WOODSIDE (LAKES ENTRANCE) OIL COMPANY N.L.



WELL COMPLETION REPORT

LAKE REEVE NO.1.WELL

WOODSIDE (LAKES ENTRANCE) OIL COMPANY N.L.

# FINAL WELL REPORT

# LAKE REEVE NO. 1 WELL

By

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For

WOODSIDE (LAKES ENTRANCE) OIL COMPANY N.L.

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CONTENTS

3/24

SUMMARY:

The Woodside (L.E.) Oil Company N.L. Lake Reeve No.1. Well was a "fault-trap" test hole. Drilling commenced on the 23rd March 1965 and except for a minor shut down period while a jack-shaft was replaced on the draw-works of the rig, and two fishing operations, the well progressed satisfactorily to 6635 feet when it was abandoned on the 26th April 1965.

The section cut contains sediments whose age ranges from Upper Jurassic - Lower Cretaceous to the Quaternary. Lithologically the section was subdivided into four major lithologic units.

Below 3,225 feet several gas kicks (maximum 32 units) were recorded. Two drill-stem-tests were run; but no oil or gas was recovered.

The well was abandoned by setting three cement plugs and welding a cap with marker and identification name plate on the casing-head.

## 11. INTRODUCTION

The Woodside (L.E.) Oil Company N.L. Lake Reeve No.1. Well is located approximately 5 miles north east of Seaspray, a small seaside town in Gippsland, eastern Victoria. (fig. 1) The well is sited on the narrow land strip between Lake Reeve and Bass Strait; its location was chosen by Dr.Boutakoff who was chief geologist for Woodside (L.E.) Oil Company N.L.

A certain amount of seismic survey was undertaken prior to selecting the well site; but interpretation of the geology below the Latrobe Valley Coal Measures is very unreliable, because of the small amount of energy which penetrated the coal measures and the high order of multiples which were recorded by reflection from the relatively thick coal beds.

The well was engineered to 7,500 feet, and was designed to test possible permeable horizons within the Latrobe Valley Coal Measures, and also possible ones in the upper part of the Upper-Jurassic - Lower Cretaceous, Strzelecki Group; where, according to Webb (1964) in an equivalent horizon, a gas flow, estimated between 50 - 100 Mcfd with 34% Ethane and higher hydrocarbons, was recorded in the North Seaspray No.1. Well - approximately 4 miles north of the Lake Reeve No.1. Well site.

4/24

The well was electrically logged; and the information resulting from the drilling of the well will be used for control in future geophysical and geological exploration.

111. WELL HISTORY

1. General data:

(a) Well name and number:- Lake Reeve No.1.

(b) Location :- Victoria, 5 miles east of Seaspray.
Latitude 38° 19' 42" S.
Longitude 147° 15' 20" E.

(c) Name and address of tenement holder:-
Lakes Oil Limited,
792 Elizabeth Street,
MELBOURNE. VICTORIA.

(d) Details of petroleum tenement :-
Petroleum Exploration Permit No. 160.
The tenement covers 183 square miles in the eastern part of Gippsland Victoria.
The tenement holder is Lakes Oil Limited.

(e) District:- Gippsland, Victoria.

(f) Total depth :- 6,635 feet. 2022'35

(g) Date drilling commenced :- 23rd March, 1965.

(h) Date drilling completed :- 26th April, 1965.

(i) Date well abandoned :- 27th April, 1965.

(j) Date rig released:- 29th April, 1965.

(k) Drilling time in days :- 35 days.

(l) Elevation :-
Ground - 5 feet A.S.L. 1·52
Kelly bushing -17 feet A.S.L. 5·18

(m) Status :- Abandoned. The well was abandoned after having penetrated 1,370 feet of Upper Jurassic-Lower Cretaceous greywacke belonging to the Strzelecki Group.
The well was abandoned by setting three cement plugs and welding a cap with marker and identification name plate on the casing-head.

(n) Cost :- £59,945.1.7. as at the 31st October, 1965 Subject to audit.

2. Drilling Data :

(a) Drilling Contractor : Reading & Bates (Australia) Pty.Ltd.
100 Collins Street,
Melbourne. Victoria.

(b) Drilling Plant :

| | | |
|---|---|---|
| Make | | National |
| Type | | 50 |
| Rated capacity with 4.1/2" Drill pipe | | 7,500 feet. |
| Motors | Make | General Motors Diesel |
| | Type | 2 only twin 6 series 71 |
| | BHP | 312 continuous |

(c) Mast :

Make Lee C. Moore

5/24

| | |
|---|---|
| Type | 131 ft. Cantilever |
| Rated Capacity | 500,000 lbs. |

(d) Pumps :

| | | |
|---|---|---|
| No. 1 Make | | National |
| Type | | C.250 |
| Size | | $7\frac{1}{4}$" x 15" |
| Motor | Make | General Motors Diesel |
| | Type | Twin 6 Series 71 |
| | BHP | 312 Driven off Drawworks compound. |
| No. 2 Make | | National |
| Type | | C.250 |
| Size | | $7\frac{1}{4}$" x 15" |
| Motor | Make | General Motors Diesel |
| | Type | Twin 6 Series 71 |
| | BHP | 312 Independent drive. |

(e) Blowout Preventer Equipment :

| | |
|---|---|
| 1. Make | Cameron |
| Size | 12" Type 'SS' |
| Series | 900 |
| 2. Make | Hydril |
| Size | 12" Type 'GK' |
| Series | 900 |

