RB 36/94

DEPARTMENT OF MINES
SOUTH AUSTRALIA

DM 165/52

SHELL GRIT RESOURCES EAST OF ST. VINCENT GULF.

INTRODUCTION.

In order to assess the available tonnage and grade of shell grit on Sections 698 and 699, hundred of Port Gawler, a survey was made and a boring and sampling programme carried out. After completion of the above programme a reconnaissance survey was carried out on the remainder of the coast from Port Gawler to Port Wakefield.

TOPOGRAPHY.

Low dunes up to 20 feet in height at the maximum, but usually about five feet, otherwise flat country from the beaches, vegetation is chiefly ti tree on the shell grit. Samphire swamps usually exist inland from the shell grit deposits. In places these swamps extend to the coast.

GEOLOGY

The deposits of shell grit occur on recent alluvial plains. These plains have been subjected to inundation by the sea during periods of fluctuating land and sea level. The deposits have been formed by wave action and latterly by the prevailing westerly winds.

PLANS

52/134; L53/1. The outline of the deposits shown on L53/1 were obtained by speedometer, pacing, and aerial photographs.

SECTIONS 698, 699.

27 miles from Adelaide. These two sections are immediately south of the numerous mineral leases at Port Gawler Beach which for many years have been exploited for garden, poultry, paths and lime purposes by various lessees and by S.A. Silicates as a source of lime in glass manufacture.

The two sections, of a total area of 57 acres, were surveyed into 200 foot grids and 80 holes bored at the grid intersections.

METHOD OF BORING.

The conventional type of four inch post hole digger proved unsuitable, in that when boring below water level, the digger failed to retain the sample of sloppy wet shell grit. The two cutting jaws of the post hole digger were bent round to meet each other, the open spaces on the sides between the jaws were closed by sections of light welded plate, and an additional three inches of core tube was made by a further section of welded plate. These alterations made it possible to secure samples below water level. The very dry shell grit near the surface necessitated the pouring of a few pints of water down the hole to give cohesion to the shell particles. To avoid salting of the samples, casing, consisting of a six foot length of five inch flanged galvanised down piping was used.
80 holes were bored, samples collected and bagged in 10 days by two men.

SAMPLING

The sections sampled were covered by about six inches of mixed fine shell grit and decayed seaweed. As these samples were required for testing the suitability of the deposit for lime purposes, and the organic matter was destroyed on ignition, the whole depth of the borehole, while in shell grit, was retained as a sample. Water level was recorded and a tonnage calculated above and below water level. No holes were bored deeper than six feet, although many bores, particularly on the "D" & "E" line did not pass out of shell grit at this depth.

ANALYSES.

The five lines of 14 - 18 bores per line were bulked and averaged as follows:-

	Line A	Line B	Line C	Line D	Line E
S_1O_2	12.38	13.30	15.50	14.60	19.96
R_2O_3	1.34	1.32	1.68	1.34	2.08
CaO	45.53	44.85	43.51	44.18	39.51
MgO	1.20	1.48	0.88	1.36	0.92
Loss	38.65	38.48	37.46	37.74	35.07
$CaCo_3$	81.04	79.83	77.44	78.64	70.32
$MgCO_3$	2.46	3.03	1.80	2.85	1.88

It is interesting to note that line A with the highest $CaCO_3$ content is furthest from the present beach.

TONNAGE CALCULATIONS.

A sample of dry shell grit was rammed fairly tightly into a box of one cubic foot capacity. The weight of the shell grit was 57 lbs. 9 ozs., equal to 38.9 cubic feet per ton. For calculation purposes the figure used was 40 cubic feet per ton. The mean depth of shell grit above water level was 4½ feet and 1½ feet below water level.

Calculated reserves are -

Above water level	279,000 tons.
Below water level	87,000 tons.
Total	366,000 tons.

At 40 cubic feet per ton, an acre foot of shell grit contains 1,089 tons.

OTHER DEPOSITS.

The reconnaissance survey of the areas north of Port Gawler to Port Wakefield was undertaken to give some indication of the potential tonnage and grade of the deposits. The possible reserves of shell grit are approximate only.

