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BIRDSVILLE TOWN BORE

QUEENSLAND

BORE HOLE SURVEY REPORT

by

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Delhi Australian Petroleum Ltd.
- Operator -

August 25, 1961

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I. SUMMARY

The Birdsville Town Bore, Queensland, was electrically logged at 4,006 feet total depth on April 19, 1961, for Delhi Australian Petroleum Ltd. and Santos Limited. Detailed study of the drill cuttings samples in conjunction with the electric log provides an effective subsurface type-section of the Mesozoic sequence in the Birdsville region.

II. INTRODUCTION

The Birdsville Town Bore was electrically logged for Delhi Australian Petroleum Ltd. and Santos Limited by Mines Administration Pty. Ltd. Drilled for the Queensland Irrigation and Water Supply Commission by W.L. Sides & Son of Morwell, Victoria, using a Cardwell Model HL rotary rig, this water bore will become the property of the Diamantina Shire Council and will be used as the Birdsville town water supply. The hole was spudded on 14th March, 1961 and, on April 18, 1961, reached a total depth of 4,006 feet, following which the electric logs were run. An attempt was made to secure a gamma ray log, but due to very high drilling mud temperature, the attempt was unsuccessful. The composite log with this report therefore shows only the sample and electric logs.

Logging of the Birdsville Town Bore was undertaken in order to obtain data for (1) compilation of a detailed, factual stratigraphic sequence, that is, a type-section, (2) a structural control point, (3) stratigraphic studies of selected zones in the Mesozoic, e.g., the widespread "fish scale zone", by correlation with other bores, (4) a stratigraphic and structural control point for inferred Paleozoic geology, and (5) detailed definition of aquifer sands.

The bores nearest to Birdsville which have been drilled to the depth of the Blythesdale aquifers as of the date of this report are:

1. Goyder's Lagoon, 77 miles southwest
2. D.F.S. Betoota No. 1, 85 miles east
3. Cluny No. 4, 74 miles north
4. Anacoora, 225 miles west
5. Carcoary, 47 miles north
6. Adria Downs, 34 miles northwest

Of these, only D.F.S. Betoota No. 1 has been logged by electrical or radioactivity methods.

III. WELL HISTORY

(a) Well name and number:

Birdsville Town Bore, Reg. No. 14645

(b) Location:

Latitude 25° 54' 40" South, Longitude 139° 21' 30" East, at town of Birdsville, Queensland.
Elevation: 160.7 feet, ground level

(c) Name and address of tenement holder:

Authority to Prospect 67P, State of Queensland, held by Delhi Australian Petroleum Ltd., 32 Grenfell Street, Adelaide, South Australia

checkerboarded and interrelated with

Authority to Prospect 66P, State of Queensland, held by Santos Limited, 44 Grenfell Street, Adelaide, South Australia.

(d) Details of Petroleum Tenement:

See Appendix No. 1

(e) District:

Diamantina Shire, State of Queensland

(f) Property (well) owner:

Diamantina Shire Council, Bedourie, Queensland

(g) Total depth:

4,006 feet

(h) Size of hole:

9-5/8" surface to 475 feet
7-3/8" 475 feet to 4,006 feet (TD)

(i) Casing:

8" standard water well casing landed at 472 feet
6" standard water well casing landed at 4,000 feet

(j) Purpose of bore:

Town water supply for Birdsville, Queensland

(k) Condition of hole and fluid content:

Completed as flowing water well from Mooga sandstone member of Blythesdale group, through casing slots 3,840 to 4,000 feet, at rate of 770,000 gallons per day, 165 p.s.i., and 209°F.

IV. DESCRIPTION OF SURVEY

(a) Personnel responsible for the supervision and conduct of the well log operations:

(1) Supervision for Delhi Australian Petroleum Ltd. by Mr. John Harrison, subsurface geologist.

(2) Operation of logging equipment for Mines Administration Pty. Ltd. by Mr. John Burbury, geophysicist.

(b) Personnel responsible for the preparation of the report:

(1) Data compilation and overall supervision by Mr. W. J. Greer, Manager of Exploration Department, Delhi Australian Petroleum Ltd.

