampled, and unusual units were also sampled. Apart from the Archerfield-Bulga Formation, rock units within the interseam intervals are laterally discontinuous to varying degrees due to the fluvial nature of the deposits, so an attempt was made to ensure that all types of rock units occurring in the mining sequence were sampled.

The Archerfield-Bulga Formation, a coarsening-upward sandy sequence interpreted as a prograding sandy beach/shallow marine deposit (Uren, 1985), separates the Wynn and Bayswater seams. The formation was sampled in both drill holes, with several samples taken from each hole. Because of its deposition in a marine environment, the formation was expected to have different chemical

properties to the fluvial sediments in the remainder of the sequence, e.g. to have a higher sulphur content and be more saline. The chemical conditions of the depositional environment would have influenced the chemical properties of the sediments.

The sampled intervals were selected by studying geological cross sections, graphic logs at 1:100 scale, photographs of the drill core, and finally visual inspection of the core. Each sample consisted of at least a 0.10 m length of drill core. For some samples, two pieces of drill core from the same rock unit were taken to cover minor variations within the unit.

A total of 21 samples were taken: 7 samples from F3 and 14 from C7. Tables 1 and 2 give the sample numbers, their depth, rock types, stratigraphic location, and analytical results. Most samples taken were of fresh rock. Unconsolidated material and highly weathered rock in the top part of the hole is not cored in diamond drilling. Coring in F3 began at a depth of 15.9 m, and in C7 at 8.6 m.

TABLE 1 CHEMICAL ANALYSIS OF OVERBURDEN MATERIAL D108AF03										
Sample	Depth (m)	Rock Type and Stratigraphic Location	pH	EC _{1.5} (µs/cm)	Soluble Cations (meq/L)			SAR	ESP	Sulphur %
					Na	Ca	Mg			
F3/1	17.49-17.63	Weathered coal, Fe stained and clayey in places. BAYSWATER SEAM, near base of seam.	7.9	2480	13.9	3.81	5.64	6.41	7.57	0.02
F3/2	18.77-18.87 19.55-19.69	Weathered medium grained sandstone, patchy Fe staining. Off-white and light grey fine grained sandstone, orange Fe staining. ARCHERFIELD-BULGA FORMATION, middle of formation.	8.2	410	2.74	0.33	0.44	4.41	4.99	0.01
F3/3	20.96-21.12	Fresh light grey fine grained sandstone, silt-lined burrows, sulphurous smell on freshly broken core. ARCHERFIELD-BULGA FORMATION, near base.	2.8	2720	1.06	5.44	7.81	0.41	0	2.1
WYNN SEAM										
F3/4	23.70-23.85	Siltstone, sandy at top. Directly beneath Wynn Seam.	7.5	434	0.92	1.16	1.80	0.76	0	0.60
F3/5	25.87-25.98	Sandstone, medium grained, speckled throughout with orange Fe staining.	7.9	84	0.56	0.07	0.10	1.90	1.53	0.02
F3/6	31.36-31.49	Sandstone, fine grained, just below a carbonate replacement zone.	8.5	196	0.94	0.26	0.36	1.69	1.22	0.05
F3/7	33.17-33.32	Interbedded fine and medium grained sandstone, siltstone laminae.	7.8	215	0.91	0.45	0.59	1.27	0.60	0.08
EDDERTON SEAM										

TABLE 2
CHEMICAL ANALYSIS OF OVERBURDEN MATERIAL
D111ACO7

Sample	Depth (m)	Rock Type and Stratigraphic Location	pH	EC _{1:5} ($\mu\text{s}/\text{cm}$)	Soluble Cations (meq/L)			SAR	ESP	Sulphur %
					Na	Ca	Mg			
C7/1	9.93-10.06	Interbedded siltstone & fine grained sandstone, fresh, minor Fe staining on bedding.	9.6	346	2.80	0.06	0.30	6.61	7.83	0.02
WARKWORTH SEAM - SPLITS 3 & 4										
C7/2	22.67-22.86	Sandstone, medium grained, Fe staining on bedding and in joint.	9.4	185	1.24	0.73	0.57	1.54	1.00	0.01
MOUNT ARTHUR SEAM - SPLIT 1										
C7/3	25.83-26.02	Tuff, silty texture with scattered medium sand-size grains. FAIRFORD FORMATION	9.2	134	1.05	0.12	0.23	2.53	2.41	0.08
MOUNT ARTHUR SEAM - SPLIT 2										
C7/4	33.79-34.00	Interbedded, claystone & siltstone, possible bioturbation in places, above a carbonaceous claystone.	8.9	177	1.47	0.12	0.30	3.22	3.38	0.03
PIERCEFIELD SEAM - SPLIT 1										
C7/5	46.63-46.80	Interbedded siltstone & claystone, many leaf fossils.	9.2	139	1.24	0.10	0.35	2.58	2.48	0.02
PIERCEFIELD SEAM - SPLIT 2										
C7/6	68.72-68.87	Sandstone, medium grained.	9.0	171	1.35	0.06	0.21	3.67	3.99	0.02
VAUX SEAM										
C7/7	100.32-100.50	Interbedded siltstone & fine grained sandstone. Some siderite & Fe oxide staining on bedding.	9.7	320	3.28	0.21	0.23	7.04	8.36	0.03
C7/8	111.63-111.72 113.75-113.84	Laminated claystone & siltstone. Claystone, laminated, varve-like, laminae of carbonaceous claystone.	9.8	189	2.53	0.18	0.19	5.90	6.93	0.02
BROONIE SEAM - SPLIT 1										
C7/9	117.50-117.70	Interbedded fine grained sandstone & siltstone, brecciated in part.	9.8	196	2.64	0.25	0.21	5.50	8.41	0.02
COMBINED BROONIE 2 & 3 + BAYSWATER 1 SEAM										
C7/10	135.31-135.44	Sandstone, fine grained. ARCHERFIELD-BULGA FORMATION, top	6.5	812	6.79	0.19	0.31	13.47	15.69	0.42
C7/11	137.05-137.17	Sandstone, fine grained. ARCHERFIELD-BULGA FORMATION, middle.	7.0	1270	7.18	3.08	2.51	4.29	4.83	0.99
C7/12	138.68-138.83	Sandstone, fine & medium grained, light grey to grey with yellow tinge, silty laminae, sulphurous smell. ARCHERFIELD-BULGA FORMATION, near base	4.8	1770	0.34	7.06	11.02	0.11	0	1.8
WYNN SEAM										
C7/13	143.45-143.65	Interbedded siltstone & very fine grained sandstone, calcite-filled vertical joints.	9.7	234	2.90	0.23	0.14	6.76	8.01	0.04
C7/14	147.52-147.68	Claystone & siltstone, partly carbonaceous.	9.9	240	2.70	0.20	0.13	6.70	7.94	0.02
EDDERTON SEAM										

3.0 CHEMICAL ANALYSIS

The following analyses were conducted on the samples to ascertain the chemical conditions that might arise from the exposure and weathering of fresh overburden:

pH	- to measure acidity and alkalinity
electrical conductivity	- to indicate salinity
soluble cations Na, Ca, Mg concentrations	- to calculate the sodium absorption ratio (SAR) and exchangeable sodium percentage (ESP) which give an indication of sodicity and the tendency for clay to disperse.
total sulphur	- to determine the presence of possible acid-producing material.

