SECTION

DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY
EXPLORATION SERVICES DIVISION

GRAVITY SURVEY OVER A SOLUTION CAVITY AT THE GLENCOE WEST OVAL. LATITUDE 37°40'; LONGITUDE 140°33'. PENOLA 1:250,000.

by

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EXPLORATION GEOPHYSICS SECTION

Rept.Bk.No.71/158

1st October, 1971

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ABSTRACT

A subsidence appeared over a suspected solution cavity at the Glencoe West Oval in August, 1971. A detailed gravity survey conducted over the oval showed anomalously negative values in the vicinity of the subsidence. A small gravity high in the centre of these negative values is attributed to denser volcanic material used to infill the hole.

Other anomalous areas have been detected: these may be sites where further subsidence may occur.

INTRODUCTION

On Saturday, August 15th, 1971 a hole appeared in the oval at Glencoe West, while a football match was in progress. Glencoe West is about 25 kilometres N.W. of Mt. Gambier, in the south east of South Australia. The hole was approximately 4 metres deep with a cross-sectional area of about 2 metres by 3 metres. At the request of the clerk of the district council of Tantanoola, B.M. Harris, Assistant Senior Geologist from the Mines Department branch office at Naracoorte inspected the site. His opinion was that the subsidence appeared to be related to solution effects in the underlying limestone. Although there was no surface evidence of any other potential areas of subsidence, he considered it possible that these could occur in the oval area, and recommended that a gravity survey be carried out.

The gravity survey was made between the 20th and the 23rd of September, by the author and G. F. Galbraith, field assistant. A preliminary appraisal of results was made on the spot and given to the president of the local football club.

GEOLOGY

The area is noted for the sudden appearance of such sink holes; and indeed Glencoe West lies not far from the Tantanoola Caves which are a well-known tourist attraction. It is underlain by the Gambier limestone of lower Tertiary age. According to local information this lies generally at a depth of the order of 20 metres.

Near the oval itself a cheese factory discharges its excess whey into a borehole. This borehole is about 100 metres due west of the subsidence. Local residents say that they could smell whey in the immediate vicinity of the subsidence.

METHODS USED

As the gravity variation was expected to be only of the order of 0.2 to 0.3 milligals over the hole itself, tight drift control had to be maintained over a close-spaced network of stations.

A grid was set up over the area with a base line running due east through the centre of the subsidence. All directions were measured by magnetic compass and correction was made for a magnetic variation of 7°E. Stations were pegged at 15m spacing starting from the western oval boundary at the base line. The station on the base line lying nearest to the centre of the oval was assigned arbitrary co-ordinates of (150N, 150E). When established, the grid covered an area extending from 105N to 225N and from 75E to 225E. A denser pattern of stations at 5m spacing was set up near the spot where the subsidence had occurred (the hole having by this time been filled).

Each station was levelled optically using the northern goalpost at the SW end of the oval as a reference datum. See Drawing No. S9444 for a plan of the station network and station levels with respect to the reference datum.

Two gravity meters were used:

(1) a La Coste and Romberg gravity meter, model G, serial no. 212;

(2) A Sharpe geodetic meter, model CG-2, serial no. 190-G.

Readings were made in loops of generally six stations, each loop closing on the same station, (150N, 150E). The duration of each loop was about 30 minutes. Adequate control of instrument drift was thus maintained. As the La Coste and Romberg instrument has a very small drift, the major variations in the drift curves measured with this were probably due to tidal effects.

REDUCTION OF RESULTS

The observed readings were plotted as a function of time and a drift curve obtained for each meter with respect to station (150N, 150E). The differences in meter dial divisions between the other station readings and the drift curve were then calculated. No correction was made for tidal variation as this was felt to be incorporated adequately in the drift curves.

The dial division differences were then reduced to observed gravity differences by applying an appropriate calibration factor. For the La Coste & Romberg meter this is 1.058 m gals. per dial division; for the Sharpe instrument it is 0.1000 (6) m gals per dial division.

