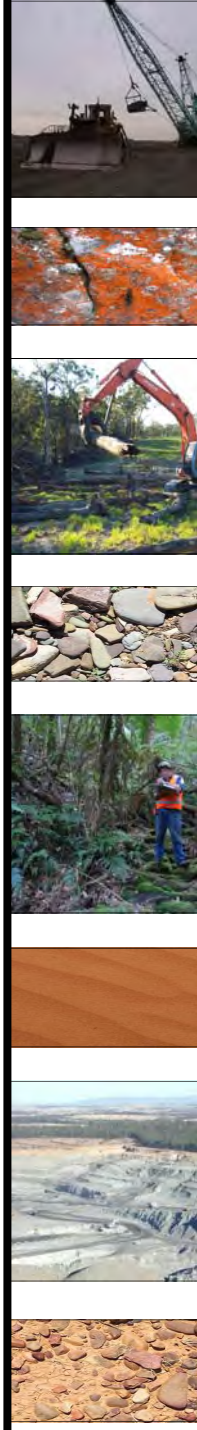
Hydrogeological Assessment (Douglas Partners 2010)



APPENDIX R

Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Hydrogeological Assessment for
Rocglen Coal Mine Extension Project

Rocglen Coal Mine
Via Gunnedah

Prepared for
Whitehaven Coal Limited

Project 49532.01
December 2010

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	49532.01	Document No.	1
Document title	Report on Hydrogeological Assessment for Rocglen Coal Mine Extension Project		
Site address	Rocglen Coal Mine Via Gunnedah		
Report prepared for	Whitehaven Coal Limited		
File name	P:\49532.01\Docs\49532.01 New.doc		

Document status and review

Revision	Prepared by	Reviewed by	Date issued
0	Will Wright & Iain Hair	Carl Deegan	16 December 2010

Distribution of copies

Revision	Electronic	Paper	Issued to
0	1	3	E Bath, GSS Environmental

The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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Table of Contents

Page

Text Figures

Report on Hydrogeological Assessment for Rocglen Coal Mine Extension Project Rocglen Coal Mine Via Gunnedah

1. Introduction

Whitehaven Coal Limited (WHC) is planning an expansion of the Rocglen Coal Mine, located approximately 25 km north of Gunnedah and 23 km southeast of Boggabri in North West NSW.

GSS Environmental (GSSE) is project managing the compilation of an Environmental Assessment (EA) for the expansion. WHC has commissioned Douglas Partners Pty Ltd (DP) to address hydrogeological (groundwater) components of the EA.

Rocglen Coal Mine has been operating for approximately 18 months and has an existing approval within ML 1620. The location of Rocglen Mine is shown on Drawing 1 in Appendix E.

2. Site Description

2.1 Data Sources

Data utilised in this investigation included:

- Topographic and geological mapping;
- Coal exploration drilling data provided by WHC;
- Information from the NSW Office of Water Groundwater Database;
- Previous investigation reports; and
- Groundwater monitoring data (levels and water quality) provided by WHC.

The above information was supplemented by a site visit / inspection undertaken by DP Principal Mr Will Wright, and discussions held with WHC personnel.

2.2 Previous Investigations

Coal Exploration Reports 1993 to 1994

Two coal exploration reports by McElroy Bryan Geological Services Pty Ltd were provided for the study. The reports are summarised as follows:

1993 Program (MBGS, 1993)

Two lines of bores were drilled, oriented in an east-west direction and spanning across the Belmont Fault which passes immediately to the east of the mine.

The northern drill line comprised 10 bores over a distance of 440 m, located about 2 km north of the proposed extent of mining. Drilling results indicated between about 10 m and 45 m of colluvium/weathered zone. Several thin coal seams were identified below about 70 m depth on the western parts of the site, with no coal seam on the eastern parts of the site. The basement of the coal measures was identified immediately below the weathered zone on the eastern parts of the site, indicating a substantial upthrust to the east of the Belmont Fault.

The southern line of bores, which passes through the northern end of the proposed extent of mining, comprised 10 bores over a distance of about 350 m and indicated no weathered zone/colluvium on the western parts of the site and between 10 m and 20 m of weathered zone/colluvium on the eastern parts of the proposed mine extent, becoming slightly deeper to the east of the mine. Several coal seams were identified on the western parts of the site below about 40 m to 70 m depth, ranging up to about 20 m in thickness. No coal seams were identified on the eastern side of the Belmont Fault, with the basement of the coal measures immediately below the weathered zone.

Groundwater depths were measured in some of the bores and were in the range 40 m to 53 m, well below the depth of the alluvium. Groundwater inflow rates were measured in the bores and generally ranged from 0.8 L/s to 3.4 L/s. A flow rate of 12 L/s was measured in one bore at a depth of 108 m, however this was in a fault zone.

1994 Program (MBGS, 1994)

This report included drilling results for an additional five bores, which were generally consistent with previous results. Comments were also provided regarding the potential for coal resources, including the following:

- The site is located in the eastern portion of the Maules Creek Sub-basin and is truncated to the east by the Mooki Thrust Fault System;
- There are numerous northwest to southeast trending structures parallel to the Mooki Thrust which limit the potential for coal resources, with no potential for coal resources to the east of the Belmont Fault;
- There is an east-west lineament (Driggle Draggle Fault) to the north of the site, with limited coal reserves to the north of this lineament; and
- Coal is moderately to extremely faulted and steeply dipping.

Groundwater Assessment 2002

A groundwater assessment was undertaken by Robert Carr & Associates Pty Ltd in 2002. A draft copy of the report text (RCA, 2002) was made available for this assessment. RCA (2002) provided the following:

- Installation of three piezometers in existing bores; one bore was screened in the Belmont Seam (EVK64), another in the Glenroc Seam (EVK25) and the third in the inter-burden between the seams (EVK64);
- Falling head tests on each bore were undertaken to assess hydraulic parameters, and indicated permeability in the range 7 x 10^{-7} m/s to 9 x 10^{-7} m/s in the coal seams and 1 x 10^{-8} m/s for the inter-burden strata;
- Groundwater depths were measured and ranged from 31.9 m to 37.3 m;
- A pumping test was undertaken on an existing registered bore (GW016874) which was screened across the Belmont Seam and underlying sandstone floor. The test was continued for 8 hours and indicated permeability in the range 4 x 10^{-6} m/s to 5 x 10^{-6} m/s;
- Rock core was inspected and no pervasive partings/fractures were noted, indicating that the inter-burden strata did not contain any moderate to high permeability layers;
- A conceptual hydrogeological model (CHM) was developed for the site which indicated the main water bearing zones or aquifers were in the coal seams with minor water bearing zones in the inter-burden rocks;
- Groundwater was sampled at nine locations and indicated that the water generally did not meet drinking water requirements, with some exceedences of irrigation guidelines. The groundwater is generally suitable for livestock watering; and
- A numerical groundwater flow model was set up and run in steady state to assess potential mine inflows and drawdowns in surrounding wells. Inflows were predicted to be initially about 7,500 m^3/day, reducing to 1,000 m^3/day after 10 years. Drawdown in surrounding wells was estimated to range from 0.7 m to 39.8 m.

Groundwater Impact Assessment, 2007

A groundwater impact assessment was carried out by Robert Carr & Associates Pty Ltd in 2007 (RCA, 2007). The assessment included the following:

- Water level survey of 14 bores;
- Sampling and testing of 4 groundwater samples;
- Additional numerical groundwater flow modelling;
- The report concluded that a 2 m groundwater drawdown could occur a distance of 5 km from the mine and predictions of flows in the range 1643 to 2235 m^3/day; and
- Recommendations were made with regard to ongoing groundwater monitoring.

2.3 Consultations

Consultation was undertaken with Mr Martin O'Rourke of the NSW Office of Water (NOW) with regard to their requirements. Mr O'Rourke indicated that NOW's main concern with the expansion of Rocglen Coal Mine was the possible affect on the Namoi Alluvium which is subject to a fully allocated water sharing plan. He indicated that Rocglen Coal Mine had an existing allocation of water from the Namoi Alluvium and the groundwater assessment for the expansion would need to assess if drainage of groundwater into the coal mine was likely to lead to extraction of water from the alluvium and if so, the predicted extraction rate compared to the existing licence.

It was noted by DP that the presence of extensive faulting around the site would complicate any modelling and that the extent of the model would be significantly less than the RCA model as the previous model did not take account of the limited extent of the coal seams. NOW indicated that in terms of the previous model by RCA, the model was probably more extensive in plan than necessary, however more importantly did not represent the Namoi Alluvium satisfactorily. It was noted that the alluvium is known to be up to 100 m thick in some places and the RCA model used a 10 m alluvium thickness.

3. Regional Setting

3.1 Topography and Drainage

Rocglen Coal Mine is located within a 3 km wide valley between elevated areas in the Vickery State Forest to the west, and Community Conservation Area (CCA) Zone 2 – Kelvin to the east (Drawing 2). The elevation of the land reaches a maximum of 479 m AHD at Bull Mountain within the Vickery State Forest. CCA Zone 2 covers much of a north-south trending ridge. The survey mark of Tulcomba is located on the ridge line at an elevation of 885 m AHD.

The land surface within ML 1620 grades from 300 m AHD on the northwestern boundary to 280 m AHD on the southwestern boundary with slopes ranging between 0.5 degrees and 8 degrees.

An ephemeral creek in the valley commences near the mine and flows in a southerly and westerly direction toward the Namoi River, which is approximately 10 km from the mine site. A second creek, named Driggle Draggle Creek, flows to the north and also eventually joins the Namoi River. The valley deepens in this northerly direction and directs surface water away from the mine site.

3.2 Geology

The project area lies within the sedimentary units of the Gunnedah Basin, which covers an area of over 15000 km^2 in North West NSW. The basin is elongated in a north-south direction, widening into the Sydney Basin at it's southern boundary. The Gunnedah sedimentary sequence of Permian age uncomfortably overlies Ordovician-Devonian metamorphic strata of the Lachlan Fold Belt. The Gunnedah Basin is bounded to the west by Lachlan Fold strata and to the east by the Hunter-Mooki Thrust and associated New England Fold Belt strata (Drawing 3).

Rocglen Coal Mine is situated within the Maules Creek Sub-basin which is characterised by the following geologic units, as identified from Raymond, et. al. (2007):

- **Willuri Formation** (Early Permian): rhyolitic to andesitic ignimbrites, rhyolite flows and dacite domes, interbedded with ash-rich siltstone and volcanolithic sandstone and conglomerate;
- **Maules Creek Formation** (Middle Permian): basal carbonaceous claystone, sandstone and minor coal, progressing into normally graded, inter-bedded sandstone/siltstone and coal measures with conglomerate dominant near top;
- **Colluvium** (Quaternary): colluvium and/or residual deposits, talus, sheet wash and scree boulders, gravels and sands; and
- **Alluvium** (Quaternary): channel and floodplain gravels, sands and silts.

The mine is located within an outcrop area of the Maules Creek Formation with Quaternary alluvium and colluvium straddling topographic lows to both the north and south. The Willuri Formation (New England Fold Belt strata) and associated Hunter-Mooki Thrust occur approximately 3.5 km east of the mine, and form the eastern margin of the Gunnedah Basin.

Three economic coal seams relevant to the Rocglen Coal Mine and proposed extension comprise the Upper and Lower Glenroc Seams and the Belmont Seam. The Belmont Seam, with an average thickness of 8 m across the mine site is the main economic target. A local northwest trending anticline and localised northwest trending fault system influence the Maules Creek Sub-basin strata in the vicinity of the mine. The Belmont Fault intersects the northeast portion of the current Rocglen Mine. Structure contours of the Belmont Seam are shown in Drawing 4.

3.3 Climate

Climatic data for the region were sourced from Bureau of Meteorology (BoM) SILO Database system using the Data Drill option, for the latitude and longitude co-ordinates of Rocglen Coal Mine. The Data Drill accesses grids of data derived by interpolating the BoM's station records. Interpolations are calculated by splining and kriging techniques. The data in the Data Drill are all synthetic; there are no original meteorological station data left in the calculated grid fields. However, the Data Drill does have the advantage of being available for any set of co-ordinates in Australia.

Rainfall and evaporation data were analysed to produce long term average monthly rainfall and evaporation totals for the mine site and surrounding region. Long term average monthly rainfall and evaporation totals are presented in Table 1, and plotted in graphical form on Drawing 5.

Table 1 - Long Term Average Monthly Rainfall and Evaporation Totals

Month	Rainfall (mm)	Evaporation (mm)	Evaporation / Rainfall
January	78	246	3.2
February	63	199	3.1
March	49	186	3.8
April	38	128	3.4
May	43	82	1.9
June	45	55	1.2
July	45	59	1.3
August	40	86	2.1
September	40	123	3.1
October	54	175	3.2
November	59	205	3.5
December	64	249	3.9
Annual	**618**	**1793**	**2.9**

Notes: Shaded cells indicate higher rainfall months

Table 1 shows that the four wettest months of the year (November to February inclusive) account for a little over 40% of total annual rainfall. Monthly rainfall totals are relatively even throughout the year with the four months May to August accounting for almost 30% of total annual rainfall.

Evaporation is highest in the summer months, with evaporation exceeding rainfall by almost three times. In the winter months of June and July, evaporation is only slightly in excess of rainfall. During the winter months, significant rainfall events have the potential to result in groundwater recharge because of the relatively low total evaporation during this period. Table 2 lists monthly total rainfall and evaporation for the period June 2008 to February 2010, and compares monthly totals with long-term averages for each month

Table 2 - Monthly Rainfall and Evaporation Totals, June 2008 to February 2010

Month-Year	Recorded Rainfall (mm)	Monthly Average Rainfall (mm)	Recorded Evaporation (mm)	Monthly Average Evaporation (mm)
Jun-2008	58	45	60	54.8
Jul-2008	25	45	66	59.2
Aug-2008	33	40	86	86.4
Sep-2008	***90***	40	117	123.5
Oct-2008	***81***	54	176	174.7
Nov-2008	***99***	59	***176***	204.8
Dec-2008	84	64	***211***	249.2
Jan-2009	18	78	249	245.7
Feb-2009	91	63	206	198.8
Mar-2009	1	49	195	186.3
Apr-2009	44	38	124	127.7
May-2009	33	43	90	81.6
Jun-2009	35	45	57	54.8
Jul-2009	24	45	65	59.2
Aug-2009	8	40	112	86.4
Sep-2009	47	40	138	123.5
Oct-2009	49	54	193	174.7
Nov-2009	25	59	270	204.8
Dec-2009	***134***	64	267	249.2
Jan-2010	***114***	78	226	245.7
Feb-2010	80	63	167	198.8

Notes: Shaded cells indicate monthly rainfall totals considerably in excess of long-term averages.
Shaded cells indicate monthly evaporation totals considerably less than long-term averages.

Table 2 shows that since the mine began operating, there have been two periods (September to November 2008 and December 2009 to January 2010) during which higher than average monthly rainfall totals have been recorded. Table 2 also shows that for the months of November and December 2008, evaporation was considerably less than the long term average for these months.

4. Project Description

4.1 Existing Approval

The Rocglen Coal Mine (formally known as Belmont Coal Project) was originally approved by the Minister on the 15 April 2008 under PA 06_0198. It was classified as a Major Project in accordance with the *State Environmental Planning Policy (Major Projects) 2005* and, subsequently, was determined under Part 3A of the *EP&A Act.* Whitehaven commenced coal production at Rocglen in late 2008.

In summary, the key activities approved are:

a) **Coal Mining by Open Cut Mining Methods –** extraction of coal by open cut mining methods within an area of approximately 114 hectares. This involves the extraction of three (3) separate coal seams with a combined thickness of up to 17 m, at an approved production rate of 1.5 million tonne per annum (Mtpa);

b) **Open Cut Mining by Auger Mining –** extraction of additional coal reserves that are uneconomical to extract by open cut mining methods using auger mining techniques;

c) **On-Site Coal Processing –** transfer of mined coal by haul truck to a coal handling and processing area located immediately south of the limit of open cut mining for crushing, screening and loading into single or B-double trucks for transport off-site;

d) **Transportation –** crushed and screened coal is transported to the Whitehaven Coal Handling and Processing Plant (CHPP) around 6 km west of Gunnedah;

e) **Relocation of Public Roads –** relocation of sections of Wean Road (not yet undertaken) and Jaeger Lane (completed) to allow for open-cut mining activities and infrastructure within these areas;

f) **Biodiversity Offset Strategy –** implement the biodiversity offset strategy to compensate for the direct loss of 95.44 ha of vegetation in various states and replacement offsets for impacts to 47.9 ha of the 131.84 ha of approved offsets on a 'like for like' basis with over 525 ha of vegetation in the Whitehaven Regional Biobank Site; and

g) **Rehabilitation –** progressive use of out-of-pit and in-pit overburden emplacements to shape and recreate the landform comparable to that of the pre-mining environment.

Based on the open cut reserves at time of approval and a maximum production rate of 1.5 Mtpa, Rocglen has a current projected life for coal extraction of between 8 to 10 years under the existing Project Approval.

4.2 Existing Groundwater Licences

Rocglen Mine currently has three groundwater extraction licences, the details of which are summarised in Table 3.

Table 3 - Rocglen Mine Groundwater Extraction Licences

Licence Number	Date of Issue	Valid Until	Allocation	Conditions
Aquifer Interference (90BL254684)	12-May-09	11-May-14	700 ML/a	Metering and annual (July) reporting, development of model, monitoring of groundwater levels and quality.
Linked Groundwater Licence (90BL254758)	18-Jan-10	17-Jan-15	120 ML/a (Total combined as linked licence)	Metering and annual (July) reporting, development of model, monitoring of groundwater levels and quality.
Linked Groundwater Licence (90BL255249)	18-Jan-10	17-Jan-15		Metering and annual (July) reporting, monitoring of groundwater levels and quality (requirements outlined in detail – See below).

Environmental monitoring for 90BL255249 licence includes the following conditions:

- Desired Outcome: Monitor and record environmental impacts on the local environment;
- Monitor the surface water level (SWL) and saturated thickness and water quality of the following registered bores:
    - GW050395, GW050166, and GW011066 on the Glenroc Property;
    - GW045621 on the Yarrawonga Property;
    - GW044068 and GW044069 on the Yarrari Property;
    - GW022319 on the Roseberry Property;
    - GW013369 on the Brolga Property.
- Timing - SWL and saturated thickness quarterly, water quality annually (subject to review).
- Construct and monitor the SWL of the three piezometers on proponent owned land between the open cut and the nearest non-project related groundwater bores.
- Timing - Continuously (data logger) with downloads monthly;
- Monitor water quality of the in-pit sump.
- Timing - 6 monthly;
- Prepare and implement a groundwater monitoring program, in consultation with DECCW, NOW and DOP.

Timing - Before commencement of mining.

The bores required to be monitored as part of the programme are listed in Table 4 below.

Table 4 - Bores to be Monitored as Condition for Licence 90BL255249

Easting	Northing	Bore ID	WHC Number	Property	Depth	Aquifer
239949	6596450	GW050395	WB02	Glenroc	36.6	Unknown
239379	6595789	GW050166	WB03	Glenroc	18.3	Well - unknown
239607	6595178	GW011066	WB05	Glenroc	47.9	Maules Creek Fmn
237808	6595812	GW045621	WB04	Yarrawonga	10.0	Unknown
241030	6594658	GW044068	WB06	Yarrari	43.6	Maules Creek Fmn
240970	6594934	GW044069 (1)	Not Monitored[3]	Yarrari	47.9	Maules Creek Fmn
239299	6592520	GW022319	WB07	Roseberry	52.4	Maules Creek Fmn
236815	6588545	GW013369 (2)	Not Monitored[3]	Brolga	22.3	Unknown

Notes: 1. Closest monitored bore is WB06, ~0.48 km distant

2. Closest monitored bore is WB12, ~1.25 km distant

3. These bores are not serviceable and are not required to be monitored as part of Rocglen's Site Water Management Plan which is approved by NOW.

4.3 Current Mine Status

General

A site visit was undertaken on 4 February 2010 by a DP Principal Groundwater Engineer. The visit included the following:

- Inspection of the existing open cut operations;
- Discussions with Rocglen Project Manager, Tony Heinrich, regarding site water management;
- Overview of monitoring well locations;
- Discussions with Whitehaven Coal Geologist, Mark Dawson, regarding the regional geology of the area; and
- Obtaining geological and bore data from recent coal exploration.

Open Cut Pit:

- Current operations were focussed on the northern end of the pit;
- In the northwest end, the Belmont Seam was exposed at the base of the pit at about RL 220 m AHD. The Upper and Lower Glenroc Seams were not present in this location. A shear zone was evident in the northern face of the pit;
- In the northeast end of the pit, to the east of the shear zone, the Glenroc Seam was exposed at the base of the cut, on a slightly higher bench level of RL 230. It is understood that the strata dips steeply to the east at this location and the Belmont Seam has not yet been excavated;
- The faces of all the seams exposed in the pit were dry;
- The Belmont Seam has been excavated on the eastern side of the pit, south of the current face and in this location it is understood that minor seepage occurred. It is understood that a 4" suction pump ran for about one quarter of the time when this face was exposed. No seepage has been observed in any other locations within the pit.

Photo 1 - Northern face showing shear zone with Belmont Seam to the west and Glenroc Seams to the east

Photo 2 - Belmont Seam exposed in the northern face of the pit

Local Geology

Discussions with mine staff indicated the following:

- The pit area includes three seams: Upper and Lower Glenroc, as well as the underlying Belmont Seam. There is an anticline aligned in an approximate north-south direction. The floor of the Belmont Seam is generally at about RL 240 to RL 260 m AHD along the central axis of the anticline, dropping to about RL 180 to RL 200 m AHD on the eastern and western sides of the pit;
- Although the main fault is to the east (as described below) there is some minor faulting in the northern face of the pit. In the northwest corner of the pit, the Belmont seam is evident and the Glenroc seams are eroded. In the northeast corner of the pit, the Glenroc Seams are present near the base of the pit and the Belmont Seam is still to be excavated (although it has already been excavated to the south);
- The strata overlying the coal seams in the pit is generally a conglomerate;
- There is a major fault (Belmont Fault) to the east of the proposed extent of mining. This fault is in an approximate northwest to southeast orientation and defines the eastern extent of the proposed mining. This is because there is an upthrow to the east, and the Belmont and Glenroc seams are not present as they have been eroded. There are some minor seams present but they correlate with seams well below the Belmont and Glenroc Seams;
- Further to the east there is the Mooki Thrust, to the east of which are volcanics associated with the mountain range;
- To the west and south of the site is the Roseberry Fault which is sub-parallel to the Belmont Fault and the strata to the west of this is down thrust by an estimated 100 to 150 m; however there is very little bore data in this area as it is a State Forest. This fault separates the site from the Namoi Alluvium to the south;

- Further west there are several other faults with the strata to the west up thrust in each case. Between the Karu Fault and the Wamboola Fault the coal is shallow again and outcrops in several locations. There are several abandoned open cut remnants in this area, within the former Vickery Mine area. The Namoi River is just to the west of the former Vickery Mine; and
- To the north of the site is the Driggle Draggle Lineament, which runs orthogonal to the Belmont and Roseberry Faults in an approximate northeast to southwest orientation.

Drawing 6 shows the location of the faults relative to the site and the proposed extent of mining.

4.4 Proposed Expansion

Following further drilling and definition of the local geological features, as well as additional reviews of the mine plan, Whitehaven proposes to expand operations at the Rocglen Coal Mine in order to maximise coal recovery and allow for improved mine progression.

The primary components of the Rocglen Project, over and above the current operations, relevant to the groundwater assessment are summarised below:

a) **Expansion of Open Cut Pit** – expansion of the open cut pit design limit in order to access an additional 4.5 to 5 Mt of coal not previously considered in the life of mine plan, which will increase coal recovery by close to 30%. The footprint of the open cut pit will increase by approximately 50 ha from the currently approved 114 ha to approximately 164 ha. Coal will be extracted from the expanded pit using the current open cut mining methods approved at Rocglen, and at the existing production rate of 1.5 Mtpa. The increase in extent is typically less than an additional 50 m width on the western and southern sides of the pit and locally up to about 250 m additional width on the eastern side; and

b) **Extension to Life of Mine** – based on the current coal production rate at Rocglen of 1.5 Mtpa, which will be maintained, it is anticipated that extraction activities will occur for approximately 10 years following the issue of Project Approval and the mining lease. This represents in increase to the project life of mine, for coal extraction, of between 2 and 4 years.

The proposed excavation sequencing will comprise a continuation towards the northern end of the extent in about 2011, followed by a retreat to the south, extending out to the eastern and western boundaries towards the central sections, then to the southern end along the western boundary, completing on the mid eastern side. The sequencing is illustrated in Figures 1 to 3 which show the active face as green for Years 1 and 5 of the expanded operation and at end of mine life, which is anticipated to be around 10 years following commencement of the expanded operation. .

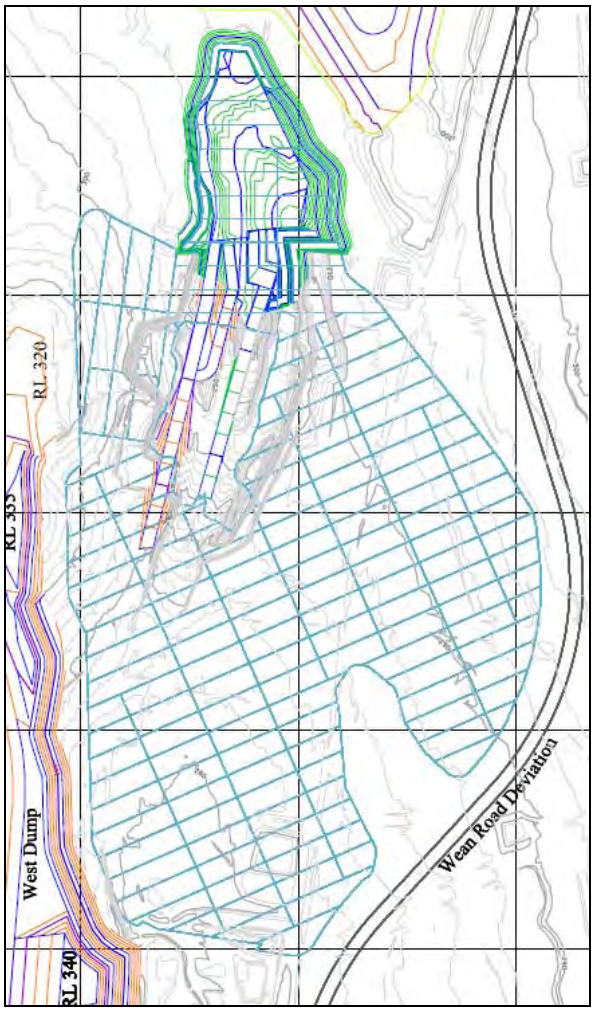

Figure 1 – Mine Plan Year 1

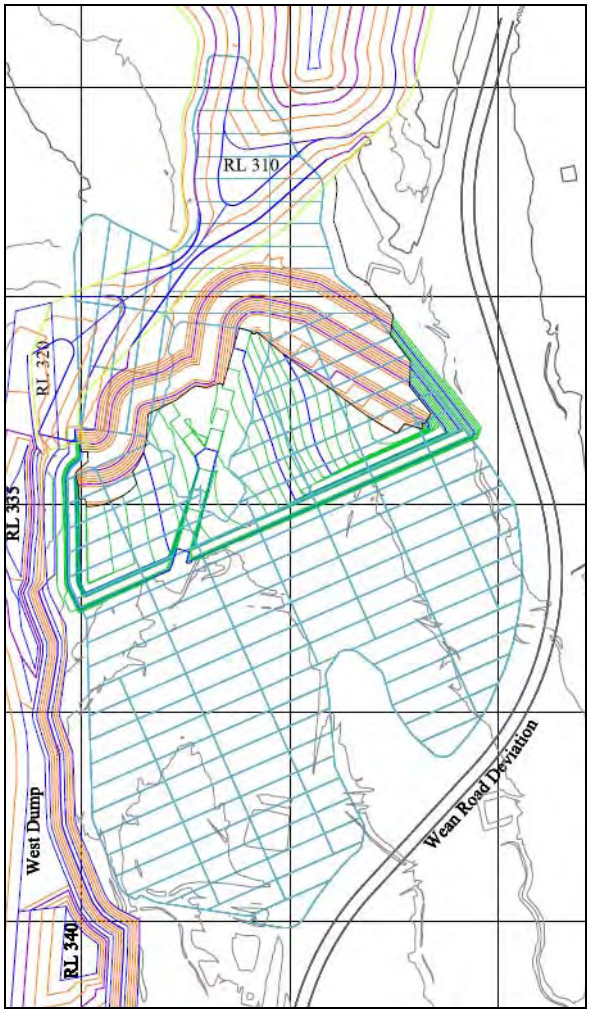

Figure 2 -Mine Plan Year 5

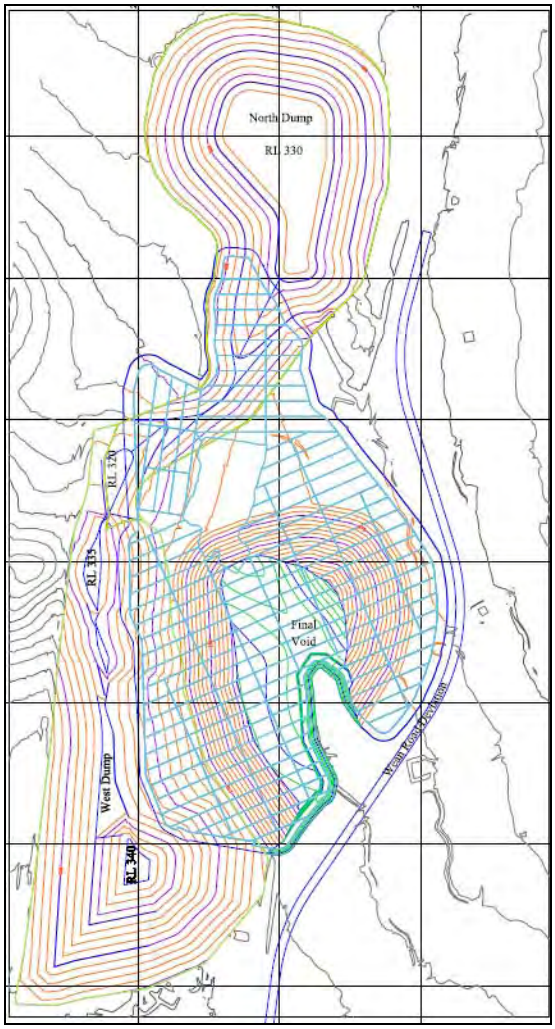

Figure 3 - Mine Plan End of Mine Life

4.5 Additional Pit Flow Information

Subsequent to the site visit in February, updated information regarding groundwater inflows to the pit was provided by Danny Young of Whitehaven Coal in November 2010 who indicated the following:
"In terms of pit inflows there has been no substantial volume of water intersected in [the] pit itself. Water has had to be pumped out of pit (23ML for period August 2009 – July 2010) but this is predominantly from the substantial extent of rainfall over the period December - July. Without this rainfall, there would have been no requirement to pump water from the pit itself. Up to December 09, the site was carting water in due to dry conditions and no perceptible water flows in pit."

5. Relevant Groundwater Guidelines / Policies

There is a Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003, amended 27 June 2008. This Water Sharing Plan identifies and regulates groundwater sources within the alluvial aquifer of the Namoi River floodplain. The identified alluvium extends into the Project Site and borders the limit of open cut mining as shown on Drawing 8.

Consultation with the NSW Office of Water indicates their primary concern with the development is the potential for the excavation to lead to extraction of water from the alluvium. Groundwater resources of the Namoi Alluvium are fully allocated. Rocglen Coal Mine currently has an annual allocation of 700 ML/yr for aquifer interference and if the mine has the potential to remove more than this volume, then it will need to source additional allocations from existing allocation holders.

The Water Sharing Plan indicates that there are no high priority groundwater dependant ecosystems within the alluvium.

It is noted Section 4, subsection 3 of the Water Sharing Plan states:

"The Upper and Lower Namoi Groundwater Sources include all water contained in the unconsolidated alluvial sediment aquifers associated with the Namoi River and its tributaries". "Note: Bores drilled through the unconsolidated alluvial sediments into the underlying Great Artesian Basin (GAB) are tapping a different groundwater source. On a map, they may appear to lie within the boundaries of the Lower Namoi, however they are within the deeper GAB groundwater source and are not included as a part of this Plan".

6. Local Hydrogeological Regime

6.1 Identified Aquifers

The stratigraphy of Rocglen Coal Mine and surrounding areas has been assessed from geological mapping, a review of coal exploration drilling data, a review of hydrogeological information from the NSW Office of Water Groundwater Database, and from information contained in previous groundwater investigation reports.

WHC provided data from the drilling of more than 160 coal exploration holes. The stratigraphy of the Maules Creek Formation in the vicinity of Rocglen Mine comprises the Upper Glenroc and Lower Glenroc Coal Seams, non-coal strata (between seams) comprising lithic conglomerates, sandstones and mudstones, and the basal Belmont Coal Seam, which is the coal seam of main economic interest.

During the drilling of the coal exploration bores, it was noted that groundwater was mainly limited to the coal seams, (particularly the Belmont Coal Seam) which is considered to be the main aquifer zone within the Maules Creek Formation sequence. The Belmont Coal Seam is generally consistent in thickness (~8 m average) and groundwater occurs in fracture cleat within the seam. A generalised stratigraphy of the Rocglen Coal Mine area is illustrated by the lithographic log of Bore EVK 110 (Drawing 7). Structure contours of the base of the Belmont Coal Seam are presented in Drawing 4.

The other major aquifer of the region is the sand/gravel accumulations within alluvium associated with the Namoi River and associated tributaries. Alluvium abuts the Maules Creek Formation to the north and to the southwest of Rocglen Mine (Drawing 8).

6.2 Aquifer Hydraulic Parameters

Evaluations of the hydraulic parameters of Maules Creek Formation strata were undertaken by RCA (2002) and RCA (2007). Hydraulic testing by RCA (2002) involved the falling head permeability testing of piezometers installed in Bores EVK25, EVK30 and EVK64. Testing assessed the permeability of the Glenroc Seams, the Belmont Seam and the interburden between the Belmont and Glenroc Seams.

Test pumping was also undertaken on Bore GW016874 and reported by RCA (2002). The test involved pumping from the bore for a period of 8 hours and measuring drawdown and recovery in the bore. The pumping rate over the test period was recorded at 0.63 L/s. Test pumping data were analysed by RCA (2002) using the program “RADFLOW”. Recovery data were also analysed using the method of Hvorslev (1951).

During the RCA (2007) investigation, the permeability of the coal seams and interburden was assessed in piezometers installed in Bores EVK61 and EVK40 (EVK40-P1 and EVK40-P2) by falling head permeability testing. Test data were analysed using the method of Hvorslev (1951).

Results of the hydraulic testing of RCA (2002) and RCA (2007) are summarised in Table 5.

Table 5 - Results of Hydraulic Testing for Rocglen Mine

Bore	Screened Interval	Strata Screened	Permeability (m/d)	Permeability m/s	Source
EVK25	39 m to 72 m	Glenroc Seams and interburden between these seams	8.6×10^{-4}	9×10^{-9}	FHT; RCA (2002)
EVK64	55 m to 70 m	Interburden between Glenroc and Belmont Seams	7.8×10^{-2}	9×10^{-7}	FHT; RCA (2002)
EVK61	48 m to 51 m	Interburden between Glenroc and Belmont Seams	1.4×10^{-2}	1.6×10^{-7}	FHT; RCA (2007)
EVK40-P2	84 m to 85.5 m	Lower Glenroc Seam	2.1×10^{-1}	2.4×10^{-6}	FHT; RCA (2007)
EVK30	42 m to 48 m	Belmont Seam	6.0×10^{-2}	7×10^{-7}	FHT; RCA (2002)
EVK40-P1	91 m to 94 m	Belmont Seam	4.3×10^{-1}	5×10^{-6}	FHT; RCA (2007)
GW016874	40.8 m to 54 m	Belmont Seam	4.3×10^{-1}	5×10^{-6}	PT; RCA (2002)
GW016874	40.8 m to 54 m	Belmont Seam	3.5×10^{-1}	4×10^{-6}	PT; RCA (2002)
EVK110	-	Belmont Seam	5.5×10^{0}	6×10^{-5}	Cooper Jacob Method (This investigation)
EVK114	-	Belmont Seam	2.8×10^{0}	3×10^{-5}	Cooper Jacob Method (This investigation)
EVK162	-	Belmont Seam	5.1×10^{-1}	6×10^{-6}	Cooper Jacob Method (This investigation)

Coal exploration holes EVK110, EVK114 and EVK162 have been converted to water bores in order to provide water for mining activities (principally dust suppression). Each of these bores were test pumped by Lambert & Torrens Pty Ltd of Gunnedah. The test pumping data have been analysed using the method of Cooper & Jacob (1946) and values of permeability assessed. Results are also included in Table 5.