(f) Hole sizes and depths:

| | |
|---|---|
| 23" hole | K.B. to 69. |
| $17\frac{1}{2}$" " | 69 ft. to 310 ft. |
| $12\frac{1}{4}$" " | 310 ft. to 2,990 ft. |
| $8\frac{3}{4}$" " | 2,990 ft. to 6,620 ft. |
| 7.7/8" Corehole | 6,620 ft. to 6,635 ft. T.D. |

(g) Casing and Liner details :

1. Conductor Pipe.

| | |
|---|---|
| Size | 18.5/8 |
| Weight | 52 lbs. |
| Grade | H40. |
| Range | 11 |
| Setting Depth | 68 K.B. |

2.

| | |
|---|---|
| Size | 13.3/8 |
| Weight | 48 lbs./ft. |
| Grade | H40 |
| Range | 11 |
| Setting Depth | 306 ft. KB |

3.

| | |
|---|---|
| Size | 9.5/8 |
| Weight | 36 lbs./ft. |
| Grade | J55 |
| Range. | 11 |
| Setting Depth | 2,970 ft. KB |

(h) Casing and liner cementing details :-

1.

| | |
|---|---|
| Size | 18. 5/8 |
| Setting Depth | 68 ft. |
| Quantity cement used | 60 bags |
| Cement to | Surface |
| Method used | BJ Cementing Service. |

2.

| | |
|---|---|
| Size | 13.3/8 |
| Setting Depth | 306 ft. |
| Quantity cement used | 280 bags + 2% Calcium chloride. |

6/24

| | | |
|---|---|---|
| | Cement to | Surface |
| | Method used | BJ Cementing Service. Guide Shoe. Top Plug, only. |
| 3. | Size | 9.5/8 |
| | Setting Depth | 2,970 ft. |
| | Quantity cement used | 732 bags + 6% bentonite |
| | Cement to | Surface |
| | Method used | BJ Cementing Service. Guide Shoe Float Collar, Top and bottom plugs. |

(i) Drilling Fluid :-

1. (a) Type — From surface to 2,996 ft. Conventional

Treatment. Conventional; using Myrtan, Caustic Soda to control viscosity.

(b) Type — From 2,996 ft. to T.D. Fresh water/ Bentonite/ Ligno - sulphonate.

Treatment. As prescribed by Munro Mud Sales Service; using Milcon, Unical and Cellucol.

2. Chemical Consumption :

| | | |
|---|---|---|
| Supercol | 38,800 | lbs. |
| Caustic Soda | 1,860 | " |
| Milcon | 4,600 | " |
| Unical | 9,050 | " |
| Myrtan | 1,200 | " |
| Soda Ash | 825 | " |
| Sod. bicarbonate | 150 | " |
| Cellucol CMC | 110 | " |
| CMC | 650 | " |
| Calcium chloride | 280 | " |
| Cement | 50 | Tons |

3. Average Weekly Mud Analysis:

| Week | Depth ft. | Weight lbs./gal. | Viscosity secs. | W.L. c.c. | F.C. ins. | pH. | Sand % |
|---|---|---|---|---|---|---|---|
| 1 | 1296 | 10.7 | 48 | | | | |
| 2 | 2996 | 9.1 | 47 | 9.1 | 2/32 | 11.5 | |
| 3 | 4915 | 9.4. | 48 | 7.4 | 2/32 | 9 | 3-5 |
| 4 | 6322 | 9.7 | 49 | 6.0 | 2/32 | 9 | 3 |
| 5 | 6635 | 9.9 | 47 | 5.6 | 2/32 | 9 | |

(j) Water Supply :

A water bore was drilled by W.L. Sides & Co. adjacent to the Rig site.

| | |
|---|---|
| Size | 6" |
| Depth | 790 feet. |
| Casing used | 292 ft. 6" casing |
| | 408 ft. 5" casing |
| | 284 ft. 4" casing |
| Supply | Water rose to surface; when bailed at 840 g.p.h. |

7/24

level stood at 60 ft. from surface.

Pump used — Pomona 4" x 4" stage - driven by 6HP Southern Cross Engine installed.

(k) Perforations : Nil.

(l) Plug back and squeeze cementations :

Abandonment plugs only were set as follows:

Plug No. 1. Bottom 5340' - 5220' 30 Sacks.
Plug No. 2. Shoe 3050' - 2933' (2 stages) 99 Sacks.
Plug No. 3. Surface. 30' - Surface. 8 Sacks.

(m) Fishing :

One Fishing job only was occasioned.
Depth. 6,615 ft. Top of fish 5,952 ft.
Nature. Drill pipe Twist-off whilst drilling.
Fish. 18 Drill Collars. 1 Stand of Drill pipe. 11 ft. of Single joint twisted-off.
Recovered. Recovered in full using 7.7/8" Bowen Overshot fitted with 4.1/2" Basket grapples and 3 ft. Extension bowl. 4.1/2" Bowen Hydraulic jars were used in Fishing string. Fish pulled free with 240,000 lbs. (Hanging wt. 137,000 lbs.) Excess weight was due to section of drill-pipe wall jammed in Bit and dragging against Hole wall.
Remarks: Two drill collars were slightly bowed and Six drill-pipe joints bent - including twisted-off joint.

(n) Side-tracked-hole. Nil.

3. Logging and Testing:

Geological logging was undertaken by R. Grasso, B.R. Boyd and F. Cox under the supervision of R.G.Perry.

(a) Ditch cuttings:-

Samples were collected at 10 foot intervals while drilling, and at 5 foot intervals while coring. Four cuts were made of each sample; one for the Victorian Mines Department, one for Australian Oil and Gas Corporation, and one for Planet Oil Company N.L. The fourth was rewashed at the well site, dried, described and kept for Woodside (L.E.) Oil N.L. Detailed descriptions of cuttings have been included as Appendix 1 of this report.

