CBM 93-002

WELL COMPLETION REPORT
Interpretive
EP 93

Northern Territory

22nd May 2010 – 10th Jun 2010

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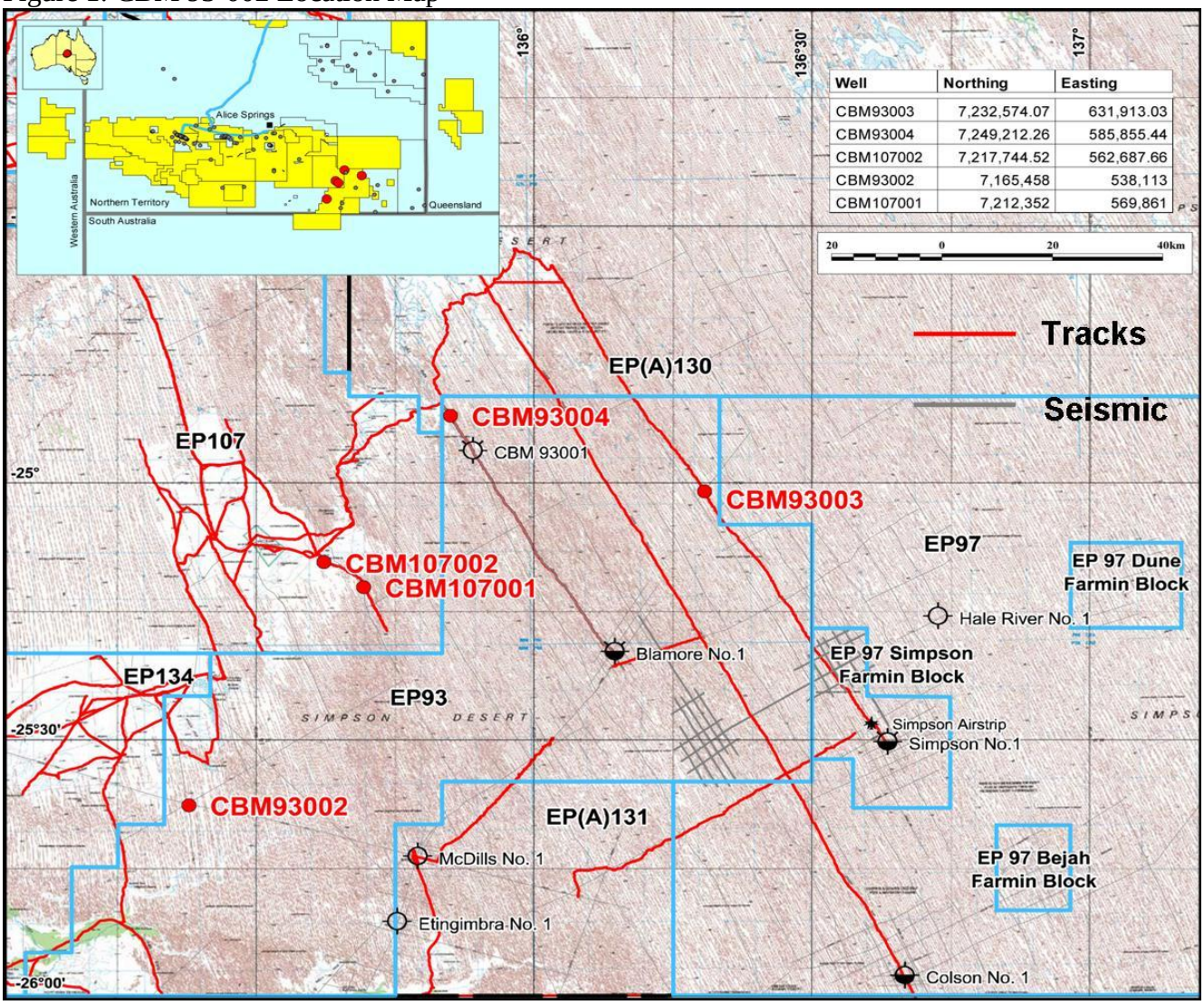
1.0 Introduction

CBM 93-002 was the last Coal Bed Methane exploration well drilled of the three planned 2010 CBM well drilling programme. The nearest well to CBM 93-002 is CBM 107-001, which is located approximately 33 km to the northeast (Figure 1).

Figure 1: CBM 93-002 Location Map



The principal objective of CBM 93-002 was the Purni Formation coal measures and this section was continuously cored in the well.

The Wallis Rig No. 39 was mobilized to the CBM 93-002 well site after the drilling of CBM 107-002. CBM 93-002 spudded on the 22nd of May 2010 and reached a total depth (TD) of 1044mRT on the 7th of June 2010.

The well was drilled to investigate the potential for CBM (Coal Bed Methane) and UCG (Underground Coal Gasification) gas production from Permian Purni Formation coal seams.

CBM 93-002 intersected a number of thick coals in the Purni Formation with a net cumulative coal thickness of 107.9m for coal seams greater than 1m thickness; with a total thickness of 117.3m for all coals including thin beds. The thickest seam was 14.4m.

Eighty-Nine 6m length HQ (63.5mm diameter) cores were cut using a continuous wireline retrievable coring system. One Water Injection Falloff Test on wireline was conducted over the interval 701.5m to 712m.

The well was plugged and abandoned at total depth. The rig was released on the 10th of June 2010.

2.0 General Data

Table 1 CBM 93-002 Well Index Sheet

WELL NAME : CBM 93-002 **OPERATOR :** Central Petroleum Limited		**CLASSIFICATION:** Coal Bed Methane Exploration			
Location: **Latitude:** 25° 21' 16.1" S **Longitude:**135° 26' 5.3" E GDA 94 Zone 53	Rig Details **Rig Name:** Wallis D 39 **Contractor**: Wallis Drilling **Rig Type:** Land – Core Rig	Dates **Spud Date:** 22nd May 2010 **TD Date:** 7th June 2010 **Rig Released**: 10th June 2010			
Basin: Pedirka **Field:** Exploration **Permit:** EP 93	Depths Surface Elevation (AHD): 158 m Rig Datum, DF (AHD): 159.3 m Total Depth: 1044.2 m (driller), 1043.1 m (logger)				Status P&A
Casing/Liner Details Size (mm) Depth (m) 10" (254mm) conductor: 10m 7" (177mm) : 247m 4 ½" (114mm): 23.4m	Mud Details section Mud Type 12 ¼" hole to 10m: Gel Spud Mud 8 ½" hole to 247m: Gel, KCl, Polymer 6 ⅛" hole to 525.6m: Gel, KCl, Polymer 3.78" HQ hole to 1044.2m: Gel, KCl, CR 650				Trajectory: Vertical
Coring Details HQ Cores were cut using a wireline retrievable system over the interval 525.6m to 1044.2m, good recovery throughout	Sidewall Cores Nil		Cuttings Interval Sample Rate 10m to 525.6m 6m		

FORMATION	MD (m)	Subsea (TVD)	Isopach (m)	TWT (msec)	Comments
Holocene-Quaternary	1.3	+158	2.7		Quaternary Holocene
Eyre Formation	4	+155.3	16		Tertiary
Undif. Winton-Oodnadatta Fm	20	+139.3	178		Cretaceous
Mackunda Fm	198	-38.7	93		
Cadna Owie Fm	291	-	6		
Murta Member	297	-	17		Early Cretaceous
Algebuckina Sandstone	314	-131.7	198		Late to Middle Jurassic
Purni Formation	512	-146.7	520		Permian
Top coal	514	-154.7			
Base Coal	902	-			
Tirrawarra Sandstone		-			Net coal: 117.26m
Crown point Formation	1032	-352.4	12		
Total Depth	1044	-884.9			Wireline TD: 1043.2m.