Results listed in Table 5 show that the coal seams are generally at least 2 orders of magnitude more permeable than the interburden strata. Permeability values derived from test pumping are generally greater than results obtained from falling head testing.

6.3 Groundwater Levels and Flow Directions

RCA (2007) recorded groundwater levels in a number of bores throughout the region and calculated approximate reduced levels to a common datum. The reduced levels were then contoured to assess groundwater levels and flow directions.

RCA (2008) designed a groundwater monitoring program (GWMP) for the original Rocglen Coal Project which involved the monitoring of groundwater levels and groundwater quality in eleven registered bores, and five piezometers (MP-01 to MP-05) to be constructed by WHC.

WHC has installed the piezometers and has also monitored groundwater levels and quality in 13 private bores, which are designated/known as WB-01 to WB-12, Yarrari Bore and Wundurra Bore. Bore WB-04 is not monitored due to casing around the bore preventing access. Summary details of monitoring bores in the Rocglen Coal GWMP are provided in Table 6. Locations of the bores are shown in Drawing 10.

Table 6 - Monitoring Bores of the Rocglen Mine GWMP

Easting (GDA-94)	Northing (GDA-94)	Bore ID	Alternate ID (RN)	Distance from Centre of Pit (km)	Water Levels (AHD)		Interval Monitored / Comments / Notes
					2007 (RCA)	2009	
238941.4	6595440.7	MP-01	GW968533	1.2	-	278.5	Conglomerate
239156.0	6592782.9	MP-02	GW968534	1.5	-	269	Unknown
238649.0	6590866.0	MP-03	GW968535	3.4	-	253	Alluvium
238838.0	6589909.1	MP-04	GW968536	4.4	-	248	Alluvium
238268.6	6594816.8	MP-05	GW968537	0.8	-	257	Conglomerate
238738.0	6597885.0	WB-01	GW000743	3.6	277	277.5	Black Shale
239906.0	6596452.0	WB-02	GW050395	2.4	286	289.5	Unknown
239394.0	6595776.0	WB-03	GW050166	1.6	-	292.5	Shallow; Alluvium?
239586.0	6595157.0	WB-05	GW011066	1.2	-	292.5	Black Shale
240696.0	6594539.0	WB-06	GW044068	1.9	289	305	Black Rock; Coal, Shale?
239321.0	6592514.0	WB-07	GW022319	1.8	268	262	Gravel; Conglomerate?
240654.0	6589786.0	WB-08	GW052958	4.8	-	250	Conglomerate
240222.0	6588393.0	WB-09	Unknown	6	-	254	Unknown
237137.0	6586489.0	WB-10	Unknown	8	-	254.5	Unknown
236405.0	6585725.0	WB-11	Unknown	8.9	-	246	Unknown
237562.0	6587535.0	WB-12	Unknown	6.9	-	256	Unknown
239156.0	6592782.9	Yarrari	Unknown	1.5	-	232.5	Unknown
239156.0	6592782.9	Wundurra	Unknown	1.5	-	262.5	Unknown
239097.9	6594298.8	EVK25	None	Within pit	256	-	Glenroc Seams and inter-burden between the seams
238777.6	6593659.5	EVK30	None	Within pit	258	-	Belmont Seam
239034.1	6594300.1	EVK64	None	Within pit	255	-	Interburden between Glenroc and Belmont Seams
239322.7	6590412	EVK40-P1	None	Within pit	258	-	Belmont Seam
		EVK40-P2	None	Within pit	258	-	Lower Glenroc Seam
238846.7	6594417.7	EVK61	None	Within pit	252	-	Interburden between Glenroc and Belmont Seams

Groundwater levels have been monitored in these bores since the commencement of mining in mid 2008. Hydrographs of groundwater levels for these monitoring bores are presented in Appendix B (Drawings A-1 to A-4).

The RCA monitoring in 2007 included bores screened in the coal seams and within the mine footprint. As is evident from Table 6 above, the current monitoring bores generally do not intersect the coal seams. This is because they are located outside the mining footprint (to avoid disturbance by mining) and, due to the geology, the coal is generally not present outside of the mine footprint.

Drawing 9 shows approximate groundwater levels across the area prior to the commencement of mining, based on the current monitoring wells shown in Table 6. The contoured surface suggests that the groundwater table is a subdued reflection of topography, and that groundwater flows from elevated areas east of the mine, westward towards the Namoi River.

The contoured groundwater levels on Drawing 9 are similar to those contoured by RCA (2007). Of particular note is that the bores within the mine footprint, which were measured in 2007 were no longer available in 2008 and were not able to be used to calculate the contours shown on Drawing 9. Reference to Table 6 indicates that for these bores the heads were generally in the range RL 252 to RL 258 in 2007. Reference to Drawing 9 indicates interpolated groundwater contours in the range RL 255 to RL 260, which is similar to the heads measured in 2007.

6.4 Groundwater Recharge

Hydrographs of groundwater levels presented in Appendix B show that recharge of the groundwater system in the vicinity of Rocglen Mine is poor. No significant groundwater level rises in response to rainfall events are apparent in any of the hydrographs presented in Drawings A-1 to A-4.

During the monitoring period, there have been a number of significant rainfall events which would be expected to result in groundwater recharge. In particular, the periods September to November 2008 and December 2009 and January 2010 recorded above average rainfall (Table 2), yet groundwater level rises did not follow.

Poor recharge of the strata in the vicinity of Rocglen Mine is probably a function of low permeability, in addition to the general exceedance of evaporation over rainfall (Table 1).

6.5 Groundwater Quality

RCA (2007) assessed baseline groundwater quality based on the laboratory analysis of 13 groundwater samples. Samples were analysed for: alkalinity, aluminium, arsenic, chloride, electrical conductivity, iron, magnesium, manganese, nitrates, nitrites, pH, potassium, sodium and sulphates.

RCA (2007) concluded that groundwater in the vicinity of Rocglen Coal Mine could be characterised as follows:

- pH ranging from 6.3 to 7.7 (essentially neutral);
- Electrical Conductivity values indicate that the groundwater is brackish; and
- The groundwater is generally of a sodium-bicarbonate/chloride type.

The range of chemical parameters analysed for by RCA (2007) was limited. Of the major ions, calcium was not included in the analysis. It is not possible to assess the "type" of groundwater without analysing for all major ions, unless 7 of the 8 major ions are analysed for and it is assumed that the groundwaters are in ionic balance. The RCA (2007) characterisation of groundwater quality cannot be relied upon.

Since mining began, WHC has periodically collected groundwater samples from a number of monitoring bores and had them laboratory analysed for an extensive range of chemical parameters. A total of 35 groundwater samples from 13 monitoring bores have been analysed since October 2008. The laboratory results have been analysed to calculate Percentage Reacting Values (PRVs) of major ions and assess water type. Table 7 lists average PRVs for groundwaters from each of the 13 monitoring bores.

Table 7 - Percentage Reacting Values of Major Ions in Groundwater at Rocglen Coal Mine

Sample ID / Source	Na	K	Ca	Mg	Cl	CO_3	HCO_3	SO_4	Type
Bore MP-01	***81.6%***	0.4%	8.5%	9.6%	28.4%	0.0%	***64.1%***	7.5%	Na-HCO3/Cl
Bore MP-02	***53.4%***	0.3%	23.1%	23.2%	***75.6%***	0.0%	22.5%	1.9%	Na-Cl
Bore WB01	***91.6%***	0.6%	2.4%	5.4%	44.0%	0.0%	***52.6%***	3.4%	Na-HCO3/Cl
Bore WB02	***38.2%***	0.3%	32.5%	29.0%	***72.0%***	0.0%	26.9%	1.1%	Na/Ca/Mg-Cl/HCO3
Bore WB03	***37.1%***	0.1%	27.7%	35.1%	***81.0%***	0.0%	17.8%	1.2%	Na/Mg/Ca-Cl
Bore WB05	***53.3%***	0.3%	18.5%	28.0%	***85.0%***	0.0%	13.1%	1.9%	Na/Mg-Cl
Bore WB07	***61.7%***	0.4%	20.1%	17.9%	***60.0%***	0.0%	37.9%	2.1%	Na-Cl/HCO3
Bore WB08	***76.4%***	0.7%	10.0%	12.8%	47.4%	0.0%	***49.2%***	3.4%	Na-HCO3/Cl
Bore WB09	***42.5%***	0.9%	28.0%	28.7%	19.9%	0.0%	***73.1%***	7.0%	Na/Mg/Ca-HCO3
Bore WB10	***47.7%***	0.0%	27.7%	24.7%	16.5%	0.0%	***60.1%***	23.4%	Na/Ca-HCO3
Bore WB11	***60.7%***	1.0%	16.2%	22.1%	39.0%	0.0%	***57.7%***	3.3%	Na-HCO3/Cl
Bore WB12	***66.1%***	0.5%	6.6%	26.8%	31.0%	5.4%	***63.0%***	0.5%	Na/Mg-HCO3/Cl
Yarri Production	***64.6%***	0.2%	26.2%	9.0%	***74.4%***	0.0%	23.1%	2.5%	Na/Ca-Cl

Notes: Shaded cells indicate the dominant cation
Shaded cells indicate a prominent, but not dominant cation
Shaded cells indicate the dominant anion
Shaded cells indicate a prominent, but not dominant anion

Sodium is the dominant cation with an average PRV of about 60%. Calcium and magnesium are also prominent cations in groundwaters from a number of monitoring bores with PRVs in excess of 25%. Chloride and bi-carbonate are the dominant anions with average PRVs of 52% and 43%, respectively. While the waters can generally be described as either sodium chloride or sodium bi-carbonate in type, the prominence of calcium and magnesium in some groundwaters indicates a wide range of chemical types.

A significant range in water quality is characteristic of groundwater systems with low permeability, minimal flow and structural complexity.

A summary of water quality is provided in Appendix C (Table B-1). This table lists averaged concentrations of all chemical parameters tested for samples from each of the monitoring bores. Results are compared with ANZECC (2000) guideline values for potable water quality and for livestock watering guideline values.

In regard to potable water quality, many of the groundwaters sampled exceed guideline values for the following parameters:

- pH and salinity (EC and TDS);
- Sodium, chloride and sulphate;
- Ammonia; and
- Arsenic, iron, lead, manganese and nickel.

In regard to stock watering guidelines, no guideline values are exceeded for the parameters analysed, with the exception of groundwater from Bore WB-5 which has an average salinity (TDS) value in excess of 5,000 mg/L.

6.6 Groundwater Utilisation

Groundwater resources are used by landholders throughout the area for domestic use, stock watering and irrigation. The major use is for stock watering. Individual bore yields are generally low (less than 1 L/s). RCA (2007) undertook a search of the former NSW Department of Water & Energy (DWE) Groundwater Database to identify groundwater users in the vicinity of Rocglen Coal Mine. DP has repeated the search for this study; results are summarised in Table 8.

The locations of the 32 identified bores are shown with respect to Rocglen Coal Mine on Drawing 11. Groundwater Works Summary sheets for each of the bores are provided in Appendix D.

Table 8 - Summary Details of Registered Bores in Close Proximity to Rocglen Mine

Easting (GDA94)	Northing (GDA94)	Bore ID	Distance from Mine (km)	Type / Use	Property
240371	6590019	GW000122	4.5	Not known	Not stated
241481	6598028	GW000713	4.6	Not known	Penryn
238686	6598022	GW000743	3.8	Not known	Costa Vale
235611	6599611	GW003083	6.2	Not known	Not stated
240560	6599793	GW009830	5.8	Stock	Penryn
239507	6594898	GW011015	0.9	Stock	Glenroc
239607	6595178	GW011066	1.2	Stock	Glenroc
237892	6588017	GW013284	6.3	Stock	Brolga
236815	6588545	GW013369	6.1	Stock	Brolga
239981	6594016	GW016871	1.2	Stock	Belmont
238943	6594022	GW016874	0.3	Stock and Domestic	Belmont
236691	6589282	GW017198	5.4	Stock	Brolga
234123	6589835	GW017199	6.5	Stock	Brolga
241539	6589031	GW020454	5.9	Stock	Carlton
242502	6588807	GW020456	6.6	Stock	Carlton
240862	6588429	GW020461	6.2	Irrigation	Carlton
239299	6592520	GW022319	1.8	Stock	Roseberry
241070	6593026	GW035706	2.6	Stock and Domestic	Surrey
238480	6587908	GW036484	6.4	Groundwater Exploration	Not stated
241213	6594786	GW044067	2.4	Stock and Domestic	Highview
241030	6594658	GW044068	2.2	Stock and Domestic	Yarrari
240970	6594934	GW044069	2.2	Stock and Domestic	Yarrari
237808	6595812	GW045621	1.9	Stock	Yarrawonga
239379	6595789	GW050166	1.6	Stock	Glenroc
239906	6596452	GW050395	2.4	Stock	Glenroc
240560	6589603	GW052956	5.0	Not known	Surrey
240669	6589780	GW052958	4.9	Stock and Domestic	Surrey
237382	6595907	GW060867	2.2	Stock and Domestic	Yarrawonga
234694	6589356	GW062364	6.4	Groundwater Exploration	Stratford
234322	6590395	GW064948	6.0	Monitoring Bore	Not stated
234359	6589964	GW064949	6.2	Monitoring Bore	Not stated
240917	6594447	GW968918	2.1	Stock and Domestic	Yarrari

The recent database search identified one bore not previously picked up by RCA (2007) (Bore GW060867), and another (Bore GW968918) which has been drilled since the RCA (2007) study.

Results of the database search show that bores in the region are on average 60 m deep. Very few bores are greater than 100 m depth or shallower than 30 m. Bore yields average 0.5 L/s, ranging from 0.1 L/s to 1.3 L/s. The depth to the groundwater table is generally about 25 m for most bores, ranging from the shallowest at ~10 m to the deepest at ~50 m.

7. Conceptual Hydrogeological Model

Figure 4 presented below is useful for explanation of a conceptual model for groundwater flow at the site. The figure shows the following items:

- General terrain, shown as shaded contours, indicating a mountainous region to the east of the site, as well as a lower, however distinct mountainous area to the west of the site;
- Alluvial soils, as defined by the Namoi Alluvium Water Sharing Plan are shown to the north of the site on relatively flat ground, with the interface with the residuals marked as a yellow line. Alluvial soils are also present to the south of the site, on relatively flat ground, at a lower elevation to the northern alluvial soils. The northern tip of the southern alluvial soils reaches within close proximity of the southern extent of proposed mining;
- The locations of faults are shown as pink lines and indicate that the site is separated from the northern alluvium by several faults, however the southern alluvium extends across the faulting to the south of the site; and
- Approximate contours of groundwater head at the various monitoring wells are also presented for July 2008, immediately prior to commencement of mining. It is noted that the contours provide only an indication of the distribution of groundwater head between monitoring points, as these are likely to be locally affected by the presence of faults and the coal seams.

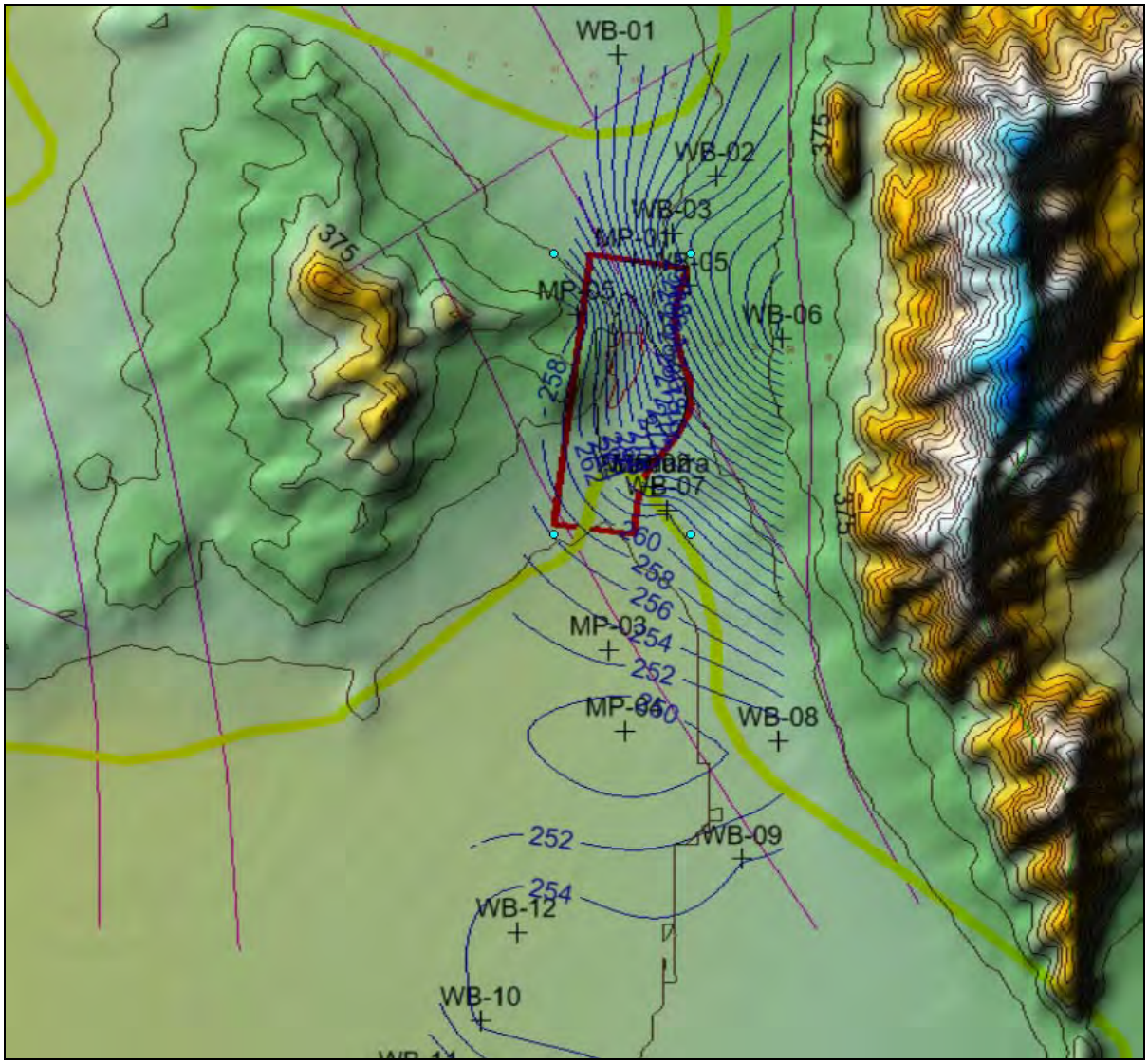

Figure 4 - Site Terrain and Contours of Groundwater Head (m AHD) in July 2008

The conceptual model for the groundwater flow at the site is described as follows:

- Rainfall recharge occurs across the model domain;
- Flow from recharge on the eastern valley sides flows in a generally westerly direction towards the site. Flow at the southern end of this range is diverted in a south-westerly direction discharging towards the southern alluvium. Flow from the northern end of the range is diverted in a north-westerly direction towards the northern alluvium;
- A similar flow regime is expected to occur on the western side of the valley, with flow in a generally easterly direction. There is little groundwater data on the western side of the valley to fully characterise this, however the groundwater divide is likely to be offset to the western side of the valley due to the reduced relief on this side;

- The head in the northern alluvium is expected to be about 20 m higher than the southern alluvium and there will also be some recharge to the site from the northern alluvium and discharge of flow from the site to the southern alluvium. It is noted that although WB01 is not screened directly in the alluvium it is screened below the alluvium in the shale, however only a slight variation in head would be expected due to some limited vertical flow, WB01 is expected to give a reasonable representation of the head in the northern alluvium. The hydraulic gradient in the alluvium is generally expected to be low, because of its relatively high permeability with respect to the coal measures rocks. In the southern alluvium there are indications of localised drawdowns (Near MP-004) which are probably related to groundwater extraction. It is noted that groundwater monitoring was prevented at times in WB07 because of the presence of a pump in the well and during the site visit high volume extraction was noted from several bores to the south of the site;
- Within the mine site the Glenroc and Belmont coal seams are the primary water bearing zones, with estimated permeability of at least two orders of magnitude higher than the surrounding strata. The seams are only present between the Belmont and Roseberry Fault, and also subcrop in several locations around the proposed extent of mining. The full extent of the seams within the areas between the faults has not been established, in particular to the south of the site, however is likely to be less than the full extent between the faults;
- Recharge into the coal seams is expected to occur from the northern alluvium and eastern and western valley sides and is expected to be impeded by the presence of faulting as discussed further below. Some very limited direct rainfall recharge on the site may also recharge the coal seams.
- Preferential flow is expected to occur within the coal seams below the site towards the south of the site which eventually discharge into the alluvium through a limited hydraulic connection. The coal will in essence act as a drainage blanket.
- The Belmont and Glenroc Coal seams are truncated by faulting and do not continue significantly to the east, west or north of the immediate mine site. The role that the faults are expected to play in the interaction between the coal seams and the surrounding strata are discussed as follows:
    - The Belmont fault immediately to the east of the site has no direct connection to the southern alluvium, however it does connect with the Mooki Thrust, further to the east, which does intersect with the southern alluvium several kilometres south of the site. The region where the faults are present to the east of the site is characterised by relatively high groundwater heads compared with heads within the coal seams at the site. This indicates that flow occurs from the strata to the east into the coal seams towards the west, however the connection seems limited, as evidenced by the elevated head to the east of the fault, suggesting the fault is having a damming effect rather than a draining effect. There is also no indication of a significant connection between the eastern faults and the southern alluvium. If a significant connection was present the faults would be expected to act as drains, leading to drawdown of head in adjacent strata and possible flow from the west towards the eastern fault; however this is not evident.

- The fault immediately east of the site also connects with a lineament to the north of the site which does intersect with the northern alluvium. However, the groundwater contours indicate there is no significant hydraulic connection between the alluvium and the coal seam. There is a minor hydraulic connection between the northern alluvium and the coal seams, however it doesn't necessarily occur through the faulting. If a significant hydraulic connection was present, the heads in the coal seams below the site would be closer to the head in the northern alluvium. However, the head in the coal seams below the site are closer to those in the southern alluvium, suggesting more connectivity to the southern alluvium than to the northern alluvium.
- The fault to the west of the site continues directly below the alluvium to the south. There are limited monitoring data to the west of the site and it is possible that the hydraulic connection between coal seams below the site could be at least partly due to preferential flow thoughout the fault, however it would also be due to vertical flow between the strata separating the alluvium and the coal seams.

Based on the conceptual model, the impacts of mine drainage would be expected to be subdued due to the presence of faulting to the east, west and north of the site, effectively limiting hydraulic connection between the coal seams within the site and the surrounding strata. There is likely to be some hydraulic connection between the coal seams and the southern alluvium. The degree of connection has been further assessed by numerical modelling, as presented in the following sections.

8. Monitored Impact to Date

RCA (2007) utilised numerical modelling techniques to assess the likely magnitude of groundwater inflows into the open pit, and the drawdown impact on the surrounding groundwater regime that would result from those inflows.

RCA (2007) predicted that over the 7 year period of mining, inflows to the open pit would be as follows:

- During mine years 1 to 3: average inflow of 1,643 m^3/day (~19 L/s);
- During mine years 4 and 5: average inflow of 2,235 m^3/day (~26 L/s); and
- During mine years 6 and 7: average inflow of 1,813 m^3/day (~20 L/s).

RCA (2007) further considered that these inflows would be balanced by evaporation in excess of rainfall, and that as a result, net seepage into the pit would be limited and not noticeable. DP does not concur with this conclusion.

While evaporation does exceed rainfall markedly on an annual basis (Table 1), there are periods during the year, notably the months of June and July, where rainfall almost balances evaporation. During such times, a baseline inflow of the order of 20 L/s to 25 L/s would be apparent. During the period of mining from mid 2008 to present, there have been a few such occasions where an inflow of the order of 20 L/s should have presented. Table 2 shows that during the period September to November 2008, June 2009, and December 2009 and January 2010, rainfall was generally high and or evaporation was low. Under such circumstances, a baseline inflow of ~20 L/s would have been noticeable.

WHC mine site personnel reported that there have generally been no noticeable inflows from the inception of mining to date, with the exception of the eastern extent where the seams dip are locally deeper. In this location it was reported that inflows were sufficient for a 4" pump to run for half of the time.

Therefore, based on site observations it seems that the predicted inflows were slightly overestimated, although such flows have probably occurred for the locally deeper parts of the excavation.

The RCA (2007) numerical model predicted the drawdown in a number of landholder's bores within 5 km of the mine, that would ensue from the aquifer dewatering impact of inflows to the mine. Table 13 of RCA (2007) lists 20 bores and outlines model predicted drawdown for each of these bores that would result from mining at the end of 7 years. DP has plotted the RCA (2007) model predicted drawdown for each of these bores against distance from the centre of the Rocglen open pit (Drawing 12). Drawing 12 also includes a plot of monitored groundwater decline (as of end 2009) for bores of the Rocglen Mine Monitoring Bore Network against distance from the mine. Apart from the groundwater levels recorded for monitoring bore WB-05, which is likely to be anomalous and affected by nearby pumping, **it is apparent that the mine has had very little impact on surrounding groundwater levels over the period mid 2008 to present.**

Based on the comparison between RCA (2007) numerical model predictions, and monitored groundwater levels to date (Drawing 12), it is considered that the RCA (2007) model over-predicts the mine induced impact on the groundwater system. This is likely to be because the model assumed that the coal seam was continuous beyond the site, and did not take account of the faulting, which is present.

In comparison with the extent of Rocglen Mine which has already been approved, the proposed extension comprises a reasonably uniform increase around the existing perimeter and therefore is not expected to have a significantly different impact on groundwater flow directions. The existing approved mine area totals ~1.14 km^2. The extension covers (approximately) an additional 0.5 km^2 in area.

9. Numerical Modelling

9.1 Introduction

In order to clarify the conceptual model, a 3D numerical model was developed using the software Visual MODFLOW. MODFLOW is a modular three dimensional finite difference groundwater model for the description and prediction of the behaviour of groundwater systems.

Due to the complexity of the geology at the site, including the presence of very steeply dipping coal seams and faulting, which is impossible to characterise in detail, the model was limited to four layers as follows:

- Layer 1: Alluvium/General Overburden;
- Layer 2: General Overburden (Volcanics on eastern part of the site);
- Layer 3: Coal Seams and Interburden (combined as one layer) between the Belmont and Roseberry Faults and General Overburden elsewhere; and
- Layer 4: Sandstone Floor.

The primary aim of the modelling was to assess potential impacts of the mine drainage on the aquifers, in particular the magnitude of interference to flow to the southern alluvium. The model domain was limited to the extent of groundwater monitoring data, as per the conceptual model. The following boundary conditions were adopted:

- Fixed head of RL 278 within the alluvium at the northern extent of the model;
- Fixed head of RL 250 within the alluvium at the southern extent of the model; and
- No flow boundaries along the western and eastern ridge lines.

As the faults were expected to be key barriers and possible conduits for groundwater flow, the model was oriented in the direction of the faulting. A variably spaced rectangular mesh was adopted with grid spacings ranging from 500 m at the outer edges of the model domain to 60 m in the location of the proposed open cut pit. The model domain extended about 5 to 6 km to the north and south of the site and 3 to 4 km to the east and west of the site.

9.2 Steady State Modelling

9.2.1 Calibration of Existing Heads

Steady state modelling was undertaken to replicate the groundwater heads measured in July/August 2008, prior to commencement of mining. As it is possible to have differing sets of permeability/recharge provide the same outcome, the model was run for a range of plausible parameters. Case 1 was based on a best estimate of the permeability of the coal seams (1.0×10^{-5} m/s / 0.86 m/day), from the well test data. The permeability of the overburden strata and recharge were then adjusted to match the observed head distribution.

For Case 2 the permeability of the coal was set to a maximum credible value (4.6×10^{-5} m/s / 4.0 m/day) and the permeability of the overburden and recharge were adjusted to fit the data.

A permeability of $5.0x10^{-5}$ m/s (4.3 m/day) was adopted as being typical of alluvial strata and to replicate the relatively low hydraulic gradients in the alluvium. The thickness of alluvium was based on bore logs from registered wells and typically ranged up to about 70 m in the model domain. The extent of alluvium was based on the Namoi Alluvium mapping, however was extended slightly to the east as part of the calibration process and the extent is shown on Figure 5 below.

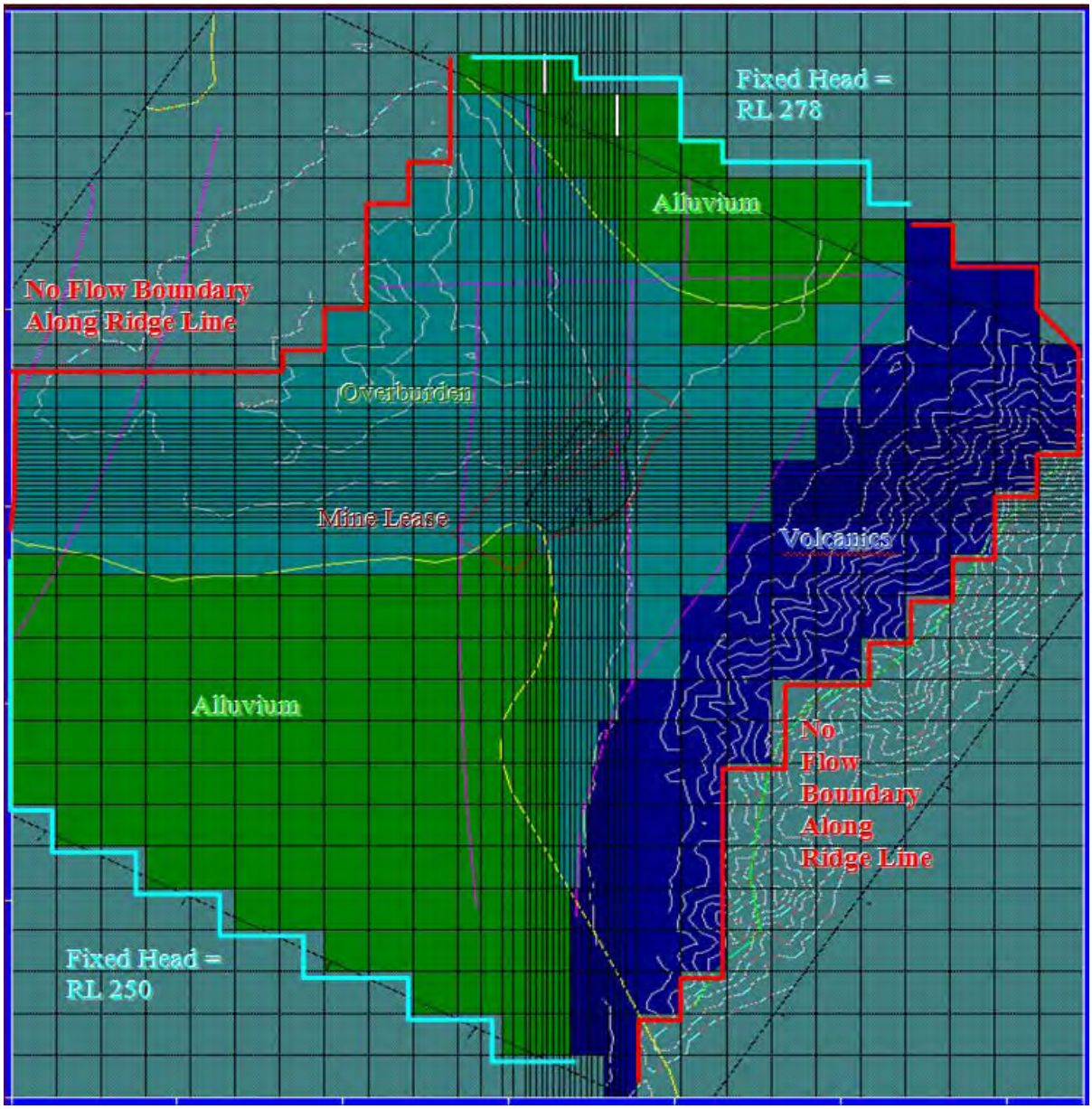

Figure 5 - Distribution of Strata in Layer 1

Due to the highly folded and faulted nature of the strata, the permeability of the coal and inter-burden were assumed as isotropic, with the other layers generally having a vertical permeability of 10% of the horizontal permeability.

The coal and inter-burden were modelled as one layer, as the seam thicknesses were too small to allow representation of such steeply and variable dipping strata. The coal seams, however are the primary water bearing zones and where faults or outcrops are present the actual contact between the seams adjacent to the lower permeability strata is significantly less than for the overall composite layer. Therefore in order to obtain an acceptable calibration it was necessary to place a strip of lower permeability material at the edge of the layer, to replicate the actual low connectivity between the strata. Without this low permeability strip it was impossible to provide the contrast in head across the faults and outcrops which is evident in the monitoring data. The approximate extent of the coal, limited by faulting and outcropping is shown in red/rust in Figure 6 below, and in a cross section in Figure 7.