Lag time was estimated at approximately 8 minutes per 100 feet. Allowances were made for this, in conjunction with recordings from the geolograph; and except for the

interval 600 - 730 feet, samples were collected at suitable times during circulation to ensure that no samples were lost during circulation. Samples were also collected for the 600 - 730 foot interval; but because of the fast penetration rate, these were not representative, and the cuttings representing this interval were lost while circulating during a shift change.

(b) Coring:

The original programme called for one core to be cut at the contact between the Lakes Entrance Formation and the Latrobe Valley Coal Measures, and subsequent cores at oil or gas shows or wherever required by the well-site geologist.

A slight deviation in the coring programme included two cores to be cut in sediments of the Strzelecki Group in addition to one in the uppermost part of the Latrobe Valley Coal Measures, immediately below the Lake Entrance Formation contact.

A total of 3 cores were cut in coring 43 feet for a recovery of 28' 6" (66.3% recovery).

The coring equipment used for cutting cores Nos. 1 and 3 was a standard "J" type core barrel using a soft formation core head for Core No.1, and a hard formation core head for core No.3. Core No.2. was cut with a Christensen 60 foot barrel with a $6\frac{3}{4}$" tooth-insert bit.
In all cases the core cut was $3\frac{1}{2}$" in diameter.
Chip samples were taken of cores 2 and 3 for Woodside (L.E.) Oil Company N.L., Australian Oil and Gas Corporation and Planet Oil Company N.L. and the bulk of the cores were sent to the Victorian Mines Department. Core No.1. was equally divided and distributed as for cuttings distribution.
Detailed descriptions of cores cut are included in depth order within Appendix 1. of this report.

(c) Side-Wall Sampling:

A total of 20 side wall samples were cut; but only 17 were recovered. Individual recovery was generally good; and in all

cases sufficient material was recovered to enable a study of the horizon sampled. All samples after logging were sent to the Victorian Department of Mines.

(d) Electrical and Other Logging:-

The well was electrically logged as follows:-

1. Electric Log:- This includes the S.P., 16" Short Normal, 64" Long Normal and the 18'8" lateral curves.
   Run 1 was made from 6095 feet to 2971 feet.
   Run 2 was made from 6593 feet to 6000 feet.
2. Microlog:- This included a Micro-Caliper log, a 1" x 1" Micro Inverse log, and a 2" Micro Normal log.
   Run 1 was made from 6095 feet to 2971 feet.
   Run 2 was made from 6593 feet to 5980 feet.
3. Sonic-Gamma-Caliper log:- This was an integrated log which includes a Sonic log, a Gamma Ray log and a Caliper log.
   Run 1 was made from 6082 feet to 2971 feet for the Sonic log and 6082 feet to 40 feet for the Gamma Ray.
   Run 2 was made from 6602 feet to 5980 feet for both Sonic and Gamma Ray logs.
4. Continuous Dip Meter log:- The results of this log are not yet available, but the following runs were made.
   Run 1 was made from 6095 feet to 2971 feet
   Run 2 was made from 6595 feet to 6000 feet

(e) (i) Drilling time log:-

A Geolograph was attached to the rig and drilling times were recorded, continuously except for minor geolograph break-down periods, while drilling below 370 feet.

(ii) Gas log:-

A hot-wire type gas detector was used while drilling below 1020. Except for minor break-down periods the instrument operated satisfactorily; but it was noted that the ligno-sulfonate mud used in drilling below 2996 feet suppressed the effects of gas on the detector. Daily carbide checks indicated that the recorded effects of the checks progressively decreased with depth; at approximately 6000 feet three quarters of a pound weight of carbide had to be used before a

gas kick was recorded. Several gas kicks were recorded while drilling. These are listed below.

| | |
|---|---|
| 3225 ft. - 3230 ft. | 15 units |
| 3230 ft. - 3233 ft. | 31 units |
| 3237 ft. - 3240 ft. | 32 units |
| 3255 ft. - 3257 ft. | 18 units |
| 3270 ft. - 3272 ft. | 11 units |
| 3278 ft. - 3279 ft. | 13 units |
| 3280 ft. - 3282 ft. | 25 units |
| 3585 ft. - 3590 ft. | 16 units |

Also, connection gas kicks as high as 59 units were recorded between 5330 feet and 5700 feet.

Two attempts were made to test the horizon from which the 32 units of gas were recorded at 3237 - 3240. D.S.T. No.1. was unsuccessful. This was to test the 3214 ft. - 3282 ft. horizon; but unfortunately the packer failed to seat, and only 560 feet of drilling mud was recovered. The second attempt, D.S.T.No.2, produced 1820 feet of mud, 900 feet of water and 30 feet of coarse grained quartz sand. The packer for D.S.T. No.2. was made to seat within the casing and the interval 2970 - 3282 was tested. This test was successful; but no oil gas was recovered. It is possible that gas under relatively low pressure may not have been released because of the hydrostatic pressure resulting from the exceptionally long tail-pipe which was necessary for setting the packer within the casing; but it is certain that had a relative high pressure gas horizon been present, some indication would have been present within the fluid which was recovered.

11/24

(f) Formation Testing:

As mentioned above two drill stem tests were run. Both were designed to test a similar horizon.

| D.S.T. No. | Interval | Recovery |
|---|---|---|
| 1. | 3214 - 3282 | 560 feet mud<br>packer failed to seat. |
| 2. | 2970 - 3282 | 1820 feet mud<br>900 feet water<br>30 feet sand<br>above tester. |

(g) Deviation Surveys:

According to the Totco readings the Lake Reeve No.1. Well appears to be a comparatively straight hole. Below are listed the depths and deviations recorded.

