Mining Branch

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DEPARTMENT OF MINES
SOUTH AUSTRALIA

GYPSUM DEPOSIT - HD. RIPON

REPORT ON ALTERNATIVE MINING METHODS

by

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ABSTRACT:

A large deposit of gypsum has recently been discovered near Streaky Bay and the estimated costs of mining 1,000 tons per week are here discussed. The deposit was inspected on the 15th and 16th February, 1960.

PREVIOUS REPORTS:

G.S.B. 8 Salt & Gypsum Resources of S.A., pp. 87, 88, 89, 91, 116. R.L. Jack.

G.S.B. 17 Geology and Development of Groundwater in the Robinson Freshwater Basin, Eyre Peninsula. R.W. Segnit and J.R. Dridan.

Unpublished Report 49/13, G.S. 1238, 3/2/59 B.G. Forbes

Unpublished Report 48/148, G.S. 1372, D.M. 2044/58 B.G. Forbes

Unpublished Report A.M.D.L. 7 Project 159/14 B.E. Ashton and P.B. Moffitt.

INTRODUCTION:

A survey of gypsum bearing lakes on Eyre Peninsula in 1959, suggested the importance of the deposits on Section 9A Hundred of Ripon. Seventy eight Proline bore-holes were put down to depths ranging from a few inches up to 16 feet. A further forty holes were put down by hand methods. The samples obtained were analysed for Insolubles, Calcium Carbonate, Gypsum and Sodium Chloride.

GYPSUM RESERVES:

On the evidence of the above drilling, geological estimates are 33,000,000 cubic yards or 30,000,000 tons of gypsum covering an area of 5.48 square miles to an average depth of 5.88 feet and assaying +90% $CaSO_4$ $2H_2O$.

The depth to water level varied between 2 feet and 5 feet.

A sample of 7 tons was obtained from 10 holes dug in the lake bed in July 1959 and submitted to the Australian Mineral Development Laboratories for metallurgical tests.

METALLURGICAL TESTS:

A report by B. E. Ashton and P. B. Moffitt on Laboratory Tests shows a recovery of 97.3% of the gypsum, the final product containing 94.2 percent $CaSO_4$ $2H_2O$. Calcination tests produced a plaster of good colour.

GEOLOGY:

R. W. Segnit (Bulletin 17) described the Robinson Freshwater basin, an area of 200 square miles extending from within a mile south of Streaky Bay township to south of Sceale's Bay, and roughly parallel to the coastline about one mile distant. The gypsum swamps thus occur within the Robinson Freshwater Basin.

B. G. Forbes, D.M. 2044/58 describes the gypsum deposits.

PLANS:

Geological plans 59-179 and 59-183 are used for reference.

PHYSICAL FEATURES OF DEPOSITS:

The surface of the swamps in which the gypsum occurs is 9¼ inches below sea level (Segnit pp. 7-8 G.S.B. 17). Seasonal differences occur in the water level on the lakes. At the time the Proline samples were taken in February-March, 1959 the groundwater level varied between 2 ft. and 5 ft. The 7 ton sample obtained in July 1959 from 10 sites disclosed a groundwater level of 24 inches on the dry lakes. On February 15th, after 80 points of rain had fallen on the 13th, the lakes were from one quarter to one third covered with water. Numerous holes bored with a post hole digger encountered groundwater level at 8 inches. A rainfall gauging of 121 points from midday on the 15th February to 9 a.m. on the 16th February resulted in the lakes being completely covered with water.

The information obtained from the pastoral lessee and local residents is to the effect that the lakes are usually covered with water in the winter months, drying off in the summer.

1959 was the driest season for over 50 years, thus the low groundwater level encountered during sampling operations is not normal.

Geological opinion is that, apart from the rain that actually falls on the lakes, the water level is dependant on the level of the Robinson Basin groundwater level, which in the winter rises above the surface of the country in the vicinity of the lakes and overflows the margin of the lakes. In the summer the Robinson groundwater table falls below the margin of the swamps and the water on the lakes becomes suspended upon an impervious layer of swamp clay.

When dry, conventional motor traffic on the lakes is hazardous, some parts being speedways, and on other sections once the surface is broken vehicles become hopelessly bogged.

The gypsum occurs in the flour, sand and crystalline forms, overlying clay, mud, or limestone. Rock gypsum was not encountered, and it is assumed not to occur, therefore explosives will not be necessary in the exploitation of the deposit.

The deposits surround an island on Sec. 9A, Hd. of Ripon.

COMMENCEMENT SITE:

It is considered that the higher grade and greater depth of gypsum in the area north of the island should be first exploited, stockpiling on the northern shore and retreating from the island.

The greatest distance from the island to the shore, scaled from the plans is two miles.

MINING METHODS:

The following methods of mining the gypsum are discussed

1. One half yard Diesel dragline loading to 1 yard side tipping trucks on 24" gauge line. Rakes of trucks hauled by diesel locomotives.