Before any exploitation of these deposits is considered, it would be necessary to grid the areas to enable closer drilling to be done. Insufficient holes were bored to enable any tonnage calculations of respective grades to be made, although in the Port Parham deposit there is a strong suggestion that the top three feet of shell grit has the highest $CaCO_3$ content.

Closer drilling of the various deposits may result in considerable amendments to the possible tonnages calculated below, and alter the order of importance of the deposits as regards quantity.

The overburden may be of economic importance dependent on the shell grit being required for

(a) lime or cement purposes, where the organic matter would be destroyed on ignition

(b) agricultural purposes.

The former would only apply if a large consumer held and worked the leases. If purchasing from a lessee the best grade shell grit would be insisted upon.

The scout bores have shown the possibility of some millions of tons of shell grit of varying grades of $CaCO_3$ and it appears likely that grades of over 80 per cent $CaCO_3$ are available for selective mining.

Middle Beach.

30 miles from Adelaide. A small area of 35 acres extends about ½ mile back from the beach. It is believed that a large portion of the occurrence is on a recreation reserve.

Hole No. 1 depth three feet.

R.A.A.F. Area near Seaweed Claim.

About 34 miles from Adelaide, an area of about 7.4 acres largely contaminated by seaweed, has shell grit of good quality. As this deposit is on the R.A.A.F. bombing range, it is probably not open for mining.

Hole No. 2 Depth six feet. Samples 2 and 2a.

Port Prime.

About 38 miles from Adelaide. Two deposits of 94 and 352 acres respectively occur here, the smaller deposit being along the shore line.

Hole No. 3 was bored on the smaller deposit, the first six inches being largely contaminated by seaweed. There is practically no vegetation. Water level was at two feet and the hole passed out of shell grit at three feet six inches. Shell grit assayed 89 per cent $CaCO_3$.

At the time of the inspection practically the whole of the area was covered by fresh seaweed which would require to be moved before any mining operations began. The actual depth of good shell grit to water level was eighteen inches and eighteen inches below water level. Possible reserves of shell grit on this deposit are:-

Above water level	94 x 1089 x 1.5	=	153,549 tons.
Below water level			153,549 tons.

The larger area of 352 acres is N.E. of, and separated from the beach deposit by a samphire swamp. Vegetation is chiefly ti tree scrub and low bushes. The terrain is flat. Hole No. 4 was bored on the eastern margin and showed one foot of decomposed seaweed and shell grit, and two feet of good shell grit, (80 per cent $CaCO_3$). Water was not encountered, the hole passing out of shell grit into clay at three feet.

Assuming the results of the bore hole to be representative of the whole area, the possible tonnage available would be

Overburden	352 x 1089 x 1	=	383,328 tons.
Shell grit	352 x 1089 x 2	=	766,656 tons.

Possible reserves in the Port Prime deposits are thus

Overburden	383,328 tons
Shell grit above water level	920,205 tons.
Shell grit below water level	153,549 tons.

South of Baker's Creek.

This area of 191 acres, about 41 miles from Adelaide, is most difficult of access, the track winding through swamps, which, after a rain, would be impassable. Dunes, covered with thick ti-tree scrub, rise to probably 20 feet above beach level. The deposit is about three miles in length and about 900 feet in maximum width. Hole No. 5 was bored here and samples 5 and 5a taken. There was no overburden of decomposed seaweed and grit, but if mining operations were commenced it is highly probable that if bulldozing of the ti-tree scrub was attempted, it would contaminate the top section. However, in calculating the possible reserves of grit, no allowance has been made for contamination. The hole was still in shell grit at six feet. The top three feet assayed 79.24 per cent $CaCO_3$, and the section three feet to six feet 82.59 per cent $CaCO_3$, an average of 80.9 per cent.

Possible reserves are 191 x 1089 x 6 = 1,247,994 tons.

Port Parham.