150 feet - $\frac{1}{2}^{o}$
300 feet - $\frac{1}{2}^{o}$
860 feet - $\frac{1}{2}^{o}$
1250 feet - $1^{o}$
1804 feet - $1^{o}$
2883 feet - $1^{o}$
2990 feet - $\frac{3}{4}^{o}$
4034 feet - $\frac{1}{4}^{o}$
4560 feet - $1\frac{1}{4}^{o}$
5004 feet - $\frac{1}{2}^{o}$
5253 feet - $1^{o}$
6080 feet - $1^{o}$
6322 feet - $1^{o}$
6567 feet - $\frac{1}{2}^{o}$

(h) Temperature Surveys:- None run.

(i) Other Well Surveys:- Nil.

## IV. GEOLOGY:

### 1. SUMMARY OF PREVIOUS WORK:

Oil was discovered at Lakes Entrance in Gippsland in 1924. Several wells were drilled and the oil-impregnated, glauconitic sandstone was delineated. A shaft was later sunk to the glauconitic sandstone horizon and near-horizontal holes were drilled to tap the "reservoir". In all, approximately 7,000 barrels of oil were "mined" but the venture proved to be uneconomic and the project eventually abandoned.

12/24

Previous work in the Gippsland sedimentary area includes a regional gravity survey made in 1949 by R.H. Ray Company for Lakes Oil Limited followed by a semi-regional gravity survey by the Bureau of Mineral Resources in East Gippsland in 1951. At the request of the Victorian State Electricity Commission the Bureau of Mineral Resources conducted in 1960 a detailed gravity survey south of the Rosedale - Sale road and west of the South Gippsland highway.

The Bureau of Mineral Resources made an aero-magnetic survey of the on-shore area of the Gippsland Basin in 1951-1952.

From mid-May to mid-September, 1960, Austral Geo Prospectors carried out the Bairnsdale - Sale Survey for Woodside (Lakes Entrance) Oil Company N.L. between the north shore of Lake Wellington and the Princes Highway. From mid-March to early June 1961, this same contractor, working for the same client evaluated the Sale area which lies between Lake Wellington and the coast. From early January to early June 1962, the same contractor extended the latter survey for Arco Limited - Woodside to include control along the coast from Lakes Entrance to Woodside and east of the South Gippsland Highway to Longford.

For a four month period from April to August 1964, Namco International Inc. conducted a reflection seismic survey for Woodside using the new geophysical technique of common-reflection-point horizontal data stacking. This survey was made over the area where previously the conventional single-shot point method had been used.

From the 5th January to 24th June 1965, the same contractor for the same client and using the same technique extended the above survey north-eastward almost to Lakes Entrance and southward to west of Woodside.

The Woodside Nos. 1 and 2 Wells were the only wells to have encountered appreciable shows of oil, and the North Seaspray No.1. Well was the only well to have produced a flow of gas.

13/24

portion of the basin, the sediments appear to be thickest in the vicinity of the township of Seaspray.

Within the northern shelf area, basement is probably reprevented by rocks of Carboniferous and older ages. Some of these outcrop immediately north of the northern margin of the basin, where they are at least partly metamorphosed.

Basement in the southern margin of the basin is represented by granitic rocks. These outcrop on the many islands comprising the Furneaux Group.

Permian sediments were cut in the Duck Bay No.1. Well and Webb (1964) suggests that Permian sediments fill depressions on the basement surface; also he suggests that the major fault-movements were post-Permian, thereby giving rise to a Mesozoic graben.

3. STRATIGRAPHIC TABLE:

The results of the palaentological investigations on the cuttings and cores of the Lake Reeves No.1. Well are not yet available, and the following stratigraphic table has been suggested as a tentative one, pending revision when the palaentological report is recieved.

| Depth | Rock Unit | Stage | Age |
|---|---|---|---|
| 0 - 60 | ----- | ----- | Quaternary-Recent |
| 60 - 400 | Lake Wellington | ----- | Pliocene |
| 400 - 910 | Jemmy's Point<br>Tambo River | Kaliman<br>Mitchellian | Lower Pliocene<br>Upper Miocene |
| 910 - 2460 | Gippsland Limestone | Bairnsdalian<br>Balcombian<br>Batesfordian<br>Longfordian | Middle to Lower Miocene |
| 2460-2982 | Lakes Entrance | Janjukian | Oligocene |
| 2982-5265 | Latrobe Valley | Anglesean | Eocene |
| 5265-6635 | Strzelecki | ------ | Lower Cretaceous - Upper Jurassic |

4. STRATIGRAPHY:

The stratigraphy of the rocks cut in the Lake Reeves No.1. Well are represented in the composite log, Fig.2. and also in the following summary.

Cainozoic:

Quaternary - Recent:

No cuttings were collected while drilling this unit; but the area in the vicinity of the wellsite is covered by sand dunes. Reworked shell fragments from the underlying sediments and lignitic fragments are common in samples taken from a shallow excavation near the well site.

Tertiary:

14/24

Pliocene:

Lake Wellington Formation:

The Lake Wellington Formation is mainly composed of quartzose sand; but the unit contains abundant shell fragments (up to 85% of the cuttings); is often very lignitic and also slightly pyritic. The sand is fine to very coarse grained, roughly sorted into lenses; the grains are subangular to sub-rounded. The section may contain clayey horizons, but is relatively unconsolidated.

Jemmy's Point Formation:

The Jemmy's Point Formation underlies the Lake Wellington Formation. In the Lake Reeve No.1. Well it is represented by silty and sandy, very fossiliferous limestone. The cuttings are predominantly fossiliferous limestone fragments and shell fragments with minor amounts of silt and fine to coarse grained quartz sand. The section is also glauconitic.