LOGGING

Date	Depth (m) From	Depth (m) To	Description
7 Jun 2010	5	1038.5	1. DLL-SLL-Sonic-Neutron-Density-GR-SP-Calliper (GR sonic from above 4½" casing shoe to surface)
8 Jun 2010	50	1039	2. Checkshot survey: 27 shots from 1039m to 50m

Well Testing:
DST #1: One Water Injection Falloff Test on wireline, conducted over the interval 701.5m to 712m, from 02/06/10 to 03/06/10 (8 hour injection, 3 l/min, 16 hour falloff)

Well Name:	CBM 93-002
Well Classification:	Wildcat
Interest Holders:	Central Petroleum Limited (80%) Petroleum Exploration Australia (20%)
Petroleum License:	EP 93, Northern Territory
Location:	Latitude 25° 21’ 16.10″ S Longitude 135° 26’ 5.30” Australian Map Grid Zone 53 GDA 94
Ground Level (GL):	158.0m
Kelly Bushing (KB):	159.3m
Total Depth:	1044m (driller’s)
Drilling Contractor:	Wallis Drilling
Drilling Rig:	Wallis Rig No. 39
Contractors:	
Drilling Fluids RMN:	Drilling Fluids
Coring Wallis:	Drilling
Mud Logging:	Weatherford
Wireline Logging:	Weatherford
Cementing:	Viking
Earth Works:	Crown Point Pastoral
DST Testing:	Weatherford
Spud Date:	22nd May 2010
Total Depth Reached:	7th June 2010
Rig Released:	10th June 2010
Well Status:	Plugged and Abandoned

3.0 Drilling

3.1 Summary of Drilling and Related Operations

The Wallis Rig No. 39 moved onto the CBM 93-002 location on the 18th of May 2010.

The well was spudded @ 08:00hrs with an 8 ½" BHA using Gel spud mud. The well was officially spudded once the cellar was drilled to 3.9mRT. The 10"conductor hole was drilled from 3.9mRT to 10.5mRT with the 8 ½" BHA.

They then POOH in order to make up a 12 ¼" hole opener BHA, then RIH with the new 12 ¼" BHA, and opened the hole to 12 ¼" from 3.9mRT to 10.5mRT. They then POOH and ran and cemented the 10" PVC conductor to 10m. They then waited on cement (WOC) for 6 hours, and laid out and strapped the 7" casing string, cut the conductor, installed the flowline from the cellar to the sump, and made up the 8 1/2" BHA whilst WOC.

They then RIH and drilled ahead with an 8 1/2" BHA from 10.5m to 248.2m with Gel-Polymer-KCl mud. A wiper trip was then performed after the hole was circulated clean @ 248.2m. Whilst POOH from 248.2m to 40m, the driller was preparing to sit the drill string in slips, when the drill string disengaged from the top drive sub and fell to the bottom of hole.

The estimated top of the fish was @ 207.85mRT depth. The total length of the fish was 40.35m (consisting of the 8 ½" Bit, float sub, 7 drill collars, x/o, and 3 drill pipes). Operations were halted and a review of the incident took place before commencing fishing operations.

To commence the fishing operations they RIH with a 6 5/8" grapple. The grapple was unsuccessful in engaging the fish as the drill pipe was lying against the side of the well. POOH to surface and then RIH with open ended drill pipe to attempt to engage the fish. This fishing method successfully engaged the fish, which was confirmed by a 10000lbs overpull. They then POOH to the surface with the fish, and no damage to any tubular were observed.

After inspection of the fish, they commenced rigging up to run the 7" casing, made up the float and shoe track, and RIH to 247m. Once at 247m, and after the necessary pre job safety meeting (PJSM), they completed the cementing job as planned. Once the cement was set they pressure tested the blow-out preventer (BOP) and repaired the HCR valve.

After a successful BOP test they rigged down the BOP testing equipment and gave the rig a full service. They then made up a new BHA with a 6 1/8" bit to drill the 6 1/8" hole section. They RIH with the 6 1/8" BHA, using KCL-Polymer mud, and tagged the top of the cement (TOC) at 220m. They then drilled out the cement plugs, and the float and shoe track, and 3m of new formation to 251m. Once in 3m of new formation, they circulated the hole clean, and then conducted a formation integrity test (FIT) with 8.8ppg KCL-Polymer mud and 105psi surface pressure, and subsequently achieved a result of 11.2ppg Equivalent mud weight (EMW).

After the completion of the FIT, they continued to drill ahead the 6 1/8" hole from 251m to 301m. At 301m they inspected and changed out the swabs on the main mud pump, and then continued drilling from 301m to 439m. At 439m there was a significant decrease in the drilling rate of penetration, therefore the 6 1/8" BHA was POOH for inspection. At the surface they noticed that 1 drill collar, 1 float sub, and the 6 1/8" bit had been left down the hole. After review of the incident they RIH to attempt to fish out the

equipment with the overshot. They tagged the top of the fish @ 427.3m, and then attempted to engage the fish with varying parameters to no avail, then POOH to 30m.

After inspecting the overshot tool, they RIH again with the overshot for the second fishing run to 427m. They attempted to engage the fish again, with no success, and therefore POOH to inspect the overshot at surface again. After discussion between the Perth office and the company men a decision was made to leave the 6 1/8" BHA in the hole and plug back the hole.

After changing over the handling equipment, they then RIH open ended with HRQ pipe to 432m, circulated bottoms up, held a PJSM, and rigged up the cement wedge. They then proceeded to mix, pump, and displace 6.5bbls of 15.6ppg cement slurry with 10.5bbls of mud to set the cement plug from 432m to 380m. After POOH from 432m to 372m, they circulated bottoms up twice, there was no cement returns to surface. They then POOH to surface, changed over the handling equipment, and made up a 6 1/8" tricone BHA. After RIH to tag the TOC @ 389m, they control drilled ahead the 6 1/8" hole from 389m to 408m to establish kick-off from the plug. After making a connection the bit became plugged, and attempts to clear the bit were unsuccessful. Therefore they POOH to 360m, and repeated the necessary procedures to clear the bit blockage, and successfully regained full circulation. They then RIH to 408m, and after successfully kicking-off in the plug and drilling away from the cemented BHA, they continued to drill ahead in the 6 1/8" hole to 443m.

They continued to drill ahead from 443m to section TD @ 525.6m. They then pumped 5bbls of Hi-Vis sweep, circulated the hole clean, and conducted a wiper trip from 525.6m to 360m. Again 5bbls of Hi-Vis sweep was pumped in and the hole was then circulated clean, then 20bbls of Hi-Vis pill was spotted on the bottom of the hole to cover the open hole section. The 6 1/8" BHA was POOH and the handling equipment to run the 4 1/2" casing was rigged up. The 4 1/2" casing was then RIH and set the casing shoe @ 523.5m.

They then rigged up the surface lines and the cement head, and completed the 4 1/2" casing cement job from 525.6m to 485m. After WOC for 8 hours, they installed the casing slips, nippled up the BOP, and then pressure tested the BOP.

After rigging down the testing equipment, they RIH with the 3.78" HQ coring assembly using Gel/ KCl/CR 650 mud, and tagged the TOC @ 485m. They then proceeded to drill out the cement plug, float, and shoe track. They then drilled ahead a rat hole and 3m of new formation to 528m. After circulating the hole clean, they conducted an FIT @ 528m with 8.6ppg MW and 30psi surface pressure, and achieved an 8.9ppg EMW FIT result.

