COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF SUPPLY AND SHIPPING.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

REPORT No. 1948/4.

(GEOPHYSICAL REPORT NO. 1948/1.)

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PRELIMINARY REPORT

ON

GEOPHYSICAL SURVEY TO THE NORTH OF LEIGH CREEK COALFIELD, S.A.

C. H. ZELMAN

GEOPHYSICIST

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF SUPPLY AND SHIPPING

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Melbourne,
28th January, 1948.

PRELIMINARY REPORT

GEOPHYSICAL SURVEY TO THE NORTH OF LEIGH CREEK COALFIELD, S.A.

I. INTRODUCTION.

The Leigh Creek Coalfield is approximately 350 miles north of Adelaide, and is traversed by the railway from Port Augusta to Alice Springs.

Coal seams of economic importance are known to occur in two basins about 5 miles apart. One basin has been worked by open cut methods since 1944 and arrangements are in hand for opening the other at an early date.

Immediately to the north of the known coal basins is an area of some hundred or more square miles, much of which is covered by a thin layer of rocks younger than the coal measures. Other coal basins could exist beneath this cover, but the task of prospecting for them by drilling only is a formidable one. Nevertheless, it is considered necessary to the sound development of the coalfield as a whole, that the prospecting of this area should be completed at an early date.

Such prospecting can be greatly accelerated by the use of geophysical methods which outline hidden sedimentary basins. In 1946 a gravity survey (I) was conducted by this Bureau to mark the limits of the coal seams in the Northern Basin. This survey demonstrated the usefulness of the gravimetric method in this class of prospecting. The efficacy of this method in the more general problem of outlining the basins themselves has been demonstrated by work done on the Collie Coalfield, W.A. (II).

(I) Gravity Survey Leigh Creek, S.A.
R.P. Thyer, J.C. Dooley,
Bureau of Mineral Resources, Geology and Geophysics,
Report No. 1946/29.

(II) Geophysical Survey of the Collie Coal Basin,
N.O. Chamberlain, Bureau of Mineral Resources,
Geology and Geophysics, Report No. 1947/59.

The present survey was undertaken at the request of the South Australian Government and was carried out during October, November and December, 1947, by officers of this Bureau. The following report is a preliminary one since the analysis of the results is not complete. However, sufficient work has been done to make possible the selection of sites for test drill holes.

The co-operation and assistance of members of the staffs of the South Australian Department of Mines, and of the Engineering and Water Supply Department are gratefully acknowledged.

II. GEOLOGY.

The known coal deposits of the Leigh Creek area are of Triassic age and occur in basins in Precambrian rocks. These rocks are mainly shales, slates and quartzites, and they form the basement of the area. They outcrop around the known coal basins and form rugged hills to the east, south and west of the area. Geological mapping to date has shown the existence of three separate basins, called the Southern, Central or Telford, and the Northern basins. The Southern basin near Copley contains no useful coal. The Telford basin is now being worked by open cut methods along its northern edge where the coal comes close to the surface. The Northern basin is shallow and the coal it contains can all be recovered by open cut mining methods. The Telford and Northern basins contain the known coal reserves of the field.

To the north of the Northern basin the Precambrian basement rocks and the Triassic coal measures should any exist, are covered by a thin layer of Cretaceous sediments which form a low tableland partly dissected by tributaries of Leigh Creek. It was over this area that the major portion of the geophysical survey was carried out.

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III. THE GEOPHYSICAL METHOD AND ITS APPLICATION TO THE PROBLEM.

The problem to be solved by geophysical means was that of detecting concealed basins in the basement rocks, and, if possible, to estimate the thickness of the covering sediments.

The gravity method was chosen because tests on the Northern basin by R.F. Thyer and J.C. Dooley (I) in 1946 had shown that this method was the most useful of those tested. The instrument used in the present survey was a Heiland type GSC2 gravity meter which is more modern than the Humble meter used on the Northern basin.