Upper Miocene:

Tambo River Formation:

This unit underlies the Jemmy's Point Formation. It consists of light grey, very fossiliferous marl, and is porous and semifriable when dry. The unit also contains dark green glauconitic grains.

Middle to Lower Miocene:

Gippsland Limestone:

In the Lake Reeve No.1 Well the Gippsland Limestone is represented by interbeds of limestone, marl, shale and siltstone. The upper part of the unit is predominantly polyzoal limestone. The middle part is mainly interbeds of fossiliferous marl, polyzoal limestone and minor lenses of shale and siltstone (especially near base).

Oligocene:

Lakes Entrance Formation:

The Lakes Entrance Formation underlies the Gippsland Limestone. The unit is a sequence of interbedded marl, shale, limestone and siltstone. The lower members are very glauconitic and in the Lake Reeve No.1. Well the base of the Lakes Entrance Formation was characterized by a very glauconitic horizon approximately 60 feet thick resting on a thin ( a few feet thick) medium grained sandstone. The sandstone appears to be the base of the Lakes Entrance Formation and itself rests on unconsolidated fine to very coarse quartz sand belonging to the Latrobe Valley Coal Measure.

In the Lakes Entrance area, the residual oil which has been removed has been associated with the glauconitic horizon of this unit. However, no oil or gas was recorded in the Lake Reeve No.1. Well while drilling this section.

Latrobe Valley Coal Measures:

This is a formation containing interbeds and intercalations of fine to pebble size quartz sand, lignite and coal, lignitic siltstone, clay and shale.

The rotary cuttings collected are not representative because they are almost entirely strongly masked by coal cavings which contaminated most of the samples collected from this formation and also those underlying it.

A more reliable interpretation of the section cut was obtained from the Electric logs and also from the sidewall samples.

According to the electric logs the unit is probably mainly lignitic siltstone, fine to coarse quartz sand with minor clay and shaly interbeds.

Contrary to the rotary cuttings, the side wall samples indicate that most of the sands cut are "dirty" and slightly consolidated; but in drilling they tend to grind up as though they represent clean, unconsolidated quartz sand lenses.

Several gas kicks were recorded while drilling this section; a list of the values has been stated above. During drill stem tests no gas was recovered, but the horizon elsewhere within the basin should be considered as a possible gas target.

Mesozoic:

Upper Jurassic - Lower Cretaceous:

Strzelecki Group:

The base of the overlying Latrobe Valley Coal Measures is a light grey kaolinitic poorly consolidated to unconsolidated sandstone. In the Lake Reeve No.1. Well the base of the Latrobe Valley Coal Measures rests with slight unconformity (probably present but not recorded in a Lake Reeve No.1. Well) on a light to medium grey sandstone - greywacke. This sandstone - greywacke formation contains a few permeable horizons near the top of the unit. The cuttings are almost entirely masked by coal cuttings but most samples contain at least a few sandstone - greywacke cuttings.

While the section is generally a monotinous one, there are local variations as to hardness, permeability and even composition. Calcareous horizons are common near the upper part of the unit. These are usually hard, and have very poor to tight porosity.

16/24

The non-calcareous horizons are usually very "dirty" and have usually poor porosity although minor local lenses may have fair porosity.

The unit is characterized by the abundance of white feldspar (partly weathered) grains, green reworked shale grains, and black carbonaceous grains in an argillaceous matrix. Lignitic fragments and thin layers containing lignitic fragments are common ( as in cores No.2 and 3), and it is possible that coal interbeds may also be present.

## 5. STRUCTURE

The structure of the sediments in the near vicinity of the well-site is not known accurately, as mentioned above, most of the seismic energy used in geophysical exploration is reflected by the coal interbeds of the Latrobe Valley Coal Measures. The interpretation of seismic results in the area has therefore been unreliable below the Lakes Entrance Formation.

Subsurface correlations with other wells in that part of Gippsland do not indicate that the well was sited on an anticlinal structure; in fact according to Fig. 4 (reproduced from Webb 1964) the well appears to be sited on a general "synclinal" structure, although it could be on a local high, but this does not appear to be probable.

A fault has been indicated immediately north of the wellsite (Webb 1964) and it appears that one or more may have been cut by the Lake Reeves No.1. Well. Minor recemented fault planes were recorded in Core No.3. (within the Strzelecki Group) as well as slickensided surfaces.

Although only 3 cores were cut, it was concluded that bedding is generally at a slight angle. The maximum angle recorded was approximately $20^{\circ}$; but this appeared to be locally affected and that the maximum average angle measured ( in the Strzelecki Group) is approximately $10^{\circ}$. A continuous dip-meter survey was also run; but the results have not yet become available.

The slickensides recorded in Core No.3. show transverse lineations across the general dip of the polished surfaces. If the core is orientated, it is certain that the slickensides may be used to help solve the structure of the area.

## 6. RELEVANCE TO OCCURRENCE OF PETROLEUM

For this purpose the sediments cut in the Lake Reeves No.1. Well may be divided into 4 units.

(i) Cover

This is the sand cover of Quaternary to Recent age. It is a veneer of unconsolidated aeolinitic sand which has

significance as to occurrence of petroleum.

(ii) The sand, fossiliferous limestone and marl sequence from approximately 60 feet to 2982 feet (to the bottom of the Lakes Entrance Formation).

