1.18 Well Costs

A summary of costs for the drilling of **Chanin 1** is given in Table 2. PetNTcw9428, 9429 and 9430 display the cement and mud chemical usage in **Chanin 1** in terms of price per unit, usage and expenditure.

Table 2.
Drilling Cost Summary - **Chanin 1**

ITEM	COSTS $A
Site preparation/Rehabilitation	24,409
Water Supply	21,989
Mobilisation/Demobilisation	127,250
Drilling	331,840
Casing	30,624
Cementing	3,564
Mud Supplies and Services	23,350
Geophysical Logging	59,669
Camp	42,566
Mudlogging Services	22,775
Drill Stem Testing	7,566
Communications	7,240
Freight	37,670
Travel & Accommodation	29,947
Vehicle Costs	7,691
Laboratory Analysis	2,535
Payroll & Benefits	-
CRA overheads	971
Consultants	65,230
Office Supplies	263
Insurance	7,500
TOTAL	**$854,679**

2 GEOLOGICAL DATA

2.1 Geological Summary

Chanin 1 was designed to test a seismically interpreted closure approximately 60km north of **Jamison 1**. The well is located near the northern margin of the Beetaloo Sub-basin and is updip of a significant hydrocarbon source region.

The primary reservoir objectives of the well were the "Jamison Sandstone" and the Moroak Sandstone Member of the McMinn Formation. Minor amounts of oil and gas were recovered from the "Jamison Sandstone" in **Jamison 1** and oil shows were encountered in the Moroak Sandstone in **Elliott 1**. Secondary reservoir objectives were sands within the lower "Hayfield Mudstone" and in the Kyalla Member of the McMinn Formation.

The well spudded in weathered kaolinitic claystones and siltstones of the Mullaman beds. A partially ferruginised sandstone is present at the base of the unit. This formation is Cretaceous in age, on which a ferruginous laterite has developed during the Tertiary Period. The base of the Mullaman beds was intersected at 76.5m.

The Tindall Limestone was drilled from 76.5m to 182.3m. The samples returned over this interval were highly contaminated with cavings from the overlying claystones. Occasional cuttings of the limestone were observed and were of a dark yellowish orange cryptocrystalline limestone. Minor pale yellowish brown chert is also believed to be associated with this formation.

The Antrim Plateau Volcanics was intersected from 182.3m to 622.4m. This greenish black flood basalt consisted of numerous flows, some of which were determined due to their weathered tops. The weathered sections are recognisable from changes in ROP, colour, and on wireline logs. The basalt has thickened significantly over the Chanin structure compared to the surrounding areas.

Beneath the volcanics the well intersected the greenish grey to greyish red claystones and siltstones of the "Hayfield Mudstone". A dolomitic siltstone marker bed was intersected at 650m, and the first of the secondary targets, the sand within the lower "Hayfield Mudstone" was intersected between 803 to 809m. This sand is poorly developed here. No hydrocarbon shows were noted over this interval. The base of the "Hayfield Mudstone" was encountered at 875m. The gamma ray log revealed the "Hayfield Mudstone" to be highly radioactive in places, with gamma ray counts exceeding 300 units, especially towards the base of the formation.

The "Jamison Sandstone" was intersected at 875m. The upper contact between this formation and the "Hayfield Mudstone" is quite sharp; it was expected to be a relatively gradual change with an increase in fine sandy interbeds over 10 to 20m. The sand is dominantly a fine grained silty sandstone, which only occasionally appears to coarsen into a clean sandstone. The gamma ray log indicates that several radioactive interbeds are present in that part of the "Jamison Sandstone" that was expected to be a clean, massive sandstone from earlier wells. The depositional environment in which the "Jamison Sandstone" was laid down in is apparently more variable than previously thought. Ten percent bright yellow fluorescence was noted in the basal three metres of the sand, with some cuttings gas. The sample was slightly damp and so was the subsequently circulated with foam. The wellbore could not be dried out after this point so drilling continued with foam.

The next sample returned (from 948m) was the medium to dark grey, laminated and well indurated claystones and siltstones of the Kyalla Member of the McMinn Formation, (948.4m from wireline logs). This formation is lithogically quite uniform, dominantly an organic-rich claystone and silty claystone. Over the interval 1135 to 1190m, siltstone interbeds comprised up to 30% of the total rock. Minor dull yellow fluorescence was observed from 948 to 957m and cuttings gas was detected throughout most of this formation. No significant hydrocarbon shows were present in any of the siltstone interbeds throughout the Kyalla Member, or in the few thin very fine sandstone interbeds towards the base of the unit.

The highly silicified, fine to very coarse sands of the Moroak Sandstone Member were intersected at 1328m. The sandstone contained a significant amount of white clay, presumably a product of diagenesis. On entering the sandstone a significant amount of water was initially produced. The well was filled with mud and drilling continued to 1411m, where it was decided to terminate the well. No shows were observed in the Moroak Sandstone and cuttings gas generally declined as drilling proceeded. Gas wetness ratios did not indicate the presence of movable oil. Wireline logs did not detect hydrocarbon in the well.