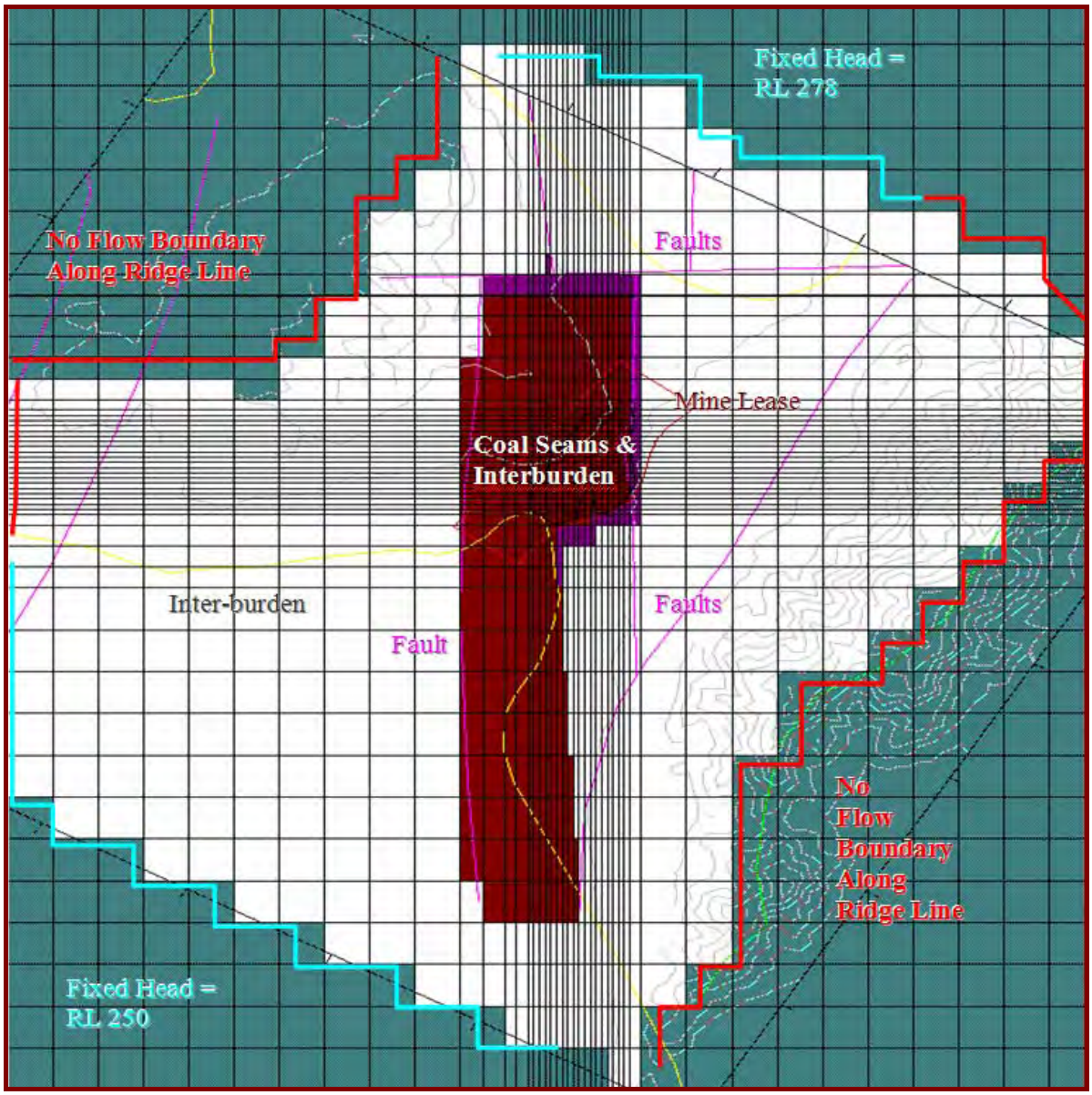

Figure 6 - Modelled Extent of Coal Seams

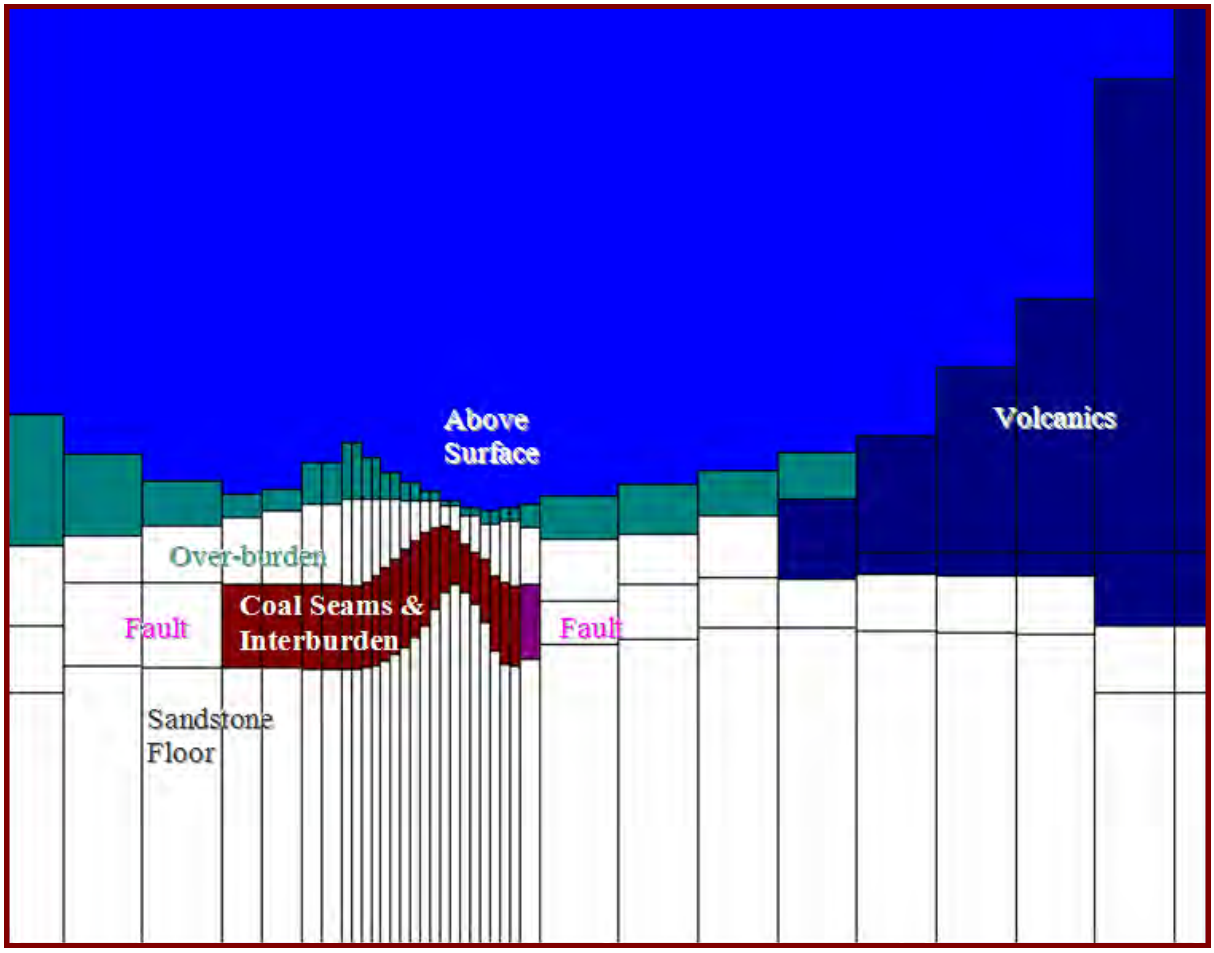

Figure 7 - Section Showing Folded and Truncated Coal Seam (rust)

The calibrated data sets are presented in Table 9 below.

Table 9 - Calibrated Steady State Parameters

Case	Case 1	Case 2
Description	Upper Bound Seam Permeability	Lower Bound Recharge
Recharge	4 mm/yr	1 mm/yr
Alluvium K	$5x10^{-5}$ m/s 4.3 m/day	$5x10^{-5}$ m/s 4.3 m/day
Volcanics K	$1x10^{-8}$ m/s 0.01 m/day	$1x10^{-8}$ m/s 0.001 m/day
Overburden K	$5x10^{-8}$ m/s 0.004 m/day	$1x10^{-8}$ m/s 0.001 m/day
Coal and Interburden K	$5x10^{-5}$ m/s 0.45 m/day	$1x10^{-5}$ m/s 0.90 m/day
Sandstone Floor K	$5x10^{-8}$ m/s 0.004 m/day	$1x10^{-8}$ m/s 0.001 m/day
Belmont Fault Interface	$1x10^{-5}$m/s 0.86 m/day	$1x10^{-5}$m/s 0.86 m/day

The calibrated recharge rates are very low, however this is consistent with the relatively steep slopes, arid climate and stability of the monitored groundwater levels, which showed little variation in response to rainfall recharge or to mining, however did respond to pumping.
The resulting head distributions are very similar and Case 1 is presented in Figure 8 below.

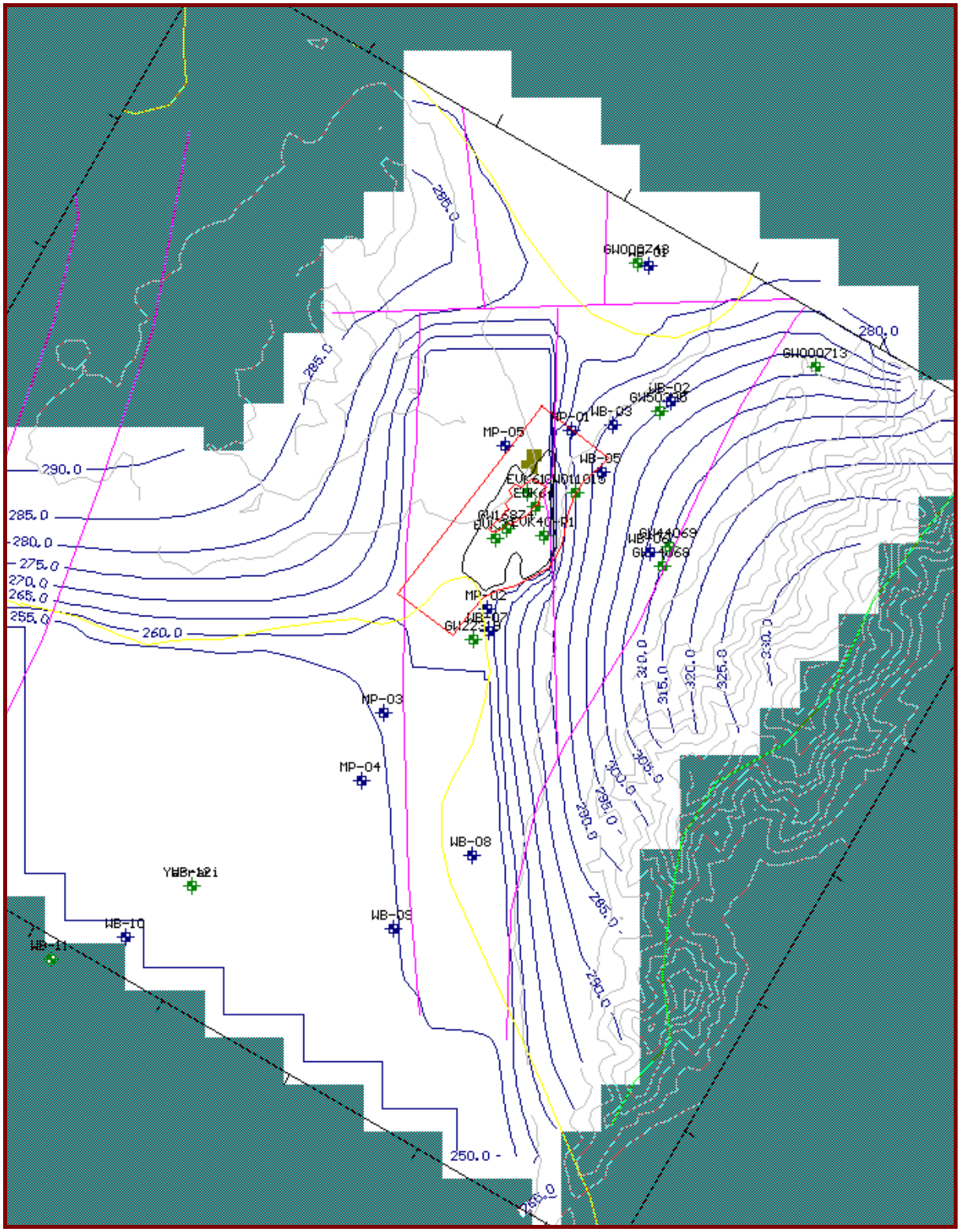

Figure 8 - Calibrated Steady State Head Distribution in Layer 3 (includes coal seams) for Case 1

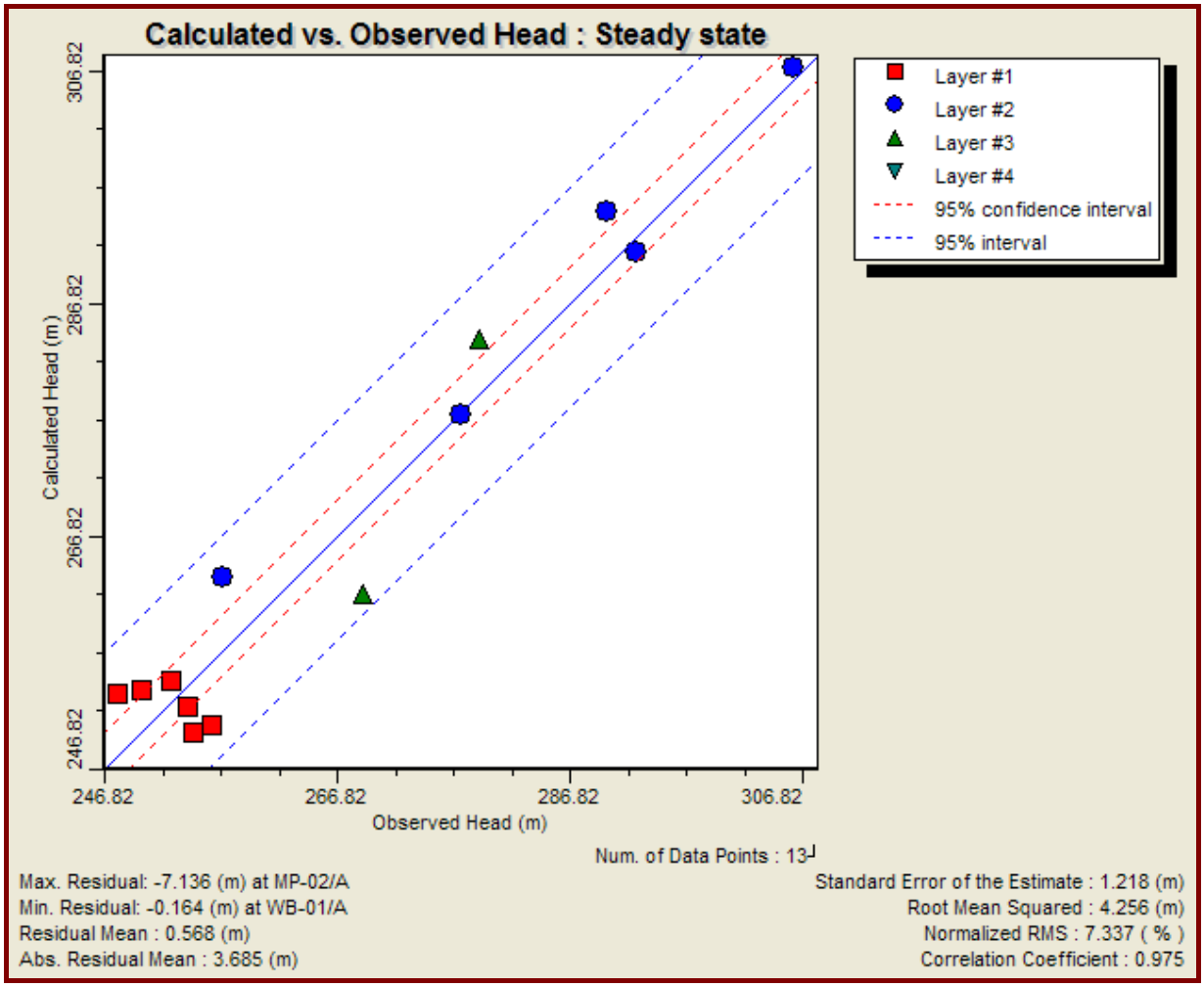

Figure 9 - Modelled and Observed Heads for Case 1 Calibration

When compared with the monitoring data from July 2008, the maximum residual head was 7.1 m with an absolute residual mean of 3.6 m and a correlation coefficient of 0.975. The model converged with a 0.01% discrepancy in the overall flow budget which is summarised in Table 9a below. Given the highly complex nature of the geology at the site, this is considered a good representation. The head distribution is also consistent with the conceptual model.

Table 9a – Steady State Water Budget

Budget Component	Rate (m^3/d)	
	Case 1	Case 2
IN		
Constant Head	0	0
Recharge	1114.9	286.21
OUT		
Constant Head	1114.9	286.19
Recharge	0	0
Percentage Discrepancy	0	0.01

9.2.2 Sensitivity to Fault Permeability

For the cases above it was assumed that there was limited hydraulic conductivity across the faults, as per the conceptual model. In order to assess the possibility that the faults were in fact conduits for flow, a number of additional cases were modelled to assess the plausibility of the faults being conduits for flow. A number of sub-cases were assessed as follows:

- Case 1A – All faults high permeability
- Case 1B – western and northern faults high permeability
- Case 1C – only western fault high permeability

The faults were modelled with a hydraulic conductivity of $1x10^{-4}$ m/s.

For Case 1A, the presence of the faults resulted in heads to the east of the site being too low. If the recharge was then adjusted to increase the heads to the east, the heads in the coal seams below the site were too high. In essence, the high hydraulic gradient to the east of the mine could not be replicated. The resulting head distribution and correlations are presented in Figures 20 and 21 below.

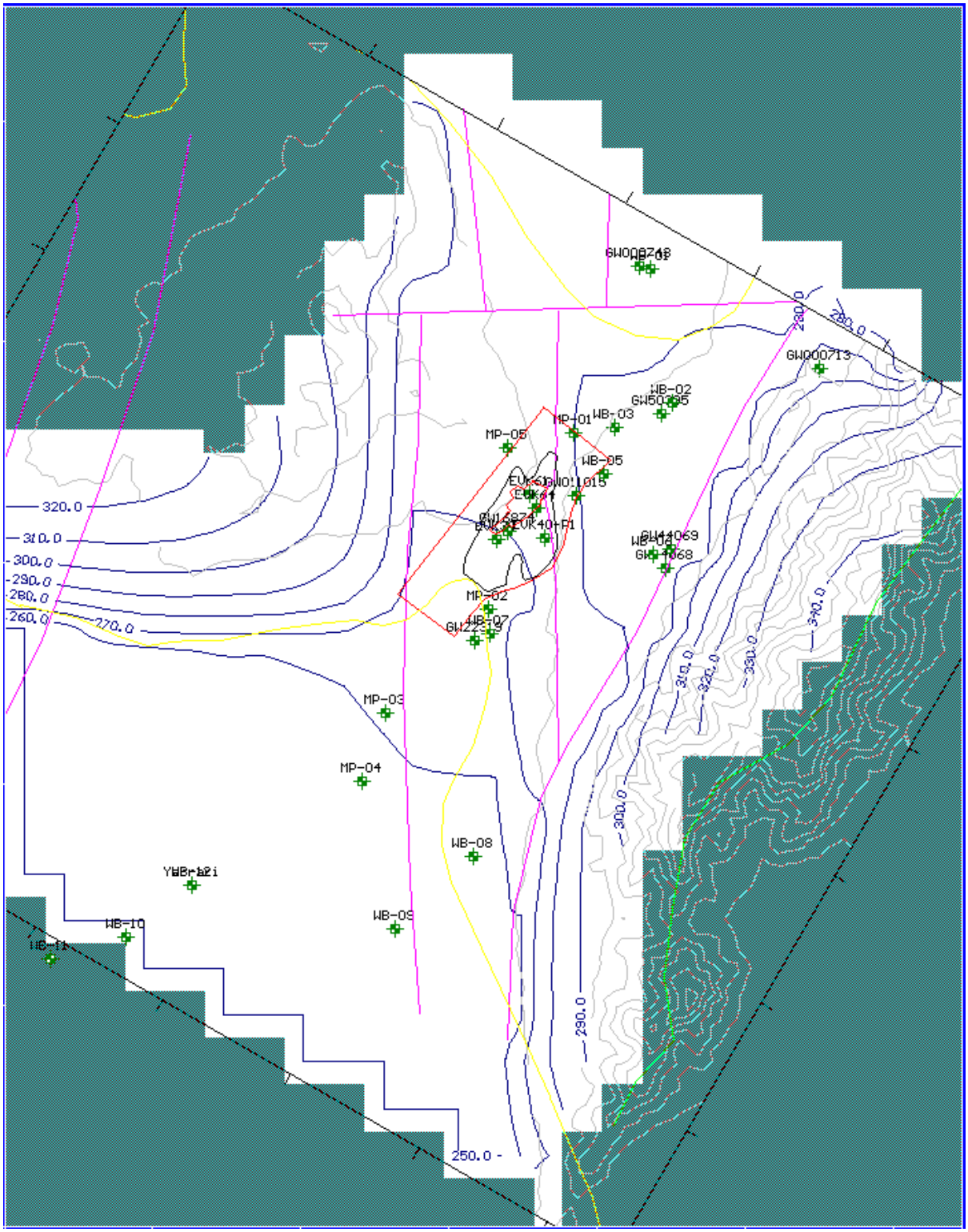

Figure 20 - Calibrated Steady State Head Distribution in Layer 3 (includes coal seams) for Case 1A

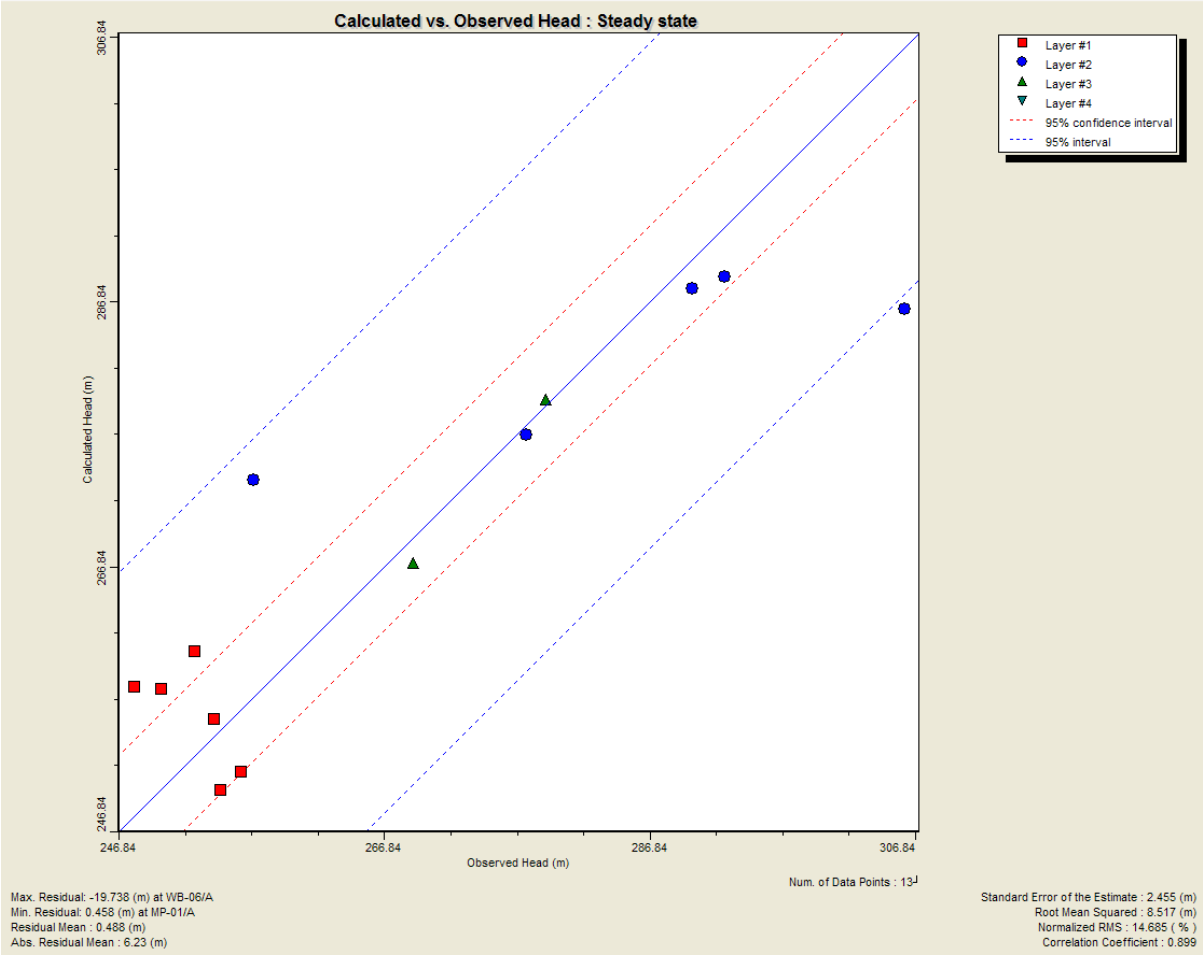

Figure 21 - Modelled and Observed Heads for Case 1A Calibration

For Case 1B the heads to the east of the site could be more closely replicated, however the heads in the coal seam were too high, and increasing the permeability of the fault lines actually made the heads higher rather than lower. This is because the strong hydraulic connection to the north alluvium resulted in the heads in the coal seam being more an average of the heads in the north and south alluvium, which is not the case. The resulting head distribution and correlations are presented in Figures 22 and 23 below.

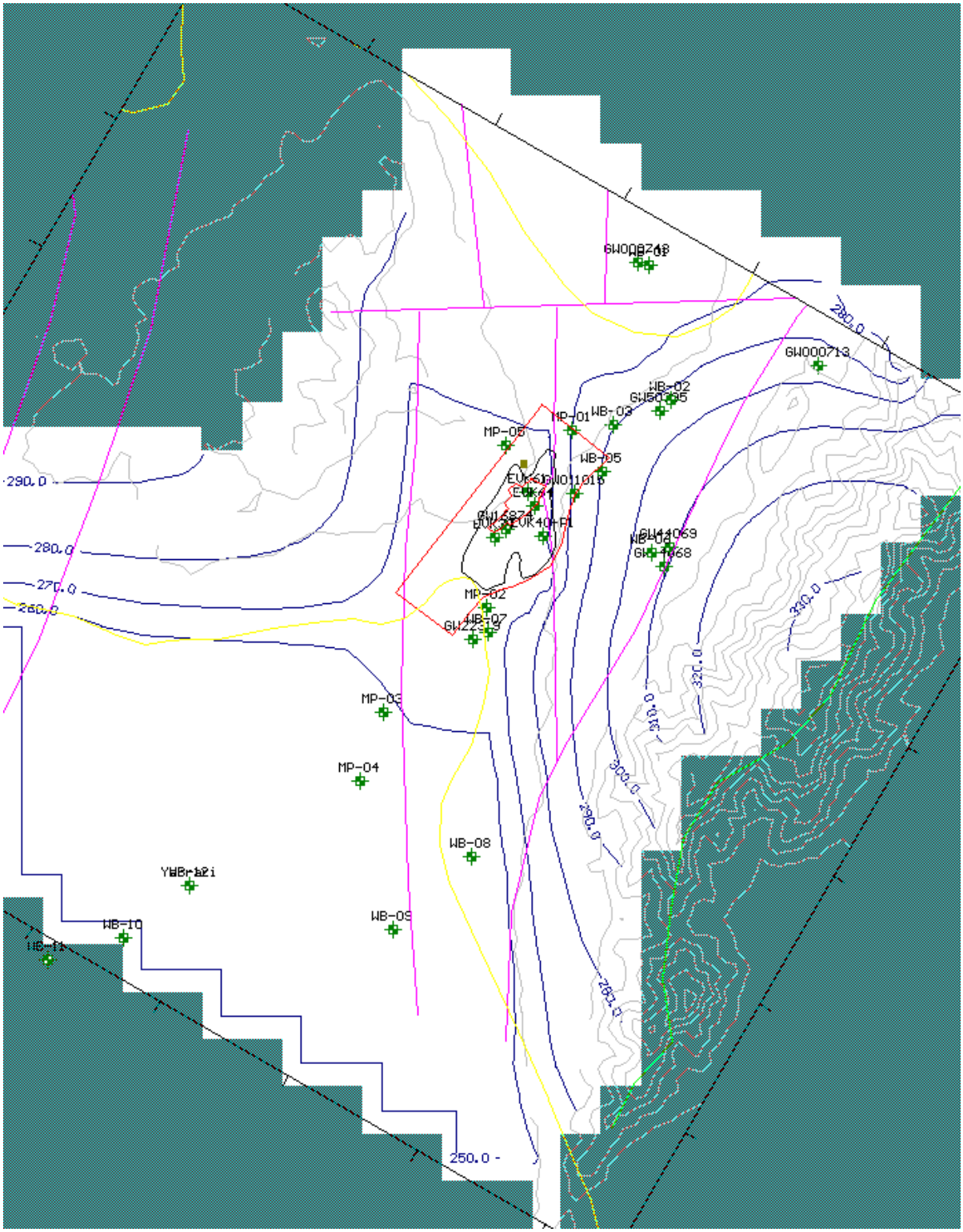

Figure 22 - Calibrated Steady State Head Distribution in Layer 3 (includes coal seams) for Case 1B

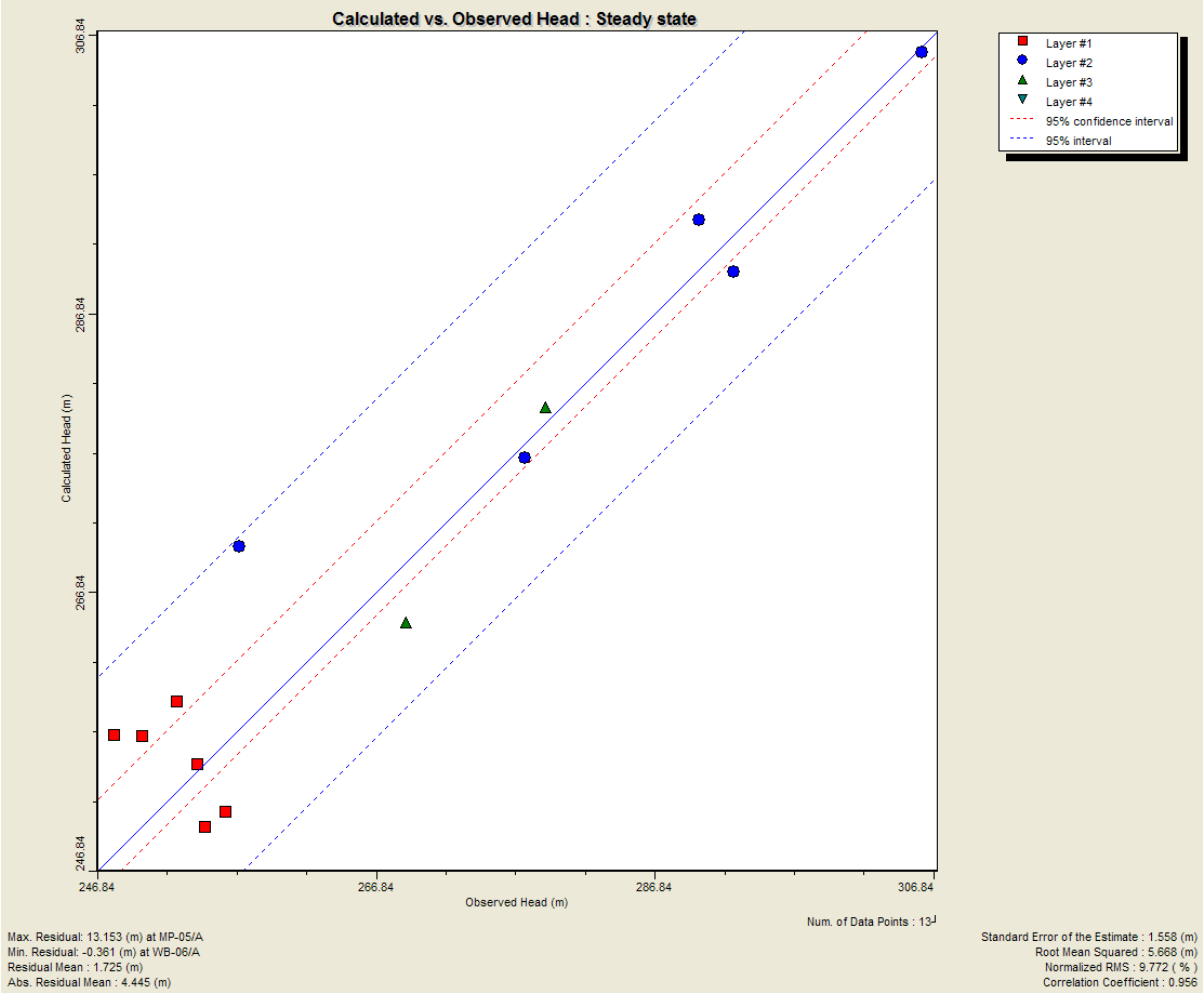

Figure 23 - Modelled and Observed Heads for Case 1B Calibration

For Case 1C, it was possible to gain a calibration close to, though not quite as good a fit as Case 1. Case 1C did not require any restriction in flow between the coal seams and eastern strata as it was offset by the additional connection to the southern alluvium. The resulting head distribution and correlations are presented in Figures 24 and 25 below.

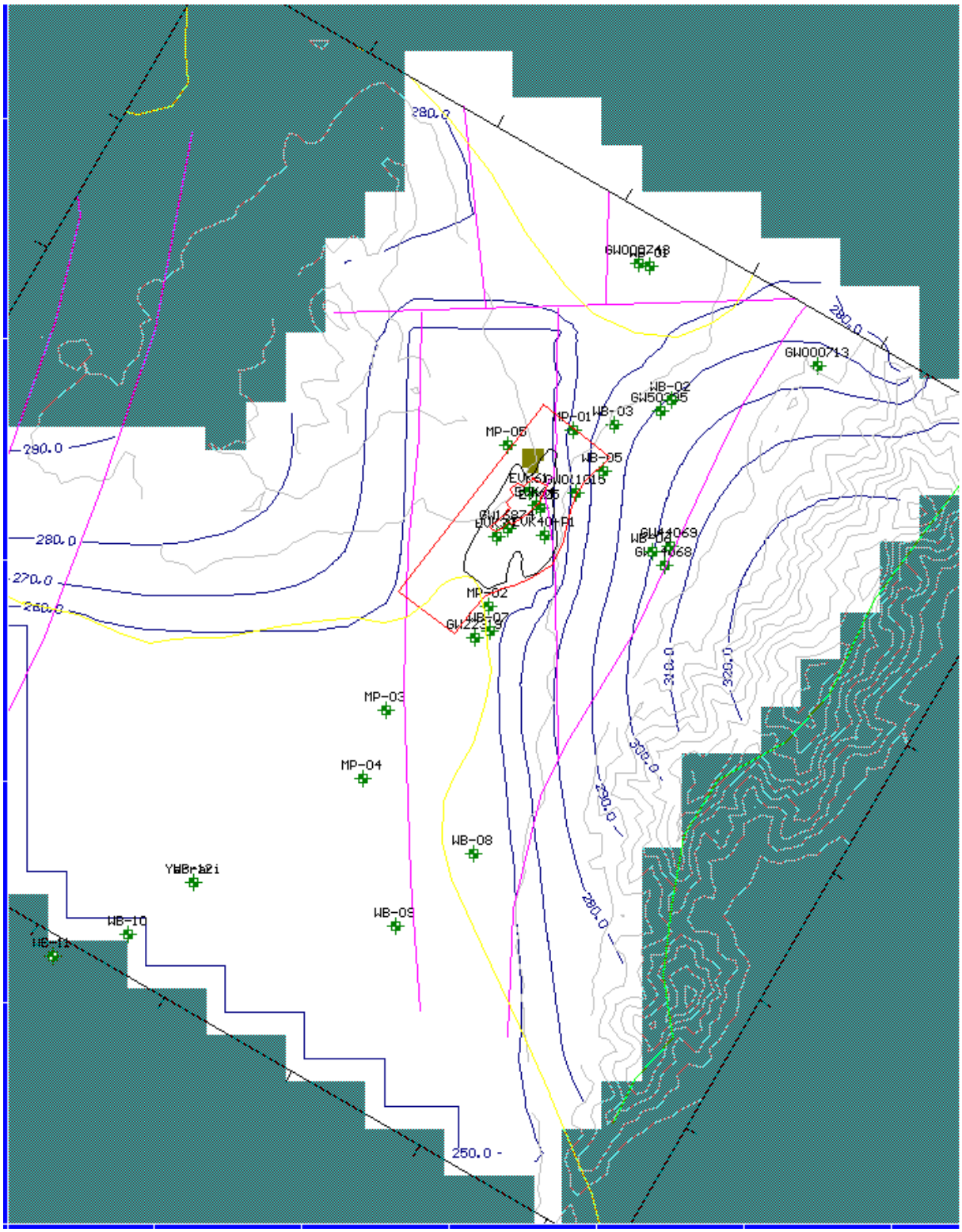

Figure 22 - Calibrated Steady State Head Distribution in Layer 3 (includes coal seams) for Case 1C

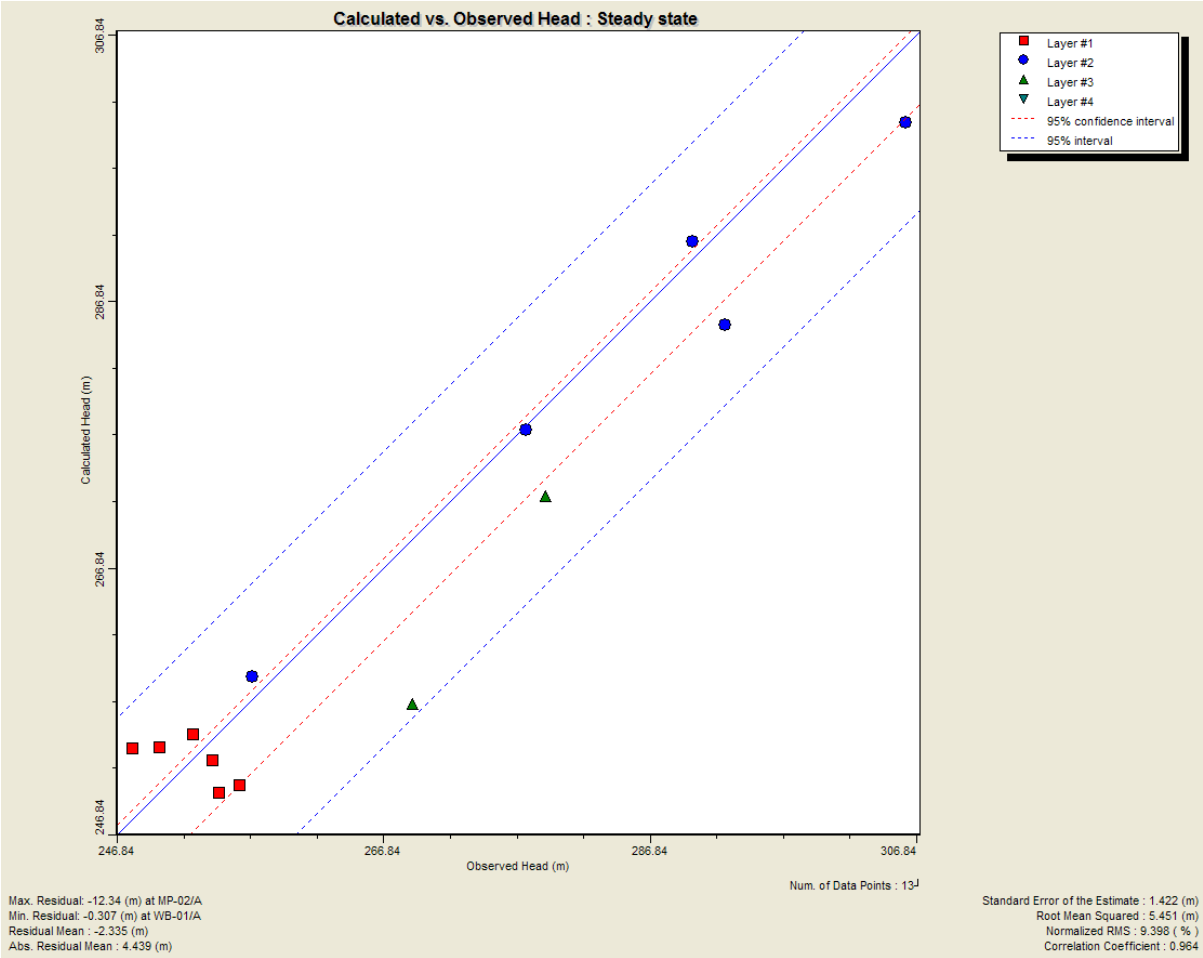

Figure 23 - Modelled and Observed Heads for Case 1C Calibration

Therefore Case 1C with a permeable fault to the west, connecting to the southern alluvium is considered a plausible alternative to Cases 1 and 2. The presence of permeable faults connecting to the alluvium to the east and/or north are considered implausible, based on an analysis of the data available.