Essentially, a gravimeter consists of sensitive spring balance which is used to weigh a small gold mass in different parts of the area surveyed. Variations in the gravitational attraction produce corresponding variations in the weight of the mass, so that the instrument measures variations in the gravitational attraction or "g". Such an instrument must be extremly sensitive and that used in this survey has a sensitivity of the order of one part in 50 millions. A more complete description of gravimetric instruments and their operation may be had in texts such as "Geophysical Exploration" by C.A. Heiland.

In field work, changes in "g" are measured at many stations over the area being surveyed. These measurements are corrected for instrumental drift, elevation and latitude at each station, the corrected values plotted and contours drawn on a plan of the area.

As Precambrian rocks are denser than the younger sediments overlying them, negative gravity anomalies may be expected over basins in the basement.

If the density difference between the basement rocks and the sediments overlying them is constant, then the gravity anomalies are related to the thickness of the overlying sediments. However changes in density in the basement rocks will give rise to anomalous gravity values, which could be confused with similar

(I) op. cit.

anomalies due to basins.

For this survey, the optimum station spacing was considered to be ½ mile in both directions. With this station density, a small basin of 1 mile diameter would have at least one station within it.

IV. RESULTS AND INTERPRETATION.

The results of the gravity investigation are shown as contours on the accompanying plan. The plan shows also stations where observations were made and suggested sites for testing by boring.

Outstanding features of the contour pattern are:-

a: A very strong negative anomaly of about 9 milligals over the deep Telford basin.

b: A weaker negative anomaly of about 2 milligals over the shallow Northern basin.

c: A strong negative anomaly of about 5 milligals with its centre about 2 miles W. S. W. from Lyndhurst Railway Station.

d: An area of weak negative anomaly in the vicinity of the Mundy Creek - Mount Fitton Road Crossing.

The anomalies observed over the Telford and Northern basins serve as a useful guide for interpretation of anomalies found during this or future surveys of the area.

The anomaly 2 miles W. S. W. of Lyndhurst is about half the intensity of that observed over the Telford basin and it is tentatively assumed that it is due to a basin about half the depth of the Telford basin. The terrain is rough, consisting of a series of hills remaining from the dissection of the tableland. A flood plain of Leigh Creek lies to the north of the anomalous area. To the south are wide low lying areas and some creek channels, with low tableland between them.

The low values observed near the Mount Fitton Road - Mundy Creek crossing apparently do not represent a basin, as Precambrian rocks outcrop in the creek and to the east of it.

The reason for this anomaly is probably a change in the density of the basement rocks.

V. TESTING.

It is possible, but not probable, that the Lyndhurst anomaly is due to a feature of the basement rocks other than a basin, but testing by boring will be the best means of deciding the matter. A suggested site for a bore is shown in Plate 1. This site is south of the centre of the anomaly in order to allow reasonable access for the drilling plant. Its position is 1⅔ miles true west of railway's 391 miles peg, and 0.75 mile true south of the trig station.

VI. CONCLUSIONS.

The geophysical survey to the north of Leigh Creek Coalfield has indicated the probable presence of a basin in the basement rocks, with its centre about 2 miles W. S. W. from Lyndhurst Railway Station. Such a basin may or may not contain coal seams and the method of using the gravity meter in this survey would give no indication of the presence of coal.

Drilling is recommended to confirm the presence of the basin, and to test for the existence of coal.

