Specialist Consultant Studies

East Boggabri Joint Venture

Proposed East Boggabri Coal Mine

Groundwater Assessment

Prepared by

RCA Australia

May, 2005

Specialist Consultant Studies Compendium
Part 2

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Groundwater Assessment

of the

Proposed East Boggabri Coal Mine

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EXECUTIVE SUMMARY

This report presents the findings of a groundwater assessment undertaken on behalf of R W Corkery & Co. Pty Limited for the Whitehaven Coal Mining Limited/Idemitsu Boggabri Coal Pty Ltd Joint Venture.

The main aims of the assessment are to predict the likely impacts of the proposed East Boggabri Coal Mine on the groundwater in the neighbouring aquifers.

The results of the assessment can be summarised as follows.

- There are four aquifers in the vicinity of the proposed East Boggabri Coal Mine. These are the coal seams (to be mined), interburden (to be mined and replaced in the mining void), alluvial aquifer to the south of the Project Site and along the surrounding creeks and the underlying basement volcanic material.
- The proposed open cut mine would intersect the regional groundwater table and thereby lower the water table in the coal measures strata.
- Inflows to the open cut mine would be small and would not provide a significant quantity of water for use in the operation of the mine.
- The drawdown with distance from the open cut mine is predicted to be minimal due to the low hydraulic conductivity of interburden and basement strata.
- Limited impact on the alluvial aquifer is predicted. Nonetheless, monitoring of adjacent bores is recommended to confirm the model predictions.

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1 INTRODUCTION

This report presents the findings of the groundwater assessment undertaken for R.W. Corkery & Co. Pty. Limited on behalf of the Whitehaven Coal Mining Limited/Idemitsu Boggabri Coal Pty Ltd, joint venture, for the proposed East Boggabri Coal Mine. The proposed mine would be located approximately 15km northeast of Boggabri (see **Figure 1**) within the Gunnedah Basin. The report has been prepared to assist in the preparation of, and accompany, an EIS for the proposal. The main aims of the assessment are to predict the likely impacts of the proposed East Boggabri Coal Mine on the groundwater beneath the Project Site and in the neighbouring aquifers.

This report provides background information on the existing groundwater environment, water usage on, and adjacent to, the Project Site and outlines a description of the proposal. The regional geology is then discussed before a summary of the fieldwork undertaken is provided. The results of the fieldwork are then incorporated into a conceptual groundwater model for the site and surrounding area. Groundwater modelling is then conducted to predict mine inflows and the drawdown effect of the mine. The report concludes with a summary of the predicted impacts upon the groundwater beneath the Project Site and in the neighbouring aquifers.

2 BACKGROUND INFORMATION

The Project Site lies immediately to the south of Leard State Forest, and principally incorporates land exhibiting natural slopes ranging from less than 2° to 5° (see **Figure 1**). Isolated rises immediately to the south and in the eastern areas exhibit slopes of up to 13°.

Drainage within the Project Site is predominantly to the south and west towards Bollol Creek with areas in the north draining in a northerly and westerly direction towards Nagero Creek. Surface water flows are ill-defined but ultimately enter the Namoi River. All drainage flows are intermittent, with local water resources restricted to those in the drainage lines for short periods following rainfall within farm dams on the “Thuin”, “Nagero” and “Forest View” properties and a major impoundment on a tributary of Nagero Creek (adjacent to the “Nagero” homestead).

Natural drainage patterns within the shallower sloping components of the Project Site have been substantially modified by the construction of contour banks and waterways. The Project Site lies above the Namoi Valley flood plain.

Available information sourced from the DIPNR Groundwater Database indicates that groundwater is contained within the coal measures, fractured rock aquifers at depth and shallow alluvial aquifers along the surrounding creeks. Standing water levels range from 5m to 100m and yields are low and quality is generally good.

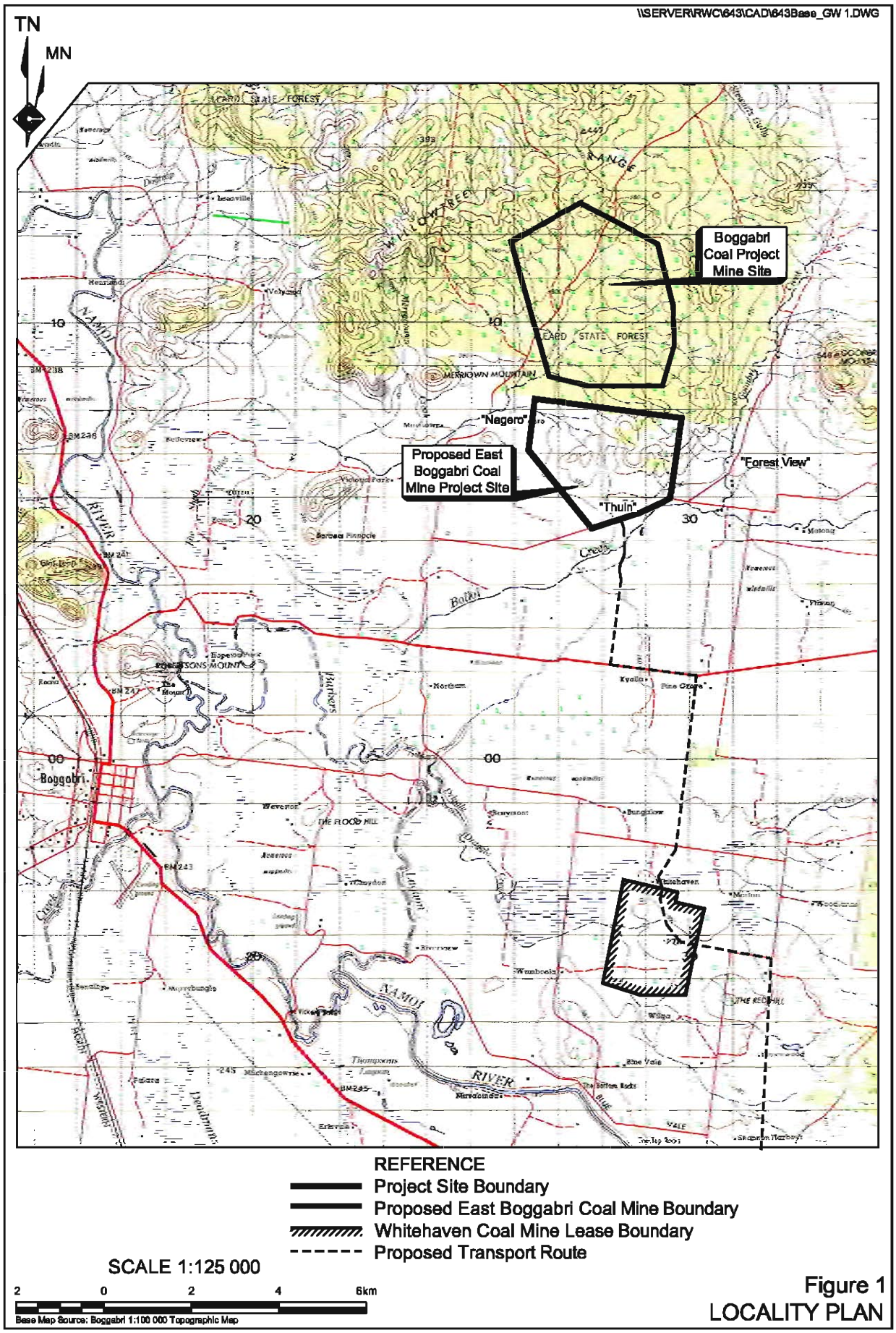


Figure 1
LOCALITY PLAN

3 PROJECT DESCRIPTION

A joint venture between Whitehaven Coal Mining Limited (WCM) and Idemitsu Boggabri Coal Pty Ltd (IBC) proposes to develop and operate an open cut coal mine ("the East Boggabri Coal Mine") within in the Gunnedah Basin. The proposed open cut mine lies within Exploration Licence (EL) 5967 (held by WCM) and Coal Lease (CL) 368 (held by IBC) and covers an area of approximately 160ha (see **Figure 2**). The nominated Project Site for the proposal covers an area of approximately 726ha centred on the "Thuin", "Nagero" and "Forest View" properties, which are owned by the joint venture partners (see **Figure 2**).

Mine production would approximate 1.6Mtpa product coal over an anticipated mine life of approximately 8 to 10 years and subject to the receipt of all necessary statutory approvals, leases and licences, production would commence in the first quarter of 2006.

Open cut mining would be by the conventional truck and shovel, haulback method involving the sequential removal of soil and overburden/interburden materials above and between the coal seams, coal removal, and progressive backfilling and rehabilitation of the mined-out areas. Blasting would be required from the outset of mining.

The average overburden to coal stripping ratio would approximate 7.2 bank cubic metres (bcm) to 1 tonne coal and the proposed open cut mine would intersect 8 main coal seams, namely:

- Braymont;
- Bollol Creek;
- Jeralong;
- Jeralong (Lower);
- Merriown;
- Meriown (Lower)
- Velyama; and
- Nagero.

These seams would provide a low ash, low sulfur, high energy, export quality, semi soft, coking coal product.

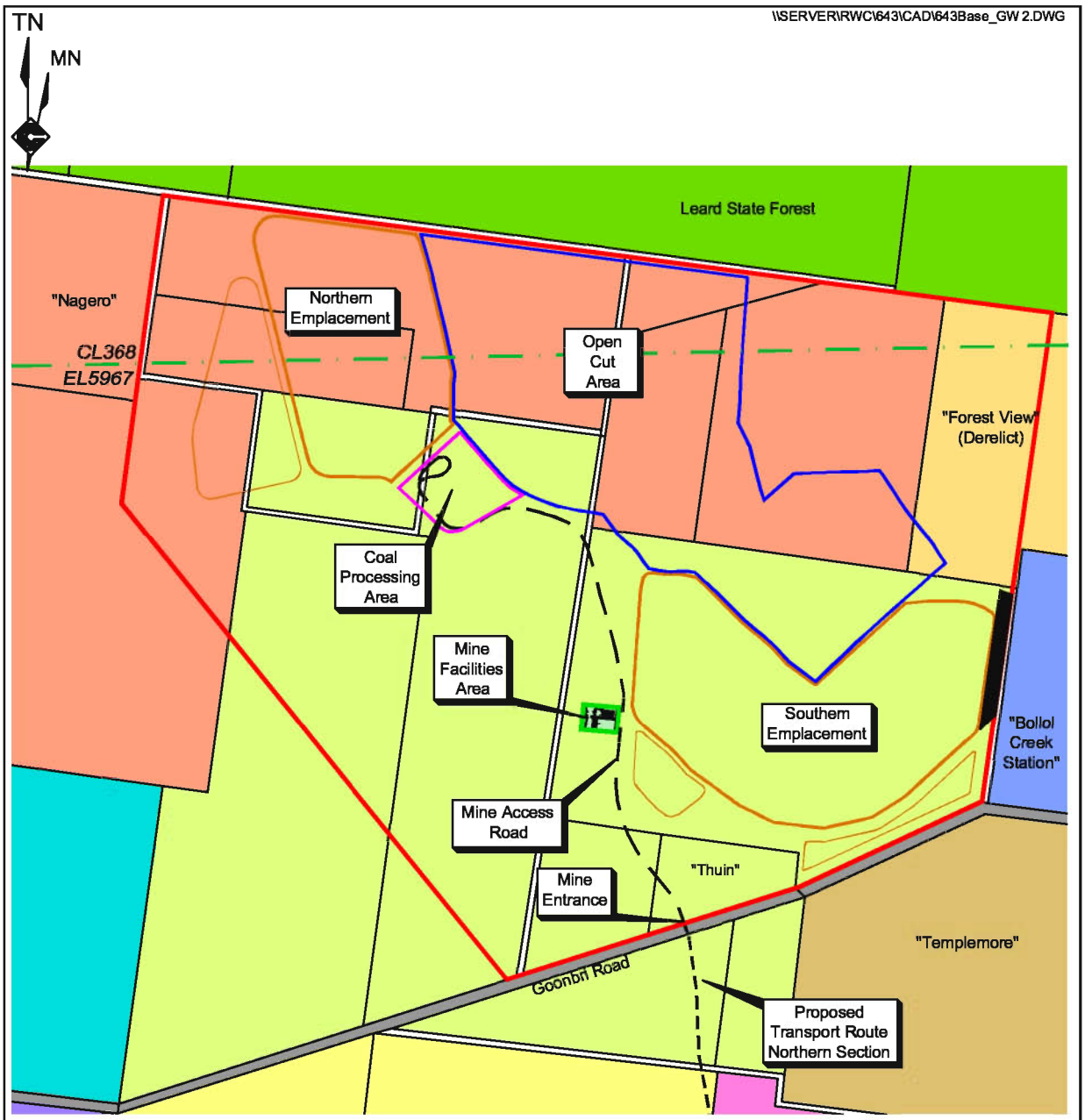
The open cut would be developed as four separate "Pits" (see **Figure 3**), with at least two of these operational at any one time to ensure the targeted stripping ratio of 7.2:1 is maintained. Mining would commence from a box cut area in the X Pit of the open cut area and then progress in an easterly and southerly direction. **Figure 4** shows the conceptual development of the mine.

Initial placement of overburden is proposed to the west of the X Pit (the northern emplacement), with subsequent placement of overburden within the mine void and to an emplacement to the south of the S Pit (the southern emplacement). Mining would be undertaken up to 24 hours per day, seven days per week while the coal transportation would be undertaken on a campaign basis up to 24 hours per day, six days per week.

The approved Boggabri Coal Project of Idemitsu Boggabri Coal Pty Ltd (IBC) is located about 0.5km north of the Project Site. The site of the Boggabri Coal Project, contained within CL 368, lies wholly within Leard State Forest. The site includes:

- open cut mine plan (approximately 1 200ha);
- coal preparation, storage and handling facilities (both initial and final);
- mine infrastructure; and
- tailings dam.

The Boggabri Coal Project is expected to start within six to twelve months of the commencement of proposed East Boggabri Coal Project.



REFERENCE
- Project Site Boundary
- EL 5967 / CL 368 Boundary
- Open Cut Area Boundary
- Out-of-Pit Emplacement Boundary
- Coal Processing Area Boundary
- Mine Facilities Area Boundary
- Soil Stockpile Area Boundary
- Mine Access Road
- Proposed Transport Route

SCALE 1:25 000

250 0 250 500 750 1000 1250 m

Base Map Source: Geo-Spectrum (Australia) Pty Ltd

Figure 2
PROJECT SITE COMPONENTS

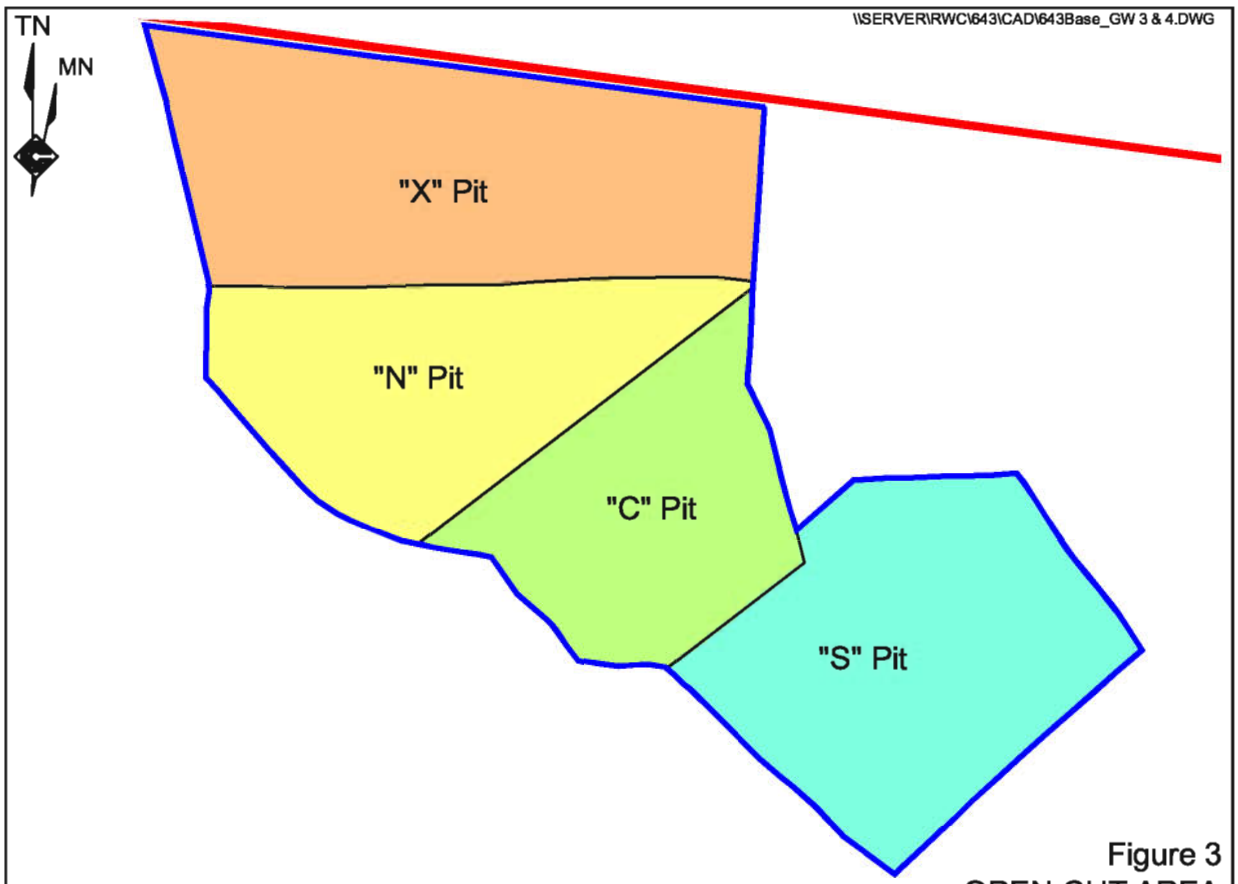


Figure 3
OPEN CUT AREA

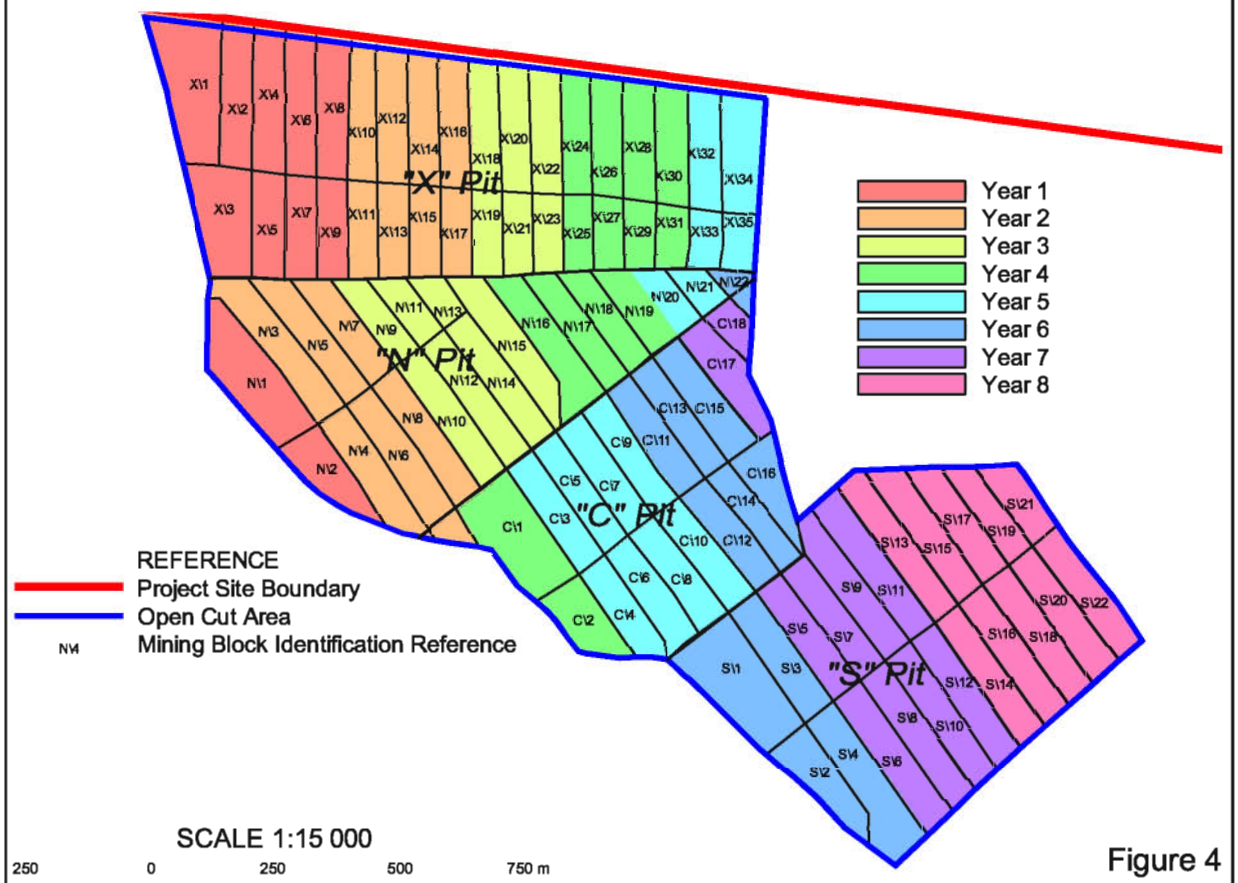


Figure 4
BLOCK MINE PLAN

4 REGIONAL GEOLOGY

A north-south trending ridge of Early Permian volcanic rocks, the Boggabri Ridge, divides the Gunnedah Basin into two sub-basins: the Maules Creek Sub-basin to the east, and the Mullaley Sub-basin to the west and south **(Figure 5)**.

