PACIFIC OIL & GAS PTY LIMITED

PHILLIP NO.1 & NO.2

EP 10. GEORGINA BASIN, N.T.

WELL COMPLETION REPORT

ONSHORE

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DATE: May, 1989

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ACCEPTED BY:

COPIES TO: N.T. Mines Department
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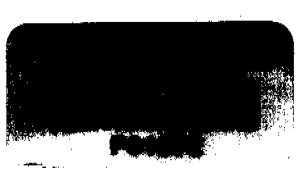
CRAE Report No. 303527



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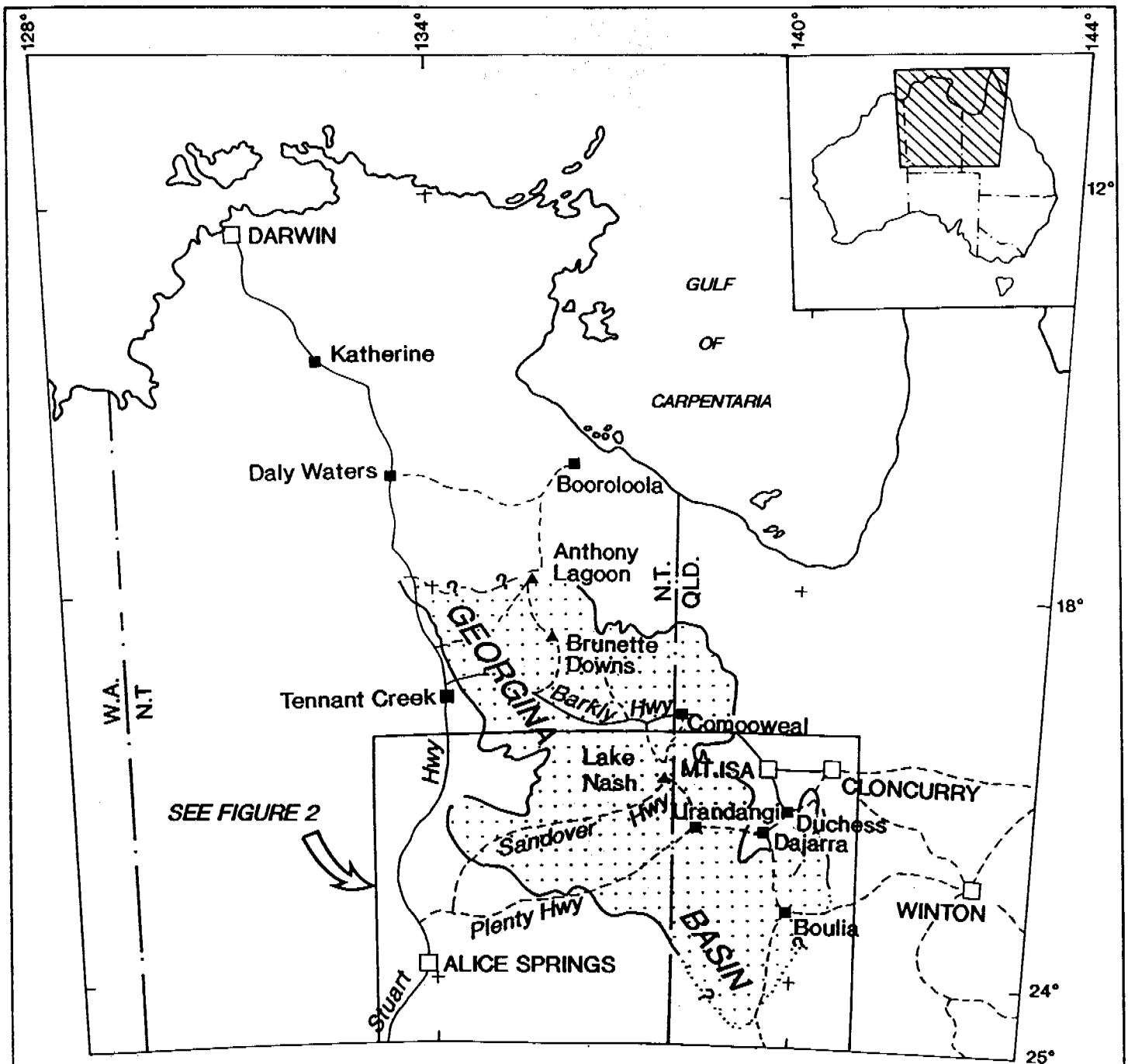


GEORGINA BASIN

Location and access roads

Figure 1

Pacific Oil & Gas Plan No. PetNTcw 589

1. SUMMARY

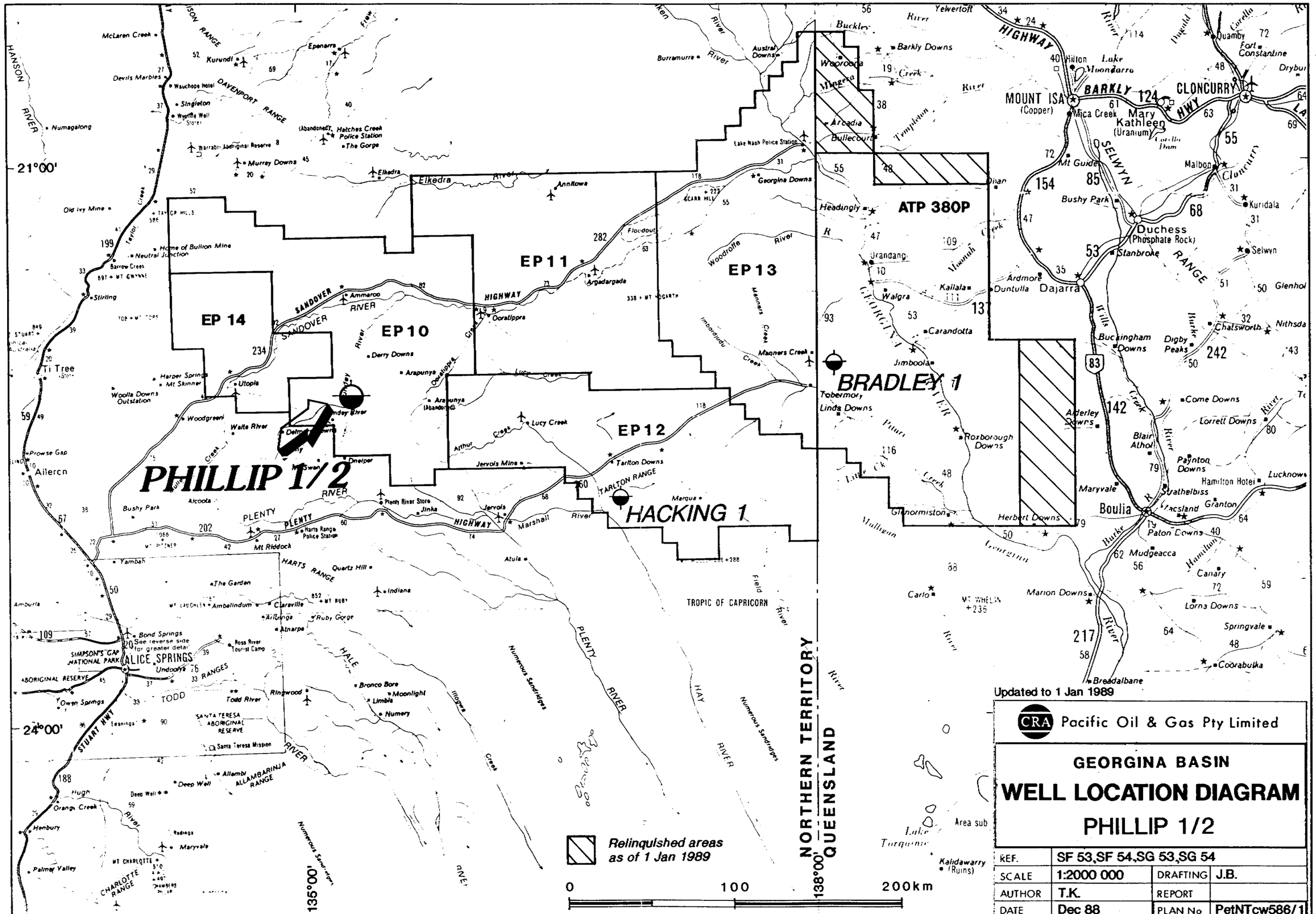
This report covers the drilling of two wells at the one location, Phillip No 1 which was lost and abandoned due to technical drilling problems and its redrill, Phillip No 2. The main text of the report covers Phillip No 2 and details of Phillip No 1 are confined to Appendix XIV and the enclosures.