A density of 1.9 gms/cc was used in computing the Bouguer correction. With this the elevation correction becomes:

$(0.0916 + 0.00090 \cos 2X - (0.01276)(1.9))$m gals./ft.

$= 0.2300\ (49)$m gals./m, where X = latitude = $37^{\circ}40'$.

A latitude correction of

1.307 sin 2x m gals./mile N-S

= 0.00078 (57)m gals./m N-S

was also applied.

To summarise, the following formula was used to compute the Bouguer gravity at each station:

g_B = kD + 0.2300h + (y-150) (0.00079)m gals.,

where g_B = Bouguer gravity,

k = instrument calibration factor,

D = dial division difference for the station,

h = elevation in metres with respect to level datum for the station,

y = N co-ordinate for the station.

The Bouguer gravity values in gravity units (1g.u. = 0.1m gals.) were plotted at each station and contour map drawn up using a contour interval of 0.2 g.u. (see Drawing No. S9443).

INTERPRETATION OF RESULTS

The Bouguer gravity map shows a general gradient dipping towards the east. This gradient becomes steepest around the line 200E. Its overall value is about 0.02 g.i. per metre.

Around the site of the subsidence a negative anomaly appears. It is circular-shaped and has a positive central core (see Drawing No. S9445) which is attributed to the nature of the material used to fill the hole (dense boulders of volcanic ejects from nearby Mt. Watch). Similar negative anomalies appear immediately to the east and to the west of this and in line with it.

A fairly strong negative anomaly is situated in the north-west corner of the grid system. The ground here is low and swampy and local information is that it was the site of a fairly large depression which has been filled over the years with low density material such as sawdust. This anomaly can therefore be explained as a function of density contrast in the near-surface sediments (which could be of the order of 0.8 - 0.9gms/cc if the low density

materials are assumed to be water-saturated).

Other significant effects are centred on the co-ordinates (180N, 225E), (135N, 225E), (105N, 120E) and (105N, 165E). The first two of these are not considered significant as they are located in a zone of generally steep gradient and may in fact be part of a regional effect. In any case they are located away from the oval itself and do not enroach on any outbuildings and so do not represent potential hazards. However, the last two, located ad they are on the southern boundary of the oval and near an area which is already depressed, may be of significance. In particular, the anomaly situated near the clubhouse may indicate a possible source of danger.

CONCLUSIONS

It appears from the gravity results that the solution cavity which caused the original subsidence has only been plugged and is not completely filled. Therefore there is a possibility that further collapse could occur in the immediate vicinity of the original hole.

Other areas of potential cavities may occur along the southern boundary of the oval, particularly near the western wall of the clubhouse.