They then cut and retrieved cores from 528m to 712m, then circulated the hole clean, and rigged up and carried out one water injection falloff test on wireline. This DST was conducted over the interval 701.5m to 712m, from 02/06/10 to 03/06/10 (8 hour injection, 3 l/min, 16 hour falloff).

After completing the DST, they resumed cutting core 712m to well TD (1044m). After reaching TD they carried out a wiper trip from 1044m back to the shoe, and POOH to surface. A PJSM was then held before rigging up to run the Weatherford Wireline logging program.

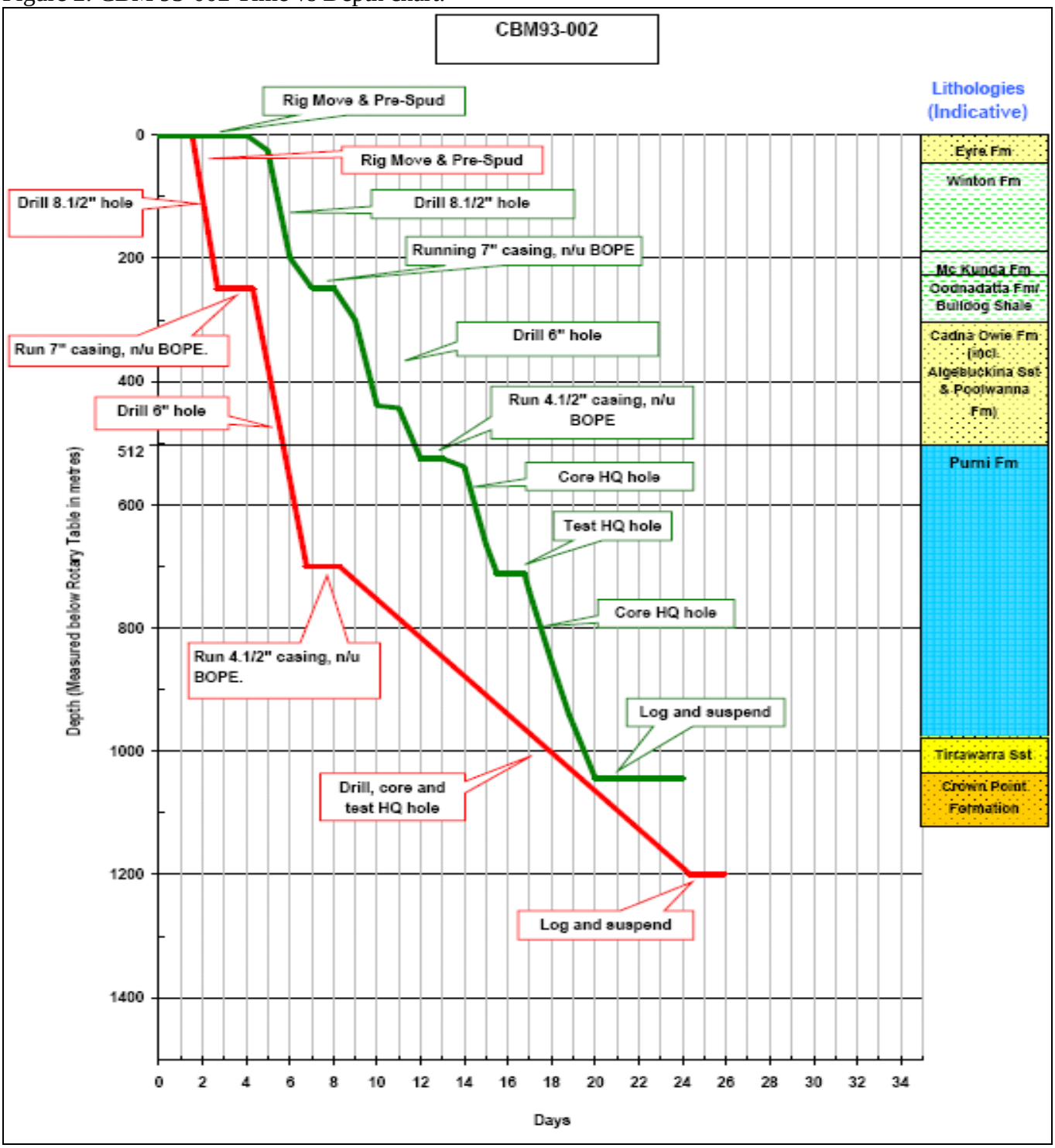
Logging commenced on the 7th of June 2010. During logging, the Super Combo tool failed, so the wireline engineers POOH to surface and rectified the problem by cycling the power to the tool. They then RIH and successfully completed run 1. They then POOH and rigged up the checkshot survey and RIH. They encountered a problem while running the checkshot survey, therefore they POOH to surface

to inspect. They repaired the locking arm, RIH, and successfully completed all 27 checkshots from 1039m to 50m. The entire logging program was completed in 16 hours.

Cement plugs were then set from 1044.2m to 493m across the casing shoe and at surface to 30m. The well was plugged and abandoned on the 10th June 2010.

The rig was released at 1900hrs 10th June 2010.

Figure 2: CBM 93-002 Time vs Depth chart.



3.1.1 Drilling equipment installed in or on the well

The Wallis Drilling Contractors rig Delta 39 was used to drill the CBM 93-002 well. This rig is a 330 HP hydraulic rig with a 226kn (50,700 lbf) pull capacity and capable of drilling to 1500m with HQ drill rods. The rig pumps are an FMC Q1832 Five Piston Pump powered by a 300 HP diesel engine driven hydraulic motor. The Diamond coring pumps are 2 x FMC Bean Model L1118SC pumps rated at 246 litres/min and 1800 psi. The mud system is a trailer mounted 2 mud tank unit rated at 8000 litres complete with agitators and mixing hoppers. This system is used in conjunction with 3 earth settling pits. The BOP system comprises a Hydril GK 7-1/16" x 3K Annular (double acting) with a 5 bottle Sanyi Model FK 125-3, 3000psi, 3 station, Accumulator Unit with a 3 station remote driller's control panel.

3.1.2 Casing and equipment installed in or on the well including details of abandonment.

10" PVC casing was set and cemented at 10m.

7" 23 ppf K55 Ozcom Vam casing was set at 247m.

4 ½" 10.8 ppf 5LB Ozcom Vam casing was set at 523m.