43 miles from Adelaide. This deposit extends from about half a mile south of Port Parham to section 72, hundred of Dublin, which is nearly five miles north of Port Parham. The deposit has a maximum width of about half a mile, and the northerly end adjoins the artillery proof range, Hole No. 5 being at the 17,000 yard mark. The area is practically flat and more or less covered by ti tree scrub. Numerous small areas are held under miscellaneous lease titles adjacent to Port Parham and the shell grit is spasmodically mined for agricultural and poultry purposes.

Boreholes 6, 7, 8, and 9 were drilled at one mile intervals, commencing one mile north of Port Parham, and samples 6, 6a, 7, 7a, 8, 8a, 9, and 9a taken. There was no overburden at the sites selected for the test holes along the beach but it would be wise to allow six inches for decayed seaweed, which is mixed with the shell grit inland. The depth of shell varied

between four feet and six feet. Water was encountered in two holes only at three feet and two feet six inches respectively, giving an average depth of shell grit below water level of 1 foot 4½ inches, and three feet nine inches above. The samples from 0' - 3' averaged 84.49 per cent $CaCO_3$ and the average of those below three feet was 72.15 per cent $CaCO_3$. The average $CaCO_3$ content of all samples was 78.3 per cent. The area is 768 acres.

Then 768 x 1089 x .5 = overburden = 418,176

768 x 1089 x 3.25 = tonnage above water level = 2,718,144

and 768 x 1089 x 1.375 = tonnage below water level = 1,149,984

Lorne

51 miles from Adelaide. This deposit of approximately 938 acres commences a few hundred yards north of the Parham deposits and continues more or less adjacent to the coast for about six miles to the gates of the Port Wakefield Artillery Proof Range Reserve. The greatest width would be about half a mile. Concrete splinterproof observation shelters are erected at intervals along the beach, the Proof Range being strictly seaward. Warning notices on roads approaching the beach state that persons visit the area at their own risk. The country is mostly flat but at the northerly end there are low coastal dunes. Vegetation is chiefly ti tree scrub.

Boreholes 10 - 19 were drilled. 10 - 16 were adjacent to the beach and about one mile apart. Holes 17, 18, and 19 were drilled at the easterly limits of the deposit. Samples taken were 10, 10a., 11, 11a., 12, 13, 14., 14a, 16, 17, 18, and 19. The average $CaCO_3$ content was 75.78 per cent.

There was no overburden on the beach holes but up to one foot was encountered on the easterly holes. For calculation purposes an average of six inches over the whole area has been taken. The average depth of shell grit above water level was three feet two inches, less six inches overburden = 2' 8", say 2' 6", and the average depth of shell grit below water level was 1' 3".

Possible reserves are then

938 x 1089 x .5 = overburden of 510,741 tons.

938 x 1089 x 2.5 = shell grit above water level 2,553,705 tons.

938 x 1089 x 1.25 = shell grit below water level 1,276,852 tons.

Total tonnage

Totals of possible tonnage in order of importance as to quantity are

	Overburden tons	Shell grit above water level.	Shell grit below water level
Port Parham	418,176	2,718,144	1,149,984
Lorne	510,741	1,553,705	1,276,852
South of Baker's Creek		1,247,994	
Port Prime	383,328	920,205	153,549
Sections 698,699 (probable)		279,000	87,000
	1,312,245	7,719,048	2,667,385

PREVIOUS PRODUCTION.

Apart from a little spasmodic production at Port Parham there has been no attempt to exploit the other shell grit deposits north of Port Gawler.

The Port Gawler deposits, being closest to the city, have received an increasing amount of attention since 1944, in which year Mr. G.D. Rivett became interested in the deposits and has been the largest individual producer since. The following are Mr. Rivett's production figures:

1944	1600	tons
1945	2840	"
1946	3340	"
1947	4250	"
1948	4350	"
1949	3890	"
1950	3400	"
1951	3180	"
1952	21,767	"

Present production 2,000 tons per week.

MINING METHODS.

Originally, the shell grit was used for poultry, paths and garden purposes, the grit being hand-shovelled on to motor trucks, any overburden being first shovelled aside. Occasionally it was shovelled through screens.