Phillip No 2 was the first deep stratigraphic test well drilled by Pacific Oil and Gas Pty Limited in the Georgina Basin. It was the first of three such tests which comprised the Company's 1988 drilling programme in the basin. The other two wells drilled were Bradley No 1 (in ATP380P, Queensland) and Hacking No 1 (in EP12, Northern Territory).

The Phillip location was chosen close to a basement high indicated by NTGS borehole Elk-6, to test the facies change between shoal and sabkha evaporites of the Chabalowe Formation and the subtidal silty carbonates of the Arthur Creek Formation. The well site was also chosen to help determine the northwesterly extent of source rocks in the Arthur Creek Formation, along the axis of the Dulcie Syncline. The reservoir-seal relationships between the lower Arrinthrunga Formation and the overlying Eurowie Sandstone Member were also of interest. Primary objectives of Phillip No 1 and Phillip No 2 were reservoirs in lower Arrinthrunga Formation, lower Chabalowe Formation and Red Heart Dolomite.

Being an early stratigraphic test, drilled prior to any seismic surveying, the Phillip location was chosen from interpretations of magnetic and gravity data. Phillip No 1 and 2 are located approximately 210 km northeast of Alice Springs in EP 10 (see figure 2) on Derry Downs Pastoral Lease.

Phillip No 1 was precollar drilled to 123m by Gorey & Cole Drillers Rig 3 from the 14th to the 20th April, 1988. Rockdril Rig 20 re-entered the precollar and commenced drilling on the 25th April, 1988. 7" casing was run in 81/2" hole to 119.16m and cemented to surface. BOP's were nippled up and 57/8" hole drilled to 586m in the uppermost Arrinthrunga Formation on the 2nd May when a major mechanical breakdown on the rig prevented rotation of the drill string which became irretrievably stuck in the hole. Numerous attempts to free the string failed and abandonment commenced on the 9th of May.


PHILLIP 1/2
BRADLEY 1
HACKING 1
EP 14
EP10
EP11
EP12
EP13
ATP 380P
21°00'
24°00'
135°00'
138°00'
NORTHERN TERRITORY
QUEENSLAND
TROPIC OF CAPRICORN
ALICE SPRINGS
MOUNT ISA
(Copper)
CLONCURRY
Duchess
(Phosphate Rock)
Kathleen
(Uranium)
Dajarra
Boulia
Ti Tree
Ailercn
Elkedra
Elkedra River
Plenty River
Sandover River
Stuart Hwy
Barkly Highway
Selwyn Range
Davenport Range
Hanson River
Harts Range
Plenty Highway
Sandover Highway
Tarlton Range
Allambarinja Range
Todd Ranges
Hale River
Hay River
Georgina River
Diamantina River
Burke River
Wills River
Numerous Sandridges
Simpson Desert
Lake Nash Police Station
Harts Range Police Station
Plenty River Store
Bond Springs
See reverse side for greater detail
Relinquished areas as of 1 Jan 1989
0 100 200km
Updated to 1 Jan 1989
CRA Pacific Oil & Gas Pty Limited
GEORGINA BASIN
WELL LOCATION DIAGRAM
PHILLIP 1/2
REF. SF 53,SF 54,SG 53,SG 54
SCALE 1:2000 000
DRAFTING J.B.
AUTHOR T.K.
REPORT
DATE Dec 88
PLAN No PetNTcw586/1

Plugs were set at 360-340m, 150-110m and 11-1.5m and the rig was moved 12.5m magnetic north to drill Phillip No 2.

Phillip No 2 was spudded on the 17th May, 1988. 95/8" steel casing was set in 121/4" hole at 34.0m and 7" casing set in 81/2" hole at 88.14m. BOP's were nippled up and 6" hole drilled to 685m and 5" casing set following wireline logging. 4.35" coring was then carried out to TD at 1493.1m, reached on the 22nd June, 1988. Following wireline logging and testing, plugs were set at 1300-1350m, 1100-1150m, 650-700m, 110-70m and 4-14m. Abandonment was completed on the 29th June, 1988.

Phillip No 2 was spudded in alluvium on Upper Devonian Dulcie Sandstone and intersected the Late Cambrian-Early Ordovician Tomahawk Beds, the late Cambrian Arrinthrunga Formation (including the Eurowie Sandstone Member), the Chabalowe and Arthur Creek formations, the Early Cambrian Red Heart Dolomite, and Late Proterozoic sediments. Granitic basement was intersected at 1489.1m.

Although no hydrocarbons flowed, this stratigraphic well met its objectives by obtaining fully cored sections through the target formations. Minor oil shows were observed in porous grainstones and sandstones in the lower Arrinthrunga Formation and in the Chabalowe Formation. Very minor oil shows were observed in the Arthur Creek Formation. Visible porosity was generally absent to low, and was generally secondary in carbonates. DST 1 at 1309.7m failed and DST 2 (1346-1493m) although plugged with mudcake, recovered water.