(2) Sample examination, data compilation, composite log, and preliminary report by Mr. John Harrison, subsurface geologist, Delhi Australian Petroleum Ltd.

(c) Purpose of logging: its relevance to oil search:

The Birdsville Town Bore is located in the west-central Great Artesian Basin in far southwestern Queensland, on Authorities to Prospect 66P and 67P. The Great Artesian Basin, occupying more than 550,000 square miles or nearly one-fifth of the continent of Australia, is essentially a single basin insofar as the Mesozoic sediments are concerned, but includes several sub-basins of Paleozoic age. The Basin as a whole has remained relatively stable throughout Mesozoic time, with sufficient subsidence having occurred to allow for the accumulation of several thousand feet of shales and sands in both marine and non-marine environments. With few exceptions, only very gentle structural disturbances have affected the Mesozoic rocks of the Basin.

The outlines of the Paleozoic sub-basins are virtually unknown at present due to the almost total lack of significant deep drilling. Projection of Paleozoic data for distances of several hundred miles into the Basin from the many peripheral Paleozoic outcrop areas may be a relatively effective means of working out the Paleozoic geologic history of the central Basin, in spite of the limitations of projecting data over such great distances, but every aid to its interpretation must be employed. It may reasonably be expected that detailed study of Mesozoic sediments from data provided by bores such as the Birdsville Town Bore where adequate sample and electrical logs are available will reveal certain information relative to the underlying Paleozoic. Specifically, this may be accomplished by construction of isopach and lithofacies maps revealing minor Mesozoic folding which may in turn reflect the dying phases of major Paleozoic tectonic movements.

From seismic and bore data it is now known that pre-Mesozoic structure in the Great Artesian Basin often has much greater relief than the overlying Mesozoic structure. Since there are a number of Mesozoic structures expressed at the surface, it is reasonable to expect that many exist which are not so expressed due to lower relief. These latter features could then reflect Paleozoic structures of lower relief than those underlying many of the surface-expressed anticlines, and such lower relief Paleozoic features may be the most prospective for accumulations of oil and gas. The situation that exists with many of the higher relief Paleozoic structures is that the pre-Mesozoic sediments have been eroded off. Stratigraphic

mapping of the Mesozoic rocks could thus prove to be a valuable and effective means of delineating areas of possible low relief Paleozoic structure where more refined exploration methods may be utilised in the search for petroleum drilling prospects.

With regard to the Mesozoic sequence, the Birdsville Town Bore will provide direct factual data regarding formation thicknesses and lithologies, and thus, in addition to permitting investigation of the inferences relative to the Paleozoic as discussed above, will result in a better understanding of the Mesozoic geologic history and petroleum potential.

The thick marine shales of the Mesozoic sequence of the Great Artesian Basin may constitute good petroleum source beds. Although thousands of bores have penetrated much of the Mesozoic throughout the Basin, virtually none has been drilled in search of petroleum, and most were drilled many years before modern logging techniques had been developed. Detailed studies are needed to evaluate fully the Mesozoic section as a possible petroleum-bearing sequence. Maps of the sands within the marine shale sequences may conceivably lead to areas prospective for petroleum at shallow depths.

(d) Types of logs run:

Electric log -
(1) 16 inch normal resistivity curve
(2) 63 inch normal resistivity curve
(3) self-potential curve

Note: A gamma ray log was attempted, although the surface temperature of the drilling mud was 128°F. and the type of gamma ray sonde used can record only in temperatures below 140°F. A doubtful log was obtained to a depth of 400 feet, where the instrument ceased to function.

(e) Description of the equipment used:

Failing Logmaster Correlation Unit, owned and operated by Mines Administration Pty. Ltd., 31 Charlotte Street, Brisbane, Queensland.

(f) Logging schedule:

Electric logs were run from bottom of surface casing at 472 feet, to total depth at 4,006 feet, on April 19, 1961, the day after total depth was reached.

(g) Logging scales:

Vertical scale:
1 inch equals 50 feet, all curves

Horizontal scales:
16 inch normal curve = 1 inch equals 20 ohms
63 inch normal curve = 1 inch equals 10 ohms
Self-potential curve = 1 inch equals 10 millivolts

V. RESULTS OF SURVEY

(a) Density and/or resistivity tests on rock and fluid samples:

None taken.