Method

Core samples were crushed to pass through a 2 mm British Standard sieve and air dried. Determinations of pH, electrical conductivity and soluble salts sodium, calcium and magnesium were carried out on 1:5 crushed rock:water extracts. Electrical conductivity was measured with a Hanna H18733 conductivity meter. Atomic absorption spectrophotometric methods were used to measure the levels of water soluble cations. The cation values were calculated in milliequivalents per litre (meq/L), SAR and ESP were calculated from the measurements. Total sulphur percentages were measured by the LECO 1 method.

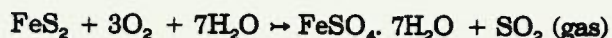
Envirosciences Pty Limited conducted all the analyses except sulphur. The BHP Rod and Bar Division carried out the sulphur determinations.

4.0 DESCRIPTION OF CHEMICAL PARAMETERS

Acidity

Acidity results from the oxidation of pyrite (FeS_2) when it is exposed to weathering. Oxidation of the sulphide produces sulphuric acid, which may attack other minerals, releasing environmentally hazardous elements (SPCC, 1983).

In the lower part of the Archerfield-Bulga Formation in the Kayuga area, just north of the Bengalla area, pyrite is common, giving the sandstone a greenish - yellow tinge. The pyrite readily oxidises to a yellow mineral, melanterite, and a strong-smelling sulphurous gas:



Melanterite is poorly soluble in water, producing an acidic solution of pH4. Further oxidation results in the formation of jarosite $\text{KFe}_3(\text{SO}_4)_2(\text{OH})_6$ and sulphur at the expense of melanterite and K-feldspar (Uren, 1985). Similar chemical changes may be expected to take place in the Archerfield-Bulga Formation at Bengalla.

Interpretation of pH Values. For 1:5 suspensions, samples having pH values below 4.5 are regarded as strongly acidic, 4.5 to 5.0 moderately acidic, 5.0 to 7.0 slightly acidic and greater than 7.0 alkaline. The pH range for most naturally occurring surface soils is between 4.0 and 8.5. This range can be exceeded in mining situations where unweathered strata are exposed to the atmosphere. The preferred pH range for vegetation establishment is 5.5 to 7.0.

Extremes of pH can have a strong effect on plant establishment through both toxicity and nutrient deficiency effects. When the pH is less than about 5.5, appreciable amounts of aluminium, manganese and iron may become soluble and in turn may become toxic to vegetation. Conversely, immobilisation of micronutrients, including zinc, copper and manganese can restrict plant growth if the pH rises much above 8. Many plants suffer phosphate deficiency under similar conditions. The effect of pH on nutrient availability is particularly important when the supply of nutrients is poor as is the case with most coal mine spoils (Burns, 1988).

Salinity

Salinity is a measure of the total soluble salt concentration in the spoil. Highly saline spoil can have a local effect by inhibiting plant growth, leaving the exposed surface more prone to wind and water erosion. Saline spoil also affects the quality of water which percolates through it, and water draining from a spoil heap may have unacceptably high concentrations of salts (SPCC, 1983).

Interpretation of Electrical Conductivity (EC). In assessing the revegetation capability of spoil, the EC of the saturation extract (EC_s) of material in the rooting zone will affect the species and management options and should be considered when selecting the material for placement as a rooting (growing) horizon. The EC_s is a measure of the total soluble salt content in the interstitial water, and is thus an estimate of the quality of potential leachate water contained in soil pores and

available to plants. A soil is usually considered to be saline when the EC_e exceeds 4000 $\mu S/cm$. Table 3 gives plant response to various EC_e ranges. In the present study, the EC of 1:5 soil:water extracts ($EC_{1:5}$) were measured because saturated extracts are time consuming to prepare and produce only a small part of the sample for analysis. To convert $EC_{1:5}$ to EC_e , the following regression equation, derived from duplicate analyses of $EC_{1:5}$ and EC_e on samples from Ravensworth South (Croft & Associates, 1986) has been used:

$$EC_e = 9.1 EC_{1:5} + 0.06$$

The effect of salinity on crops and pasture are well documented. The same is not the case for native tree, shrub and grass species, although knowledge of tolerance levels is improving with ongoing research and experience.

Salinity effects can be complex and vary with the type of salts present, the stage of vegetation development (e.g. germination or growth), and the tolerance of individual species. Salt levels in soil can vary over time (with leaching) and with the variable distribution of salts at wetting fronts throughout the soil profile.

EC_e at 25° ($\mu S/cm$)	$EC_{1:5}$ [*] ($\mu S/cm$)	Effect on Plants
0-2,000	0-220	Salinity effects are mostly negligible.
2,000-4,000	220-440	Yields of very sensitive crops are restricted.
4,000-8,000	440-879	Yields of many crops are restricted.
8,000-16,000	879-1,758	Only tolerant crops grow and yield satisfactorily.
>16,000	>1,758	Only a few very tolerant crops grow and yield satisfactorily.

^{*} calculated from EC_e using equation given above

The State Pollution Control Commission (1983) found that only 16 per cent of overburden samples from the Wittingham Coal Measures and 1 per cent of topsoils sampled had a salinity which could adversely affect the growth of some crop species. No particular formation was identified which was consistently highly saline at all sites. However, a highly saline horizon was detected in the Bulga/Foybrook formations at Saxonvale and Mount Thorley. It is highly probable that this horizon correlates with the saline Archerfield-Bulga Formation at Bengalla.