2. GENERAL DATA

2.1 Permit EP 10 NT

2.2 Permit Holder and Operator

Pacific Oil & Gas Pty Limited 100%
826 Whitehorse Road, Box Hill, VIC 3128

2.3 Location and Evaluation

Map Sheet	HUCKITTA 1:250 000 SF 53-11 McDONALD DOWNS 1:100 000 5953
Latitude	22o 15' 58.62"
Longitude	135o 16' 17.86"
Elevation	424.4m AHD GL 426.9m AHD RT
AMG Co-ordinates (Zone 53)	Northing 7 537 665.0 M Easting 527 985.2 M

The location was measured by conventional land surveying methods during the Bundey River Seismic Survey and was derived from nearby Government survey points to an accuracy of ± 1m.

The unsuccessful Phillip No 1 drill hole is located 12.5m magnetic south of this location.

The well location is shown on Figure 2.

2.4 Well Type

Deep stratigraphic test

2.5 Objectives

Primary:	lower Arrinthrunga Formation lower Chabalowe Formation Red Heart Dolomite
Secondary:	Arthur Creek Formation

2.6 Dates and Duration

Spudded	0915 hrs on 17/5/88
Reached TD	0215 hrs on 22/6/88
Plugged and Abandoned	1700 hrs on 29/6/88
Spud to TD	34.7 Days
Spud to P & A	43.3 Days
Down time	2.0 Days

(Note: down time is time spent on other than programmed operations).

2.7 Total Depth/Status

Total Depth	1493.1m RT
Status	Plugged and abandoned as a dry hole

2.8 Water Supply

Water was supplied from a water bore drilled specifically for the project. Detailed data is included in Appendix VI of this report.

2.9 Principal Contractors

Precollar/water bore drilling	Gorey & Cole Drillers
Rotary and Core drilling	Rockdril Contractors Pty Ltd
Drillstem testing	Aust DST Pty Limited
Mud Chemicals	Milpark Aust Pty Ltd
Wireline Logging	BPB Instruments Pty Ltd
Mudlogging	Gearhart Geodata Pty Ltd
Velocity Survey	Velocity Data Pty Ltd

Rig details are included in Appendix V

2.10 Well Cost (for Phillip No 1 and 2)

Drilling contractors	$580 342
Others (vehicle operations, payroll, analyses, etc.)	$ 54 073
Total	$634 415

3. DRILLING

3.1 Drilling Summary

Phillip No 2 was spudded on 17 May 1988 after attempts to salvage the drillstring from Phillip No 1 proved unsuccessful. Rockdril Rig 20 was relocated 12.5m magnetic north of the original location. Precollaring was performed by Rig 20.

The hole was spudded with a 151/2" auger and drilled to 6.5mRT and a 133/8" steel conductor cemented. 121/4" hole was drilled to 34m and 3 joints of 95/8" steel casing were cemented to surface. The 81/2" drilling asembly was picked up and 81/2" hole drilled to 89m. A spud mud of Rapidgel with a viscosity of 44 sec was used to prevent rod rattle. 7 joints of 7" casing were run to 88.14m and cemented to surface with Class A, 15.6 ppg slurry. The wellhead and blow-out preventers were nippled up and tested to 1500 PSI. The annular BOP was tested to 1000

PSI. Pressures were held for 10 minutes. The 6" rotary drilling assembly was picked up, the cement shoe and 2m of new formation drilled out, and a leak-off test was carried out. Leak-off occurred at 100 PSI, equivalent to a mud weight of 14.6ppg.

6" hole was drilled to 240m where the mud system was displaced from bentonite-CMC to Newdrill-CMC. 6" hole was drilled to the 5" casing point at 685mDF. Wireline logs were run as detailed in section 4.2. The casing was cemented up to 400m. The cement shoe and 2m of new formation were cored and a leak-off test was performed. No leak-off was recorded at 510 PSI, giving a minimum formation strength of 12.8 ppg EMW. CHD 101 coring in 4.35" hole continued to 1309.7m where DST No 1 was carried out. The test was a misrun due to a mis-assembled testing string and washed out drill pipe. Coring continued to TD 1493.1m. After wireline logging an attempt was made to set cement plugs to re-test the interval of DST No 1. The cement could not be made to go off. DST No 2 was carried out over the interval 1346 - 1493.1m. 18m of water was recovered from the drill pipe but the tool became plugged with mudcake during the test. Pressure information recovered was not useable.

The 5" casing was cut at 350m and recovered. The hole was then plugged and abandoned. Abandonment details are provided in Appendix IV.

3.2 Drilling Rigs

(i) Waterbore/Precollar drilling :
Gorey & Cole Rig 3, Ingersoll-Rand TH60
Airhammer/foam

(ii) Rotary/cored section:
Rockdril Rig 20
Longyear 600 Coremaster
full rig details are provided in Appendix V.

3.3 Drilling Method

Drilling parameters by depth are provided in Appendix II.

3.4 Hole Size, Depth & Casing Details

Hole Size	151/2"	121/4"	81/2"	6"	4.35"
Depth (mDF)	6.5	34	89	685	1493.1
Casing Size	133/8"	95/8"	7"	5"	-
Type	BTC	BTC	8 RND	FL 45	-
Weight ppf	68	36	26	13	-
Grade	K55	K55	K55	K55	-
Depth (mDF)	6.5	34	88.14	683	-

3.5 Drilling Fluids

A Bentonite mud system was utilised from surface to a depth of 240m. Soda ash was used to combat water hardness. At 240m the mud system was displaced to Newdrill-New Vis-CMC with a water spacer. Mud properties specified were:

Weight < 9.0 ppg
Viscosity > 36 secs
WL < 12 ml over target formations.

During the 4.35" cored section a viscosity greater that 40 sec was required to prevent rod-rattle.

Daily mud properties and consumption are included as Appendix III.

3.6 Surveys

Hole deviation was measured using a Eastman camera. Specified maximum deviation was 5o. The following deviations were recorded:

165m	13/4o	339m	31/2o	504m	2o
224	4o	369	2o	636	11/2o
236	31/4o	400	1o	741	1o
276	31/4o	430	13/4o	919	1/2o
309	31/4o	465	21/4o	1138	1/2o

4. FORMATION EVALUATION

4.1 Mudlogging

During rotary drilling cutting samples were examined for hydrocarbon fluorescence and described every 2m. Ditch gas values, and C1-C5 breakdowns were monitored continuously with a Carlo Erba 4200 Flame ionisation device. H2S was monitored continuously. 2x samplex tray samples, 2x washed and dried cuttings and 2x unwashed cuttings, were preserved for future analysis. One set will be forwarded to the Northern Territory Department of Mines and Energy.

During CHD 101 coring gas was monitored continuously and core was described and examined for porosity and hydrocarbon fluorescence as it was recovered. A chip sample was taken from core every 2m and preserved in samplex trays. A mudlog at 1:500 scale (Enclosure II) was updated continuously.