2. One half yard diesel dragline loading into 6 ton International trucks equipped with Terra-type low pressure tyres.

3. One half yard Diesel dragline loading onto 14" sectional Conveyor belt discharging to stockpile on shore.

4. Suction Dredge with cutting head, and pumping to a stockp ile on shore.

5. Suction Dredge loading to 6 ton International Trucks with Terra-type tyres.

1. Dragline & Train on 24" Gauge Track

A 10R.B. diesel dragline equipped with a 30' boom and a half yard dragline bucket would cost £8,308 in Adelaide plus £250 freight = £8,558 at Streaky Bay. The unit weighs about 9½ tons and would be capable of digging up to 50 tons per hour. In view of the soft nature of the gypsum surface such a unit would have to stand on timber mats or pads. Allowance is made for 10 such mats at a cost of £100 each or £125 each at Streaky Bay. Solar Salt Ltd. have 2¼ miles of 14 lb. railway track plus 95 lengths of new 14 lb. rails. They also have 41 one yard side tipping and 4 flat top trucks ex I.C.I. works Dry Creek disposed of for £5 each as well as two International AUD-264 Diesel motors converted to locomotives by Gray & Donaldson, Engineers of Pirie Street. All the railway equipment is redundant and could be purchased from Solar Salt Ltd. The second hand value of the two locomotives is estimated at £800 each. 2¼ miles of railway track would be equivalent to 50 tons, and the 95 lengths of unused rails would weigh approximately 4 tons. New 14 lb. rails are quoted at £54. 10. 0. ton C.I.F. Pt. Adelaide. Assuming a second hand value of £35 per ton the 54 tons would cost £1,890 including fish plates and bolts.

Solar Salt Ltd. equipment = £3,695.

Road freight on Solar Salt equipment is estimated at 5 trips @ £80 trip plus £10 for crane to Saltfields for loading locomotives plus £45 for crane from Kimba if none available at Streaky Bay = £455.

Sleepers must be closer spaced in view of the soft nature of the ground and a spacing of 1 ft. between the sleepers is suggested. For 24" track 4 ft. x 6" x 2" sleepers are normally used. Quote for red gum or blue gum sleepers is 4/- each delivered at Pt. Adelaide. At the suggested spacing 7920 sleepers would be required for 2¼ miles of tramway say 8000 @ 4/- = £1600. Freight to Streaky Bay £576. Laying of track, 6 men for fortnight, say £200.

For disposal and stacking of gypsum on the lake shore the estimate of £2,000 is made for excavation and concrete lining of a pit 12 ft. x 6 ft. x 6 ft. deep and containing a longitudinal hopper feeding a screw conveyor, which in turn feeds a sump with a waterflow to the drowned suction side of a 6 inch gravel pump driven by a diesel motor. Discharge would be to a stockpile through 100 ft. of 6 inch pipe. This is the system used at Langhorne's Creek Salt Works.

Sump, screw, conveyor and pump £2,000.

The cost of a boot and conveyor of 100 ft. inclined at 45° plus a diesel motor is estimated at £2721. As the material will be sticky, and draining water, conditions would not be ideal for the use of an inclined conveyor belt, therefore as water will have to be pumped, the use of this water to stock pile the gypsum is preferable and cheaper.

For dewatering and to supply water for stockpiling, a pomona type pump and motor will be required on the lake near the shore, estimated cost = £1000.

It will also be necessary to prepare a level area of - say one acre for stock piling. The cheapest material would be gypsum - £1000 is allowed for this. Stockp ile £1000.

A further mile of 6" pipe may be necessary under winter conditions to dispose of the water in the working area, to the lakes on Section 290 Hd. Ripon. Under dry conditions water may be needed for make up purposes from a shallow bore in the vicinity of the stockpile. Bore - pump and motor £1000.

Then

Hopper, Screw Conveyor etc.		£2000
Victaulic pipe 5280 ft. @ 15/- ft.		£3960
270 joints @ 28/-		£378
2 valves @ £13		£26
Freight on pipes & joints 40 tons @ £6 ton		£240
Laying pipes		£60
2 bores, 2 pumps & 2 motors		£2000
Preparation of stockpile area		£1000
Sheds		£1000
Miscellaneous tools		£500
		£11,154

Then Capital Cost would be -

Half yd. dragline at Streaky Bay		£8558
10 wooden pads @ £125 each		£1250
2 locos. ~~ex Solar Salt~~ secondhand	£1600	
45 trucks, flat tops, etc.	£225	
Rails	£1890	
Freight on locos. rails & trucks	£455	
Sleepers plus freight	£2176	
Laying track	£200	£6546
		£16,354
Provision screw conveyor pump etc.		£2000
Victualic pipes, pumps as listed above		£11154
Holden utility		£1000
2-3 ton truck		£2000
Total		£32,508

Operating Costs

Half yard dragline estimated life 5 years			
Cost per week of fuel & oil @ 3/6 hour	£7.	0.	0.
" " " " repairs @ 30/- "	£60.	0.	0.
" " " " depreciation 5 years on £8558	£34.	4.	8.
C/Fwd.	£101.	4.	8.

B/Fwd.	£101.	4.	8.
Cost per week of interest on £8558 @ 6%	£10.	5.	5.
Timber pads estimated life 1 year			
Cost per week of depreciation on £1250	£25.	0.	0.
" " " interest @ 6%	£ 1.	10.	0.
Locos., Trucks, rails, sleepers etc.			
Estimated life of 10 years on £6546			
Cost per week of fuel & lubricant	£13.	0.	0.
" " " repairs	£25.	0.	0.
" " " depreciation on £6,546	£13.	1.	10.
" " " interest @ 6%	£7.	17.	1.
Screw conveyor victaulic pipes, pumps			
estimated life of 5 years on £11,154			
Cost per week fuel and lubricant	£20.	0.	0.
" " " repairs	£25.	0.	0.
" " " depreciation	£44.	12.	4.
" " " interest @ 6%	£13.	7.	8.
	£299.	19.	0.
Add 20% contingencies	£59.	19.	9.
	£359.	18.	9.