9.3 Transient Modelling

9.3.1 Calibration

The results of groundwater monitoring during the first year of operation of the pit indicated minimal impact on water levels and generally no observable or only slight inflows to the pit. The level of excavation during this period ranged down to about RL 200, however more generally in the range RL 220 to RL 240, and an average drainage RL of about RL 230 was modelled.

The model was run in transient mode, simulating a 12 month period, to allow calibration to the observed changes in head. Daily time steps were used.

The pumping test data did not include observation wells and therefore no measurements of Storage Coefficients were available. Therefore typical storage coefficients were adopted, based on DPs experience with coal measures rocks. In the case of the composite coal and interburden layer the storage was based on a weighted average of a typical coal measures interburden (S_y=1%) and typical coal (S_y=5%). The adopted parameters are presented in Table 10 below.

Table 10 - Adopted Storage Coefficients

Storage	Specific Yield	Specific Storage
Alluvium K	0.20	$1x10^{-4}$
Volcanics K	0.01	$1x10^{-5}$
Overburden K	0.01	$1x10^{-5}$
Coal and Interburden K	0.02	$1x10^{-5}$
Sandstone Floor K	0.01	$1x10^{-5}$

The four cases were modelled as follows:

- Case 1 Upper Bound Permeability
- Case 1C Upper Bound Permeability with Permeable Western Fault
- Case 2 Lower Bound Permeability; and
- Case 2C Lower Bound Permeability with Permeable Western Fault

The resulting variations in head at each monitoring well are presented in Figures 10 and 11 below for Cases 1 and 2.

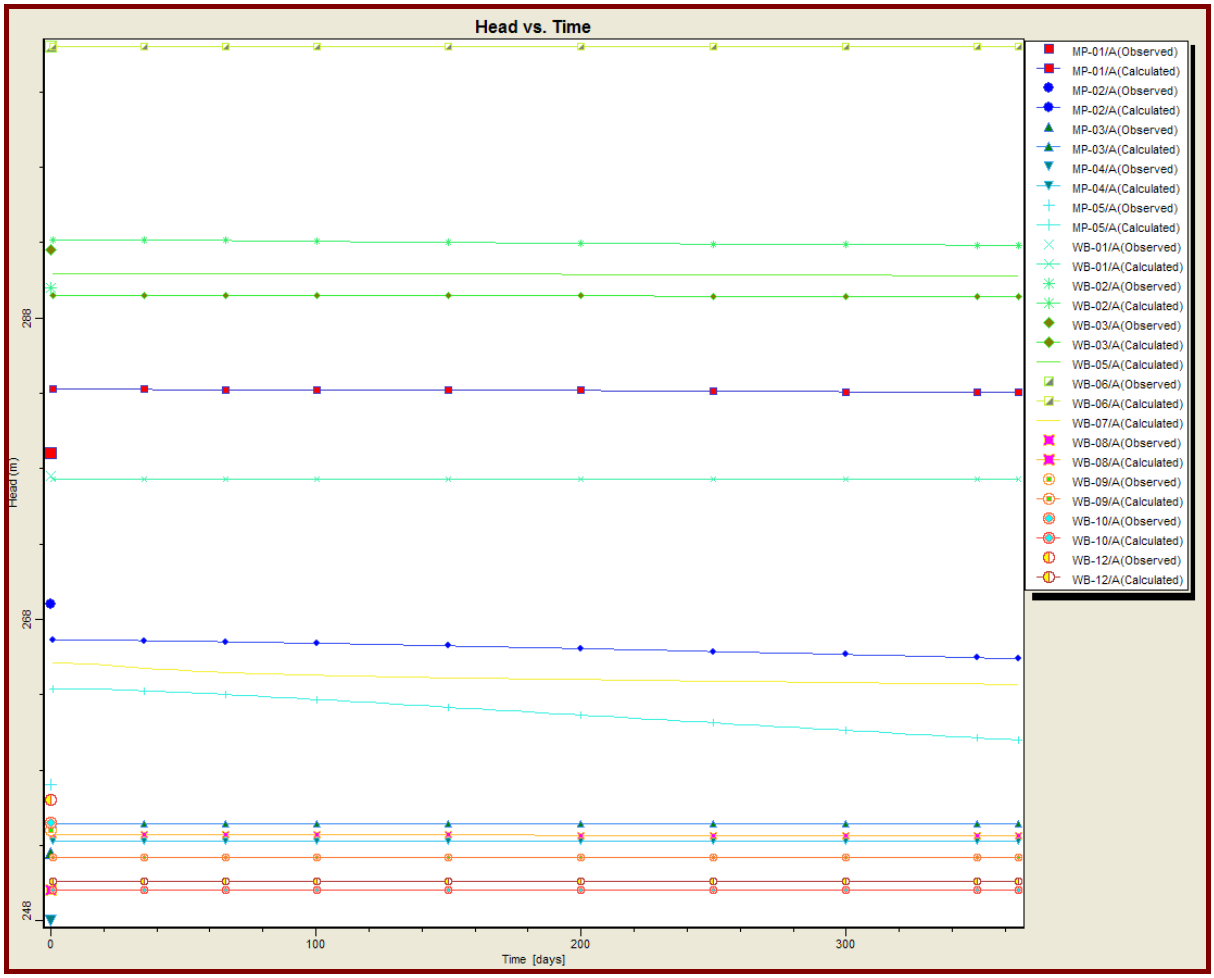

Figure 10 - Calculated Heads during First Year of Mine Operation – Case 1

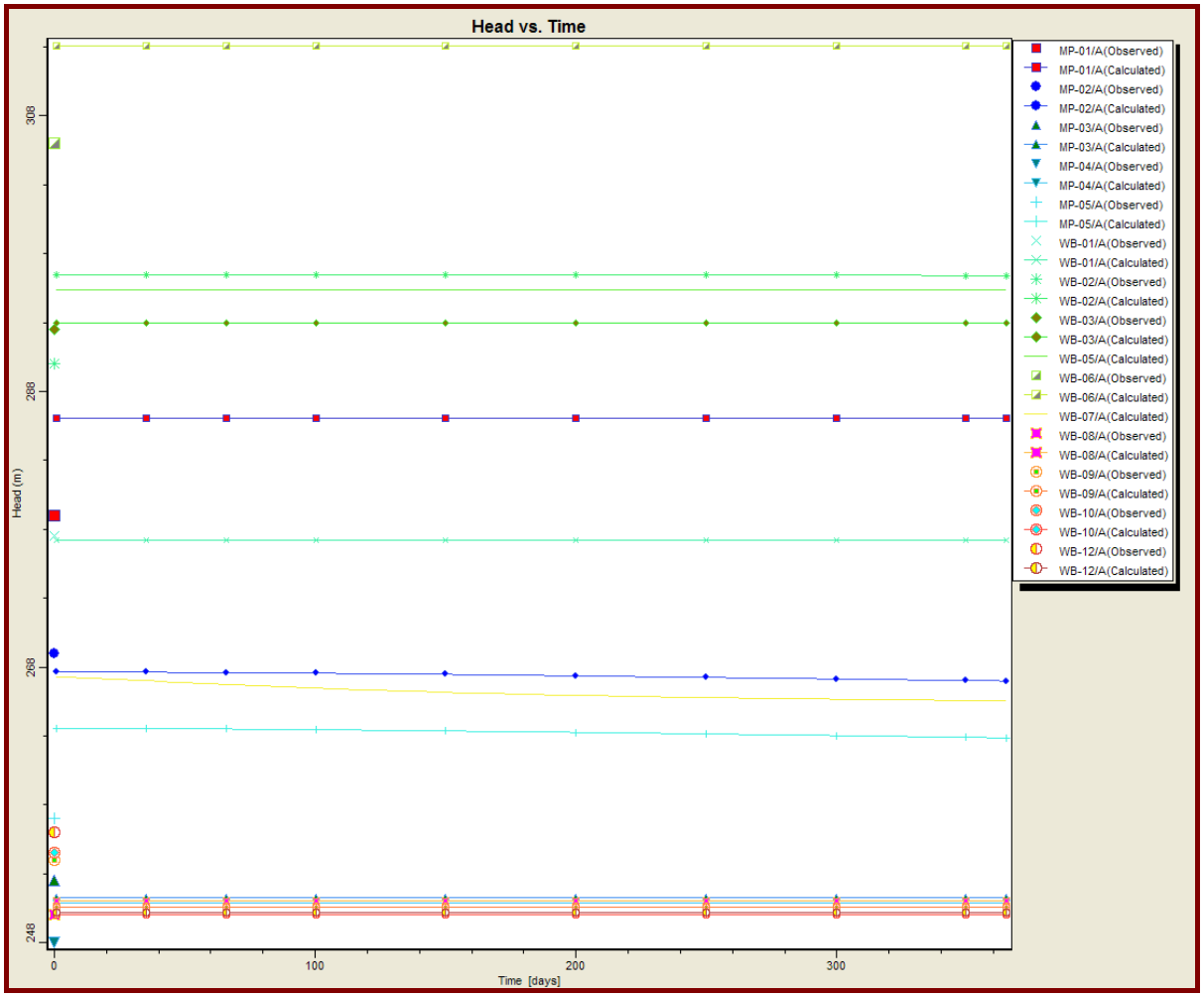

Figure 11 - Calculated Heads during First Year of Mine Operation – Case 2

The observed changes in head versus the calibrated changes in head are presented in Table 11 below.

Table 11 - Calibrated Drawdown at Monitoring Points in First Year

Monitoring Well	Observed	Case 1	Case 1C	Case 2	Case 2C	Comment
MP01	0.3	0.2	0.01	0.01	0.02	
MP02	0.35	1.2	2.86	0.63	1.02	
MP03	>0.9	0.03	0.19	0	0.05	Incomplete data set. Drawdown is likely to be due to pumping of WB08
MP04	>1.5	0.01	0.02	0	0.01	Incomplete data set. Drawdown in likely to be due to pumping of WB08
MP05	1.5	3.4	1.94	0.68	0.2	
WB01	0.1	0.01	0.01	0.01	0.01	Incomplete data set
WB02	0.42	0.35	0.01	0.5	0.01	
WB03	0.2	0.03	0.18	0.3	0.01	
WB05	10	0.13	0.01	0	0.01	Observed head variation likely to be due to pumping
WB06	0.84	0	0.01	0.06	0.01	Observed head variation is unlikely to be due to mine, due to proximity from site
WB07	2.0	1.4	1.1	1.7	0.4	Incomplete data set
WB08	-14/-3	0.06	0.01	0	0.01	Observed head variation likely to be due to pumping
WB09	0.2	0.02	0.02	0	0.01	
WB10	0.85	0	0	0	0	
WB12	0.2	0	0	0	0	

Table 11 above generally indicates that the monitoring data falls between the two cases, with some outliers, such as WB05 and WB08 which have atypical drawdown and are likely to be due to pumping from the wells.

WB-05 indicated a relatively large drawdown which isn't matched in other bores similar distances from the mining, such as MP-01. WB-05 was an existing registered water bore and is also in close proximity to EVK114, which has been converted to a bore used to provide water for dust suppression. It is considered likely that the drawdown in WB-05 is due to pumping from a well or well in the vicinity, and not due to the excavations associated with mining. It is also understood that more recent monitoring has indicated that the water level in WB-05 has returned to near pre-mining levels.

In January 2009, the groundwater level for Bore WB-08 was initially at about RL 235 m AHD, which is well below the regional level. It then rebounded to about RL 250 in June 2009, similar to regional water levels and then fell again to about RL 235 by February 2010. The water level in Bore WB-08 is currently at about RL 250. The varying nature of groundwater levels in this bore indicates that it is subject to the influence of intermittent pumping. The heads in MP-02 and MP-03, just to the north west of WB-08, also fell slightly for the period they were monitored and this is consistent with drawdown associated with WB-08.

The calibrated flows into the pit are presented in Table 12 below. The model assumes an instant drawdown occurs, however, in reality the mining occurs over a period and the drawdown is more gradual. As the model simulates instant drainage, the initial flow rates are over-estimated. Therefore the first 50 days of calculations has been ignored for the purpose of the flow assessment.

Table 12 – Calibrated Flow in Pit During First Year of Operation

Flow into Pit	Case 1	Case 1C	Case 2	Case 2C
Initial (50 days)	2850 m^3/day 33 L/s	2534 m^3/day 29 L/s	1656 m^3/day 19 L/s	1097 m^3/day 13 L/s
Final (360 days)	1664 m^3/day 19 L/s	1641 m^3/day 19 L/s	607 m^3/day 7 L/s	509 m^3/day 6 L/s

Observations from the mine were that there was generally no seepage observed in the pit during this time, with some localised seepage on the eastern side where the excavation was deeper and in this instance the flow may have been in the order of about 20 L/s.

The model simulates an average drainage level, however due to the steep dip of the seams, the drainage level will vary and in cases where the mining is locally deeper, such as along the eastern side, the flow rates will be above the average and visa-versa. Therefore the Case 2/2C calculated flow rates are considered more consistent with site observations. Flows in the range 19 to 32 L/s, as calculated for Case 1 would be expected to have resulted in clearly evident flows much of the time.

Subsequent records from the mine indicate that 23ML has been pumped from the pit for the period August 2009 to July 2010 which is equivalent to 63 m^3/day (0.7 L/s). Much of this is likely to have been from rainfall, which further supports that Case 2 conditions are more likely.

9.3.2 Predictive Modelling

The calibrated models were used to simulate flow rates and drawdowns for the future mine operations. The mining sequence was split into two periods as follows:

- Northern Mining Phase – to simulate mining in the northern parts of the pits which is anticipated to be from 2008 to 2015;
- Southern Mining Phase – to simulate mining in the southern parts of the pits which is anticipated to be from 2015 to 2020.

For the northern end of the pit the floor level of the Belmont Seam is in the range RL 180 to RL 240 and for purposes of the modelling an average drainage level of RL 210 was adopted.

The pit was modelled as a material with a high permeability of $1x10^{-4}$ m/s (8.6 m/day), commensurate with mine spoil. In order to assist with numerical stability a transition material was placed around the perimeter of the area with an intermediate permeability of $1x10^{-6}$ m/s (0.086 m/day). Figure 12 below provided the distribution of permeability used for layer 1.

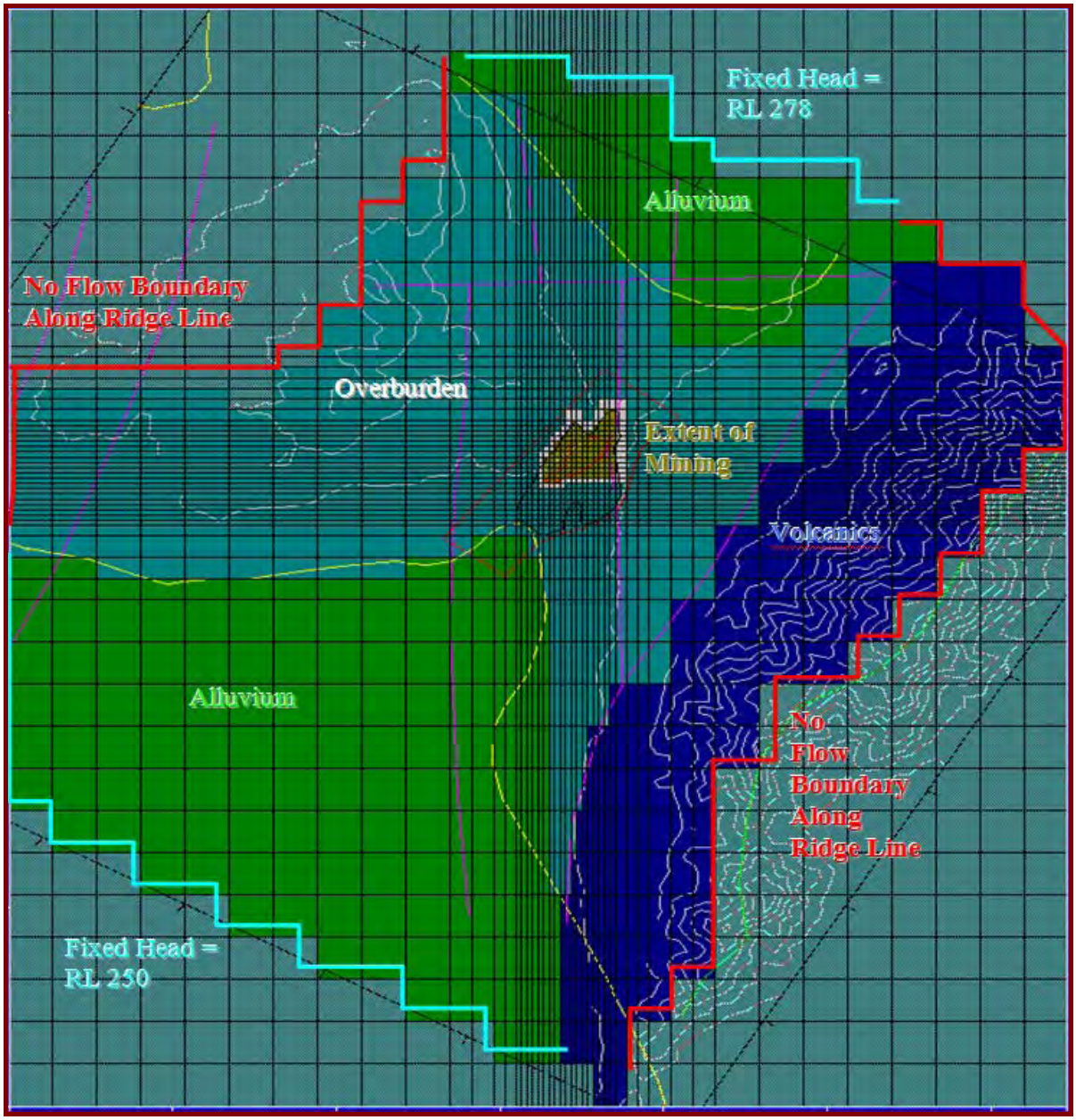

Figure 12 - Distribution of Permeability for Model Layer 1 for Northern Mining Phase

The predicted drawdown in monitoring wells for Case 1 parameters over the Northern Mining Phase is presented in Figure 13 below.

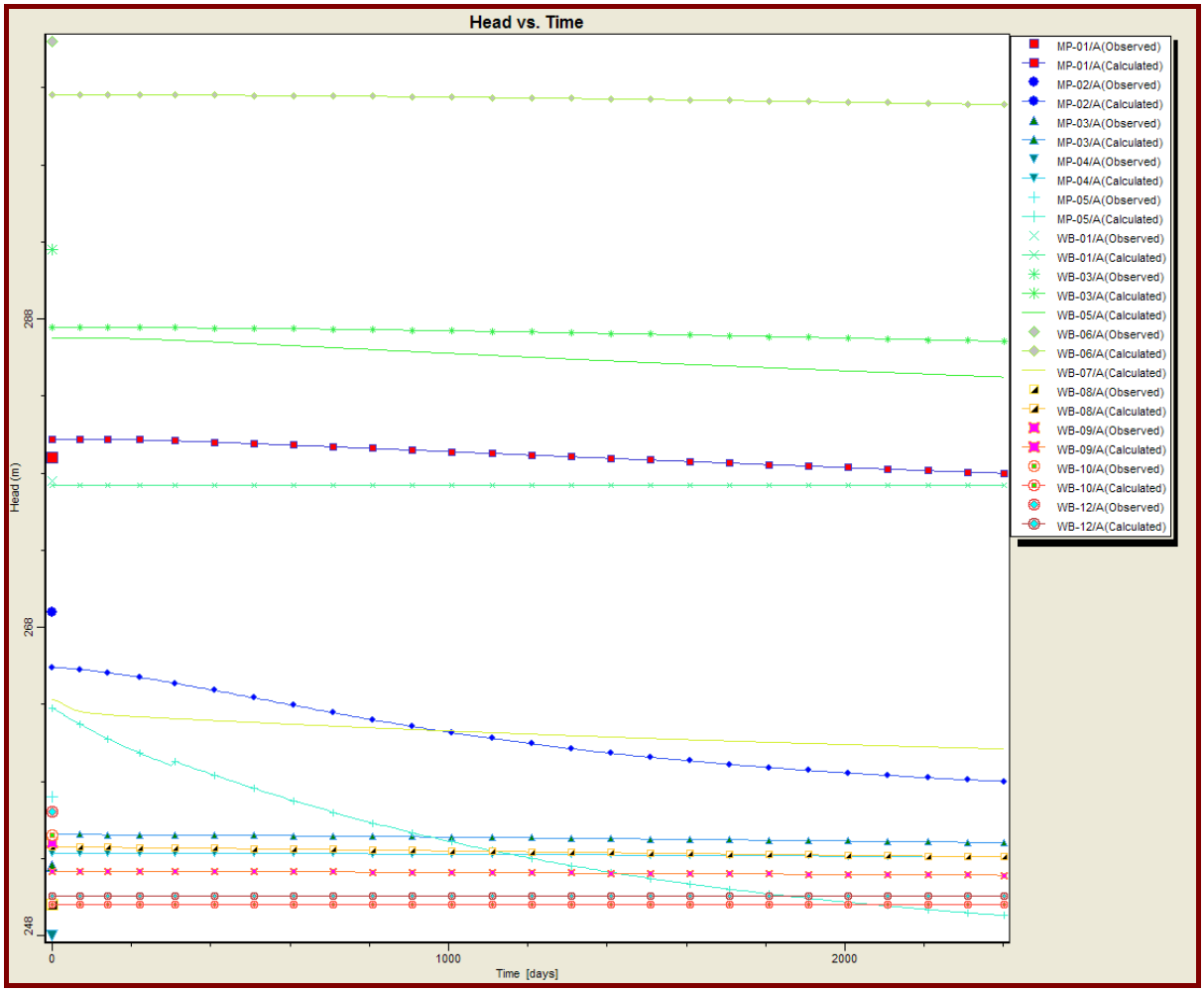

Figure 13 - Predicted Drawdowns for Northern Mining Phase - Case 1

The predicted distribution of head in Layer 3 at end of Northern Mining Phase is shown in Figure 14.

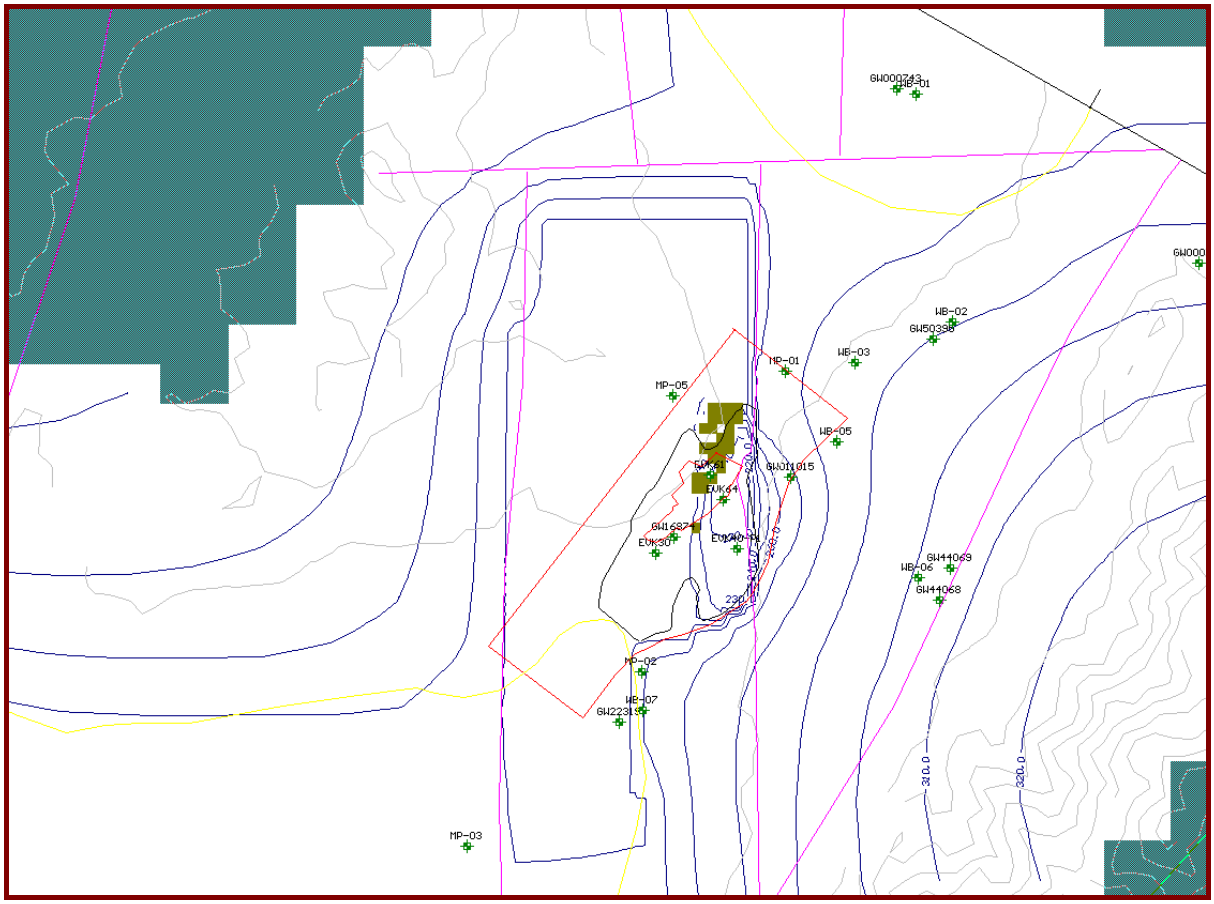

Figure 14 - Predicted Distribution of Head in Layer 3 at completion of Northern Mining Phase

The predicted drawdown in monitoring wells for Case 2 parameters over the Northern Mining Phase is presented in Figure 15 below.

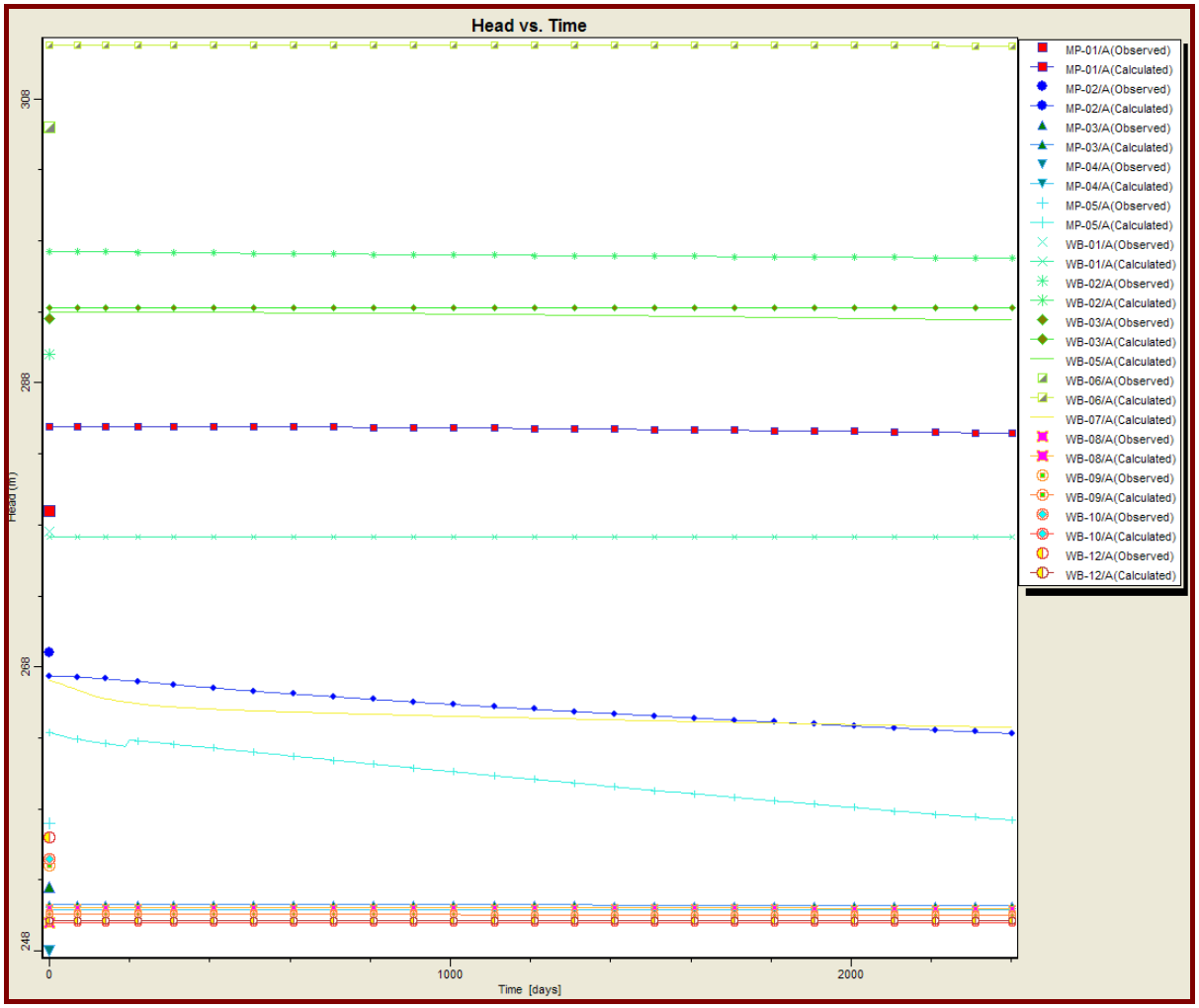

Figure 15 - Predicted Drawdowns for Northern Mining Phase - Case 2

The predicted drawdown in monitoring wells for Case 1 parameters over the Southern Mining Phase is presented in Figure 16 below.

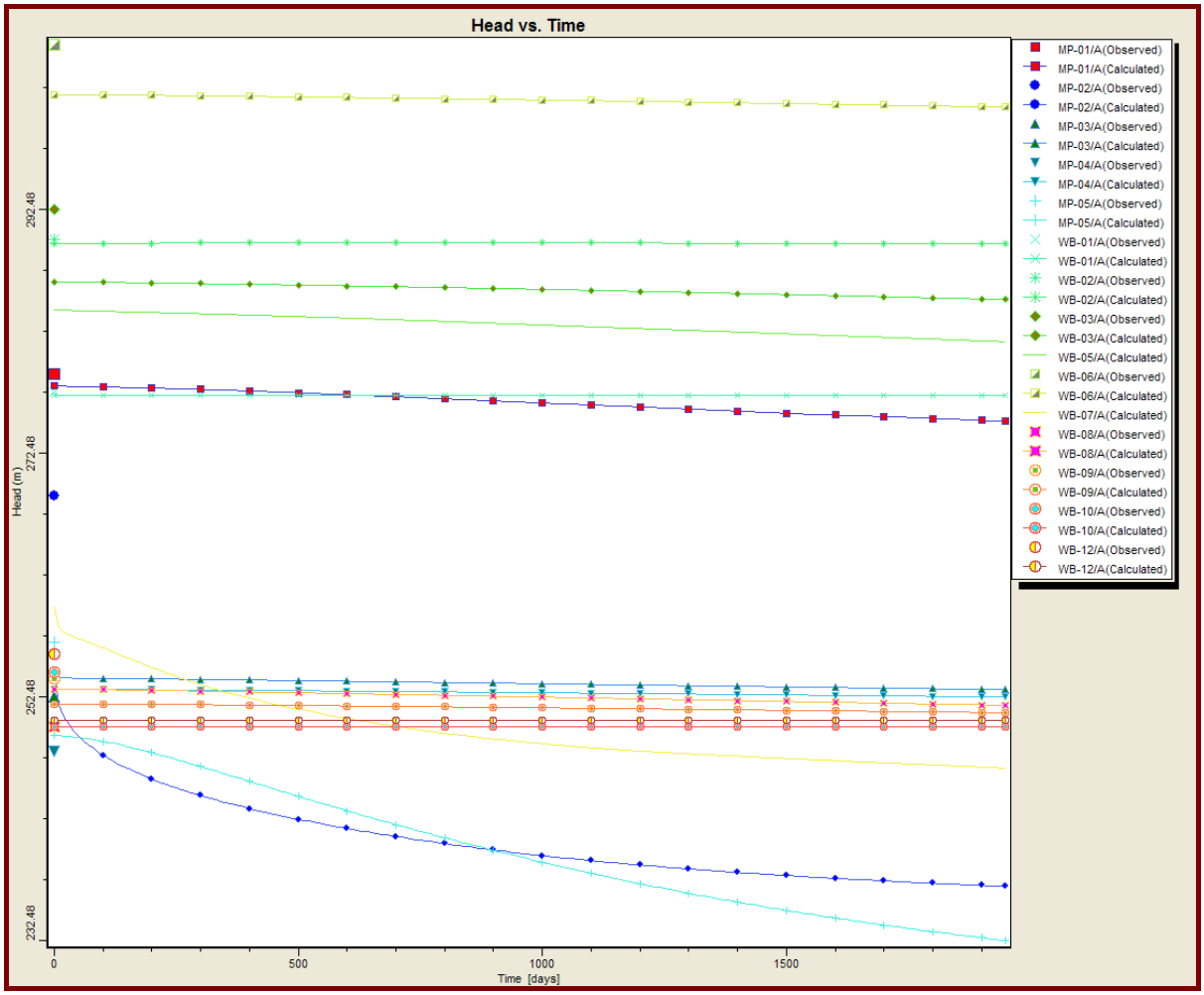

Figure 16 - Predicted Drawdowns for Southern Mining Phase - Case 1

The predicted distribution of head in Layer 3 for Case 1 at the completion of the Southern Mining Phase (end of all mining) is shown in Figure 17 below.