(b) Cable stretch correction:

None applied. Driller's and logger's casing shoe depths and total depths in agreement.

(c) Correlation of lithologic and electric logs:

The electric log obtained is sharp and clear with bed boundaries well defined. However, the top 230 feet of both resistivity curves, that is from casing shoe at 472 feet to approximately 700 feet, show curves which indicate that the instrument was not functioning quite normally, as they are at variance with both the S.P. and lithologic log. The latter indicate that the stratigraphic section here is interbedded sandstone and shale, whereas the resistivity curves appear to be giving a shale response. The reason why the resistivity curves functioned in this manner is not definitely known. The curves were taken on different runs of the sonde, yet both started recording normally below 700 feet. The effect may be due to the condition of the mud. During logging operations it was noticed that the formations were taking fluid and, to keep the hole full, water was added. This action may have considerably altered the electrical response of the mud in the top part of the hole.

Correlation of electric and lithologic logs through the Winton formation is very good, the thin, very calcareous sandstones as at 1,600 feet being clear cut. The base of Winton/top of Tambo is clearly defined on both the sample and electric logs, as are also the thin limestone bands which punctuate the long shale section of the Tambo. The "fish scale zone" is very well marked on both logs, although the base is not as clearly defined as has been noted on other electric logs. Whether this is a function of the electrode spacing used, or the nature of the base of the unit in the Birdsville area, cannot be ascertained. Good correlation between both the lithologic and electrical logs can be seen through the Roma formation, while the tops of both the Transition Beds and the Mooga sandstone of the Blythesdale group are very well defined. The Mooga sandstone shows good porosity and permeability, is water-bearing, and contains several very thin shale or shaly sandstone bands.

The lithologic log and the electric log are complementary, as the first gives the rock type within narrow limits, while the second defines exactly those limits and also supports the diagnosis of the rock type. Thus, together, they afford a detailed picture of the Recent, Tertiary, Cretaceous and Jurassic stratigraphy in the Birdsville region down to total depth of the well.

(d) Stratigraphy:

The stratigraphy encountered in the Birdsville Town Bore is essentially the same as that found in other water bores drilled to the main aquifer in the central western part of the Great Artesian Basin. The following units are recognised:

0 - 210 feet	Recent, Pleistocene and Tertiary Thickness - 210 feet Surface desert sands and siliceous sandstones. "Duricrust", porcellainite and white, soft, silty clay.
210 - 1,936 feet	Middle Cretaceous - Winton Formation Thickness - 1,726 feet Grey, soft, partly silty, carbonaceous shales and "salt and pepper", fine to coarse grained, argillaceous, occasionally calcareous, tight, carbonaceous sandstone. Occasional very thin lignite seams. Between 590 and 600 feet, grey, microcrystalline, arenaceous limestone.
1,936 - 3,013 feet	Lower Cretaceous - Tambo Formation Thickness - 1,077 feet Monotonous sequence of grey shales, partly silty, with occasional bands of brown, microcrystalline to medium crystalline, argillaceous to arenaceous, dense limestone. Inoceramus prisms and shell fragments frequent throughout unit.
2,980 - 3,013 feet	Lower Cretaceous - "Fishscale Zone" Thickness - 33 feet Dark brown to grey, silty, very calcareous, pyritic shale with organic material and abundant fish remains in form of scales, spines and plates. White to brown, medium crystalline, dense, pyritic limestone with Inoceramus prisms and shell fragments. (This zone occurs at the base of the Tambo formation but it has such widespread occurrence and shows so clearly in samples and on electric logs that it has been described separately here. It is an excellent correlation marker.)
3,013 - 3,691 feet	Lower Cretaceous - Roma Formation Thickness - 678 feet Predominantly dark grey, fissile, splintery, hard, micaceous shales with very occasional thin beds (2 feet) of grey-green, fine grained, argillaceous, glauconitic, tight sandstone. Some Inoceramus prisms and shell fragments.
3,691 - 3,857 feet	Lower Cretaceous - Blythesdale Group - Transition Beds Thickness - 166 feet Mainly dark grey, fissile, micaceous, silty shale with minor grey, very fine to medium grained, glauconitic, kaolinitic, tight sandstone.
3,857 - 4,006 feet	Lower Cretaceous - Upper Jurassic - Blythesdale Group - Mooga Sandstone Thickness - 149 feet plus Cream to buff, medium to very coarse grained, angular to subangular, poorly sorted, poorly consolidated, clean, quartz sandstone showing very good porosity. Few thin dark grey, hard, splintery, shale bands. Sandstone ironstained near top of unit.