On 1000 tons week = 86.38d. say 7/3 ton

Motor Vehicles

Holden ute. 400 miles week @ 1/-	£20.	0.	0.
Truck 250 miles @ 2/6	£31.	5.	0.
	£51.	5.	0.

On 1000 tons week = 7.5d. say 8d.

No provision has been made to paddock off sections of the lake as it is doubtful if this can be done in view of the soft nature of the gypsum. Elsewhere it has been successfully accomplished on rock gypsum deposits, covered by a few inches of flour gypsum. A water tight seal on the rock gypsum has been made by earthen embankments at Kangaroo Island.

(a) Method of Working

The method of working is visualised as retreating from

the vicinity of the island to the lake shore. The 24" tram track would extend the maximum distance of 2 miles. A double track should be provided adjacent to the stockpile tip and near the dragline. It is suggested that as the excavation retreats, this double track could be moved back at ¼ mile intervals by breaking the line and inserting a set of points. A rake of 12 trucks is suggested, one rake being loaded, one being in transit or shunting to the shovel and one being tipped. The two locos. with the two shunt lines should handle this easily. The 10RB shovel should handle 50 tons per hour but will only be required to dig 25 tons per hour. One man would be required at the tip and one man to attend the pump and one man to keep the track in order and one mechanic.

Total Labour

1 manager	£30 week
1 dragline operator	£17. 2. 6.
2 Loco. drivers	£31. 6. 0.
3 labourers @ £13. 11. 0.	£40. 13. 0.
1 mechanic @ £20	£20. 0. 0.
	£139. 1. 6.
Oncost 50% to cover payroll Tax, Insurance, Holiday Pay and Long Service leave	£69. 10. 9.
	£208. 12. 3.

Then Labour costs on the basis of 1,000 tons per week to stockpile

= $\frac{208.\ 12.\ 3.}{1000}$ = 4.172/- say 4/2 ton

add operating costs	7/3 ton
Motor vehicles	8 ton
Total	12/1 ton

Total Capital Cost £32,508.

The estima ted capital cost of £2,840 ~~for equipment ex Solar Salt Ltd.~~ is based on present second hand value and the fact that the equipment is no longer used ~~there.~~ To replace the

equipment at new prices would cost considerably more

e.g. 2 locos. new would cost	£4000
The 45 trucks were sold ~~by I.C.I.~~ for £5 each but to replace they would probably cost £100 each =	£4500
54 tons new rails @ £60 ton S.Bay.	£3240
	£11,740
less present est. value Solar Salt Eq.	£3,695
saving	£8,055

Thus, for new equipment the capital cost would be increased by £8,055 adding 6d. per ton for depreciation and interest charges over ten years and bring the total capital required to £40,563 and costs per ton to 12/7.

2. Diesel Dragline Loading to Motor Trucks

The Capital cost of dragline equipment would be similar to (1). viz. £8,558

Timber pads would also be required 10 @ £125 = £1,250

3 International 4 wheel drive trucks AA-160 @ £2600 would be required fitted with Terra-type tyres. These are large low pressure tyres designed to traverse muddy or sandy conditions that would bog conventional tyres. They cost approximately £250 each, then 3 trucks @ £2600 fitted with 5 Terra tyres each would cost £11,550

It is estimated that the hire rate per mile to cover fuel, and oil, maintenance, depreciation and interest charges would be 4/- mile, then delivery to Streaky Bay would be an extra cost of 3 x 500 x 4/- plus drivers wages and expenses 2 days £340

£11,890

Carrying a pay load of 6 tons would require 34 trips per day. This could involve under the worst conditions a round trip of 4 miles or 136 miles per day, or an avera ge round trip of 2 miles from half way across the lake equivalent to 68 miles per day. Loading time is estimated at 10 minutes and tipping

and return trip at an average distance of 1 mile at 30 m. p. h. is estimated at 8 minutes, say 10 minutes. Then with two trucks 36 tons per hour would be carted.

For 200 tons per day only 6 hours would require to be worked, leaving plenty of time for dragline and truck maintenance after building up a stockpile.

At the maximum distance of 2 miles with 2 trucks the return trip would take an extra 5 mins. = 15 mins. or 25 minutes loading, tipping and return.

Then 2 trucks = $\frac{60}{25}$ x 2 x 6 = 28 tons per hour requiring a little over 7 hours.

It is thus apparent that 2 trucks could maintain production with one truck as a spare. Near the plant one truck could handle the required output.

Under average conditions of 1 mile carting - the distance travelled would be 68 miles @ 4/- per mile = 272/- or 1/4.3 say 1/5 ton.

Transport to lake shore 1/5 ton.

For the stock piling arrangements, the digging of the pit would not be necessary as the sump could be built at ground level and a ramp provided for the trucks to tip to the screw conveyor. The cost has been left the same however.

The rest of the capital expenditure is somewhat similar to Scheme 1.

Then capital cost

Half yard dragline at Streaky Bay		£8558
10 wooden pads @ £125		£1250
3 International trucks with Terra tyres		£11890
Provision Sump, screw conveyor, & pump 5280' Victaulic pipe, joints, valves freight, pumps, motors, stockpile preparation etc. as in (1)	£11154	
Sheds, garage and tools	£2000	£13154
Holden Utility	£1000	£1000
		£35852

Operating Costs

Dragline as in 1. cost per week	£111. 10. 1.
Pads	£26. 10. 0.
Screw conveyor, victaulic pipe, pumps etc. £11,154 total cost per week	£103. 0. 0.
	£241. 0. 1.
Add 20% contingencies	£48. 4. 0.
	£288. 4. 1.

On 1000 tons week = 69.17d. say 5/10 ton.