3.1.3 Cementing operations carried out

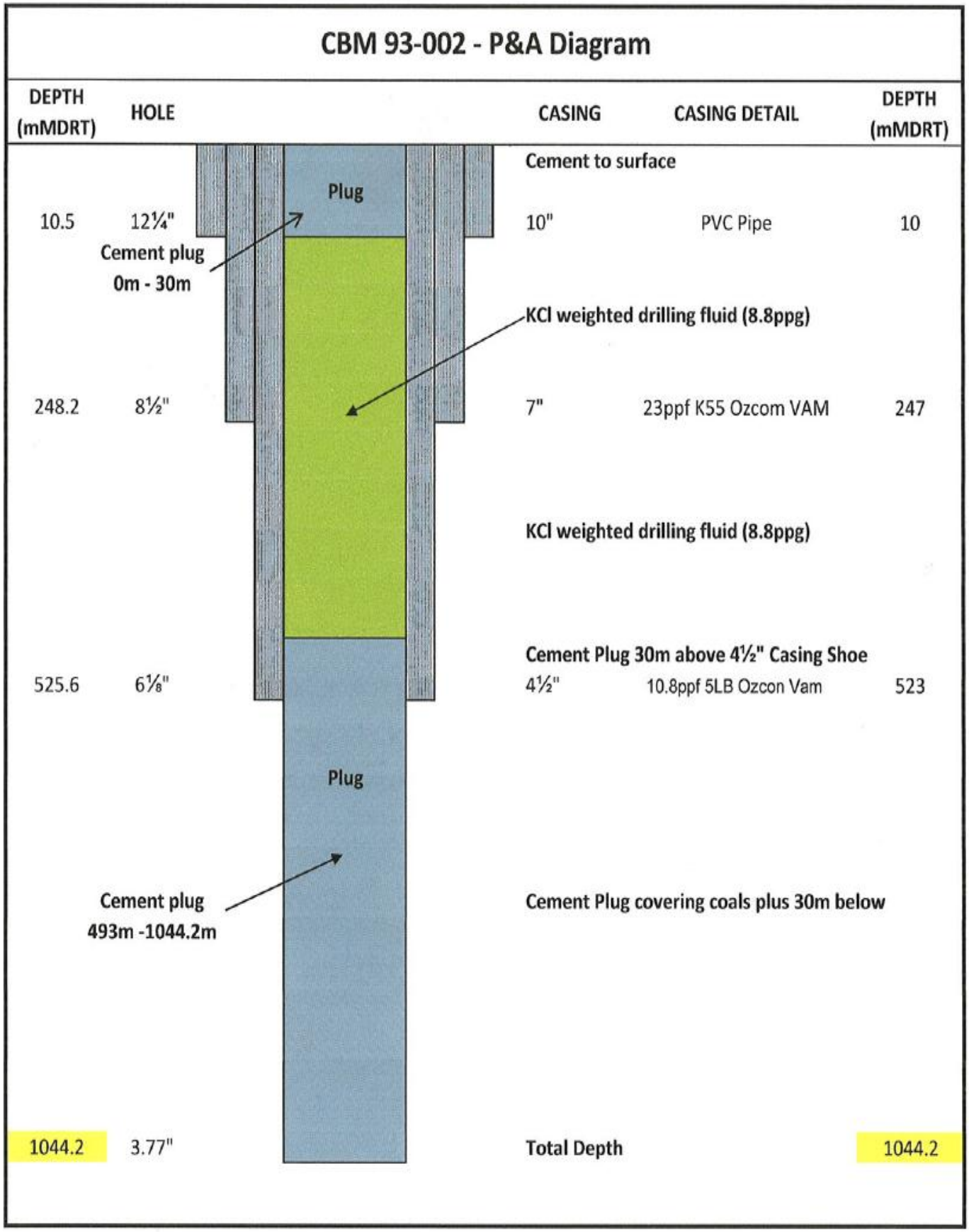
The surface hole was opened up to 12¼" from surface to 10.5m and 10" conductor pipe was run and cemented at 10m.

The 8 ½" hole was drilled from 10.5m to 248.2m and the 7" K55 casing was run and cemented at 247m.

The 6 1/8" hole was drilled from 248.2m to 525.6m and the 4 ½" casing was run and cemented at 523m.

The 3.78" hole was drilled from 525.6m to 1044.2m and a cement plug was set from 493m to 1044.2m. See figure 3 for the P&A diagram.

Figure 3: CBM 93-002 P&A diagram.



3.1.4 Bit Records

Comprehensive details of bit records and drilling parameters are contained within the IDS Final Well Report in Appendix 3.

3.1.5 Deviation Surveys

No surveys were conducted in CBM 93-002 and the hole is assumed to be vertical.

3.1.6 Drilling Fluids

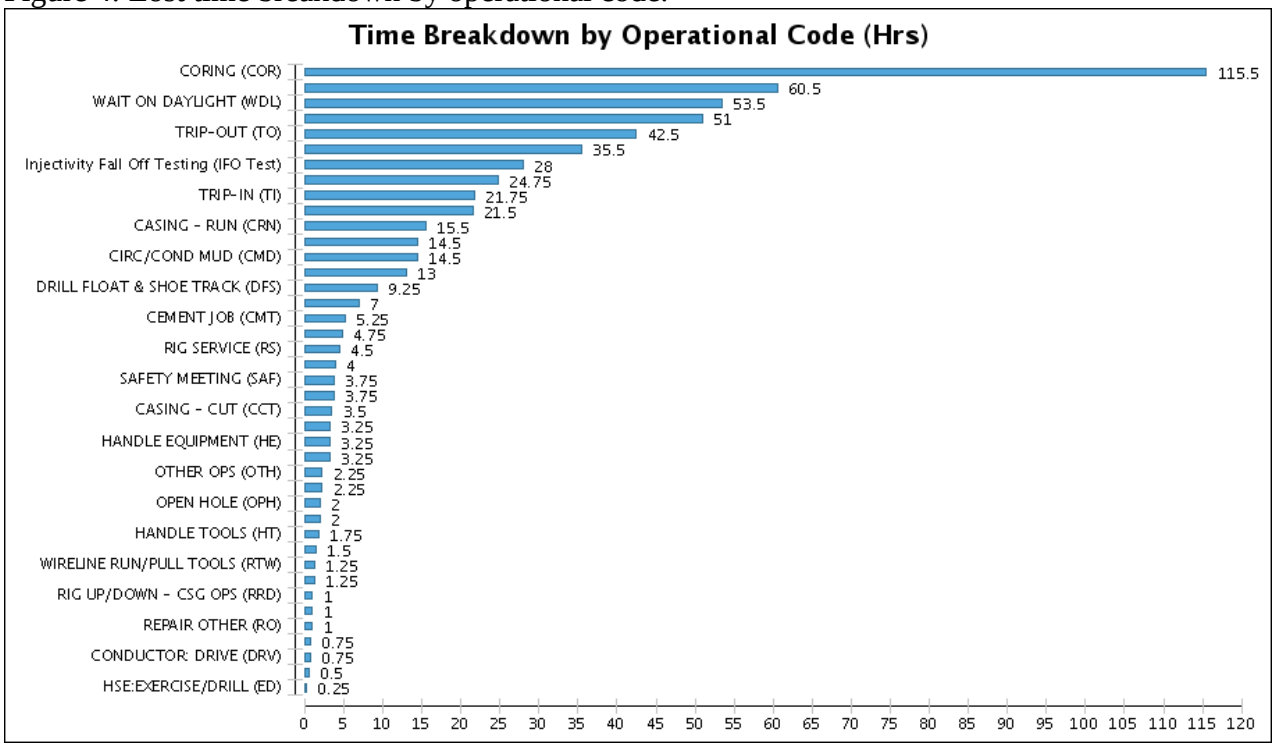
RMN Drilling Fluids were contracted to supply and maintain drilling fluids. After initially using gel water spud mud for the surface hole, a KCl/ Polymer mud system was utilized while drilling the 8.5" and 6 1/8" hole sections. A Gel, KCl, and CR 650 mud system was used for the coring section (528m to 1044.2m).

A drilling fluids recap (mud report) can be found in Appendix 7.

3.1.7 Lost Time

A breakdown of operational time and lost time is summarized in Figure 4 below. Further information on lost time during the drilling of CBM 93-002 can be found in the IDS Final Well Report in Appendix 3.

Figure 4: Lost time breakdown by operational code.



3.2 Water Supply

Water supply was sourced from the Old Andado bore for the camp water supply and the North Bore for the rig's water supply. Both bores are to the north of the CBM 93-002 well.

4.0 Logging, Sampling and Testing

4.1 Cuttings Samples Collected

Cuttings samples were collected and bagged at 6m intervals from 10m to 525.6m.