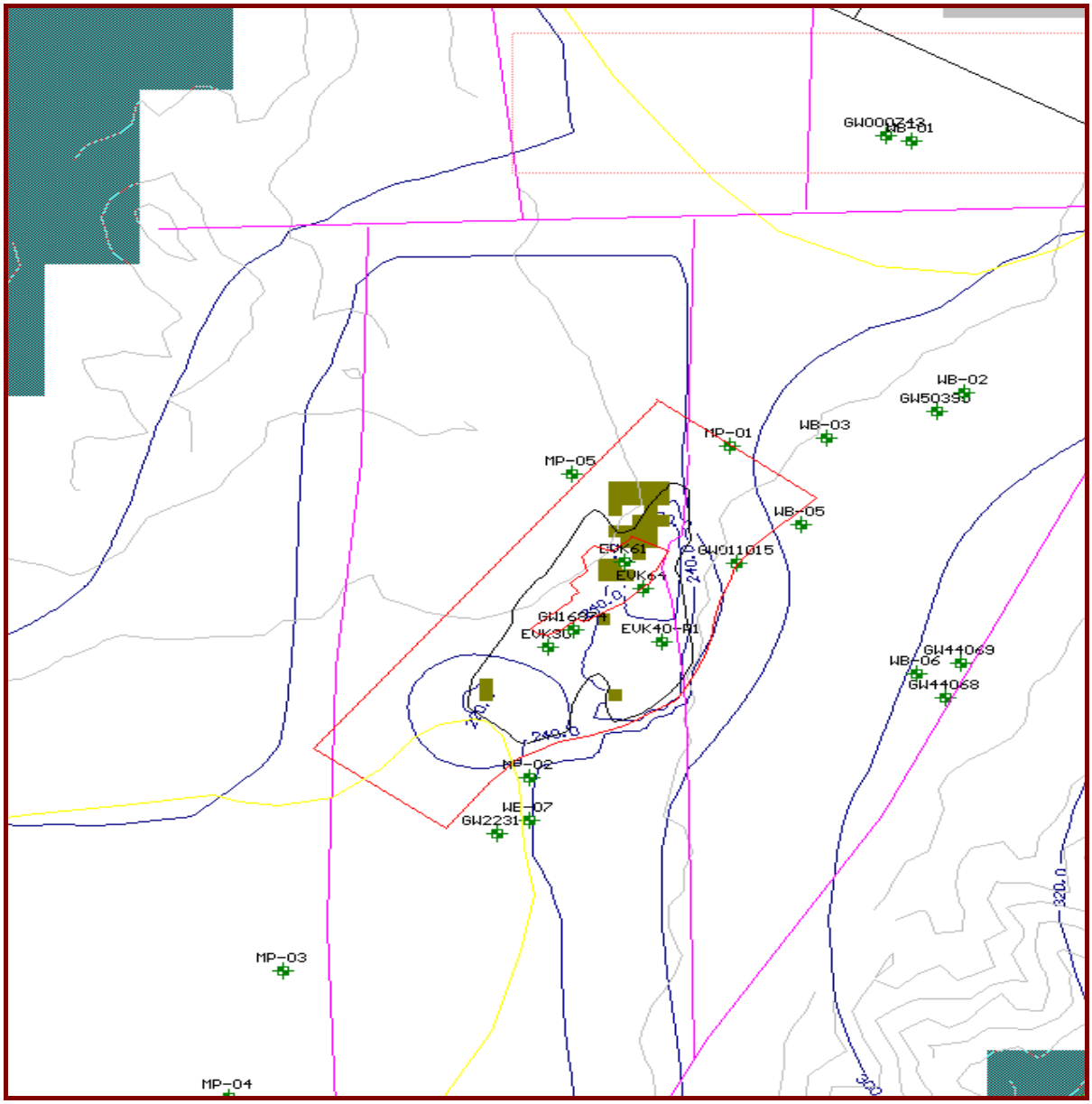

Figure 17 - Predicted Distribution of Head in Layer 3 at completion of Southern Phase of Mining (Case 1)

The predicted drawdown in monitoring wells for Case 2 parameters over the Southern Mining Phase is presented in Figure 18 below.

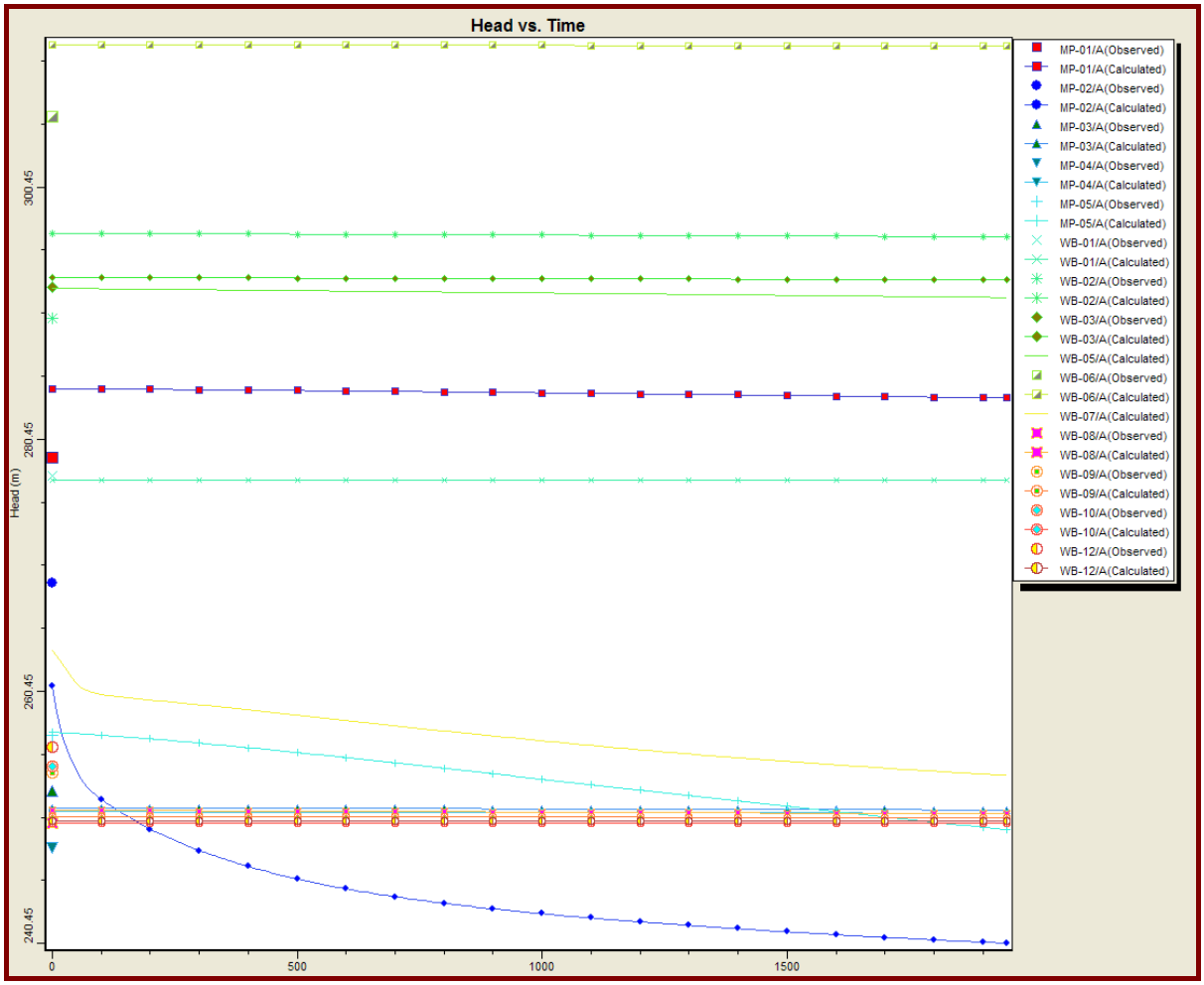

Figure 18 - Predicted Drawdowns for Southern Mining Phase - Case 2

The predicted distribution of head in Layer 3 for Case 2 at the completion of the Southern Mining Phase (end of all mining) is shown in Figure 19 below.

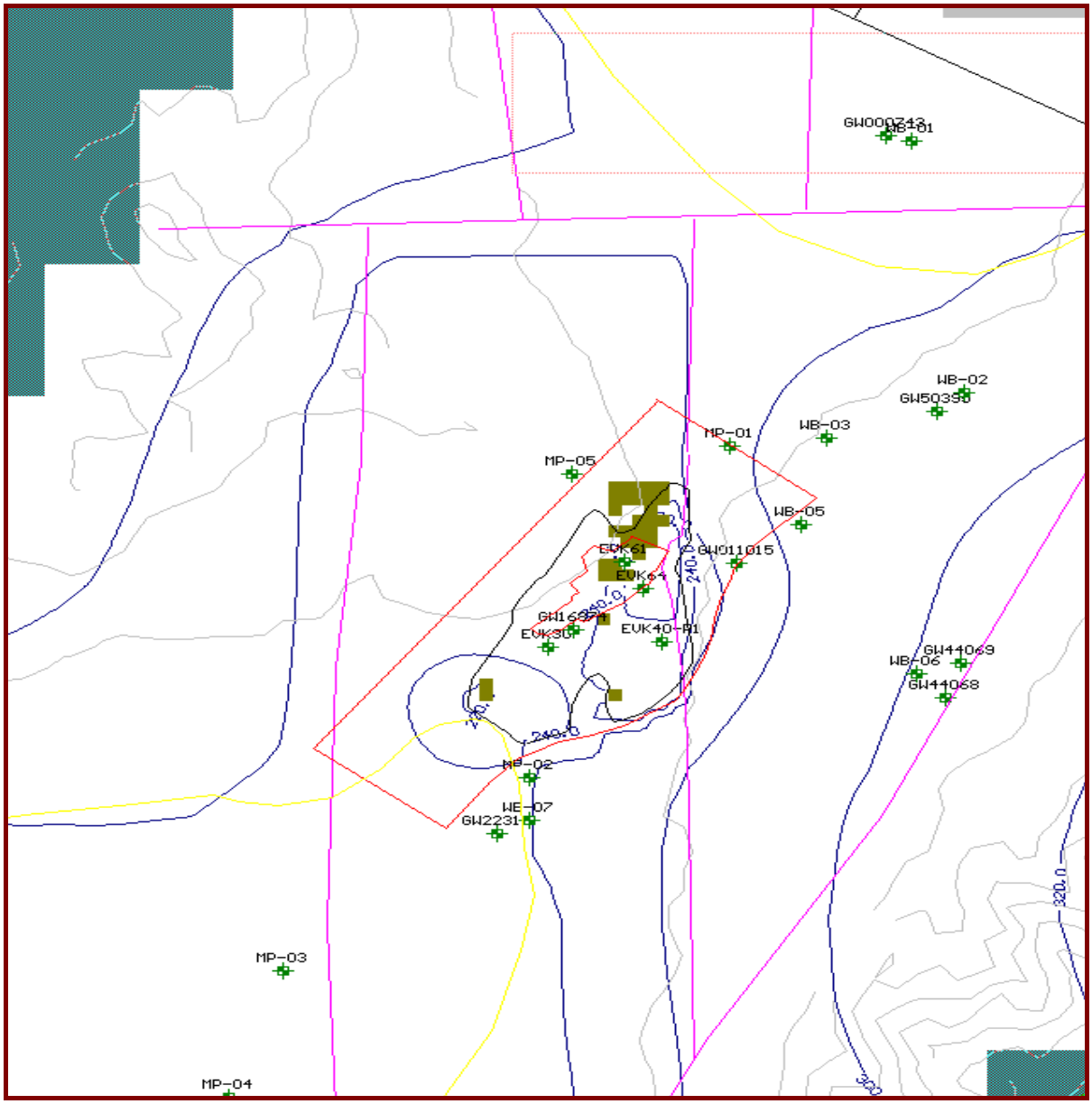

Figure 19 –Predicted Distribution of Head in Layer 3, Completion of Southern Phase of Mining – Case 2

The predicted drawdown at each of the monitoring wells, from the start of mining, is presented in Table 13 below.

Table 13 - Predicted Drawdown at Monitoring Points (m)

Monitoring Well	Case 1 (Case 1C)		Case 2 (Case 2C)	
	End of Northern Mining Phase	End Southern Phase	End of Northern Mining Phase	End of Southern Phase
MP-01	2.2 (1.9)	3.0 (5.2)	0.5 (0.5)	0.6 (3.7)
MP-02	7.4 (6.5)	27.8 (30.0)	4.0 (3.2)	24.3 (32.1)
MP-03	0.5 (1.8)	0.65 (2.4)	0.1 (0.6)	0.2 (1.4)
MP-04	0.2 (0.1)	0.3 (1.9)	0.1 (0.2)	0.1 (1.0)
MP-05	13.4 (8.7)	21.2 (24.7)	6.2 (2.7)	22.9 (9.9)
WB-01	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)
WB-02	0.7 (0.6)	1.0 (0.7)	0.5 (0.4)	0.8 (0.3)
WB-03	0.9 (0.6)	1.1 (1.9)	0.3 (0.1)	0.5 (0.3)
WB-05	2.5 (2.8)	3.2 (5.4)	0.5 (0.5)	0.7 (1.6)
WB-06	0.6 (0.6)	0.7 (1.7)	0.1 (0.1)	0.2 (0.1)
WB-07	2.9 (3.3)	12.9 (20.9)	3.3 (1.3)	13.2 (14.0)
WB-08	0.7 (0.4)	0.9 (2.1)	0.1 (0.1)	0.1 (0.3)
WB-09	0.3 (0.4)	0.4 (2.3)	0.1 (0.1)	0.1 (0.2)
WB-10	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)
WB-12	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)

Table 13 indicates high drawdowns in close proximity to the mine site, up to about 30 m near MP-02 and MP-05, with relatively low impacts to the east of the faulting. The predicted impacts on the alluvium are also low, however are slightly higher in the alluvium immediately south of the pit in the case that a permeable fault was present to the west of the site. The extent of the impacts on groundwater head are expected to be less than previously predicted by RCA (2007) for areas outside the area of faulting.

It is noted that the geology at the site is very complex and actual drawdowns may vary somewhat from those predicted. An ongoing monitoring programme is important to allow measurement of the ongoing impacts and further development of the groundwater model. Comments on groundwater monitoring are provided in Section 10.

Table 14 below presents the predicted flow rates into the pit for current, end of Northern Mining Phase and end of Southern Phase. The table also includes the estimated interference that the mine drainage will have on base flows into the alluvium.

Table 14 - Modelled Pit Inflows

Time	Case 1 – Flow Components (m^3/day) (Case 1C – Permeable Faulting)			Case 2 – Flow Components (m^3/day) (Case 2C – Permeable Faulting)		
	Into Pit	Storage loss from Alluvium	Reduction of flow in Alluvium**	Into Pit	Storage loss from Alluvium	Reduction of flow in Alluvium**
Initial (50 days)*	2850 (2534)	189 (611)	1	1656 (1097)	66 (136)	<1
2009	1664 (1641)	419 (833)	4	607 (509)	70 (254)	<1
End of Northern Mining Phase	1105 (1326)	518 (809)	52 (30)	491 (516)	106 (243)	6 (2)
End of Southern Mining Phase	2614 (3381)	1206 (1932)	191 (187)	1057 (1504)	270 (751)	37 (25)

Notes: * assumes instant excavation and over-estimates initial flow rates
** measured at constant head boundaries

Flow rates are generally expected to decrease as mining continues in the northern end of the pit, however are expected to increase as the mining progresses to the southern end of the pit, due to the increased area of the pit and because the flow is less restricted by the faulting at the northern end of the pit. The variations in flow between the various years will be less distinct than those predicted as the modelling assumed three distinct stages of mining, however in reality the sequencing will be gradual.

As the floor of the Belmont Seam ranges in elevation, the flow rates into the pit will vary according to the depth of the seam. For areas where the seam floor is about RL 210, mostly on the central parts of the proposed mining extent, the flows can be expected to be less than the average predicted values and will probably generally not be visible in the pit due to evaporative effects. For deeper parts of the excavation the flow rates can be expected to be higher and free flow into the pit can be expected.

The predicted impact on flows in the alluvium, as measured from the reduction in flows to the constant head boundaries, is minor as most of the flow comes from storage, however as the life of the mine increases the influence of storage reduces and the impact of flows to the alluvium increases slightly. Impacts on storage in the alluvium occur in close proximity to the mine and the percentage contribution to the inflow to the mine from storage depends on the presence of permeable faulting to the west of the site. For possible permeable faulting to the west of the site or for the higher ranges of permeability with no faulting, the component of flow from alluvial storage is initially low and then ranges up to about 50%. For the more likely Case 2, with lower permeability and limited permeability faulting to the west of the site, the component ranges up to about 25%. The impact on flows/storage in the alluvium is primarily to the southern alluvium (at least 90%) as the northern alluvium is up gradient and essentially hydraulically separated.

The range of possible inflows to the pit, based on the credible range of parameters, ranges from 1057 to 3381 m^3/day. Overall, the predictions for Case 1 are similar to the predictions of the previous modelling by RCA (2007), however based on site observations to date it is considered that the Case 2 flows are more likely to occur. Therefore it is unlikely that the annual flow rates into the pit will exceed the existing groundwater interference licence of 700ML/yr (1918m^3/day). It is noted however that there is some uncertainty in the site conditions, in particular to the south west of the site, and flows greater than 700 ML/yr may be possible if adverse conditions occur. Therefore a robust ongoing monitoring program and updating of the predictive model are recommended as mining continues.

9.4 Mine Closure

It is understood that the majority of the pit will be backfilled to an elevation above 250 m AHD, with the exception of an area of about 38 ha in the southern side of the pit where the surface levels will be in the range RL 225 to RL 250. It is expected that once mining is complete, recharge of groundwater and rainfall infiltration into the pit will result in the formation of a water table within the backfill. It is likely that this will eventually lead to the formation of surface water in the southern part of the pit with the locally deeper final surface level.

The inflow to the pit will be offset by evaporation from the area of surface water and therefore it is unlikely that the groundwater levels within the pit will ever fully recover to pre-development levels. It is estimated that the final equilibrium water levels will range between RL 220 and RL 245, however this may take 20 to 50 years to occur and would also be subject to variations according to climatic conditions.

The existing groundwater in the Maules Creek Formation is generally brackish with total dissolved solids in the range 1000 to 5130 mg/L. In general, the pore water in the backfilled mine spoil is expected to become less saline over time due to the percolation of rainfall through the spoil pile. The exception to this will be in the area of surface water in the non-backfilled portion of the pit. In this location, the salinity is expected to increase over time as the evaporation leads to reduction in water volume and leaves the dissolved salt behind. The increase in concentration is expected to be generally isolated to the surface water in the locally deep area, with some minor mixing with the adjacent pore water in the mine spoil.

Consideration was given to raising the backfill levels such that surface water is never formed within the pit, thereby reducing evaporation and associated increase in salinity over time. Calculations indicate that a final fill level of about RL 275 m AHD is required to prevent surface water ever occurring. This level is above the pre-development groundwater level because the mine spoil will be relatively permeable and porous, and recharge rates into the mine spoil will be substantially higher than for the surrounding undisturbed ground. Such a high final ground level, well above pre-development groundwater levels, is understood to be impractical from a mine spoil management perspective.

It is considered that, although the proposed final void form will, over time, lead to increasing salt concentrations in the localised area of surface water within the final void, this will be of minimal impact outside the final void for the following reasons:

- The final void will behave as a groundwater sink. Therefore any increases in salinity within the sink will not affect the surrounding groundwater quality as the flow will be towards the area of higher salinity and not away from it;
- The surface water level at equilibrium will be well below surrounding groundwater levels; and
- The surface water will be located within a small final void with relatively steep sloping sides. This small area will be unsuitable for alternative land uses which would be sensitive to the potential saline surface water.

10. Conclusions and Recommendations

The groundwater investigation documented in this report has been undertaken in support of an application for expansion of the Rocglen Coal Mine, near Gunnedah in North West NSW. This hydrogeological assessment of the area around the mine is aimed at evaluating the potential impact of the expanded mine on the groundwater system, and assessing the quantum of groundwater inflow that is likely to occur.

Data relied upon for this investigation included previous study reports, topographic and geographic mapping, information from the NSW Office of Water, coal exploration drilling data provided by WHC, and information from a groundwater monitoring program undertaken by WHC since the commencement of mining in mid 2008.

The Conceptual Hydrogeological Model (CHM) derived by RCA (2002) and RCA (2007) has been confirmed and updated. A revised numerical groundwater flow model has been structured and calibrated in order to assess impact on the surrounding groundwater system and assess the quantum of groundwater seepage that may occur into the pit.

Study Findings

The results of the investigation are summarised as follows:

- Rocglen Coal Mine is located within the Maules Creek Formation of Permian age and mines coal from the Glenroc Seams (Upper and Lower) and (mainly) from the Belmont Seam. The Belmont Seam averages about 8 m in thickness;
- Rocglen Coal Mine is situated within a narrow valley between elevated topography of the Vickery State Forest to the west and the Community Conservation Area (CCA) Zone 2 – Kelvin to the east. Rocglen Coal Mine is situated on a saddle, with the land slightly sloping to the north and to the south;
- Alluvium associated with the Namoi River and tributaries borders ML 1620 to the north and also exists approximately 2 km south and southwest of the limit of the proposed expanded open cut. The NSW Office of Water is concerned about the potential for mining to impact on significant groundwater resources within the alluvium associated with the Namoi River and tributaries;

- A number of private bores have been identified within a 5 km distance of the mine. Some of these bores draw water from the alluvium, but most in close proximity to the mine draw water from the coal seams and sandstone / conglomerate intervals of the Maules Creek Formation;
- Groundwater resources in the region are utilised primarily for stock watering;
- The geology in close proximity to the mine is disturbed by folding and faulting, thereby complicating the groundwater flow regime. The Mooki Thrust which forms the margin of the Gunnedah Basin, is located only a few kilometres east of the mine. Several smaller faults with near vertical displacements of up to 150 m surround the mine;
- Within the Maules Creek Formation, groundwater is more prevalent in the coal seams than in the intervening interburden sediments. Hydraulic testing shows that the hydraulic conductivity of the coal seams is at least an order of magnitude greater than that of the interburden sandstone, conglomerate, siltstone and shale;
- An analysis of monitoring data shows that to date, the mine has had little effect on surrounding groundwater levels. Drawdown has been proportionately less than was predicted by the numerical modelling of RCA (2007). Similarly, recorded inflows have been much less than the seepage volumes predicted by the RCA (2007) modelling;
- Long-term average monthly rainfall data show that rainfall is relatively evenly distributed throughout the year, with slightly more rainfall occurring during the summer months. Evaporation greatly exceeds rainfall during most months, however it is almost balanced by rainfall during the winter months of June and July;
- Recharge of the groundwater system is small. No recharge events of significance are noted in groundwater hydrographs since mid 2008, despite some considerable rainfalls being recorded during that period;
- Laboratory analysis of groundwater samples shows that quality is spatially highly variable. This is probably a function of the amount of faulting in the area restricting groundwater flow; and
- Based on the conceptual hydrological model it is considered that drawdown on the surrounding groundwater system as a result of the expanded mining operation will be limited in the future. Because of the many faults in the vicinity of the mine and generally low permeability of the Maules Creek Formation strata, hydraulic connectivity with the alluvium is considered to be limited. It is possible that the faulting to the west of the site has some elevated permeability and in this case slightly increased drawdowns could occur in the southern alluvium, however this would still be expected to be no more than about 2 m near the pit to minimal impact to the south of the pit.

A revised numerical groundwater flow model has been calibrated in steady state to match groundwater levels recorded in July 2008. There is a reasonable degree of replication of the pre-mining groundwater levels by the model, particularly considering the geological complexity in the vicinity of the mine.

In transient mode, the revised model simulates observed changes in head reasonably well, apart from a few instances in which recorded groundwater levels may be related to local pumping.

The revised numerical model has been used to assess the likely impact of Rocglen Mine to the end of mine life, which is anticipated to be around 10 years following commencement of the expanded operation (at this point in time, this is considered year 2020). Modelling results suggest that groundwater levels will be drawn down ~30 m in close proximity to the pit, but that drawdown will be mostly limited to within the fault block which surrounds the mine. Relatively little drawdown is predicted to occur outside the faults.

Average inflows to the pit going forward are expected to be lower than previously modelled by RCA (2007). Depending on the permeability case value adopted, inflows are expected to be of the order of 6 L/s to 15 L/s mid way though the project (Year 5 of expanded operation, which is anticipated to be year 2015), and between 13 L/s and 40 L/s at the end of mining (anticipated to be around 10 years following commencement of the expanded operation, which, at this point in time, is thought to be year 2020).

Final water levels within the pit are expected to be equilibrate at about RL RL220 to RL245 AHD and would be expected to take about 20 to 50 years to occur. Some increase in salinity will occur in surface water in the remnant pit due to evaporative effects, however this would be expected to have very limited impact on the surrounding land and groundwater.

Recommendations

Groundwater monitoring undertaken since 2008 has been based on available existing bores in proximity to the mine site and several established bores for monitoring purposes. Whilst this extent of monitoring has allowed review of impacts for the purposes of this assessment, DP recommends the following actions to improve monitoring outcomes moving forward:

- The aquifer interval monitored by each of the bores is not known with certainty. Bores should be cleaned out (air-lift developed) and depth checked with a weighted tape. Bores should then be geophysically wireline logged (SP/SPR and Gamma) to confirm slotted intervals and the nature of the strata over slotted intervals;
- All monitoring bores should be surveyed for location and level (both ground level and the level of the Reference Point (RP) from which groundwater levels are measured);
- Monitoring of groundwater levels should initially be undertaken on a monthly basis for the first year of the expansion, after which the monitoring interval could potentially be relaxed subject to review of the results. In the longer term a monitoring interval of three months is anticipated. The monitoring should be undertaken in the first week of the nominated month. The frequency of groundwater sampling and laboratory analysis of water samples should remain as is. Water samples should be analysed for all major ions, including carbonate; and
- Pressure transducers/dataloggers should be installed in monitoring bores MP-01 to MP-05 for the continual recording of groundwater levels. These instruments should be downloaded every 2 months. In the case of MP-04 and MP-05, these wells only just intersected the water table when installed and have been observed to run dry. It is recommended that these bores be deepened to at least 10 m below the water table.

The above improvements to the groundwater monitoring regime will facilitate easier upgrading of the current groundwater flow model at a later date.

In order to address the concerns of the NSW Office of Water in regard to the potential for impact on alluvial aquifers of the Namoi River and associated tributaries, the following program of investigations is recommended:

- Bore MP-4 is nominally located within the alluvium south of the mine. Once this is confirmed through the activity recommended above, a second bore should be drilled adjacent to it, to a depth at which the base of the alluvium is intersected. This adjacent bore should be completed as a monitoring bore in the Maules Creek Formation and have a pressure transducer/datalogger installed for continuous water level monitoring; and
- Bore WB-01 is located within the alluvium north of the mine. Once this is confirmed through the activity recommended above, a second bore should be drilled adjacent to it, to a depth at which the base of the alluvium is intersected. This adjacent bore should be completed as a monitoring bore in the Maules Creek Formation and have a pressure transducer/datalogger installed for continuous water level monitoring. Such actions will need to be agreed to by the relevant landowners;
- There is some uncertainty regarding the nature of the interface between the southern alluvium and the weathered conglomerate profile of the Maules Creek Formation at the southern end of the proposed pit. It is recommended that a pair of piezometers be installed immediately to the south of the proposed pit, one in the Belmont Seam and one in the alluvium/weathered conglomerate. It is also recommended that hydraulic testing be undertaken on the bore in the alluvium/weathered conglomerate to allow refinement of the groundwater model in this regard.

Regular monitoring of both MP-4 and WB-01, the new piezometers immediately to the south of the pit, and their adjacent bores will assist in assessing the degree of hydraulic connection between the Maules Creek Formation and the alluvial aquifer.

11. References

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4. **McDonald, M. G., & Harbaugh, A. W., 1988:** A modular three-dimensional finite-difference ground-water flow model. USGS Techniques of Water Resources Investigations, Book 6, Chapter A1. Washington DC.
5. **McElroy Bryan Geological Services Pty Ltd., 1993:** Exploration Report - Exploration Licence 4501, East Vickery Area, Gunnedah NSW. Report prepared for Novacoal Australia Pty Ltd. Report No 129/4/2. October, 1993.

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8. **Robert Carr & Associates Pty Ltd., 2002:** Groundwater Assessment Proposed Belmont Mine near Boggabri. Report prepared for Whitehaven Coal Mining Limited. Report 3065-001. October 2002.

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10. **Robert Carr & Associates Pty Ltd., 2008:** Site Water Management Plan for the Rocglen Coal Mine. Prepared in conjunction with the Soil Conservation Service of NSW Department of Lands for Whitehaven Coal Mining Pty Ltd.

12. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for a project at Rocglen Coal Mine, Gunnedah in accordance with DP's proposal dated 23 December 2009 and acceptance received from Whitehaven Coal Limited dated 29 January 2010. The report is provided for the exclusive use of GSS Environmental and Whitehaven Coal Limited for this project only and for the purpose(s) described in the report. It should not be used for other projects or by a third party. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions only at the specific sampling or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of anthropogenic influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be limited by undetected variations in ground conditions between sampling locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion given in this report.

Douglas Partners Pty Ltd

Appendix A

About this Report

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

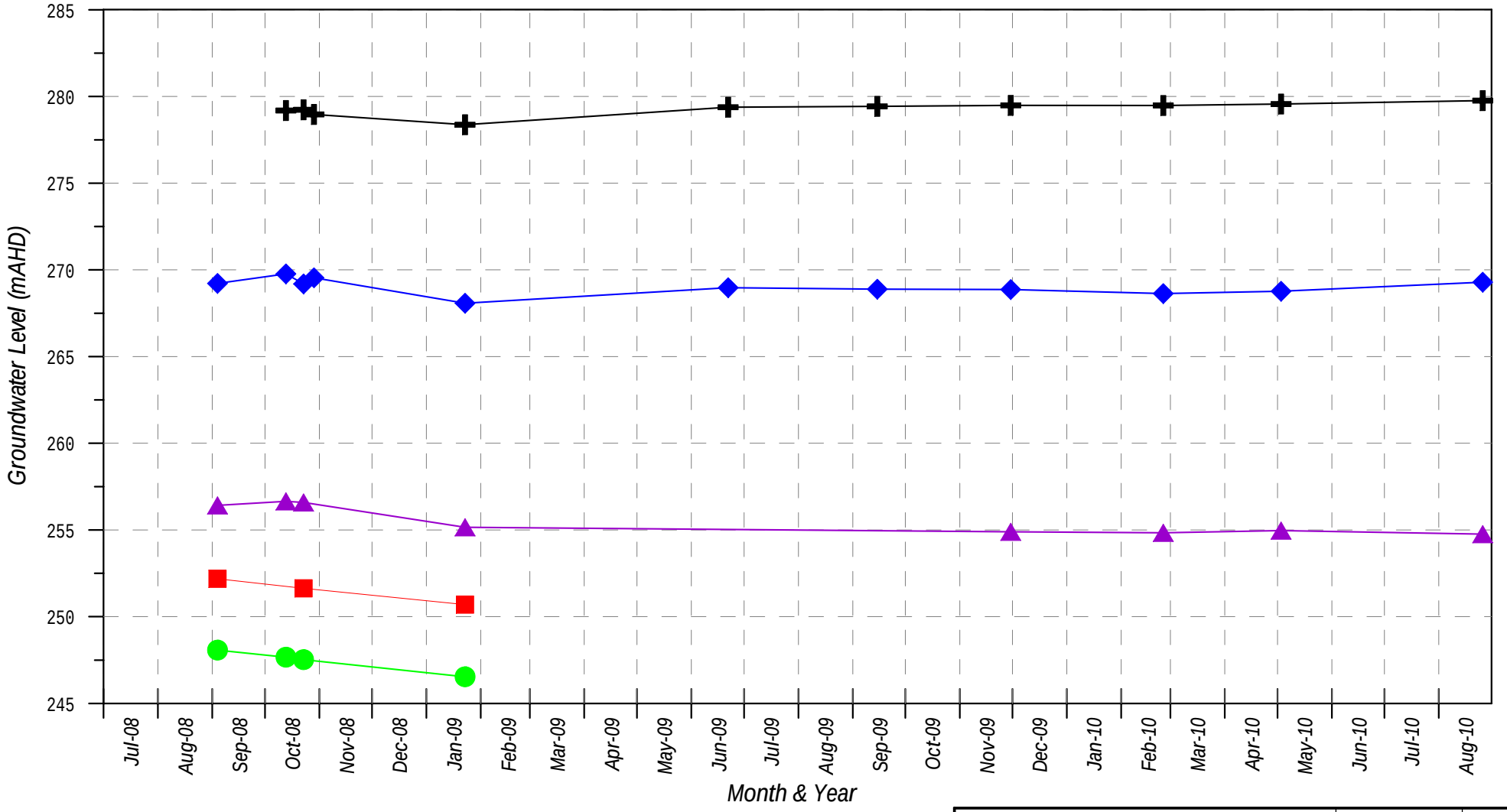
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Appendix B

Hydrographs of Groundwater Levels for Rocglen Mine Monitoring Bores



- Monitoring Bore MP-01
- Monitoring Bore MP-02
- Monitoring Bore MP-03
- Monitoring Bore MP-04
- Monitoring Bore MP-05

Douglas Partners
Geotechnics - Environment - Groundwater

Brisbane, Cairns, Campbelltown, Canberra, Darwin, Gold Coast, Melbourne

Newcastle, Perth, Sunshine Coast, Sydney, Townsville, Wollongong, Wyong

TITLE: **HYDROGRAPHS FOR BORES MP-01, MP-02, MP-03, MP-04 & MP-05**
Hydrogeological Assessment for Rocglen Coal Mine Expansion
Rocglen Coal Mine, via Gunnedah, New South Wales

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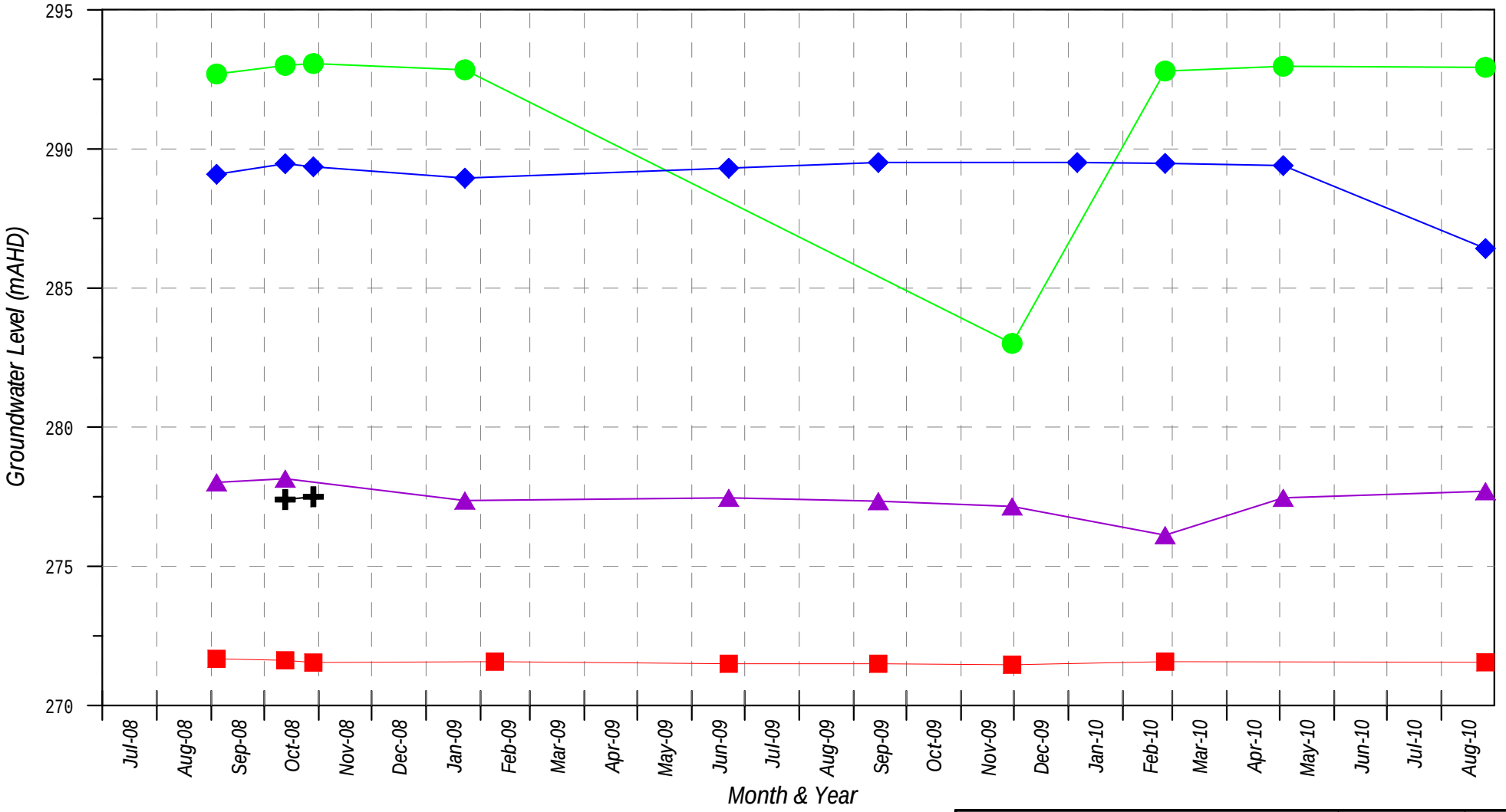
DRAWN BY: AP		PROJECT NO: 49532.00	DRAWING NO: A-1
APPROVED:		DATE: Nov 2010	



Monitoring Bore WB-01
Monitoring Bore WB-02
Monitoring Bore WB-03
Monitoring Bore WB-05
Monitoring Bore WB-06