Holden Ute. 400 miles week @ 1/- mile	£20. 0. 0.
250 miles week other carting International @ 4/- mile	£50. 0. 0.
	£70. 0. 0.

On 1000 tons week = 16.8d. say 1/5 ton.

Labour required would be -

1 manager - per week	£30. 0. 0.
1 dragline operator	£17. 2. 6.
2 truck drivers @ £17. 1. 6.	£34. 3. 0.
2 labourers @ £13. 11. 0.	£27. 2. 0.
1 mechanic £20	£20. 0. 0.
	£128. 7. 6.
add 50% oncosts	£64. 3. 9.
	£192. 11. 3.

Labour costs on 1,000 tons week = 3/10 per ton

Total costs Lake to Stockpile

Operating	5. 10.
Transport	1. 5.
Holden running and other carting	1. 5.
Labour	3. 10.
	12. 6. per ton
Total capital cost	£35,852.

Representatives of The Goodyear Tyre & Rubber Co. are confident that the Terra-type tyres would be satisfactory on the described lake surface conditions. Their opinions are quoted, but no responsibility is accepted in this report that such tyres will not bog.

To try them out at £250 per tyre would be a costly procedure. Messrs. M.S. McLeod Ltd. of Pulteney St. would sell second hand aircraft tyres 1700 x 20 or 1550 x 20 at about £50 each. Mr. Vincen of the above firm states that if these large surface contact, low pressure tyres do not bog on the surface, he would be quite confident of the ability of the Terra-tyres to do the work. McLeods would repurchase the tyres after a test had been made, the repurchase price probably being £5-£10 less per tyre.

To test with the above tyres would cost -

5 tyres at £50 each	£250	
Alter truck wheels @ £20 each	£80	
Transp ort 1000 miles @ 2/6 mile	£125	
200 miles running on lake at 2/6 mile	£25	
Wages 2 men 8 days @£5 day	£80	
Travelling expenses 8 days @ 32/-	£25. 12. 0.	
	£585. 12. 0.	
less repurchase of tyres @ £40 each	£200	
	£385. 12. 0.	

3. Dragline to Conveyor Belt

In this scheme a similar dragline loading to a 14" sectional conveyor belt is discussed. The discharge would be to the similar sump and stockpile arrangements as used in 1 and 2.

Cost of dragline	£8558	
Timber pads	£1250	
Stockp ile arrangements	£11154	
2 miles of sectional conveyor @ £40 per 12 ft. length	£35200	
4 miles 14" conveyor belting @ 34/- ft.	£35904	
Freight on 19 tons belting @ £6/10/-	£123. 10. 0.	
" " 141 " conveyor " "	£916. 10. 0.	
C/fwd.	£93.106. 0. 0.	

B/Fwd.	£93,106. 0. 0.	
5/12 h.p. motors @ £360	£1,800	
Drive Pulleys & transfers 5 @ £500	£2,500	
	£97,406. 0. 0.	

Operating cost per week

Dragline as in 1 & 2	£111. 10. 1.
Pads	£26. 10. 0.
Screw conveyor etc. £11154 as in 1 & 2	£103. 0. 0.
Conveyor system £76444	
Depreciation over 5 years on £76444	£305. 15. 6.
Interest @ 6%	£91. 14. 7.
Maintenance	£60. 0. 0.
Fuel & Lubrication	£30. 0. 0.
	£728. 10. 2.
Add 20% contingencies	145. 14. 0.
	£874. 4. 2.
On 1000 tons week = 209.8d. say	17. 6. ton.

Labour costs per week

Manager	£30. 0. 0.
Dragline operator	£17. 2. 6.
2 labourers	£27. 2. 0.
1 mechanic	£20. 0. 0.
	£94. 4. 6.
Add 50% on cost	£47. 2. 3.
	£141. 6. 9.
On 1000 tons per week = 33.9d. say	2. 10. ton

Land Rover and 4 wheeled trailer with Terra tyres £4400

1 Holden utility £1000

£5400

Running Landrover and trailer

250 miles per week @ 4/- mile	50. 0. 0.
Running Holden 400 miles @ 1/- mile	20. 0. 0.
	£70. 0. 0.

On 1000 tons week = 16.8d. say 1. 5. ton

Then operating cost	17. 6.	ton
Labour	2. 10.	ton
Motor vehicles	1. 5.	ton
	21. 9.	per ton

Capital cost £102,806.

4. Suction Dredge Pumping to Stockpile

The boom in ilmenite and rutile mining a few years ago resulted in several companies adopting suction dredges for the recovery of the heavy sands from N.S.W. and Queensland beach and dune deposits.

One Dredge cost £1,200, using a 4" - 3" Warman sand pump with a pontoon made of 30/44 gallon petrol drums and output is 30 tons dry sand per hour. Pumping distance is 360 ft.

Another dredge cost £12,500 in 1957 and uses an 8" gra vel pump delivering 100 cubic yards of dry sand per hour 400 ft. to shore.

A further dredge is quoted at £60,000 to dredge 400 cubic yds. dry sand per hour from 30 ft. below water level with 14 inch gravel pump delivering through 400 ft. of 16 inch diameter pipe line.

The above dredges are operating on electric power, purchased from the local or State authorities.

Essentially a suction dredge consists of a sand pump mounted on a floating pontoon. The suction pipe is fitted with a heavy rubber hose to give flexibility. Attached to the suction nozzle is a jetting nozzle, which carries high pressure water from another pump to break up the sands and suspend them in water so that the suction of the main pump may pick up the suspended material and pump it to the shore.