4.2 Coring

The well was continuously cored from 528m to Total Depth of 1044.2m. The Wallis D 39 drilling rig was a heavy duty coring rig well equipped to core and to recover cut cores with a wireline retrievable system. Core recovery was excellent for the majority of the cores; however, poor recovery was experienced in the Upper Purni Formation while coring friable argillaceous sandstone. Core no.1 only recovered 0.3m out of a possible 6m, core no.2 only recovered 2.1m out of a possible 6m, and core no.3 only recovered 3.7m out of a possible 6m core barrel.

A total of 89 coring runs were made and detailed records of these runs are contained in the IDS Final Well Report in Appendix 3 and within the Daily Geological Reports in Appendix 2.

Various samples of core were selected for Palynological, Petrological and Geochemical analyses, discussed below.

4.3 Mudlogging

Basic mudlogging services were provided by Weatherford (WFT), collecting and bagging samples and monitoring gas and drilling parameters. A mudlog was produced with lithological descriptions provided by the wellsite geologists. WFT also provided laboratory facilities for measurement of gas desorption of coal core samples. Results obtained were used to assess the gas potential of the Primary Objective, Purni Formation Coal measures.

4.4 Wireline Logging

Wireline logging services were provided by Weatherford.

Run No. 1 was the super combo (DLL-SLL-Sonic-Neutron-Density-GR-SP-Calliper (GR sonic from above 4½" casing shoe to surface), and it ran from 1038.5m to 5m.

During logging, the Super Combo tool failed, so the wireline engineers POOH to surface and rectified the problem by cycling the power to the tool. They then RIH and successfully completed run 1.

Run No. 2 was the checkshot survey, ran by SGS, which comprised of 27 shots from 1039m to 50m.

During Run No. 2, they encountered a problem, therefore they POOH to surface to inspect. They repaired the locking arm, RIH, and successfully completed all 27 checkshots from 1039m to 50m.

The entire logging program was completed in 16 hours.

The maximum bottom-hole temperature recorded was 75 degrees Celsius.

Wireline log data is included in Appendix 6 and the checkshot survey data in Appendix 10.

4.5 Vertical Seismic Profile

No Vertical seismic profiles were conducted.

4.6 Water Injection Falloff Tests

One Water Injection Fall Off test was conducted in the well. The test was conducted over the interval 701.5m to 712m, from 02/06/10 to 03/06/10, with an 8 hour injection at 3 l/min, and a 16 hour falloff. The test was carried out to measure coal permeability. The test was conducted using a wireline conveyed test tool with two flexible tubes run with the tool from the surface. One provided pressure to set the packer and the other pumped water into the coal seam being tested. On setting the packer a water injection phase of 8 hours commenced, followed by a falloff phase of 16 hours, during which the coal zone being tested relaxes back towards static formation pressure. From these pressure measurements, certain reservoir parameters of the coal zone (interest zone) can be deduced, in particular, coal permeability can be calculated. Reports on the results of these tests are included in Appendix 9.

4.7 Coal Desorption Sampling

Coal desorption sampling was carried out by Weatherford. A total of 89 coal samples were placed in desorption canisters and desorbed on site. Results are discussed in Section 5, Formation Evaluation and basic and interpreted data is included in Appendix 5.

5.0 Geology and Formation Evaluation

5.1 Regional Geological Setting and Discussion of the Prospect

The permits encompass four superimposed sedimentary basins, namely the Palaeozoic Warburton Basin, the Permo–Carboniferous Pedirka Basin, the Triassic Simpson Basin, and the Jurassic–Cretaceous Eromanga Basin, Figure 5 shows the structural elements of the Pedirka Basin.

Particular reference is made to the Permian Purni Coal Formation which thins in a northwest direction onto the Andado Shelf. It is this sequence, which is interpreted to be present in both permits and is the primary objective of the 2009/2010 CBM drilling campaign (Ambrose, 2007).

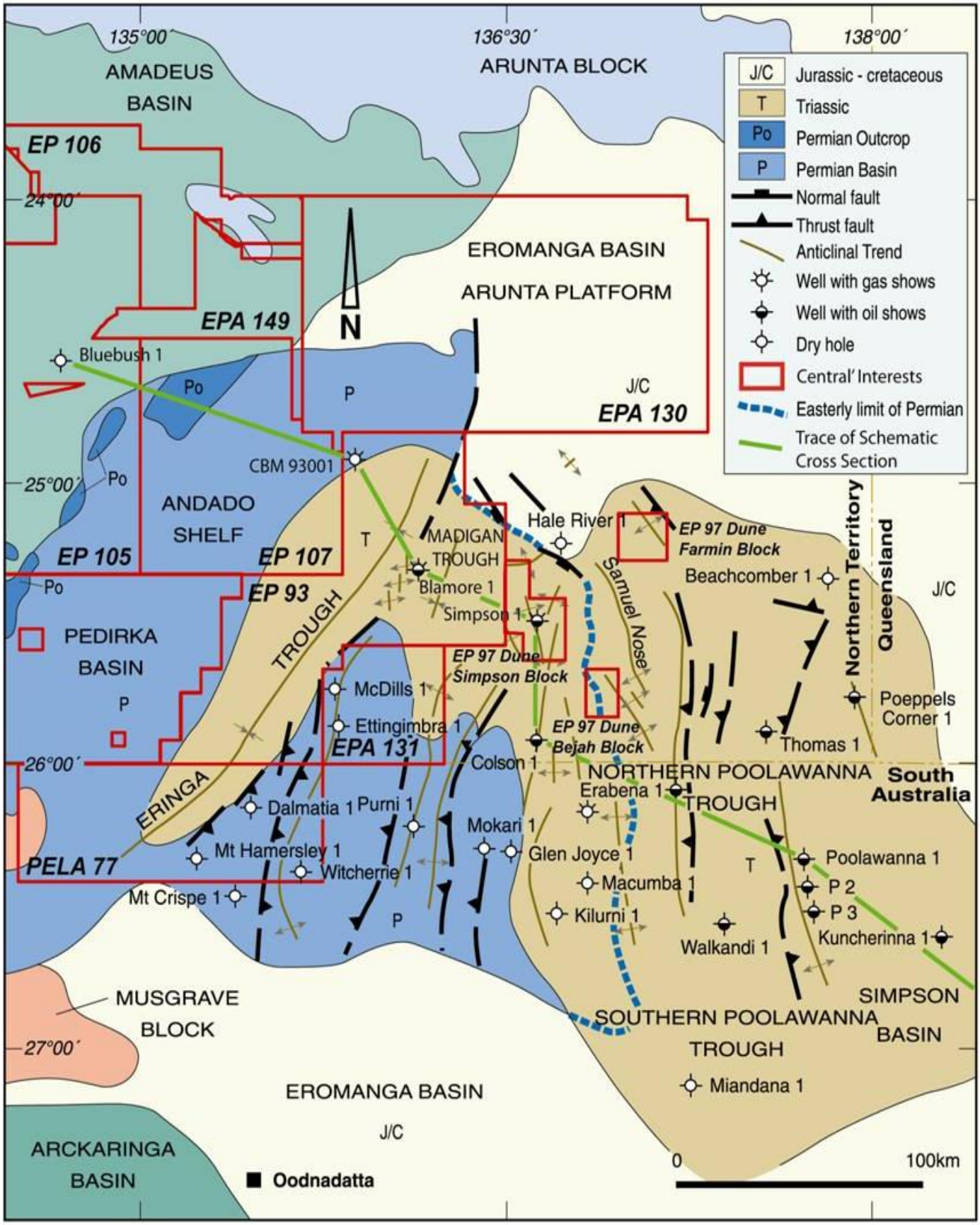
The sequence subdivision appears, based on limited data, to be valid on a regional scale and thick individual coal seams do have wide lateral continuity although they appear to split and condense fairly rapidly. The thicker coal seams on the Andado Shelf were deposited in high latitudes on Arctic style coal mire where periodic freezing, dry out phases, fires and refreezing took place. Maceral content is variable between mainly vitrinite (woody organic matter) and inertinite (charcoal). Oil prone liptinites average 5-10% and where mature these coals would provide good oil source rocks (Ambrose, 2007).