Sodicity

Sodicity refers to a condition where a relatively high proportion of readily soluble sodium is present in spoil. Fine silt, clay and organic particles (the exchange complex) in spoil adsorb sodium, potassium, calcium, magnesium, aluminium and hydrogen cations. If the adsorbed sodium exceeds a certain proportion of the total adsorbed cations, colloidal particles disperse; if calcium or magnesium dominate, the colloids flocculate. Spoils containing dispersive clays become puddled and impermeable when wet, and dry with a hard surface crust. This results in a poorly aerated growing medium with a low water availability for plants. Spoil containing dispersive clays is also easily eroded, thus further inhibiting revegetation and polluting runoff water with suspended solids. By contrast, spoil containing flocculated clay is more permeable and less prone to erosion (SPCC, 1983).

Interpretation of Sodium Absorption Rate (SAR). SAR is calculated from the concentration of cations in meq/L as follows:

$$SAR = Na \cdot \sqrt{(Ca^{2+} + Mg^{2+})/2}$$

The interpretation of data on SAR has been widely studied in the case of agricultural soils, but very little information is available in the case of mine spoils where unweathered rock is exposed to atmospheric conditions (Croft & Associates, 1986). The relationship between SAR values and sodicity used by Croft & Associates (1986) is given below:

- | | |
|----------|--|
| SAR < 5 | - favourable for maintaining soil structures and for avoiding sodium toxicity problems |
| SAR 5-15 | - unfavourable |
| SAR > 15 | - a serious sodic problem could result if the material is exposed to the surface |

Interpretation of Exchangeable Sodium Percentage (ESP). ESP gives a direct measure of the proportion of sodium adsorbed on the exchange complex. The ESP was calculated from the SAR as follows:

$$ESP = \frac{100(-0.0126 + 0.01475 \cdot SAR)}{1 + (-0.0126 + 0.01475 \cdot SAR)}$$

This formula is from Richards (1969), and has been used for evaluating the sodicity of alkaline soils, mined land spoils and overburden in the western USA (Sandoval and Power, 1977).

The implication of ESP values, as given in Croft & Associates (1986), are as follows:

- ESP > 6 - material prone to clay dispersion and described as sodic
- ESP 15-40 - material has adverse effects on plants

The potential problems relating to revegetation of spoil from the Wittingham Coal Measures in the Upper Hunter Valley mainly relate to surface sealing, poor moisture penetration and erosion which, in turn commonly relate to an unfavourable ESP. The SPCC (1983) noted that while sodicity varied markedly from site to site, at least 67 per cent of Wittingham overburden samples had poor sodic properties.

However, the effect of sodicity on plant establishment should be kept in perspective. In studies on the dispersion characteristics of Permian overburden in Central Queensland, Seedsman and Emerson (1981), indicated that mechanical disruption (e.g. by dozers and scrapers) of moist overburden particles is of greater importance in affecting subsequent dispersion than very high ESP levels.

Total Sulphur

A total sulphur percentage greater than about 0.7 indicates the possibility of acid-producing material if the material is deficient in neutralising capacity. High sulphur values indicate the presence of pyrite and minerals formed by the oxidation of pyrite. A low pH indicates that oxidation of pyrite has occurred.

5.0 RESULTS

The results of the chemical analyses are given in Tables 1 and 2, and are discussed below.

pH (Acidity)

In drill hole C7, the pH of samples excluding those taken of the Archerfield-Bulga Formation ranges from 8.9 to 9.9, indicating that the overburden materials are quite alkaline. However, the pH of the Archerfield-Bulga Formation ranges from 4.8 at the base of the formation to 7.0 near the

middle, indicating moderately to slightly acidic forming material. The low pH in the lower part of the formation is due to the oxidation of pyrite.

In drill hole F3, the sample of the Archerfield-Bulga Formation taken from the lower part of the formation has a pH of 2.8, indicating strongly acidic conditions due to oxidation of pyrite. The remainder of the strata are alkaline, with pHs ranging from 7.5 to 8.5.

Electrical Conductivity (Salinity)

The electrical conductivity ($EC_{1.5}$) of the Archerfield-Bulga Formation in C7 ranges from 812 $\mu S/cm$ at the top to 1770 $\mu S/cm$ at the base. Vegetation establishment could be expected to be affected in spoil with salinity levels in the higher part of this range. The $EC_{1.5}$ of all other strata in this drill hole are significantly lower, ranging from 134 to 346 $\mu S/cm$. These values denote that salinity effects from these strata will be minor.

In F3, the base of the Archerfield-Bulga Formation has an $EC_{1.5}$ of 2720 $\mu S/cm$, which is very saline. However, a weathered sample of the Archerfield-Bulga Formation taken just above the unweathered sample referred to above has an $EC_{1.5}$ of only 410 $\mu S/cm$, suggesting that the soluble salts have been leached out during weathering. By contrast, weathered Bayswater Seam above the weathered part of the Archerfield-Bulga is very saline with an $EC_{1.5}$ of 2480 $\mu S/cm$.

The remainder of the samples taken from F3 are not saline, with $EC_{1.5}$ values ranging from 84 to 434 $\mu S/cm$.

The weighted average electrical conductivity (1.5) of all the overburden, taking into account overburden thickness is 251 $\mu S/cm$. The expected conductivity of any water leaching from the spoils is expected to be a saturated extract and so, using the equation in Section 4, is likely to be approximately 2,300 $\mu S/cm$.

SAR (Sodicity)

The SAR of the Archerfield-Bulga Formation in C7 ranges from 0.11 at the base to 13.47 at the top. These ratios indicate that the top part of the formation could have a moderate sodic problem if exposed at the surface. The middle and lower part of the formation would not present a sodic problem. The SARs of other strata in C7 are also relatively low and range from 1.54 to 7.04.

A15:11

In F3, only weathered Bayswater Seam had a SAR above 5 (6.41). Values obtained for the Archerfield-Bulga Formation are 0.41 at the top and 4.41 at the base. The remainder of the strata vary from 0.76 to 1.90. Strata within this drill hole are unlikely to create sodic problems when exposed at the surface.

ESP (Sodicity)

The ESP values parallel and support the SARs discussed above. In C7, the top of the Archerfield-Bulga Formation has an ESP of 15.69, suggesting that this material could have an adverse effect on plant establishment. Strata above the Warkworth Seam, in the Vaux to Broonie 2 interval and in the Wynn-Edderton interseam interval are slightly sodic, with ESP values between 6.41 and 8.36. The remainder of the strata have ESPs less than 6.