In hard material a mechanically operated cutting head is necessary as well as the jetting nozzles, to break up the material.

The cost of these dredges varies according to the output required and the type of pontoon. A small dredge now in course of construction will use old railway compressed air cylinders for the pontoon. These cylinders will be provided with stub axles at each end and be fitted to bearings on the structure carrying the deck, so that the whole dredge may be rolled over the ground, as well as floated in the water.

The cylinders, 2 ft. in diameter by 8'6" or 10' in length, are quoted at £10 each. Ten cylinders would make a pontoon 20 ft. by 10 ft.

The Warman Equipment Co. have made a preliminary quote, based on

(a) a specific gravity of 1.4 (Dr. Jack used a figure of 35 cu. ft. per ton in similar material and the writer once weighed one cubic ft. of dry flour gypsum at 64 lbs.).

(b) 25 tons of solids per hour at 25% solids.

(c) Pumping distance of 2 miles maximum.

The quote is for suction dredge complete ex works £4600

The equipment consists of a pontoon 17'6" x 10'0"
Deutz air cooled diesel Type A4L 514 driving
Warman 6/4 split casing dredge pump and
Warman 3/2 jetting water pump
Armoured Rubber suction hose
Jetting water line
Armoured rubber discharge hose
Discharge valve
4 two ton hand winches,

The firm suggests that in view of the long line (2 miles) tests should be carried out at the A.M.D.L. to confirm both the velocities and the friction gradients before the line was installed.

If, following tests, a second stage unit was found necessary, the estimated additional cost would be

6/4 gland pump	£390
Drive	£45
40 H.P. Diesel	£835
Pipe work etc.	£50
Gland water pump	£45
Plus drive	£15
Extra pontoon space	£150
Plus single stage Dredge as already quoted	£4600
	£6130

say £6,200 for estimate ex works Perth.

If a cutting head is necessary to deal with the crystal gypsum an additional £1500 for a 50 h.p. motor and head is allowed, bringing the total to £7700

Shipping to Ceduna or Pt. Lincoln, carted to site and erected would probably cost £1200

Then Total £8900

Two miles of 6" victaulic pipe would be required at 15/- ft. £7920

540 joints at 28/-	£756
Freight	£480
Laying pipes	£100
Pipeline	£9256

At the Lake shore a sump and further diesel driven pump to elevate to stockpile would be required say £1500

Preparation of stockpile as before £1000

2 Bores, diesels and pumps and 1 mile of pipe to deal with excess water and make up water £6654

Sheds	£1000
Miscellaneous tools	£500
	£10,654

Motor Vehicles

Landrover equipped with Terra-tyres	£3000
4 wheeled Terra-tyred trailer for servicing	£1400
Holden utility	£1000
	£5400

Then

Dredge complete	£8900
Pipe line 2 miles	£9256
Shore installations	£10654
Motor Vehicles	£5400
Total capital cost	£34,210

Operating costs at 1000 tons week			
Fuel and oil ~~for~~ at 31/- hour	£62.	0.	0.
Maintenance of pumps and diesels	£60.	0.	0.
Replacement costs of 50 ft. pipe per week	£40.	0.	0.
Depreciation on £28,810 over 5 years	£115.	4.	9.
Interest at 6%	£34.	11.	6.
	£311.	16.	3.
Contingencies 20%	£62.	7.	3.
	£374.	3.	6.
On 1000 tons week = 89.8d. say		7.	6. ton

Labour requirements

1 Manager	£30.	0.	0.wk.
1 dredge operator	£20.	0.	0.
1 pump attendant	£17.	2.	6.
2 labourers	£27.	2.	0.
1 mechanic	£20.	0.	0.
1 welder	£20.	0.	0.
	£134.	4.	6.
Add 50% on cost	£67.	2.	3.
	£201.	6.	9.
On 1000 tons week = 48.32 say		4.	1.

Running Landrover and trailer 250 miles per week @ 4/-	£50. 0. 0.
Running Holden utility 400 miles per week @ 1/-	£20. 0. 0.
	£70. 0. 0.

The above hire rates should cover running, depreciation and interest

On 1000 tons week = 16.8d. say 1. 5.ton

Then

Operating costs	7. 6.
Labour costs	4. 1.
Motor vehicles	1. 5.
Total	13. 0.ton

and Capital cost £34,210

The capital cost might well be reduced by the use of the air cylinders for the pontoon, and halving the length of the pipe line, by pumping to the island and then carting. One stage of pumping and horse power requirements would then be lessened.

The amount of wear on the pipes cannot be predicted, gypsum is not abrasive, but the velocity of flow, and the percentage of solids pumped would be the chief factors contributing to wear in pipes, which is always greatest adjacent to the dredge.

5. Single Stage Dredge to Terra-tyred Motor Trucks

The method of working would be to use Terra-tyred vehicles carting from a single stage suction dredge to the stockpile. Then

Single stage dredge	£4600
Freight and erection	£1200
3 Terra-tyred vehicles as in (2)	£11890
Provision bores pumps 1 mile pipe stockpile preparation as in (2)	£11154
Holden utility	£1000
	£29,844

Then operating costs would be

Cost per week of fuel and oil	£25. 0. 0.	
Cost per week maintenance	£25. 0. 0.	
Depreciation over 5 years on £16,954	£67. 16. 4.	
Interest @ 6%	£20. 6. 10.	
	£138. 3. 2.	
Add 20% contingencies	£27. 12. 8.	
	£165. 15. 10.	
On 1000 tons week = 39.8d. say		3. 4.ton
Holden Ute. 400 miles week @ 1/- mile ÷ 250 & 4/- misc carting.	£70. 0. 0.	