The electric and sample logs of the Birdsville Town Bore show that the well passed through Winton, Tambo and Roma formations and penetrated 149 feet of the Mooga sandstone of the Blythesdale group. These are the normal formations encountered by water bores over most of the Great Artesian Basin. Only two other wells in the deeper part of the basin were electrically logged - D.F.S. Betoota No. 1, 85 miles east, and D.F.S. Innamincka No. 1, 144 miles southeast of Birdsville. All three electric logs correlate very well and show a remarkable similarity of response at the top of each formation. In general, the thicknesses of the various formations in the Birdsville Town Bore are approximately the same as those found in the Betoota No. 1 well, except that the Winton formation is 400 feet thicker at Birdsville than at Betoota. The formation thicknesses at Innamincka are greater than at Birdsville by 360 feet for the overall thickness down to the top of the Mooga sandstone.

VI. REFERENCES

Final report - D.F.S. Innamincka No. 1, South Australia, subsidised stratigraphic test well, unpublished B.M.R. report.

Final report - D.F.S. Betoota No. 1, Queensland, subsidised stratigraphic test well, unpublished B.M.R. report.

B.M.R. Records 1961/62 - The Geology of the Birdsville 4 mile sheet Area, Queensland, by F. Olgers.

B.M.R. Records 1961/54 - Geology of the Bedourie, Machattie, Birdsville, Betoota 4 mile sheet Areas in Western Queensland, by M. A. Reynolds, F. Olgers and W. Jauncey.

APPENDIX NO. 1

Authority to Prospect 67P, State of Queensland

Summary of Provisions of the Authority

Area:	Southwestern Queensland, between 138° and 143° East longitude and 24° and 29° South latitude, a total area of 67,600 square miles, of which one half (or 33,800 square miles) constitutes Authority to Prospect 67P and one half Authority to Prospect 66P, the latter being assigned to Santos Limited. The two Authorities are checkerboarded and interrelated on the basis of alternating rectangles measuring one minute of latitude and longitude each way.
Term:	Ten years from January 1, 1959, with right of renewal for five years from January 1, 1969, and further five years from January 1, 1974.
Rental:	£422.10.0 for first year, then threepence per square mile per year.
Expenditures Required:	During each year 1959-1963 inclusive, not less than £50,000. During each year 1964-1968 inclusive, not less than £100,000. During each year 1969-1973 inclusive, not less than £200,000. During each year 1974-1978 inclusive, not less than £400,000.
Work Required:	Topographical, geological, geophysical examinations and/or surveys and scout or deep test drilling, as may be appropriate in the opinion of the Company, for determining the existence of petroleum or geologic structures favourable for petroleum occurrence. All work may be done by Santos Limited (holding Authority to Prospect 66P, see above) or approved assignee of either Company.

Australian Mineral Development Laboratories

Telephone: 79 1662
Telegrams: "AMDEL," Adelaide.
Address all communications to the Director.

CONYNGHAM STREET,
PARKSIDE,
SOUTH AUSTRALIA.

Our Reference AN 1.4.0/1205

15th August, 1962

Department of Mines,
Rundle Street,
ADELAIDE, South

17.8/62

Sample of water marked as under yielded on analysis:—

	P.P.M.	GRAINS PER GALLON
Chlorine, Cl		3.8
Sulphuric acid (radicle), SO_4		0.1
Carbonic acid (radicle), CO_3		16.3
Nitric acid (radicle), NO_3		Nil
Sodium, Na		13.9
Potassium, K.		
Calcium, Ca		1.6
Magnesium, Mg.		trace
Silica, SiO_2		
Total saline matter		35.1
Suspended matter		
Organic matter		

ASSUMED COMPOSITION OF SALTS	P.P.M.	GRAINS PER GALLON
Calcium carbonate		2.5
Calcium sulphate		
Calcium chloride		
Magnesium carbonate		trace
Magnesium sulphate		
Magnesium chloride		
Sodium carbonate		26.1
Sodium sulphate		0.2
Sodium chloride		6.3
Sodium nitrate		Nil
Potassium chloride		

Name .....

