1 ENGINEERING DATA

1.1 Engineering Summary

Elliott 1 is located in the Northern Territory Exploration Permit 33 (EP33), approximately 30km northeast of Elliott (Figure 1). The well was designed as a stratigraphic test to identify the type and nature of the sedimentary section in the southern part of a large gravity low, inferred to be a depression, informally termed the Beetaloo Sub-Basin. **Elliott 1** was drilled using Rockdril Contractors Pty Ltd's Rig 20, a Longyear 600.

The location was accessed via the Stuart Highway, turning east 16km north of Elliott and travelling approximately 35km along the existing pastoral road leading to Beetaloo Station, then following a fence line in a southeast direction for 4km, at which point the fence line intersects seismic line MA91-103. The **Elliott 1** well was situated on this seismic line, 10km south of the fence-line intersection. Site preparation involved the clearing of an area approximately 100m by 150m and the digging of several pits. Water was obtained from a water bore on site, which encountered water at 130 metres.

Well site supervision was provided by Kevin Lanigan, John Torkington, Shane Hibbird and Amanda Howlett.

Drilling operations commenced at 1400 hrs on August 20, 1991 with the drilling of a 12¼-inch hole to 10.0m below the drilling floor (bdf), using an air rotary drilling method. A 9 5/8-inch conductor was run and cemented to the surface using 5½ barrels of 15.6 pounds per gallon (ppg) class "A" cement. Drilling operations were then suspended while rigging up of the camp was completed and recommenced at 0430 hrs August 22, 1991 with the drilling of an 8½-inch hole to a depth of 126.0 metres using a downhole hammer. A wiper trip was conducted prior to running the 7-inch casing. Ten joints of 7-inch casing were run and set at a depth of 125.4 metres using 13 barrels of class 'A' cement and the B.O.P. stack was nippled up.

The casing shoe was drilled out using a 6-inch rotary bit to 125.4 metres. The 6-inch hole was continued using compressed air and a downhole hammer to a depth of 273.7 metres. At this point the water column was too great to displace with air, necessitating a change to a 6-inch rotary drilling assembly. Rotary drilling with water was continued, with intermittent circulation loss, to a depth of 460.7 metres, at which

point the drill pipe became stuck in the hole. This problem seemed to be the result of cuttings falling back into the hole and settling around the drill bit. To remedy this, 950 litres of diesel and 200 litres of Milfree were spotted in the hole as lubricants, following which the drill pipe was dislodged and run out of the hole twelve hours after it became stuck.

Drilling resumed at 0915 hrs on August 28 and continued slowly, due to loss of circulation and insufficient water supply, to a depth of 595.0 metres. Several wiper trips were conducted prior to running casing. At 1200 hrs on September 3, 61 joints of 5-inch casing were run, and the casing shoe landed at 593.7 metres (bdf). The string was cemented with 25 barrels of class 'A' cement (15.6 ppg). After the cement had set the drill string was run in the hole and the casing, choke manifold, floor manifold, choke and kill lines and HCR valve were pressure tested to 2000 psi against the pipe rams. All were found to be in working order. The B.O.P. stack was nippled up and pressure tested at 2000 psi for 15 minutes. The casing shoe and cement were drilled out with a 4¾-inch rotary bit and the pipe pulled from the hole.

The CHD-101 coring assembly (fitted with a 110mm reamer) was run in the hole, and the water down hole was displaced by a Newdrill/Newvis polymer-based mud. Coring commenced at 593.70 metres, and new formation was cut at 594.92 metres (bdf). A formation integrity test was conducted at 596.32 metres, and indicated a maximum allowable mud weight of 16.2 ppg.

The hole was then continuously cored down to 807.62 metres (revised to 807.50 metres after strapping out) where encouraging shows and slightly elevated gas readings between 790 and 801 metres prompted the running of a Drill Stem Test (DST).