The thicker coal seams in the well, which are up to 15 m thick, show marked lateral continuity having been deposited via large scale cyclic sedimentation on the Andado Shelf. Sedimentation was largely allocyclic i.e. related to changes in cyclothemic deposition caused by factors such as climatic variation and changes in eustatic sea level. On a smaller scale, deposition of thinner peat mire coals was auto-cyclic and decoupled from the constraint of available accommodation space in the basin. Autocyclic sedimentation of clastics and thin coal seams within the subunits occurred via processes such as channel migration and river avulsion (Ambrose, 2007).

The CBM 93-002 well is located on the Andado Shelf, which is blanketed by a Permian sequence including coal measures containing up to 107.9m of coal in seams greater than 1 m thick. The nearest well to this location is CBM 107-001, which is located approximately 33 km to the southwest and intersected 134 m of coal. Ambrose (2011) has divided the coal sequence on a regional basis into 3 units, Units A, B and C. All 3 units were intersected in CBM 93-002, which intersected a total of 117.9m of coal, with significant coal developments in all three units.

Overall the well was a positive result and confirmed the presence of widespread coal seams in this general area. However the coals registered very low gas contents and future development will concentrate on coal stratigraphy exploration holes to define a resource for possible underground coal gasification and/or mining, as the coal bed methane resource appears minimal.

Figure 5: Pedirka Basin Structural Elements



5.2 Lithology and Formation Tops

Table 2 below shows the prognosed vs actual depths of the Formation Tops for CBM 93-002.

Table 2: CBM 93-002 predicted vs actual formation tops

Formation Tops CBM 93-002	Prognosed Depths		Final Depths		Difference High / Low To Prognosis
	(mKB)	(mSS)	(mKB)	(mSS)	
Eyre Fm	4	-155.3	4	-155.3	0
Winton Fm	60	-95.3	20	-139.3	40H
Mackunda Fm / Bulldog Shale	N/A	N/A	198	38.7	Not Prognosed
Cadna-owie Fm	484	324.7	291	131.7	193H
Algebuckina Ss	490	330.7	314	154.7	176H
Purni Fm	700	540.7	512	353.7	188H
Tirrawarra Sandstone Eq	N/A	N/A	971.5	812.2	Not Prognosed
Crown Point Fm	N/A	N/A	1032.9	873.6	Not Prognosed
Total Depth	1200	1040.7	1044.2	884.9	155.8H

5.2.1 Tertiary - Eyre Formation: 4m to 20m

Claystones and minor siliceous sandstone are assigned to the Tertiary Eyre Formation although they may simply represent a weathered top to the underlying Winton Formation. Claystones are orange, grading to yellow and red brown, with traces of limonite fragments. White fine to very fine sandstone is partly silicified and is identified as silcrete.

5.2.2 Winton Formation: 20m to 198m

The Winton Formation is a non-marine sequence of Early to Late Cretaceous age. In CBM 93-002 the sequence is dominated by medium to dark grey, predominantly soft to occasionally firm, non-calcareous claystone, rarely silty, with rare very fine sand grains, and rare specks of carbonaceous fragments and coal. In CBM 93-002, the claystone was generally as above, however, it occasionally graded to silty claystone and was interbedded with light grey, very fine to medium grained, slightly calcareous, glauconitic sandstone.

5.2.3 Mackunda Formation / Bulldog Shale: 198m to 291m

The MacKunda Formation is a marginal marine sequence of Early Cretaceous age. In CBM 93-002, the sequence is dominated by claystone, which is dark grey, with rare carbonaceous fragments and very fine disseminated glauconite grains, grading to mid to dark grey siltstone, with common disseminated fine glauconite grains. These are interbedded with light to mid grey, very fine to medium grained sandstone, with very common lithics and subrounded black glauconite grains, slightly calcareous (up to 40% calcareous, decreasing downwards), with trace off white limestone/calcite.

5.2.4 Cadna-Owie Formation: 291m to 314m

The Cadna-Owie Formation was distinguished by a positive drilling break at 297m (from 16m/hr to 43 m/hr), and the first appearance of fine sandstone, after the dominantly argillaceous assemblage of the Mackunda Formation. It was very thin and hard to separate from the below Algebuckina Sandstone whilst

drilling. Wireline logs display a slight decrease in gamma ray response and a significant increase in density and neutron response at this level.

In the cuttings, the sandstone is predominantly translucent to clear, and occasionally light grey, predominantly fine to occasionally medium and coarse grained, loose, moderately to well sorted, subrounded, occasionally subangular, with traces of pink and orange garnet, and yellow and yellow brown quartz, rare carbonaceous fragments, with excellent inferred porosity.

5.2.5 Algebuckina Sandstone: 314m to 512m

The Algebuckina Sandstone was picked by a positive fast drilling break from an average of approximately 15m/hr in the Cadna-Owie Formation to 65m/hr.

The Algebuckina Sandstone is a series of stacked braided fluvial sandstone beds, generally very coarse at the base, and fining upwards to medium grained. The sandstones are typically light or medium grey, loose, medium to very coarse, and subangular to angular. However, in CBM 93-002, the sandstone is clear, milky, trace light yellow or yellow brown, fine grained, generally very well sorted, rounded to sub rounded, with rare carbonaceous fragments. Although, from 410m to 415m, the sandstone becomes very coarse quartz grains, subangular to subrounded.

In addition, the samples from approximately 434m to at least 450m were affected by poor returns and poor samples due to the drilling problems fully described in 3.1 - Summary of drilling and related operations. From 450m to 512m the sample returns and sample quality improve. The sandstone from 450m to 512m is clear, milky, trace light yellow, light pink, and light brown, fine to medium grained, loose, trace dark grey claystone, light grey lithic fragments, pink garnet, and trace carbonaceous fragments and coal, mostly in the lower 30m.

5.2.6 Purni Formation: 512m to 971.5m

The Purni formation was picked by a reverse drilling break, approximately 5.5m above the first true Purni coal interval. There were no returns from 512m to 519m, and the lithology was first inferred to be claystone or argillaceous sandstone based on the drop in ROP, however, the wireline logs indicate sandstone, with possibly argillaceous sandstone from 512m to 514m.

The Permian part of the sequence in CBM 93-002 consists of stacked upward fining sequences of coarse to medium sandstones grading upwards to coals. The entire interval is identified with the Purni Formation and correlates well to similar intervals in CBM 93-001 and CBM 93-004.

The drilling of CBM 93-002 matched expectations in terms of coal thickness within the Purni Formation with a net cumulative coal thickness of 107.9m for coal seams greater than 1m thickness; with a total thickness of 117.3m for all coals including thin beds. The thickest coal seam was 14.4m.