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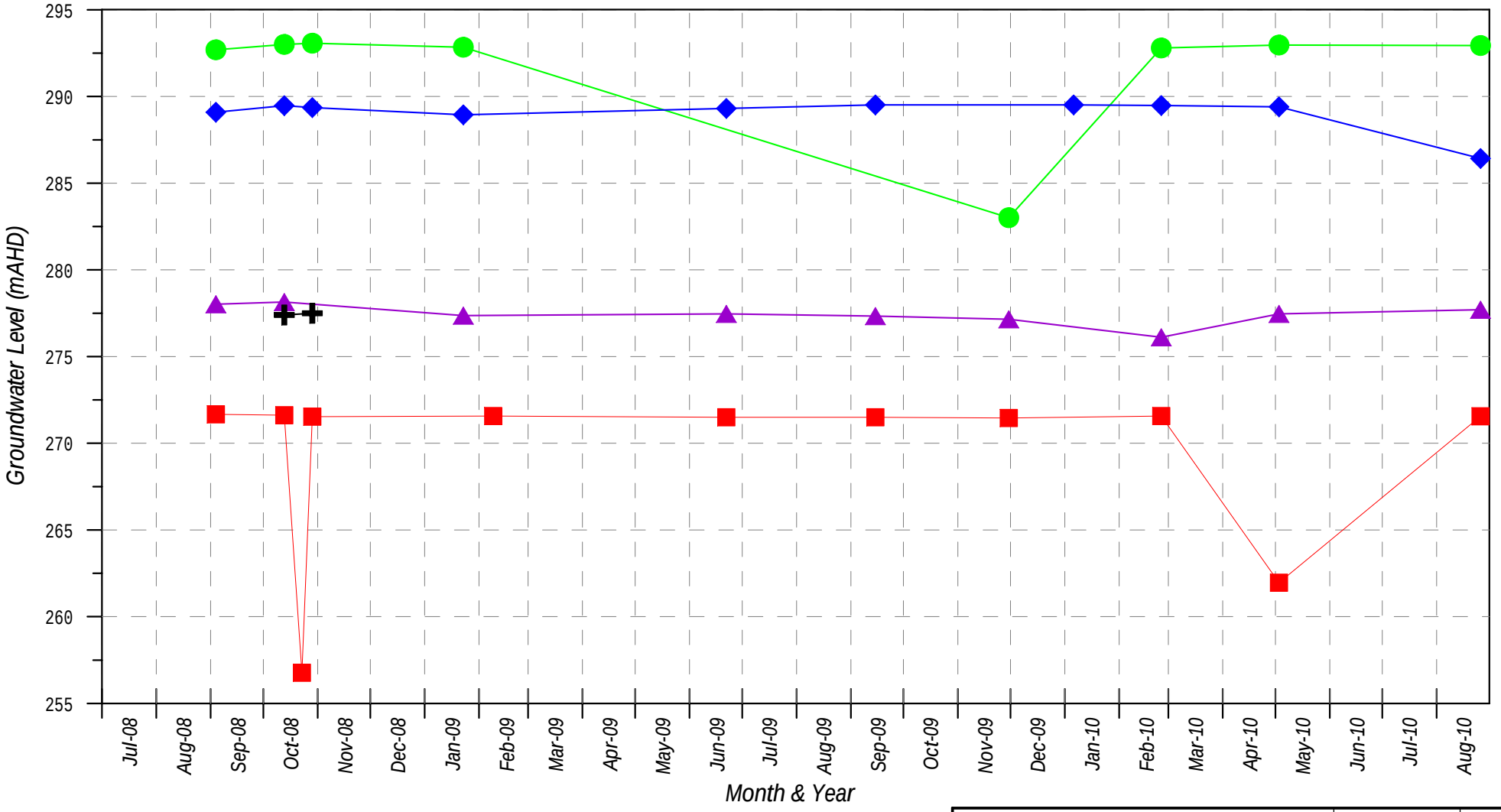
Geotechnics - Environment - Groundwater

Brisbane, Cairns, Campbelltown, Canberra, Darwin, Gold Coast, Melbourne

Newcastle, Perth, Sunshine Coast, Sydney, Townsville, Wollongong, Wyong

TITLE: **HYDROGRAPHS FOR BORES WB-01, WB-02, WB-03, WB-05 & WB-06**
Hydrogeological Assessment for Rocglen Coal Mine Expansion
Rocglen Coal Mine, via Gunnedah, New South Wales

CLIENT: GSS ENVIRONMENTAL			OFFICE: NEWCASTLE
DRAWN BY: AP		PROJECT NO: 49532.00	DRAWING NO: A-2
APPROVED:		DATE: Nov 2010	



Monitoring Bore WB-01
Monitoring Bore WB-02
Monitoring Bore WB-03
Monitoring Bore WB-05
Monitoring Bore WB-06

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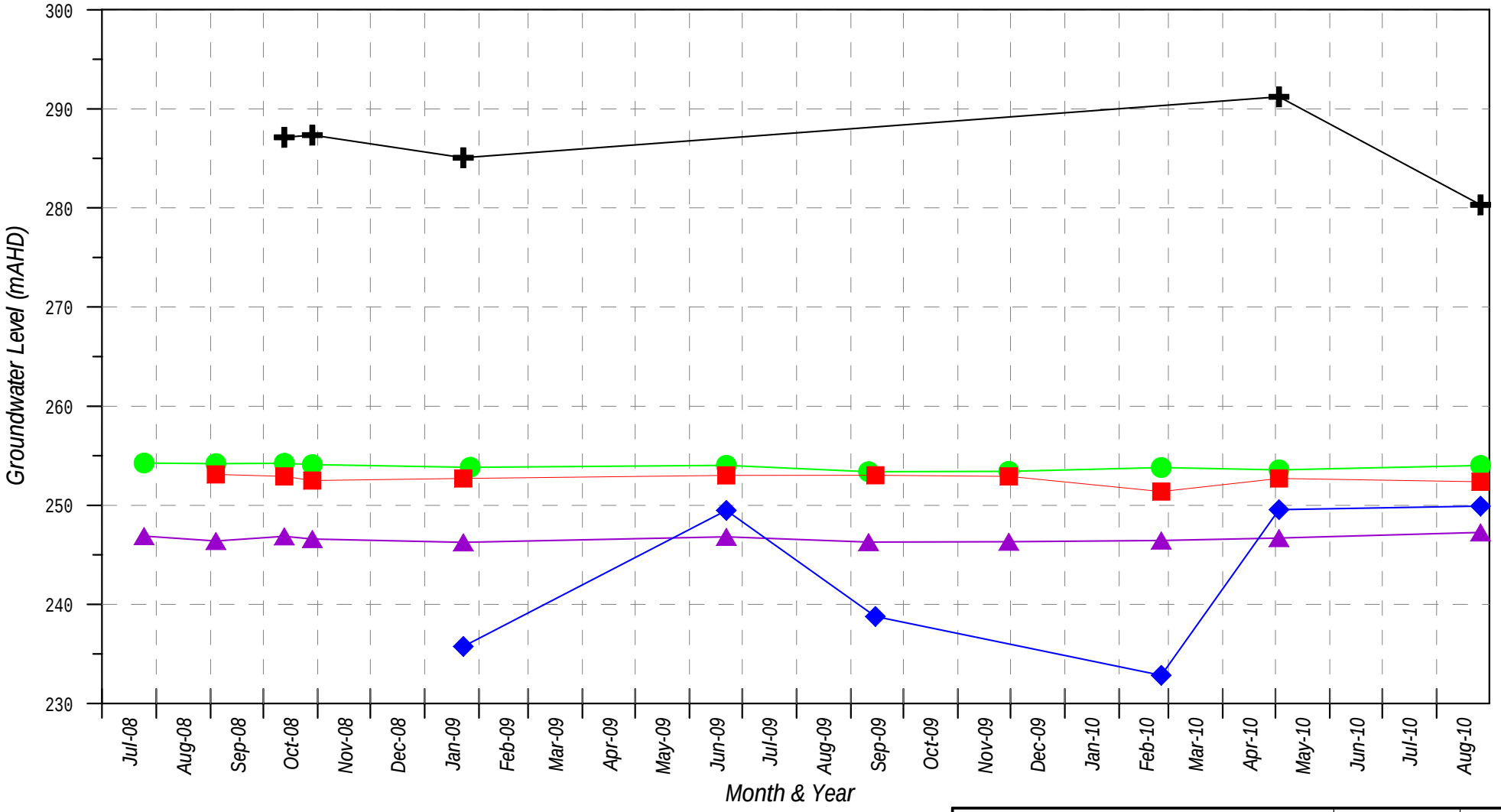
Brisbane, Cairns, Campbelltown, Canberra, Darwin, Gold Coast, Melbourne

Newcastle, Perth, Sunshine Coast, Sydney, Townsville, Wollongong, Wyong

TITLE: **HYDROGRAPHS FOR BORES WB-01, WB-02, WB-03, WB-05 & WB-06**
Hydrogeological Assessment for Rocglen Coal Mine Expansion
Rocglen Coal Mine, via Gunnedah, New South Wales

CLIENT: GSS ENVIRONMENTAL			OFFICE: NEWCASTLE
DRAWN BY: AP		PROJECT NO: 49532.00	DRAWING NO: A-2
APPROVED:		DATE: Nov 2010	



Monitoring Bore WB-07
Monitoring Bore WB-08
Monitoring Bore WB-09
Monitoring Bore WB-10
Monitoring Bore WB-11

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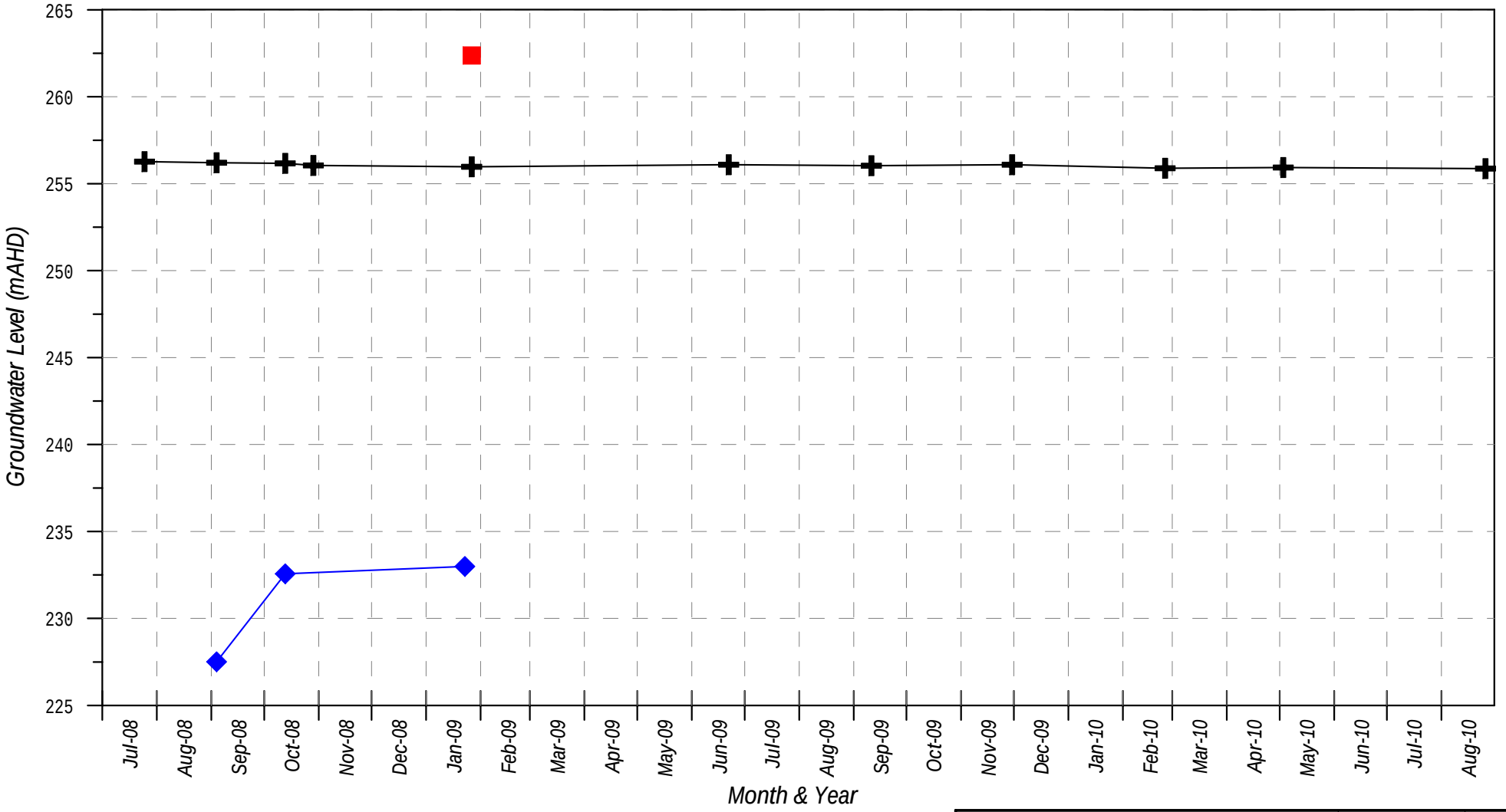
TITLE: **HYDROGRAPHS FOR BORES WB-07, WB-08, WB-09, WB-10 & WB-11**
Hydrogeological Assessment for Rocglen Coal Mine Expansion
Rocglen Coal Mine, via Gunnedah, New South Wales

CLIENT: GSS ENVIRONMENTAL			OFFICE: NEWCASTLE
DRAWN BY: AP		PROJECT NO: 49532.00	DRAWING NO: A-3
APPROVED:		DATE: Nov 2010	



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Newcastle, Perth, Sunshine Coast, Sydney, Townsville, Wollongong, Wyong

TITLE: **HYDROGRAPHS FOR BORES WB-12, YARRARI & WUNDURRA**
Hydrogeological Assessment for Rocglen Coal Mine Expansion
Rocglen Coal Mine, via Gunnedah, New South Wales

CLIENT:	GSS ENVIRONMENTAL		OFFICE: NEWCASTLE
DRAWN BY: AP		PROJECT NO: 49532.00	DRAWING NO: A-4
APPROVED:		DATE: Nov 2010	

Appendix C

Groundwater Quality and ANZECC (200) Guidelines Values

Table B-1: Summary Chemical Analyses for Groundwaters – Rocglen Coal Mine

Bore ID	MP-01	MP-02	WB-01	WB-02	WB-03	WB-05	WB-07	DW GVs	CW GVs
Field Parameters									
pH - Field	7.7	7.1	7.9	7.8	7.5	7.0	7.3	**6.5 - 8.0**	-
EC - Field - µs/cm	2290	4875	1995	2885	3920	7070	2710	**2200**	-
General Parameters								-	-
pH - Lab	7.9	7.0			7.7	7.3	7.3	**6.5 - 8.0**	-
EC - Lab - µs/cm	2230	4695		3050	3985	7420	2460	**2200**	-
Total Dissolved Solids			1050	2030	2690	5130	1500	**1000**	-
Alkalinity - mg/L	726	514	483	427	384	537	506	-	-
Major Ions									-
Sodium (Na) - mg/L	451	589	388	278	377	1008	390	**180**	-
Potassium (K) - mg/L	4	6	4	4	2	9	4	-	-
Calcium (Ca) - mg/L	40	225	9	206	246	305	111	-	**1000**
Magnesium (Mg) - mg/L	28	137	12	112	188	279	60	-	-
Chloride (Cl) - mg/L	227	1269	286	807	1233	2453	568	**250**	-
Carbonate Alkalinity as CaCO3 - mg/L	<1	<1	<1	<1	<1	<1	<1	-	-
Bicarbonate Alkalinity as CaCO3 - mg/L	726	514	483	427	384	537	506	-	-
Sulfate (SO4) - mg/L	83	42	30	17	24	73	27	**250**	**1000**
Nutrients									
Ammonia as Nitrogen (N)	<0.01	0.02	1.23	0.13	0.12	0.12	1.40	**0.5**	-
Nitrite as N (mg/L)	<0.01	<0.01			<0.01	<0.01	0.09	**3**	**30**
Nitrate as N (mg/L)	0.17	0.60			3.78	2.23	5.94	**50**	**400**
NOX as N (mg/L)	0.17	0.60			3.78	2.23	6.03	-	-

Bore ID	***MP-01***	***MP-02***	***WB-01***	***WB-02***	***WB-03***	***WB-05***	***WB-07***	***DW GVs***	***CW GVs***
Metals									
Aluminium (Al) - mg/L	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	**0.2**	**5**
Arsenic (As) - mg/L	0.009	0.001	0.018	0.003	0.002	<0.001	0.002	**0.007**	**0.5**
Barium (Ba) - mg/L	0.148	0.692	0.355	0.128	0.009	0.164	0.637	**0.7**	**1**
Beryllium (Be) - mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**-**	**-**
Cadmium (Cd) - mg/L	0.0001	0.0001	0.0001	<0.0001	0.0004	0.0002	<0.0001	**0.002**	**0.01**
Chromium (Cr) - mg/L	0.006	0.006	<0.001	0.001	0.050	<0.001	<0.001	**0.05**	**1**
Cobalt (Co) - mg/L	0.002	0.002	<0.001	<0.001	0.001	<0.001	<0.001	**-**	**1**
Copper (Cu) - mg/L	0.006	0.010	0.009	0.072	0.018	0.002	0.020	**2**	**-**
Iron (Fe) - mg/L	1.0	3.1	8.7	10.1	0.3	1.4	0.1	**0.3**	**-**
Lead (Pb) - mg/L	0.004	0.009	0.027	0.012	0.003	<0.001	<0.001	**0.01**	**0.1**
Manganese (Mn) - mg/L	0.273	0.150	0.045	0.418	0.011	0.250	0.010	**0.1**	**-**
Mercury (Hg) - mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	**0.001**	**0.002**
Nickel (Ni) - mg/L	0.120	0.084	0.045	0.017	0.012	0.090	0.012	**0.02**	**1**
Vanadium (V) - mg/L	<0.01	0.010	<0.01	0.035	0.040	<0.01	0.020	**-**	**-**
Zinc (Zn) - mg/L	0.042	0.049	1.190	0.672	0.078	0.078	0.042	**3**	**20**

Table B-1: Summary Chemical Analyses for Groundwaters – Rocglen Coal Mine (Cont'd)

Bore ID	WB-08	WB-09	WB-10	WB-11	WB-12	Yarri PB	DW GVs	CW GVs
Field Parameters								
pH - Field	8.2	7.4	7.2	7.7	8.3	7.2	**6.5 - 8.0**	-
EC - Field - µs/cm	2240	1100	2170	1012	1920	3465	**2200**	-
General Parameters							-	-
pH - Lab		7.1	6.9	6.7	8.3	7.2	**6.5 - 8.0**	-
EC - Lab - µs/cm	2190	1020	1935	930	1815	3115	**2200**	-
Total Dissolved Solids	1210	417	1315	575	1045	1980	**1000**	-
Alkalinity - mg/L	554	414	700	287	659	394	-	-
Major Ions								-
Sodium (Na) - mg/L	429	107	263	136	303	525	**180**	-
Potassium (K) - mg/L	7	4	1	4	4	3	-	-
Calcium (Ca) - mg/L	49	66	133	32	27	186	-	**1000**
Magnesium (Mg) - mg/L	38	39	72	26	67	39	-	-
Chloride (Cl) - mg/L	378	72	136	136	221	908	**250**	-
Carbonate Alkalinity as CaCO3 - mg/L	<1	<1	<1	<1	29	<1	-	-
Bicarbonate Alkalinity as CaCO3 - mg/L	554	414	700	287	630	394	-	-
Sulfate (SO4) - mg/L	37	41	261	17	6	41	**250**	**1000**
Nutrients								
Ammonia as Nitrogen (N)	0.12	4.5	0.13	0.78	6.89	<0.01	**0.5**	-
Nitrite as N (mg/L)		<0.01	<0.01	<0.01	0.02	<0.01	**3**	**30**
Nitrate as N (mg/L)		0.20	0.15	0.08	1.37	0.51	**50**	**400**
NOX as N (mg/L)		0.20	0.15	0.08	1.39	0.51	-	-

Bore ID	*WB-08*	*WB-09*	*WB-10*	*WB-11*	*WB-12*	*Yarri PB*	*DW GVs*	*CW GVs*
Metals								
Aluminium (Al) - mg/L		<0.01	<0.01	<0.01	<0.01	<0.01	**0.2**	**5**
Arsenic (As) - mg/L	0.020	0.011	0.002	<0.001	0.001	0.003	**0.007**	**0.5**
Barium (Ba) - mg/L	0.173	0.459	0.048	0.124	0.105	0.083	**0.7**	**1**
Beryllium (Be) - mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**-**	**-**
Cadmium (Cd) - mg/L	0.0004	0.0008	<0.0001	<0.0001	0.0001	<0.0001	**0.002**	**0.01**
Chromium (Cr) - mg/L	<0.001	0.001	0.001	<0.001	0.003	<0.001	**0.05**	**1**
Cobalt (Co) - mg/L	<0.001	<0.001	<0.001	<0.001	0.001	0.004	**-**	**1**
Copper (Cu) - mg/L	0.004	0.012	0.005	0.003	0.005	0.009	**2**	**-**
Iron (Fe) - mg/L	0.4	18.8	6.7	2.1	7.3	0.1	**0.3**	**-**
Lead (Pb) - mg/L	0.003	0.017	0.004	0.002	0.003	<0.001	**0.01**	**0.1**
Manganese (Mn) - mg/L	0.016	0.158	0.018	0.253	0.086	0.019	**0.1**	**-**
Mercury (Hg) - mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	**0.001**	**0.002**
Nickel (Ni) - mg/L	<0.001	0.080	0.008	0.253	0.036	<0.001	**0.02**	**1**
Vanadium (V) - mg/L	0.010	0.020	0.010	<0.01	<0.01	<0.01	**-**	**-**
Zinc (Zn) - mg/L	0.335	2.110	0.541	0.027	0.401	0.021	**3**	**20**

Appendix D

Groundwater Works Summary Sheets – Private Bores

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW000122

Works Details (top)

GROUNDWATER NUMBER	GW000122
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	NOT KNOWN
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1917-09-01
FINAL-DEPTH (metres)	152.40
DRILLED-DEPTH (metres)	152.40
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-2N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6590019.00
EASTING	240371.00
LATITUDE	30 47' 40"
LONGITUDE	150 17' 12"
GS-MAP	0028B4

AMG-ZONE	56
COORD-SOURCE	PR.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	37

Licensed (top)

no details

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
39.60	39.60	0.00	Unconsolidated			0.00			Good
102.10	102.10	0.00	Fractured			0.00			(Unknown)

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	34.75	34.75	Sand Boulder		
34.75	36.48	1.73	Conglomerate		
36.48	51.82	15.34	Clay Yellow Water Bearing		
51.82	60.96	9.14	Sand Boulder		
60.96	68.88	7.92	Clay Yellow Sand		
60.96	68.88	7.92	Boulders		
68.88	83.52	14.64	Clay Yellow Sand		
83.52	100.58	17.06	Shale		
100.58	128.02	27.44	Shale Water Bearing		
100.58	128.02	27.44	Sandstone Streaks		
128.02	152.40	24.38	Shale		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
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Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW000713

Works Details (top)

GROUNDWATER NUMBER	GW000713
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	NOT KNOWN
WORK-TYPE	Bore open thru rock
WORK-STATUS	Supply Obtained
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1921-05-01
FINAL-DEPTH (metres)	65.20
DRILLED-DEPTH (metres)	65.20
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-1S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6598028.00
EASTING	241481.00
LATITUDE	30 43' 21"
LONGITUDE	150 18' 1"
GS-MAP	0028B3

AMG-ZONE	56
COORD-SOURCE	PR.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	WILLURI
PORTION-LOT-DP	32

Licensed (top)

no details

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	0.00	40.00	152			(Unknown)

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
64.60	64.60	0.00	Fractured	33.50		0.51			Good

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	22.25	22.25	Clay Yellow		
22.25	24.38	2.13	Stones		
24.38	26.52	2.14	Stones Clay		
26.52	30.78	4.26	Rock		
30.78	33.83	3.05	Sandstone Yellow		
33.83	35.05	1.22	Stones		
35.05	37.49	2.44	Sandstone		
37.49	40.54	3.05	Rock		
40.54	41.76	1.22	Clay Swelling		
41.76	65.23	23.47	Rock Black Water Supply		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
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Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW000743

Works Details (top)

GROUNDWATER NUMBER	GW000743
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	NOT KNOWN
WORK-TYPE	Bore open thru rock
WORK-STATUS	Supply Obtained
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1921-06-01
FINAL-DEPTH (metres)	70.40
DRILLED-DEPTH (metres)	70.40
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-1S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6598022.00
EASTING	238686.00
LATITUDE	30 43' 19"
LONGITUDE	150 16' 16"
GS-MAP	0028B3

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	WEAN
PORTION-LOT-DP	59

Licensed (top)

no details

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	0.00	48.10	152			(Unknown)

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
54.90	54.90	0.00	Fractured	25.90		0.72			Good

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	12.19	12.19	Clay Yellow		
12.19	20.42	8.23	Clay Sandstone		
20.42	30.18	9.76	Sandstone		
30.18	32.00	1.82	Shale		
32.00	39.62	7.62	Shale Stones		
39.62	46.94	7.32	Shale Grey		
46.94	57.91	10.97	Rock Water Supply		
57.91	63.09	5.18	Shale Grey		
63.09	70.41	7.32	Rock		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW003083

Works Details (top)

GROUNDWATER NUMBER	GW003083
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	NOT KNOWN
WORK-TYPE	Bore open thru rock
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1932-01-01
FINAL-DEPTH (metres)	100.00
DRILLED-DEPTH (metres)	100.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-4S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6599611.00
EASTING	235611.00
LATITUDE	30 42' 25"
LONGITUDE	150 14' 22"
GS-MAP	0028A3

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	VICKERY
PORTION-LOT-DP	6

Licensed (top)

no details

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.30	87.60	152			Suspended in Clamps

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
30.80	30.80	0.00	(Unknown)	20.10		0.09			Good
93.90	99.40	5.50	Fractured	30.80		0.61			Good

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	2.13	2.13	Clay Reddish		
2.13	8.23	6.10	Clay Yellow		
8.23	10.06	1.83	Conglomerate		
10.06	26.82	16.76	Clay Yellow		
26.82	32.61	5.79	Stones Large Coarse Gravel Water Supply		
32.61	36.58	3.97	Gravel Coarse		
36.58	54.86	18.28	Conglomerate		
54.86	64.92	10.06	Clay Yellow		
64.92	76.20	11.28	Clay		
76.20	80.77	4.57	Conglomerate		
80.77	85.34	4.57	Sand Rock		
85.34	91.44	6.10	Shale Grey		
91.44	92.96	1.52	Coal		

92.96	93.88	0.92	Shale Black
93.88	99.36	5.48	Shale Black Coal Bands Water Supply
99.36	99.97	0.61	Rock

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW009830

Works Details (top)

GROUNDWATER NUMBER	GW009830
LIC-NUM	90BL002917
AUTHORISED-PURPOSES	STOCK
INTENDED-PURPOSES	STOCK
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1951-03-01
FINAL-DEPTH (metres)	67.10
DRILLED-DEPTH (metres)	67.10
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	PENRYN
GWMA	604 - GUNNEDAH BASIN
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-1S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6599793.00
EASTING	240560.00
LATITUDE	30 42' 23"
LONGITUDE	150 17' 28"
GS-MAP	0028B3

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	WEAN
PORTION-LOT-DP	96

Licensed (top)

COUNTY	NANDEWAR
PARISH	WEAN
PORTION-LOT-DP	96

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.30	67.10	127			Seated on Bottom

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
61.00	62.80	1.80	Consolidated	18.30		0.76			Good

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	1.52	1.52	Soil		
1.52	67.06	65.54	Sandstone Water Supply		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW011015

Works Details (top)

GROUNDWATER NUMBER	GW011015
LIC-NUM	90BL004125
AUTHORISED-PURPOSES	STOCK
INTENDED-PURPOSES	STOCK
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1954-11-01
FINAL-DEPTH (metres)	39.00
DRILLED-DEPTH (metres)	39.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	N/A
GWMA	604 - GUNNEDAH BASIN
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-2N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6594898.00
EASTING	239507.00
LATITUDE	30 45' 1"
LONGITUDE	150 16' 44"
GS-MAP	0028B4

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	30

Licensed (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	30

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.60	39.00	152			Seated on Bottom
1	1	Opening	Slots	32.90	39.00	152		1	SL: 0mm; A: 15.88mm

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
34.70	36.50	1.80	Consolidated	29.00		0.44			Good

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	16.46	16.46	Soil		
16.46	39.01	22.55	Sandstone Water Supply		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW011066

Works Details (top)

GROUNDWATER NUMBER	GW011066
LIC-NUM	90BL004169
AUTHORISED-PURPOSES	STOCK
INTENDED-PURPOSES	STOCK
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1954-12-01
FINAL-DEPTH (metres)	47.90
DRILLED-DEPTH (metres)	47.90
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	GLENROE
GWMA	604 - GUNNEDAH BASIN
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-1S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6595178.00
EASTING	239607.00
LATITUDE	30 44' 52"
LONGITUDE	150 16' 48"
GS-MAP	0028B3

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	30

Licensed (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	30

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.80	47.80	152			Seated on Bottom
1	1	Opening	Perforations	42.40	47.90	152		1	SL: 0mm; A: 15.88mm

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
42.70	44.20	1.50	Fractured	30.80		0.63			Good Stock

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	20.42	20.42	Soil		
20.42	47.85	27.43	Shale Black Water Supply		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW013284

Works Details (top)

GROUNDWATER NUMBER	GW013284
LIC-NUM	90WA808995
AUTHORISED-PURPOSES	STOCK
INTENDED-PURPOSES	NOT KNOWN
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1920-01-01
FINAL-DEPTH (metres)	18.30
DRILLED-DEPTH (metres)	0.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	BROLGA
GWMA	004 - UPPER NAMOI(U/S NARRABRI)
GW-ZONE	004 - 004 - NAMOI VALLEY (KEEPIT DAM TO GINS LEAP) GROUNDWATER SOURCE
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-2N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6588017.00

EASTING	237892.00
LATITUDE	30 48' 43"
LONGITUDE	150 15' 37"
GS-MAP	0028B4
AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	BRENTRY
PORTION-LOT-DP	lt 2 dp 219575

Licensed (top)

COUNTY	NANDEWAR
PARISH	BRENTRY
PORTION-LOT-DP	2 219575

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.30	-0.30	152			(Unknown)

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW013369

Works Details (top)

GROUNDWATER NUMBER	GW013369
LIC-NUM	90WA808994
AUTHORISED-PURPOSES	STOCK
INTENDED-PURPOSES	NOT KNOWN
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1946-01-01
FINAL-DEPTH (metres)	22.30
DRILLED-DEPTH (metres)	0.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	BROLGA
GWMA	004 - UPPER NAMOI(U/S NARRABRI)
GW-ZONE	004 - 004 - NAMOI VALLEY (KEEPIT DAM TO GINS LEAP) GROUNDWATER SOURCE
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-3N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6588545.00

EASTING	236815.00
LATITUDE	30 48' 25"
LONGITUDE	150 14' 57"
GS-MAP	0028A4
AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	BRENTRY
PORTION-LOT-DP	LT 2 DP 219575

Licensed (top)

COUNTY	NANDEWAR
PARISH	BRENTRY
PORTION-LOT-DP	2 219575

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.30	22.30	152			Suspended in Clamps

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW016871

Works Details (top)

GROUNDWATER NUMBER	GW016871
LIC-NUM	90BL007353
AUTHORISED-PURPOSES	STOCK
INTENDED-PURPOSES	STOCK
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1958-09-01
FINAL-DEPTH (metres)	62.50
DRILLED-DEPTH (metres)	62.50
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	BELMONT
GWMA	604 - GUNNEDAH BASIN
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-2N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6594016.00
EASTING	239981.00
LATITUDE	30 45' 30"
LONGITUDE	150 17' 1"
GS-MAP	0028B4

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	31

Licensed (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	31

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.50	62.50	152			Seated on Bottom
1	1	Opening	Perforations	55.80	62.50	152		1	SL: 0mm; A: 0mm

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
59.40	62.40	3.00	Consolidated	45.70		0.38			(Unknown)

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	1.52	1.52	Topsoil		
1.52	9.14	7.62	Basalt		
9.14	42.06	32.92	Clay Gravel		
42.06	59.44	17.38	Sandstone Coarse		
59.44	62.48	3.04	Sandstone Grey Water Supply		

should be sought in interpreting and using this data.