4.2 Wireline Logging

Wireline logs were run at intermediate casing depth and at TD. Field tapes of logs were later processed and played back at 1:200 and 1:500 scale in BPB's Brisbane office, and a 1:1000 composite log produced. Final composite log disply was produced at 1: 500 scale by Encom Technology Pty Ltd. Log plots are included as Enclosure III.

Suite 1

Log	Interval	Scale	BHToC	Elapsed time(hrs)
SONIC (SN1)	685 - 88m	1:500	45oC	4.00
GR-DENS-CAL(DD3)	685 - 2.5m	1:500	45oC	8.00
SP	685 - 88m	1:500	45oC	14.00

2 hours time was lost due to downhole failure of the GR-DENS-CAL (DD3) Sonde, and the dual resistivity (DFE) sonde. The resistivity sonde could not be repaired, preventing acquisition of resistivity data on this run.

Suite 2

Log	Interval	Scale	BHTOC	TALC
SP	1493 - 685m	1:500	70o	8:45
GR-DENS (DD3)	1489 - 685	1:500	70o	21:00
NEUTRON (NN1)	1488 - 685	1:500	70o	28:00

DIPMETER	1380 - 1130	1:500	70o	31:15
DUAL RES (DFE)	1487 - 685	1:500	70o	39:15
SONIC 1 (SN1)	1380 - 685	1:500	70o	56:45
SONIC 2 (SN1)	1489 - 1380	1:500	70o	72:00
VELOCITY	1487 - 25			

Time Lost During Logging.

Suite 1
41/2 hours was lost while waiting on logger to arrive at wellsite. A further 12 hours was lost when the DFE (Dual Focus Resistivity) sonde had to be re-run as the depth calibration was lost while RIH. The tool failed while logging and was re-run later in the programme.

Suite 2
The sonic tool was found to be faulty at surface. A replacement tool was brought in and two sonic runs were made. Sonic run 1 was performed while waiting on cement prior to DST No 1. Sonic run 2 was performed after the failed cement plug had been circulated out of the hole.

4.3 Drill Stem Testing

Two DST's were carried out using conventional bottom hole testing equipment run on CHD 101 drill pipe. DST No 1, 1222-1309.7m failed to provide useable pressure information due to the mis-assembly of the DST tools, however 0.2 BBls of water was recovered from the tool sample chamber. DST No 2, 1346-1493.1m failed due to blocking of tool ports by mudcake. 0.8 BBls of water were recovered. Water analyses are provided in Appendix X.

Problems encountered during testing were:

a. difficulty in applying sufficient weight to activate the tool within a reasonable time;

b. the failure of CHD pipe threads in compression;

c. the collection of large quanitities of mudcake around the packers while running in the hole.

5. GEOLOGY

5.1 Geological Summary

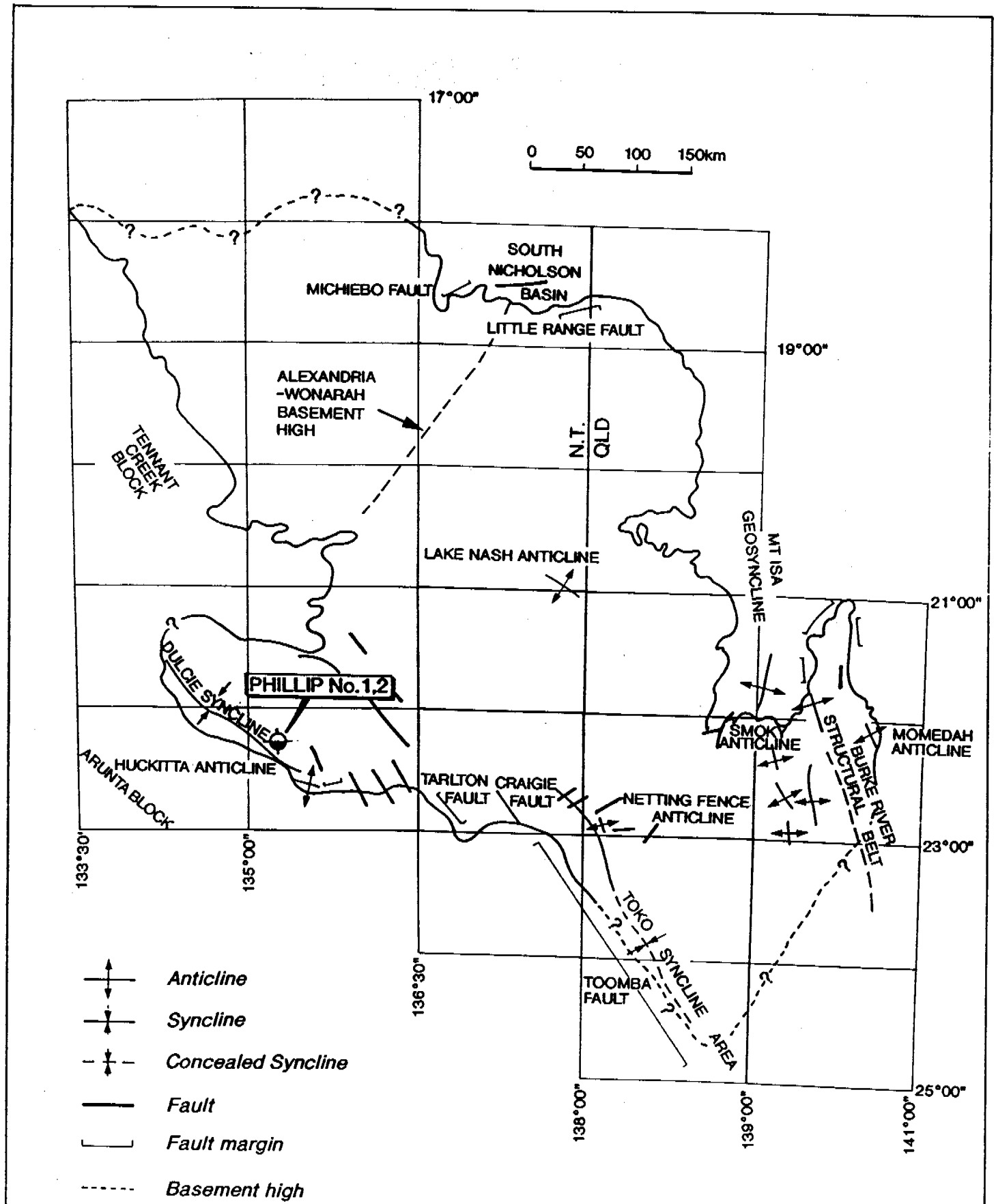
The Phillip No 2 stratigraphic well was drilled following the loss of Phillip No 1 due to technical problems. The objectives of the well were to test for reservoir rocks in the Cambrian sequence of the Georgina Basin, and to help establish the extent of source rocks in the middle Cambrian Arthur Creek Formation.

