COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1964/192

EXPERIMENTAL "VIBROSEIS" SURVEY, MAITLAND AREA, NSW 1964

FINAL PROGRESS REPORT

ON AN

EXPERIMENTAL "VIBROSEIS"* SEISMIC SURVEY

CONDUCTED IN

THE CITY OF MAITLAND AREA

OF

THE SYDNEY BASIN

NEW SOUTH WALES

FOR THE

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

BY

SEISMOGRAPH SERVICE LIMITED

DURING

SEPTEMBER - OCTOBER, 1964

* A Trademark of Continental Oil Company

C O N T E N T S.

SYNOPSIS

An Experimental "Vibroseis" Seismic Survey was conducted in the Maitland Area of the Sydney Basin in New South Wales by Seismograph Service Limited, Party 243 on behalf of the Bureau of Mineral Resources, Geology and Geophysics; the survey occupied six working days during the period from September 28th to October 3rd, 1964.

The objective of the Built-Up Area Project was to assess the Vibroseis Method in an area of dense population and building where conventional shot-hole seismic methods would be impracticable.

The survey was conducted along main roads and was located entirely within the limits of the City of Maitland.

The results of the survey show that data was obtained to depths of approximately 8,000 feet and over the major part of the traverse, a strong and continuous reflector was recorded at depths which varied between 4,800 and 5,400 feet and which probably corresponds to the Greta Coal Measures.

This Final Progress Report is based on a preliminary study of the results; a final interpretative report will be submitted upon the completion of the entire experimental survey of which this project forms a part.

The results of the survey are presented in variable area cross-sectional form for this report. The Progress Report which was submitted during the course of the Built-Up Area Project is available at the office of the Bureau of Mineral Resources.

GEOLOGY AND PREVIOUS GEOPHYSICS

GEOLOGY

The City of Maitland is located in the northern part of the Sydney Basin.

The Sydney Basin probably originated during the early Permian and continued as a gradually sinking, but predominantly shallow water basin through to Triassic time. Two major transgressive cycles are present. An early marine phase is succeeded by a continental coal measure sequence, a marine phase and finally a continental sequence, the lower part of which contains Permian coal measures and the upper part of which is Triassic.

The Permian normally passes, without any apparent depositional break, into the lower beds of the Triassic Narrabeen Group; however, in at least one place, an angular unconformity is present at this boundary.

The Sydney Basin is flanked on the north, south and west by Carboniferous, Devonian and Lower Palaeozoic rocks and it is truncated in the east by the coastline. The Triassic System forms a blanket cover and the Permian rocks are exposed only on the periphery.

The Lochinvar Anticline forms the most prominent uplift in the northern part of the Basin and East

Maitland No. 1 Bore was drilled on a gentle fold located in a graben which, in the west is faulted against the Lochinvar structure by the Buchanan Fault.

In East Maitland No. 1, petroleum source rocks are present in considerable thickness but no potential reservoirs were encountered.

PREVIOUS GEOPHYSICS

The only previous seismic work carried out in the area was a reflection survey made between January and April 1962, by Namco International Inc. for Planet Exploration Co. Pty. Ltd. One strong and continuous reflector was mapped in the area and this was shown to correspond to the Greta Coal Measures by a subsequent velocity survey and sonic log in the East Maitland No. 1 Bore.

Complete seismic coverage of the area was not possible because of the large areas of swamp, the high density of residential areas and a number of near surface coal mines in the area.

The standard field technique utilised a 1,320 feet straddle spread, 12 geophones per trace and an average charge size of 25 lbs. in a single deep hole. Some improvement in record quality was obtained when 3 holes in a linear pattern were used. Recordings were made on magnetic tape with a wide filter band and were then played back through a 17-52 cycles per second filter with 25% mixing of traces.

OBJECTIVES

Conventional Seismic methods require the detonation of explosive charges in shot-holes and therefore cannot operate within built-up areas without causing damage to property and disruption of the normal towns activities.

A large portion of the Sydney Basin is heavily built-up and densely populated and it has not therefore been practical to conduct seismic traverses within these areas by means of the conventional method.