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW016874

Works Details (top)

GROUNDWATER NUMBER	GW016874
LIC-NUM	90BL007355
AUTHORISED-PURPOSES	DOMESTIC STOCK
INTENDED-PURPOSES	DOMESTIC STOCK
WORK-TYPE	Bore open thru rock
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1958-03-01
FINAL-DEPTH (metres)	53.90
DRILLED-DEPTH (metres)	54.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	BELMONT
GWMA	604 - GUNNEDAH BASIN
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-2N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6594022.00
EASTING	238943.00
LATITUDE	30 45' 29"
LONGITUDE	150 16' 22"
GS-MAP	0028B4

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	LT 1 DP 787417

Licensed (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	31

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.50	51.30	127			Suspended in Clamps

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
45.10	46.30	1.20	Fractured	24.40		0.38			(Unknown)
51.80	53.90	2.10	Consolidated			0.88			(Unknown)

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	1.52	1.52	Soil		
1.52	6.71	5.19	Clay Sandy		
6.71	25.60	18.89	Clay Gravel		
25.60	29.26	3.66	Boulders Loose		
29.26	40.84	11.58	Clay Gravel		
40.84	46.33	5.49	Coal Water Supply		
46.33	51.82	5.49	Shale Sandy		
51.82	53.95	2.13	Sandstone Water Supply		

(DIPNR) by drillers, licensees and other sources. The DIPNR does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW017198

Works Details (top)

GROUNDWATER NUMBER	GW017198
LIC-NUM	90WA808996
AUTHORISED-PURPOSES	STOCK
INTENDED-PURPOSES	NOT KNOWN
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1920-01-01
FINAL-DEPTH (metres)	37.50
DRILLED-DEPTH (metres)	0.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	BROLGA
GWMA	004 - UPPER NAMOI(U/S NARRABRI)
GW-ZONE	004 - 004 - NAMOI VALLEY (KEEPIT DAM TO GINS LEAP) GROUNDWATER SOURCE
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-3N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6589282.00

EASTING	236691.00
LATITUDE	30 48' 1"
LONGITUDE	150 14' 53"
GS-MAP	0028A4
AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	BRENTRY
PORTION-LOT-DP	7

Licensed (top)

COUNTY	NANDEWAR
PARISH	BRENTRY
PORTION-LOT-DP	7

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.30	37.20	152			Suspended in Clamps

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW017199

Works Details (top)

GROUNDWATER NUMBER	GW017199
LIC-NUM	90BL007679
AUTHORISED-PURPOSES	STOCK
INTENDED-PURPOSES	NOT KNOWN
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1939-01-01
FINAL-DEPTH (metres)	37.50
DRILLED-DEPTH (metres)	0.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	BROLGA
GWMA	604 - GUNNEDAH BASIN
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-3N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6589835.00
EASTING	234123.00
LATITUDE	30 47' 41"
LONGITUDE	150 13' 17"
GS-MAP	0028A4

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	BRENTRY
PORTION-LOT-DP	7

Licensed (top)

COUNTY	NANDEWAR
PARISH	BRENTRY
PORTION-LOT-DP	7

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.30	36.30	152			Suspended in Clamps

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW020454

Works Details (top)

GROUNDWATER NUMBER	GW020454
LIC-NUM	90BL013494
AUTHORISED-PURPOSES	STOCK
INTENDED-PURPOSES	NOT KNOWN
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1912-01-01
FINAL-DEPTH (metres)	73.20
DRILLED-DEPTH (metres)	0.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	CARLTON
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-2N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6589031.00
EASTING	241539.00
LATITUDE	30 48' 13"
LONGITUDE	150 17' 55"
GS-MAP	0028B4

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	YARRARI
PORTION-LOT-DP	171

Licensed (top)

COUNTY	NANDEWAR
PARISH	YARRARI
PORTION-LOT-DP	171

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW020456

Works Details (top)

GROUNDWATER NUMBER	GW020456
LIC-NUM	90BL013495
AUTHORISED-PURPOSES	STOCK
INTENDED-PURPOSES	NOT KNOWN
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1925-01-01
FINAL-DEPTH (metres)	56.40
DRILLED-DEPTH (metres)	79.30
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	CARLTON
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-2N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6588807.00
EASTING	242502.00
LATITUDE	30 48' 21"
LONGITUDE	150 18' 31"
GS-MAP	0028B4

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	YARRARI
PORTION-LOT-DP	171

Licensed (top)

COUNTY	NANDEWAR
PARISH	YARRARI
PORTION-LOT-DP	171

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.40	41.70	152			Suspended in Clamps
1	1	Casing	Threaded Steel	39.60	56.40	127			(Unknown)

Water Bearing Zones (top)

no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	41.76	41.76	Driller		
41.76	48.77	7.01	Slate Green Hard		
48.77	49.99	1.22	Slate Yellow Hard		
49.99	56.39	6.40	Slate Green Soft Waterworn Traces		
56.39	79.25	22.86	Slate Green Soft		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW020461

Works Details (top)

GROUNDWATER NUMBER	GW020461
LIC-NUM	90WA809031
AUTHORISED-PURPOSES	IRRIGATION
INTENDED-PURPOSES	IRRIGATION
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1963-04-01
FINAL-DEPTH (metres)	47.20
DRILLED-DEPTH (metres)	47.20
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	CARLTON
GWMA	004 - UPPER NAMOI(U/S NARRABRI)
GW-ZONE	004 - 004 - NAMOI VALLEY (KEEPIT DAM TO GINS LEAP) GROUNDWATER SOURCE
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-2N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6588429.00

EASTING	240862.00
LATITUDE	30 48' 32"
LONGITUDE	150 17' 29"
GS-MAP	0028B4
AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	YARRARI
PORTION-LOT-DP	171

Licensed (top)

COUNTY	NANDEWAR
PARISH	YARRARI
PORTION-LOT-DP	171

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
6.10	7.90	1.80	Unconsolidated	31.10		0.00			(Unknown)

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.61	0.61	Topsoil		
0.61	2.13	1.52	Subsoil		
2.13	4.42	2.29	Clay Fatty		
4.42	9.14	4.72	Clay Fine Gravel		
9.14	15.85	6.71	Clay Fatty		
15.85	22.40	6.55	Clay Matrix		
15.85	22.40	6.55	Gravel Red		
22.40	34.90	12.50	Clay Light		
22.40	34.90	12.50	Limestone Fused Traces		
34.90	41.15	6.25	Clay		
41.15	47.24	6.09	Clay Light		
41.15	47.24	6.09	Traces Micaceous Feldspar		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW022319

Works Details (top)

GROUNDWATER NUMBER	GW022319
LIC-NUM	90BL013922
AUTHORISED-PURPOSES	STOCK
INTENDED-PURPOSES	STOCK
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1964-06-01
FINAL-DEPTH (metres)	52.40
DRILLED-DEPTH (metres)	52.40
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	BELMONT
GWMA	604 - GUNNEDAH BASIN
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-2N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6592520.00
EASTING	239299.00
LATITUDE	30 46' 18"
LONGITUDE	150 16' 34"
GS-MAP	0028B4

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	31

Licensed (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	31

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.50	47.10	152			Suspended in Clamps
1	1	Opening	Perforations	41.70	47.20	152		1	SL: 0mm; A: 0mm

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
3.00	3.00	0.00	Unconsolidated			0.00			(Unknown)
44.20	46.00	1.80	Unconsolidated	12.20		0.20			(Unknown)

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.91	0.91	Soil		
0.91	44.20	43.29	Gravel Clay		
44.20	46.02	1.82	Gravel Water Supply		
46.02	52.43	6.41	Sandstone Grey		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW035706

Works Details (top)

GROUNDWATER NUMBER	GW035706
LIC-NUM	90BL029137
AUTHORISED-PURPOSES	DOMESTIC STOCK
INTENDED-PURPOSES	DOMESTIC STOCK
WORK-TYPE	Bore open thru rock
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1973-08-01
FINAL-DEPTH (metres)	124.90
DRILLED-DEPTH (metres)	125.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	SURREY
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-2N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6593026.00
EASTING	241070.00
LATITUDE	30 46' 3"
LONGITUDE	150 17' 41"
GS-MAP	0028B4

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	111

Licensed (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	A 405391

Water Bearing Zones (top)

no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.45	0.45	Topsoil		
0.45	19.05	18.60	Boulders Large Clay		
19.05	33.22	14.17	Basalt		
33.22	60.96	27.74	Stones Grey Hard Soft Seams		
60.96	112.77	51.81	Rock Grey Hard		
112.77	124.96	12.19	Rock Dark Grey Very Hard		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW035706

Works Details (top)

GROUNDWATER NUMBER	GW035706
LIC-NUM	90BL029137
AUTHORISED-PURPOSES	DOMESTIC STOCK
INTENDED-PURPOSES	DOMESTIC STOCK
WORK-TYPE	Bore open thru rock
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1973-08-01
FINAL-DEPTH (metres)	124.90
DRILLED-DEPTH (metres)	125.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	SURREY
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-2N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6593026.00
EASTING	241070.00
LATITUDE	30 46' 3"
LONGITUDE	150 17' 41"
GS-MAP	0028B4

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	111

Licensed (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	A 405391

Water Bearing Zones (top)

no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.45	0.45	Topsoil		
0.45	19.05	18.60	Boulders Large Clay		
19.05	33.22	14.17	Basalt		
33.22	60.96	27.74	Stones Grey Hard Soft Seams		
60.96	112.77	51.81	Rock Grey Hard		
112.77	124.96	12.19	Rock Dark Grey Very Hard		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW036484

Works Details (top)

GROUNDWATER NUMBER	GW036484
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	G/WATER XPLORE
WORK-TYPE	Bore
WORK-STATUS	Test Hole
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	NSW Office of Water
COMMENCE-DATE	
COMPLETION-DATE	1983-12-01
FINAL-DEPTH (metres)	40.00
DRILLED-DEPTH (metres)	60.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-2N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6587908.00
EASTING	238480.00
LATITUDE	30 48' 47"
LONGITUDE	150 15' 59"
GS-MAP	0028B4

AMG-ZONE	56
COORD-SOURCE	SURV,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	YARRARI
PORTION-LOT-DP	134

Licensed (top)

no details

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Backfill	Backfill	40.00	60.00	0			
1	1	Casing	P.V.C.	-1.00	40.00	101			Seated on Bottom
1		Casing	Casing Protector	0.00	5.40	203			(Unknown)
1	1	Opening	Slots - Horizontal	34.00	35.00	101		1	Mechanically Slotted; SL: 0mm; A: 3mm

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
34.50	35.00	0.50	Unconsolidated	26.00		0.38			(Unknown)

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	1.00	1.00	Topsoil		
1.00	7.00	6.00	Clay Dark Brown		
7.00	9.00	2.00	Clay Light Brown		
9.00	10.00	1.00	Clay Gravel		
10.00	18.00	8.00	Clay Light Brown Sticky		
18.00	30.00	12.00	Clay Gravel		
30.00	34.50	4.50	Clay Light Brown		
34.50	35.00	0.50	Sand Gravel Water Supply		

35.00	43.00	8.00	Clay Light Brown Small Gravel
43.00	44.00	1.00	Gravel Sandy Clay
44.00	50.00	6.00	Clay Light Brown Dark Brown Cored
50.00	60.00	10.00	Clay Red Bedrock

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW044067

Works Details (top)

GROUNDWATER NUMBER	GW044067
LIC-NUM	90BL102846
AUTHORISED-PURPOSES	DOMESTIC STOCK
INTENDED-PURPOSES	DOMESTIC STOCK
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Rotary Air
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1974-11-01
FINAL-DEPTH (metres)	121.90
DRILLED-DEPTH (metres)	121.90
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	HIGHVIEW
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-2N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6594786.00
EASTING	241213.00
LATITUDE	30 45' 6"
LONGITUDE	150 17' 48"
GS-MAP	0028B4

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	36

Licensed (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	36 754950

Water Bearing Zones (top)

no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.91	0.91	Topsoil		
0.91	4.88	3.97	Clay Stoney		
4.88	10.97	6.09	Clay		
10.97	24.69	13.72	Rock Soft		
24.69	40.23	15.54	Rock Black Soft		
40.23	41.45	1.22	Rock Black Hard		
41.45	74.07	32.62	Rock Soft		
74.07	113.39	39.32	Rock Black Soft		
113.39	121.92	8.53	Shale Black Traces Coal		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW044068

Works Details (top)

GROUNDWATER NUMBER	GW044068
LIC-NUM	90BL102845
AUTHORISED-PURPOSES	STOCK
INTENDED-PURPOSES	DOMESTIC STOCK
WORK-TYPE	Bore open thru rock
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Rotary Air
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1974-12-01
FINAL-DEPTH (metres)	43.50
DRILLED-DEPTH (metres)	43.60
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	HIGHVIEW
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-2N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6594658.00
EASTING	241030.00
LATITUDE	30 45' 10"
LONGITUDE	150 17' 41"
GS-MAP	0028B4

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	36

Licensed (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	36 754950

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.30	39.00	152			Driven into Hole

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
38.40	39.00	0.60	(Unknown)	18.50		0.32			Good

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.61	0.61	Topsoil		
0.61	5.49	4.88	Clay Sandstone		
5.49	9.45	3.96	Clay Yellow		
9.45	26.52	17.07	Sandstone Soft		
26.52	34.14	7.62	Rock Black Soft		
34.14	38.40	4.26	Rock Black		
38.40	39.01	0.61	Rock Black Soft Stones White Water Supply		
39.01	43.59	4.58	Rock Black		

should be sought in interpreting and using this data.

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW044069

Works Details (top)

GROUNDWATER NUMBER	GW044069
LIC-NUM	90BL102847
AUTHORISED-PURPOSES	DOMESTIC STOCK
INTENDED-PURPOSES	DOMESTIC STOCK
WORK-TYPE	Bore open thru rock
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Rotary Air
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1974-12-01
FINAL-DEPTH (metres)	47.80
DRILLED-DEPTH (metres)	47.90
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	HIGHVIEW
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-2N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6594934.00
EASTING	240970.00
LATITUDE	30 45' 1"
LONGITUDE	150 17' 39"
GS-MAP	0028B4

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	36

Licensed (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	36 754950

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.30	41.70	152			Driven into Hole

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
42.00	42.90	0.90	(Unknown)	19.80		0.38			Good

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.61	0.61	Topsoil		
0.61	5.79	5.18	Clay		
5.79	8.23	2.44	Claystone		
8.23	25.30	17.07	Sandstone Clay		
25.30	41.15	15.85	Rock Soft		
41.15	42.06	0.91	Rock Black Soft		
42.06	42.98	0.92	Rock Black Water Supply Stones White		
42.98	47.85	4.87	Rock Black		

should be sought in interpreting and using this data.

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW045621

Works Details (top)

GROUNDWATER NUMBER	GW045621
LIC-NUM	90BL104367
AUTHORISED-PURPOSES	STOCK
INTENDED-PURPOSES	STOCK
WORK-TYPE	Bore
WORK-STATUS	Collapsed Bore
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1930-01-01
FINAL-DEPTH (metres)	10.00
DRILLED-DEPTH (metres)	0.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	KURIAL
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-1S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6595812.00
EASTING	237808.00
LATITUDE	30 44' 30"
LONGITUDE	150 15' 41"
GS-MAP	0028B3

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	VICKERY
PORTION-LOT-DP	18

Licensed (top)

COUNTY	NANDEWAR
PARISH	VICKERY
PORTION-LOT-DP	18

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	0.00	0.00	600			(Unknown)

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW050166

Works Details (top)

GROUNDWATER NUMBER	GW050166
LIC-NUM	90BL110883
AUTHORISED-PURPOSES	STOCK
INTENDED-PURPOSES	NOT KNOWN
WORK-TYPE	Well
WORK-STATUS	Supply Obtained
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1899-01-01
FINAL-DEPTH (metres)	18.30
DRILLED-DEPTH (metres)	0.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	GLENROC
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-1S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6595789.00
EASTING	239379.00
LATITUDE	30 44' 32"
LONGITUDE	150 16' 40"
GS-MAP	0028B3

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	30

Licensed (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	30

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Timber	0.00	0.00	1829			Suspended in Clamps

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 16, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW050395

Works Details (top)

GROUNDWATER NUMBER	GW050395
LIC-NUM	90BL111536
AUTHORISED-PURPOSES	STOCK
INTENDED-PURPOSES	NOT KNOWN
WORK-TYPE	Bore
WORK-STATUS	Supply Obtained
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	36.60
DRILLED-DEPTH (metres)	0.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	N/A
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-1S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6596450.00
EASTING	239949.00
LATITUDE	30 44' 11"
LONGITUDE	150 17' 2"
GS-MAP	0028B3

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	30

Licensed (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	30

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	(Unknown)	0.00	0.00	178			(Unknown)

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW052958

Works Details (top)

GROUNDWATER NUMBER	GW052958
LIC-NUM	90BL107181
AUTHORISED-PURPOSES	DOMESTIC STOCK
INTENDED-PURPOSES	DOMESTIC STOCK
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1980-11-01
FINAL-DEPTH (metres)	53.00
DRILLED-DEPTH (metres)	53.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	SURREY
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-2N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6589780.00
EASTING	240669.00
LATITUDE	30 47' 48"
LONGITUDE	150 17' 23"
GS-MAP	0028B4

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	37

Licensed (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	37

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Corrugated Galvanised Iron	-0.50	42.00	160			Suspended in Clamps
1	1	Casing	Welded Steel	41.00	53.00	130			Seated on Bottom
1	1	Opening	Slots - Vertical	36.00	41.50	160		1	Oxy-Acetylene Slotted; SL: 0mm; A: 2mm
1	1	Opening	Slots - Vertical	45.00	48.00	130		2	Oxy-Acetylene Slotted; SL: 0mm; A: 2mm

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
45.00	45.20	0.20	(Unknown)	34.00		0.10			Good

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.40	0.40	Topsoil		
0.40	6.30	5.90	Clay Gravel		
6.30	18.20	11.90	Clay Sandy Some Gravel		

18.20	21.60	3.40	Clay Compacted Gravel
21.60	33.10	11.50	Clay Some Gravel
33.10	34.90	1.80	Clay Compacted Gravel
34.90	41.50	6.60	Clay Sandy
41.50	42.10	0.60	Rock Slightly Conglomerated
42.10	42.40	0.30	Clay Gravel
42.40	48.30	5.90	Rock Slightly Conglomerated Water Supply
48.30	51.00	2.70	Clay Compacted Gravel
51.00	52.00	1.00	Clay
52.00	53.00	1.00	Clay

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW060867

Works Details (top)

GROUNDWATER NUMBER	GW060867
LIC-NUM	90BL132319
AUTHORISED-PURPOSES	DOMESTIC STOCK
INTENDED-PURPOSES	DOMESTIC STOCK
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Rotary Air
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1985-05-01
FINAL-DEPTH (metres)	100.00
DRILLED-DEPTH (metres)	100.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	N/A
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-1S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6596082.00
EASTING	237482.00
LATITUDE	30 44' 21"
LONGITUDE	150 15' 29"
GS-MAP	0028B3

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	VICKERY
PORTION-LOT-DP	18

Licensed (top)

COUNTY	NANDEWAR
PARISH	VICKERY
PORTION-LOT-DP	18

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	P.V.C.	-0.50	100.00	130			Seated on Bottom
1	1	Opening	Slots - Horizontal	82.00	100.00	130		1	Plastic; SL: 0mm; A: 4mm

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
85.00	86.00	1.00	Fractured			1.00			(Unknown)
91.00	92.00	1.00	Fractured	40.00		1.25			(Unknown)

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	1.00	1.00	Soil Surface		
1.00	15.00	14.00	Shale		
15.00	60.00	45.00	Shale		
60.00	85.00	25.00	Basalt		
85.00	100.00	15.00	Basalt Fractured Water Supply		

(DIPNR) by drillers, licensees and other sources. The DIPNR does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW062364

Works Details (top)

GROUNDWATER NUMBER	GW062364
LIC-NUM	90BL123440
AUTHORISED-PURPOSES	TEST BORE
INTENDED-PURPOSES	G/WATER XPLORE
WORK-TYPE	Bore
WORK-STATUS	Test Hole
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1982-10-01
FINAL-DEPTH (metres)	30.50
DRILLED-DEPTH (metres)	30.20
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	STRATFORD
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-3N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6589356.00
EASTING	234694.00
LATITUDE	30 47' 57"
LONGITUDE	150 13' 38"
GS-MAP	0028A4

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	BRENTRY
PORTION-LOT-DP	11

Licensed (top)

COUNTY	NANDEWAR
PARISH	BRENTRY
PORTION-LOT-DP	11

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Opening	Slots - Horizontal	15.00	22.00	165		1	SL: 0mm; A: 0mm

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
18.00	19.00	1.00	Unconsolidated			0.25			(Unknown)

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	3.00	3.00	Clay		
3.00	7.00	4.00	Clay		
7.00	11.00	4.00	Clay Grey		
11.00	12.00	1.00	Gravel Dry Clay		
12.00	19.00	7.00	Clay Cream Water Supply		
19.00	19.50	0.50	Sand Small Gravel		
19.50	21.00	1.50	Gravel Dry Clay		
21.00	22.00	1.00	Rock Sharp		
22.00	28.00	6.00	Basalt Grey		
28.00	28.50	0.50	Clay Grey Sandy		
28.50	30.20	1.70	Basalt Grey		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW064948

Works Details (top)

GROUNDWATER NUMBER	GW064948
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Rotary Mud
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1985-12-01
FINAL-DEPTH (metres)	49.00
DRILLED-DEPTH (metres)	0.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-3N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6590395.00
EASTING	234322.00
LATITUDE	30 47' 23"
LONGITUDE	150 13' 25"
GS-MAP	0028A4

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	BRENTRY
PORTION-LOT-DP	7

Licensed (top)

no details

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	(Unknown)	0.00	0.00	600			
1	1	Opening	Screen	28.40	33.60	152		1	Stainless Steel; SL: 0mm; A: 0mm
1	1	Annulus	(Unknown)		0.00	305			GS: 5-5mm

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
28.40	31.00	2.60	Unconsolidated						
32.00	33.60	1.60							

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW064949

Works Details (top)

GROUNDWATER NUMBER	GW064949
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Rotary Mud
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1985-12-01
FINAL-DEPTH (metres)	41.00
DRILLED-DEPTH (metres)	0.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-3N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6589964.00
EASTING	234359.00
LATITUDE	30 47' 37"
LONGITUDE	150 13' 26"
GS-MAP	0028A4

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	BRENTRY
PORTION-LOT-DP	7

Licensed (top)

no details

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
16.00	18.00	2.00							
30.20	32.80	2.60							

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Tuesday, March 2, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW968918

Works Details (top)

GROUNDWATER NUMBER	GW968918
LIC-NUM	90BL246117
AUTHORISED-PURPOSES	DOMESTIC STOCK
INTENDED-PURPOSES	DOMESTIC STOCK
WORK-TYPE	Bore
WORK-STATUS	Supply Obtained
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	2008-09-15
FINAL-DEPTH (metres)	103.00
DRILLED-DEPTH (metres)	103.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	YARRARI
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	40.00
SALINITY	
YIELD	3.42

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-2N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6594447.00
EASTING	240917.00
LATITUDE	30 45' 17"
LONGITUDE	150 17' 37"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	GIS - Geographic Information System
REMARK	

Form-A (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	36//754950

Licensed (top)

COUNTY	NANDEWAR
PARISH	TULCUMBA
PORTION-LOT-DP	36 754950

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	103.00	125			(Unknown)
1	1	Casing	Steel	0.00	0.00	125			(Unknown); (Unknown)

Water Bearing Zones (top)

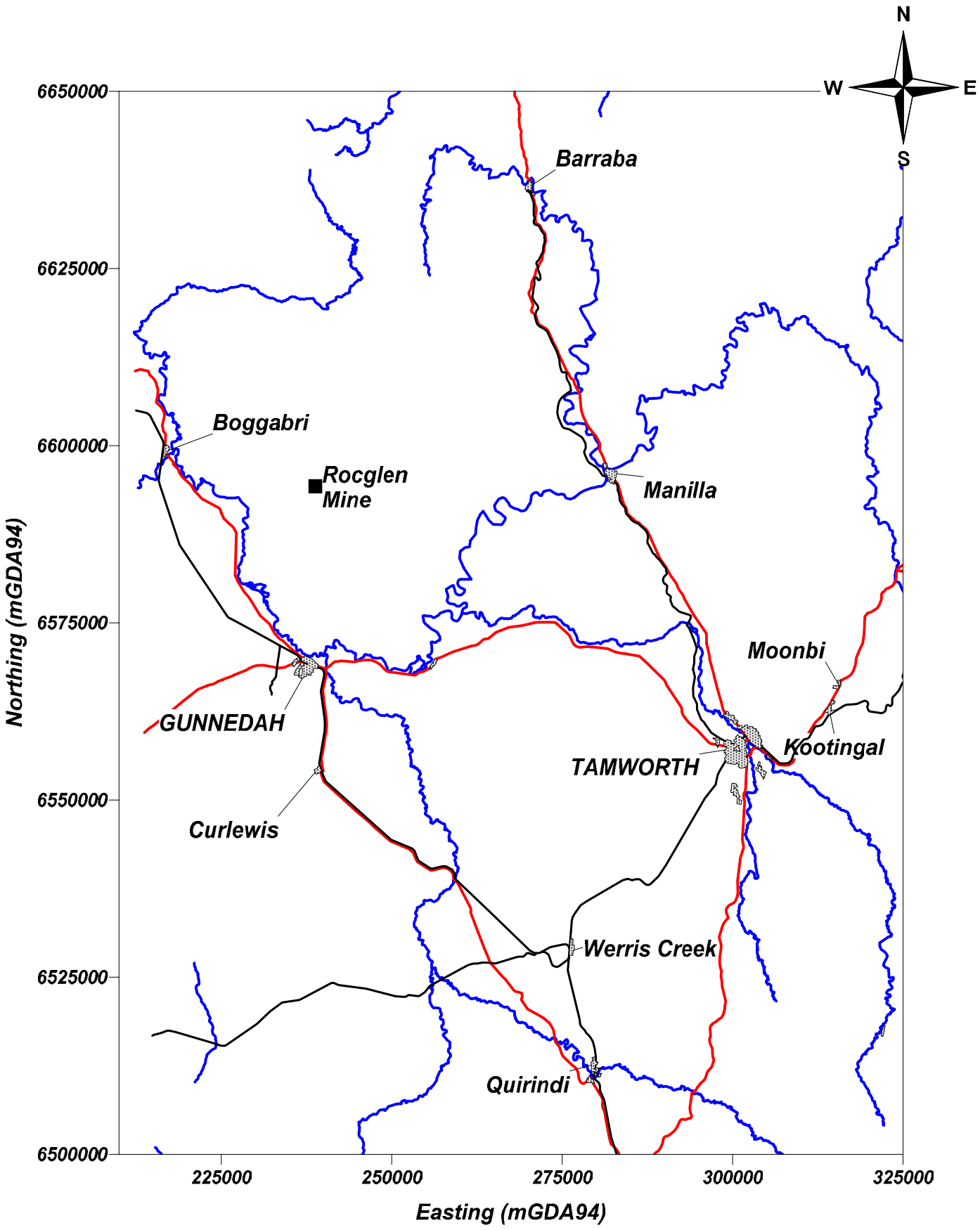
no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	16.00	16.00	Alluvium		
16.00	37.00	21.00	Basalt, flow		
37.00	90.00	53.00	Conglomerate		
90.00	103.00	13.00	Felsic Volcanics		

Appendix E

Drawing 1 – Location of Rocglen Mine
Drawing 2 – Local Topography and Drainage
Drawing 3 – Regional Geology
Drawing 4 – Structure Contours – Base of Belmont Seam
Drawing 5 – Monthly Average Rainfall and Evaporation – Gunnedah Area
Drawing 6 – Locations of Faults – Rocglen Mine
Drawing 7 – Lithostratigraphy at Rocglen Mine – Bore EVK110
Drawing 8 – Local Geology – Alluvium North and South of the Mine
Drawing 9 – Pre-mine Groundwater Levels (After RCA, 2007)
Drawing 10 – Locations of Groundwater Monitoring Bores
Drawing 11 – Locations of Private Groundwater Bores
Drawing 12 – Model Predicted and Monitored Drawdown – Rocglen Pit



Major Road

Railway Line

Major Stream

Population Centre

Projection - GDA94 Zone 56
Level Datum - Australian Height Datum (AHD)

Douglas Partners
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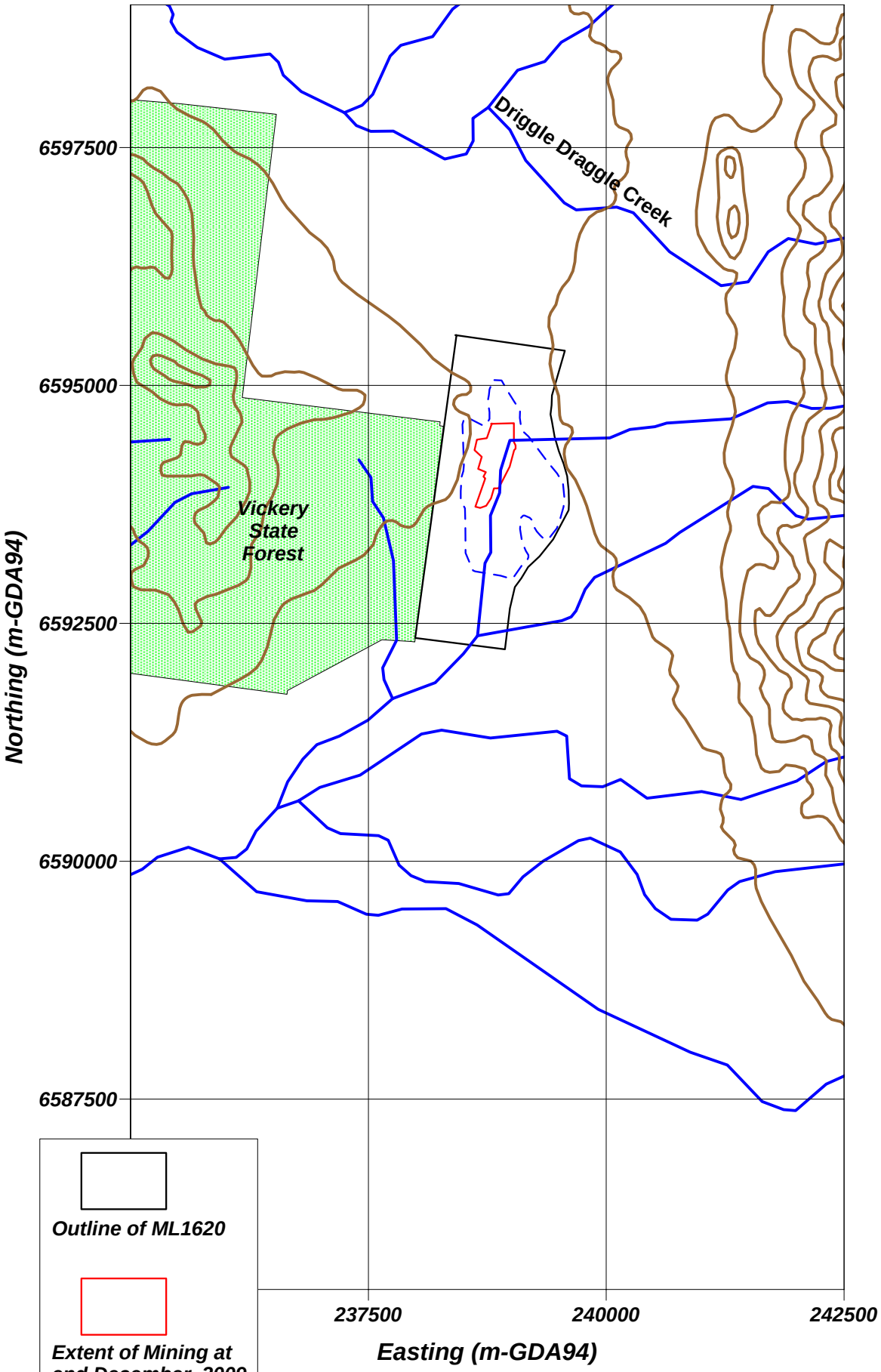
Brisbane, Cairns, Campbelltown, Canberra, Darwin, Gold Coast, Melbourne

Newcastle, Perth, Sunshine Coast, Sydney, Townsville, Wollongong, Wyong

TITLE: LOCATION OF ROCGLEN MINE
Hydrogeological Assessment for Rocglen Coal Mine Expansion
Rocglen Coal Mine, via Gunnedah, New South Wales

CLIENT: GSS ENVIRONMENTAL			OFFICE: NEWCASTLE
DRAWN BY: AMP	SCALE: 1:750000	PROJ NO: 49532.00	DRAWING NO: 1
APPROVED BY: IDH		DATE: Mar 2010	



Projection - GDA94 Zone 56
Level Datum - Australian Height Datum (AHD)

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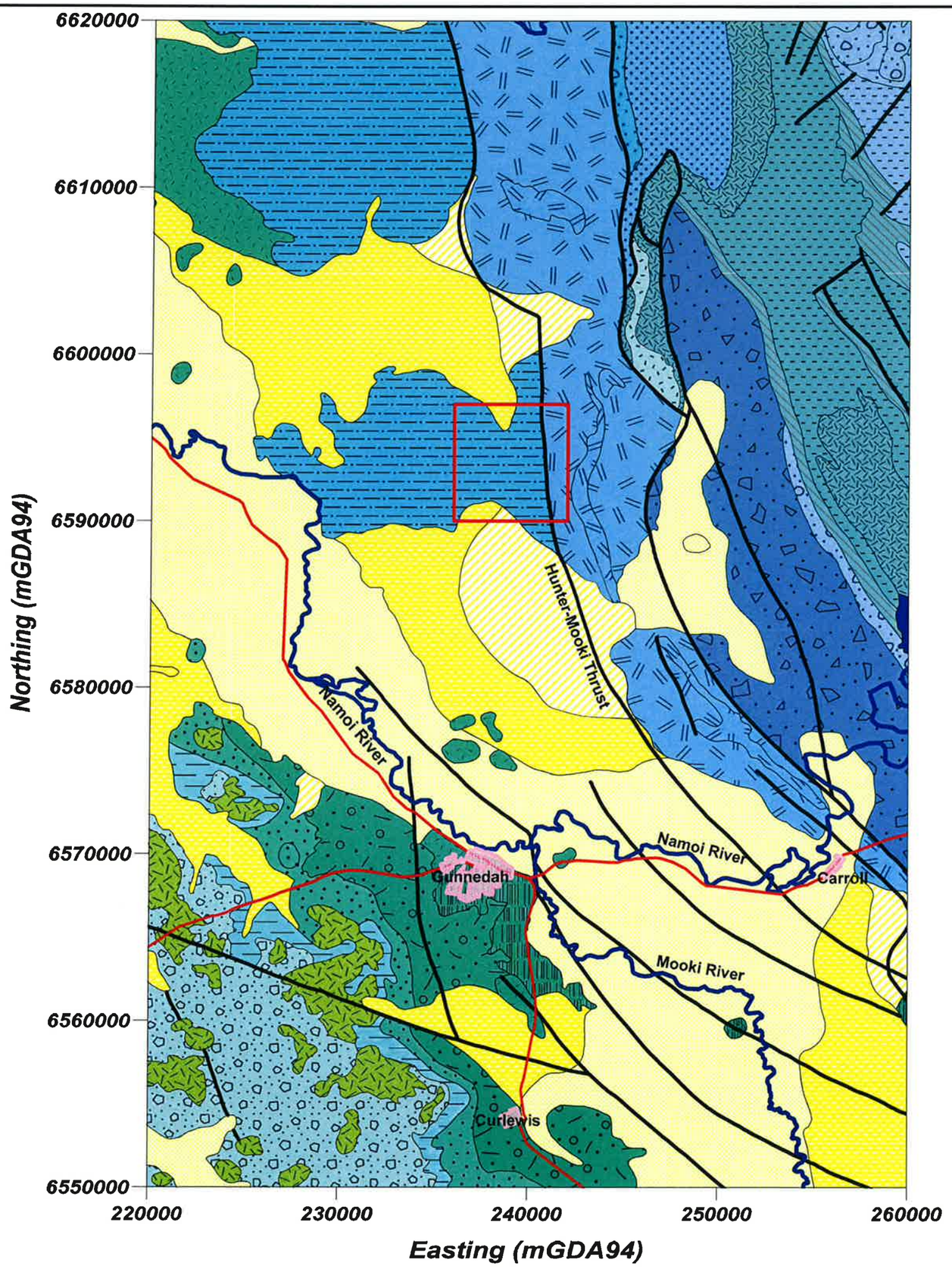
TITLE: LOCAL TOPOGRAPHY & DRAINAGE
Hydrogeological Assessment for Rocglen Coal Mine Expansion
Rocglen Coal Mine, via Gunnedah, New South Wales

CLIENT: GSS ENVIRONMENTAL			OFFICE: NEWCASTLE
DRAWN BY: AMP	SCALE: 1:60,000	PROJ NO: 49532.00	DRAWING NO: 2
APPROVED BY: IDH		DATE: Mar 2010	



Quaternary Alluvium:
Gravel, sand, silt , clay

Quaternary Colluvium:
Boulder, gravel, sand

Cainozoic Sand Plain:
Dominant sand, gravel, clay

Glenrowan Intrusives & Garrawilla Volcanics:
Dolerite, basalt

Digby Napperby Formation:
Pebble/ boulder conglomerate, sandstone

Coogal, Nea Subgroup:
Siltstone, sandstone, claystone

Brothers Subgroup:
Medium grained, normally graded sandstone

Millie Group:
Basal conglomerate, sandstone, siltstone

Maules Creek Formation:
Carbonaceous claystone, sandstone, coal

Werrie Basalt:
Basaltic lavas, tuffs

Boggabri Volcanics:
Rhyolitic to dacite lavas, tuffs

Willuri Formation:
Rhyolitic to andesitic ignimbrite, rhyolite

Clifden Formation:
Coarse sandstone, crossbedded

Rocky Creek Conglomerate:
Boulder, cobble, pebble

Barney Springs Andesite:
Porphyritic andesite

Namoi Formation:
Thinly bedded mudstone and siltstone

Tulcumba, Tangaratta Formation:
feldsarenite, siltstone, mudstone, limestone

Keepit, Lowana Conglomerate:
Boulder, pebble, mudstone, sandstone

Mandowa Mudstone:
Green-black, thinly bedded siltstone, mudstone

Mostyn Vale Formation:
Pebbly lithic wacke

N
W
E
S

Major River

Waterbody

Regional Faults

Major Town

Major Roads

Inset for Drawings 2 & 3

Projection - MGA94 (Zone 56)
Level Datum - Australian Height Datum (AHD)

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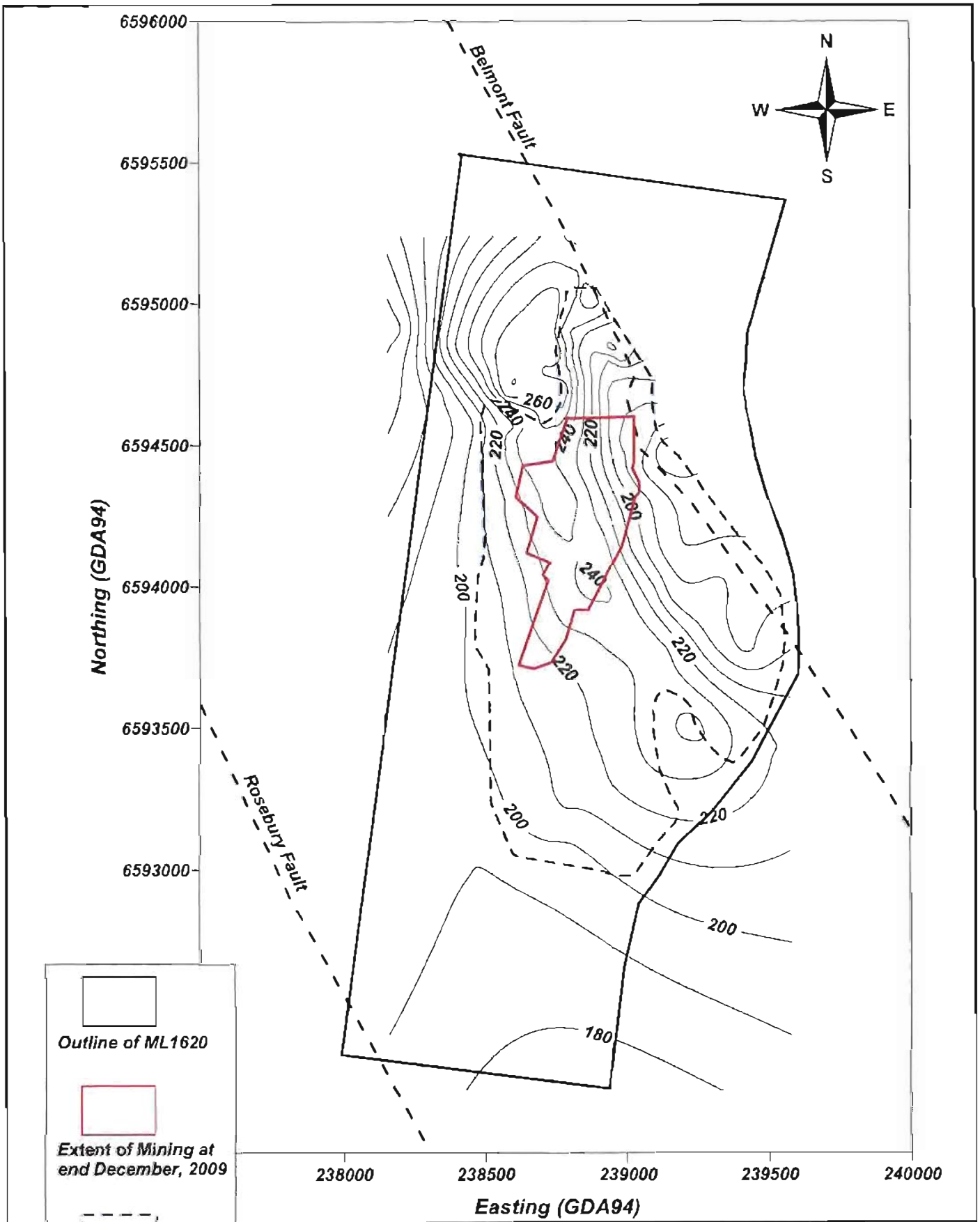
Newcastle, Perth, Sunshine Coast, Sydney, Townsville, Wollongong, Wyong