The well was precollared in the Dulcie Sandstone. Water flow rates from the Dulcie Sandstone whilst precollaring Phillip No 1 exceeded 100 000 gph. This unit unconformably overlies the Cambro-Ordovician Tomahawk Beds. No evidence of hydrocarbons was detected above the base of the Tomahawk Beds.

The eroded top of the Early to Middle Cambrian section occurs as an abrupt change to recrystallised silty dolomite of the upper Arrinthrunga Formation. The 7" casing was set in the upper part of the Arrinthrunga Formation and the remainder of the well was cored.

The Eurowie Sandstone member, the middle unit of the Arrinthrunga Formation, consisted of metre scale stringers of tight sandstone, interbedded with carbonate and red and green shales. The top of the lower Arrinthrunga Formation is defined by the disappearance of clastic sediments and the appearance of high energy carbonates and oolites. The carbonates are commonly dolomitised and recrystallised, and are generally non-porous. Rare instances of fine solution channels occur in ooid grainstones and intergranular porosity occurs in sandstone stringers. A small oil show was encountered over a 0.5m interval of solution porosity in an ooid grainstone.

The Arrinthrunga Formation dolomites grade downward into thinly bedded shales, siltstones and limestones of the Chabalowe Formation. Anhydrite becomes increasingly common toward the base. The Hagen Member of the Chabalowe Formation contains minor bedded anhydrite cemented sandstones and bands and nodules of chert. Intercrystalline microporosity is common in the anhydritic beds and numerous oil saturated intervals were encountered. Measured porosity and permeability is very poor. The lowermost unit of the Chabalowe Formation consists of a lagoonal facies with occasional partly silicified stomatolites interbedded with calcilutites,



GEORGINA BASIN
Main structural features

(After Draper et al., 1978)

Pacific Oil & Gas Plan No.3046

overlying a thin quartz siltstone. Oil bled from fenestral porosity associated with stromalites.

The Chabalowe Formation conformably overlies the open marine facies of the Arthur Creek Formation. Porosity is completely occluded by stylolite formation and by late stage anhydrite deposition in intergranular and solution cavities. The base of the Arthur Creek Formation is marked by a thin white intraclast grainstone with primary porosity almost totally occluded by clear crystalline anhydrite. Remnant porosity in a thin zone within this unit was found to be very poor, and occupied by a black bitumenous material. Minor oil bleeds and associated fluorescence was noted from fine "pinhole" solution porosity and from vugs occurring sporadically throughout the formation. Phosphate occurred over a 12 metre interval of fine grained bioturbated peloidal sediments towards the top of the Arthur Creek Formation. The basal intraclast grainstone overlies an oxidised laminated carbonate/mixed siliclastic interval with dewatering structures.

The top of the Red Heart Dolomite is brecciated. This formation contains an upper section of crystalline dolomite and a lower section of dark red massive shale. The transition between the two is gradational and interdigitating. No porosity was observed in either section.

The Red Heart Dolomite overlies a thin sequence of finely laminated grey shale and siltstone considered to be Proterozoic. Minor normal and bedding plane micro-faulting was observed within this interval.

Basement lithology is a slightly weathered gneiss with a subtle high angle preferred orientation.

Drillstem Testing in the basal shoal facies of the Arthur Creek Formation and lower Hagen Member recovered small amounts of water, but did not record pressure information sufficient to derive reservoir information.

AGE		NORTHWEST DULCIE SYNCLINE	SOUTHEAST DULCIE SYNCLINE	WEST TOKO SYNCLINE	EAST TOKO SYNCLINE	EVENTS
	TERTIARY	Undifferentiated	Undifferentiated	Poodyea Formation /Austral Downs Lst	Austral Downs Limestone	
MESOZOIC	LATE JURASSIC-CRETACEOUS			Hooray Sandstone	Hooray Sandstone	Alice Springs Orogeny
MIDDLE DEVON	EMSIAN	Dulcie Sandstone (<500m)	Dulcie Sandstone (660m)	Cravens Peak Beds (280m)		Rodingan Mvt
	LATE ORD/SIL					
EARLY & MIDDLE ORDOVICIAN	LLANDEILIAN					
	LLANVIRNIAN	Nora Formation (113m)	? ?	? ?	Ethabuka Sst(1147m) Mithaka Fm(94-127m) Carlo Sst(125-174m) Nora Fm(114-250m) Coolibah Fm(2-79m) KellyCr Fm(110-250m)	
	ARGENIGIAN	? ?				Kelly Creek Mvt Black Mountain Eustatic Event
	WARENDIAN	Tomahawk Beds (190m)	Tomahawk Beds (~200m)	Ninmaroo Formation (225-500m)	Ninmaroo Formation (100-400m)	
	DATSONIAN					Lange Ranch Eustatic Event
	PAYNTONIAN					
	pre PAYNTON post IDAMEAN					Delamerian Orogeny
CAMBRIAN	IDAMEAN	Eurowie Sst Mbr (15-30m)		Arrinthrunga Formation (601-770m)	Georgina Limestone (409m)	
	MINDYALLAN					
	BOOMER-ANGIAN	Arrinthrunga Formation (390-680m)	Arthur Creek Formation (30-418m)	U.Hay R. Fm.Mbr 2 (62-85m)	Blazan Shale (8m)	
	UNDILLAN					
	FLORAN					
	TEMPLETONIAN	Chabalowe Fm (150-200m)		U.Hay R. Fm Mbr 1		
	ORDIAN	Hagen Mbr (100m)	?	L. Hay R. Fm (56m)	Thorntonia Lst (40m)	
	EARLY CAMBRIAN (Undiff)	Andagera Formation (<50m)	Red Heart Dolomite (20-129m)	Red Heart Dolomite (20m)	Sun Hill Arkose (17m)	
		Unnamed Clastics	? ? Mt Baldwin Fm	? ? Adam Shale(16m)		

FIG.4

CRA Pacific Oil & Gas Pty Limited

SOUTHERN GEORGINA BASIN

CORRELATION OF STRATIGRAPHIC UNITS

(Modified from Morris, 1988)