Labour required would be

1 manager	£30. 0. 0.wk.	
1 dredge operator	£20. 0. 0.	
2 truck drivers	£34. 3. 0.	
2 labourers	£27. 2. 0.	
1 mechanic	£20. 0. 0.	
	£131. 5. 0.	
50% on cost	£65. 12. 6.	
	£196. 17. 6.	
On 1000 tons week = 47.25d. say		4. 0.ton
Carting costs as in (2)		1. 5.ton
Motor vehicles		/. 5.ton
Operating costs		3. 4.ton
Total		10. 2.ton
Capital cost	£29,844	

GENERAL:

The above estimates have been prepared on five methods of mining under extreme conditions.

Method No. 5 is a combination of methods 2 and 4. It is possible that other combinations or variations could be adopted.

It is recommended that whatever method of mining is adopted the area ahead of operations should be test drilled on suitable grids as a guide to depth in extraction. For dragline operation when the aim would be to keep the water level low, 100 ft. grids would suffice, for dredging operations where the bottom would not be visible, a 50 ft. grid should be used.

Although methods 2 and 5 call for the use of the expensive Terra tyres, it is possible that the soft sections of the lake may follow some definite pattern, and if the pattern was established, conventional tyred trucks might well be used from stockpiles on the lake, in some adaption or combination of the methods discussed.

The expenditure of the £385.12.0. for testing with second hand aircraft tyres might be justified for this additional reason.

STOCKPILE TO LOADING POINT:

1. Streaky Bay

The above estimates are for loading the gypsum on to a stockpile at the lake shore.

From the Northern section of the lake, which it is proposed to mine first, to Streaky Bay jetty is approximately 8 miles. As the deposit is mined the distance will increase to 12 miles at the south end of the lake.

Hire rates paid by the Highways Dept. for country cartage from quarries are 1/3 per ton for the first mile, then 9d. per ton mile, one way. Then from the Northern section carting rate to

Streaky Bay would be	=	6.	6.	ton
South end to Streaky Bay	=	9.	6.	ton
Average over 10 miles	=	8.	0.	ton

The use of owner-driver trucks on a tonnage rate is recommended. An overloader would cost £2600 plus say £200 delivery to Streaky Bay, a total of £2800.

This equipment is rubber tyred and has been suggested instead of a front end loader, to obviate turning on the prepared gypsum floor.

Estimated cost of overloader operation per week

Fuel and lubrication at 2/6 hour	£5. 0. 0.
Repairs at 10/- hour	£20. 0. 0.
Depreciation over 5 years on £2800	£11. 4. 0.
Interest at 6%	£3. 7. 2.
	£39. 11. 2.
Add 20% contingencies	7. 18. 3.
	£47. 9. 5.

On 1000 tons week = 11.39d. ton say 1/-.

The award rate for an overloader driver is £17. 2. 6.

Add 50% on cost 8. 11. 3.

Total £25. 13. 0.

On 1000 tons week = 6.15d. say 7d. ton.

Then total cost

Operating Costs	1. 0.
Labour	7.
Transport	8. 0.
	9. 7. ton

At Streaky Bay the jetty is about 1000 ft. in length, of which about 250 ft. is available for berthing.

Depth of water at low tide is about 9'6". Ketches and coastal ships like the Yandra (912 tons) are the maximum sized craft that can use the jetty. The Yandra could take a cargo of 500 tons once a fortnight.

The only loading facilities are flat top hand trucks. It would not be possible to use 5 ton motor trucks on the jetty.

The only economic method of loading gypsum into ships would be by conveyor belt and to ship the required tonnage would call for ships of much greater capacity, and deep water berths; this does not seem practicable, as by Admiralty charts, there appears to be a great expanse of shoal water of 2 to 2½ fathoms to cross to reach the present jetty.

At the shore end of the jetty there is a shed measuring 200

ft. by approximately 40 ft. The shed was formerly used for wheat storage and has open sides. It is doubtful if the washing of the gypsum would be permitted here as the mud would probably pollute the bathing beach.

2. Sceale Bay

The maximum distance to Sceale Bay from the Northern section of the lake is 8 miles decreasing to 4 miles at the South end.

Carting costs to Sceale Bay would then average 5/- per ton, plus 1/7 loading at Stockpile = 6/7 ton.

A small jetty exists at Sceale Bay but does not extend to deep water; however Admiralty charts show 4 to 5 fathoms close inshore on the south side of the Bay west of the jetty, and no shoals. It is suggested that the opinion of the Harbour's Board be obtained as to the relative merits and disadvantages of providing deep berthing facilities at Streaky and Sceale Bays.

A further advantage of Sceale Bay is that it is within one and a quarter miles of the Robinson Fresh Water Basin and water could be obtained cheaply for washing purposes.

The surrounding land has good drainage to the sea and ample room for stockpiles and loading arrangements. Any clay or mud from washing operations would not be a nuisance to the public.

Sceale Bay would not be sheltered from westerly winds, but the Harbours Board may be able to advise on compressed air breakwaters which have been the subject of much technical discussion recently in overseas journals.

The final transport of gypsum from the Stockpile, particularly if Sceale Bay was chosen as the shipping port, might well be done by pumping in suspension.

HYDROLOGICAL:

Mention has been made of suggested bores adjacent to the lake for make up water, and the possibility of siting a washing plant at Sceale Bay with a freshwater bore in the Robinson basin, and of pumping lake water to the lakes north of the gypsum deposits.