On its western and southern margins, the Maules Creek Sub-basin onlaps the Boggabri Ridge while, to the east, the Sub-basin is bounded by the Hunter-Mooki Thrust. To the north the Sub-basin continues at depth below overlying basaltic rocks of Nandewar Range Volcanics.

The Maules Creek Sub-basin contains coal seams, sedimentary and volcanic rocks, mainly of Early Permian age, with other minor volcanic and igneous rocks of a younger age. Large portions of this sub-basin are covered by recent alluvial deposits, particularly in the centre and to the east.

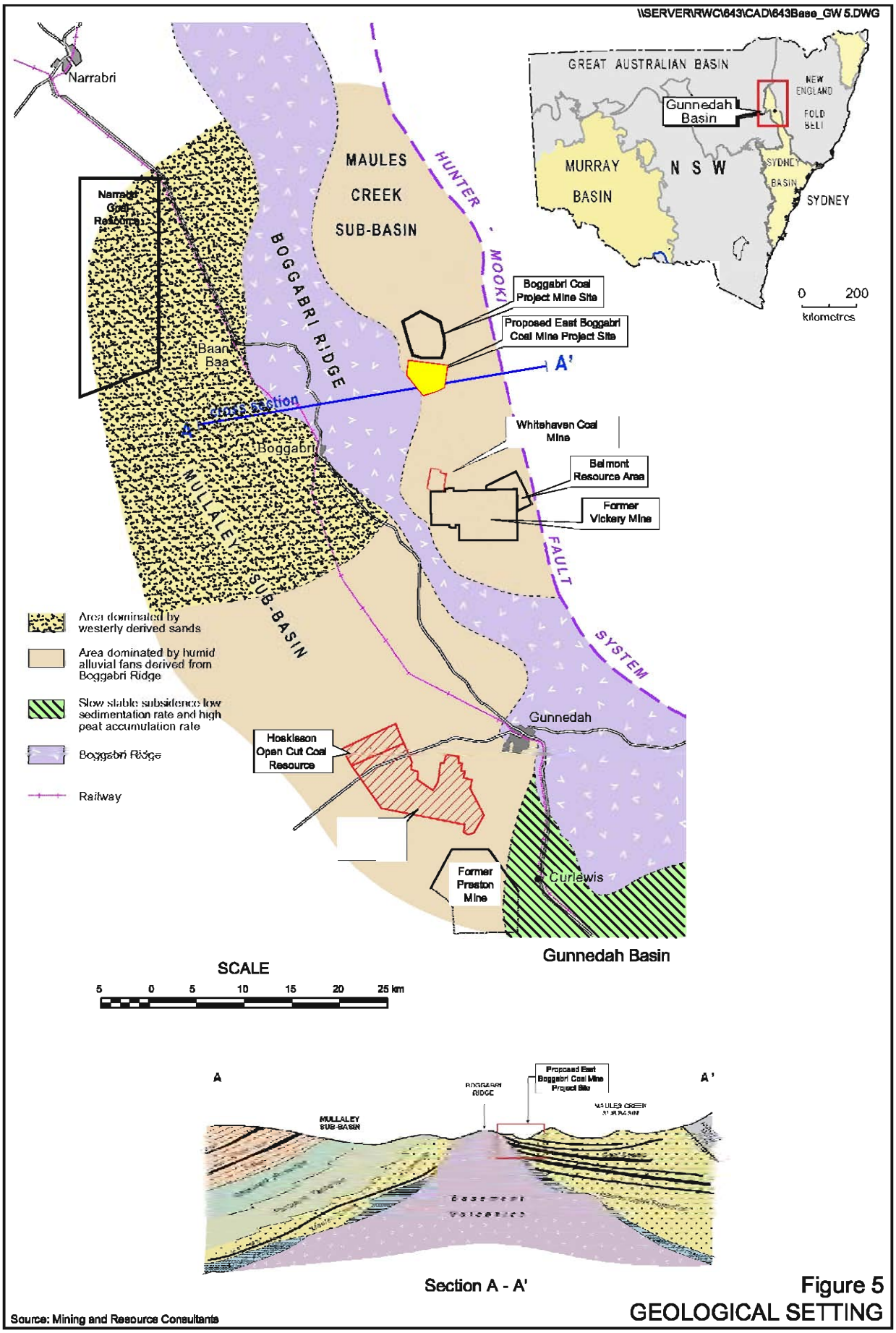
The Early Permian Maules Creek Formation thickens rapidly to the east and northeast from the western onlap on the Boggabri Ridge and is over 800m thick against the Mooki Thrust in the northeast (**Figure 5**). It unconformably overlies the basement rocks of the Boggabri Volcanics, or the variably developed Leard Formation and Goonbri Formation.

The Maules Creek Formation contains a multi-seam coal resource in a sedimentary section dominated by lithic conglomerate, lithic sandstone, siltstone and minor claystone. The formation is interpreted as being deposited primarily in a braided fluvial system. The coal seams are generally thicker and closer together along the eastern side of the basin. To the east and southeast the coals seams are split by an increasingly thick section of clastic rocks (Corkery, 2004).

Local Geology EL 5967 and CL 368

EL 5967 and CL 368 are located on the western side of the Maules Creek Sub-basin. Rocky outcrops of the Boggabri Volcanics occur in the westernmost part of the EL/CL. Coal seams and clastic rocks or the Maules Creek Formation subcrop on low hills in the northern part of EL 5967, and open cut resource area within CL 368. In the central and southern parts of the EL, the Early Permian geology is obscured by extensive deposits of unconsolidated recent alluvium that ranges up to 50ms in thickness.

The coal-bearing Maules Creek Formation onlaps the Boggabri Ridge in the west but quickly thickens to over 200m and is in excess of 400m thick along the eastern side of EL/CL. A cumulative thickness of more than 20m of coal is developed in a group of eleven correlated major coal seams that subcrop across the EL/CL.



Source: Mining and Resource Consultants

Figure 5
GEOLOGICAL SETTING

5 BACKGROUND DATA

5.1 INTRODUCTION

The background data reviewed in this assessment includes a groundwater report conducted for Amax/BHP on the adjacent proposed Boggabri Mine and a groundwater report on another proposed open cut coal mine known as Belmont (located about 15km to the south).

5.2 BOGGABRI COAL PROJECT (HERRING, 1979)

AMAX-BHP commissioned an evaluation of the hydrogeologic conditions beneath the Boggabri Coal Project Area addressing the following.

- Groundwater conditions on the site.
- The location of the existing wells on and near the site.
- The construction of a potentiometric map for the shallower aquifer.
- Possible mine pumpage.
- Groundwater quality.
- Impacts of mining upon groundwater conditions.
- Possible measures to mitigate impacts upon groundwater.
- Existing stream quality and quantity.
- Relationship between stream quality and soils, geology and other factors
- Impacts of mining upon surface water conditions.
- Possible measures to mitigate impacts upon surface water.

For this work, pumping tests were conducted during May and June 1978 in five bores (duration of pumping one to three hours) and identified the transmissivity and hydraulic conductivity of the strata. The results of the testing are presented in **Table 1**.

Table 1
Aquifer Parameter Estimated From AMAX – BHP Pumping Test

Well	Aquifer	Transmissivity T (gpd/ft)	Transmissivity T (m^2/day)	Saturated thickness of the tested layer (m)	Hydraulic conductivity K (m/sec)
1070A	Jeralong Seam	80	1	2.5	$4.5x10^{-6}$
1070B	Interburden Above Jeralong	26	0.325	18	$2x10^{-7}$
1067A	Merriown and above	54	0.675	8.2	$1x10^{-6}$
1067B	Merriown and above	172	2.15	8.2	$3x10^{-6}$
1070C	Merriown and above	420	5.25	38	$1.6x10^{-6}$

Based on above data the following permeabilities were calculated for two of the coal seams and two of the interburden strata. The results are presented on **Table 2**. This calculation is based on the assumption that total transmissivity (hydraulic conductivity times thickness of the layer) is a superposition of individual transmissivities. For example, from bores 1067A and 1067B Merriown and above, has average transmissivity of 1.4125 (m^2/day). If Merriown Seam has Transmissivity of 1 (m^2/day) same as the Jeralong, the interburden would have Transmissivity of 0.4125 (m^2/day) - this divided by the saturated interburden thickness of 6m gives hydraulic conductivity value in the range of 7×10^{-7} (m/sec).

Table 2
Calculated Hydraulic conductivity From Pumping Test Data.

Aquifer	Hydraulic conductivity (m/sec)
Interburden Above Jeralong	$2x10^{-7}$
Jeralong	$5x10^{-6}$
Interburden between Jeralong and Merriown	$7x\ 10^{-7}$
Merriown	$5x10^{-6}$

The results of these tests showed that in the area of the proposed open cut mine, the hydraulic conductivity of the coal seams (5×10^{-6}m/s) is an order of magnitude higher than the interburden strata.

A summary of onsite boreholes with water levels measured in coal measures is presented in **Table 3**.

Table 3
Depth to Water Measured During 1976 to 1979

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Hole No	Type of strata	Ground surface Elevation (m AHD)	Water Level Elevation (m AHD)	Depth to water table (m)
001	MN	302.3	264.7	37.6
032	MN	329.5	271.5	58
1066BR	MN	302.5	263.24	39.26
1066JR	BR	302.5	264.6	37.9
1066MN	JR	302.5	265.34	37.16
1067	MN	287.5	257.56	29.94
1067A	MN	287.9	257.68	30.22
1067B	MN	288.2	257.67	30.53
1069	MN	281.5	261	20.5
1070	MN	286.6	262.32	24.28
1070A	JR	287.2	260.54	26.66
1070B	JR	287.4	260.31	27.09
1070C	MN	287.3	260.51	26.79
1001	MN	359.6	285.6	74
1002	MN	361	284	77
1004	MN	314.5	267.45	47.05
1005	MN	333.3	276.96	56.34
1006	MN	377	317	60
1007	MN	320.1	282.79	37.31
1008	MN	308.52	265.15	43.37

Table 3 (Cont'd)
Depth to Water Measured During 1976 to 1979

Hole No	Type of strata	Ground surface Elevation (m AHD)	Water Level Elevation (m AHD)	Depth to water table (m)
1009	MN	298.79	271.74	27.05
1010	MN	359.37	274.6	84.77
1011	MN	297.3	265.36	31.94
1012	MN	282.56	261.24	21.32
1013	MN	310.26	270.09	40.17
1014	MN	327.2	274.4	52.8
1016	Below MN	271.1	260.1	11
1017	MN	295.67	268.24	27.43
1018	MN	366.3	270.57	95.73
1020	Below MN	286	266	20
1021	MN	358.4	269.4	89
1022	Below MN	318.4	274.4	44
1023	Below MN	288.8	268.8	20
1024	MN	291.5	263	28.5
1025	Below MN	280.3	260.9	19.4
1026	Below MN	266	247	19
1027	Below MN	270	253	17
1028	Below MN	277.9	264.9	13
1029	Below MN	259	248.5	10.5
1030	Below MN	263	254	9
1034	MN	288.2	261.99	26.21
1055	MN	297.66	262.44	35.22
1059	Below MN	285.1	261.33	23.77
1063	MN	321.95	265.17	56.78
1064	MN	282.2	259.34	22.86
1144	MN	286	260.58	25.42
Notes: MN-Merriown Seam, JR-Jeralong Seam, BR-Braymont Seam				
Source: Based on Table 11 of (Herring, 1979)				

Based on these data, the average level of the regional groundwater table is about 35m below the surface reaching up to 96m in the surrounding hills. Groundwater flows toward south-west direction at a gradient of about 0.0067 (see **Figure 6**). Water level in the alluvium to the south is about 10m below the surface.

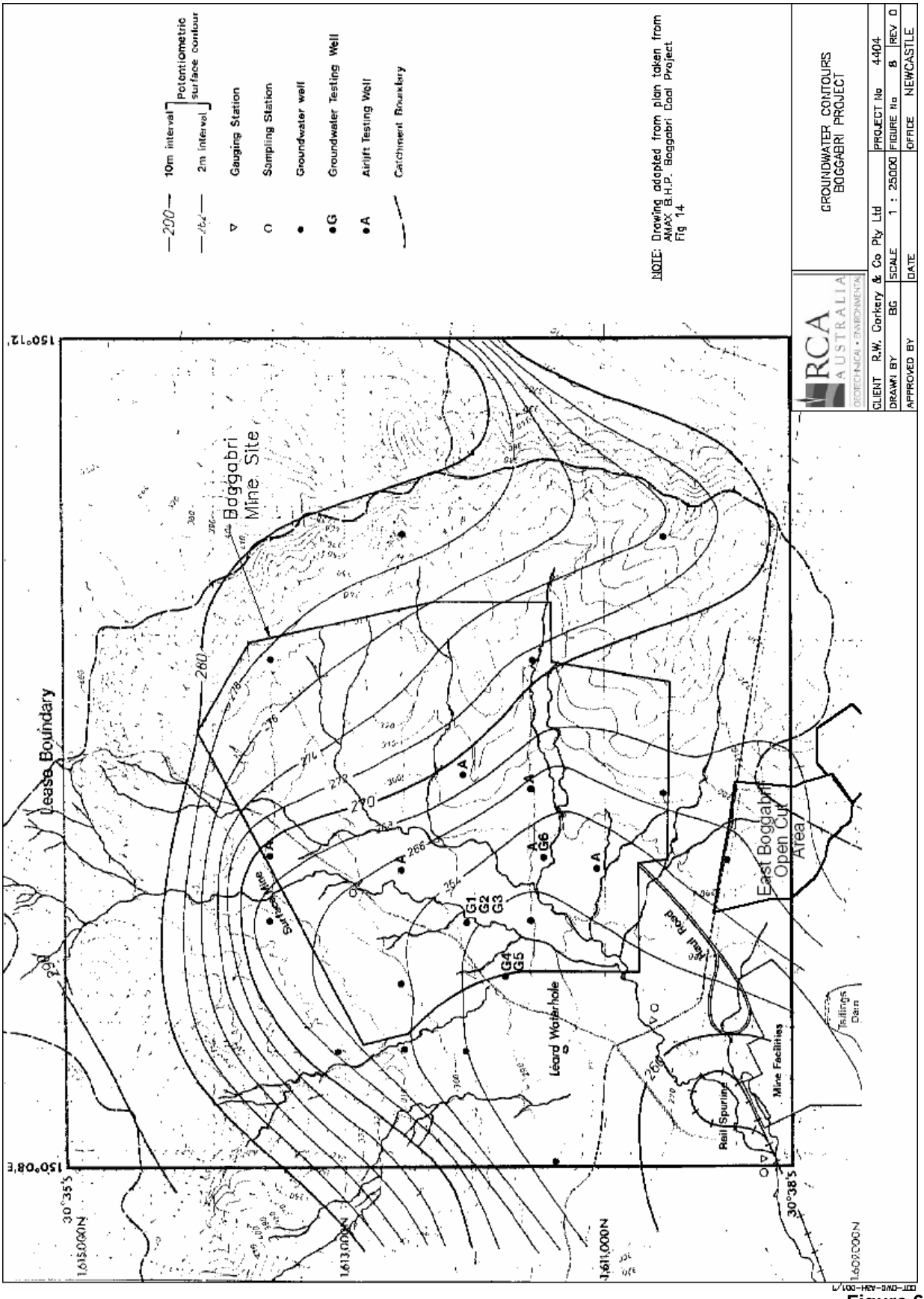

Figure 6
Groundwater Contours at Proposed Boggabri Mine

Numerous water samples were taken for the Boggabri Coal Project and the results are summarised in **Table 4**.

The above indicates that the groundwater at the site has the following characteristics.

- pH ranges from 6.9 to 8.1 and can be described as neutral to slightly alkaline.
- The Electrical Conductivity varies from 680μS/cm to 1500μS/cm. The groundwater can therefore be classified as fresh (ie, lower than 1500μS/cm).
- Cadmium, Chromium, Nickel and Silver were undetected. Manganese concentrations ranged from 0.05mg/L to 0.1mg/L, Lead concentrations ranged from undetected to 0.09mg/L, Copper concentrations ranged from undetected to 0.03mg/L, Zinc concentrations ranged from undetected to 0.13mg/L. Given that detection limit was 0.01mg/L, there is no significant change in heavy metal concentrations in the bores tested.
- The cation concentrations ranged from 10 mg/L to 13mg/L for Potassium, 7mg/L to 18mg/L for Magnesium, 10 to 55 for Calcium and 145mg/L to 280mg/L for Sodium. With Sodium being the dominant cation.
- Anion concentrations ranged from 60mg/L to 200mg/L for Chloride, 14 to 40 for Sulfates and 200 to 520 for Bicarbonate. Bicarbonate and Chloride are the dominant anions.
- The groundwater is generally of a sodium-bicarbonate/chloride type.
- There is no significant difference in water quality of coal seams and interburden, with slightly higher TDS, Copper, Lead and Zinc concentrations observed in the coal seams compared to the interburden.
- The water is moderately hard (60mg/L to 120mg/L of $CaCO_3$) to very hard (>180mg/L of $CaCO_3$).
- Lead concentration is recorded higher than the current drinking water guidelines of 0.01mg/L.

Table 4
Water Quality Data

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Parameter	**Well 1070A (Jeralong Seam)**					**Well 1070B (Interburden above Jeralong Seam)**			**Well1067B (Merriown Seam and overlying interburden)**	
	2 June 1978	3 June 1978	17 Nov 1978	19 Dec 1978	29 Mar 1979	7 June 1978	17 Nov 1978	29 Mar 1979	19 Dec 1978	29 Mar 1979
pH (units)	8.0	7.9	7.2	7.5	7.2	7.6	7.5	7.2	8.1	6.9
Turbidity (NTU)			15	18	30		9	3	5.7	5
Non-filterable Residue		44	10	6	2	3680	12	<1	4	<1
Conductivity (μS/cm)	1250	1250	1200	1300	1500	1060	1300	1300	680	800
TDS	799	778		819		673			449	
Bicarbonate	428	431	520	435	455		500	260	305	206

Table 4 (cont'd)
Water Quality Data

Parameter	Well 1070A (Jeralong Seam)					Well 1070B (Interburden above Jeralong Seam)			Well1067B (Merriown Seam and overlying interburden)	
	2 June 1978	3 June 1978	17 Nov 1978	19 Dec 1978	29 Mar 1979	7 June 1978	17 Nov 1978	29 Mar 1979	19 Dec 1978	29 Mar 1979
Chloride		175	150	200	190	115	180	190	60	80
Sulfate		39.5	28	33	27	17.8	33	34	14	18
Fluoride		0.4		0.4		0.6			0.3	
Sodium	252	256	268	284	260	282	268	260	158	145
Potassium	10.9	10.4		10		12.7			13	
Calcium	25.5	25.5	30	27	27	55	27	27	11	19
Magnesium	12.8	12.8	13	15	15	18.1	14	15	7	11
Iron	0.45	0.31	1.0	4.6	6.9	1.15	0.5	0.52	0.4	1.0
Manganese	0.05	0.07		0.06		0.05			0.1	
Cadmium	<0.01	<0.01		<0.01		<0.01			<0.01	
Chromium	<0.01	<0.01		<0.01		<0.01			<0.01	
Copper	0.01	0.01		0.03		<0.01			0.02	
Lead		0.01		0.09		<0.01			0.09	
Nickel	<0.01	<0.01		<0.01		<0.01			<0.01	
Silver	<0.01	<0.01		<0.01		<0.01			<0.01	
Zinc	0.06	<0.01		0.13		0.03			0.08	
SAR (ratio)	10.17	10.33	10.29	10.87	9.96	8.43	10.32	9.96	9.17	6.55
Calcium Hardness as $CaCO_3$			80	70	66		68	66	28	46
Total Hardness		119	130	126	128	214	124	128	60	92
Selenium	<0.002	<0.002		<0.002		<0.002			<0.002	

All units are in mg/L unless specified. Blank = not analysed

Source of Data: AMAX/BHP
Determinations were made using sample treatment and methods of analysis in compliance with NSW Clean Waters Act 1970, Regulations.

5.3 RCA BELMONT REPORT

RCA undertook a groundwater assessment of the proposed Belmont Coal Mine near Boggabri (RCA Australia, 2004), about 15km south of current project in a similar geological environment of Maules Creek Sub-Basin of Gunnedah-Basin and the findings are summarised below.