The Vibroseis method however can operate in built-up areas without any risk of causing damage and the objective of this project was to assess the results of the method in such areas.

The location chosen was the City of Maitland and the Vibroseis traverse was sited to straddle the city and bridge the gap between two previous conventional seismic traverses which could not otherwise have been tied together.

PROGRAMME

The location of the Vibroseis traverse is shown on the Location Maps, Enclosure Nos. 1 and 2, and in greater detail on Enclosure No. 3 which shows the location of the traverse superimposed on a street map of the City of Maitland.

The traverse passed through the heavily built-up areas of East Maitland, Maitland and Telarah and was sited largely along the New England Highway and the Maitland By-Pass.

A total of six days was worked on the project.

RESULTS

The results are presented in Variable Area Section form on Enclosure No. 4 to this report.

The technique employed was a transposed method employing a vibrator pattern length of 132 feet, a nominal geophone pattern containing 360 geophones of length 400 feet, one spread (1320 - 2640 feet) offset, 10 sweeps per trace and a sweep frequency of 14-40 cycles per second. During the course of the work the nominal geophone pattern length was increased to 600 feet and the vibrator pattern length to 396 feet.

For operational reasons such as the presence of buildings and road intersections, it was not always possible to conform to the optimum geophone patterns indicated above and several profiles were produced with shorter geophone pattern lengths and sometimes with the number of geophones reduced. The quality of the results was little affected by these changes in technique. It was found to be preferable to move the geophones as far from the road as possible in order to reduce the traffic noise recorded and in order to achieve this some pattern dimensions were changed.

The results show one horizon with good continuity

over most of the section. At the south east end of the section, this horizon is at a reflection time of 0.84 seconds which corresponds to a depth of 5,800 feet and may therefore be related to the Greta Coal Measures which, 1¼ miles to the east, at East Maitland No. 1 are at a depth of 4,618 - 4,762 feet. The previous conventional results indicated steep west dip between the bore and the south eastern extremity of the Vibroseis section.

Between V.P. 1883 and V.P. 1869, this horizon is continuous and shows approximately 1,000 feet of SE dip; however the Greta Coal Measures are known to out-crop in the vicinity of V.P. 1865 - V.P. 1866 and therefore faulting must be postulated between V.P. 1869 and V.P. 1866 with an overall throw of approximately 4,800 feet.

At V.P. 1869, continuity on the seismic section is interrupted but futher west between V.P. 1868 and V.P. 1865, several shallow horizons can again be followed which exhibit steep east dip.

Between V.P. 1881 and V.P. 1873, a deeper reflection band at times of 1.1 - 1.2 seconds also shows fair continuity; this corresponds to depths of 8,000 - 8,800 feet.

CONCLUSIONS

The Vibroseis results have demonstrated that the method is capable of obtaining acceptable data within the confines of a heavily populated built up area and under high traffic density conditions.

On the traverse through Mailtand, a good quality reflector was recorded at reflection times varying between 0.70 and 0.84 seconds; this reflector probably corresponds to the Greta Coal Measures; in addition deeper reflections can be discerned to times of 1.1 - 1.2 seconds which correspond to depths of 8,000 - 8,800 feet.

The results of the traverse predict a major fault in the region of V.P. 1866 - V.P. 1869 which has a throw of approximately 4,800 feet and is probably the northern extension of the Buchanan Fault.

Due to the very high random noise level resulting from operation along roads carrying heavy and continuous traffic; the successful recording of seismic data necessitates the compositing of a greater number of samples than would be the case in open country where the ambient noise level would be lower, hence the geophones were planted as far from the road as possible in order to reduce the recorded traffic noise. Even so an average production rate of 1¼ miles per day was achieved through the built up area surveyed.

ACKNOWLEDGEMENTS

The information in the section on 'Geology and Previous Geophysics' has been abstracted from the 'East Maitland No. 1 Well Completion Report' for Planet Exploration Co. Pty. Ltd., by D. D. Hamling (Bullock and Associates) and M. G. McKellar (Planet Exploration Co. Pty. Ltd.) dated August 1963.

The Geological boundaries shown on the V.P. Location Map, have been obtained from the Geological Map, Enclosure No. 3 to the above Well Completion Report.