No bores should be drilled except on the advice and under the supervision of a hydrologist, nor should pumping of saline waters from one lake to another be done except with the approval of a hydrologist.

The fresh groundwater of the Robinson basin occurs as a thin layer resting upon and in contact with saline water. (Segnit Bulletin 17, p. 47), thus the depth of any bore drilled for fresh water is critical.

The natural flooding of the lakes is also attributed to the overflow of fresh water from the Robinson basin, conversely pumping saline water from one lake to another could possibly raise the level of the lake water and cause it to overflow into the fresh water basin.

It may thus be necessary to pump excess water to the sea, which would require a longer pipe line.

SUMMARY & CONCLUSIONS:

1. The following estimates of costs of mining 1000 tons/week to stockpile on shore have been made.

(a) Dragline shovel to 24" gauge rail—ex Solar Salt Ltd.

Capital cost £32,508 Cost per ton to stockpile 12/1

do new equipment

Capital Cost £40,563 Cost per ton 12/7

(b) Dragline loading to 4 wheel drive trucks equipped with Terra tyres

Capital cost £35,852 Cost per ton 12/6

(c) Dragline loading to 14" Conveyor belt

Capital cost £102,806 Cost per ton 21/9

(d) Suction Dredge pumping to Stockpile

Capital cost £34,210 Cost per ton 13/-

(e) Suction Dredge pumping to Terra tyred motor vehicles

Capital cost £29,844 Cost per ton 10/2

2. Carting costs are as follows:

(a) Lake shore to Streaky Bay 9/7 ton

(b) Lake shore to Sceale Bay 6/7 ton

3. Loading facilities at Streaky Bay are poor and limited depth of water would prevent large vessels loading.

4. Harbours Board advice should be sought regarding costs of facilities at Sceale Bay and the magnitude of operations required to justify same.