The groundwater at the site occurs at a depth of around 35m from the surface. The piezometric levels in both the coal seams and interburden are similar with the seams having slightly higher levels.

Insitu testing as well as information gathered from literature for this site on hydraulic conductivity and storage values are summarised in **Table 5**.

Table 5
Aquifer Parameters from Belmont Site

Layer	Hydraulic conductivity (m/s)	Total Porosity	Eff. Porosity	Storativity	Head (RL m, AHD)
Upper Interburden	1E-08	0.05	0.01	0.001	252.85
Upper Glenroc Seam	7E-07	0.10	0.05	0.01	253.03
Interburden	1E-08	0.05	0.01	0.001	252.85
Lower Glenroc Seam	7E-07	0.10	0.05	0.01	253.03
Interburden	1E-08	0.05	0.01	0.001	252.85
Belmont Seam	9E-07	0.10	0.05	0.01	255.31
Floor	4E-06	0.05	0.01	0.001	252.85
Sandstone beneath Floor	1E-08	0.05	0.01	0.001	252.85

The results of the water quality data from the Belmont site are presented in the **Tables 6** and **7**.

Table 6
Belmont Site Groundwater Quality, Heavy Metals

Bore	Sampling Location	Aluminium	Arsenic	Iron	Manganese
GW016874	BG-1	0.27	*0.001*	0.80	1.400
GW022319	BG-2	*0.01*	0.005	0.08	0.007
GW016877	BG-3	*0.01*	0.002	0.92	0.010
EVK88	BG-4	0.62	0.012	0.44	0.086
EVK85	BG-5	1.40	0.009	0.44	0.320
EVK94C	BG-6	5.50	0.002	8.00	0.190
EVK89	BG-7	2.10	*0.001*	1.30	0.190
GW044068	BG-8	*0.01*	0.005	0.03	*0.0015*
GW044069	BG-9	*0.01*	0.012	5.30	0.046

All units in mg/L unless otherwise noted
Italics – Undetected concentration reported as half the practical quantification limit

.

Table 7
Belmont Site, Groundwater Quality Characteristics

Bore	Sampling location	pH Field	EC mS/cm	Cl	Alkalinity	Sulfate	Nitrate	Na Total	Mg total	K total
GW016874	BG-1	6.3	2120	156	950	1	0.10	400	28.0	7.0
GW022319	BG-2	7.2	2960	610	560	20	4.70	400	66.0	3.9
GW016871	BG-3	6.9	2120	354	560	29	0.50	320	44.0	3.4
EVK88	BG-4	7.1	3160	425	1100	4	*0.05*	720	26.0	6.2
EVK89	BG-5	7.0	3280	567	900	80	0.10	640	44.0	6.6
EVK94C	BG-6	6.9	815	64	310	20	0.50	180	10.6	11.8
EVK89	BG-7	7.0	2080	255	730	*0.5*	0.20	420	15.0	5.4
GW044068	BG-8	6.6	3500	865	440	42	1.20	460	35.0	3.4
GW044069	BG-9	6.4	7000	2198	410	60	3.60	630	247	10.7

All units in mg/L unless otherwise noted, Italics – Undetected concentration reported as half the PQL

The above indicates that the groundwater at the Belmont site has the following characteristics.

- pH ranges from 6.3 to 7.2 in the field and can be described as neutral to slightly acidic.
- The Electrical Conductivity varies from 815 to 7 000µS/cm. However, these two values appear to be at the extreme ends of the range, with an average value of approximately 3 000µS/cm. The groundwater can therefore be classified as brackish (ie, greater than 1 500µS/cm, (Fetter, 1994).
- The concentration of heavy metals varied markedly between groundwater bores.
- Aluminium concentrations range from non-detected to 5.5mg/L, Arsenic concentrations range from non-detected to 0.12mg/L, Iron concentrations range from 0.44mg/L to 8 mg/L and Manganese concentrations range from 0.01mg/L to 1.4mg/L.
- The cation concentrations ranged from 3.4mg/L to 8.0mg/L for Potassium, 26mg/L to 66mg/L for Magnesium, and 180mg/L to 720mg/L for Sodium, with Sodium being the dominant cation.
- Anion concentrations ranged from 64mg/L to 2 198mg/L for Chloride, 0.5 to 80 for Sulfates and Alkalinity in the range of 310mg/L to 1 100mg/L. Chloride and Bicarbonate are the dominant anions.
- The groundwater is generally of a sodium-bicarbonate/chloride type.

6 EAST BOGGABRI FIELDWORK

6.1 INTRODUCTION

Fieldwork was undertaken on 26 to 28 October 2004 and on 1 to 3 February 2005 by an experienced hydrogeologist and an Environmental Scientist from RCA Australia. The aim of the fieldwork was to further define the aquifer characteristics in the proposed open cut area.

6.2 PIEZOMETER INSTALLATION AND TESTING

Based on a review of the borelogs for the exploration holes drilled within the Project Site, six bores were chosen for piezometer installation. These were chosen to enable assessment of the properties of the interburden strata and coal seams. Unfortunately, bore IEB-3 was collapsed and bore IEB-4 was overfilled and these bores were unable to tested/gauged.

Fieldwork consisted of performing hydraulic conductivity tests (rising head tests) on four piezometers onsite. Piezometers, comprising 50mm diameter SWV PVC pipe, were installed to the target depth with a screen. The annulus between the wall of the bore and casing was backfilled using 2mm to 3mm diameter aggregate. The screened interval was sealed from the surface using bentonite and the remaining annulus was backfilled with aggregate to the surface.

Rising head tests were undertaken to assess the hydraulic conductivity of the screened section of the piezometers. Results were analysed using the Hvorslev method (Fetter, 1994); and the results are presented on **Table 8**. Calculations are provided in **Appendix A**.

Table 8
Results of Permeability Testing

Bore ID	Aquifer	Hydraulic conductivity (m/sec)
IEB-1	Nagero Seam	$6x10^{-6}$
IEB-2	Interburden between Nagero and Velyama Seams	$7x10^{-7}$
IEB-5	Merriown Seam	$6x10^{-6}$
IEB-6	Interburden between Merriown and Nagero Seams	$1x10^{-8}$
EBI-40	Volcanic Basement	$3x10^{-7}$

The above results are similar to that recorded during the pumping test at the Boggabri Coal Project (**Tables 2, 3** and **4**) and the previous work in similar strata at the nearby proposed Belmont mine (**Tables 5, 6** and **7).**

6.3 WATER LEVEL GAUGING

Water levels were recorded during the field work in the installed piezometers within the Project Site. Static water levels were measured on 26 to 28 October 2004, and are presented in **Table 9**.

The average water depth is 38m which is similar to that recorded in the previous work at the site. Groundwater flows to the south-west at a gradient of about 0.005.

Table 9
Water level measured and screen intervals of different layers

Bore	Collar Height (m AHD)	Water Depth (m)	Stick up (m)	Screening	Groundwater Level (m AHD)	Comment
IEB-1	295	26.2	0.45	33.5-36m	268.4	Nagero Seam 34.6-36m
IEB-2	305	36.0	0.40	46-49m	268.6	Interburden between Nagero and Velyama Seams
IEB-5	320	51.3	0.10	53.6-56.5m	268.6	Merriown Seam 52.5-56.5m
IEB-6	330	59.3	0.18	65.8-78.5m	270.7	Interburden between Merriown and Nagero Seams
EBI-40	NK	17.9	0.35		NK	Volcanic Basement
NK – not known						

6.4 GROUNDWATER QUALITY

Groundwater samples were taken at four open holes and piezometers on the proposed Project Site and water quality was tested onsite using a Horiba water quality meter. The results of field testing are presented in the **Table 10**.

Table 10
Field Water Quality Results

Bore ID	Aquifer	Conductivity mS/cm	Turbidity NTU	Salinity %	pH
IEB-6	Interburden	1.74	546	0.08	7.25
IEB-5	Coal Seam	2.72	77	0.13	7.40
IEB-2	Coal Seam	2.96	177	0.14	7.46
EBI-40	Volcanics	0.90	172	0.03	7.59

Groundwater was sampled at the five locations on 27 and 28 October 2004 by RCA Australia. The locations of these sites are shown on **Figure 7**. Analysis was undertaken by Labmark which is NATA registered for the tests performed. Samples were transported under chain of custody documentation and the laboratory report sheets are attached in **Appendix B**.

The results of the groundwater analyses are presented in **Table 11**. To assess the impact of any water leaving the site the results have been compared to ANZECC drinking water, irrigation use and stock watering standards, these are shown on **Table 12**.

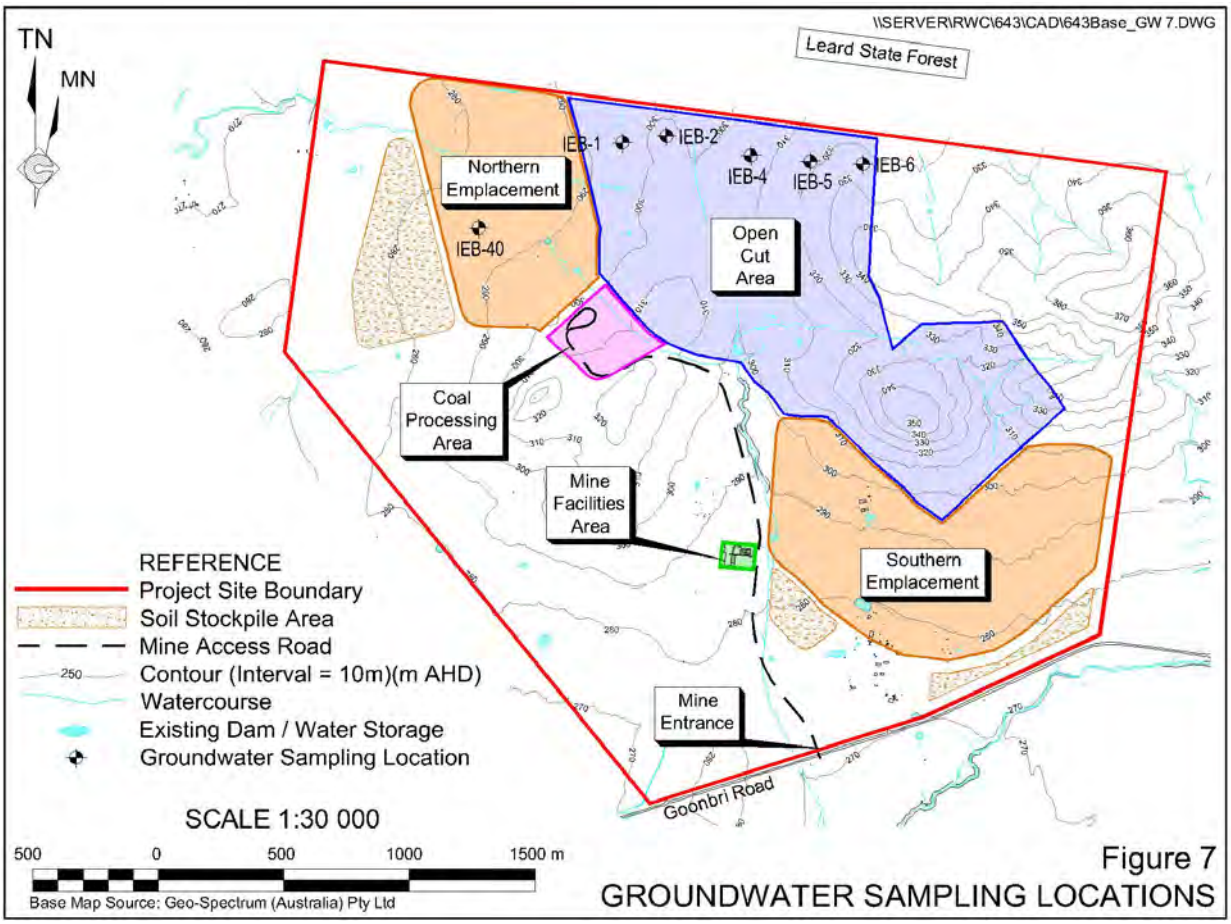


Figure 7
GROUNDWATER SAMPLING LOCATIONS

Table 11
Summary of Laboratory Water Quality Results

Analytes	IEB-1	IEB-2	IEB-5	IEB-6	EBI-40
Aquifer	**Coal Seam**	**Interburden**	**Coal Seam**	**Interburden**	**Boggabri Volcanics**
Arsenic	0.002	0.001	<0.001	0.002	0.006
Cadmium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	0.001	0.001	0.001	0.001	<0.001
Copper	0.006	0.006	0.006	0.006	0.005
Nickel	0.005	0.004	0.003	0.009	0.005
Lead	**0.028**	**0.071**	**0.057**	**0.042**	0.002
Zinc	0.023	0.074	0.076	0.062	0.031
Mercury	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
pH (pH units)	7.5	7.4	7.1	7.1	7.8
Electric conductivity (uS/cm)	**2930**	**3700**	**2660**	**1679**	1101
Alkalinity (as CaCO3)	810	780	610	480	430
Bicarbonate (converted from alkalinity)	987	951	744	585	524
Chloride	420	630	690	220	90
Fluoride	0.3	0.2	0.2	0.1	0.5
Sulfate	100	250	200	63	3
Calcium	56	95	103	64	21
Magnesium	38	59	59	32	8.3
Sodium	486	553	349	220	193
Potassium	17	29	21	13	9
Suspended Solids (TSS)	82	140	250	430	45
SAR	12.2	10.9	6.7	5.5	9

All units in mg/L unless otherwise noted.
***BOLD -** Exceeds Drinking Water Health Guidelines,*
Grey - Exceeds Drinking Water Aesthetic Guidelines
<u>Underlined</u> - Exceeds Agriculture Irrigation Guidelines,
Italics - Exceeds Agriculture Livestock Guidelines

Table 12
Water Quality Criteria for Drinking Water, Irrigation and Livestock Use

Parameter	Drinking Water	Irrigation	Livestock
	Health (Aesthetic)		
Electric conductivity (µS/cm)	1500[#]	Δ	▲
Calcium	*	*	1000
Chloride	(250)	700	*
Arsenic	0.007	0.1	0.5
Cadmium	0.002	0.01	0.01
Chromium	*	1.0	*
Copper	2.0 (1.0)	0.2	0.5
Nickel	0.02	0.02	1.0
Lead	0.01	0.2	0.1
Zinc	(3.0)	2.0	20.0
Mercury	0.001	0.002	0.002

* *= no criteria, criteria are in mg/L, unless otherwise stated.*
[#] *=EC of 1500* µS/cm *is equivalent to 1000 mg/L of TDS,which is the drinking water guideline (EC (*µS/cm*)×0.67=TDS (mg/L)).*
Δ = depends on crop type, soil type and SAR value, for moderately tolerant crops with loamy soil EC can be 4000 µS/cm.
▲= depends on livestock type but most sensitive poultry can tolerate 2000mg/L of TDS which is equivalent to 3000µS/cm.
(ANZECC, 2000)

The above results indicate that the Coal Seams, Interburden and Volcanics contain similar concentrations of all the analytes with slightly lower salinity recorded in Volcanics.

The above indicates that the groundwater at the site has the following characteristics.

- pH ranges from 7.1 to 7.8 in the field and can be described as neutral to slightly alkaline.
- The Electrical Conductivity varies from 1 100µS/cm to 3 700µS/cm. However, these two values appear to be at the extreme ends of the range, with an average value of approximately 2 400µS/cm. The groundwater can therefore be classified as brackish (ie, greater than 1 500µS/cm, (Fetter, 1994)).
- The concentration of heavy metals was similar in groundwater bores with the exception of lead which was higher up to 0.071mg/L in coal seams compared to 0.002mg/L in volcanics.
- The cation concentrations ranged from 9mg/L to 29mg/L for Potassium, 8.3mg/L to 59mg/L for Magnesium, 21mg/L to 103mg/L for Calcium, 190 to 550 for Sodium, with Sodium being the dominant cation.
- Anion concentrations ranged from 90mg/L to 690mg/L for Chloride, 3mg/L to 250mg/L for Sulfates and Bicarbonate in the range of 520mg/L to 990mg/L. Bicarbonate and Chloride are the dominant anions.
- The groundwater is generally of a Sodium to Bicarbonate/Chloride type.

A summary of the chemical types of groundwater for each sample is presented in **Table 13**. When defining chemical types of groundwater it is common practice to list the most commonly occurring cations and anions in order of decreasing abundance. The chemical type generally reflects the chemistry of the rocks or sediments through which the water percolates.

Table 13
Summary of Groundwater Chemical Types

Sample Number	Water Type	Aquifer
IBE-1	Na-HCO_3-Cl	Nagero Seam
IBE-2	Na -Cl-HCO_3	Interburden between Nagero and Velyama Seams
IBE-5	Na -Cl-HCO_3	Merriown Seam
IBE-6	Na-Ca-Mg-HCO_3-Cl	Interburden between Merriown and Nagero Seams)
EBI-40	Na-HCO_3-Cl	Volcanic Basement

Table 13 shows that the groundwater type in each aquifer is similar. Groundwater quality of alluvial aquifer was not tested but would be expected to be of low salinity and of sodium-chloride type.

The groundwater quality measured at the current location is similar to that presented in AMAX/BHP report on the proposed adjacent Boggabri Mine, although the salinity is slightly higher at the Project Site compared to the Boggabri mine site.

7 HYDROGEOLOGICAL CONDITIONS

7.1 FLOW MECHANISMS

Coal Seams

Permian aged coal measures strata generally have low hydraulic conductivity and porosity due to their compacted nature. Groundwater in these strata occurs in fractures, joints, cleats and bedding. The fractures are usually a result of faulting or tensional folding and stress release where the overlying rock has been removed by erosion.

As groundwater in these strata occurs mainly in the fractures, flow rates and storages are small. The rate at which groundwater would flow into the mining void is governed by the hydraulic conductivity of the strata, the hydraulic gradient and the areas of entry. This in turn is related to the degree of fracturing or jointing of the rock strata.

The main water-bearing zones or aquifers occur in the coal seams with minor water-bearing zones in the interburden rocks. The groundwater is partially confined and under pressure in the coal seams with the interburden rocks acting as semi-confining layers or aquitards.

Interburden between coal seams

Interburdens between coal seams have even lower storage and hydraulic conductivities (generally by an order magnitude) values compared to the coal seams. These Interburden layers act as aquitards and can also provide water to the coal seams by vertical leakage when there is a pressure drop in the coal seam such as would occur as a consequence of coal extraction in adjacent areas. Groundwater flow in these strata is governed by the presence of fractures and joints as in the case of coal seams.

Boggabri Volcanics

Flow in the basement volcanics would occur along fractures in the bedrock rather than the interstitial pores. Groundwater flow in these strata is usually at a slower rate than would occur in the coal measures, particularly the coal seams.

Alluvial Sand and Gravels

High hydraulic conductivity alluvial sand and gravels occur about 1.0km to the east and south of the open cut mine within and adjacent to Bollol Creek as well as to the north-west by Nagero Creek. Flow in these sediments is through the pore space between the grains which can be up to 35% of the total sediment volume. The groundwater pumped principally from wells in these materials is used mainly for domestic and stock watering purposes. Only one bore, GW017148, is used for irrigation.

7.2 GROUNDWATER FLOW DIRECTIONS AND RATES

Beneath the proposed open cut area, groundwater generally occurs at a depth of about 38m below the surface and flows to the south-west which is governed by the topography. The only source of recharge to the basin would be from rainfall falling directly on to the footprint of the coal measures strata. Based on the average hydraulic conductivity and groundwater gradient, flow rate (specific discharge) would be expected to be about 0.5m to1m/year in coal seams and 0.05m to 0.1m/year in the interburden strata. The groundwater flow direction determined for the Project Site is comparable to that recorded at both the proposed Belmont Mine and the proposed adjacent Boggabri Mine site.

Depth to water in alluvium ranges from 5m to 10m and the expected flow direction, based on topography, is towards the south-west.

7.3 GROUNDWATER USE

A total of 35 DIPNR registered water bores were identified within a radius of 5km of the proposed Project Site (on 08-10-2004)**.**

Table 14 and **Table 15** summarise the information obtained relating to these bores from the search of the DIPNR database.