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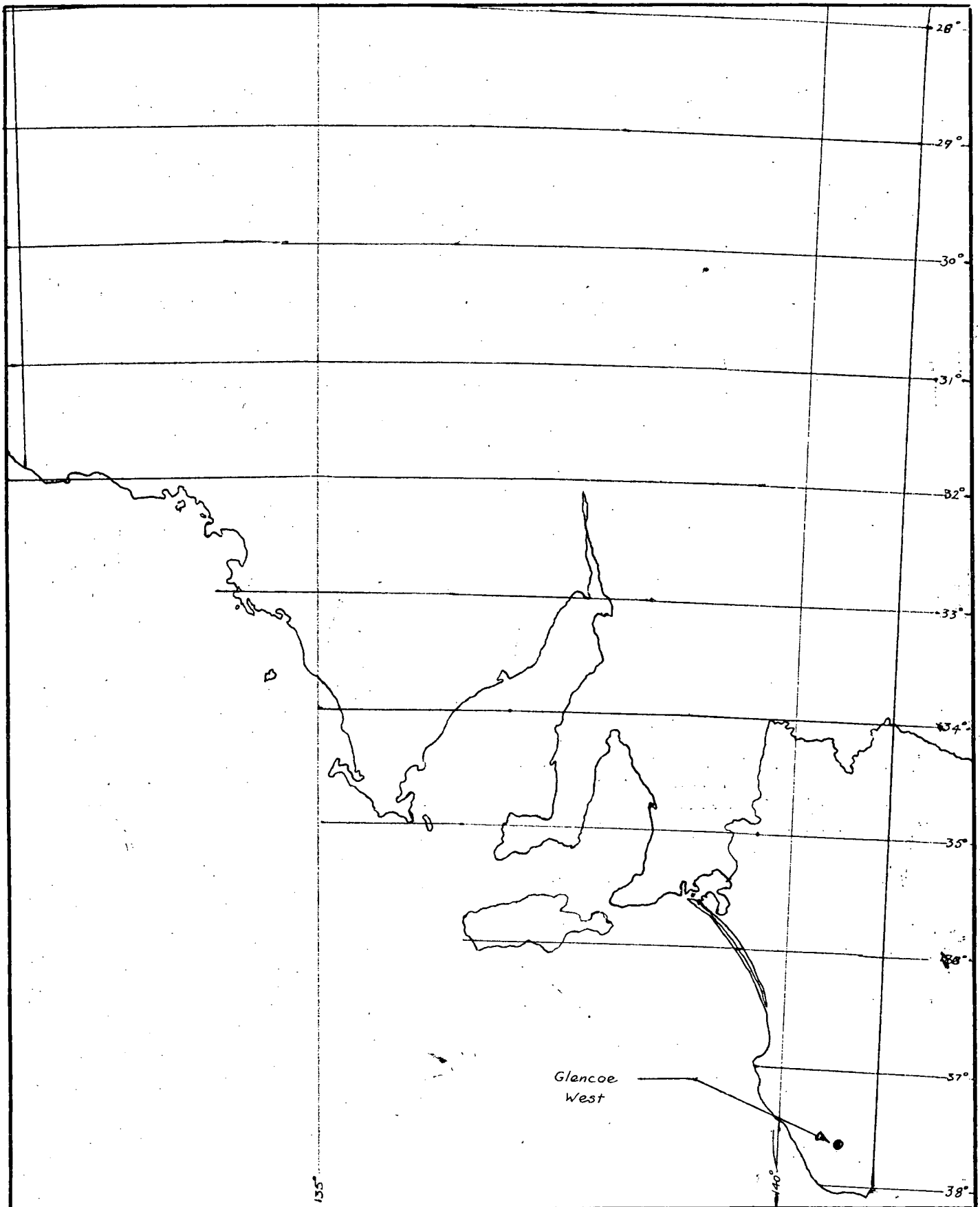
1.10.71
RGN:MFV