DISTRIBUTION

Bureau of Mineral Resources, Melbourne.	8 Copies
Seismograph Service Limited, London.	1 Copy
Seismograph Service Limited, Melbourne.	1 Copy
Party 243	1 Copy

December, 1964.

T. L. Kendall.
Party Chief,
Party 243,
Seismograph Service Limited.

LIST OF ENCLOSURES

No. 1 LOCALITY MAP.
Scale: 1 : 250,000

No. 2 V.P. LOCATION MAP
Scale: 1 inch to 1 mile

No. 3 MAP SHOWING SEISMIC LINE LOCATION
Scale: 2½ inches to 1 mile

No. 4 VARIABLE AREA SECTION, BUILT UP AREA, V.P.'s 1865 - 1891A

151° 20′

151° 40′

152° 00′

32° 30′

32° 45′

33° 00′

BRANXTON

CLARENCE TOWN

PORT STEPHENS

MAITLAND

KURRI KURRI

CESSNOCK

LOCATION MAP
BUILT-UP AREA
ENCLOSURE 2

NEWCASTLE BIGHT

NEWCASTLE.

SEISMOGRAPH SERVICE LIMITED
LONDON ENGLAND
FOR BUREAU OF MINERAL RESOURCES

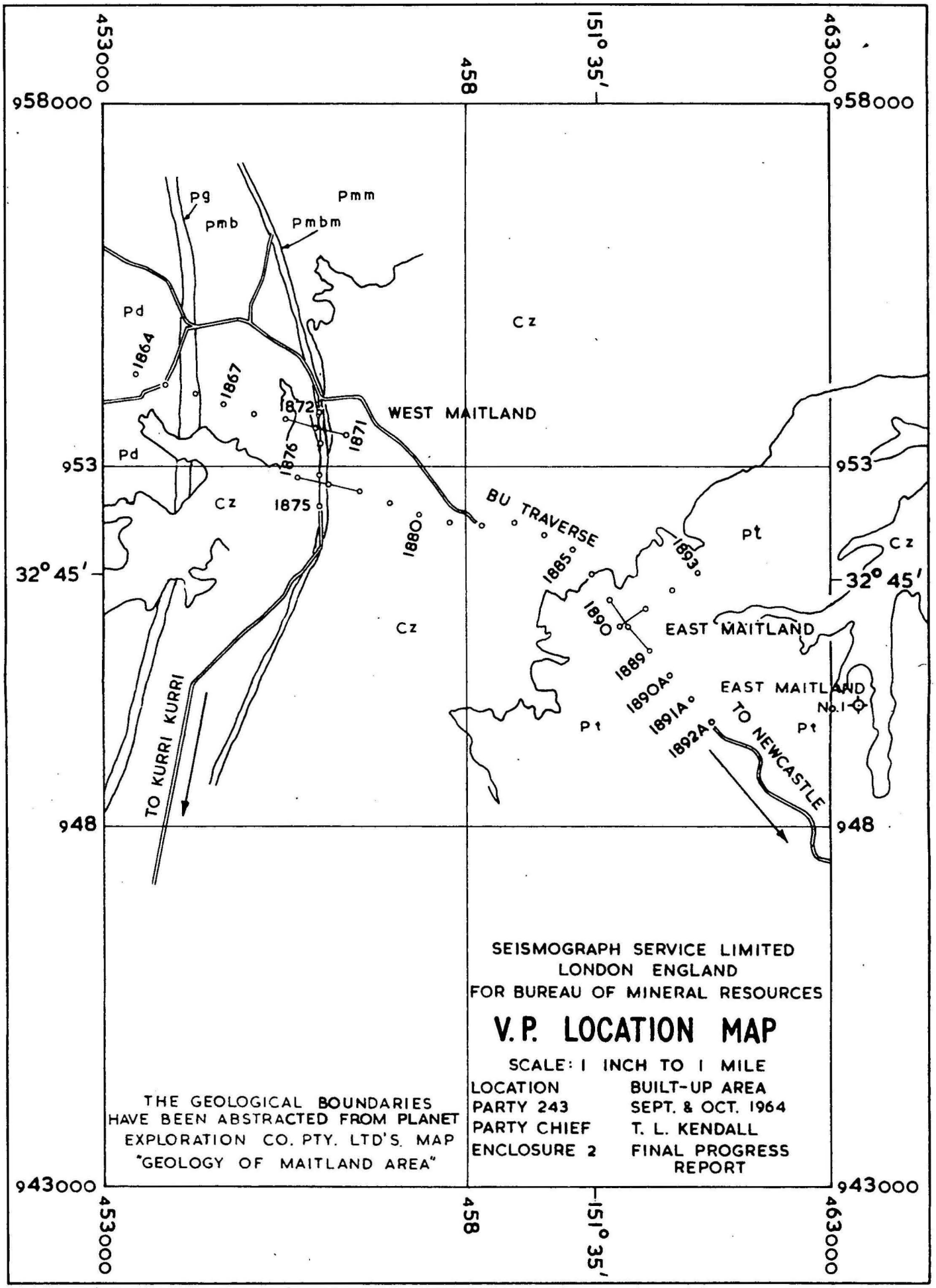
LOCALITY MAP

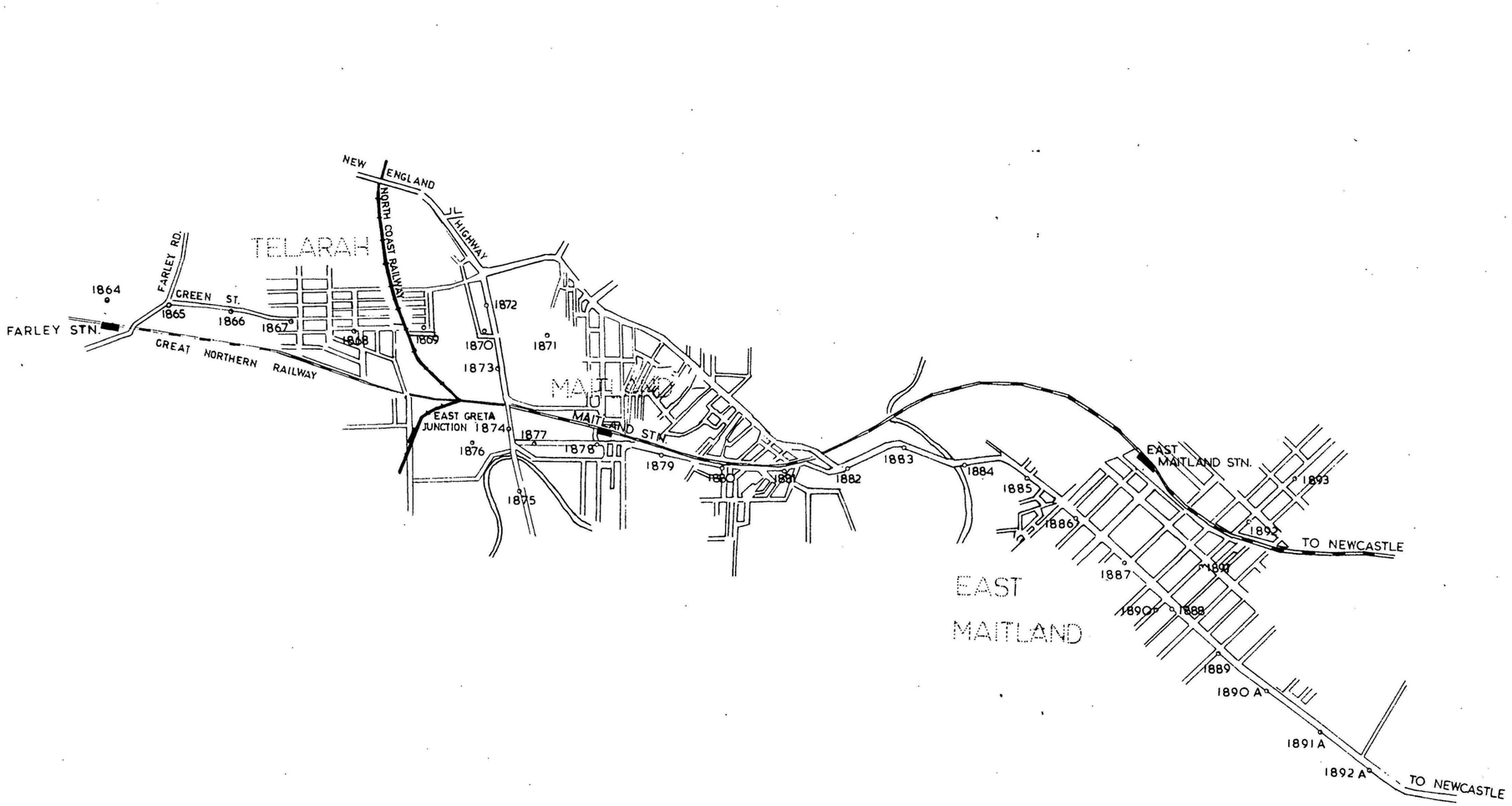
EXPERIMENTAL VIBROSEIS SURVEY

BUILT-UP AREA PROJECT

FINAL PROGRESS REPORT. ENCLOSURE 1.

SCALE 1 : 250,000


453000
458
151° 35'
463000
958000
953
32° 45'
948
943000
Pg
Pmb
Pmbm
Pmm
Pd
Cz
Pt
1864
1867
1872
1871
1876
1875
1880
1885
1893
1890
1889
1890A
1891A
1892A
WEST MAITLAND
EAST MAITLAND
EAST MAITLAND No.1
BU TRAVERSE
TO KURRI KURRI
TO NEWCASTLE
SEISMOGRAPH SERVICE LIMITED
LONDON ENGLAND
FOR BUREAU OF MINERAL RESOURCES
V.P. LOCATION MAP
SCALE: 1 INCH TO 1 MILE
LOCATION BUILT-UP AREA
PARTY 243 SEPT. & OCT. 1964
PARTY CHIEF T. L. KENDALL
ENCLOSURE 2 FINAL PROGRESS REPORT
THE GEOLOGICAL BOUNDARIES HAVE BEEN ABSTRACTED FROM PLANET EXPLORATION CO. PTY. LTD'S. MAP "GEOLOGY OF MAITLAND AREA"
Pt TOMAGO COAL MEASURES
Pmm MULBRING SILTSTONE
Pmbm BRANXTON FORMATION
Cz RIVER ALLUVIUM
Pg GRETA COAL MEASURES
Pd DALWOOD GROUP