Table 14
Summary of Bore Location and Use Details

Registration No. @	Property	Aquifer	Usage	Approx. distance from the proposed mining (m)
GW000507	"Merriown"	Volcanic	NR	1800
GW000526	"Nagero"	Interburden		1200
GW000963	NR	NR	NR	3100
GW002129	"Thuin"	Coal	NR	200
GW002501	"Thuin"	Interburden	NR	500
GW002506	NR	Interburden	Stock	3700
GW002550	"Northam"	Interburden	NR	3400
GW002569	"Northam"	Interburden	Stock	3500
GW003115	"Merriown"	NR	NR	3000
GW006013	"Bollol Creek Station"	Coal	Stock	2700
GW006790	"Jeralong"	NR	Domestic/Stock	4500
GW006813	"Jeralong"	NR	Domestic/Stock	4500
GW009931	"Tarrawonga"	Gravel	Stock	3000
GW009932	"Northam"	Interburden	Stock	4000
GW011116	"Northam"	NR	Stock	4000
GW016878	"Thuin"	Interburden	Domestic/Stock	1100
GW017148	"Bollol Creek Station"	Alluvial/Gravel	Irrigation	2100
GW020432	"Merriown"	Volcanics	NR	3500
GW020434	"Merriown"	Volcanics	NR	4300
GW020437	"Nagero"	NR	NR	1600
GW026419	"Merriown"	NR	Domestic/Stock	3700
GW028563	"Tarrawonga"	Interburden	Domestic/Stock	3500
GW030472	NR	Alluvial/Gravel	G/W Exploration	3500
GW031856	"Kyalla"	Alluvial	Stock	3500
GW032236	"Northam"	Alluvial	Stock	4500
GW032831	"Templemore"	NR	Stock	2000
GW032832	"Templemore"	NR	Stock	2700
GW032929	"Templemore"	NR	Domestic/Stock	2700
GW038841	"Matong"	NR	Domestic/Stock	4500
GW044997	"Templemore"	Alluvial	Domestic/Stock	2000
GW048934	NR	Interburden	Domestic/Stock	4500
GW052266	"Tarrawonga"	Alluvial	Domestic/Stock	2800
GW059961	"Tarrawonga"	Coal	Domestic/Stock	3100
GW071484	"Matong"	NR	Domestic/Stock	4500
GW071532	"Matong"	NR	Domestic/Stock	4500
GW965624	"Matong"	Alluvial	Domestic/Stock	4500
NR = not recorded				

Table 15
Summary of and Aquifer Details.

Registration No. @	Aquifer	Total Depth (m)	Standing Water Level (m, below surface)	Saturated Thickness (m)	Yield (L/s)
GW000507	Interburden	60.7	23.6	37.1	0.82
GW000526	Volcanic	105.2	NK	NK	NK
GW000963	NK	NK	NK	NK	NK
GW002129	Coal	297.1	51.8	245.3	NK
GW002501	Interburden	77.1	51.8	25.3	0.63
GW002506	Interburden	33.5	10.1	23.4	0.59
GW002550	Interburden	91.4	NK	NK	NK
GW002569	Interburden	148.4	42.7	104	0.05
GW003115	NK	82.9	29	53.9	0.63
GW006013	Coal	103.6	79.2	24.4	0.32
GW006790	NK	78.6	NK	NK	0.11
GW006813	NK	61	NK	NK	0.42
GW009931	Gravel	44.8	9.1	35.7	0.76
GW009932	Interburden	73.2	22.9	50.3	0.88
GW011116	NK	77.1	45.7	31.4	0.51
GW016878	Interburden	50.3	9.1	41.2	0.91
GW017148	Alluvial/Gravel	21.3	9.4	12.3	1.26
GW020432	NK	NK	NK	NK	NK
GW020434	NK	NK	NK	NK	NK
GW020437	Volcanic	NK	NK	NK	NK
GW026419	NK	60	22.6	43.4	0.76
GW028563	Interburden	74.8	25.9	48.9	0.44
GW030472	Alluvial/Gravel	103	NK	NK	2
GW031856	Alluvial	50.3	NK	NK	NK
GW032236	NK	14	NK	NK	NK
GW032831	NK	3.4	NK	NK	NK
GW032832	NK	29.3	NK	NK	NK
GW032929	NK	44.5	NK	NK	NK
GW038841	NK	15.2	NK	NK	NK
GW044997	Alluvial	45.7	4.6	41.1	NK
GW048934	Interburden	95.1	NK	NK	1.5
GW052266	Alluvial	91.4	9	82.4	NK
GW059961	Coal	59.2	6.2	53	1.5
GW071484	NK	6	NK	NK	NK
GW071532	NK	7	NK	NK	NK
GW965624	Alluvial	47	5.7	NK	0.5
GW965624	Alluvial	NK	NK	NK	NK

NK = not known

The coal seams and interburden aquifers (shale, sandstone, and conglomerate) are low to moderate yielding ranging from 0.60 and 1.5 litres per second with the highest yields in the coal seams. Standing water levels are typically 10m to 80m from the surface with 20m to 60m of saturated thickness. Water is mainly used for stock watering and domestic purpose in this aquifer.

The alluvial aquifer in the Bollol Creek valley is high yielding with a shallow water table (up to 2.0 litres per second). Most of the wells/bores are only shallow with a limited saturated thickness.

7.4 SUMMARY OF GROUNDWATER CONDITIONS

Groundwater occurs in four main strata in the vicinity of the Project Site. The coal measures strata in the open cut area contain low to moderate hydraulic conductivity coal seams and lower hydraulic conductivity interburden strata. The depth to groundwater is about 38m (RL270m) and as mining would occur to RL 220m, the water table would be intersected.

Groundwater currently flows in a NE to SW direction which is governed by the regional topography at a flow rate of about 0.5m to 1 m/year. The basement underlying the coal measures comprises volcanics of lower hydraulic conductivity.

The alluvial aquifer contains strata of higher hydraulic conductivity and is recharged through direct infiltration. This aquifer occurs only locally along the creeks. The main alluvium occurs about 1.0km from the open cut area and is used mainly for stock watering.

8 GROUNDWATER MODELLING

8.1 INTRODUCTION

Groundwater modelling was conducted so that the impact of the proposed mining can be quantified. Mining is proposed to a depth approximately 50m below the regional groundwater table which would have a drawdown effect on the water table. The modelling was used to define the magnitude of the drawdown and to assess how this impacts on the neighbouring groundwater systems. The model was also used to predict the amount of groundwater inflow to the open cut area and the time it would take to resaturate the backfilled mining void.

8.2 MODEL SETUP

Visual Modflow (a commercially available finite difference programme) was used for the modelling. The model was set up as a number of layers reflecting the coal seams, interburden strata, the underlying volcanic basement and the alluvial strata (see **Figure 8**). The layers were set up based on the cross sections provided by the Proponent as part of a project description and preliminary mine plan.

A conservative assumption of coal measures intersecting the alluvium was made, to simulate the worst case scenario of impact on alluvial aquifer. Data from the field testing was used to assign the heads and hydraulic conductivity values for each layer. **Table 16** shows the adopted values, which were based on the field measurements undertaken during this work and previous experience in similar strata. The modelling grid used varied from 25m in the open cut area to 100m at the extremities of the model.

Table 16
General Model Parameters

Layer	Hydraulic Conductivity (m/s)	Specific Yield	Specific Storage (1/m)
Coal Seams	5×10^{-6}	0.05	1×10^{-5}
Interburden	7×10^{-7}	0.02	1×10^{-5}
Boggabri Volcanics	3×10^{-7}	0.02	1×10^{-5}
Alluvial Strata	8×10^{-5}	0.20	1×10^{-4}

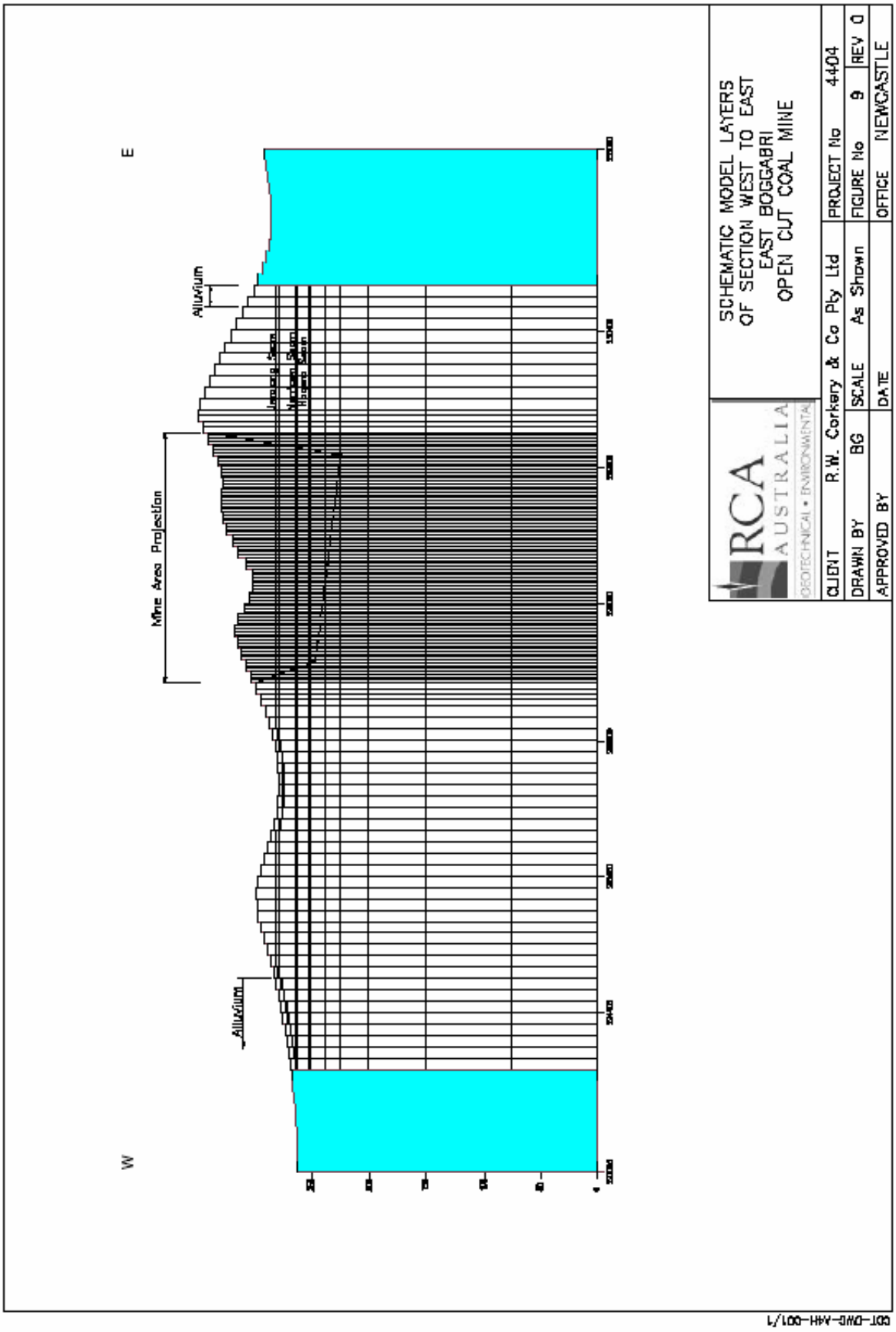


Figure 8
Model Layer Assumption

The storativity values were based on past experience in similar strata in the Hunter Valley and published values (AGC, 1984). It is noted that the hydraulic conductivity values in the coal measures are similar in magnitude to those encountered in the Hunter Valley (AGC, 1984).

No-flow boundaries were assigned to the north-west, north-east (both intermittent creeks and topogragphic divides) and to the south-east, along the line that divides Bollol creek and the adjacent gully (see **Figure 9**). A constant head boundary has been assigned to the south-west along the topographic contour of 260m. The head values adopted are based on elevations from the neighbouring bores. The head at the eastern part of what is taken as 250m AHD where as to the west as 240m AHD. The areal extent of Boggabri Volcanics, and alluvial aquifer were taken from the local geological map (**Figure 10**) and **Figure 11** shows the hydraulic conductivity zones adopted.

The model was initially run at steady state conditions to establish the initial heads in all layers. These heads were then used as the initial conditions for the transient model run.

The proposed open cut area was simulated using the drainage package in Modflow by setting the drain elevation equal to the basal coal seam within the limit of mining, ie, thus assuming all mining would be undertaken by open cut methods to the limit of mining. The mining was simulated to approximate four stages to represent two, four, six and eight years of mining. This was based on the limit of mining footprint provided by the Proponent. The model was run in transient mode for a period of eight years (the expected life of the mine) and flows and heads recorded at timed intervals.

The model was calibrated by varying the boundary conditions and the amount of recharge to simulate the observed water levels recorded during the fieldwork. The modelled initial water levels are indicated on **Figure 12.** Calibration was achieved with a normalised root mean square error of only 6.5% (**Figure 13**) which signifies good calibration.

A recharge value of 8mm/year and 35mm/year was achieved during model calibration for overburden and alluvial strata respectively. Given the low annual precipitation of 616mm/year (at Gunnedah Station), low hydraulic conductivity of overburden strata, high evaporation in the area (1 200mm/year) and the deep groundwater table, these low recharge values are considered appropriate.

8.3 MODELLING SCENARIOS

The mining was simulated in four stages based on the year two, four, six and eight mine plan provided. As mining progressed, the backfilling of the completed sections was simulated for each stage by replacing the void with backfilled rock mass. The backfilled pit area was modelled as a uniform mass with hydraulic conductivity of 1×10^{-5} m/s and a specific yield of 0.1 (reflecting the disturbed nature and higher porosity of the material).

Drawdown was assessed by comparing the pre-mine development water levels to those occurring at various times after mining has commenced. This was undertaken for registered and potentially affected neighbouring bores.

Re-establishment of the water levels in the mining void was assessed by running the eight year model without the drainage package to allow resaturation.