Later, Mr. Rivett installed a screening plant at Fulham and used a front end loader, first to remove the overburden, and then to load the shell grit. As demand for the shell grit increased, a power shovel was used, but was not practicable, as the excessive weight often caused bogging. A Barber-Greene bucket loader was then obtained and has been used with success, together with a Fiat 40 hp diesel overloader operating a one cubic yard bucket. The 1952-1953 output reflects the large demands of the cement industry.

The Barber-Greene bucket loader is powered by a35 hp Buda-Lanover diesel. It is mounted on caterpillar tracks, and at the front end has a bucket elevator which discharges to a chute mounted above the loader and pointing to the rear. Two revolving spiral feeding scrolls cut the shell grit the full width of the loader and feed it inward to the elevator. The depth of cut varies between two feet and four feet, and is dependent on the depth of shell grit above water level, the aim being to mine the material about two inches above water level. Although the machine weighs 3½ tons the design of the caterpillar tracks is such, and the weight is distributed so well, that there has been no trouble with the machine bogging. In practice, the loader is advanced to the face, the spirals and elevator started and the machine advanced as necessary to keep a full bucket load which is discharged to the rear of the machine.

A new area at Port Gawler beach of approximately 1000 feet by 200 feet has had about one foot of overburden removed by means of a bulldozer. This overburden consists of fine decayed seaweed mixed with shell grit. It is carted to a screening plant nearby and about 75 per cent of the material is recovered through ten mesh screens and sold as lawn dressing.

The Barber-Greene bucket loader is advancing from one end on

its initial cut of 200 feet into the centre of the bulldozed area. Motor tipping trucks back up the narrow cutting to spot under the loading chute. As the loader advances the truck has to back. A truck was loaded in five minutes and the load estimated at eight tons. However, ten minutes were taken for the truck to move out of the cutting and another to take up its position under the chute.

As the cut advances further the spotting time will be increased to the disadvantage of loading. To eliminate the waiting time of trucks an overhead loader is also used to attack the 200 foot wide face. It is claimed that the overloader can fill eight tons in five minutes but track and rope maintenance is high.

Once the cut has been widened out, the time lost in spotting motor trucks is lessened, but it is still necessary to continually back the truck, and hand-shovel the shell grit to keep the load forward.

A more efficient method would be to have the chute designed to load on either side as well as the rear. The loader could then travel along the face, trucks could spot alongside and keep pace with the loader in a low forward gear. Spotting time would be minimised. and the overloader could be retained as an emergency unit.

Three men operate the plant consisting of Barber-Greene loader, Fiat overloader, trucking and screening overburden, and production is now 2,000 tons per week, the chief consumer being the Port Adelaide cement works. Costs are estimated at 1/- per ton stripping, and 1/- per ton loading, equal to 1/4d. per ton on the present ratio of one foot overburden to three feet of shell grit. Carting to Port Adelaide costs 12/6 ton.

The owner is satisfied that the Barber-Greene bucket loader is the machine best suited to his purposes, after numerous trials with front end loaders and power shovels.

SHELL GRIT BELOW WATER LEVEL.

Experiments with altered post hole diggers in an effort to design a digger to retain a shell grit sample from below water level were conducted in some old pits where the water level was an inch or two below the pit floor. Some holes bored showed a maximum of three feet of shell grit below water level.

The possible tonnages of shell grit above and below water level are

Above water level	7,719,048 tons.
Below water level	2,667,385 tons.

No attempt has yet been made to mine any shell grit below water level, and while large reserves exist above water level, it is unlikely that any attention will be paid to those below the water line.

The Barber-Greene loader would not be suitable for working below water level. The ideal plant would be one that could move along the top of the deposit and excavate the shell grit above and below water level in the one operation. No such small machine similar to the Barber-Greene unit is manufactured, but a clam shell bucket on a revolving boom and mounted on caterpillar tracks might be suitable. Mining below water level would suffer from the following disadvantages:

1. varying depth of shell grit,
2. clay and mud fouling the product,
3. alternatively leaving six inches to one foot at the bottom to avoid fouling and thus reducing the shell grit reserve figures,
4. probable higher capital cost of equipment to excavate below its own level,
5. added maintenance cost due to handling wet material,
6. extra weight of water to be carted.