The top of the Purni Formation was placed 5.5m above the uppermost coal seam. The sandstones of the Purni Formation differ significantly from those higher in the sequence, such as the Algebuckina Sandstone. The Purni Formation sandstones possess considerably higher gamma ray values and greater density (i.e. it is quite radioactively “hot” due to the possible presence of radioactive minerals such as feldspar and zircon), and the sandstones are considerably more compacted than the overlying Jurassic sandstones.

As in adjacent wells, the Purni Formation has been informally divided into the Upper Purni, with numerous thick coal seams, and a Lower Purni where coals are still present but are thinner and comprise a lower

proportion of the sequence. The boundary is transitional and arguable, but is here placed at the base of the coal at 828.4m. This pick could be reviewed after correlation with other wells.

Upper Purni Formation: 512m to 828.4m.

Palynological analysis of thin claystones, from the upper part of the sequence, indicates they were deposited in a lacustrine environment during the Late Permian (appendix 11). This age was assigned to four samples the deepest of which was 588.7m.

Further palynological analysis was carried out on samples from 634.8m to 940.7m. These samples, from thin beds of claystone deposited in a lacustrine environment, showed a distinct Early Permian palynozone.

The upper part of the Purni (512m – 828.4m) is typified by stacked sequences of light to medium grey, medium to coarse quartzose sandstones, in part very coarse, which grade up rapidly through fine sandstones, medium grey siltstones and dark grey, in part carbonaceous claystones to thick, quite uniform coals. The transition from medium to coarse sandstones to coal is thin, rarely more than 2m in thickness. The proportion of coal in this interval is high.

The lower sandstones in each upward fining unit show subtle and irregular variations in grain size but overall appear quite uniform. Occasional cross laminae are present, as are thin claystone laminae, sometimes carbonaceous, and laminae dominated by fine to medium carbonaceous fragments and muscovite. Ripped up coal fragments are sometimes present near the base, which is usually sharp and probably erosive into underlying coals. Occasional coal or coalified wood fragments may be present higher up.

The sandstones themselves are dominated by quartz, generally clear or white in the upper part, but becoming grey with depth. Rare dark grains of chert and black lithic fragments are present, pink garnet is occasionally common, particularly in finer bands, and yellow or orange quartz is present in trace amounts. White muscovitic mica is generally visible, and dark mica (biotite) occurs in trace amounts in the lower half.

Poor, to rarely fair, visual porosity is occasional present to a depth of 572.2m but for the most part intergranular spaces are filled with soft white kaolinitic clay, becoming a little firmer with depth and no porosity is evident.

In the transition from medium sandstone to coal, fine to very fine quartzose sandstones are thinly interbedded or interlaminated with siltstone and claystone, the proportion of sandstone decreasing upwards. Claystones are most common at the top, and become carbonaceous and often grade into the overlying coal. Plant fragments may be quite common on bedding planes below 706m.

Coals in the upper Purni are predominately very dark blackish brown to black and dull with occasional bright bands 2-3mm thick. They have a rough texture and may be quite porous. The detailed petrology of these and lower coals is described elsewhere. Cleat is visible only in the bright bands at intervals of 3-10mm, but vertical fractures are evident in most seams, usually as a single fracture through the core but occasionally two or three may be present.

With depth the coal is black, predominantly dull with bright bands, but often with common discontinuous bright laminae up to 10mm in length. On bedding planes these bright laminae look like wood chips, with a fibrous woody texture. Occasional fragments have more regular striations and have a reedy appearance. The

proportion of both bright bands and laminae increases gradually and irregularly with depth, but the coal is overall dull.

Lower Purni Formation: 828.4 to 971.5m

The Lower Purni is an informal term that seeks to define the sandstone predominant section with only few and generally thin coal seams. The lower part of the Purni is also typified by upward fining sequences but the coarser basal sandstones are thinner as are the coals at the top of each sequence, and the transition from sandstone to coal is thicker and more gradual. Leafy plant material is frequently present on bedding planes and the proportion of bright components in the coals increases downwards, such that the lower coals contain fairly equal proportions of bright and dull coal. Discontinuous bright laminae are more common, but still have the appearance of wood or rush fragments on bedding planes.

Basal sandstones in these predominantly upward fining sequences are usually similar to those in the upper part of the Purni, although a little finer overall. Quartz is white to grey in colour, and black lithic and carbonaceous fragments are a little more common. Pink garnet is still present in finer sandstones, but dark mica occurs in equal or sometimes greater amounts than muscovite.

White or light grey clay matrix is usually pervasive, and consists of varying proportions of softer white kaolinitic clay and more structured shiny light grey clay, often in booklets.

Below 828.4m interbedded siltstones and sandstone become more prevalent. The Sandstone is light grey, fine to very fine, and the siltstone is dark grey, interbedded and interlaminated, with minor cross laminations.

A variation of the sandstone is present below 847.5m. It is light to mid grey in colour and consists of coarse to medium grains of quartz and light grey feldspar. Accessories are the same as elsewhere, but the clay is usually white and soft. The rock itself is firm rather than hard, and can often be disaggregated by hand. Rare bands of sandstone to 30cm are friable and contain good visual porosity.

The coarser and more massive sandstones grade upwards to thinly bedded and laminated sequences of fine to very fine sandstone, siltstone and claystone, as in the upper part of the Purni Formation. In general grainsize and bed thickness both decrease upwards, with claystones becoming more carbonaceous and often, but not always, grading into coals of between 30cm and 6m thick, with the thicker coals occurring towards the top of the interval. In some cases coals are not present at the top of an upward fining sequence, but while the base of the overlying sandstone is usually sharp, it is difficult to tell whether the coals are absent because of erosion or non-deposition.

In the upper part of the lower Purni, plant fragments may be quite common on bedding planes, and include *Gangamopteris* and possibly *Glossopteris* leaves, plus indeterminate stems and thin branched fragments. The plant fragments become rarer with depth.

5.2.7 Tirrawarra Sandstone Equivalent: 971.5m to 1032.9m

The Tirrawarra Sandstone equivalent in the Pedirka Basin area consists of glacial outwash sandstones at the base of the Purni Formation, displaying both fining upward and coarsening upward sequences. The sandstone is characteristically thick in the adjacent Cooper Basin. However, it is much thinner in the Pedirka Basin (at least in EP93 and EP 97), and both interfingers with and conformably overlies glacio-lacustrine diamictites and varvites of the Late Carboniferous-Early Permian Crown Point Formation (Merrimelia Formation in the Cooper Basin). The Tirrawarra Sandstone is interpreted as being deposited in

a glacio-fluvial braided river/glacial outwash environment. The Early Permian Purni Formation/Tirrawarra Sandstone source/reservoir couplet is correlated with the prolific Patchawarra/Tirrawarra petroleum system in the Cooper Basin (Ambrose and Heugh, 2010).

The onset of Tirrawarra Sandstone deposition is marked by influx of felspathic sandstone and the cessation of coal deposition. In general, the sandstone is feldspar-rich, medium grained to conglomeratic, massive to cross-bedded, kaolinitic, with occasional carbonaceous interbeds. The upper member consists of palludal/floodplain deposits, comprising very fine to fine grained carbonaceous sandstone and interbedded siltstone, shale and coal (Ambrose and Heugh, 2010).

In CBM 93-002, from 971.5m to 990.5m the sandstone is very light grey, quartzose, grading slightly from medium to fine grained at the base, with subrounded to subangular grains, becoming more rounded with depth, and well sorted. Bedding is very uniform apart from weak cross lamination and rare claystone laminae. The sandstone displays poor to good visual porosity, and good permeability indicated by mud penetration (mudcake build up).