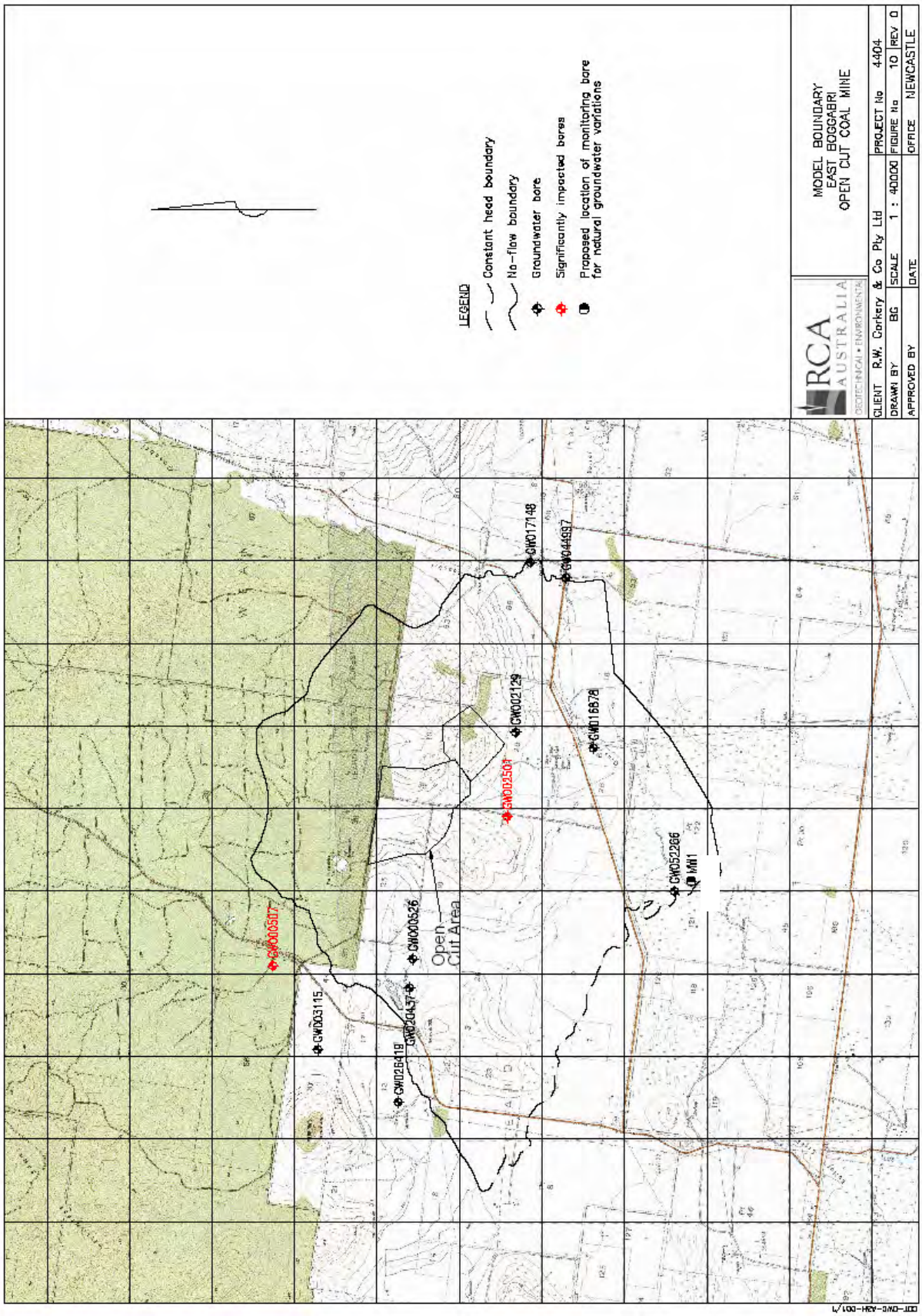


Figure 9
Model Boundary and Boundary Conditions

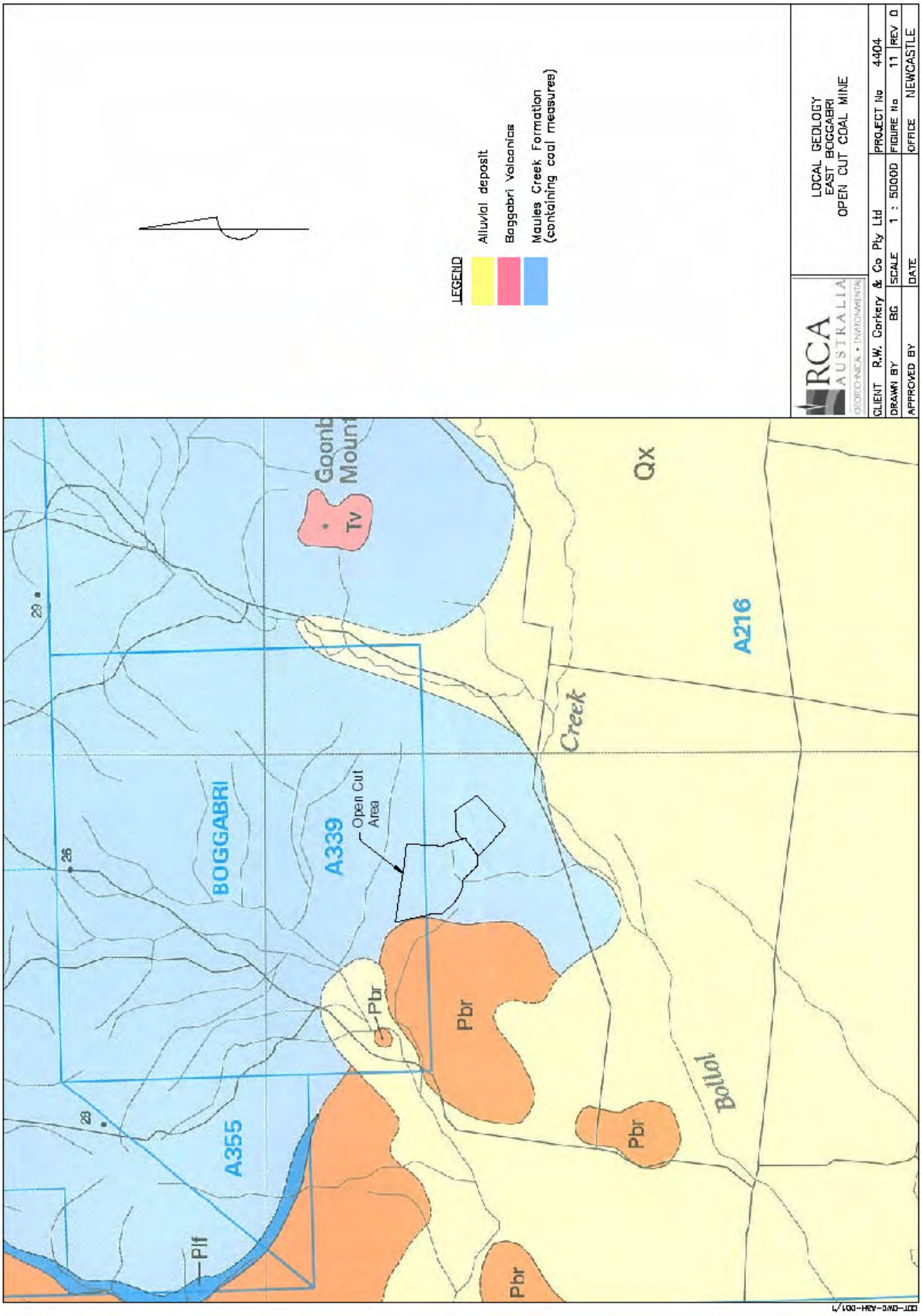


Figure 10
Local Geological Map

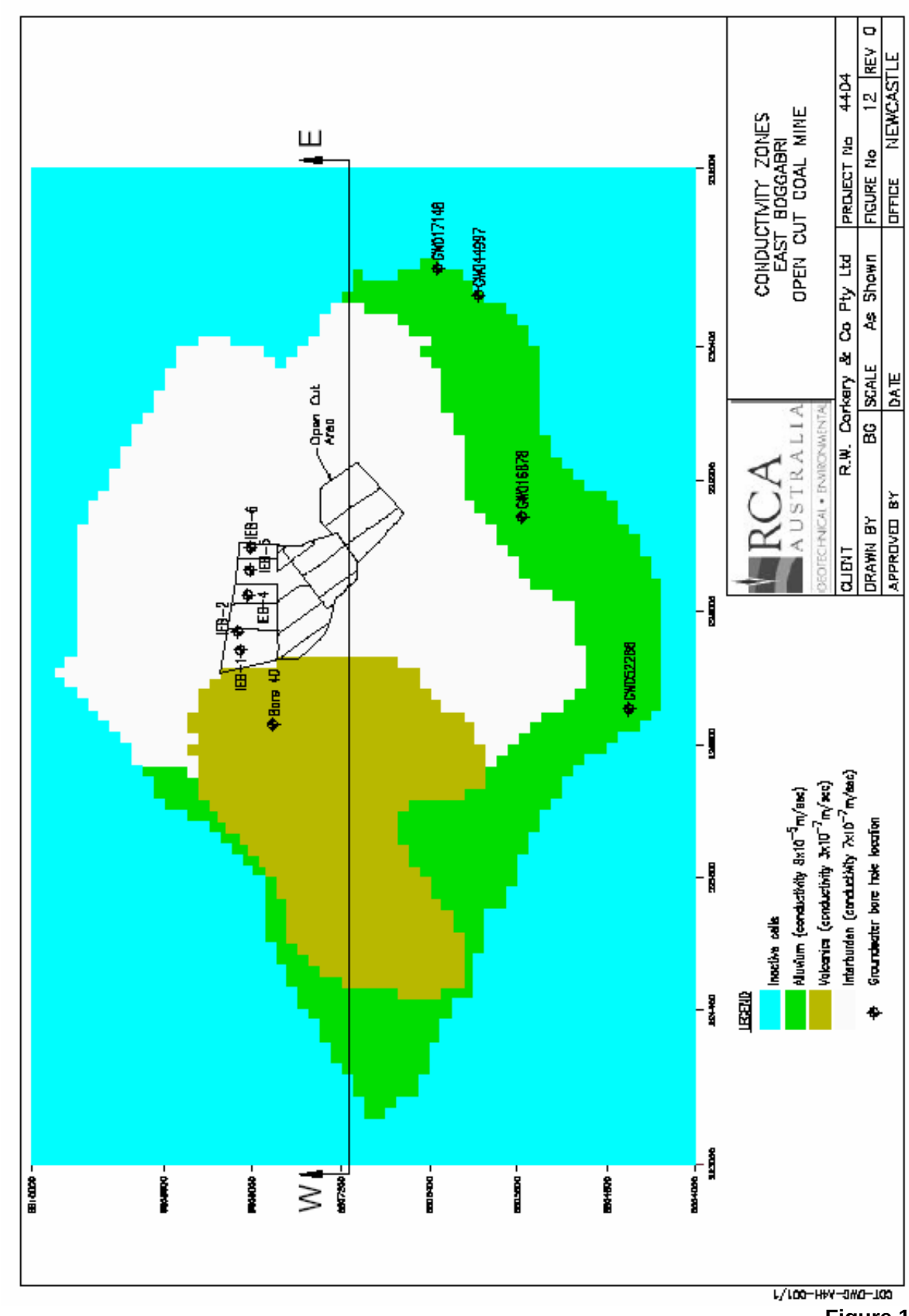


Figure 11
Conductivity Zones

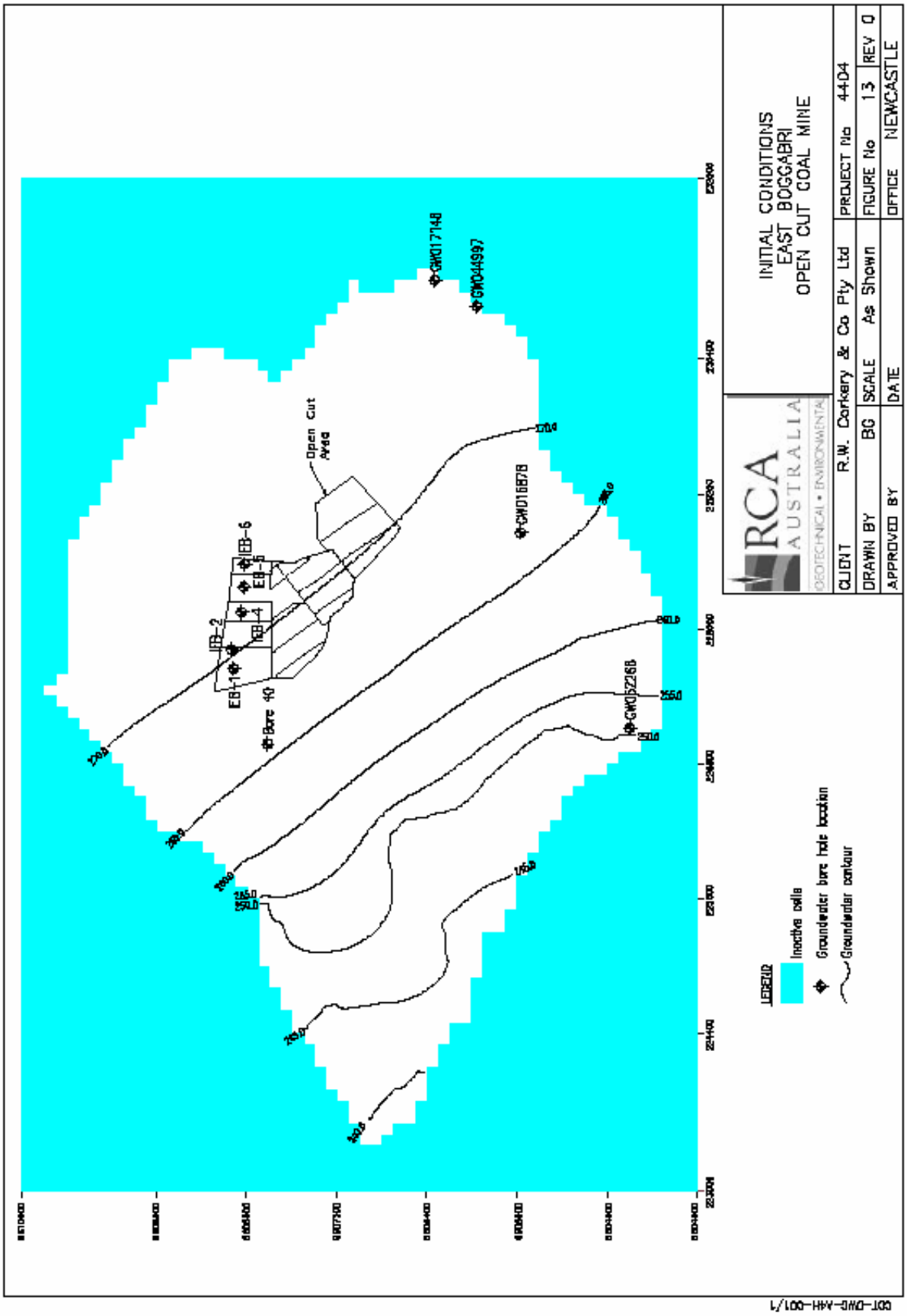


Figure 12
Initial Conditions

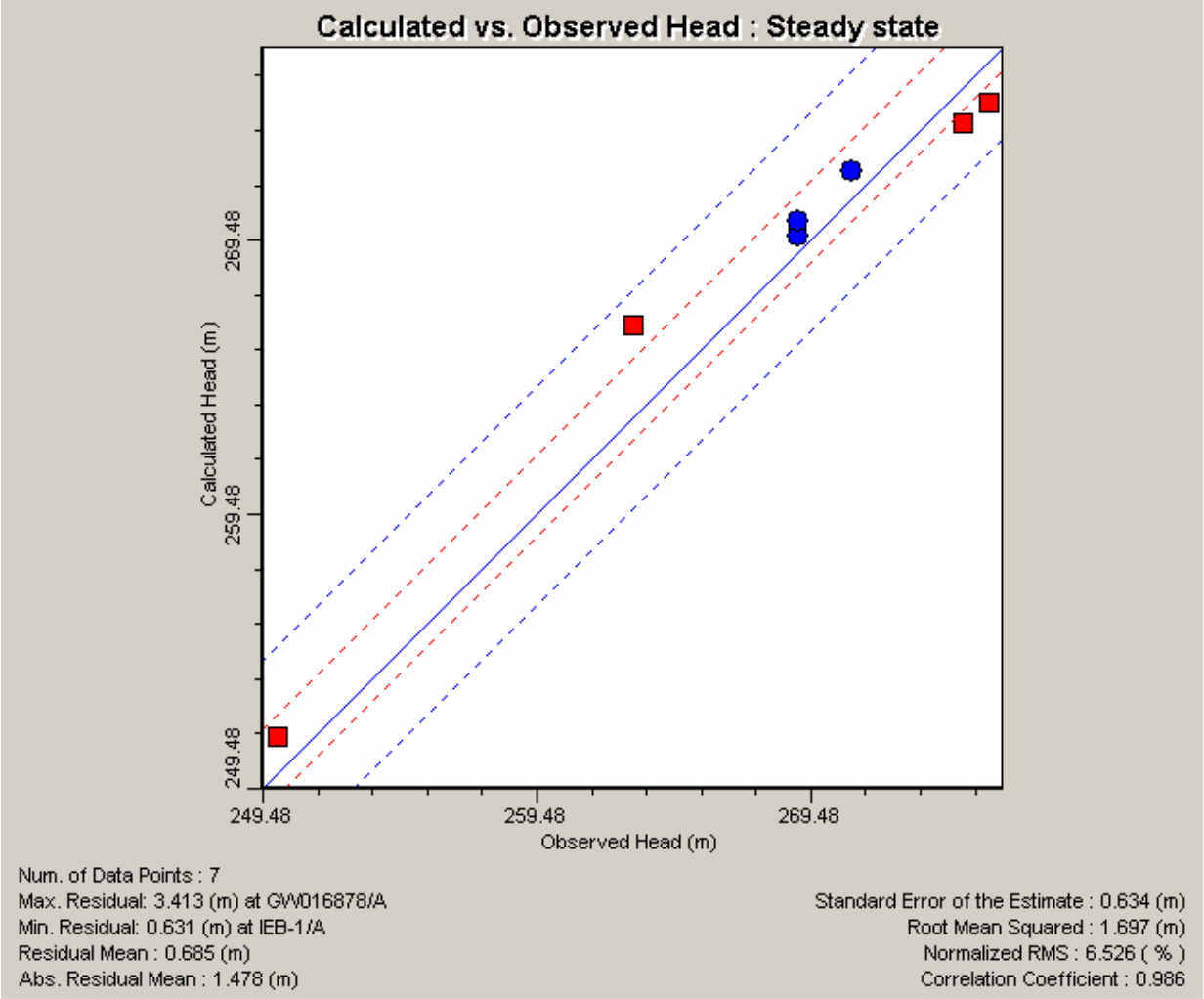


Figure 13
Calibration Output

8.4 RESULTS

8.4.1 Inflows

The predicted inflows to the open cut area during the nominated years are listed in **Table 17**. Flows in the second year were determined to approximate 650m^3/day increasing to 700m^3/day after six years and decreasing to 520m^3/day at the end of eight year.

Table 17
Modelled Inflows into Open Cut Area

Year	Inflow (m^3/day)	Evaporation Rate (m^3/day)	Net Inflow (m^3/day)
2	650	1320	0
4	640	1150	0
6	700	1120	0
8	520	1050	0

It is noted that the calculated inflow rate is approximately half of the evaporation rate which can be calculated by multiplying the evaporation rate (approx 1.2m/year) by the surface area of the exposed surface. This suggests that generally there would be no net inflow, ie, it would be a "dry mine" (as is the case with other coal mines in the area).

8.4.2 Drawdown

The drawdown pattern after two, four, six and eight years mining is shown on **Figure 14**. The extent of drawdown and the area of influence from the open cut area plotted at the 2m contour for the final mine stage is shown in **Figure 15**.

The drawdown predicted at completion of mining, at the closest bores/wells to the open cut mine are summarised in **Table 18**.

Table 18
Calculated model drawdown for neighbouring bores

Bore ID	Property	Aquifer	Approximate distance from open cut mine (m)	Calculated Drawdown (m)	Saturated Thickness (m)	% Decline in Saturated Thickness
GW002129	"Merriown"	Coal	200	10.2	245	4.2
GW002501	"Nagero"	Interburden	500	7.8	25.3	30.8
GW000526	"Thuin"	Volcanic	1200	2.7	70*	3.8*
GW020437	"Thuin"	Volcanic	1600	2.0	25*	8.0*
GW052266	"Tarrawonga"	Alluvial	2800	Negligible	82.4	Negligible
GW016878	"Thuin"	Alluvial/ Interburden	1100	0.5	41.2	1.2
GW044997	"Templemore"	Alluvial	2000	0.45	41.1	1.1
GW017148	"Matong"	Alluvial	2100	0.4	12.3	3.2
GW026419#	"Merriown"	NK	3700	1	43.4	2.3
GW000507#	"Merriown"	Interburden	1800	3	37.1	8.1
GW003115#	"Tarrawonga"	Interburden	3000	2	53.9	3.7

*# - From the **Figure 15** it is inferred that some drawdown is expected outside of the model domain in the north-west portion the drawdown in this area is minimal and has been inferred from the modelled contours.*
NK – not known
** Inferred data from the model, bore depth available and water level taken from initial modelling conditions*

As recorded in **Table 18**, the drawdown effect is generally minimal (ie, less than 10% reduction in saturated thickness in all but one of the registered bores (GW002501 in the interburden strata. Mitigation measures are discussed in Section 9.6.

8.4.3 Cumulative Effect

In order to estimate the cumulative effect of mining of the two mines (East Boggabri and Boggabri which commences after 6 to 12 months from the start of the East Boggabri mine), the model was rerun. This necessitated a change in the model grid and location of boundaries to the north so that the Boggabri Mine could be assessed at the same time as mining was occurring at the proposed mine. The model was run for a 10 year period with both mines in operation. The Boggabri mine configuration was sourced from (BHP-AGIP-Idemitsu Joint Venture, 1987).

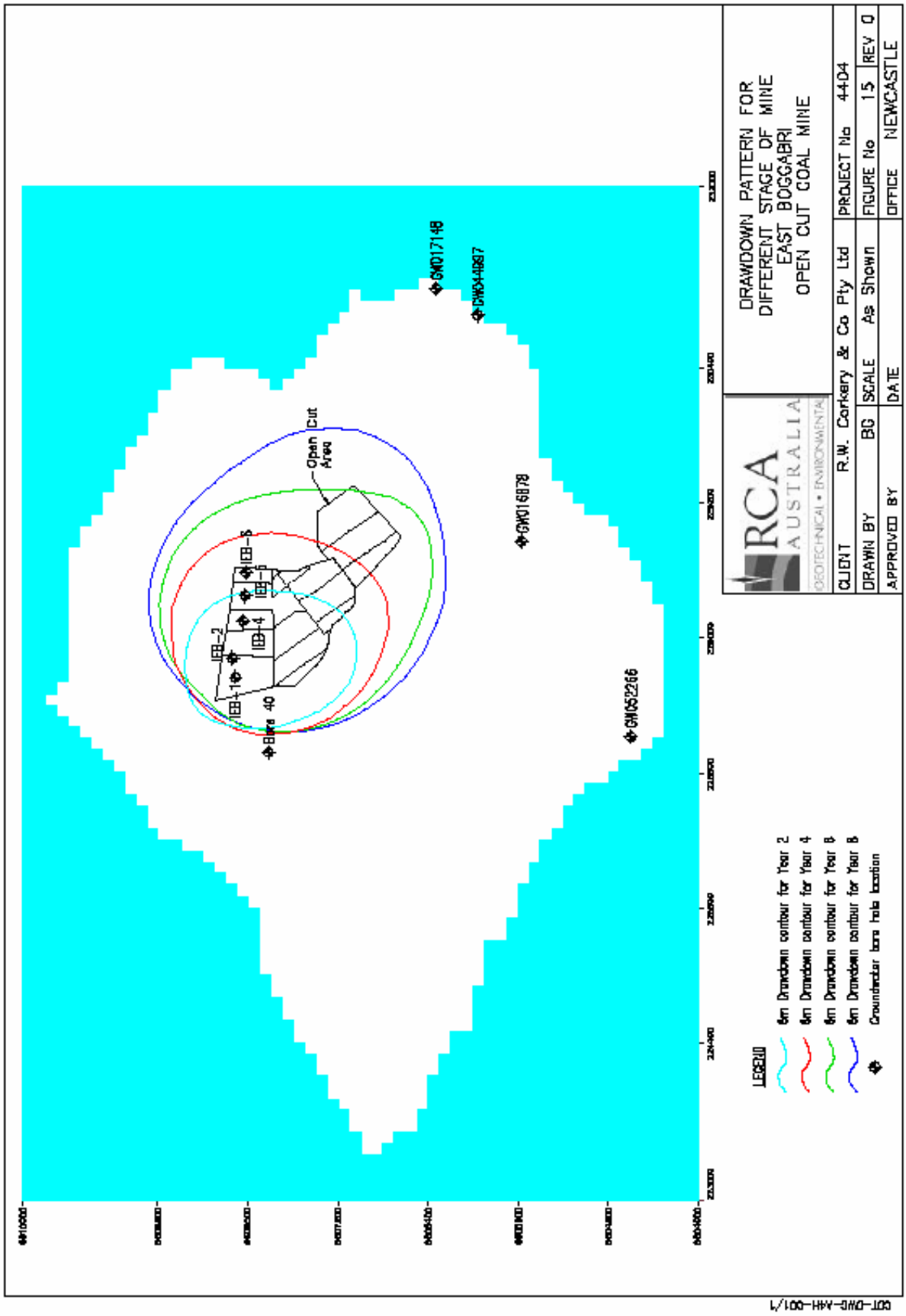


Figure 14
Drawdown Pattern for Different Stage of Mine

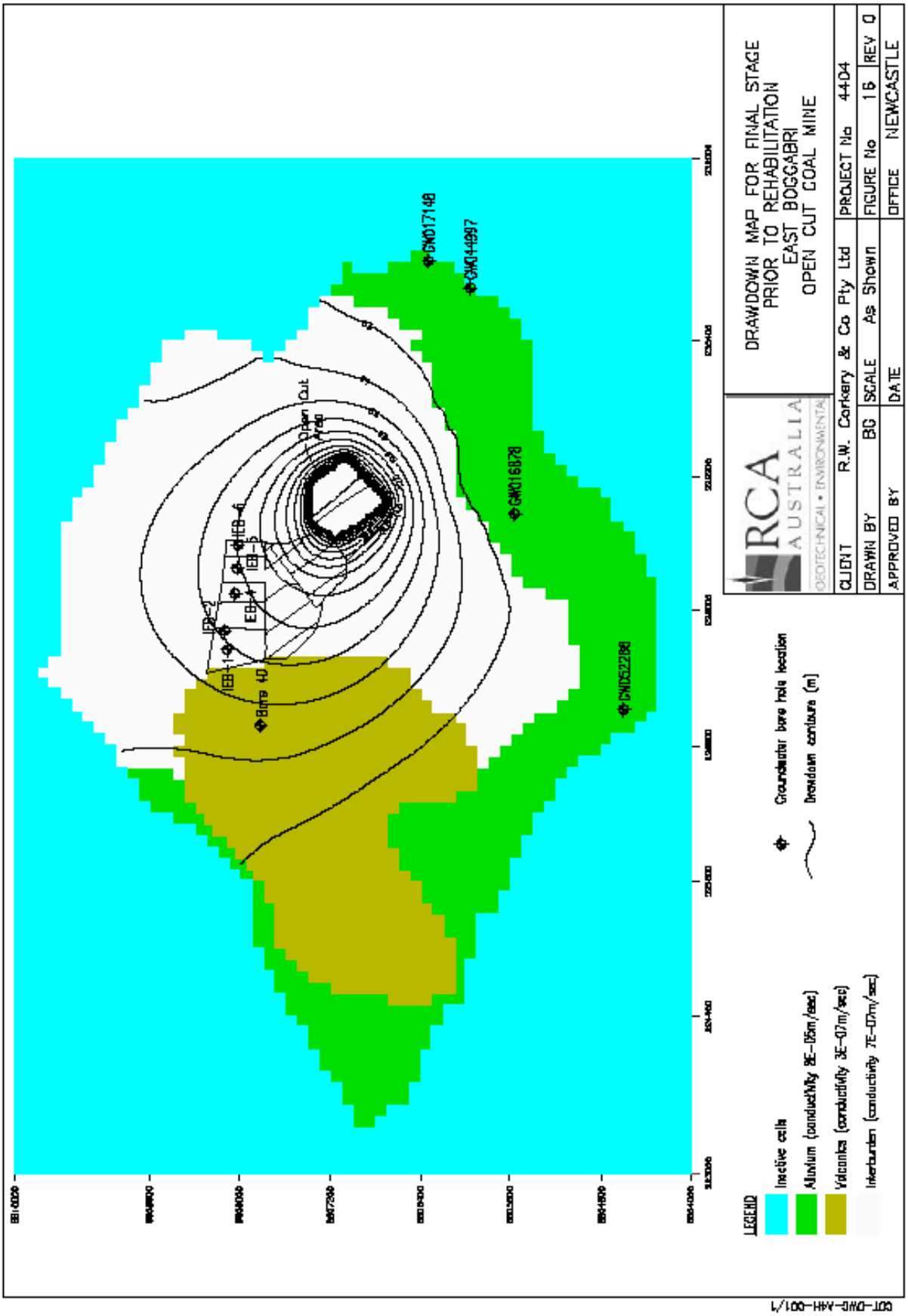


Figure 15
Drawdown Map for Final Mine Stage

The results of the model show that with both mines operating, there is slightly higher drawdown in the alluvial aquifer along Bollol Creek compared to the results presented in **Table 18** for the East Boggabri Coal Mine only. The effect is not significant due to the location of the Boggabri mine being further from the alluvium than the East Boggabri mine. **Table 19** shows the predicted drawdown at the registered bores with both mines operating.