In F3, weathered Bayswater Seam has an ESP of 7.57. The Archerfield-Bulga Formation has ESPs up to 5, whereas the remainder of the sequence varies from 0.6 to 1.53.

Total Sulphur

The total sulphur percentage of the Archerfield-Bulga Formation in C7 decreases upwards from 1.8 at the base, 0.99 in the middle, to 0.42 at the top of the formation. The high sulphur values in the lower part of the formation indicate the presence of pyrite and other sulphurous minerals. The low pH in the sample from near the base as well as the sulphurous smell of the fresh drill core demonstrates that some oxidation of pyrite has occurred and the rock could produce sulphuric acid if exposed to air and water. The rest of the sequence is low in sulphur, with sulphur percentages between 0.01 and 0.08.

The lower part of the Archerfield-Bulga Formation in F3 is also high in sulphur (2.1 per cent), has a low pH, (2.8), and has a sulphurous smell on freshly broken drill core, denoting acid-producing potential if exposed to air and water. The sulphur percentage of the rest of the sequence is low, ranging from 0.01 to 0.6. The 0.6 value occurs in a sandy siltstone directly beneath the Wynn Seam.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Chemical analysis demonstrates that the Archerfield-Bulga Formation, which was deposited in a marine environment, has distinctly different chemical properties from the rest of the coal measure sediments, which were deposited in a fluvial environment. The whole Archerfield-Bulga Formation is saline and high in sulphur. The lower part of the formation is moderately to strongly acidic due to the oxidation of pyrite. The top part of the formation is sodic. Therefore, no unweathered rock from the formation should be placed in the future root zones of reshaped spoil piles, but should be buried and covered by at least 5 m of suitable overburden. The Archerfield-Bulga Formation comprises all the strata between the Wynn and Bayswater seams, and will be encountered during

excavation of the initial box cut and all subsequent mining strips. In the proposed mining area, the formation varies in thickness from 3.9 to 8.6 m.

Weathered Bayswater Seam is very saline and sodic, and should be handled like the Archerfield-Bulga Formation. Other weathered coal seams have not been tested.

All other strata analysed are not saline, are not acid forming, and are low in sulphur. Except for the intervals discussed below, they are also non-sodic, and their position in the spoil heap is not critical.

In C7, strata above the Warkworth Seam, between the Vaux and Broonie 2 seams, and between the Wynn and Edderton seams are slightly sodic. In F3, however, the Wynn-Edderton interseam interval is not sodic. The stratigraphically higher sodic strata encountered in C7 were not intersected in F3. Such variation within a strata is not uncommon and reflects from other analysis e.g. SPCC (1983). However, the result does highlight the need for regular spoil analysis as mining proceeds, particularly once a chemical problem has been noted in a strata.

Throughout the stratigraphic interval sampled, (Warkworth Seam to Edderton Seam), the following relationships between rock types and chemical properties were found:

- higher pHs occur in interbedded sandstone/siltstone units and siltstone/claystone units
- higher ECs occur in siltstone/claystone units
- higher SARs and ESPs occur in interbedded sandstone/siltstone units.

Recontoured overburden will be covered with a 200 mm veneer of prestripped topdressing material. This together with implementation of the above recommendations will provide a suitable root growth medium to at least 5 m depth. This should be adequate for the successful long term establishment of trees and pasture and for the prevention of erosion and surface water quality problems.

APPENDIX 16

**LIGHTING IMPACTS AND RECOMMENDATIONS FOR
PROPOSED BENGALLA MINE**

Engineering Report

Lighting Impacts and Recommendations for
PROPOSED BENGALLA MINE
MUSWELLBROOK NSW

Electrical Services

Project No.: 8119.01
FEBRUARY 1993

CONNELL WAGNER

TABLE OF CONTENTS

	Page
1 INTRODUCTION	1
2 EXECUTIVE SUMMARY	1
3 INSPECTIONS	1
3.1 Day Inspections of Bengalla Mine Site	1
3.2 Night Time Inspections of Operating Mines	2
3.3 Day Time Inspections of Ravensworth Mine	2
4 EXPECTED LIGHTING IMPACTS FROM BENGALLA MINE	2
4.1 Lighting Impacts from the Mine Facilities	2
4.2 Lighting Impacts from the Stockpile Area and Washery	4
4.3 Lighting Impacts from the Mine	5
5 RECOMMENDATIONS TO REDUCE LIGHTING IMPACTS	6
5.1 Reducing Lighting Impacts from the Mine Facilities	7
5.2 Reducing Lighting Impacts from the Stockpile Area and Washery	9
5.3 Reducing Lighting Impacts from the Open Cut Mine	10
6 CONCLUSIONS	10
APPENDIX "A" - INFORMATION PROVIDED BY ENVIROSCIENCES PTY LIMITED	
APPENDIX "B" - PHOTOGRAPHS	

1.0 INTRODUCTION

We were engaged by ENVIROSCIENCES PTY LIMITED to examine the likely lighting impacts from the proposed new Bengalla Mine located approximately 6.5km south west of Muswellbrook and bounded by Wybong Road, Roxburgh Road, the Hunter River, and Logues Lane. Having examined the impacts we were to make recommendations.

We were supplied with the information listed in Appendix "A" and given the opportunity to visit Drayton and Ravensworth Mines. These visits allowed us to see lighting in operation on working mines which contained elements similar to those planned for Bengalla.

2.0 EXECUTIVE SUMMARY

The lighting impacts will be severe because of the close proximity of the proposed mine to residences and to the township of Muswellbrook, and the nature of open cut mining.

These impacts can be substantially reduced by a combination of recommended technical measures and operational practices.

The thrust of the technical measures is to: screen all exterior lights from direct view as far as practicable, and eliminate glowing translucent panels from buildings.

Operational practices recommended include: keeping workshop doors closed when vehicle access is not required; providing blinds for Bath House and office windows; operating dump trucks with dipped headlamps where practicable and pro-active monitoring of the open cut mine and mine facilities lighting from viewpoints external to the mine.

3.0 INSPECTIONS

3.1 Day Inspections of Bengalla Mine Site

During the afternoon of 1 December 1992 accompanied by Terry O'Hanlon of Quinn O'Hanlan Architects Pty Limited we inspected the proposed site for Bengalla Mine.