DST 1 (Appendix 11a) was run on September 8 and 9, and tested very tight sands between 787.54 and 807.50 metres (bdf) in a closed chamber test with a 10 minute Pre-Flow, 60 minute Initial Shut In, 120 minute Main Flow and 482 minute Final Shut-In. No hydrocarbon gas was detected during blow down of the chamber and when the test string was pulled from the hole an 11.1 metre column (17.2 litres) of drilling mud was recovered above the shut-in valve.

The CHD-101 drilling assembly was run back in the hole and coring resumed, continuing down to 1029.30 metres. Between 1008 and 1022 metres patchy but encouraging shows were again encountered with slightly higher gas readings supporting the decision to run another test.

DST 2 (Appendix 11b) was run on September 16, and tested very tight sands in a closed chamber test between 1006.96 and 1029.30 metres (bdf) with a 16 minute Pre-Flow, 60 minute Initial Shut-In, 60 minute Main Flow, and a 181 minute Final Shut-In. On pulling the test string from the hole a 3.87 metre column (6 litres) of drilling mud was recovered above the shut-in tool and no hydrocarbons were detected.

The CHD-101 drilling assembly was run back downhole and resumed continuous coring down to 1141.00 metres (revised to 1141.05 metres after strapping out). Below 1119 metres patchy to solid shows of dull to bright fluorescence were encountered, with minor bleeds of oil and super saline formation water emanating from the core. These were accompanied by relatively high gas readings down to 1141 metres, providing the incentive to run another DST.

DST 3 (Appendix 11c) was a closed chamber test run on September 20 over the interval 1101.35 to 1141.05 metres (bdf) with a 15 minute Pre-Flow, 60 minute Initial Shut-In, 91 minute Main Flow, and a 363 minute Final Shut-In. The recovery comprised a 63.39 metre column (98.3 litres) of drilling mud with a 15 millilitre cap of light oil and very minor gas. Immediately after the test it became apparent that mud from the annulus had leaked into the chamber whilst running in the hole, thereby creating a cushion against influx from the formation. It was decided to run another test (DST 4) over this same interval to see if more oil could be recovered.

After checking the test string for leaks DST 4 (Appendix 11d) was run on September 20 and 21 over the DST 3 interval with a 15 minute Pre-Flow, 60 minute Initial Shut-In, 540 minute Main Flow, and a 16 minute Final Shut-In. The long Main Flow and short Final Shut-In resulted from the decision to maximize flow time at the expense of build-up information. The recovery consisted of a 19.72 metre column (30.57 litres) of drilling mud and very minor gas.

Again the CHD-101 drilling assembly was run back in the hole and coring resumed, continuing down to 1349.30 metres. Poor to good shows, most notably from 1338 to 1346 metres, accompanied by minor gas and super saline formation water exuding from relatively permeable sandstone provided the incentive to run another test.

DST 5 (Appendix 11e) was a closed chamber test run on October 3 over the interval 1330.0 to 1349.30 metres (bdf) with a 15 minute Pre-Flow, 60 minute Initial Shut-In, 83 minute Main Flow, and a 420 minute Final Shut-In. The recovery comprised a 1049 metre column

(approximately 5200 litres) of super saline formation water, increasingly cut with drilling mud towards the top, but with no hydrocarbons detected.

The CHD-101 drilling assembly was run back in the hole and coring resumed, continuing to a total depth (T.D.) of 1729.20 metres (bdf) which was reached at 2130 hrs on October 20, 1991. (Note: TD was amended from 1729.05 to 1729.20 after strapping out of the hole).

After circulating the hole clean and strapping out, BPB rigged up and ran a full suite of slimhole wireline logs (see Section 2.5.3 and Enclosure 3), followed by Velocity Data conducting a 12-level velocity survey (see Section 2.5.5 and Appendix 8).

The well was abandoned by setting cement plugs over the intervals 1290-1245 metres, 700-580 metres and (after initial rigging down) 50 metres to surface. Rig 20 was released at 0800 hrs on October 24, 1991, after placement of the surface cement plug. A chronological log of drilling activities is included as Appendix 1a and a time summary as Appendix 1b, with graphical presentation given in the Drilling Progress Chart (Figure 2).