Table 19
Cumulative Impact of Both Mines in Operation

Bore ID	Property	Aquifer	Distance from East Boggabri mine (m)	East Boggabri only Drawdown (m)	Cumulative Drawdown (both mines) (m)	% Decline in Saturated Thickness (Cumulative)
GW002129	"Merriown"	Coal	200	10.2	10.2	4.2
GW002501	"Nagero"	Interburden	500	7.8	7.8	30.8
GW000526	"Thuin"	Volcanic	1200	2.7	4.5	6.4*
GW020437	"Thuin"	Volcanic	1600	2.0	3.5	14.0*
GW052266	"Merriown"	Alluvial	2800	Negligible	Negligible	Negligible
GW016878	"Bollol Creek Station"	Alluvial/ Interburden	1100	0.5	0.9	2.1
GW044997	"Templemore"	Alluvial	2000	0.45	0.9	2.2
GW017148	"Nagero"	Alluvial	2100	0.4	0.85	6.9
GW026419	"Merriown"	NK	3700	1	2	4.6
GW000507	"Merriown"	Interburden	1800	3	6	16.1
GW003115	"Tarrawonga"	Interburden	3000	2	4	7.4
** Inferred data from the model*						

From the cumulative impact assessment in addition to bore GW002501, bore GW000507 (located in interburden strata) is also predicted to be impacted (see **Figure 10**).

8.4.4 Re-establishment of Water Levels

A chart of the groundwater level recovery in the open cut mine versus time following cessation of mining is shown in **Figure 16**. This indicates that the mine void would be resaturated to near original levels within approximately 25 years after mining ceases. Overburden placed into the void has been modelled with a higher hydraulic conductivity (10^{-5}m/sec) and specific yield of (0.1, considering the expansion of voids). This would result in a standing water level in the final void at about 270 m AHD.

8.4.5 Impact on Groundwater Quality

Australian Laboratory Services (ALS), a NATA accredited laboratory performed a series of standard geochemical tests on the samples from the site including pH, Electrical Conductivity (EC), Total Sulfur, Acid Neutralising Capacity (ANC), Net Acid Producing Potential (NAPP) and Net Acid Generation (NAG). An independent assessment of these chemical analyses was undertaken by URS Australia Pty Ltd who established that there is a low potential for both acid formation and soluble salt generation from the overburden and interburden material (URS, 2005). Therefore, it is considered that the fragmentation of the interburden material (which would be used to fill the mining void) during mining is unlikely to results in a significant increase in the salinity or acidity of the groundwater.

This is also supported by the fact that the groundwater in the interburden and coal seam aquifers are of similar chemistries and a similar conclusion was reached in the assessment of the adjacent Boggabri Mine (Herring, 1979).

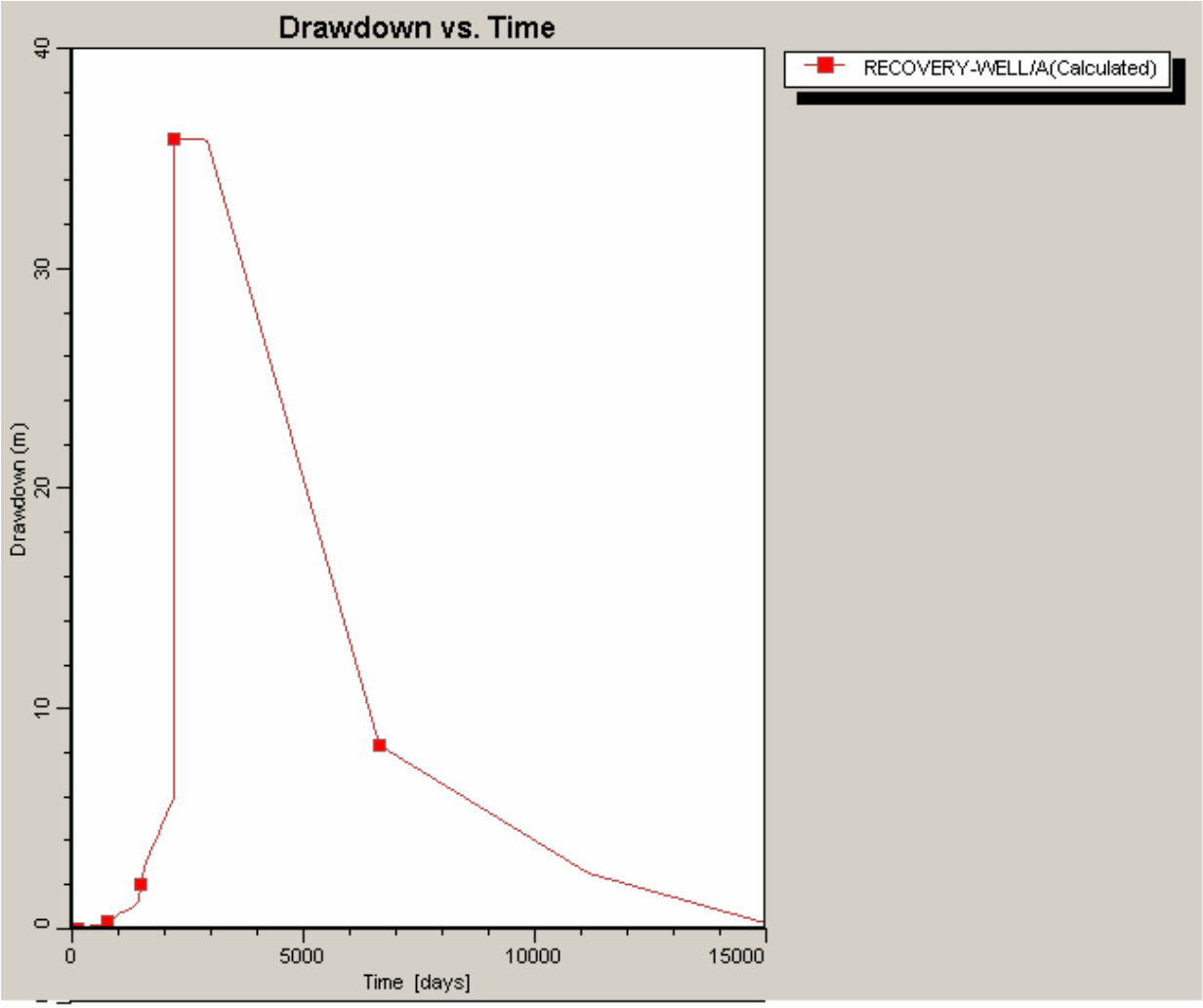


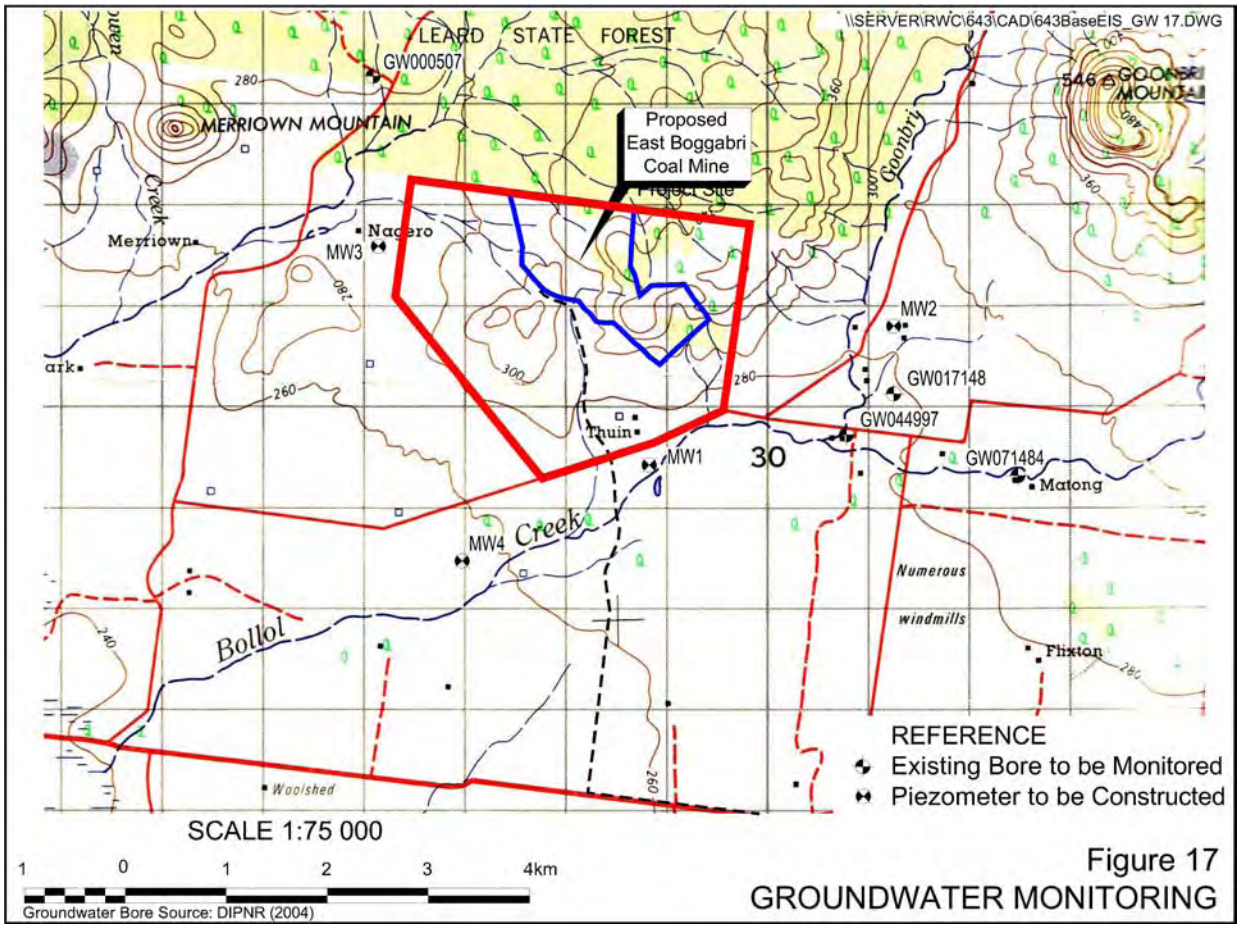
Figure 16
Time Taken for re=establishment of pre-mining groundwater level

9 FUTURE MONITORING

9.1 LOCATIONS

The recommended monitoring program comprises a number of bores where both groundwater levels and quality should be measured. The suggested locations are shown on **Figure 17** and include the following.

- MW-1: within the Permian coal measures aquifer on the “Thuin” property.
- MW-2: within the alluvial aquifer on the “Bollol Creek” property.
- MW-3: within the Boggabri volcanics aquifer on the “Nagero” property.
- MW-4: within the alluvial aquifer on the “Tarrawonga” property.



MW-1 and MW-2 would be used to assess the extent of drawdown within the Permian coal measures aquifer and determine whether the mine related drawdown reaches the alluvial aquifer to the south and southeast of the Project Site. MW-3 would be used to assess whether mine related drawdown affects the aquifer within the Boggabri Volcanics. MW-4 would be used to assess natural variation in the water level and quality of the alluvial aquifer.

In addition to these four piezometers, it is recommended that groundwater levels in three of the bores predicted to be slightly affected by the proposed East Boggabri Coal Mine be monitored, namely:

- GW000507 – within the Permian coal measures and interburden on IBC's "Merriown" property;
- GW017148 – within the alluvial aquifer on the "Bollol Creek Station" property;
- GW044997 – within the alluvial aquifer on the "Templemore" property; and
- GW071484 – within the alluvial aquifer on the "Matong" property.

9.2 FREQUENCY OF MONITORING AND PROCEDURES

A baseline monitoring event is recommended and this should be conducted prior to the commencement of mining. This should include all of the monitoring wells. Groundwater levels should be recorded to the nearest 0.01m and all monitoring locations should be surveyed to AHD so relative levels can be determined.

Table 20 presents the recommended monitoring following the establishment of baseline values. Subsequent measurement of groundwater levels should be undertaken at quarterly intervals with assessment of chemical parameters every second event. Monitoring should continue for a period of 10 years after mining has ceased, however it is recommended that the frequency be reassessed after mining is complete as it may be possible, depending on results, to lengthen the intervals between monitoring events.

It is recommended that a data logger be placed in MW1 during the operational life of the mine to continually monitor water levels and assess natural variations in the alluvial aquifer.

Table 20
Summary of Monitoring

Event Timing	Groundwater Levels	Contaminant/Chemical Testing
Baseline	Install data logger in MW1, assess levels in all bores	All bores
Quarterly	Assess levels in all bores, download MW1 data	Every fourth event, once a year

Wells should be purged prior to sampling until pH and salinity measurements have become stable. This usually involves removal of at least three bore volumes of groundwater or purging until dry. Samples should be collected and placed in appropriately preserved containers and kept on ice. Samples should be transported on ice under chain of custody documentation and arrive at the laboratory within appropriate holding times.

9.3 ANALYTES FOR MONITORING

The recommended analytes for the monitoring are as follows.

- pH – to assess if any increase in acidity occurs due to disturbance of sulfides.
- Salinity – to assess if infilling of the mining void with mine overburden results in any changes in salinity.
- Total Petroleum Hydrocarbons – these contaminants (typically oils and diesel) may be used during mining.
- Heavy Metals – some heavy metals may be used during mining eg associated with the use of waste oils. These should include arsenic, cadmium, chromium, nickel, lead, copper, manganese and zinc.
- Major cations and anions – to assess overall changes in groundwater chemistry.

9.4 TRIGGER LEVELS

Groundwater levels would be expected to naturally vary by up to 15%, so any reduction in levels greater than this should be treated as significant and subject to further investigation.

The groundwater is used for irrigation and watering of livestock in the area so the ANZECC 2000 irrigation and livestock guidelines should be used as trigger levels. These are shown on **Table 21**. Note that the data obtained to date suggests that neither of these guidelines is exceeded at the present time.

9.5 REPORTING

An annual report should be prepared providing comment on trends in groundwater levels and quality. The report is to be completed by a suitably qualified and independent Hydrogeologist, whose appointment has been approved by the Director-General. Note, the assessment of trends should not only consider the ANZECC trigger levels but also the natural variation that can occur.

9.6 CONTINGENCIES

9.6.1 Groundwater Levels

Should groundwater levels reduce by more than 15% of the saturated thickness compared to baseline pre-mining levels, and this is assessed to be caused by the mining, then the suggested remedial measure is to establish a new bore in the impacted area. The new bore should be installed to greater depth than the original such that the yield of the new bore is at least equal to the current yield. The aquifers in the region are typically low yielding and seem to generally rely on a significant saturated thickness to achieve the required yield rather than a particular high hydraulic conductivity layers. To re-establish the original yield may therefore be a simple matter of increasing the bore depth by the maximum amount of drawdown predicted. However in some cases, deepening the bores to beyond this depth may be required.

Table 21
Groundwater Assessment Criteria

Analyte	ANZECC Guideline Levels*	
	Agricultural Irrigation mg/L	Livestock mg/L
Arsenic (total)	0.1	0.5
Cadmium	0.01	0.01
Chromium (Total)	-	-
Chromium (VI)	0.1	1
Copper	0.2	0.4
Lead	2	0.1
Manganese	0.2	-
Mercury (total)	0.002	0.002
Nickel	0.2	1
Zinc	5/2	20
Calcium	-	1000
Conductivity (us/cm)	1900 – 4500[@]	2000 – 5000[#]
Magnesium	230 – 460[@]	-
Chloride	350 – 700[@]	-
Sulfate	-	1 000
Total Petroleum Hydrocarbons	<0.01^	

[@] For moderately tolerant crops
[#] Poultry – sheep value / long term trigger value
^ There are no guidelines for this parameter but as levels of this are not naturally occurring in the area, the trigger level should be set at typical detection limits.
- No published values

Source: NEPM Schedule B(1) Guideline on Investigation Levels for Soil and Groundwater ANZECC

9.6.2 Groundwater Quality

Should the monitoring data show that any of the trigger levels are reached then the data should be statistically analysed to assess if the impacts are due to natural variations or the activities of the mine.

If this occurs, then the following measures should be undertaken.

- Resample the impacted bore(s).
- If the result is still elevated then, install more bores around the area to assess the extent of the impact and conduct a risk assessment to assess the risk to the nearest groundwater user.
- If this risk is significant then, assess remedial options such as pump and treat or hydraulic isolation.
- Conduct remediation if necessary.

10 CONCLUSIONS

Based on the results of this investigation, the following conclusions can be made.

- Groundwater occurs in three main strata in the vicinity of the Project Site.
- Groundwater currently flows in a NE to SW direction which is governed by the regional topography at a flow rate of about 0.5m to 1 m/year.
- The depth to groundwater is about 38m (RL270m) and as mining would occur up to RL 220m, the water table would be intersected.
- Inflows would be minimal and the mine dry.
- Resaturation of the mining void would take about 25 years after the mining has ceased.
- Impacts are localised with only one bore significantly impacted from operation of East Boggabri Mine while one more bore would be significantly impacted from the cumulative effect of both the East Boggabri and Boggabri mines operating conjunctively. These impacts can be mitigated by the deepening of the bores or installation of new bores.
- A groundwater monitoring program is recommended to enable the predicted impacts to be assessed.

11 REFERENCES

1. *R/ W/ Corkery and Co. Pty. Limited (2004)*, Specialist Consultant Groundwater Assessment Brief – 6 September 2004, East Boggabri Coal Mine Proposal.

2. *Joint Venture: Whiteheaven Coal Mining Limited and Idemitsu Boggabri Coal Pty Ltd (2004)*, Conceptual project development plan for the proposed East Boggabri Open Cut Coal Mine, August 2004

3. *William C Herring, AMAX Coal Company (1979)*, Hydrology of the Boggabri Coal Prospect near Boggabri, NSW, Australia, Indianapolis, 19 October 1979.

4. *RCA Australia (2002)*, Groundwater Assessment of Proposed Belmont Mine near Boggabri, Job Number 3066, November 2002

5. *AGC (1984)*, Effects of Coal Mining on Groundwater Resources in the Hunter Valley

6. *Fetter (1994)*, Applied Hydrogeology, Third Edition, Prentice Hall

7. *URS Australia (2005).* Acid Mine Drainage and Salinity Potential Assessment for the Proposed East Boggabri Coal Mine, Prepared on behalf of the East Boggabri Joint Venture - Part 9 of the Specialist Consultant Studies Compendium

APPENDICES

Appendix A: Hvorlev Method Calculations

Appendix B: Water Quality Laboratory Analysis

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APPENDIX A

Hvorslev Method Calculations

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RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PIEZOMETER TEST

CLIENT:	R. W. Corkery & Co.	**DATE:**	01-11-2004
PROJECT:	Groundwater Modelling	**RCA ref:**	4404
LOCATION:	East Boggabri	**CLIENT REF:**	

BORE DETAILS

Bore No. IEB-6

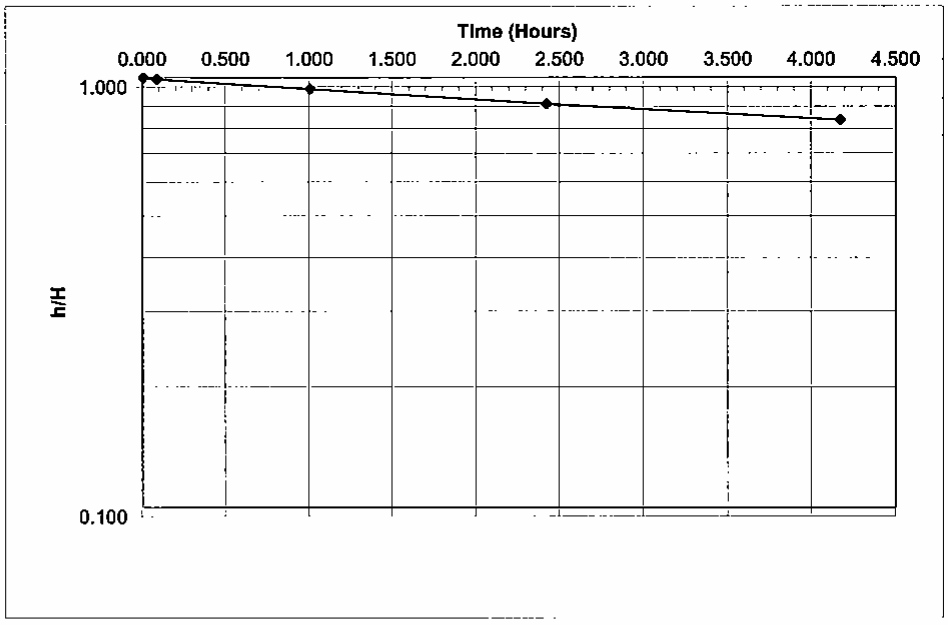
Piezometer Intake leng	1.5	m
Piezometer radius (r)	0.025	m
Bore radius (R)	0.05	m
Depth of piezometer		m
Static water level		m
Lag time T_o	16.667	Hours(extrapolation)

37% relative drawdown or 63% recovery.