This is a unit of marine origin. The sequence is predominantly permeable and is mainly saturated with water. The base of the unit is very glauconitic; and at Lakes Entrance approximately 7000 barrels of residual oil was recovered from an equivalent horizon (Boutakoff 1955). However, in the Lake Reeves No.1. Well no oil or gas was recorded while drilling the glauconitic section.

(iii) The lacustrine deposits belonging to the Latrobe Valley Coal Measures.

These are fresh or brackish water deposits comprising of fine to very coarse and pebble size quartz sand and poorly consolidated lignitic sandstone and siltstone, with interbeds of clay, shale, lignite and coal.

Gas kicks were recorded within this unit, and it seems possible that commercial accumulation of gas may be located in these sediments elsewhere in the Gippsland Basin. Also residual oil has been recorded in the upper part of the unit (Boutakoff 1955). It seems likely that if suitable structure is located, sediments from this unit may be worthy of careful investigation.

(iv) The Lower Cretaceous - Upper Jurassic sandstone and greywacke (Strzelecki Group)

The upper part of this unit (5265 - 6030 feet) contains permeable horizons which under favourable structural conditions could contain oil or gas accumulations. The reservoir characteristics of these permeable horizons are also enhanced by the presence in the Lake Reeves No.1. Well of interbeds of poor to tight porosity sediments.

## 7. POROSITY AND PERMEABILITY

Most of the post-Cretaceous sediments appear to be relatively porous and permeable. Some of the Upper members of the Cretaceous - Jurassic sediments are also relatively permeable. The electric logs indicate that there are several such horizons above 6030 feet. Below 6030 feet the cuttings and electric logs generally indicate poor porosity for most of the section.

## 8. CONTRIBUTION TO GEOLOGICAL CONCEPT RESULTING FROM DRILLING

Several wells had previously been drilled in this part of the Gippsland Basin, and the generalized stratigraphic column had already been established. However, the drilling of the present well has contributed the following information as to the nature and behavior of the sediments filling this part of the basin.

The well was a test for a supposed fault trap. No commercial oil or gas reservoirs were found.

It provided the depths at which the major litholigic units were cut. This includes the Lakes Entrance - Latrobe Valley Coal Measures and the Latrobe Valley Coal Measures - Strzelecki Group contacts - both important marker horizons necessary for re-assessment of existing geophysical work and in the interpretation of future seismic and gravity surveys.

The base of the Lakes Entrance formation was accurately recorded. For future logging it should be noted that the base can be easily picked by slowing down drilling when the glauconite content of the marl reaches high proportion ( in excess of 5%). The actual base in the Lake Reeve No.1. Well was represented by a thin ( a few feet) medium grained sandstone lens. Unless drilling is very slow this would be penetrated before the cuttings reach the surface. However, the contact could possibly be cored in future near-by wells if it is kept in mind that the glauconitic horizon here is approximately 60 feet thick. Perhaps cutting a 20 feet core after 40 or 50 feet of glauconitic marl is drilled will straddle the contact.

The Latrobe Valley Coal Measures - Strzelecki Group contact was not picked from the cuttings as the conglomeratic horizon indicated in the Carr's Creek No.1. Well, approximately 3 miles north, did not exist in the present well. However, for future logging the contact may be recognised when the cuttings change from kaolinitic sand to light grey friable sandstone containing appreciable quantities of green reworked shale grains and carbonaceous grains as well as quartz grains.

Gas was recorded in the upper part of the Latrobe Valley Coal Measures and although the drill stem tests failed to produce a flow, equivalent intervals at which the gas kicks were recorded, should be considered in any future drilling.

V. REFERENCES:


| | | |
|---|---|---|
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# APPENDIX NO.1.

## CORE DESCRIPTIONS

## LAKE REEVE NO.1. WELL

**CORE NO.1.** 2984' - 2996' Recovered 1'.
Entire core recovered was:
Sand; medium grey, fine to fine-medium, angular to subrounded, generally clean, but slightly calcareous. Unconsolidated, very friable. Composed of quartz grains with minor amounts of glauconite, white feldspar grains?, mica flakes and traces of reworked coal grains. No bedding recorded. No oil or gas shows recorded.

**CORE NO.2.** 6080' - 6096 Cored 16 feet, recovered 14 feet. (86% recovery.)

Top 2'3" SUB-GREYWACKE: Green-grey, fine to coarse grained, subangular to subrounded, poor to fair sorting, cemented with kaolinitic and chloritic cement. Consolidated, but friable on sharp edges. No bedding apparent. Composed of quartz grains, reworked shale and other rock grains, low rank coal grains (vitrain and macerated material) feldspar grains, mica flakes and red-brown rock grains. Approximate estimates of constituents are, quartz 70%, coal 10%, matrix 10%, shale 5%, other 5%. Also contains clay pellets and blebs up to $\frac{3}{4}$" diameter. Poor porosity.

2'5" SUB-GREYWACKE; as above; but slightly coarser grained, fine to fine pebbles, but main distribution is medium to coarse. Clay/shale pellets and blebs up to 2" diameter near the bottom of the unit where it accounts for approximately 15% of the rock. A portion is green-grey clay as for top unit, rest is dark green-grey, with traces of bedding. Some fine coal laminae. Porosity, poor. Bedding indistinct, may be approximately 5 degrees.

1'7" SUB-GREYWACKE; as for top unit, but contains slightly more matrix. Clay/shale pellets and blebs occur mainly near the bottom of the unit, where they may be up to $2\frac{1}{2}$" diameter. Coal fragments up to $\frac{3}{4}$" and commonly $\frac{1}{4}$" are abundant along bedding planes. Porosity poor.
Indistinct bedding (probably current bedding) 10-15 degrees.

7" SUB-GREYWACKE; as for top part of unit 3 (Next 1'7") above.