REF.			
SCALE		DRAFTING	
AUTHOR	A.G. KRESS	REPORT	303525
DATE	APRIL 1989	PLAN No	PetNTcw3023

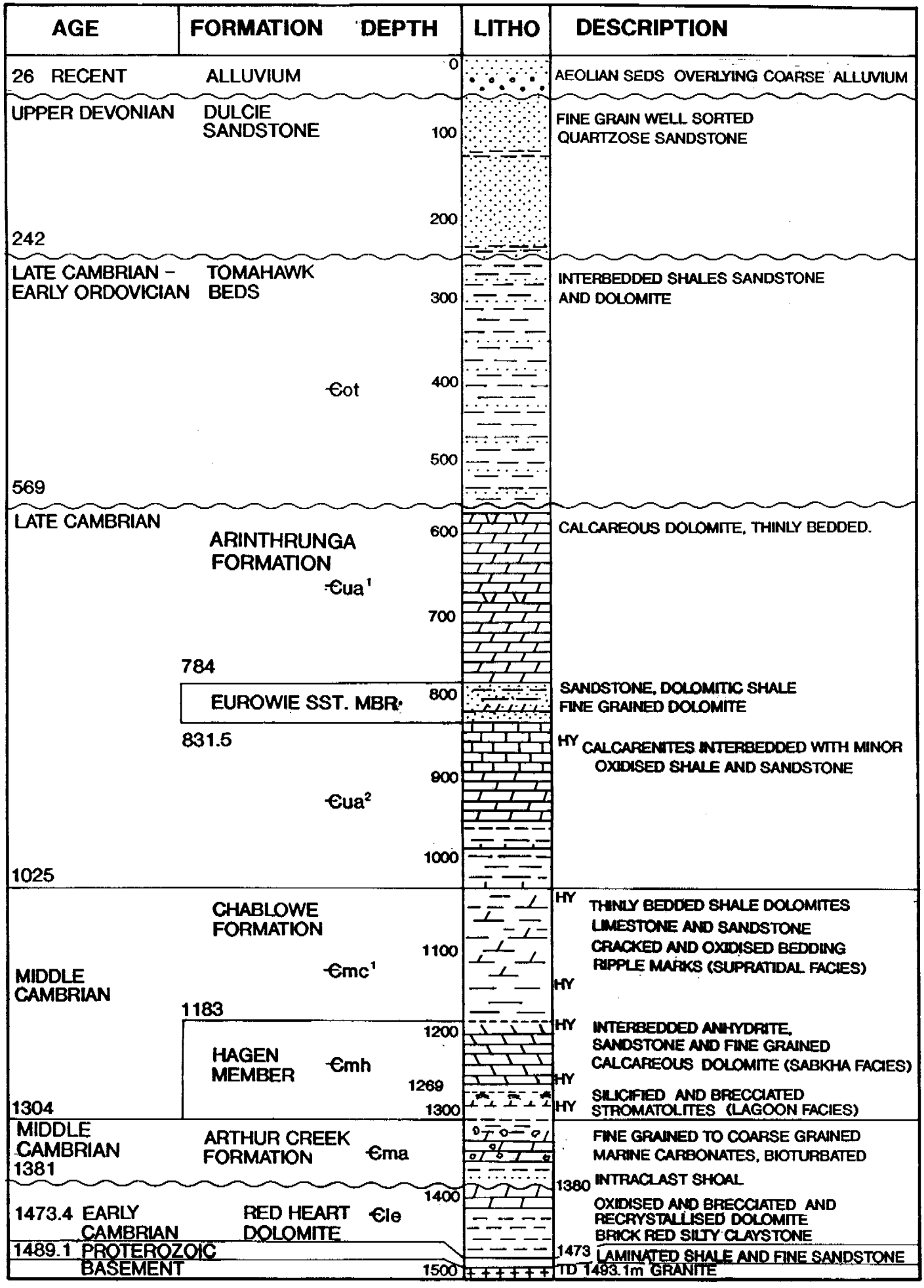


FIG 5

Pacific Oil & Gas Pty Limited

PHILLIP NO. 2

ACTUAL SECTION

Author	Date	Plan No.
G.W.K.	April 1989	PetNTcw 3047

5.2 Stratigraphic Table

Formation	Age	Depth (mRT)	Thickness (m)	Index
Aeolian sand	Rec	2.5	3.5	Smpls
Alluvium	Rec	6	20	Smpls
Dulcie Sandstone	Dev	26	216	Smpls, logs
Tomahawk Beds	Cam-Ord	242	327	Smpls, logs
Post - Cambrian subtotal			566.5	
U.Arrinthrunga Fm	U Cam	569	215	Smpls, logs
Eurowie Sst Mbr	U Cam	784	47.5	Core, logs
L.Arrinthrunga Fm	U Cam	831.5	193.5	Core, logs
Arrinthrunga Fm subtotal			456	
Chabalowe Fm	M Cam	1025	279	Logs
Arthur Creek Fm	M Cam	1304	77	Core, logs
Middle Cambrian subtotal			356	
Red Heart Dolomite	E Cam	1381	92.4	Core, logs
Unnamed clastics	Late Prot	1473.4	15.7	Core, logs
Basement	Prot	1489.1	4	Core
Total Depth		1493.1		

5.3 Stratigraphy

Quaternary surficial deposits 2.5 - 26m

Solid geology at the Phillip location is obscured by a thin veneer of fine red dune sand, currently stablilised by vegetation and interstitial clay. The dune sand overlies 20m of loose unconsolidated alluvial sand and gravel. The alluvium is clean, moderately sorted and rich

in chalcedony, ironstone, metamorphic lithic grains, muscovite and garnet. The sediment is texturally and mineralogically similar to that in the nearby Bundey River and presumably has been deposited by an earlier channel of that river. Lowermost samples of this unit show significant beneficiation of heavy minerals.

Upper Devonian Dulcie Sandstone 26 - 242m (216m)

The Dulcie Sandstone is a white, occasionally yellowish grey, massive quartz sandstone, with a sucrosic texture. It is fine to medium grained, moderately to well sorted and moderately well cemented with silica throughout. A white clay matrix is occasionally present. Thin horizons of brick-red silty clay occur at 117m and 163-170m, and become abundant near the weathered contact with the Tomahawk beds.

Cambro-Ordovician Tomahawk Beds 242 - 569m (327m)

The Tomahawk beds occur as a monotonous sequence of thinly bedded silty shales, tight sandstones, and dolomites. Bedding thickness ranges from 0.5 to 5m. An oxidised, dispersive clayey interval occurs immediately below the upper contact. The contact occurs approximately 4m higher relative to sea level in Phillip No 2 than in Phillip No 1, suggesting some topographic relief on the contact.

The shale is greyish green to occasionally reddish brown, silty, very fissile, micaceous and hard. Silty shale forms approximately 45% of the section. The sandstone is light brown to greenish brown, very fine to fine grained, densely cemented with silica and minor dolomite, and contains glauconite, chamosite and lithic grains. Sandstone forms approximately 40% of the section. The dolomite is greyish to yellowish brown and is very finely recrystallised. It forms approximately 15% of the section as discreet beds and also occurs as thin laminae throughout the other lithotypes.