1.2 General Data

Well Name:	**Elliott 1**
Well Type:	Stratigraphic well
Operator:	Pacific Oil & Gas Pty Limited
Licence Holders:	Pacific Oil & Gas Pty Limited
Petroleum Title:	EP33, Northern Territory
CRAE Hole Number:	PDRDDD91MB21
Location: Elliott	Approx. 30km northeast of Easting - 368 118.4 Northing - 8 076 830.1 Latitude - 17° 23'25.191" Longitude - 133° 45'30.601" 1:250 000 Mapsheet: Beetaloo SE53-6
Access:	Via the Stuart Highway and existing pastoral roads towards Beetaloo Homestead, then 4km southeast along a fenceline and 10km south along seismic line MA91-103.

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Elevation:	Ground Level - 243.9m AHD Drill Floor - 246.3m AHD
Total Depth:	1729.20m (Driller) 1729.28m (Logger)
Commencement Date:	August 20, 1991
Total Depth Reached:	October 20, 1991
Rig Released:	October 24, 1991
Drilled By:	Rockdril Contractors Pty Ltd Rig 20, Longyear 600
Datum:	Drill Floor - 246.3m above AHD
Hole Size:	12¼-inch to 10.0m 8½-inch to 125.4m 6-inch to 595.0m 4.35-inch to 1729.20m (T.D.)
Wireline Logs: Resistivity	Spontaneous Potential, Dual Resistivity (from 1728m to 575m) Sonic (from 1728m to 575m) Density, Neutron, Gamma Ray (from 1729m to surface)
Velocity Survey:	A 19-shot, 12-level survey was recorded.

1.3 Drilling Rig

Rockdril Contractors Rig 20, a Longyear 600, was used to drill **Elliott 1**. Specifications for this rig and all associated plant are given in Appendix 2.

1.4 Hole Sizes And Depths

Drilling at **Elliott 1** commenced with the air rotary drilling of a 12¼-inch hole to 10.0m. An 8½-inch downhole hammer was then used to percussion drill to a depth of 126.0m, with the casing shoe being set at 125.4m. The 6-inch hole was drilled using compressed air and a downhole hammer to a depth of 273.73m, rotary drilled to a depth of 595.0m, using fresh water and occasional high viscosity Rapid Gel sweeps as the drilling medium, with the casing shoe being set at 593.70m. A CHD-101 coring assembly (fitted with a 110mm reamer) and a Newdrill/Newvis polymer-based mud system (with the addition of KCl) was used to continuously core the formation to total depth of 1729.20m.

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1.5 Casing

Details of the various casing runs in **Elliott 1** are given in Table 1.

CASING SIZE	DEPTH SET	GRADE	JOINTS	WEIGHT	CEMENT (Class A)
9 5/8"	9.5m	*	*	*	6 bbl
7"	125.4m	K-55	10 X 8 ROUND	23 lb/ft	13 bbl
5"	593.7m	K-55	61 X AB-FL4S	13 lb/ft	25 bbl

Table 1: **Elliott 1** Casing Details

1.6 Drilling Mud

The **Elliott 1** well was spudded using air as the drilling medium and continued down to 273.73 (bdf). At this depth the water column could no longer be displaced with compressed air, so a change to rotary drilling with water was made, with occasional high viscosity Rapid Gel sweeps to clean the bottom of the hole. Circulation was lost intermittently below 274 metres, and then completely below 410 metres, down to 595 metres, where 5-inch casing was set.

After drilling out the cement and casing shoe the drilling medium was changed to a Newdrill/Newvis polymer-based system, with about 3% potassium chloride (KCl) added to inhibit swelling clays.

Typical mud properties were;

mud weight 8.7 - 9.0 ppg
viscosity 35-48 seconds
pH 9.0 - 9.5

Occasional problems and uncertainties associated with the reliability of the mud balance and the rheometer rendered some mud readings as questionable.

Solids content of the mud was maintained as low as possible by replacing solids-contained mud with fresh pre-mix.