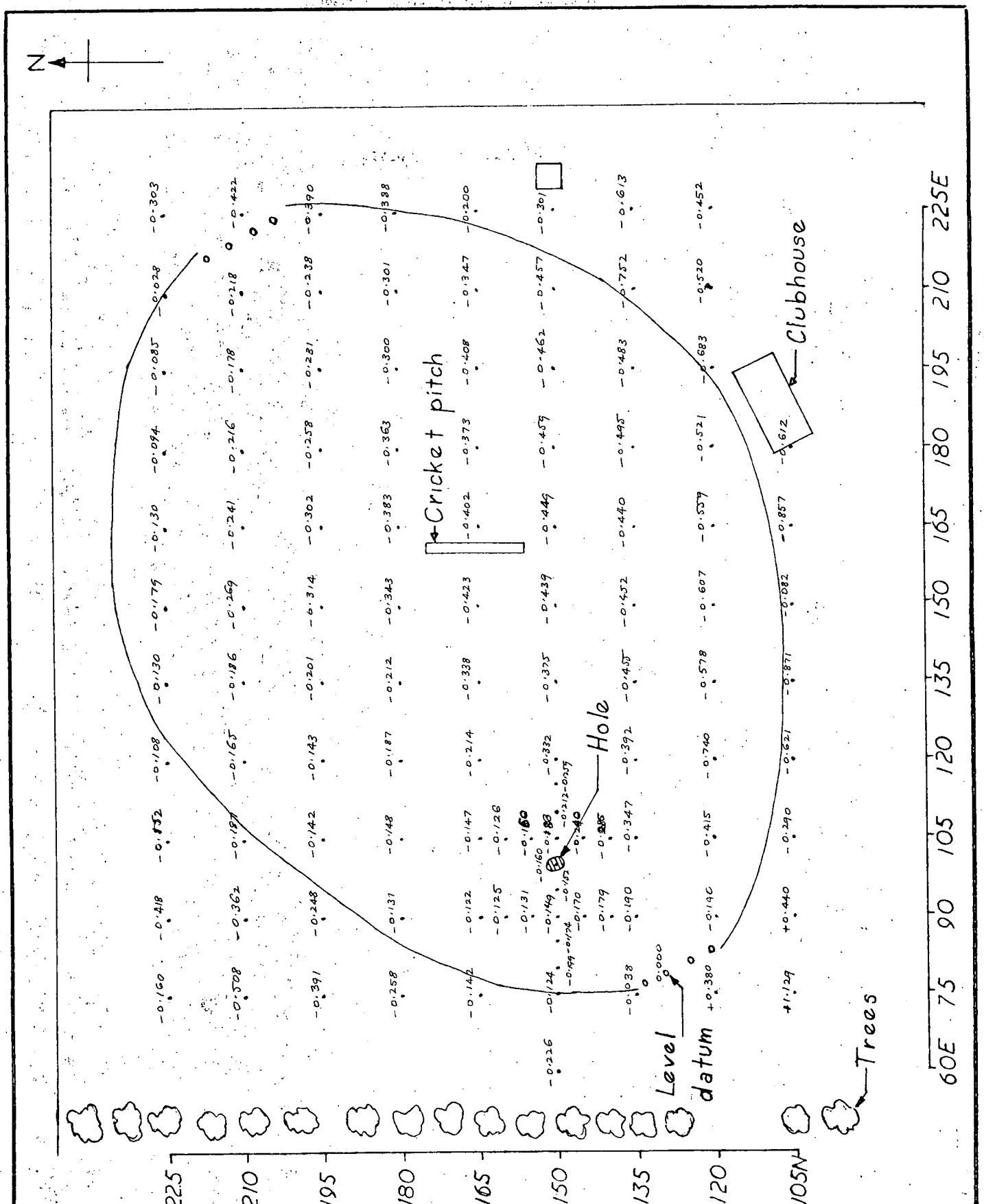
S9446



	DEPARTMENT OF MINES — SOUTH AUSTRALIA	Scale: 1:5,000,000
Compiled: R.C.N.	LOCALITY MAP	Date: 1-10-71
Drn. | Ckd.		Drg. No. S9446