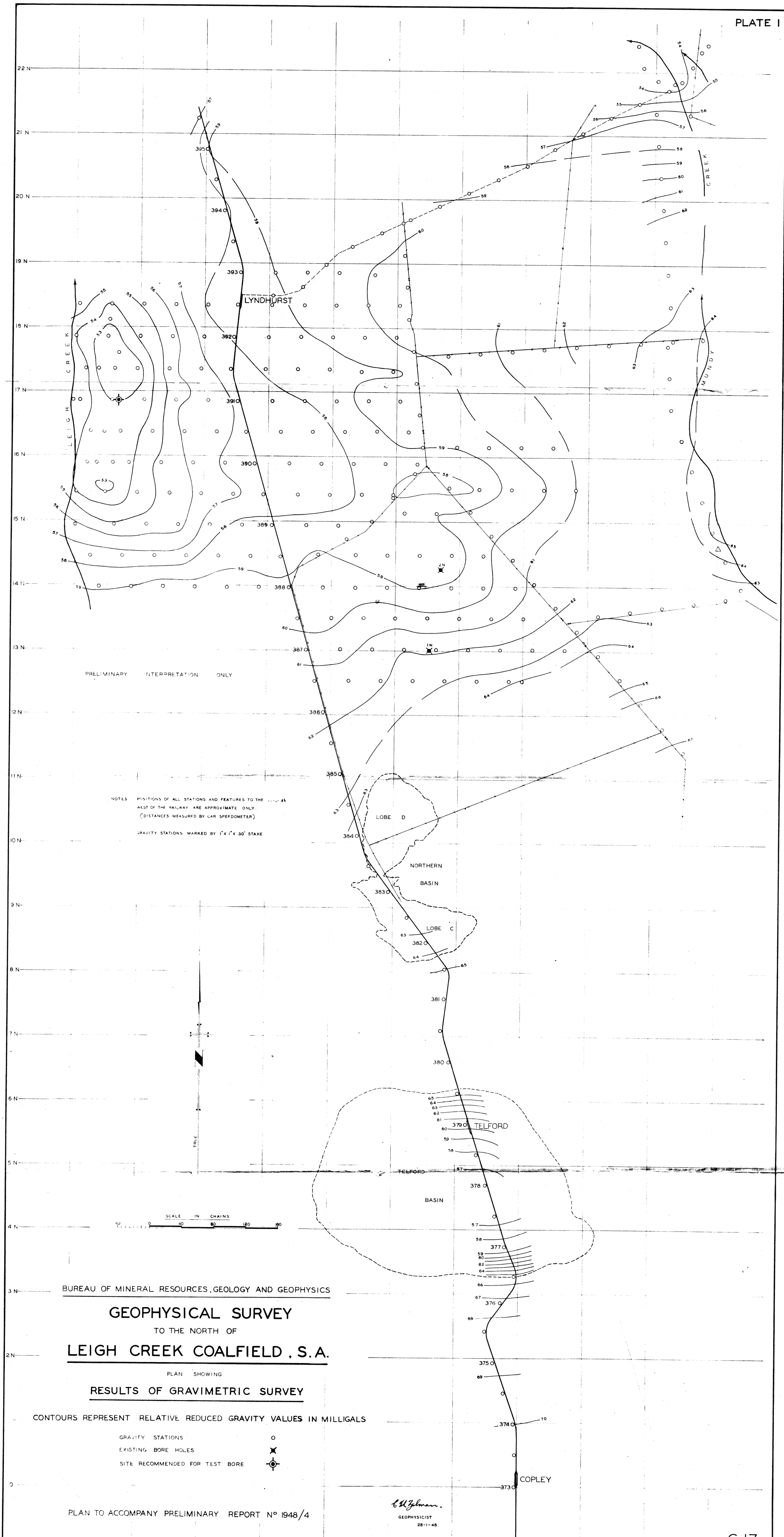
It is proposed to resume gravity surveys to the north of Leigh Creek early in 1949 and preferably after the drilling recommended above has been carried out since the results of this test may have a bearing on the planning of further field operations.

C. H. Zelman.

(C. H. ZELMAN),
Geophysicist.

Melbourne,
28th January, 1948.

PLATE I



BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOPHYSICAL SURVEY

TO THE NORTH OF

LEIGH CREEK COALFIELD, S.A.

PLAN SHOWING

RESULTS OF GRAVIMETRIC SURVEY

CONTOURS REPRESENT RELATIVE REDUCED GRAVITY VALUES IN MILLIGALS

GRAVITY STATIONS o

EXISTING BORE HOLES ×

SITE RECOMMENDED FOR TEST BORE ⊕

PLAN TO ACCOMPANY PRELIMINARY REPORT Nº 1948/4

E.W. Gilman.
GEOPHYSICIST
28-1-48.

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