All these factors would increase the mining costs.

The mining of shell grit below water level in unlikely to be attempted until such time as reserves above water level within easy carting distance are depleted and higher carting costs make the mining of underwater deposits economically attractive.

SUMMARY.

1. From Port Gawler to Port Wakefield there is a possible 7,719,048 tons of shell grit above water level.

2. Close gridding and boring would be necessary to establish areas of plus 80 per cent $CaCO_3$ grade for selective mining.

3. The most satisfactory method of mining would be by the Barber-Greene bucket loader with the chute designed to operate at the rear and either side.

4. It is most unlikely that any attempt will be made in the near future to mine the two million odd tons of shell grit below water level.

9.12.53

INSPECTOR OF MINES AND QUARRIES.

Hole & Sample No.	Vegetable Matter	Water Level	Ins %	Oxides Fe & Al.%	$CaCO_3$ %	$MgCO_3$ %			Remarks
1	0 - 6"	3' 0"	2.6	0.28	89.43	4.20	Middle Beach	6" - 3'4"	clay at 3'4"
2	0 - 6"		2.54	0.22	90.04	4.09	R.A.A.F.	6" - 3'0"	
2a			2.30	0.34	91.21	3.02	"	3'0" - 6'0"	
3	0 - 6"	2' 0"	3.34	0.14	89.08	4.36)	Port	6" - 3'6"	
4	0 - 1'		12.74	0.38	80.00	3.67)	Prime	1' - 3'0"	clay at 3'0"
5	-		12.94	0.26	79.24	4.27)	Baker's	0' - 3'0"	
5a	-		10.00	0.28	82.59	4.12)	Creek	3'0" - 6'0"	still in grit
6	-		7.76	0.38	85.58	3.24)		0' - 3'0"	
6a	-		14.22	0.44	79.09	3.41)		3' - 4'	clay at 4'0"
7	-	3' 0"	6.44	0.22	86.9	3.12)		0' - 3'	
7a	-		22.40	0.48	71.23	2.85)	Port	3' - 6'	
8	-		9.58	0.3	82.49	4.24)	Parham	0' - 3'	
8a	-		24.72	0.34	69.31	3.20)		3' - 4'6"	limestone at 4'6"
9	-	2' 6"	9.44	0.24	83.00	3.70)		0' - 3'	coarse shells.
9a	-		23.44	0.44	69.00	4.29)		3' - 6'	fine shells
10	-	3' 0"	16.16	0.34	76.91	3.77)		0' - 3'	
10a	-		37.7	0.86	56.33	2.08)		3' - 6'	
11	-	3' 0"	10.96	0.28	82.24	3.26)		0' - 3'	
11a	-		18.96	0.40	75.14	2.70)		3' - 6'6"	dark shells at 6'0"
12	-	3' 0"	12.88	0.24	79.95	3.41)	Lorne	0' - 3'6"	limestone at 3'6"
13	-		10.62	0.32	82.49	4.06)		0' - 2'0"	limestone at 2'0"
14	-	2' 6"	7.16	0.26	85.33	4.41)		0' - 3'0"	fine shells
14a	-		20.06	0.38	72.91	3.94)		3' - 6'	coarse shells
						)			limestone at 6'
15		4' 6"				)		1' - 6'	
16	0 - 1'	3' 6"	5.10	0.28	87.2	5.03)		1' - 4'	
17	0 - 1'		43.2	1.56	49.94	2.29)		1' - 3'	clay at 3'0"
18	0 - 1'		19.72	0.30	75.09	2.23)		1' - 6'	
19	0 - 6"		8.68	0.44	85.84	2.06)		6" - 4'0"	clay at 4'0"