The section preserved at this location is thicker than that described elsewhere in the western part of the basin. The evidence for a period of exposure between the Tomahawk beds and the Dulcie Sandstone suggests that the upper portion of the Tomahawk beds has been removed by erosion. The section intersected in Phillip No 1 and 2 is more silt/clay rich than is apparent from outcrop in the

region. The contact with the Arrinthrunga Formation is abrupt and there is no evidence of weathering.

Late Cambrian upper Arrinthrunga Formation 569-784m (215m)

The upper Arrinthrunga Formation in the rotary drilled section of the well appears as a homogeneous, finely crystalline silty dolomite. Where cored, the primary lithotypes are fine to medium grained intraclast grainstones with zones of intense recrystallisation, ooid grainstones, and stromatolites. Recrystallisation and stylolisation has occurred throughout the section. Intraclast grainstones occur as thin to very thin fining upward microcycles with scoured bases, grading upward on a centimetre scale to dark grey dolomitic shale. Zones of intense recrystallisation and stylobrecciation possibly represent and obliterate what were originally coarser grained fabrics. Cavities up to 4cm in diameter lined with brown sparry dolomite crystals occur rarely within recrystallised dolomite. Ooid grainstones form a minor lithotype and are generally well preserved. Coarsening upward cycles are prevalent in coarse grained lithotypes, suggesting shoaling episodes within a predominantly shallow water, low energy environment.

Reddish brown to green dolomitic shales and siltstones with scouring and ripple marks, interbedded with algal structures, become common towards the base of the unit. This gradual increase in the proportion of siliclastics is distinct on the density and gamma-ray logs. The contact with the Eurowie Sandstone member is gradational and interdigitating.

Late Cambrian Eurowie Sandstone Member 784-381.5m (47.5m)

For this well the boundary between the Eurowie Sandstone and the upper Arrinthrunga Formation is selected as being identified by the disappearance of sandstone as a distinct rock type and by mixed carbonates becoming the dominant lithology.

The sandstone is quartzose, fine grained, moderately to well sorted and well cemented by silica, dolomite and rarely anhydrite. Silica cement formed prior to dolomite cement. Tourmaline is present in trace amounts. The sandstone is interbedded on a metre scale with fine grained silty dolostone and reddish brown shales in poorly

defined fining upwards sequences.

The base of the Eurowie Sandstone is relatively abrupt and is marked by the appearance of the coarse grained carbonates of the Lower Arrinthrunga Formation.

Late Cambrian lower Arrinthrunga Formation 831.5-1025m (193.5m)

The lower Arrinthrunga Formation consists of thinly laminated light to medium grey carbonate mudstones in fining upward microcycles. Scours and ripple marks, with rare vertical and horizontal burrows occur in the lower and central part of the unit. Recrystallised grainstones and ooid grainstones are more frequent toward the top of the unit. Algal boundstones occur sporadically throughout the unit except in the lowermost portion where the unit grades into the oxidised mixed siliclastics and minor carbonates of the Chabalowe Formation.

The lower boundary of the Formation is gradational over more than 50m. In Phillip No 2 the base is identified by the change from the carbonate dominated sediments of the Arrinthrunga Formation to the siliclastic dominated sediments with subaerial exposure sedimentary structures of the Chabalowe Formation.

Middle Cambrian Chabalowe Formation 1025 - 1304m (279m)

The Chabalowe Formation consists of an extensive upper unit of thinly bedded siliclastics with minor limestone and anhydrite, and a lower evaporitic and lagoonal unit, the Hagen Member.

In the upper unit is thickly laminated grey to reddish brown calcareous siltstone and shale interbedded with minor sandstone, peloidal and ooidal limestone, and stromatolites. Carbonates become less significant toward the base. Scouring, ripple marks, cracked and ripped-up bedding and occasional flat-pebble conglomerates, occur throughout, increasing in abundance toward the base. Occasional thin bands of anhydrite, both massive and as a cement to quartz sandstone, occur near the base.

The Hagen Member is divisible into two primary facies; an anhydrite/sandstone facies; and a stromatolite/silty lime mudstone facies. The anhydrite facies consists of metre

scale bands of finely crystalline anhydrite grading to anhydrite cemented fine grained sandstone, interbeded with minor dololutite. Bedding is planar, and occasionally cracked. The anhydrite is light grey to yellowish grey, and is composed of a microscopic network of acicular crystals. Intercrystalline microporosity occurs throughout, particularly in anhydrite cemented sandstones. Thin chert bands and dark grey algal laminae are common. The anhydrite facies is clearly distinguished on the logs as a highly stratified zone of high density and resistivity. The lower lagoonal facies consists of partly to completely silicified and brecciated stromatolites alternating with a very fine ?bioturbated silty dololutite. Algal horizons form approximately 10% of the section. Although banded, patchy or nodular silicification of the algal horizons is common, the original fabric is sometimes preserved. Fenestrate porosity is preserved immediately above the contact with the Arthur Creek Formation. Occasional algal laminae and faint wispy bedding are preserved in the fine grained sediments. In the lowermost part of this facies the quartz grain component and silicification of the fine grained sediments becomes more dominant and stromatolites do not occur. Rare centimetre scale planar crossbedding is visible. This lagoonal facies lies conformably on the marine dolomites of the Arthur Creek Formation.

Middle Cambrian Arthur Creek Formation 1304 - 1381m (77m)

The Arthur Creek Formation is represented in this well by a brownish grey partly fossiliferous and stylobrecciated grainstone. Recrystallisation is intense. Clear crystalline anhydrite is very common, infilling cavities in the stylobreccia. The stylobreccia is interbedded at the top and bottom of the formation with greyish brown bioturbated argillaceous dolomicrite, in which stylolitisation is absent.

A 12 metre section of slightly argillaceous peloid rich arenite and carbonate mudstone near the top of the formation yielded a yellow precipitate to the nitric acid/molybdate test indicating the presence of phosphate.

A thin shoal near the base of the formation consists of white, medium to very coarse grained, intraclast grainstone. Original high primary and solution porosity has been almost completely occluded by clear crystalline anhydrite. Shelly fossil fragments in the shoal have been

replaced by anhydrite. Remnant porosity over a 0.5m interval has been further occluded by a soft brown crystalline substance (?crystalline hydrocarbons). Remaining porosity in this interval is low.

The shoal overlies a basal 10m section of dark grey, green and reddish brown, thinly laminated shales, siltstones and carbonate mudstones. Reddish colours, siliclastics and ?glauconite become more common toward the base of this section. Bedding is irregular and occasionally burrowed. The most prominent features are large dewatering structures which may be traced for up to 20cm through the section. On bedding surfaces the structures have linear traces and 3-way intersections. This unit grades downward to a reddish brown sandy wash over the Red Heart Dolomite.