1M—2.70 A1810

89444



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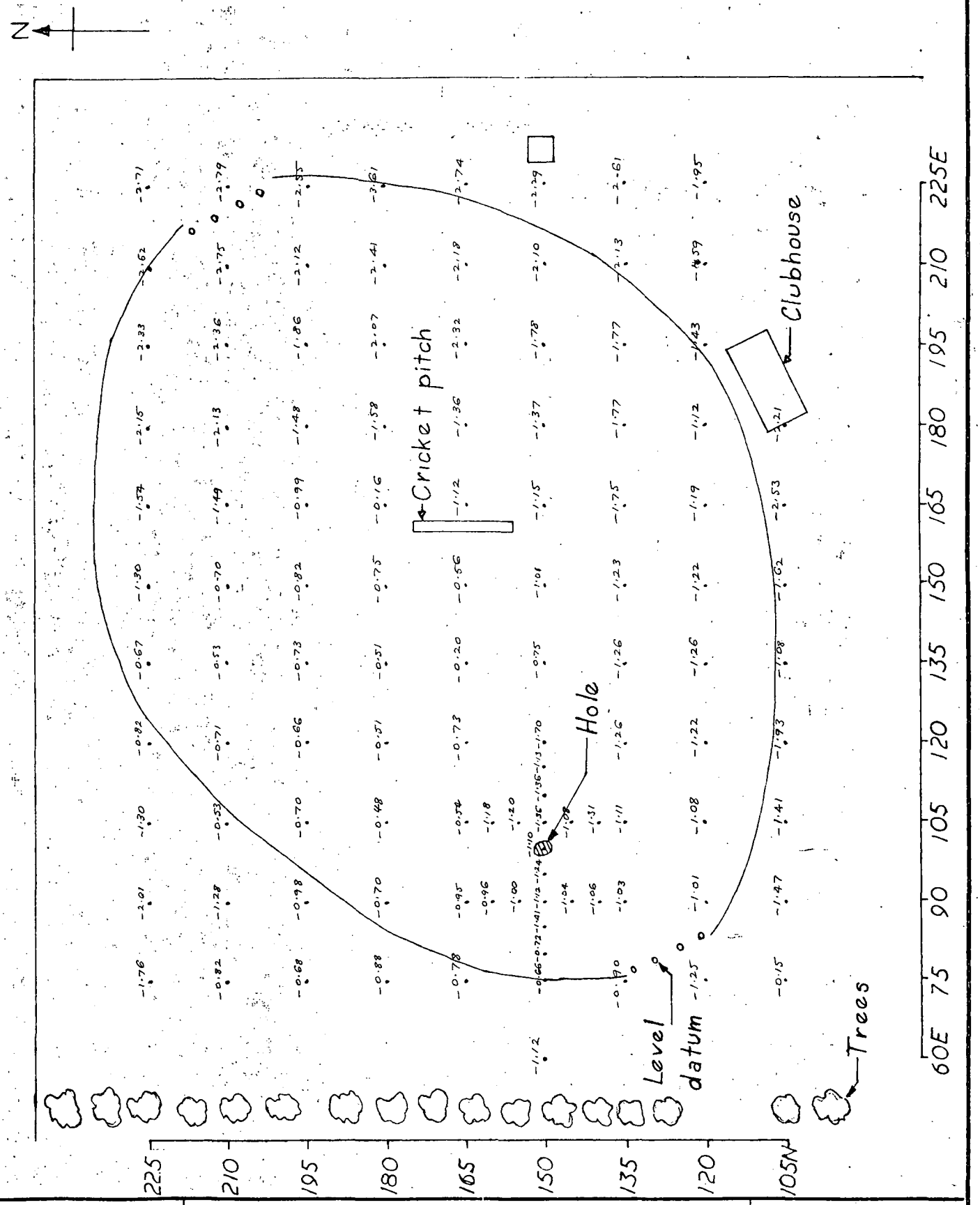
Compiled: R.G.N.	GLENCOE WEST OVAL	Date: 24-9-71
Drn. | Ckd.	STATIONS & ELEVATIONS	Drg. No. 89444