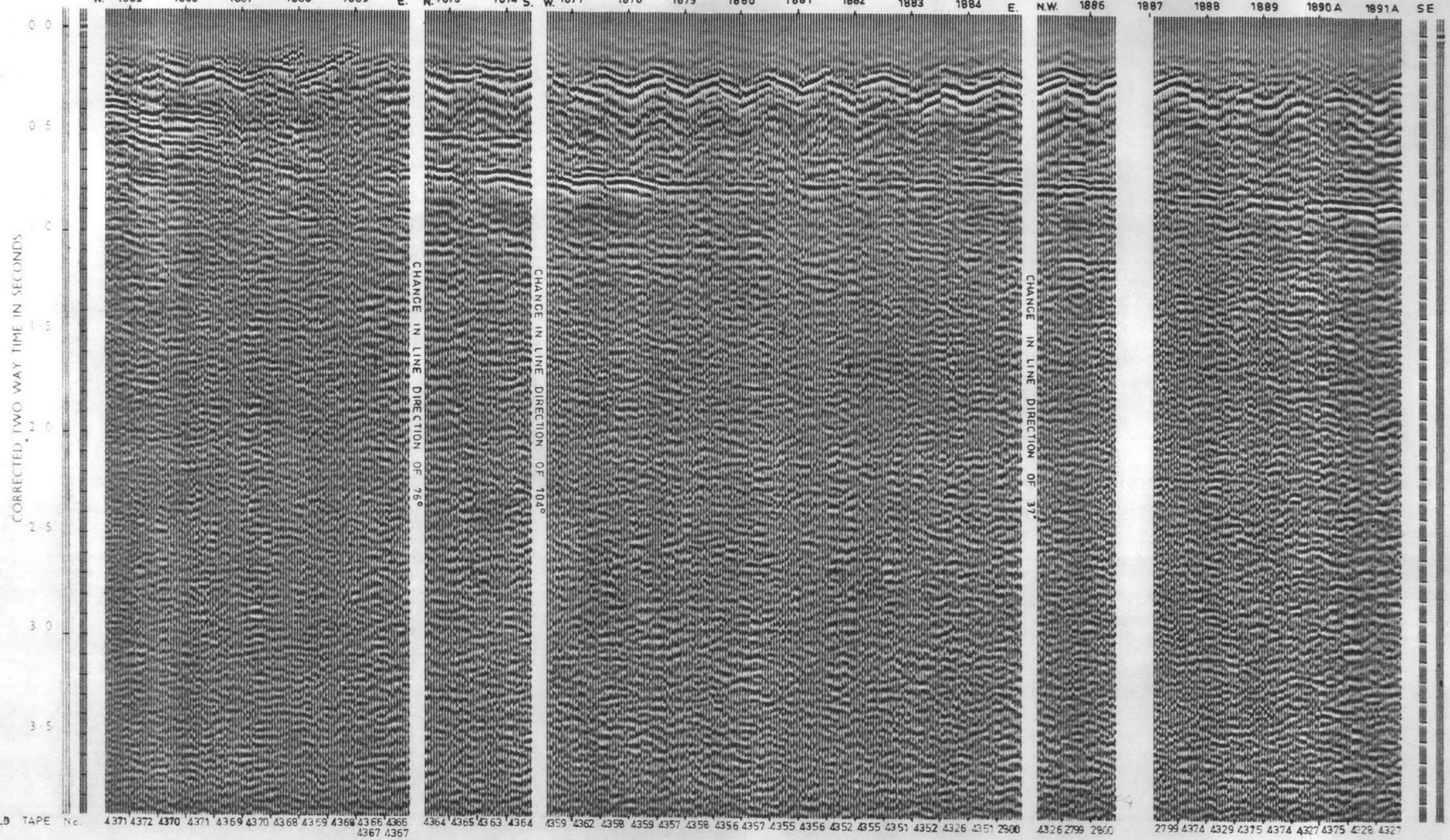
SEISMOGRAPH SERVICE LIMITED
LONDON ENGLAND

FOR BUREAU OF MINERAL RESOURCES

MAP SHOWING
SEISMIC LINE
LOCATION IN BUILT-UP AREA

LOCATION	MAITLAND
SCALE	2·5 INCHES TO 1 MILE
PARTY CHIEF	T. L. KENDALL
PARTY 243	DATE SEPTEMBER - 1964
ENCLOSURE No. 3	FINAL PROGRESS REPORT

LINE B.U.



SEISMOGRAPH SERVICE LIMITED
LONDON ENGLAND

VARIABLE AREA CROSS-SECTION
VIBROSEIS®
FOR BUREAU OF MINERAL RESOURCES

BUILT-UP AREA

LINE B.U. S.P.'S. 1865 - 1891A	
VELOCITY DISTRIBUTION	Vi = 12000 + 6z
WEATHERING VELOCITY (V_w)	-
HORIZONTAL VELOCITY (V_h)	-
ELEVATION VELOCITY (V_e)	10000 F/SEC.
WEATHERING METHOD	-
HORIZONTAL SCALE 1": 2400'	DATUM M.S.L.
TYPE OF PROFILING	TRANSPOSED
TRACE INTERVAL	132'
OFFSET DISTANCE	1386'-2574' & 2706'-3894'
No. AND TYPE OF VIBRATORS	3
SWEEP FREQUENCY 14-40	No. OF SWEEPS 10
PLAYBACK FILTER	OUT - 42
MIXING	3/2 COMPOSITED

VIBRATOR PATTERN:

1888W - 1891A W 396' IN LINE
1865W - 1877E 132' IN LINE

GEOPHONE PATTERN:

RECTANGULAR

PARTY 243	DATE NOVEMBER - 1964
ENCLOSURE No. 4	FINAL PROGRESS REPORT

SSL 94A. ®A TRADE MARK CONTINENTAL OIL CO.