Referring to Local Government Map (LGM) Muswellbrook 9033-11-N scale 1:25,000 (available from newsagent at Muswellbrook) the inspections covered the following viewing points :-

- VPI travelling west along Wybong Road, near east-west Grid 95 where a farm house exists.
- VP2 off Roxburgh Road, near east-west Grid 92 and between north south grids 25 and 26, at the residence of Mr and Mrs Grahame Collins.
- VP3 travelling east along Denman Road, near east-west Grid 96 and the residence known as "Edinglassie".
- VP4 housing estate at Muswellbrook, at locations with a view east :
 - Turaville Street and Flanders Avenue
 - Dumareique Street and Flanders Avenue
 - Cabenet Street
 - Heliers Street

3.2 Night Time Inspections of Operating Mines

We visited Drayton and Ravenworth Mines to view mines with similar lighting requirements to Bengalla Mines.

The Drayton inspection covered the mine facilities, the mine, and the rail loop.

The Ravensworth facilities covered the mine facilities and the mine.

3.3 Day Time Inspection of Ravensworth Mine

On the morning of 2 December 1992 we viewed Ravensworth Mine from the approach road and from the public view point and took photographs to use in this report.

4.0 EXPECTED LIGHTING IMPACTS FROM BENGALLA MINE

4.1 Lighting Impacts From the Mine Facilities

One of the joint venturers for the proposed Bengalla Mine, Costain Resources Limited, advised that the mine facilities would be modelled generally on the facilities at their Ravensworth Mine. Specifically we were supplied with the

following preliminary drawings by our client Envirosiences Pty Limited :-

- Gutteridge Haskins and Davies (GHD) preliminary drawing scale 1:10,000 "Overall Site Plan Showing Proposed Link Road and Industrial Area" dated 10 November 1992.
- GHD preliminary drawing scale 1:250 "proposed office and workshop area" dated 6 November 1992.

We can list the following severe lighting impacts from the mine facilities if the lighting design and operational practices at Bengalla Mine are the same as Ravensworth Mine :-

- MFL1-viewed from residences west of the proposed mine facilities (for example "Wyndham Arms" and Mr & Mrs Grahame Collins residence) the night time appearance of the mine facilities will reduce both twilight and night time amenities.

Views from the Collins place towards the east to enjoy sunlit hills as the sun sets will be impacted. One's eyes will be drawn towards the visible lights of the mine facilities. Also views from the Collins' residence towards the lights of Muswellbrook will be interfered with by the attraction of the mine facility lights.

- MFL2-viewed from residences along the Denman Road (for example "Lyndhurst", "Frenchaven", "Bundaleer", "Edinglassie", "Delhaven") views to the west as the sun sets will also be impacted by the mine facility lights.
- MFL3-viewed from the residences at the high points of Muswellbrook who currently enjoy a view towards the river and the south west. Those views will be impacted by the unavoidable attraction of the eye to the mine facility lights.

Based on Ravensworth Mine the mine facilities lighting which will cause these impacts is listed below. Two types of light sources are used : White fluorescent (F) and yellow high pressure sodium (HPS).

- Strongly visible (HPS) flood lights on the truck washing facilities
- Column mounted floodlights (see right side of photograph 2)
- Lit views inside workshops when truck entry doors are open
- HPS glow from translucent panels at the top of workshop walls (see photograph 5)

- Visible HPS streetlights mounted on the workshop walls
- HPS floodlit plant (trucks, 4 wheel drives, lighting skids etc) moving or parked on hard stand areas
- HPS floodlit heliport
- F glow from high level windows of the bath house
- F glow from office windows
- HPS floodlit external stores
- Visible F lights under the carpark shelter

The lighting of the mine facilities at Ravensworth is appropriate for its location where there are no nearby residences with views onto those facilities. Furthermore by typical mining standards it is unobtrusive. However, the situation at Bengalla Mine would be quite different where nearby residences do have direct views onto the proposed location of the mine facilities. This issue is addressed in the recommendations of this report.

The general thrust of the recommendations is to eliminate or greatly reduce direct views of lights and to eliminate the glow from translucent panels and high level windows. These recommendations are made bearing in mind the functional, safety, and amenity needs for lighting of mine facilities.

4.2 Lighting Impacts from the Stockpile Area and Washery

Costain Resources Limited advised us there would be no floodlighting of the local stockpiles. The stackers and reclaimers would have lighting typical for those types of machines. And the rail loop and load-out bin lighting would be modelled on Drayton Mine.

From our inspection of Drayton Mine and from previous design experience we can list the following severe lighting impacts from the stockpile area and washery :-

- SWL1-viewed from positions already described (see 4.1), there will be an impact similar to MFL1.
- SWL2-likewise the impact will be similar to MFL2.
- SWL3-likewise the impact will be similar to MFL3.

Based on Drayton Mine, and our previous experience, the Stockpile Area and washery lighting which will cause these impacts is listed below :-

- Visible HPS floodlighting on the stackers and reclaimers
- Visible HPS lights for walkways and ladders on the stackers and reclaimers
- Visible column mounted HPS streetlights around the rail loop
- Visible HPS streetlights mounted off the side of the bin, transfer houses, and crushers
- HPS or F glow from translucent panels on the sides of transfer and crusher houses
- HPS or F glow from translucent panels on the covered sides of the rising load out and washery conveyors
- Visible HPS floodlights mounted under the load out bin
- HPS or F glow from translucent panels on the sides of the washery
- Visible HPS floodlights mounted on the sides of the washery
- HPS floodlights on columns for the run of mine stockpile at the washery

The type of lighting described above is appropriate for stockpile areas and washeries located away from residences. Again the situation at Bengalla is different because of the proximity of residences to the stockpile area. This issue is addressed in the recommendations.

The general thrust of the recommendations is to shield lights from direct view and to eliminate glowing translucent panels.

4.3 Lighting Impacts from the Open Cut Mine

The Envirosciences brief to Subconsultants indicates the Bengalla Mine will be developed over a 21 year period. The yearly output will be 6.5 million tons. Overburden will be removed by a large dragline with pre-stripping material carried out by a loader or electric shovels and transported by rear dump trucks to selected spoil heaps. Coal will be recovered by continuous miner, transported from the working face to conveyor loading points then by conveyor to the run of mine (ROM) stockpile at the coal washery.

From our night time inspections of Drayton and Ravensworth Mines we can list the impacts shown below. These will be reduced after the ridge line is reconstructed.