1M—2.70 A1810

S9447



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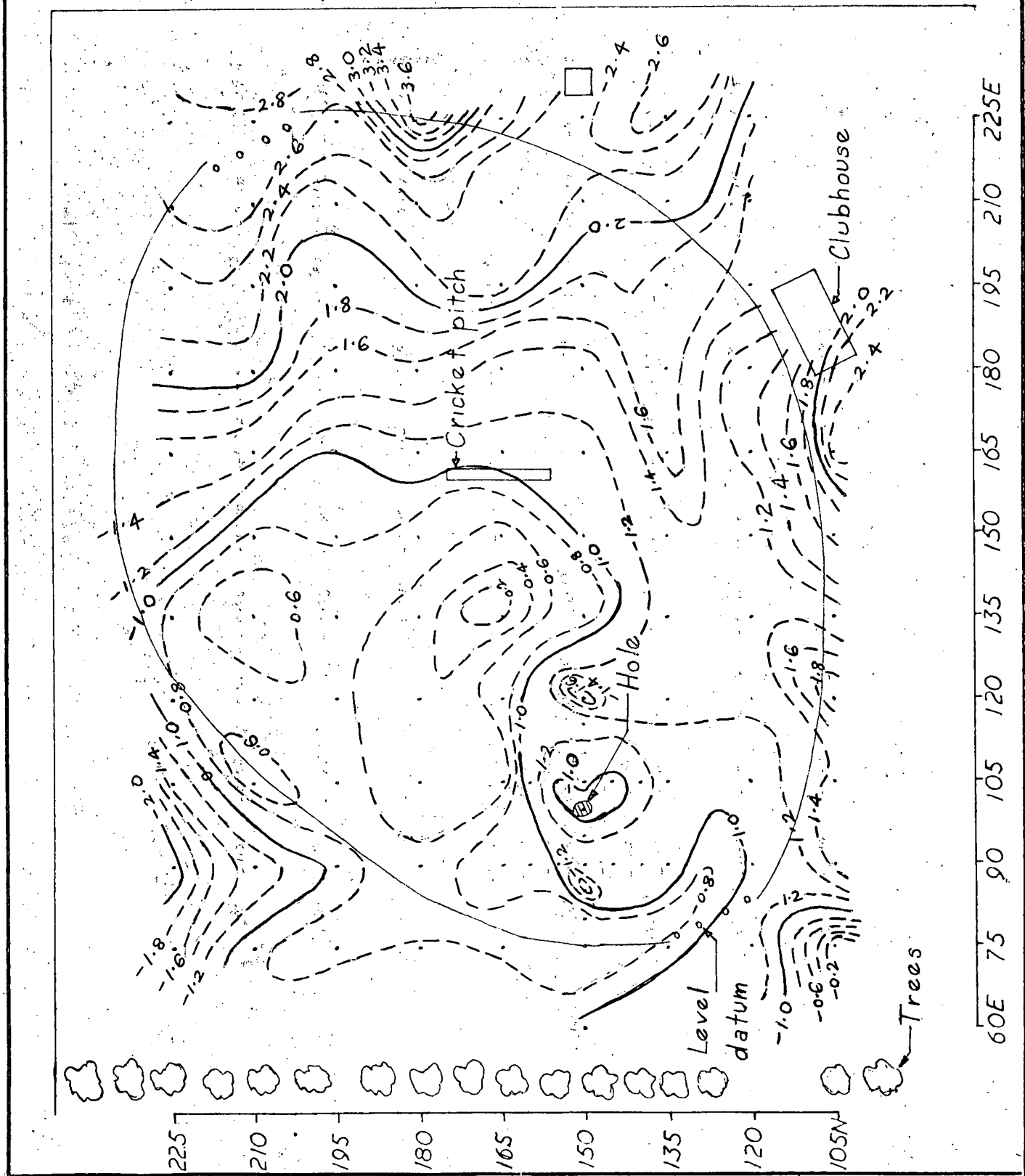
Compiled: R.G.N.	GLENCOE WEST OVAL	Date: 24-9-71
Drn. | Ckd.	BOUGUER GRAVITY VALUES (g.u.)	Drg. No. S9447