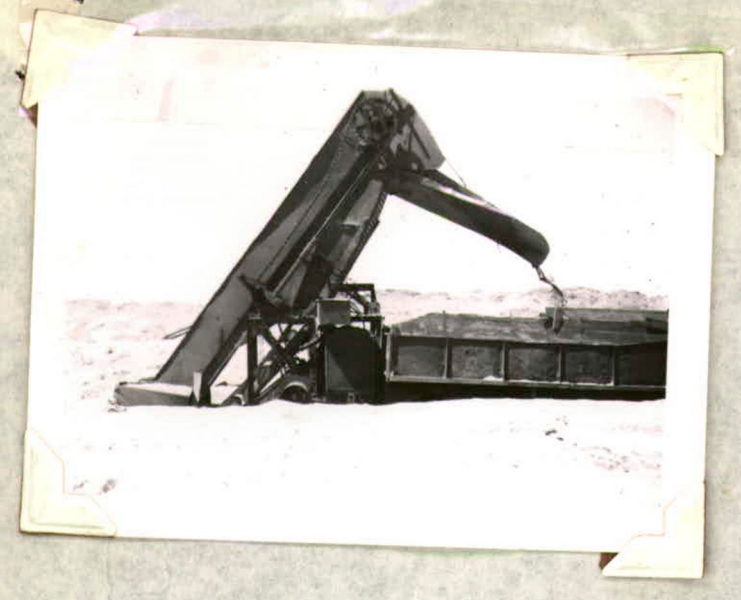


Plate I

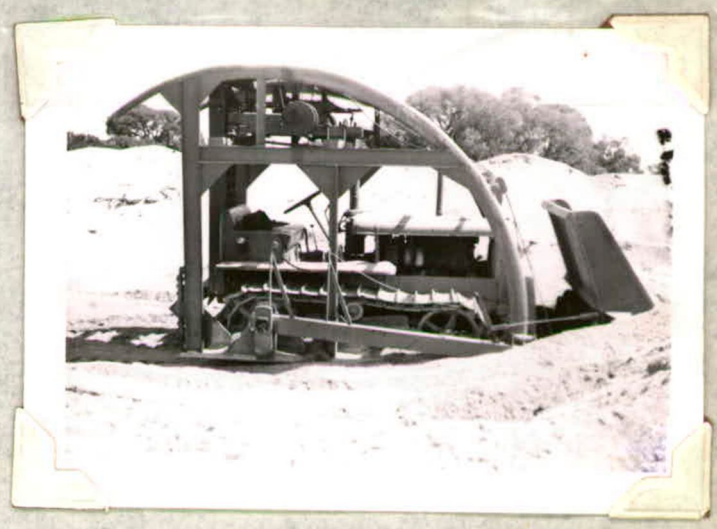
Plate II

Side views of Barber-Greene bucket loader. Note man shovelling forward.

Plate III
Front view

Plate IV
View showing rotary spirals

Plate V
Over loader.



CENTIMETRES 0 5 10
INCHES 0 1 2 3 4

(1)

F 1

To accompany report by L. L. Hansfield
Inspector of Mines.

S. A. DEPT. OF MINES

Associated Drg.	No.	No.	Amendment	Exd.	Date	Req. No. 191 Compiled from Air photos & L.L.M.'s Originals	SHELLGRIT DEPOSITS GULF ST. VINCENT AREA	Approved Director of Mines	Passed C.D.	Drn. M.B.L. Ckd. Exd. R.R.	Scale 1:34000 – 1.8" to 1 mile 53- Date 9-1-53 Gj 1+5+8