- ML1-viewed from the positions already described for mine facilities impact MFL1 (see 4.1) there will be dynamic impacts on twilight and night views due to moving lights as the dragline swings and dump trucks move on mine roads.
- ML2-likewise the dynamic impact will be similar in the positions described for mine facilities impact MFL2 (see 4.1).
- ML3-likewise the dynamic impact will be similar in the positions for mine facilities impact MFL3 (see 4.1).

Based on Drayton and Ravensworth Mines the lighting that will cause those impacts is listed below :-

- Direct view of HPS and metal halide (MH) floodlights mounted on the dragline boom as it swings clear of the overburden pile and as it is elevated above the top of the overburden pile (see photograph 6)
- Direct views of HPS floodlights on electric drills
- Direct views of HPS and MH floodlights on skid mounted lighting plant
- Direct views of headlights on dump trucks as they move up sloping mine roads, along level mine roads, and as they turn bends

The type of lighting described above is typical for open cut mines. Due to the nature of open cut mining there is limited scope to reduce the dynamic impacts created by it.

This issue is addressed in the recommendations and the main thrust is towards monitoring for potential impacts, and shielding floodlights. Also operating haul trucks with dipped headlights where practicable.

5.0 RECOMMENDATIONS TO REDUCE LIGHTING IMPACTS

The following recommendations are shown in bold type. These would increase the capital and operating costs of the mine facilities. However we believe they are essential if the severe lighting impacts are to be reduced.

5.1 Reducing Lighting Impacts From the Mine Facilities

- Because lighting for truck washing has to be side lighting and truck washing bays are open, the floodlights used are directly visible from either end of the bays.

Screen the open ends of enclosed truck washing bays and finish the inside surface of bays in a dark colour.

- Floodlights mounted on 10m high columns and aimed outwards at perhaps 40° from the pole, as at Ravensworth Mine, allow direct views of the bright parts of those floodlights.

Use taller columns, perhaps 15 to 20 metres high, and low brightness floodlights with the floodlight body horizontal and the floodlight reflector designed to provide sharp cut-off and restrict stray light.

- Mining workshops have to be lit to relatively high lighting levels, approximately 400 lumens per square metre (lux), to suit the visual tasks involved. Consequently when a truck access door to a mine workshop is open it exposes a large view of the brightly lit interior.

Keep access doors shut at night except of course when open for trucks and other equipment to be moved in or out. Ventilate doors at low level with closeable grilles plus improved roof level ventilation to provide comfortable working conditions on hot summer nights. Provide door contacts and link to a mine facilities building automation system which records and logs when doors are open. This tool would help to keep control over doors. Finish inside surfaces in a colour at the bottom of the range of reflectances recommended in AS1680 - "Interior Lighting Code".

- Translucent panels are provided at high level on the sides of workshop walls to allow daylight to enter. However, these panels glow at night.

Eliminate these panels and clad the whole of the sides of the workshop. Daylight will enter the workshops when truck access doors are open during summer days. During winter when truck access doors are generally closed there would be no daylight entry. A compromise would be to have roof level skylights but these would glow at night and be seen from a number of the identified viewing positions.

- Lights have to be mounted on the sides of workshop walls to light the concrete strip surrounding the workshop and portion of the hard stand area beyond the concrete strip. Lack of such light would compromise safety. Also a part of this floodlighting has to light the number signs mounted on

the workshop wall above each access door (see photograph No. 5).

Use wall mounted lights with horizontal bodies and a low brightness design to light the concrete strip to 50 lux and portion of the hard stand area to 10 lux. Finish the exterior surfaces of the workshop in a camouflage scheme with the darkest patches in areas lit by these lights.

- Hard stand areas have to be lit to approximately 10 lux for safe movement of trucks and other equipment and for security. Use of floodlights on 10m high columns with floodlights aimed out at approximately 40° fulfils this function but allows direct views of the bright parts of those floodlights.

Use 15 to 20m high columns with low brightness floodlights mounted horizontally. Where exposed to damage from trucks the base of the columns would have to be protected. This could be done perhaps by half buried dump truck tyres painted white.

- High level windows on the Bath House allow daylight entry but these glow at night. Daylight is a benefit which should be retained for the Bath House but the glow at night prevented.

Use a system of blinds which can be manually lowered by controls (mechanical or electrical) located at convenient points in the Bath House. Blind contacts should be provided and linked to the mine facilities building automation system which can record and log instances when blinds are open after dark.

- Windows are needed on the office block primarily for the amenity value of daylight and for views out.

Use a system of blinds and automation system monitoring similar to the recommendation for the Bath House.

- Unshielded fluorescent lights located under the carpark roof will be seen from lower level residences to the south west.

Provide egg-crate louvre shielding of these lights. This will increase the number of lights required and require greater maintenance to regularly clean dust and spider webs from louvres. Besides providing shielding the lamps used should be " warm white" fluorescent to soften the lit appearance of cars parked under it.

5.2 Reducing Lighting Impacts from the Stockpile Area and Washery

- **HPS floodlights mounted on the stackers and reclaimers are essential to allow visual checks for set up and to see that these machines are operating correctly.**

Shield these floodlights by hoods and louvres to reduce the chances of direct views of lamps.

- **Lights are obviously required for safe use of walkways and ladders on the stackers and reclaimers. The typical light used is not shielded in any way.**

Enclose these lights and include louvres to provide shielding.

- **Typically the lights used around the load out rail loop are HPS streetlights on columns following the loop. These lights will appear bright to lower level residences to the south of the loop.**

Use taller columns, perhaps 15-20 metres high, and low brightness floodlights with the floodlight body horizontal and the floodlight designed to provide sharp cut off and restrict stray light.

- **Typically lights provided for function, security, safety, and access around and under bins, on transfer houses, and on crusher houses and washeries are HPS streetlights mounted off the sides of those structures. These lights will also appear bright to lower level residences who could view the loop.**

Use low brightness floodlights, similar to those described above for the rail loop, except wall mounted at convenient heights for maintenance.

- **Translucent panels are usually provided on the sides of washeries, transfer and crusher houses, and on the sides of rising conveyors to admit daylight. However at night these panels glow.**

Eliminate these translucent panels and use only artificial lighting. Provide flexible and conveniently located switching controls to reduce energy use where practicable.

- **Lights provided around the run of mine stockpile dump area are typically streetlights or open floodlights mounted on columns. These allow views of lamps.**

Use low brightness floodlights mounted on 15-20m columns similar to that described for the rail loop.