1M—2.70 A1810

S9443



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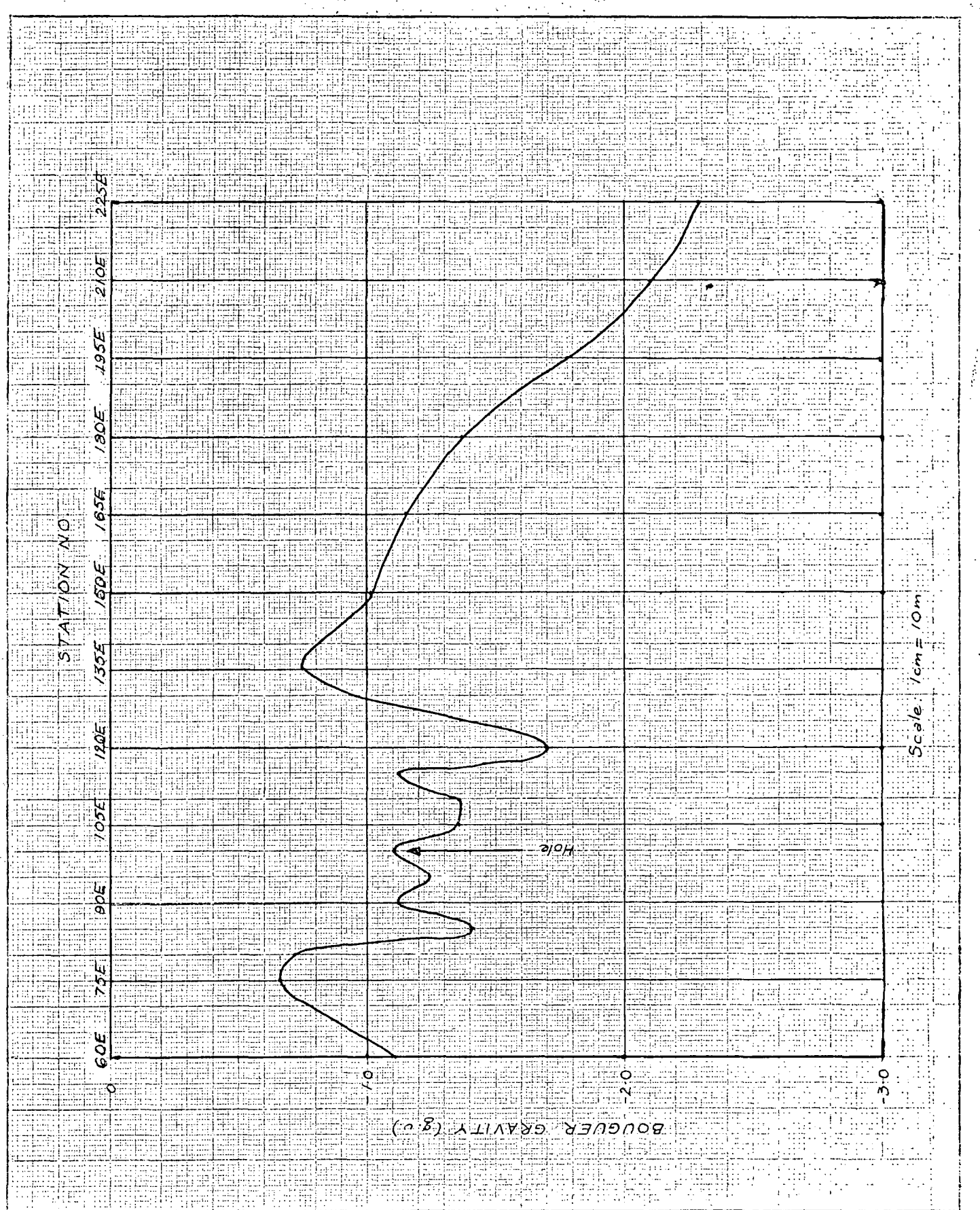
Compiled: R.G.N.	GLENCOE WEST OVAL	Date: 24-9-71
Drn. | Ckd.	BOUGUER GRAVITY MAP (C.I. 0.2g.u.)	Drg. No. 59443

1M—2.70 A1810

S9445



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Compiled: RGN	PROFILE ALONG LINE 150N	Date: 1-10-71
Drn. | Ckd.		Drg. No. S9445

1M—2.70 A1810