Address .....

Hundred Queensland

Section .....

Sample collected by .....

Bore No. Birdsville Bore

Water Cut .....

Water Level Flows

Supply .....

Depth Bore 4002'

Date Collected .....

HARDNESS
(as Calcium Carbonate)

	P.P.M.	GRAINS PER GALLON
Total		2.5
Temporary		2.5
Permanent		Nil
Due to calcium		2.5
Due to magnesium		Nil

U729-3/61

L. Wallace Collins
Director.

Chief Analyst

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22 NOV 1961

SR 11/5/59 Envelope No 150.

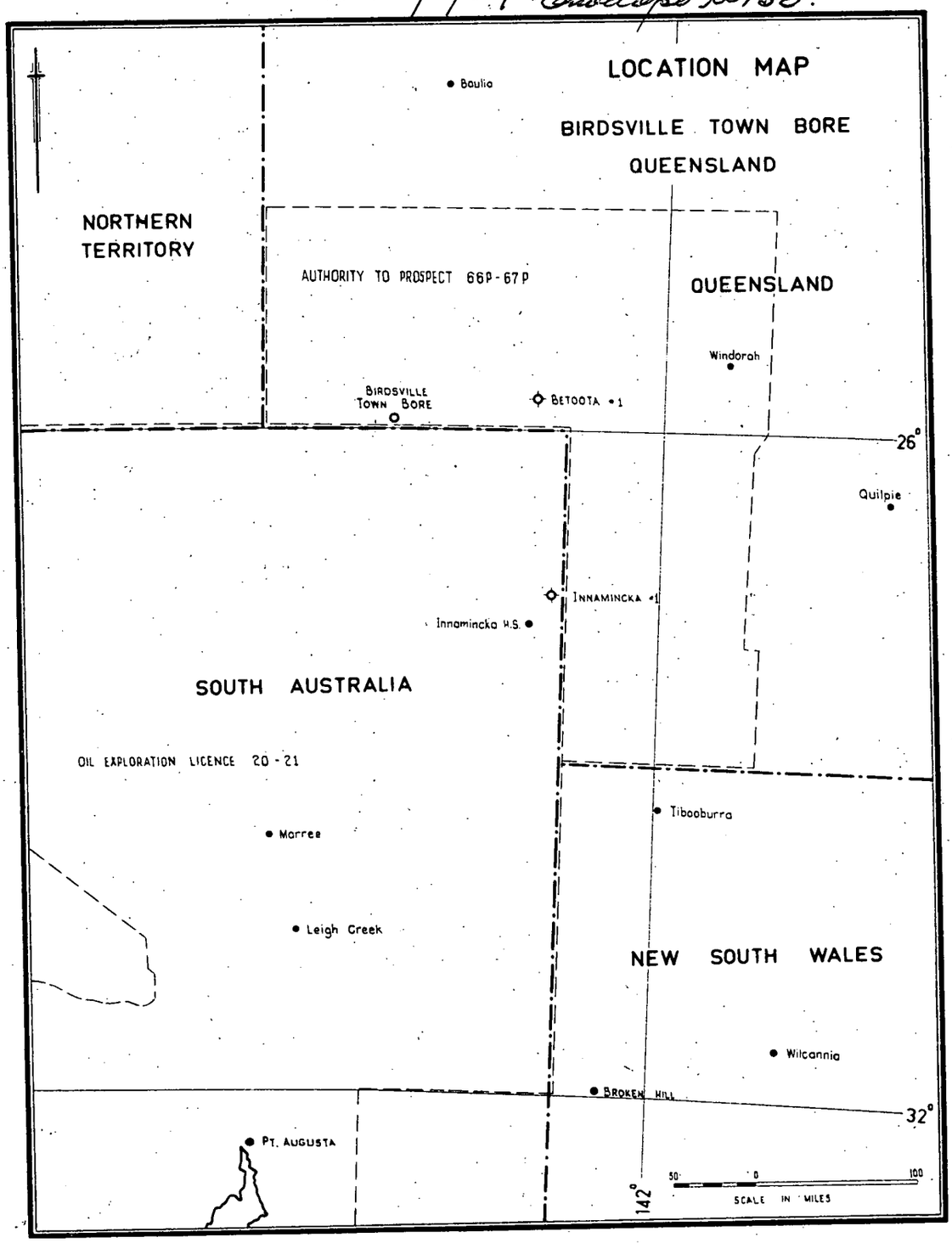

Figure 1

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COMPOSITE WELL LOG

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QUEENSLAND IRRIGATION & WATER SUPPLY COMMISSION

BROSVILLE TOWN BORE REG. No. 16645

LOGGED FOR DELHI AUSTRALIAN PETROLEUM LTD.

STATE: QUEENSLAND

PETROLEUM TENEMENT: 65P & 67P

4 MILE SHEET: BROSVILLE

BASIN: GREAT ARTESIAN

WELL STATUS: ARTESIAN WATER BORE

LOCATION: Lat. 25° 54' 46" Long. 139° 21' 30"

ELEVATION: 160 F

Date Spudded 14 March 1961
Date Drilling Stopped 18 April 1961