From 990.5m to 997.13m the sandstone becomes well sorted, decreasingly well sorted with depth, the grains become rounded to subrounded, and the base is conglomeratic, with rounded pebbles up to 3cm big (indurated sedimentary and low grade metamorphics). The sandstone displays good visual porosity and very good apparent permeability at this depth.

From 997.13 to 1032.9m the sandstone sequence indicates upward fining, and pebbles become rare. It also becomes coarser towards the base, with occasional bands of grit to pebble conglomerate with clasts less than 1cm big. The basal 1.5m of the sandstone includes beds of boulder conglomerate, with one quartzite boulder up to 0.5m in size.

No Hydrocarbon shows were recorded in the Tirrawarra Sandstone.

5.2.8 Crown Point Formation: 1032.9m to 1044.2m Total Depth

The basal Permian unit is a predominantly glacial succession, consisting of extensive diamictite, glacial-fluvial outwash, ripple-laminated sandstone and siltstone, and thick shale and varved successions. Coarse sandstone, conglomerate and diamictite are common around palaeo-highs, whereas basinal areas focussed shale and varve sedimentation (Ambrose and Heugh, 2010).

The Crown Point Formation in CBM 93-002 was picked from the first appearance of predominant diamictite. The diamictite is mid to dark grey, with a sandstone matrix. It is poorly sorted with scattered hard and uniform pebbles, mostly less than 2cm in diameter, with a few pebbles up to 12cm in diameter.

5.3 Hydrocarbon Indications and Sample Analysis

5.3.1 Hydrocarbon shows

No hydrocarbon shows were recorded. However, tiny gas bubbles were observed on the surface of coal around 702m. In addition, very rare dark brown material was noted in some sections in the upper Tirrawarra Sandstone, however, the sandstone showed no fluorescence.

5.3.2 Gas detection whilst drilling

10 – 25m: Total gas and background gas was 100 ppm. These gas readings were probably from machinery or ambient gas.

25 – 124m: Total gas and background gas was 100 ppm. Only the background gas was being recorded. CO2 was up to 4 units.

124 – 181m: Total gas and background gas was 200 ppm. Only the background gas was being recorded. Maximum gas was 3 units (300 ppm) at 181m. CO2 was up to 5 units.

181 – 248.2m: Total gas and background gas was 300 ppm. Only the background gas was being recorded. Maximum gas was 3 units (300 ppm) at 242m. CO2 was up to 6 units.

288 – 301m: Total gas and background gas was 100 ppm. These gas readings were probably from machinery or ambient gas. CO2 was up to 4 units.

408 – 434m: Total gas was 400 ppm and background gas was 200 ppm. Maximum gas was 4 units (400 ppm) at 427m. CO2 was up to 2 units. No C1 or C2 was recorded, so the gas readings were probably exhaust contamination.

535 – 560m: Total gas was 300 ppm and background gas was 50 ppm. Maximum gas was 4.5 units at 546m. No C1 or C2 was recorded, so the gas readings were probably exhaust contamination. A gas sample was then taken from the possum belly and gave a total gas reading of 200 ppm and background gas was 50 ppm.

590 – 604m: Total gas was 1500 ppm and background gas was 300 ppm whilst drilling in dull coal with common intermittent bright laminae. C1 ranged from 2 to 74 ppm, and C2 ranged from 0-16 ppm.

638 – 646m: Total gas was 1800 ppm and the background gas was 500 ppm whilst drilling in coal with bright intervals and occasional oblique fractures healed with pyrite.

664 – 712m: Total gas was 4600 ppm and the background gas was 2600 ppm whilst drilling upwards fining sandstone. The maximum gas reading was 52 units at 687m. However, the gas system was not fully operational, as CO2 was reading 150 – 180 ppm throughout the interval. Nevertheless, tiny gas bubbles were observed on the surface of coal below 702m. C1 ranged from 13-37 ppm, and C2 ranged from 1-3 ppm. However, desorption report (Appendix 5) gives a very low raw desorbed gas value of 0.01 scc/g for coal samples number 36 to 45 (702.2 – 712.2m). This indicates that the gas system was not truly functional and that, instead, it was giving spurious readings.

736.2 – 742.2m: Total gas was 1000 ppm and background gas was 200 ppm whilst drilling in hard, dull coal, with occasional bright bands and weak vertical fractures (with one 15cm pyrite concretion noted), grading to carbonaceous claystone in part, particularly in the upper 1.5m. The maximum gas reading was 22 units at 736m. CO2 was 224ppm background whether circulating or not.

742 – 856m: Total gas was 1100 ppm and background gas was 600 ppm whilst drilling in sandstone. C1 ranged from 4 – 10 ppm, and C2 ranged from 0 – 1 ppm. CO2 was 220ppm background.

874.2 – 880.2m: Total gas was 3000 ppm and background gas was 1600 ppm whilst drilling bright banded coal. C1 ranged from 3-11 ppm, and C2 ranged from 0-2 ppm. CO2 was 232ppm background. However, the core desorption report (Appendix 5) gives a very low raw desorbed gas value of 0.05 scc/g for coal core sample 72 (876.55 – 877.55m) and 0.04 scc/g for coal core sample 73 (877.55 – 878.55m). This indicates that the gas system was not truly functional and that, instead, it was giving spurious readings.

940.2 – 946.2m: It was noted that C1 and total gas was increasing below 935m. The total gas for this interval was the highest reading for the well at 7900 ppm, with a background gas value of 1600 ppm. The maximum peak gas was 78 units at 941.5m. C1 ranged from 2-11 ppm, and C2 ranged from 0-2 ppm. Background CO2 was 211 ppm. These readings occurred whilst drilling light grey, medium to coarse grained sandstone, with occasional very coarse bands and rare laminated carbonaceous zones. The sandstone was also interbedded and interlaminated with dark grey, occasionally discontinuous siltstone laminae (up to 60%), with scattered clasts of ripped up sediment. Unfortunately, the last core desorption sample was taken from 899.62 to 900.62m.

982.2 – 988.2mm: The total gas reading was 5700 ppm, with a background gas reading of 700 ppm. C1 ranged from 1-10 ppm, and C2 ranged from 0-1 ppm. Background CO2 was 230 ppm. These readings occurred whilst drilling the Tirrawarra Sandstone. The sandstone was very light grey, quartzose, grading slightly from medium grained to fine grained, the grains were subrounded to subangular, becoming more rounded with depth, and well sorted. In general the sandstone was very uniform, except for weak cross laminations and rare claystone laminae. The sandstone displayed poor to good visual porosity, and good permeability shown by mud penetration into the core.

5.4 Source Rock analysis

Numerous coal samples were evaluated for Maceral composition and Vitrinite Reflectance; and others were subjected to Rockeval Pyrolysis. These results are not discussed in great detail herein. However, the results deserve to be considered in a regional sense, in particular in considering the oil generative potential of the Purni Formation Coals in the deeper more thermally mature part of the Madigan Trough. CBM 93-002 is located west of the Madigan Trough in an area where the Purni Formation coals have never been deeply buried as demonstrated by low Vitrinite Reflectance values. The analyses of coal samples are included in Appendix 12.

6.0 References

Ambrose, G., 2007. The Petroleum Geology of the Simpson Desert Area: The Eromanga, Simpson and Pedirka Basins. Abstract presented at the Northern Territory AGES symposium 2007.

Ambrose, G.J. and Heugh, 2010: The Petroleum Geology of the Simpson Desert Area: The Eromanga, Simpson, Pedirka and Warburton Basins. Central Petroleum Unpublished Report (45 pp).

Ambrose, G.J., 2011. Pedirka Basin Coal Geoscience, Central Petroleum Unpublished Report (23 pp).