1.7 Water Supply

Water was obtained from a water bore on site, which encountered water at 130m, in cavernous limestone. This water was suitable for use in the camp and for drilling

purposes. During the period from August 27, 1991 to September 2, 1991 (i.e. the period in which severe circulation losses occurred), it was necessary to have additional water trucked in from a nearby waterhole (approximately 20km to northeast).

Towards the end of the hole the bore water became increasingly salty, so drinking water was brought in from the Elliott township.

1.8 Bit and Deviation Record

1.8.1 Drilling Bits

Details of all bits used in drilling **Elliott 1** are contained in Appendix 3.

1.8.2 Deviation Surveys

No deviation surveys were conducted in the 12¼-inch or 8½-inch holes. The first deviation survey was conducted in the 6-inch hole at a depth of 240m, and thereafter surveys were conducted at approximately 100m intervals, with the last survey at 1700m. All information regarding deviation surveys conducted during the drilling of **Elliott 1** is given Table 2.

SURVEY #	DEPTH	DEVIATION	HOLE SIZE
1	240m	1.00°	6-inch
2	350m	0.50°	6-inch
3	596m	0.25°	4.35-inch
4	700m	0.50°	4.35-inch
5	800m	0.25°	4.35-inch
6	925m	0.25°	4.35-inch
7	1000m	0.50°	4.35-inch
8	1111m	0.50°	4.35-inch
9	1200m	1.50°	4.35-inch
10	1314m	0.75°	4.35-inch
11	1400m	2.00°	4.35-inch
12	1500m	0.75°	4.35-inch
13	1600m	* 10.00°	4.35-inch
14	1700m	1.00°	4.35-inch

Table 2: **Elliott 1** Deviation Surveys

* This particular survey was conducted three times, yielding values of 8, 9, and 10 degrees, the latter being accepted by the toolpusher. Initially it was thought that this sudden significant deviation may have been indicative of a formation change (i.e. moving

from the Moroak Sandstone of the McMinn Formation into the Upper Velkerri Formation), but the subsequent survey (at 1700m) does not seem to support this interpretation. The reason for this localised deviation is not understood.

1.9 Formation Testing

A total of five Drill Stem Tests (DST's) were conducted in **Elliott 1**. A summary of testing results is illustrated in Table 3.

DST #	INTERVAL (m)		RECOVERY
	FROM	TO	
1	787.54	807.50	17.2L of drilling mud in the drill string
2	1006.96	1029.30	6.0L of drilling mud in the drill string
* 3	1101.35	1141.05	15mL of oil and 98.3L of drilling mud
4	1101.35	1141.05	30.57L of drilling mud
5	1330.00	1349.30	Approx. 5200L of highly saline formation water

Table 3: Drill Stem Test Results from **Elliott 1**

* It appears that most of the drilling mud recovered in DST 3 actually leaked into the sample chamber prior to the test being conducted, that is, as the tool was run into the hole. For this reason the test was considered a misrun, and the same interval was tested again. A more detailed account of each individual DST is available in Appendix 11.

1.10 Time Distribution

A daily summary of drilling operations can be found in Appendix 1a and a summary of time distribution is given in Appendix 1b. A drilling progress chart for the well is included as Figure 2.

1.11 Well Costs

A summary for the costs of drilling **Elliott 1** is given in Table 4.

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ITEM/S	COST ($)
Drilling	293,076
Casing and Cement	39,348
Water	22,944
Mob./Demob.	90,000
Mud Supplies	36,066
Mudlogging	77,307
Drill Stem Testing	116,791
VSP/Wireline Logging	60,653
Other Consultants	11,800
Access/Rehabilitation	26,596
Lab. Analysis	24,992
Field and Transport	61,669
Camp	78,793
Travel and Accommodation	8,295
Computer Services	610
Prof. Charges	234
Office/Communications	25,308
Payroll and Benefits	49,272
Overheads	43,696
TOTAL	1,067,450

Table 4: Elliott 1 Well Costs up to 29 February 1992