Early Cambrian Red Heart Dolomite 1381 - 1473.4m (92.4m)

The Red Heart Dolomite in Phillip No 2 is a red, completely recrystallised dolomite, overlying and interdigitating with a massive deep reddish brown silty shale. The top of the dolomite is heavily oxidised to a deep reddish brown and weathering has highlighted an original stromatolitic fabric. The uppermost metre of the dolomite is brecciated and cracked. Cracks and interstices are filled with clear crystalline anhydrite and detrital material. Below the weathered zone the colouration is of alternating millimetre scale bands of light brown and red. Bedding is horizontal and perfectly planar. At 1404.5m a zone of nodular anhydrite and ?chert nodules occurs within a thin dark red fissile shale. The shale is reduced to a pale green colour and is deformed in a halo around the nodules.

The finely banded dolomite grades downwards and interdigitates with a massive, dark red shale, approximately 25 metres thick. The shale is fissile, micaceous and very hard. The lower contact between the Red Heart Dolomite and the underlying unnamed clastics is abrupt and is possibly a disonformity.

Late Proterozoic Unnamed Clastics 1473.4 - 1489.1m (15.7m)

The lowermost sediments in Phillip No 2 consist of thinly laminated, very fine grained sandstone, siltstone and shale. Laminations are parallel, planar to undulating and

truncated, occasionally ripple marked and occasionally contorted. Very small scale sedimentary boundinage is common in the siltstone laminae. Contortions are due to slumping and also to drag on normal and bedding plane microfaults.

Colouration in this unit varies from dark greenish grey at the base to reddish brown and greyish laminae at the top. Shale predominates except immediately above the basement wash where fine grained densely cemented sandstone (quartzite) predominates. A greyish green ?chloritic claystone containing abundant angular quartz and feldspar fragments immediately overlies weathered basement.

Proterozoic Basement 1489.1 - 1493.1m (4m)

Crystalline basement at this location is a granite gneiss composed of slightly elongated domains of equant potassium and plagioclase feldspars in a groundmass of quartz and amphibole. The plagioclase is altered to sericite. The upper two metres of the basement is oxidised to a brick red colour by weathering. The basement rocks are considered to be part of the Arunta Block.

5.4 Porosity and Permeability

Porosity was low to absent throughout most of the cored section of the well. Primary porosity has been reduced firstly by recrystallisation of carbonates and subsequently by diagenic clear crystalline anhydrite. The best measured permeability (382md) occurs in the Hagen Member where fenestrate porosity exists in some unsilicified stromatolites.

Secondary porosity caused by solution and removal of cements and primary material occurs sporadically in the Middle and Late Cambrian rocks. Cavities produced in this way range in size from pinhole up to the full diameter of the core and are often encrusted with sparry dolomite crystals. Pinhole porosity is present over thin zones in the Middle Cambrian carbonates. Connection between pore spaces is incomplete to absent, as indicated by low measured permeabilities and the isolation of most larger cavities. Zones of secondary porosity are rarely greater than 0.3m thick and occur too infrequently to be volumetrically significant.

Low intercrystalline microporosity occurs within the fine network of anhydrite crystals in massive and sandy anhyrite beds in the Hagen Member of the Arthur Creek Formation. Permeabilities are less than 0.1md.

Core analysis results are provided in appendix VII. Some rehydration of anhydrite to gypsum may have taken place since recovery. Log determination of porosity in the drill hole is not very satisfactory, because of the thin porous intervals. Where usable figures have been derived from the logs they are included in the following summary.

The table is based on core plug measurements and log readings from the most visible porous sections of the core, however, small. They represent the "best" values rather than the average. Permeabilities are less than 1.0md in most cases. Cavernous porosity in the Arrinthrunga Formation was not analysed because the cavities are too large relative to core diameter and the results would be meaningless. Although permeability associated with this type of porosity is expected to be great, cavernous porosity accounts for a total of less than two metres.

Porosity summary

Zone	Log (%)	Core (%)	Comments
Dulcie Sandstone	16-19	N/A	homogenous
Tomahawk Beds	0-Tr	N/A	
U.Arrinthrunga Fm	2-3	N/A	6-9% in clayey zones, mostly microporosity
Eurowie Sandstone	1-3	N/A	
L.Arrinthrunga Fm calcite cmt sst	2-5	6-18	thin zones are beyond vertical resolution of logs
Chabalowe Fm calcareous sst	2-12	1-8	19% in one interval of chalk-like dolomite
Hagen Member anhydrite zone	N/A	1-4	oil bearing. Litho-logy too complex for log analysis

Zone	Log (%)	Core (%)	Comments
Lagoonal facies	N/A	8-11	porous zones beyond vertical resolution of logs
Arthur Creek Formation			
subtidal shoal	2-3	N/A	homogenous
basal shoal	2-4	2-4	
Red Heart Dolomite			
carbonates	1	N/A	homogenous

5.5 Hydrocarbon Indications

On completion of rotary drilling at 685m, the final cuttings were coated with a bitumen like substance. Subsequent analysis (see appendix VIII) identified the substance to be a refined hydrocarbon, probably deisel.

Minor hydrocarbon shows were recorded in porous grainstones and sandstones in the lower Arrinthrunga Formation and in the upper siliclastic portion of the Chabalowe Formation. Gas and gas chromatograph breakdowns are provided on the Mudlog (Enclosure II). Oil shows are typically restricted to 10-30 centimetre intervals and are visible as bleeding yellow oil under white light. The oil fluoresces a strong blue-white under UV light. Residual oil saturations in cores ranged up to 46% which is consistent with the observation of live oil in the core.

Oil staining was also observed within massive and sandy anhydrite in the Hagen Member of the Chabalowe Formation. Oil saturations measured by core analysis (Appendix VII) range up to 43% and are consistent with field observations. No zones of free water were present. Gas readings in the field showed strong peaks corresponding to oil shows in the core.

In the lagoonal facies of the Hagen Member porous stromatolites contained traces of mobile oil but were predominantly water flushed. Measured values (6.5% So and 59% Sw) are consistent with this observation. Gas backgrounds and peaks were lower within this slightly porous and permeable interval than in the overlying tight

anhydrite rich sediments.

Minor oil bleeds were present in fine "pinhole" porosity in the stylobrecciated shoal and in the clean basal intraclast shoal of the Arthur Creek Formation. The basal shoal contains a dark brown ?crystalline hydrocarbon material filling the pore spaces remaining after anhydrite deposition.

Drill stem test No 2 covered the interval from 1346m to 1493m and tested hydrocarbon shows in the basal shoal of the Arthur Creek Formation. Although pressure data was not recovered due to plugging by filter cake, a small (18m) water column was recovered.

No hydrocarbon shows were present below the base of the Arthur Creek Formation.

Samples of oil bleeding cores were submitted to Amdel Laboratories at well completion. Results have not yet been received, but will be forwarded for inclusion at a later date.

Samples of core were also submitted to Amdel for source rock analysis. The rsults will be forwarded for inclusion when received.