10" SUB-GREYWACKE; as above, but slightly lighter coloured. Constituents approximately, quartz 65%, coal 10%, shale 5%, other 5%, cement 15%. Slightly harder and less friable than previous. Porosity poor, dip 5 degrees.

4'6" SUB-GREYWACKE; as for unit 3 (Next 1'7") above. Strongly developed bedding planes; marked by coal-rich laminae. Dip 5 degrees. Mica flakes more abundant.

1'5" SUB-GREYWACKE; medium green-grey, fine to coarse-medium, subangular to subrounded, poor to fair sorting, medium hard to hard. Composed of approximately 65% quartz, 10% coal, 5% shale, argillaceous matrix 10%, calcareous cement 10%. The calcareous cement is predominantly calcite. Porosity very poor to tight.

Bottom 5" SUB-GREYWACKE; as above, but slightly coarser, less calcite, slightly softer than unit immediately above.

Throughout the entire core, no oil or gas shows were recorded. Bedding is generally of the order of 5 degrees.

CORE NO.3. 6620' - 6635' Cut 15' recovered 13'6" (90%) recovery).

Top 10" GREYWACKE; light grey, fine grain, medium hard. Contains quartz grains, white feldspar grains, medium/grey rock grains, with minor amounts of mica (biotite) and traces of carbonaceous grains in a tight, non-calcareous, argill.matrix. Sorting is fair to good.

Bedding dips approximately 15 degrees in the middle of the unit, and approximately 20 degrees at the base of the unit. A well developed parting was recorded cutting the short axis of the core at an angle of approximately 60 degrees.

4'6" GREYWACKE; light to medium grey, medium to medium-coarse grain, soft to medium hard, fairly friable. Contains poorly sorted angular to sub-angular quartz grains, white feldspar (partly weathered) grains, grey reworked shale grains, (mainly rounded), light brown rock grains, biotite and muscovite flakes, and rare carbonaceous grains, in a silty and argill. matrix. Porosity poor.

Slickensides common. Also minor faulting, as indicated by slightly different lithology cut off by recemented slickensided surfaces. The

main partings fall into two directions, each makes an angle of approximately 60 degrees to the short axis of the core, and often intersect each other to form an "X" pattern.

1'8" SILTSTONE; medium grey, medium hard, shaly. Contains quartz, and feldspar silt and fine mica flakes in an argill. matrix. Lignite fragments up to 1" long are very abundant, especially along bedding planes. Very poor to tight porosity.

Slickensides are common. Minor partings almost parallel to the long axis of the core. Some partings contain wavy concentrations of white flakey ? gypsum. Bedding dips approximately 10 degrees.

1'4" GREYWACKE; Light to medium grey, medium grained, soft to medium hard, friable. Contains poorly sorted angular to subrounded quartz grains, white feldspar grains, rounded rock grains, biotite, muscovite, and rare carbonaceous grains in a silty and argillaceous matrix. Porosity poor.

Slickensides common; minor changes in lithology across partings indicates faulting. Partings are approximately 70 degrees to the short axis of the core.

3'6" GREYWACKE; As for unit 2 above, but slightly more variable in grain size. Also contains traces of lignite streaks, some across bedding. Poor porosity.

Bottom 1'8" GREYWACKE; light to medium grey, medium grain, hard, only semifriable; contains quartz, feldspar, rock grains, mica flakes and carbonaceous grains, as above. Porosity poor.

Slickensides common. Evidence of faulting, marked variation in the grain size of greywackes on either side of recemented faults. Slickensided surfaces are generally coated with a black (carbonaceous) film which reflect lineations clearly. The predominant slickensided surface cuts the short axis of the core with an angle of approximately 65 degrees. Lineations on the surfaces make an angle of approximately 30 degrees to the long axis of the slickensided surfaces. "X" patterns of partings and slickensided surfaces are common. Bedding is approximately 15 degrees.

Average bedding for the entire core is 10 degrees.

No oil or gas shows were recorded.

## SIDE WALL CORES

| Depth | LITHOLOGY |
|---|---|
| 4110 ft. | SAND; quartzose, light grey, coarse to pebbly grained subrounded, argillaceous. Poor sorting. |
| 4250 ft. | SAND; quartzose, white to grey. Medium to coarse grained. Composed of poorly sorted subangular grains with minor amounts of carbonaceous matter and trace of mica flakes in a slightly argillaceous matrix. |
| 4420 ft. | SAND; quartzose, light grey, fine to very coarse and pebbly but mainly medium grained argillaceous. Poorly sorted. |
| 4494 ft. | SILTSTONE; white to light grey, soft to medium hard, argillaceous, trace porosity. |
| 5020 ft. | SHALE-SILTSTONE; dark brown-grey, medium hard, slightly sandy with occasional quartz grains. Contains thin lignitic lenses. Porosity trace to tight. |
| 5230 ft. | SAND; quartzose, white, medium grained, subangular to subrounded, argillaceous. Poor sorting. |
| 5290 ft. | SANDSTONE; light grey, fine to medium grained, composed of subrounded quartz grains, green-grey and grey reworked shale grains, carbonaceous grains and biotite flakes in a kaolinitic cement. Fair to poor porosity. |
| 5305 ft. | SANDSTONE; light grey, medium grained, soft to medium hard, composed of poorly sorted subrounded quartz grains, carbonaceous grainsand mica flakes in an argillaceous matrix. |
| 5420 ft. | SANDSTONE; light green-grey, fine to medium grained, composed mainly of poorly sorted subrounded quartz grains, grey shale grains and red rock grains with biotite grains in an argillaceous matrix. Porosity fair to poor. |
| 5435 ft. | SANDSTONE; light green-grey, as above |
| 5485 ft. | SANDSTONE; light green-grey, fine to medium grained soft. Composed of poorly sorted subrounded quartz grains, grey shale grains, red rock fragments, white feldspar (partly weathered) and biotite in an argillaceous matrix. Poor to fair porosity. |
| 5530 ft. | SANDSTONE; green-grey, fine to medium grained. Composed of subangular to subrounded quartz grains, grey shale grains, white feldspar grains, and |

other rock fragments in an argillaceous and chloritic matrix. Sorting poor to fair. Porosity poor.