2.2 Well Objectives and Performance

Chanin 1 was designed to test a structural closure approximately 60km north of **Jamison 1**. The very poor hydrocarbon shows encountered in the well suggests that the **Chanin 1** structure may have developed after hydrocarbon generation and migration.

The Mullaman beds, from surface to 76.5m proved difficult to drill. The intention was to have the weathered claystones of this formation behind a surface conductor before drilling ahead into the underlying Tindall Limestone. The depth of the Tindall Limestone and where to run the conductor to was inferred from lost circulation zones encountered in the water bore drilling. This depth proved inadequate, as 17.5m of weathered claystone was open to the borehole whilst drilling the Tindall Limestone and top of the Antrim Plateau Volcanics, severely contaminating the samples of these formations and causing drilling difficulties.

An erroneous seismic interpretation (which was revised soon after spud), placed the prognosed top and base of the Antrim Plateau Volcanics lower than intersected in the well. The revised seismic depth prognosis was accurate.

Air and mist/foam drilling proved very successful with regard to ROP, bit life and reducing well costs, but as a trade off sample quantity was at times low, and quality was generally poor. Detailed show description was impossible with the samples generated by air drilling. Lithological identification was however, quite good once the logger became accustomed to the samples. Lithological identification and show evaluation with air mist/foam drilling is a significant improvement over purely air drilling.

The depth prognosis from seismic, to the top of both the "Jamison Sandstone" and the Moroak Sandstone Member was within several metres. This accuracy gives a great deal of confidence in the integrity of the structure. It does not, however confirm the validity of the interpreted four way dip closure or suggest a structural reason for the lack of hydrocarbons.

Chanin 1 successfully tested all of the proposed targets, the "Jamison Sandstone", Moroak Sandstone Member, the sands within the lower "Hayfield Mudstone" and the Kyalla Member in what is believed to be the first test of a four way dip closure in the Beetaloo Sub-basin. The lack of hydrocarbons is a serious concern, at the time of writing this report it was considered that the timing of structural deformation may have been too late at Chanin for the feature to have received and trapped migrating hydrocarbons.

2.3 Stratigraphy

Appendix 5 contains a full description of cuttings from **Chanin 1**.

Mullaman beds (Cretaceous)

Surface to 76.5 metres. (71.6 metres thick)
White, very pale orange, light brown, dark yellowish orange and greyish orange claystone, siltstone and sandstone, minor ironstone. Minor loose quartz grains, medium to coarse, subrounded to rounded.

Tindall Limestone (Cambrian)

76.5 to 182.3 metres. (105.8 metres thick)
This formation was drilled with poor returns. Dark yellowish orange cryptocrystalline limestone and minor pale yellowish brown chert.

Antrim Plateau Volcanics (Cambrian)

182.3 to 622.4 metres. (440.1 metres thick)
Tholeiitic basalt. Dark grey, olive black to black fine grained basalt. Occasional weathered horizons.

"Hayfield Mudstone" (Proterozoic)

622.4 to 875.0 metres. (252.6 metres thick)
Predominantly greyish green to brownish grey claystone and siltstone, with minor white, very fine sandstones which became more common towards the base.

"Jamison Sandstone" (Proterozoic)

875.0 to 948.4 metres. (73.4 metres thick)
875.0 to 894.0 metres. Interbedded pale greyish orange, clean, very fine sandstone and silty, very fine sandstone, well sorted, sub-rounded with abundant clay matrix and quartz cement, with moderate brownish orange siltstone.

894.0 - 927.0 metres. Pale greyish orange, clean, well rounded, well sorted, very fine sandstone in clayey siltstone. Abundant silica cement. Minor moderate brownish orange siltstone.

927.0 to 948.0 metres. Pale greyish orange, well rounded, well sorted, very fine to fine, silty sandstone. Abundant silica cement. Minor moderate brownish orange siltstone.

McMinn Formation-Kyalla Member (Proterozoic)

948.0 to 1328.0 metres (379.6 metres thick).
Interbedded medium grey to dark grey micaceous claystone and siltstone. Minor glauconite and pyrite.

McMinn Formation-Moroak Sandstone Member (Proterozoic).

1328.0 to 1411.0 metres (83.0 metres cut).
1328.8 to 1341.0 metres
White very fine to fine silicified sandstone. Well sorted and rounded, well to very well indurated. No visible porosity. Intergranular space filled with quartz overgrowths and minor white clay.

1341 to 1350m..
White, very fine to medium silicified sandstone. Well sorted and rounded, well to very well indurated. No visible porosity. Intergranular space filled with quartz overgrowths and minor white clay.

1350 to 1411m.
White fine to very coarse silicified sandstone. Well sorted and rounded, well to very well indurated. No visible porosity, intergranular space filled with quartz overgrowths and minor white clay.