5.3 Reducing Lighting Impacts From the Open Cut Mine

- Typically floodlights used on draglines, drills, and lighting skids are not shielded and allow open views of lamps. This creates dynamic lighting impacts which are disturbing to people in residences with a view onto the mine site.

Shield all floodlights to the maximum extent practicable. Finish exterior surfaces of major mine vehicles and machines in dark colours with a camouflage scheme to reduce the brightness of lit surfaces.

- Dump trucks have to use headlights to safely travel on mine roads. On some of these roads, depending on the direction trucks are taking, and on whether there is a slope, or a bend, residences overlooking the mine will get direct views of moving headlamps. These dynamic impacts are disturbing and difficult to reduce.

Where safe to do so operate trucks with dipped headlamps; use portable visual edge markers to increase drivers visibility of road edges when driving with dipped headlamps; and increase the height of safety berms where practicable to act as visual barriers.

6.0 CONCLUSIONS

Because of the close proximity of residences to the proposed mine site the impacts from lighting will be severe unless strong steps are taken to reduce them. With the recommendations made those impacts would be substantially reduced. However lighting impacts would still exist. It is not practicable to eliminate them from a working mine site.

APPENDIX "A"

INFORMATION PROVIDED BY ENVIROSCIENCES PTY LIMITED

APPENDIX "A"

INFORMATION PROVIDED BY ENVIROSCIENCES PTY LIMITED

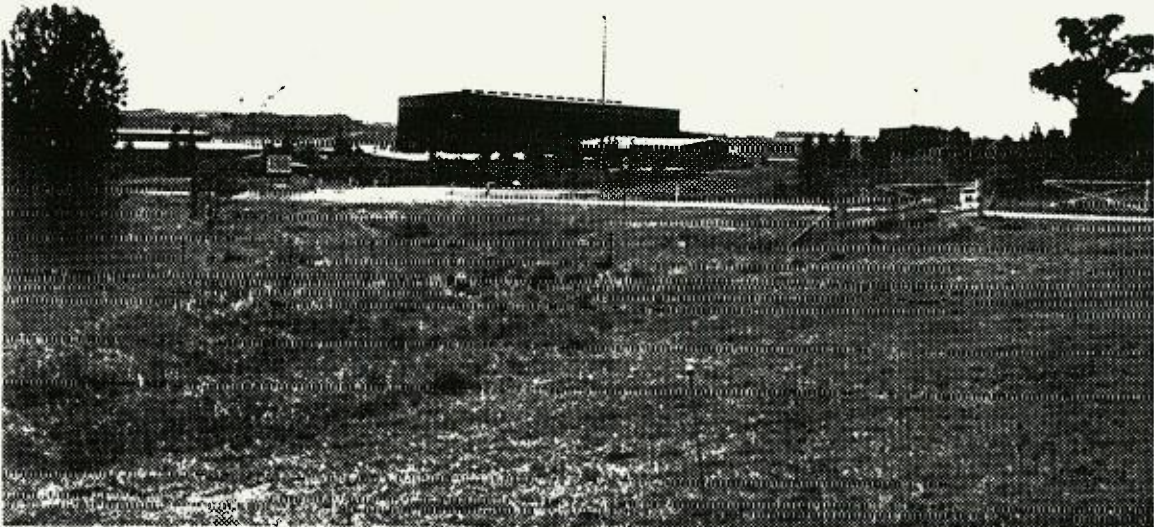
We were supplied with the following information by Mr Brian House of Envirosiences :-

1. "Bengalla Environmental Impact Statement Brief to Subconsultants" (undated).
2. Coal seam pass diagrams: "1st pass vaux seam; 2nd pass Ba/By seam; 3rd Wynn seam; and 4th pass EDDN seam" (undated).
3. Draft "Layout of stockpile and washery area" (undated).
4. "Layout of Bengalla Project at 1 year", scale 1.25,000, infrastructure not in finally selected configuration, (undated).
5. "Proposed open cut mine and infrastructure figure 2" scale 1.25,000, November 1992.
6. Coloured aerial photograph, scale 1.25,000 showing the proposed Bengalla site in relation to Muswellbrook and surrounds.
7. Drawings and sketches produced by Sedgman & Associates Pty Limited :
"preliminary layout of coal stockpiles and washery" scale 1.4,000 (undated); and
"preliminary sections of coal stockpiles and washery" scale 1.1,000 (undated).
8. Drawings and sketches produced by Gutteridge Haskins and Davey Pty Limited :
"proposed office and workshop area" scale 1.250 6 November 1992; and
preliminary "overall site plan showing proposed link road and Industrial Area"
scale 1.10,000 10 November 1992.

APPENDIX "B"

PHOTOGRAPHS

APPENDIX "B"



PHOTOGRAPH NO. 1

BATH HOUSE ON LEFT, WORKSHOP AND STORES CENTRE

APPENDIX "B"



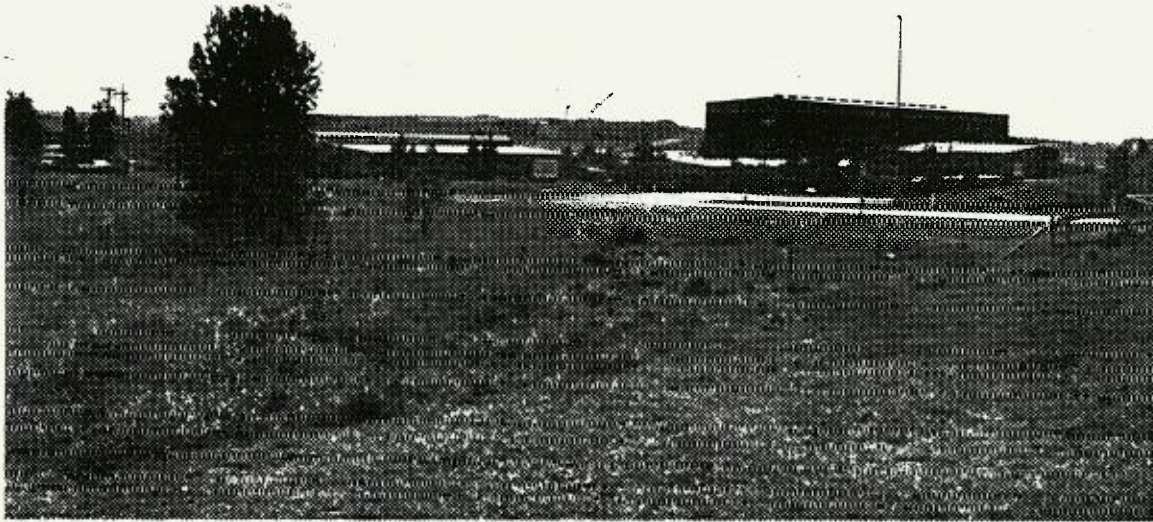
PHOTOGRAPH NO. 2

COVERED CARPARK LEFT, MINE ENTRY ROAD RIGHT

Points to Note :-

- Column mounted floodlights on right hand side

APPENDIX "B"