5620 ft. SILTSTONE; light-grey, medium hard. Composed of quartz grains in an argillaceous matrix. Poor to trace porosity.

5715 ft. SANDSTONE; green-grey, fine to medium grained. Composed of subangular subrounded quartz grains, grey shale grains, feldspar, other rock grains, mica and carbonaceous grains in a slightly chloritic and calcareous, argillaceous matrix. Sorting poor to fair, porosity poor.

5860 ft. SILTSTONE; light grey, soft to medium hard, earthy in patches. Composed of subrounded quartz grains in an argillaceous matrix. Porosity poor.

5950 ft. SANDSTONE; green-grey, fine to course grained, predominantly medium grained. Composed of angular to subrounded quartz grains, grey shale grains, white feldspar grains, mica flakes, carbonaceous grains and other rock grains in a slightly chloritic argillaceous matrix. Sorting poor. Porosity poor.

6000 ft. SANDSTONE; light green-grey, very fine to medium grained. Composed of angular to subrounded quartz grains, green-grey shale grains, white feldspar grains, mica flakes, carbonaceous grains and other rock fragments in a slightly chloritic matrix. Sorting is poor. Porosity poor.

PE906138

This is an enclosure indicator page.
The enclosure PE906138 is enclosed within the container PE902950 at this location in this document.

The enclosure PE906138 has the following characteristics:

| | |
|---|---|
| ITEM_BARCODE | = PE906138 |
| CONTAINER_BARCODE | = PE902950 |
| NAME | = Locality Map |
| BASIN | = GIPPSLAND |
| PERMIT | = PEP160 |
| TYPE | = WELL |
| SUBTYPE | = PROSPECT_MAP |
| DESCRIPTION | = Locality Map showing Lake Reeve-1 |
| REMARKS | = |
| DATE_CREATED | = 30/04/1965 |
| DATE_RECEIVED | = 07/03/1986 |
| W_NO | = W489 |
| WELL_NAME | = LAKE REEVE-1 |
| CONTRACTOR | = |
| CLIENT_OP_CO | = WOODSIDE OIL COMPANY |

(Inserted by DNRE - Vic Govt Mines Dept)

PE906139

This is an enclosure indicator page.
The enclosure PE906139 is enclosed within the container PE902950 at this location in this document.

The enclosure PE906139 has the following characteristics:

| | |
|---|---|
| ITEM_BARCODE | = PE906139 |
| CONTAINER_BARCODE | = PE902950 |
| NAME | = Time-Depth Curve |
| BASIN | = GIPPSLAND |
| PERMIT | = PEP160 |
| TYPE | = WELL |
| SUBTYPE | = VELOCITY_CHART |
| DESCRIPTION | = Time-Depth Curve for Lake Reeve-1 with interpretation. |
| REMARKS | = |
| DATE_CREATED | = |
| DATE_RECEIVED | = |
| W_NO | = W489 |
| WELL_NAME | = LAKE REEVE-1 |
| CONTRACTOR | = |
| CLIENT_OP_CO | = WOODSIDE OIL COMPANY |

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PE602049

This is an enclosure indicator page.
The enclosure PE602049 is enclosed within the container PE902950 at this location in this document.

The enclosure PE602049 has the following characteristics:

| | |
|---|---|
| ITEM_BARCODE | = PE602049 |
| CONTAINER_BARCODE | = PE902950 |
| NAME | = Composite Well Log |
| BASIN | = GIPPSLAND |
| PERMIT | = PEP/160 |
| TYPE | = WELL |
| SUBTYPE | = COMPOSITE_LOG |
| DESCRIPTION | = Composite Well Log Lake Reeves No 1, sheet 1 of 2, (enclosure from WCR) |
| REMARKS | = |
| DATE_CREATED | = 26/04/1965 |
| DATE_RECEIVED | = |
| W_NO | = W489 |
| WELL_NAME | = Lake Reeve-2 |
| CONTRACTOR | = Woodside oil co NL |
| CLIENT_OP_CO | = Woodside oil co NL |

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PE602704

This is an enclosure indicator page.
The enclosure PE602704 is enclosed within the container PE902950 at this location in this document.

The enclosure PE602704 has the following characteristics:

| | |
|---|---|
| ITEM_BARCODE | = PE602704 |
| CONTAINER_BARCODE | = PE902950 |
| NAME | = Lake Reeve 1 Composite well log sheet 2 of 2 |
| BASIN | = GIPPSLAND |
| PERMIT | = PPL160 |
| TYPE | = WELL |
| SUBTYPE | = COMPOSITE_LOG |
| DESCRIPTION | = Lake Reeve 1 Composite well log sheet 2 of 2 (enclosure from WCR) |
| REMARKS | = |
| DATE_CREATED | = 26/04/65 |
| DATE_RECEIVED | = 17/03/86 |
| W_NO | = W489 |
| WELL_NAME | = Lake Reeve-1 |
| CONTRACTOR | = Schlumberger |
| CLIENT_OP_CO | = Wooside (Lakes Entrance) Oil Company N.L |

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