2.4 Mud Logging

Mud logging services were provided by Halliburton Drilling Systems. Their personnel were responsible for the collection of cuttings every 5m in the 8.5" hole and every 3m in the 6" hole, or more frequently as directed by the wellsite geologist. Each sample was evaluated for hydrocarbons and described. Rate of penetration, total gas, gas chromatography, pump strokes and H_2S concentration were monitored. Rate of penetration, total gas and gas chromatography were plotted on a continuous mud log at a scale of 1:500. A copy of the mud log is included in this report as PetNTcw9424.

2.4.1 Cutting Samples (Air Drilling)

Samples were collected over 5m intervals through the 8.5" hole and over 3m intervals throughout the remainder of the hole. Samples were divided into three, with one being sent to the Northern Territory Department of Mines and Energy and the other two being stored at Pacific's Alice Springs office. A small proportion of the original sample was placed in a samplex tray which was also retained by Pacific.

2.4.2 Cutting Samples (Mud Drilling)

Lightly washed and dried cuttings samples were collected over 3m intervals throughout the part of the hole drilled with a mud system. Each sample was divided into three with one being sent to the Northern Territory Department of Mines and Energy and the other two being stored at Pacific's Alice Springs office. A small proportion of the original sample was placed in a samplex tray which was also retained by Pacific.

2.4.3 Core Samples

No cores were cut in **Chanin 1**.

2.5 Geophysical Logging

2.5.1 Wireline Logging

After reaching total depth the hole was circulated clean and the following logs were run:-

Run No. 1	DLL-MSFL-AS-GR-CAL from 1411m to casing shoe, GR to surface.
Run No. 2	LDL-CNL-GR from 1411m to casing shoe.
Run No. 3	DIL from 1411 to casing shoe.
Run No. 4	WST from 1328.0 to 44.9m.

The logs are displayed in their separate runs at two scales, 1:200 and 1:500, PetNTcw9407 to 9413 and also as a composite log at 1:1000, PetNTcw9426.

2.5.2 Bottom Hole Temperature

Bottom hole temperatures were recorded on all total depth logging runs. Extrapolating the temperature data gives a bottom hole temperature of 80.5°C at 1411m. Assuming a 25°C surface temperature this equates to a geothermal gradient of 39.3°C/km.

2.5.3 Synthetic Seismogram

The sonic log recorded in **Chanin 1** was drift corrected using check shot data and along with the density log used to generate a synthetic seismogram for **Chanin 1**. PetNTcw9414.

2.6 Reservoir Analysis

No reservoir analysis work was carried out.

2.7 Source Rock and Show Analysis

Fifteen small (30 - 50 gram) samples were taken at intervals through the Kyalla Member of the McMinn Formation. Some samples were high-graded by selecting the darkest chips. The samples were submitted to Geotech (Perth) and, following determination of total organic carbon content (TOC), those reporting greater than 0.4% TOC were subjected to Rock-Eval pyrolysis. A sample of cuttings recovered from the basal "Jamison Sandstone" which possessed weak fluorescence, was submitted also to Geotech for liquid chromoatographic separation of extracted organic matter and gas chromatography of the saturate fraction. Results of these analyses are given in Appendix 6.

Duplicates of seven of these samples were despatched to Dr M. Glikson of the University of Queensland to determine maturity by alginite reflectance. Results of these analyses are given in Appendix 7.

2.8 Water Analysis

Two water samples were submitted to Geotech (Perth) for analysis. One sample was of the bore water and one was a sample of formation water recovered from the top of the Moroak Sandstone Member. Results of these analyses are given in Appendix 8.

2.9 Contributions to Geological Knowledge

Chanin 1 was significant as it was the first test within the "Beetaloo Sub-basin" of a structural feature which is believed to possess four-way dip closure. The results of Rock-Eval pyrolysis analysis and alginite reflectance on organic-rich samples of the Kyalla Member, reveal that the section is mature for hydrocarbon generation.

The Chanin structure is possibly a late structure and may not have been in place early enough to have received a charge of hydrocarbon. The validity of the structural closure has a degree of uncertainty associated with it, but the paucity of shows may suggest that little or no hydrocarbon has moved through the rocks drilled in **Chanin 1**. This result was unexpected given our current knowledge of the basin. It has proven that the basin's post-depositional history is not as simple as previously believed.

The seismic depth prognosis proved to be very accurate in **Chanin 1**. The top of each formation was picked to within a few metres, except for the top and bottom of the Antrim Plateau Volcanics. The original prognosis was incorrect because of an erroneous seismic interpretation. A revised interpretation and depth prognosis was accurate. Such a result confirms the existence of the structure, and the ability of seismic to find such features within a basin that has proved to be very difficult to explore.

KEYWORDS

Petroleum, Proterozoic, Rotary Drilling, Hydrocarbon Potential, McArthur Basin, Roper Group, Well Logs.

LOCATION

1:250 000 Sheet	1:100 000 Sheet
Tanumbirini SE53-2	Scarlet Hill 5665

LIST OF DPO'S

77754, 77755, 77756, 77757, 77758, 77762, 77763, 77768

DESCRIPTOR

This report details the drilling and results of the petroleum exploration well **Chanin 1**.