TEST METHOD: Rising head

Results

Time (Hour)	Depth to water (m)	Change in level (m)	h/H
Static	56.20		
0.000	63.850	7.650	1.000
0.083	63.780	7.580	0.991
1.000	63.400	7.200	0.941
2.417	62.850	6.650	0.869
4.167	62.300	6.100	0.797



Based on Hvorslev method $K = \frac{r^2 \ln(L/R)}{2LT_o}$

Calculated Permeability **4.3E-05 m / hour**
1.2E-08 m / sec

RCA Australia	**Tested by:FR**	**Date:**
Office:	**Checked by:**	**Date:**

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APPENDIX B

Water Quality Laboratory Analysis

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LabMark

CUSTOMER CENTRIC - ANALYTICAL CHEMISTS

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No. 13542

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APLAC

Quarantine Facility NO356

AQIS

FINAL CERTIFICATE OF ANALYSIS - ENVIRONMENTAL DIVISION

Laboratory Report No:	019941	Cover Page 1 of 3
Client Name:	Robert Carr and Associates Pty Ltd	plus Sample Results
Client Reference:	4404	
Contact Name:	Fiona Robinson	
Chain of Custody No:	S0110	Date Received: 29/10/04
Sample Matrix:	WATER	Date Reported: 5/11/04

This Final Certificate of Analysis consists of sample results, DQI's, method descriptions, laboratory definitions, and internationally recognised NATA accreditation and endorsement. The DQO compliance relates specifically to QA/QC results as performed as part of the sample analysis, and may provide an indication of sample result quality. Transfer of report ownership from Labmark to the client shall only occur once full & final payment has been settled and verified. All report copies may be retracted where full payment has not occured within the agreed settlement period.

QUALITY ASSURANCE CRITERIA

Accuracy:	matrix spike:	1 in first 5-20, then 1 every 20 samples
	lcs, crm, method:	1 per analytical batch
	surrogate spike:	addition per target organic method
Precision:	laboratory duplicate:	1 in first 5-10, then 1 every 10 samples
	laboratory triplicate:	re-extracted & reported when duplicate RPD values exceed acceptance criteria
Holding Times:	soils, waters:	Refer to LabMark Preservation & THT table VOC's 14 days water / soil VAC's 7 days water or 14 days acidified VAC's 14 days soil SVOC's 7 days water, 14 days soil Pesticides 7 days water, 14 days soil Metals 6 months general elements Mercury 28 days
Confirmation:	target organic analysis:	GC/MS, or confirmatory column
Sensitivity:	EQL:	Typically 2-5 x Method Detection Limit (MDL)

QUALITY CONTROL GLOBAL ACCEPTANCE CRITERIA (GAC)

Accuracy:	spike, lcs, crm surrogate:	general analytes 70% - 130% recovery phenol analytes 50% - 130% recovery organophosphorous pesticide analytes 60% - 130% recovery
	anion/cation bal:	+/- 10% (0-3 meq/l), +/- 5% (>3 meq/l)
Precision:	method blank:	not detected >95% of the reported EQL
	duplicate lab RPD (metals):	0-30% (>10xEQL), 0-75% (5-10xEQL) 0-100% (<5xEQL)
	duplicate lab RPD:	0-50% (>10xEQL), 0-75% (5-10xEQL) 0-100% (<5xEQL)

QUALITY CONTROL ANALYTE SPECIFIC ACCEPTANCE CRITERIA (ASAC)

Accuracy:	spike, lcs, crm surrogate:	analyte specific recovery data <3xsd of historical mean
Uncertainty:	spike, lcs:	measurement calculated from historical analyte specific control charts

RESULT ANNOTATION

DQO:	Data Quality Objective	s:	matrix spike recovery	p:	pending
DQI:	Data Quality Indicator	d:	laboratory duplicate	lcs:	laboratory control sample
EQL:	Estimated Quantitation Limit	t:	laboratory triplicate	crm:	certified reference material
^ - - :	not applicable	r:	RPD relative % difference	mb:	method blank

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CUSTOMER CENTRIC - ANALYTICAL CHEMISTS

Laboratory Report: 019941

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NEPC GUIDELINE COMPLIANCE - DQO

1. GENERAL

A. Results relate specifically to samples as received. Sample results are not corrected for matrix spike, lcs, or surrogate recovery data.

B. EQL's are matrix dependant and may be increased due to sample dilution or matrix interference.

C. Laboratory QA/QC samples are specific to this project.

D. Inter-laboratory proficiency results are available upon request. NATA accreditation details available at www.nata.asn.au.

E. VOC spikes & surrogates added to samples during extraction, SVOC spikes & surrogates added prior to extraction.

F. Recovery data outside GAC limits shall be investigated and compared to ASAC (historical mean +/- 3sd). If recovery data <20%, then the relevant results for that compound are considered not reliable.

G. Recovery data (ms, surrogate, crm, lcs) outside ASAC limits shall initiate an investigative action. Anomolous QC data is examined in conjunction with other QC samples and a final decision whether to accept or reject results is provided by the professional judgement of the senior analyst. The USEPA-CLP National Functional Guidelines are referred to for specific recommendations.

H. Extraction (preparation) date refers to the date that sample preparation was initiated. Note that certain methods not requiring sample preparation (eg. VOCs in water, etc) may report a common extraction and analysis date.

I. LabMark shall maintain an official copy of this Certificate of Analysis for all traceable reference purposes.

2. CHAIN OF CUSTODY (COC) & SAMPLE RECEIPT NOTICE (SRN) REQUIREMENTS

A. SRN issued to client upon sample receipt & login verification.

B. Preservation & sampling date details specified on COC and SRN, unless noted.

C. Sample Integrity & Validated Time of Sample Receipt (VTSR) Holding Times verified (preservation may extend holding time, refer to preservation chart).

3. NATA ACCREDITED METHODS

A. NATA accreditation held for each method and sample matrix type reported, unless noted below.

B. NATA accredited in-house laboratory methods are referenced from NEPC, ASTM, modified USEPA / APHA documents.

C. Subcontracted analyses:

Suspended Solids (TSS) contracted by Sydney Analytical Laboratories, NATA accreditation No.1884.

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CUSTOMER CENTRIC - ANALYTICAL CHEMISTS

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4. QA/QC FREQUENCY COMPLIANCE TABLE SPECIFIC TO THIS REPORT

Matrix: **WATER**

Page:	Method:	Totals:	#d	%d-ratio	#t	#s	%s-ratio
1	Filtered metals (M7)	5	1	20%	0	1	20%
2	Filtered mercury	5	1	20%	0	1	20%
3	pH in water	5	1	20%	0	0	0%
4	Electrical conductivity (EC)	5	1	20%	0	0	0%
5	Total alkalinity	5	1	20%	0	1	20%
6	Chloride	5	1	20%	0	1	20%
7	Fluoride	5	1	20%	0	1	20%
8	Major cations	5	1	20%	0	1	20%
9	Suspended Solids (TSS)	5	1	20%	0	0	0%

NEPC guideline for laboratory duplicates is 1 in 10 samples (10%).
USEPA guideline for laboratory matrix spikes is 1 in 20 samples (5%).

5. ADDITIONAL COMMENTS SPECIFIC TO THIS REPORT

A. SAL reference SAL 15239, results issued 04/11/04.

Laboratory QA/QC Self Assessment data shall relate specifically to this report, and may only provide an indication of sample result quality. Acceptance of this Self Assessment certificate does not preclude any requirement for a QA/QC review by a accredited contaminated site EPA auditor, when and wherever necessary. Laboratory QA/QC Self Assessment references available upon request.

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Laboratory Report No: 019941 **Page:** 1 of 9 Final

Client Name: Robert Carr and Associates Pty Ltd plus cover page Certificate of Analysis

Contact Name: Fiona Robinson **Date:** 5/11/04

Client Reference 4404 This report supercedes reports issued on: N/A

Laboratory Identification			40726	40727	40728	40729	40730	40726d	40726r	40727s	lcs	mb
Sample Identification			IEB-1	IEB-2	IEB-5	IEB-6	IEB-40	QC	QC	QC	QC	QC
Depth (m)			--	--	--	--	--	--	--	--	--	--
Sampling Date recorded on COC			28/10/04	28/10/04	28/10/04	28/10/04	28/10/04	--	--	--	--	--
Laboratory Extraction (Preparation) Date			1/11/04	1/11/04	1/11/04	1/11/04	1/11/04	1/11/04	--	1/11/04	1/11/04	1/11/04
Laboratory Analysis Date			2/11/04	2/11/04	2/11/04	2/11/04	2/11/04	2/11/04	--	2/11/04	1/11/04	1/11/04
Method	**Filtered metals (M7)**	**EQL**										
E022.1	Arsenic	1	2	1	<1	2	6	2	0%	92%	91%	<1
	Cadmium	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	--	97%	98%	<0.1
	Chromium	1	1	1	1	1	<1	1	0%	83%	90%	<1
	Copper	1	6	6	6	6	5	6	0%	88%	97%	<1
	Nickel	1	5	4	3	9	5	5	0%	98%	101%	<1
	Lead	1	28	71	57	42	2	30	7%	113%	98%	<1
	Zinc	5	23	74	76	62	31	20	14%	96%	108%	<5

Results expressed in ug/l unless otherwise specified

Comments:

E022.1: Filtered HNO3 preserved sample directly analysed by ICP-MS.

Laboratory Report No:	019941	**Page:** 2 of 9	Final
Client Name:	Robert Carr and Associates Pty Ltd	plus cover page	Certificate
Contact Name:	Fiona Robinson	**Date:** 5/11/04	of Analysis
Client Reference	4404	This report supercedes reports issued on: N/A	

Laboratory Identification			**40726**	**40727**	**40728**	**40729**	**40730**	**40726d**	**40726r**	**40727s**	**lcs**	**mb**
Sample Identification			IEB-1	IEB-2	IEB-5	IEB-6	IEB-40	QC	QC	QC	QC	QC
Depth (m)			--	--	--	--	--	--	--	--	--	--
Sampling Date recorded on COC			28/10/04	28/10/04	28/10/04	28/10/04	28/10/04	--	--	--	--	--
Laboratory Extraction (Preparation) Date			1/11/04	1/11/04	1/11/04	1/11/04	1/11/04	1/11/04	--	1/11/04	1/11/04	1/11/04
Laboratory Analysis Date			2/11/04	2/11/04	2/11/04	2/11/04	2/11/04	2/11/04	--	2/11/04	2/11/04	2/11/04
Method	**Filtered mercury**	**EQL**										
E026.1	Mercury	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	--	103%	99%	<0.1

Results expressed in ug/l unless otherwise specified

Comments:

E026.1: Analysis by CV-ICP-MS or FIMS following BrCl pre-treatment.

Laboratory Report No:	019941
Client Name:	Robert Carr and Associates Pty Ltd
Contact Name:	Fiona Robinson
Client Reference	4404

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plus cover page
Date: 5/11/04
This report supercedes reports issued on: N/A

Final
Certificate
of Analysis

Laboratory Identification			**40726**	**40727**	**40728**	**40729**	**40730**	**40726d**	**40726r**			
Sample Identification			IEB-1	IEB-2	IEB-5	IEB-6	IEB-40	QC	QC			
Depth (m)			--	--	--	--	--	--	--			
Sampling Date recorded on COC			28/10/04	28/10/04	28/10/04	28/10/04	28/10/04	--	--			
Laboratory Extraction (Preparation) Date			29/10/04	29/10/04	29/10/04	29/10/04	29/10/04	29/10/04	--			
Laboratory Analysis Date			29/10/04	29/10/04	29/10/04	29/10/04	29/10/04	29/10/04	--			
Method	**pH in water**	**EQL**										
E031.1	pH (pH units)	0.1	7.5	7.4	7.1	7.1	7.8	7.4	1%			

Results expressed in pH units unless otherwise specified

Comments:

E031.1: Direct measurement by pH ion selective electrode.

LabMark

Laboratory Report No: 019941
Client Name: Robert Carr and Associates Pty Ltd
Contact Name: Fiona Robinson
Client Reference 4404

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Date: 5/11/04
This report supercedes reports issued on: N/A

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of Analysis

Laboratory Identification		**40726**	**40727**	**40728**	**40729**	**40730**	**40726d**	**40726r**	**mb**		
Sample Identification		IEB-1	IEB-2	IEB-5	IEB-6	IEB-40	QC	QC	QC		
Depth (m)		--	--	--	--	--	--	--	--		
Sampling Date recorded on COC		28/10/04	28/10/04	28/10/04	28/10/04	28/10/04	--	--	--		
Laboratory Extraction (Preparation) Date		29/10/04	29/10/04	29/10/04	29/10/04	29/10/04	29/10/04	--	29/10/04		
Laboratory Analysis Date		29/10/04	29/10/04	29/10/04	29/10/04	29/10/04	29/10/04	--	29/10/04		
Method **Electrical conductivity (EC)**	**EQL**										
E032.1 Electric conductivity (uS/cm)	1	2930	3700	2660	1679	1101	2910	1%	1		

Results expressed in uS/cm unless otherwise specified

Comments:

E032.1: Measurement by EC probe. Results expressed in uS/cm.

Laboratory Report No:	019941	**Page:** 5 of 9	Final
Client Name:	Robert Carr and Associates Pty Ltd	plus cover page	Certificate
Contact Name:	Fiona Robinson	**Date:** 5/11/04	of Analysis
Client Reference	4404	This report supercedes reports issued on: N/A	

Laboratory Identification			**40726**	**40727**	**40728**	**40729**	**40730**	**40726d**	**40726r**	**40727s**	**lcs**	**mb**
Sample Identification			IEB-1	IEB-2	IEB-5	IEB-6	IEB-40	QC	QC	QC	QC	QC
Depth (m)			--	--	--	--	--	--	--	--	--	--
Sampling Date recorded on COC			28/10/04	28/10/04	28/10/04	28/10/04	28/10/04	--	--	--	--	--
Laboratory Extraction (Preparation) Date			29/10/04	29/10/04	29/10/04	29/10/04	29/10/04	29/10/04	--	29/10/04	29/10/04	29/10/04
Laboratory Analysis Date			29/10/04	29/10/04	29/10/04	29/10/04	29/10/04	29/10/04	--	29/10/04	29/10/04	29/10/04
Method	**Total alkalinity**	**EQL**										
E035.1	Alkalinity	5	810	780	610	480	430	820	1%	#	89%	<5

Results expressed in mg/l unless otherwise specified

Comments: # Percent recovery not available due to significant background levels of analyte in sample.

E035.1: Determination by colour. Expressed as $CaCO_3$. Samples filtered through a 0.45um filter prior to analysis.

Laboratory Report No:	019941	**Page:** 6 of 9	Final	
Client Name:	Robert Carr and Associates Pty Ltd	plus cover page	Certificate	
Contact Name:	Fiona Robinson	**Date:** 5/11/04	of Analysis	
Client Reference	4404	This report supercedes reports issued on: N/A		

Laboratory Identification			**40726**	**40727**	**40728**	**40729**	**40730**	**40726d**	**40726r**	**40727s**	**lcs**	**mb**
Sample Identification			IEB-1	IEB-2	IEB-5	IEB-6	IEB-40	QC	QC	QC	QC	QC
Depth (m)			--	--	--	--	--	--	--	--	--	--
Sampling Date recorded on COC			28/10/04	28/10/04	28/10/04	28/10/04	28/10/04	--	--	--	--	--
Laboratory Extraction (Preparation) Date			29/10/04	29/10/04	29/10/04	29/10/04	29/10/04	29/10/04	--	29/10/04	29/10/04	29/10/04
Laboratory Analysis Date			1/11/04	1/11/04	1/11/04	1/11/04	1/11/04	1/11/04	--	1/11/04	1/11/04	1/11/04
Method	**Chloride**	**EQL**										
E033.1	Chloride	1	420	630	690	220	90	420	0%	#	108%	<1

Results expressed in mg/l unless otherwise specified

Comments: # Percent recovery not available due to significant background levels of analyte in sample.

E033.1: Determination by colour. Sample filtered through a 0.45um filter prior to analysis.

Laboratory Report No: 019941
Client Name: Robert Carr and Associates Pty Ltd
Contact Name: Fiona Robinson
Client Reference 4404

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Date: 5/11/04
This report supercedes reports issued on: N/A

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of Analysis

Laboratory Identification			**40726**	**40727**	**40728**	**40729**	**40730**	**40726d**	**40726r**	**40727s**	**lcs**	**mb**
Sample Identification			IEB-1	IEB-2	IEB-5	IEB-6	IEB-40	QC	QC	QC	QC	QC
Depth (m)			--	--	--	--	--	--	--	--	--	--
Sampling Date recorded on COC			28/10/04	28/10/04	28/10/04	28/10/04	28/10/04	--	--	--	--	--
Laboratory Extraction (Preparation) Date			29/10/04	29/10/04	29/10/04	29/10/04	29/10/04	29/10/04	--	29/10/04	29/10/04	29/10/04
Laboratory Analysis Date			29/10/04	29/10/04	29/10/04	29/10/04	29/10/04	29/10/04	--	29/10/04	29/10/04	29/10/04
Method	**Fluoride**	**EQL**										
E034.1	Fluoride	0.1	0.3	0.2	0.2	0.1	0.5	0.3	0.0%	104%	109%	<0.1

Results expressed in mg/l unless otherwise specified

Comments:

E034.1: Determined by FIA-Ion Selective Electrode. Samples filtered through a 0.45um filter prior to analysis.

Laboratory Report No:	019941	**Page:** 8 of 9	Final
Client Name:	Robert Carr and Associates Pty Ltd	plus cover page	Certificate
Contact Name:	Fiona Robinson	**Date:** 5/11/04	of Analysis
Client Reference	4404	This report supercedes reports issued on: N/A	

Laboratory Identification			**40726**	**40727**	**40728**	**40729**	**40730**	**40726d**	**40726r**	**40727s**	**lcs**	**mb**
Sample Identification			IEB-1	IEB-2	IEB-5	IEB-6	IEB-40	QC	QC	QC	QC	QC
Depth (m)			--	--	--	--	--	--	--	--	--	--
Sampling Date recorded on COC			28/10/04	28/10/04	28/10/04	28/10/04	28/10/04	--	--	--	--	--
Laboratory Extraction (Preparation) Date			29/10/04	29/10/04	29/10/04	29/10/04	29/10/04	29/10/04	--	29/10/04	29/10/04	29/10/04
Laboratory Analysis Date			1/11/04	1/11/04	1/11/04	1/11/04	1/11/04	1/11/04	--	1/11/04	1/11/04	1/11/04
Method	**Major cations**	**EQL**										
E020.1/E	Calcium	0.1	56	95	103	64	21	55	2%	#	95%	<0.1
	Magnesium	0.1	38	59	59	32	8.3	37	3%	#	98%	<0.1
	Sodium	0.1	486	553	349	220	193	478	2%	#	99%	<0.1
	Potassium	0.1	17	29	21	13	9.0	17	0%	100%	96%	<0.1

Results expressed in mg/l unless otherwise specified

Comments: # Percent recovery not available due to significant background levels of analyte in sample.

E020.1/E030.1: Sample directly analysed by Flame AAS and/or ICP-OES.