PHOTOGRAPH NO. 3

**LEFT TO RIGHT: SUBSTATION, BATH HOUSE, OFFICE, WORKSHOP
AND STORES**

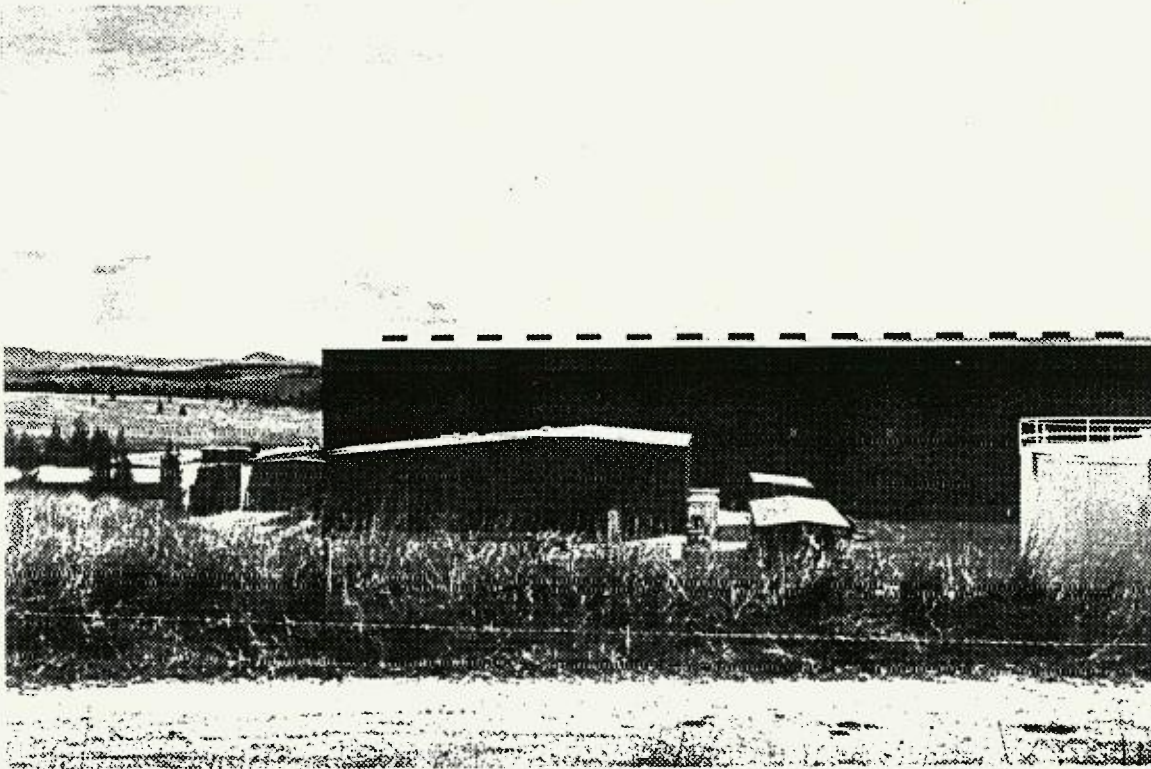
APPENDIX "B"



PHOTOGRAPH NO. 4

BATH HOUSE ON LEFT, OFFICE CENTRE, WORKSHOPS RIGHT

APPENDIX "B"



PHOTOGRAPH NO. 5

WORKSHOP WITH INTERNAL STORES BUILDING IN FRONT

Points to Note :-

- Translucent panels at top of workshop walls
- Access door signs above doors

APPENDIX "B"



PHOTOGRAPH NO. 6

SPOIL HEAPS ON LEFT, DRAGLINE ON RIGHT

Points to Note :-

- Height of the dragline boom above the heap of material

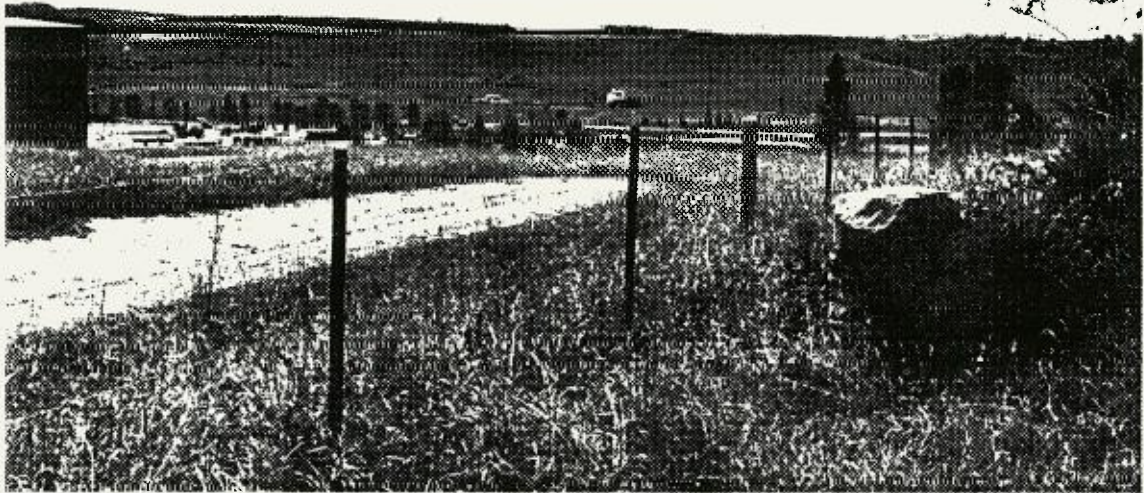
APPENDIX "B"



PHOTOGRAPH NO. 7

HAUL TRUCKS ON TOP OF MINE

APPENDIX "B"



PHOTOGRAPH NO. 8
HAUL TRUCK ON HAUL ROAD