TITLE **REGIONAL GEOLOGY**
Hydrogeological Assessment for Rocglen Coal Mine Expansion
Rocglen Coal Mine, via Gunnedah, New South Wales

CLIENT: GSS ENVIRONMENTAL			OFFICE: NEWCASTLE
DRAWN BY: AMP	SCALE: 1:400000	PROJ NO: 49532.00	DRAWING NO: 3
APPROVED BY:		DATE: Mar 2010	



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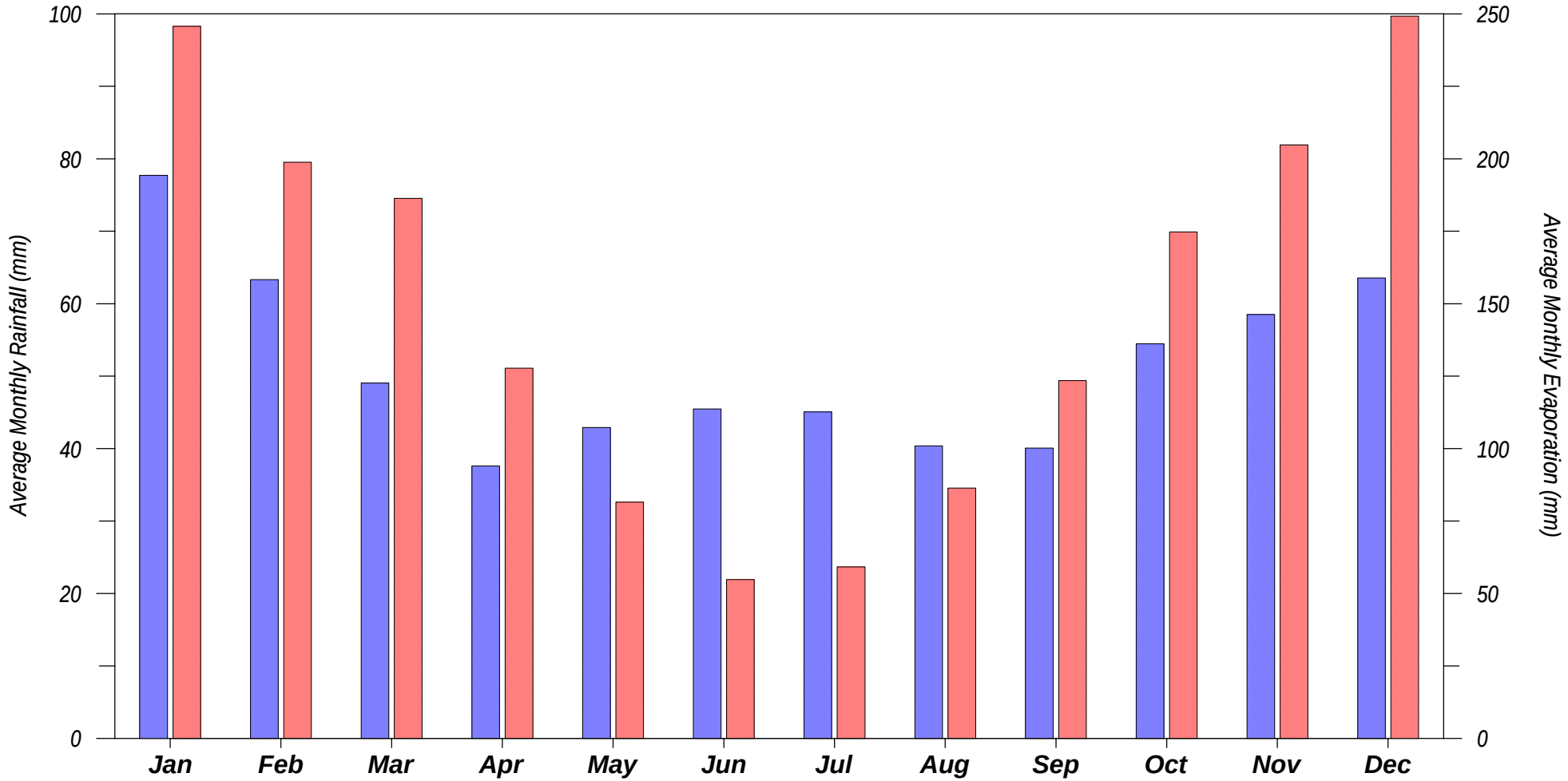
Newcastle, Perth, Sunshine Coast, Sydney, Townsville, Wollongong, Wyong

TITLE: STRUCTURE CONTOURS - BASE OF BELMONT SEAM
Hydrogeological Assessment for Rocglen Coal Mine Expansion
Rocglen Coal Mine, via Gunnedah, New South Wales

CLIENT: GSS ENVIRONMENTAL			OFFICE: NEWCASTLE
DRAWN BY: AMP	SCALE: 1:17,500	PROJ NO: 49532.00	DRAWING NO: 4
APPROVED BY: IDH		DATE: Mar 2010	

Projection - GDA94 Zone 56
Level Datum - Australian Height Datum (AHD)



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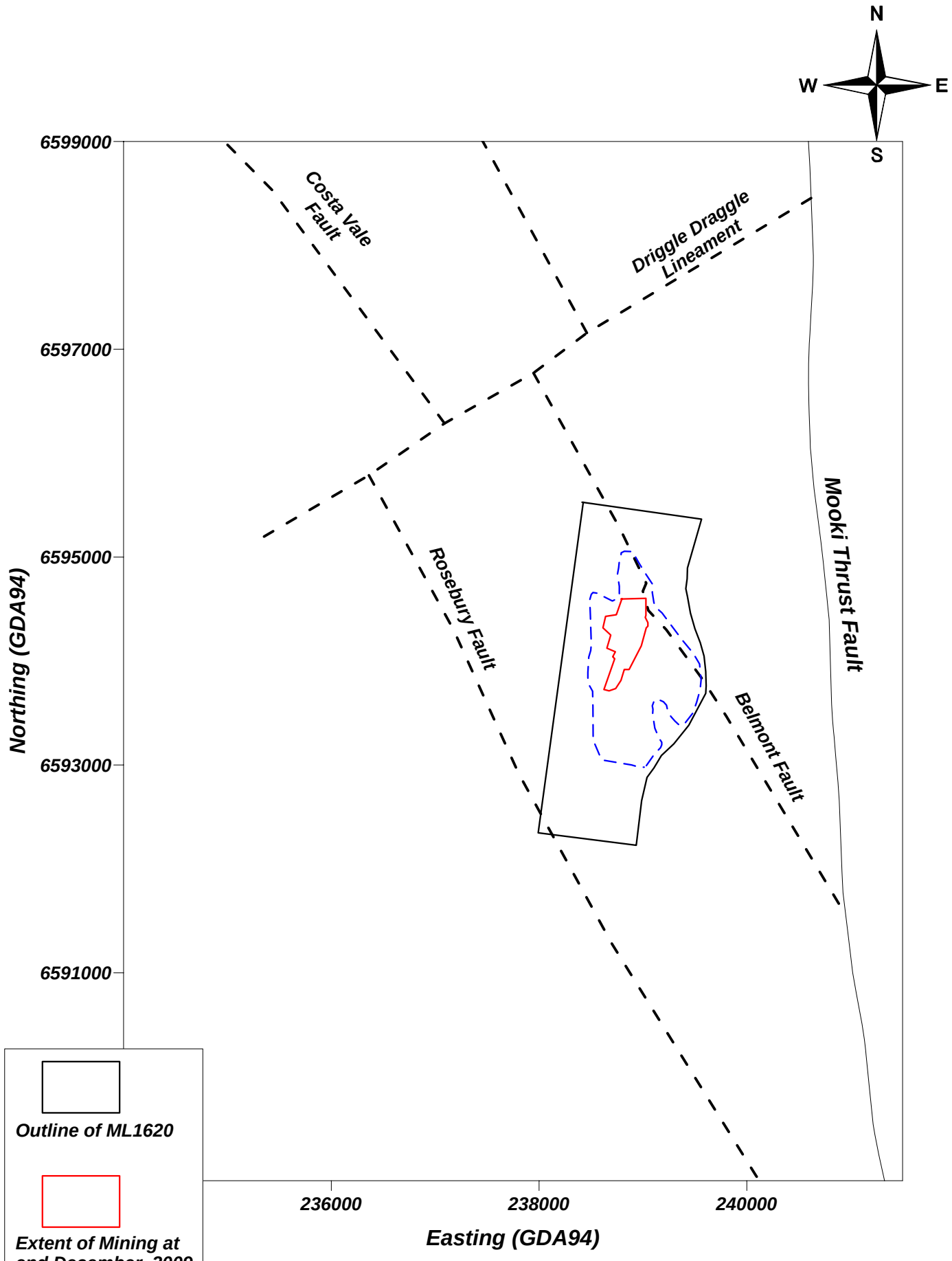
Brisbane, Cairns, Campbelltown, Canberra, Darwin, Gold Coast, Melbourne

Newcastle, Perth, Sunshine Coast, Sydney, Townsville, Wollongong, Wyong

TITLE: MONTHLY AVERAGE RAINFALL & EVAPORATION - GUNNEDAH AREA
Hydrogeological Assessment for Rocglen Coal Mine Expansion
Rocglen Coal Mine, via Gunnedah, New South Wales

CLIENT:	GSS ENVIRONMENTAL			OFFICE: NEWCASTLE
DRAWN BY:	AMP	PROJECT NO:	49532.00	DRAWING NO: 5
APPROVED:		DATE:	Mar 2010	



Projection - GDA94 Zone 56
Level Datum - Australian Height Datum (AHD)

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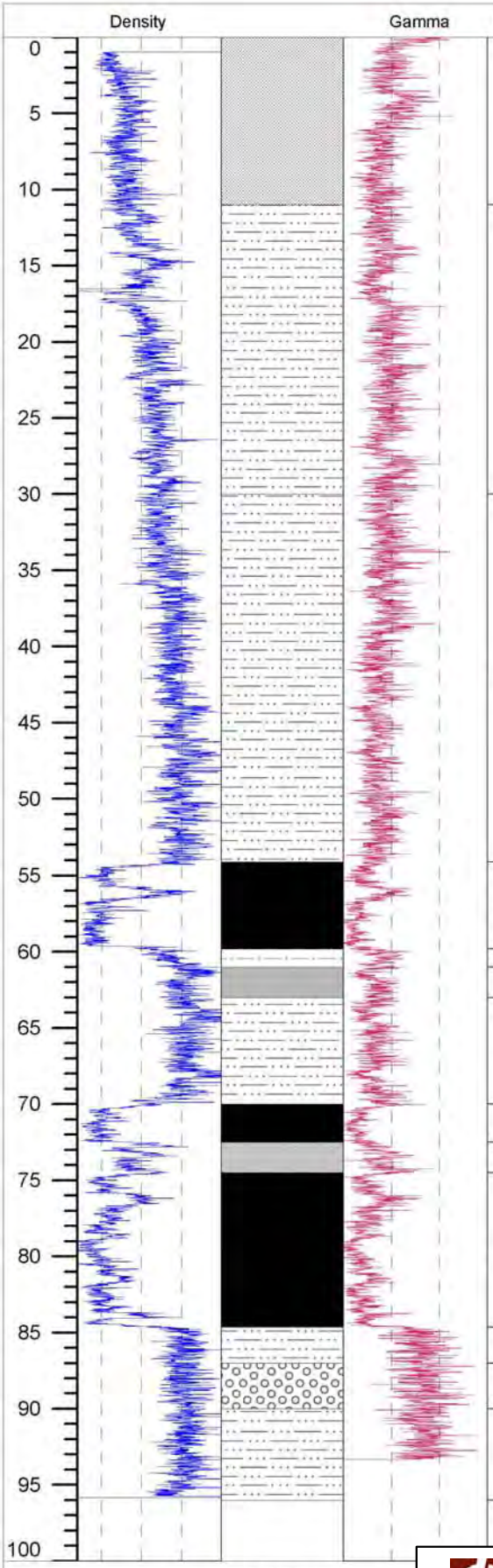
Brisbane, Cairns, Campbelltown, Canberra, Darwin, Gold Coast, Melbourne | Newcastle, Perth, Sunshine Coast, Sydney, Townsville, Wollongong, Wyong

TITLE: LOCATIONS OF FAULTS - ROCGLEN MINE
Hydrogeological Assessment for Rocglen Coal Mine Expansion
Rocglen Coal Mine, via Gunnedah, New South Wales

CLIENT: GSS ENVIRONMENTAL			OFFICE: NEWCASTLE
DRAWN BY: AMP	SCALE: 1:50,000	PROJ NO: 49532.00	DRAWING NO: 6
APPROVED BY: IDH		DATE: Mar 2010	



ROCGLEN DEPOSIT

Depth	Thick	Lithology	Description
11	11	Clay	Clay, light brown off white
30	19	Laminite	Laminite, Sandstone 50%, light orange, lithic, siltstone 50%, brown
54.09	24.09	Laminite	Laminite, Sandstone 50%, light grey, lithic, siltstone 50%, grey
59.82	5.73	Coal	***Upper Glenroc Coal Seam***
61	1.18	Siltstone	Siltstone, grey
63	2	Sandstone	Sandstone, fine to coarse grained, lithic, grey
70	7	Laminite	Laminite, Sandstone 50%, light grey, lithic, siltstone 50%, grey
72.51	2.51	Coal	***Lower Glenroc Coal Seam***
74.5	1.99	Claystone PC	Carbonaceous Claystone
84.65	10.15	Coal	***Belmont Coal Seam***
87	2.35	Laminite	Laminite, Sandstone 50%, light grey, lithic, siltstone 50%, grey
90	3	Conglomerate	Conglomerate, multicoloured, pebble to cobble, lithic
96	6	Laminite	Laminite, Sandstone 50%, light grey, lithic, siltstone 50%, grey

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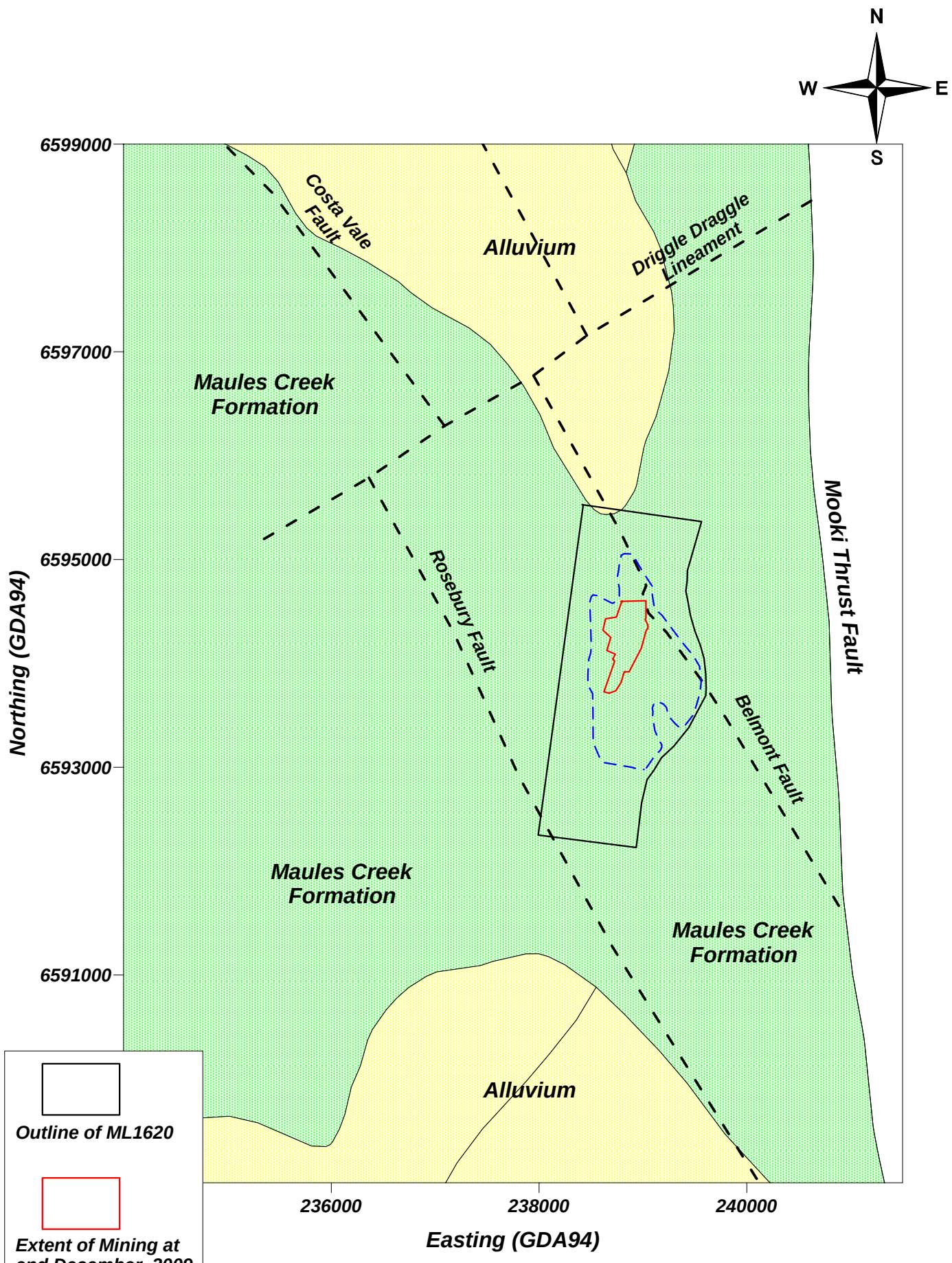
TITLE: LITHOSTRATIGRAPHY AT ROCGLEN MINE - BORE EVK110
Hydrogeological Assessment for Rocglen Coal Mine Expansion
Rocglen Coal Mine, via Gunnedah, New South Wales

CLIENT: GSS ENVIRONMENTAL			OFFICE: NEWCASTLE
DRAWN BY: AMP	SCALE: N/A	PROJ NO: 49532.00	DRAWING NO: 7
APPROVED BY: IDH		DATE: Mar 2010	



Projection - GDA94 Zone 56
Level Datum - Australian Height Datum (AHD)

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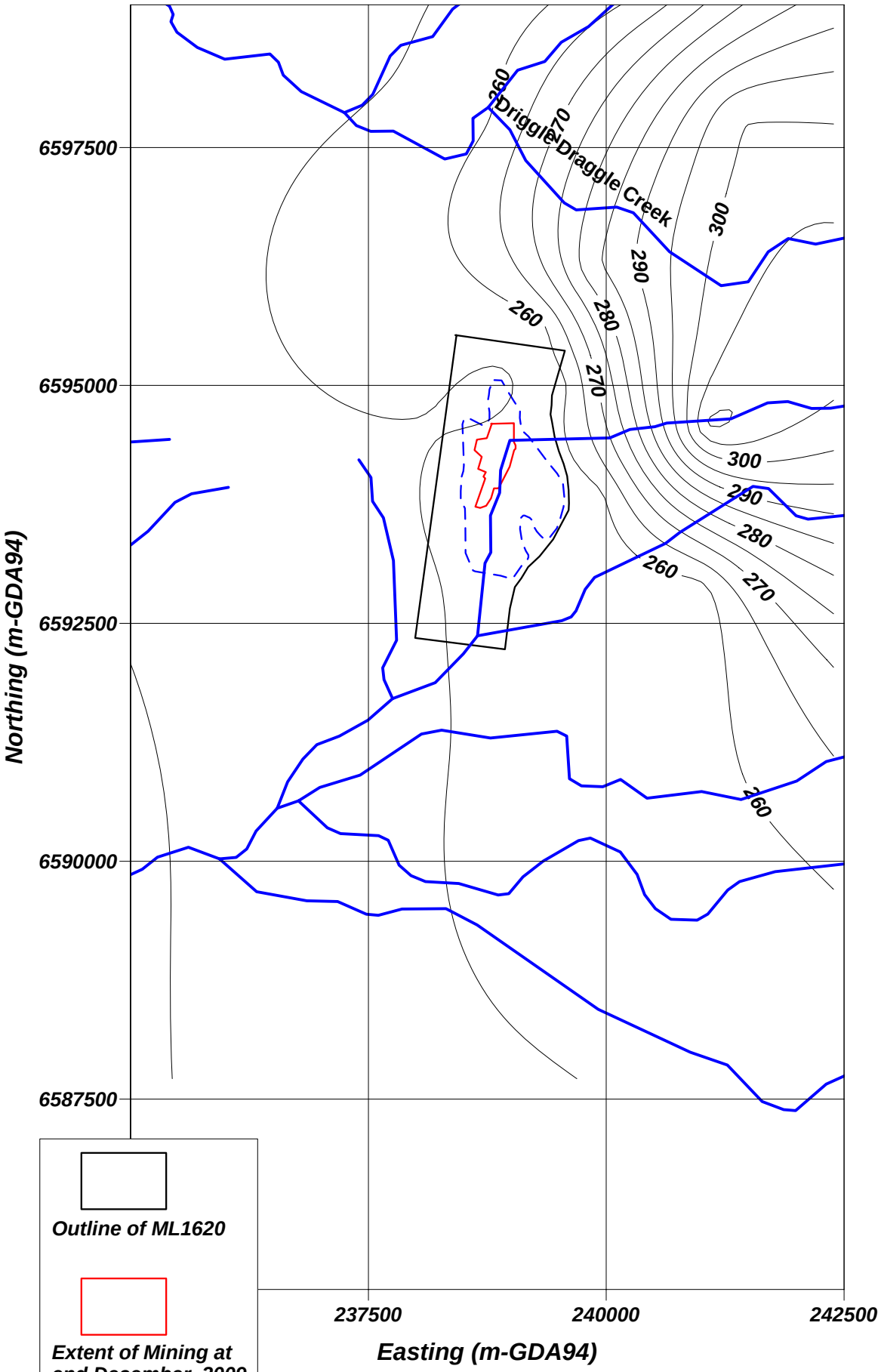
TITLE: LOCAL GEOLOGY - ALLUVIUM NORTH & SOUTH OF MINE
Hydrogeological Assessment for Rocglen Coal Mine Expansion
Rocglen Coal Mine, via Gunnedah, New South Wales

CLIENT: GSS ENVIRONMENTAL			OFFICE: NEWCASTLE
DRAWN BY: AMP	SCALE: 1:50,000	PROJ NO: 49532.00	DRAWING NO: 8
APPROVED BY: IDH		DATE: Mar 2010	



Projection - GDA94 Zone 56
Level Datum - Australian Height Datum (AHD)

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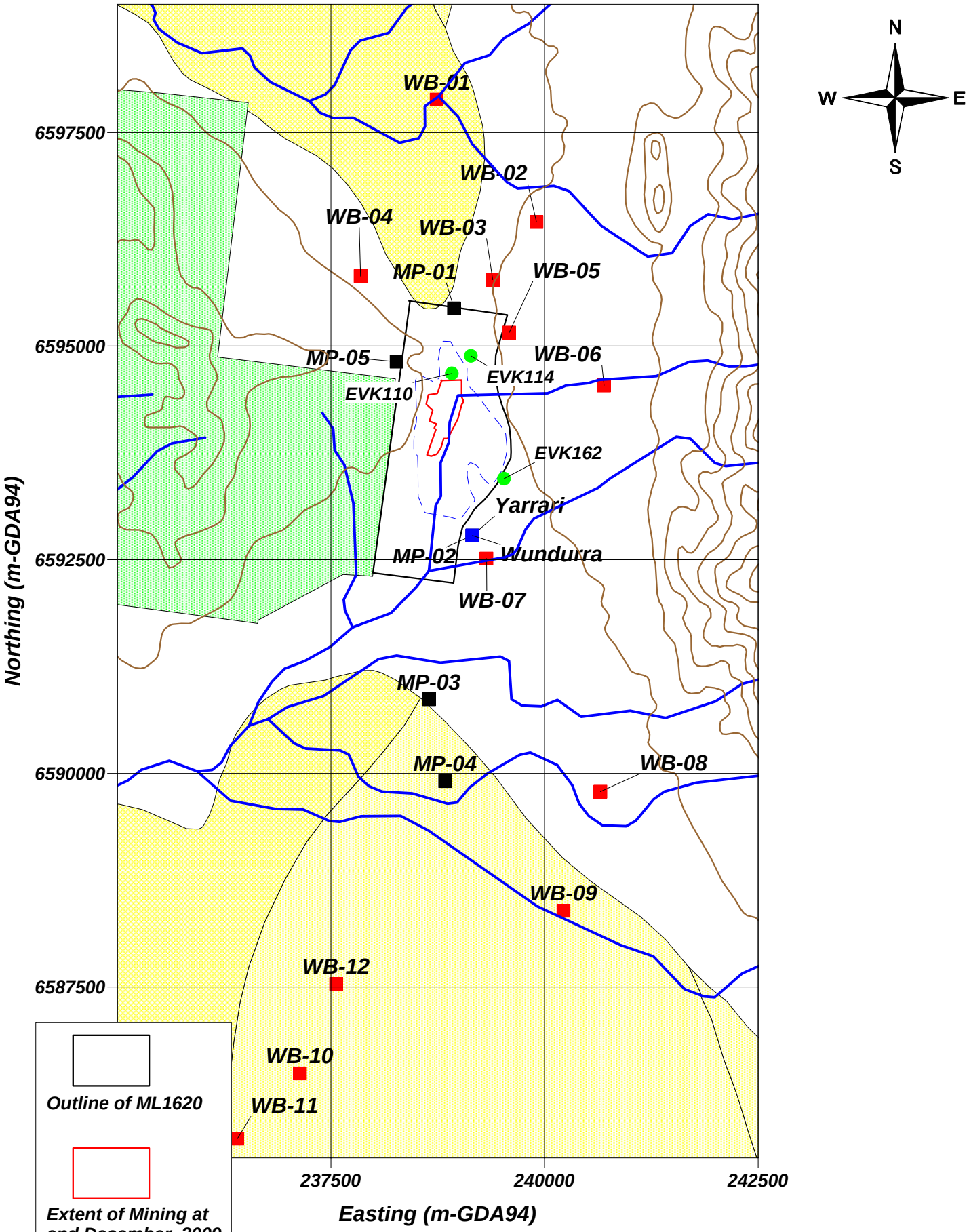
TITLE: PRE-MINING GROUNDWATER LEVELS (After RCA, 2007)
Hydrogeological Assessment for Rocglen Coal Mine Expansion
Rocglen Coal Mine, via Gunnedah, New South Wales

CLIENT: GSS ENVIRONMENTAL			OFFICE: NEWCASTLE
DRAWN BY: AMP	SCALE: 1:60,000	PROJ NO: 49532.00	DRAWING NO: 9
APPROVED BY: IDH		DATE: Mar 2010	



Projection - GDA94 Zone 56
Level Datum - Australian Height Datum (AHD)

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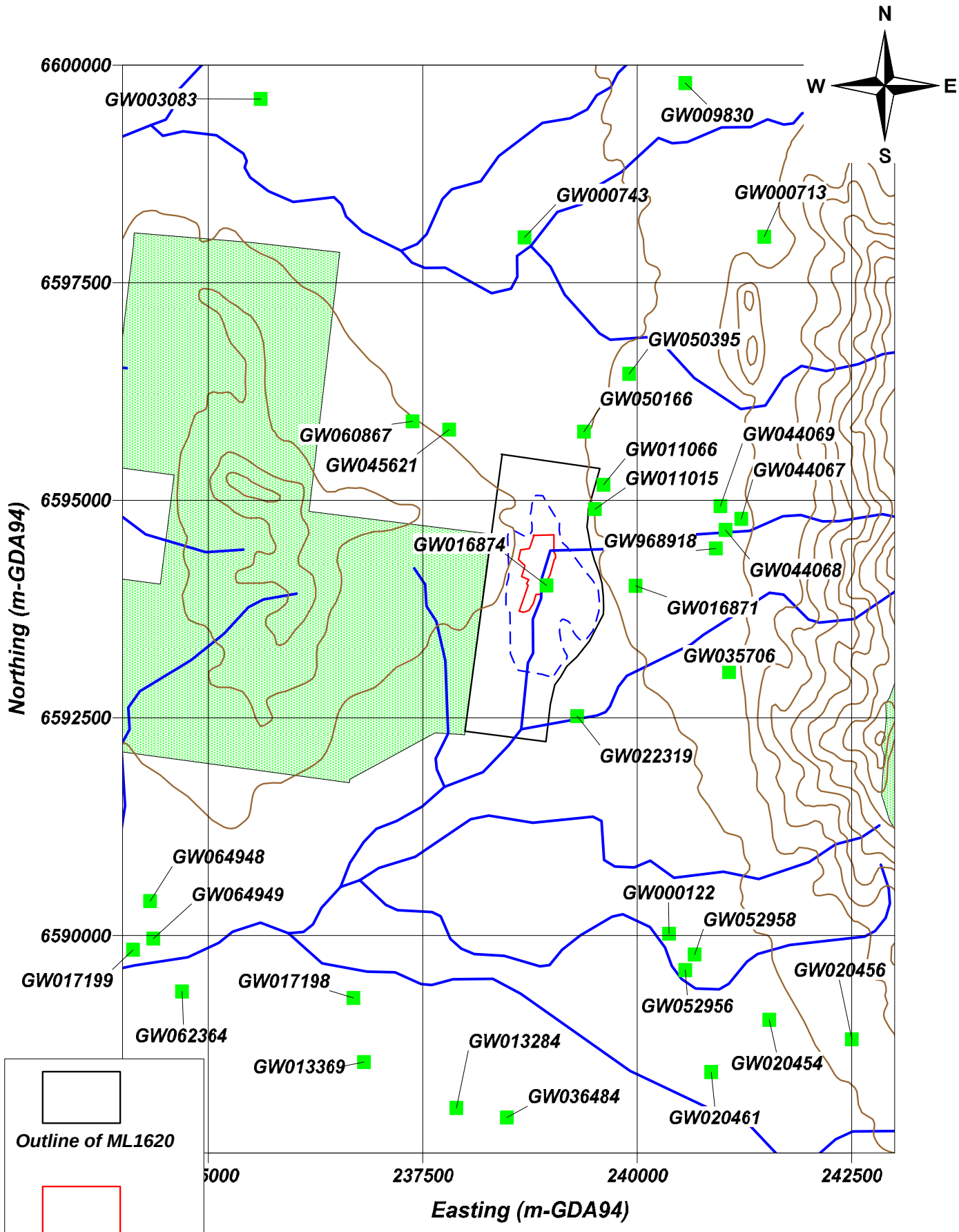
Newcastle, Perth, Sunshine Coast, Sydney, Townsville, Wollongong, Wyong

TITLE: LOCATIONS OF GROUNDWATER MONITORING BORES
Hydrogeological Assessment for Rocglen Coal Mine Expansion
Rocglen Coal Mine, via Gunnedah, New South Wales

CLIENT: GSS ENVIRONMENTAL			OFFICE: NEWCASTLE
DRAWN BY: AMP	SCALE: 1:60,000	PROJ NO: 49532.00	DRAWING NO: 10
APPROVED BY: IDH		DATE: Mar 2010	



Projection - GDA94 Zone 56
Level Datum - Australian Height Datum (AHD)

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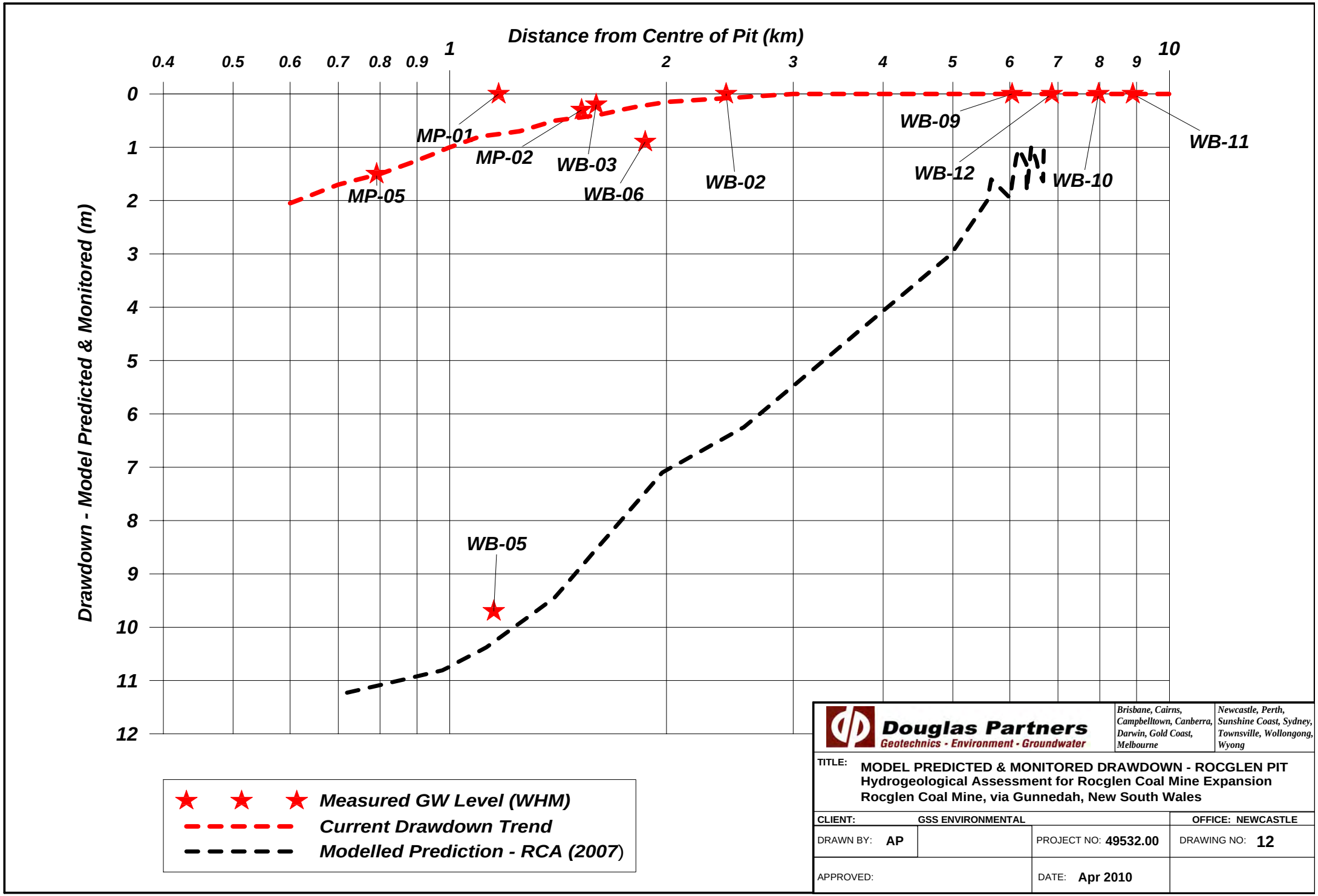
TITLE: LOCATIONS OF PRIVATE GROUNDWATER BORES
Hydrogeological Assessment for Rocglen Coal Mine Expansion
Rocglen Coal Mine, via Gunnedah, New South Wales

CLIENT: GSS ENVIRONMENTAL			OFFICE: NEWCASTLE
DRAWN BY: AMP	SCALE: 1:60,000	PROJ NO: 49532.00	DRAWING NO: 11
APPROVED BY: IDH		DATE: Mar 2010	



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Newcastle, Perth, Sunshine Coast, Sydney, Townsville, Wollongong, Wyong

TITLE: MODEL PREDICTED & MONITORED DRAWDOWN - ROCGLEN PIT
Hydrogeological Assessment for Rocglen Coal Mine Expansion
Rocglen Coal Mine, via Gunnedah, New South Wales

CLIENT: GSS ENVIRONMENTAL			OFFICE: NEWCASTLE
DRAWN BY: AP		PROJECT NO: 49532.00	DRAWING NO: 12
APPROVED:		DATE: Apr 2010	