LabMark

Laboratory Report No: 019941
Client Name: Robert Carr and Associates Pty Ltd
Contact Name: Fiona Robinson
Client Reference 4404

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plus cover page
Date: 5/11/04
This report supercedes reports issued on: N/A

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Certificate
of Analysis

Laboratory Identification			**40726**	**40727**	**40728**	**40729**	**40730**	**40726d**	**40726r**	**mb**		
Sample Identification Depth (m) Sampling Date recorded on COC			IEB-1 -- 28/10/04	IEB-2 -- 28/10/04	IEB-5 -- 28/10/04	IEB-6 -- 28/10/04	IEB-40 -- 28/10/04	QC -- --	QC -- --	QC -- --		
Laboratory Extraction (Preparation) Date Laboratory Analysis Date			29/10/04 29/10/04	29/10/04 29/10/04	29/10/04 29/10/04	29/10/04 29/10/04	29/10/04 29/10/04	29/10/04 29/10/04	-- –	29/10/04 29/10/04		
Method 2540D	**Suspended Solids (TSS)** TSS	**EQL** 1	82	140	250	430	45	85	4%	<1		

Results expressed in mg/l unless otherwise specified

Comments:

2540D: Gravimetric test.

LabMark
Quality, Service, Support

Sample **Receipt** Notice (SRN)

Client Details		Laboratory Reference Information	
Client Name:	Robert Carr and Associates Pty Ltd	**Please have this information ready when contacting Labmark.**	
Client Phone:	02 4902 9200		
Client Fax:	02 4902 9299	**Laboratory Report:**	**019941**
Contact Name:	Fiona Robinson	**Quotation Number:**	- Not provided, standard prices apply
Contact Email:	Flonar@rca.com.au	**Laboratory Address:**	Unit 1, 8 Leighton Pl. Asquith NSW 2077
Client Address:	92 Hill Street Carrington NSW 2294	**Phone:**	61 2 9476 6533
		Fax:	61 2 9476 8219
Project Name:	4404		
Project Number:	- Not provided -	**Sample Receipt Contact:**	Ros Schacht
CoC Number:	S0110	**Email:**	ros.schacht@labmark.com.au
Purchase Order:	- Not provided -	**Reporting Contact:**	Jyothi Lal
Surcharge:	No surcharge applied	**Email:**	jyothi.lal@labmark.com.au
Sample Matrix:	WATER		
Date Sampled (earliest date):	28/10/2004	**NATA Accreditation:**	13542
Date Samples Received:	29/10/2004	**TGA GMP License:**	185-336
Date Sample Receipt Notice Issued:	01/11/2004	**TGA Enterprise:**	41681
Date Preliminary Report Due:	05/11/2004	**AQIS Approval:**	NO356
		AQIS Entry Permit:	200409998

Sample Condition:
COC received with samples. Report number and lab ID's defined on COC.
Samples received in good order .
Samples received with cooling media: Crushed ice .
Samples received chilled.
Security seals not required. Direct Labmark's custody taken .
Sample container & sample integrity suitable .

Comments:
Samples tested on the day the THT runs out.

Holding Times:
Date received allows for insufficient time to meet Technical Holding Times.
Note: Samples received 0 day(s) after Technical Holding Times expire. LabMark can not guarantee holding time compliance.

Preservation:
Chemical preservation of samples satisfactory for requested analytes.

Important Notes:
Sample disposal of environmental samples shall be 31 days after laboratory receipt, unless otherwise requested in writing by the client. Sample requested to be held in non-refrigerated storage shall incur $5.00/ sample/ 3 months. Additional refrigerated storage shall incur $40/ sample/ 3 months. Transfer of report ownership from Labmark to the client shall occur once full and final payment has been settled and verified. All report copies may be retracted where full payment does not occur within the agreed settlement period.

Analysis comments:

Subcontracted Analyses:
Suspended Solids (TSS) contracted to Sydney Analytical Laboratories, NATA accreditation No.1884.

Thank you for choosing Labmark to analyse your project samples.
Additional information on www.labmark.com.au

Form QS0012, Rev 8: Date Issued 23/07/04.

PAGE ___ OF ___

S0110 CHAIN OF CUSTODY

Form QS0073, Rev.7 : Date Issued 11/03/20

LABMARK NATA 13542, AQIS N0356

Dispatch samples to:
Geoff Weir
Unit1/8 Leighton Place
Hasquith NSW 2077
Australia

Telephone: 612-9476 6533
Facsimile: 612-9476 8219
After hours (DB): 0409 449684
After hours (IP): 0419 689300
E-mail: labmark@ozemail.com.au
Web : www.labmark.com.au

Client Details

Safety Precaution: laboratory sample bottles may contain preservation acid or chemicals, refer to label on bottle.

Company & Address: RCA AUST Tel:
Project Manager: FIONA ROBINSON Sampler: Fx 49029259
Project Name: Date Required:
Project Number: 4404 Lab. Quote No:

Global Specifications I require:

	YES (tick)
Urgent TAT required? (please circle: 1 day 2 days 3 days ...5... days)	
Fast TAT Guarantee required? (Surcharge may apply - Receipt cutoff time 1.00pm)	
Do you wish any sediment layer present in waters to be excluded from extractions?	
Additional QA/QC reported where sample batches submitted are < 10 samples?	
% extraneous material removed from samples to be reported as per NEPM 5.1.1?	
NATA accredited USEPA methods, where available? (USEPA surcharge applies)	
Electronic data transfer (circle: fax .xls .csv .pdf)?	

Note1: Additional water sample must be submitted for lab. duplicate & spike analysis.
Note2: Contact lab if consolidating multiple analyses into a single sample container.

Analysis Request

Lab. Number	Sample ID	Sample Depth	Sampling Date	Matrix: soil	water	air	paint, filters	other	Container Type (Nat. = unpreserved, Gn=glass, P=plastic)	Combo (circle)	BTEX+VTPH (C5-9) EB220 PT	VHC EB10 PT GCMS	THM EB10 PT GCMS	MTBE EB11 PT GCMS	VAC EB05 PT GCMS	VOC EB16 PT GCMS	TPH (C10-36) EB044	PAH's EB07 GCMS	Phenols EB09 GCMS	Aromatics/ Aliphatic TPH EB12 GC/FID	OC, OP, PCB EB13 GC/ECD/FID	SVOC EB17 GCMS	Explosives EB27 HPLC	Metals* (dissolved / total)	TCLP EB19 (specify test - other)	ZHE TCLP EB19 (specify test - other)	pH, EC EB31 & EB32	NH_3, TKN, N_{total} TN EB36 & EB38	NO_x, NO_3^-, NO_2^- EB37	TP, ortho-P, TKP EB38	Cl, F, SO_4^{2-} EB33, EB34 & EB42	Total Alk, CO_3^{2-}, HCO_3^- EB35	Free CN, WAD, Total CN EB40	Total Phenolics EB41	Major Cations EB30 + Anions	Other (specify TCLP tests here)
40726	IEB-1																							X		X	X	X	X	X	X	X	X	X	
40727	IEB-2																							X		X	X	X	X	X	X	X	X	X	
40728	IEB-5																							X		X	X	X	X	X	X	X	X	X	
40729	IEB-6																							X		X	X	X	X	X	X	X	X	X	
40730	IEB-40																							X		X	X	X	X	X	X	X	X	X	
Totals																																			

Metals (circle): As, Cd, Cr, Cu, Ni, Pb, Zn, Hg, Cr^{6+}, Cr^{3+}, Fe^{2+}, Fe^{3+}, Be, B, Al, V, Mn, Fe, Co, Se, Sr, Sn, Mo, Ag, Ba, Tl

Comments (Highly contaminated samples):

Lab Report No. 019941

Security Seal Applied YES / NO
Security Seal Serial #

Relinquished by (print): Signed: Date: 29/10/04 Received By: RB 29/10 Date: 2pm

Relinquished by (print): Signed: Date: Received By: Date:

RCA Australia

LabMark

CUSTOMER CENTRIC - ANALYTICAL CHEMISTS

No. 13542

NATA is Australia's government-endorsed laboratory accreditor, and a leader in accreditation internationally. NATA is a signatory to the international mutual recognition agreement of the International Laboratory Accreditation Cooperative (ILAC), and the Asian Pacific Laboratory Accreditation Cooperative (APLAC).

APLAC

Quarantine Facility NO356 AQIS

FINAL CERTIFICATE OF ANALYSIS - ENVIRONMENTAL DIVISION

Laboratory Report No:	020037	Cover Page 1 of 3
Client Name:	Robert Carr and Associates Pty Ltd	plus Sample Results
Client Reference:	4404-additional request	
Contact Name:	Fiona Robinson	
Chain of Custody No:	na	Date Received: 8/11/04
Sample Matrix:	WATER	Date Reported: 10/11/04

This Final Certificate of Analysis consists of sample results, DQI's, method descriptions, laboratory definitions, and internationally recognised NATA accreditation and endorsement. The DQO compliance relates specifically to QA/QC results as performed as part of the sample analysis, and may provide an indication of sample result quality. Transfer of report ownership from Labmark to the client shall only occur once full & final payment has been settled and verified. All report copies may be retracted where full payment has not occured within the agreed settlement period.

QUALITY ASSURANCE CRITERIA

Accuracy:	matrix spike:	1 in first 5-20, then 1 every 20 samples
	lcs, crm, method:	1 per analytical batch
	surrogate spike:	addition per target organic method
Precision:	laboratory duplicate:	1 in first 5-10, then 1 every 10 samples
	laboratory triplicate:	re-extracted & reported when duplicate RPD values exceed acceptance criteria
Holding Times:	soils, waters:	Refer to LabMark Preservation & THT table VOC's 14 days water / soil VAC's 7 days water or 14 days acidified VAC's 14 days soil SVOC's 7 days water, 14 days soil Pesticides 7 days water, 14 days soil Metals 6 months general elements Mercury 28 days
Confirmation:	target organic analysis:	GC/MS, or confirmatory column
Sensitivity:	EQL:	Typically 2-5 x Method Detection Limit (MDL)

QUALITY CONTROL GLOBAL ACCEPTANCE CRITERIA (GAC)

Accuracy:	spike, lcs, crm surrogate:	general analytes 70% - 130% recovery phenol analytes 50% - 130% recovery organophosphorous pesticide analytes 60% - 130% recovery
	anion/cation bal:	+/- 10% (0-3 meq/l), +/- 5% (>3 meq/l)
Precision:	method blank:	not detected >95% of the reported EQL
	duplicate lab RPD (metals):	0-30% (>10xEQL), 0-75% (5-10xEQL) 0-100% (<5xEQL)
	duplicate lab RPD:	0-50% (>10xEQL), 0-75% (5-10xEQL) 0-100% (<5xEQL)

QUALITY CONTROL ANALYTE SPECIFIC ACCEPTANCE CRITERIA (ASAC)

Accuracy:	spike, lcs, crm surrogate:	analyte specific recovery data <3xsd of historical mean
Uncertainty:	spike, lcs:	measurement calculated from historical analyte specific control charts

RESULT ANNOTATION

DQO:	Data Quality Objective	s:	matrix spike recovery	p:	pending
DQI:	Data Quality Indicator	d:	laboratory duplicate	lcs:	laboratory control sample
EQL:	Estimated Quantitation Limit	t:	laboratory triplicate	crm:	certified reference material
^ - - :	not applicable	r:	RPD relative % difference	mb:	method blank

David Burns
Quality Control (Report signatory)
david.burns@labmark.com.au

Geoff Weir
Authorising Chemist (NATA signatory)
geoff.weir@labmark.com.au

Simon Mills
Authorising Chemist (NATA signatory)
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CUSTOMER CENTRIC - ANALYTICAL CHEMISTS

Laboratory Report: 020037

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NEPC GUIDELINE COMPLIANCE - DQO

1. GENERAL

A. Results relate specifically to samples as received. Sample results are not corrected for matrix spike, lcs, or surrogate recovery data.

B. EQL's are matrix dependant and may be increased due to sample dilution or matrix interference.

C. Laboratory QA/QC samples are specific to this project.

D. Inter-laboratory proficiency results are available upon request. NATA accreditation details available at www.nata.asn.au.

E. VOC spikes & surrogates added to samples during extraction, SVOC spikes & surrogates added prior to extraction.

F. Recovery data outside GAC limits shall be investigated and compared to ASAC (historical mean +/- 3sd). If recovery data <20%, then the relevant results for that compound are considered not reliable.

G. Recovery data (ms, surrogate, crm, lcs) outside ASAC limits shall initiate an investigative action. Anomolous QC data is examined in conjunction with other QC samples and a final decision whether to accept or reject results is provided by the professional judgement of the senior analyst. The USEPA-CLP National Functional Guidelines are referred to for specific recommendations.

H. Extraction (preparation) date refers to the date that sample preparation was initiated. Note that certain methods not requiring sample preparation (eg. VOCs in water, etc) may report a common extraction and analysis date.

I. LabMark shall maintain an official copy of this Certificate of Analysis for all tracable reference purposes.

2. CHAIN OF CUSTODY (COC) & SAMPLE RECEIPT NOTICE (SRN) REQUIREMENTS

A. SRN issued to client upon sample receipt & login verification.

B. Preservation & sampling date details specified on COC and SRN, unless noted.

C. Sample Integrity & Validated Time of Sample Receipt (VTSR) Holding Times verified (preservation may extend holding time, refer to preservation chart).

3. NATA ACCREDITED METHODS

A. NATA accreditation held for each method and sample matrix type reported, unless noted below.

B. NATA accredited in-house laboratory methods are referenced from NEPC, ASTM, modified USEPA / APHA documents.

C. Subcontracted analyses:

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CUSTOMER CENTRIC - ANALYTICAL CHEMISTS

Laboratory Report: 020037

Cover Page 3 of 3

4. QA/QC FREQUENCY COMPLIANCE TABLE SPECIFIC TO THIS REPORT

Matrix: **WATER**

Page:	Method:	Totals:	#d	%d-ratio	#t	#s	%s-ratio
1	Sulphate	5	1	20%	0	1	20%

NEPC guideline for laboratory duplicates is 1 in 10 samples (10%).
USEPA guideline for laboratory matrix spikes is 1 in 20 samples (5%).

5. ADDITIONAL COMMENTS SPECIFIC TO THIS REPORT

A. Samples tested outside THT, refer to SRN comment.

Laboratory QA/QC Self Assessment data shall relate specifically to this report, and may only provide an indication of sample result quality. Acceptance of this Self Assessment certificate does not preclude any requirement for a QA/QC review by a accredited contaminated site EPA auditor, when and wherever necessary. Laboratory QA/QC Self Assessment references available upon request.

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p: 61-2-9476 6533 f: 61-2-9476 8219 w: www.labmark.com.au

Laboratory Report No:	020037	**Page:** 1 of 1	Final
Client Name:	Robert Carr and Associates Pty Ltd	plus cover page	Certificate
Contact Name:	Fiona Robinson	**Date:** 10/11/04	of Analysis
Client Reference	4404-additional request	This report supercedes reports issued on: N/A	

Laboratory Identification			**41775**	**41776**	**41777**	**41778**	**41779**	**41775d**	**41775r**	**41776s**	**lcs**	**mb**
Sample Identification			IEB-1	IEB-2	IEB-5	IEB-6	IEB-40	QC	QC	QC	QC	QC
Depth (m)			--	--	--	--	--	--	--	--	--	--
Sampling Date recorded on COC			28/10/04	28/10/04	28/10/04	28/10/04	28/10/04	--	--	--	--	--
Laboratory Extraction (Preparation) Date			9/11/04	9/11/04	9/11/04	9/11/04	9/11/04	9/11/04	--	9/11/04	9/11/04	9/11/04
Laboratory Analysis Date			9/11/04	9/11/04	9/11/04	9/11/04	9/11/04	9/11/04	--	9/11/04	9/11/04	9/11/04
Method	**Sulphate**	**EQL**										
E042.1	Sulphate	2	100	250	200	63	3	99	1%	#	91%	<2

Results expressed in mg/l unless otherwise specified

Comments: # Percent recovery not available due to significant background levels of analyte in sample.

E042.1: Determination by colour.

LabMark
Quality, Service, Support

Sample **Receipt** Notice (SRN)

Client Details		Laboratory Reference Information	
		Please have this information ready when contacting Labmark.	
Client Name:	Robert Carr and Associates Pty Ltd	**Laboratory Report:**	**020037**
Client Phone:	02 4902 9200	**Quotation Number:**	- Not provided, standard prices apply
Client Fax:	02 4902 9299	**Laboratory Address:**	Unit 1, 8 Leighton Pl. Asquith NSW 2077
Contact Name:	Fiona Robinson	**Phone:**	61 2 9476 6533
Contact Email:	Fionar@rca.com.au	**Fax:**	61 2 9476 8219
Client Address:	92 Hill Street Carrington NSW 2294	**Sample Receipt Contact:**	Ros Schacht
		Email:	ros.schacht@labmark.com.au
Project Name:	4404-additional request	**Reporting Contact:**	Jyothi Lal
Project Number:	- Not provided -	**Email:**	jyothi.lal@labmark.com.au
CoC Number:	- Not provided -		
Purchase Order:	- Not provided -		
Surcharge:	No surcharge applied		
Sample Matrix:	WATER		
Date Sampled (earliest date):	28/10/2004	**NATA Accreditation:**	13542
Date Samples Received:	08/11/2004	**TGA GMP License:**	185-336
Date Sample Receipt Notice Issued:	08/11/2004	**TGA Enterprise:**	41681
Date Preliminary Report Due:	15/11/2004	**AQIS Approval:**	NO356
		AQIS Entry Permit:	200409998

Sample Condition:
COC received with samples. Report number and lab ID's defined on COC.
Samples received in good order .
Samples received with cooling media: Fridge .
Samples received chilled.
Security seals not applicable. Samples in LabMark's custody .
Sample container & sample integrity suitable .

Comments:
SO4 tested outside THT as per client's request. Additional request for Labmark job No. 019941.

Holding Times:
Date received allows for insufficient time to meet Technical Holding Times.
Note: Samples received 4 day(s) after Technical Holding Times expire. LabMark can not guarantee holding time compliance.

Preservation:
Chemical preservation of samples satisfactory for requested analytes.

Important Notes:
Sample disposal of environmental samples shall be 31 days after laboratory receipt, unless otherwise requested in writing by the client. Sample requested to be held in non-refrigerated storage shall incur $5.00/ sample/ 3 months. Additional refrigerated storage shall incur $40/ sample/ 3 months. Transfer of report ownership from Labmark to the client shall occur once full and final payment has been settled and verified. All report copies may be retracted where full payment does not occur within the agreed settlement period.

Analysis comments:

Subcontracted Analyses:

Thank you for choosing Labmark to analyse your project samples.
Additional information on www.labmark.com.au

Form QS0012, Rev 8: Date Issued 23/07/04.

PAGE ____ OF ____

s0110 CHAIN OF CUSTODY

Form QS0073, Rev.7 : Date issued 11/03/20

LABMARK NATA 13542, AQIS N0358

Dispatch samples to: Geoff Wek, Unit1/8 Leighton Place, Asquith NSW 2077, Australia

Telephone: 612-9476 6533
Facsimile: 612-9476 8219
After hours (DB): 0409 449684
After hours (IP): 0419 689300
E-mail: labmark@ozemail.com.au
Web: www.labmark.com.au

Client Details

Safety Precaution: laboratory sample bottles may contain preservation acid or chemicals, refer to label on bottle.

Company & Address: KCA AUST
Tel:
Project Manager: FIONA ROBINSON Sampler:
Fx: 49029259
Project Name:
Date Required:
Project Number: 4404
Lab. Quote No:

Global Specifications I require:

YES (tick)

- Urgent TAT required? (please circle: 1 day 2 days 3 days 5 days)
- Fast TAT Guarantee required? (Surcharge may apply - Receipt cutoff time 1.00pm)
- Do you wish any sediment layer present in waters to be excluded from extractions?
- Additional QA/QC reported where sample batches submitted are < 10 samples?
- % extraneous material removed from samples to be reported as per NEPM 5.1.1?
- NATA accredited USEPA methods, where available? (USEPA surcharge applies)
- Electronic data transfer (circle: fax .xls .csv .pdf)?

Note1: Additional water sample must be submitted for lab. duplicate & spike analysis.
Note2: Contact lab if consolidating multiple analyses into a single sample container.

Analysis Request

Lab. Number	Sample ID	Sample Depth	Sampling Date	Metals	pH, EC	Cl, F, SO_4	Major Cations + Anions	Other (TSS)
[illegible]40726	IEB-1			X	X	✓	X	X
[illegible]40727	IEB-2			X	X	✓	X	X
[illegible]40728	IEB-5			X	X	✓	X	X
[illegible]40729	IEB-6			X	X	✓	X	X
[illegible]40730	IEB-40			X	X	✓	X	X

(Additional requested by phone 3/11)

Totals

Metals (circle): As, Cd, Cr, Cu, Ni, Pb, Zn, Hg, Cr^{6+}, Cr^{3+}, Fe^{2+}, Fe^{3+}, Be, B, Al, V, Mn, Fe, Co, Se, Sr, Sn, Mo, Ag, Ba, Tl

Comments (Highly contaminated samples):

Lab Report No. 010941

Security Seal Applied YES / NO
Security Seal Serial #

Relinquished by (print): Signed: [signature] Date: 29/10/14 Received By: RB 29/10 Date: 2pm
Relinquished by (print): Signed: Date: Received By: Date:

New Job No [illegible]

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