F 2

GULF ST. VINCENT

INKERMAN

DUBLIN

Lorne

Parham

Port Prime

BAKERS CREEK

16 500 yds

938 Acres

768 Acres

191 Ac

352 Acres

Swamp

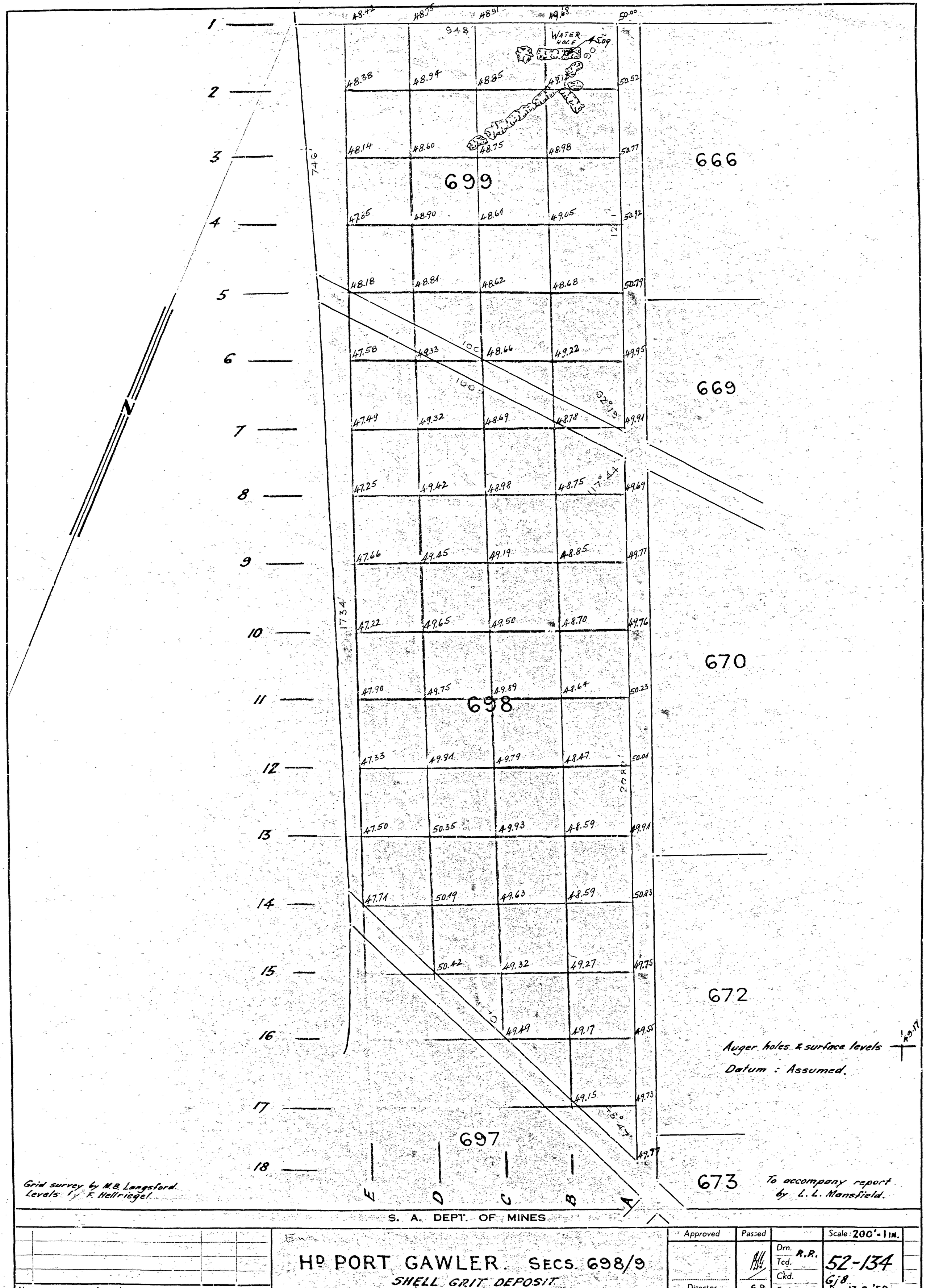
7.4 Acres

2 Modras Seaweed

15 16 17 14 13 18 12 11 19 10 9 8 7 6 5 3 4

T/N

-LEGEND-



Grid survey by M.B. Langsford.
Levels by F. Hellriegel.

To accompany report by L. L. Mansfield.

S. A. DEPT. OF MINES

No.	Amendment	Exd.	Date

Hd PORT GAWLER. SECS. 698/9

SHELL GRIT DEPOSIT

Approved	Passed		Scale: 200'=1 IN.
Director	C. D.	Drn. R.R. Tcd. Ckd. Exd.	52-134 G/8 Date 13.2.'52