Total Depth Driller 4315'

Hole Size: in. From To
6¼" 0 475'
1¾" 475' 4315'

Casing: in. Wt. Gr. Depth Cmt. Cmt'd To
6" Standard water well casing 417' 4316' Surface "

Perforations: Type Size From To No/Ft.
Slotted 1846' 4315'

Drilling Method: Rotary

ELECTRIC LOG DATA

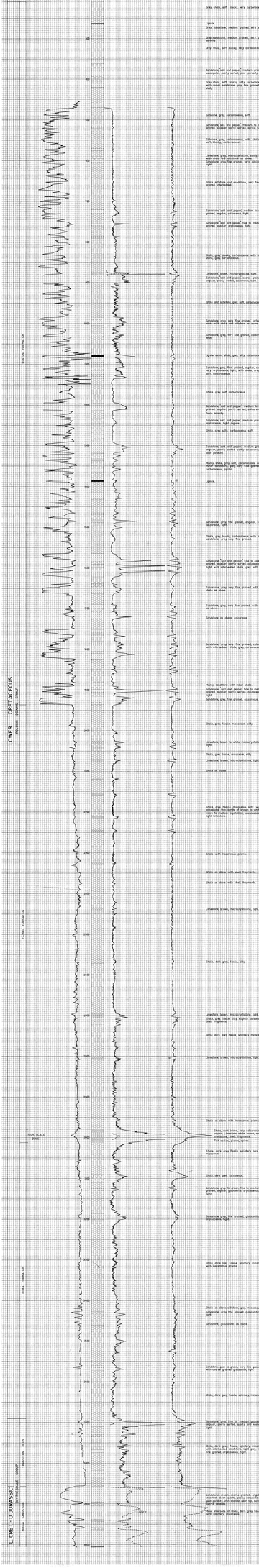
Run No.	1
Date	19 April 1961
Footage Logged	3514'
Bottom Driller	4315'
Logged To	4306'
Total Depth-Electric Log	4306
Casing Shoe Driller	417'
Casing Shoe Electric Log	417'
Casing Shoe Logger	417'
Mud - Type	Bentonite
Mud - Kind	Bentonite
Electrode Spacing	16"
Recorded by	J.R. Richary
Witnessed by	J. Harrison

LITHOLOGIC REFERENCE

Shale — Sandstone
Lignite — Limestone

LITHOLOGY BY J.HARRISON, Delhi Australian Petroleum Ltd.
COMPILED BY J.H.ALLEN

DRILLING CONTRACTOR W.L.GOES & SON.
LOGGING CONTRACTOR HINES ADMINISTRATION PTY. LTD.


SPONTANEOUS POTENTIAL
millivolts
RESISTIVITY
ohms / ohm.M.
LITHOLOGY
RECENT AND TERTIARY
LOWER CRETACEOUS
ALBIAN - CENOMANIAN
ROMA FORMATION
L. CRET - U. JURASSIC
HUTTON SANDSTONE
FORMATION
GROUP
FORMATION
FORMATION
FORMATION