5. All handling of water onto and from the gypsum lakes should be done with the advice of the Hydrological section.

INSPECTOR OF MINES & QUARRIES

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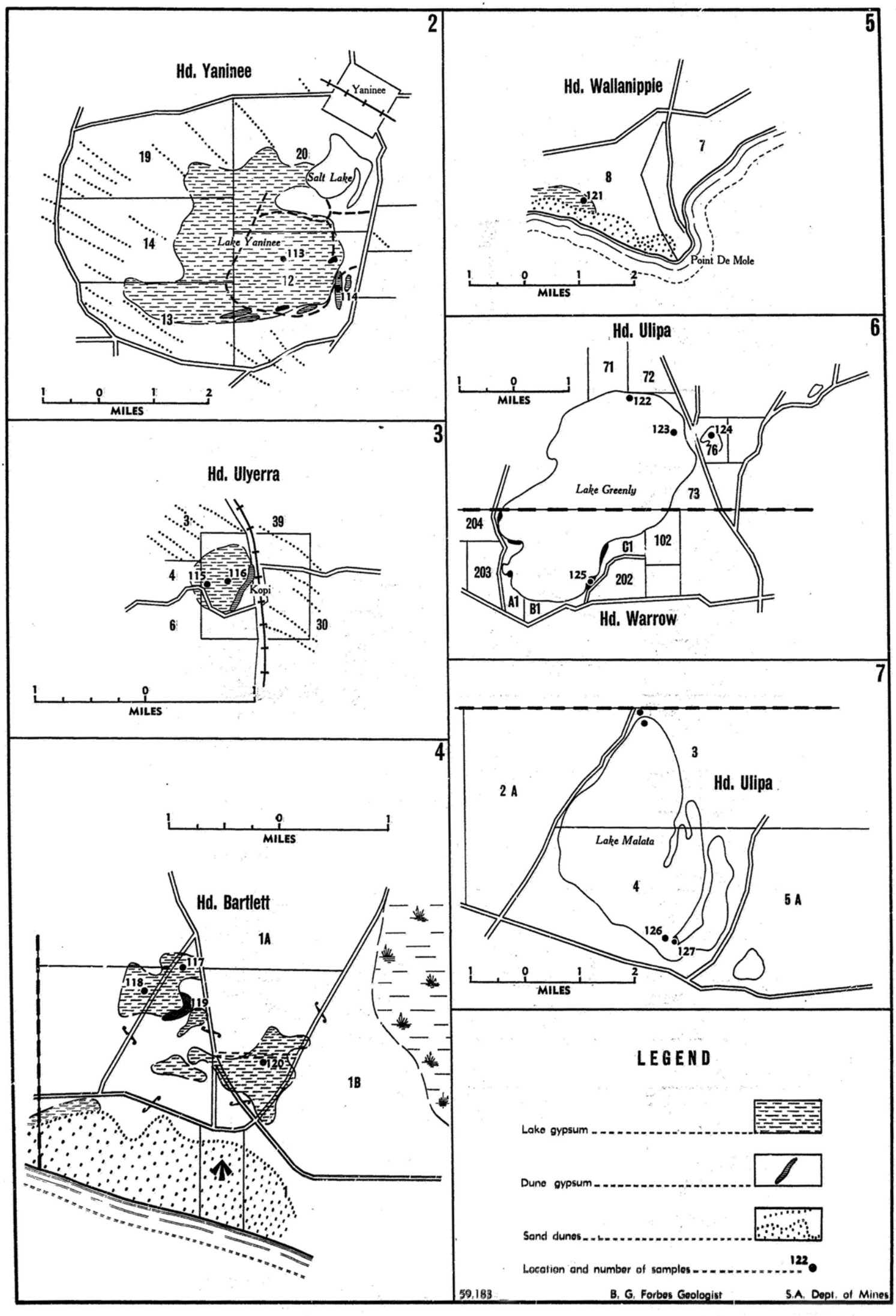
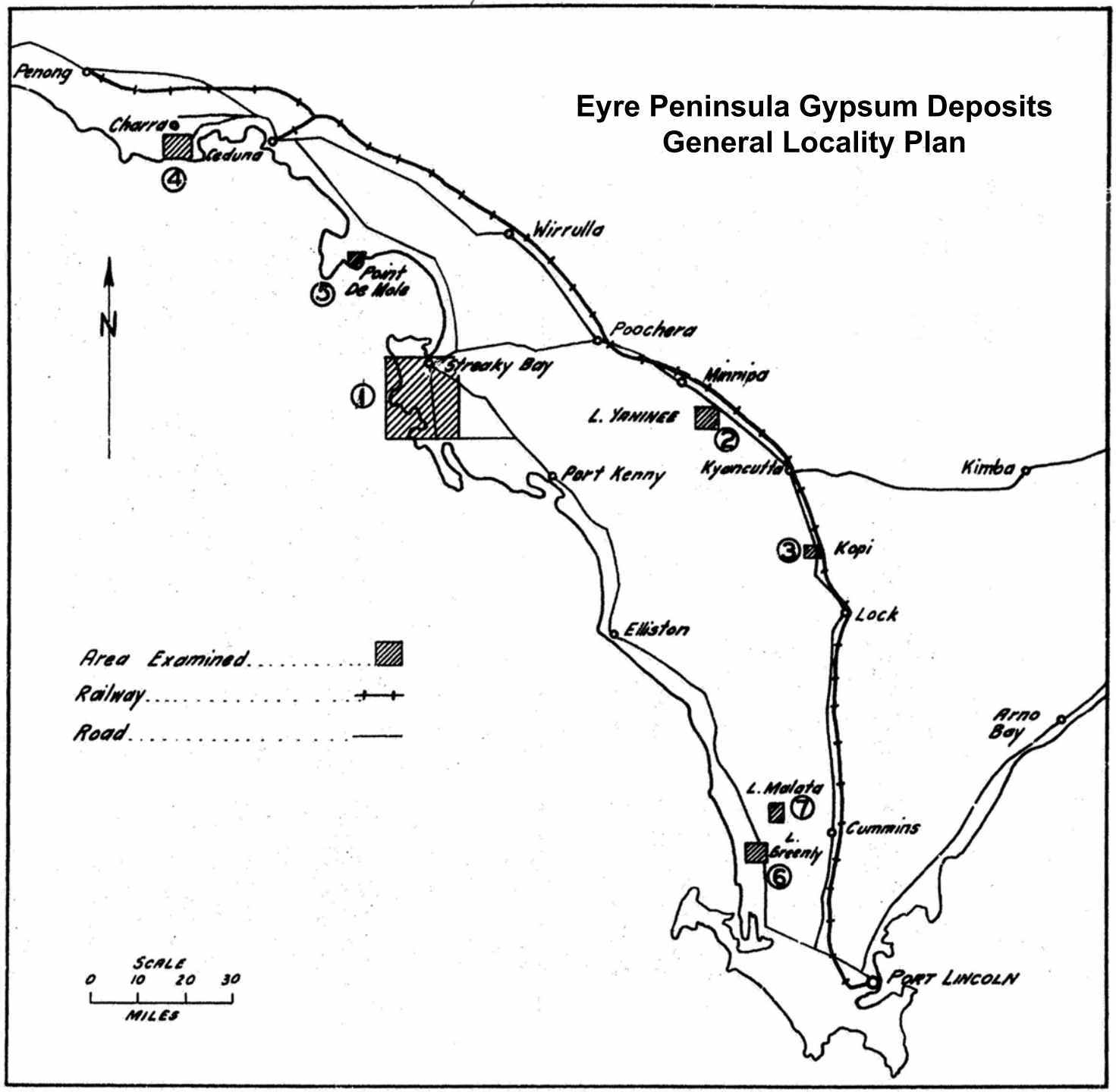
29/3/60


2
Hd. Yaninee
Yaninee
19
20
Salt Lake
14
Lake Yaninee
113
12
114
13
1 0 1 2
MILES
5
Hd. Wallanippie
7
8
121
Point De Mole
1 0 1 2
MILES
6
Hd. Ulipa
71
72
1 0 1
MILES
122
123
124
76
Lake Greenly
73
204
102
C1
203
125
202
A1
B1
Hd. Warrow
3
Hd. Ulyerra
3
39
4
115
116
Kopi
6
30
1 0 1
MILES
7
3
Hd. Ulipa
2 A
Lake Malata
4
5 A
126
127
1 0 1 2
MILES
4
1 0 1
MILES
Hd. Bartlett
1A
117
118
119
120
1B
1
LEGEND
Lake gypsum
Dune gypsum
Sand dunes
Location and number of samples
122
59.183
B. G. Forbes Geologist
S.A. Dept. of Mines


Eyre Peninsula Gypsum Deposits
General Locality Plan
Penong
Chara
Seduna
④
Wirrulla
Point
De Mole
⑤
N
Poochera
Streaky Bay
Minnipa
①
L. YANINEE
②
Kyancutta
Kimba
Port Kenny
③
Kopi
Lock
Elliston
Area Examined.....
Railway.....
Road.....
Arno
Bay
L. Malata
⑦
Cummins
L.
Greenly
⑥
SCALE
0 10 20 30
MILES
PORT LINCOLN

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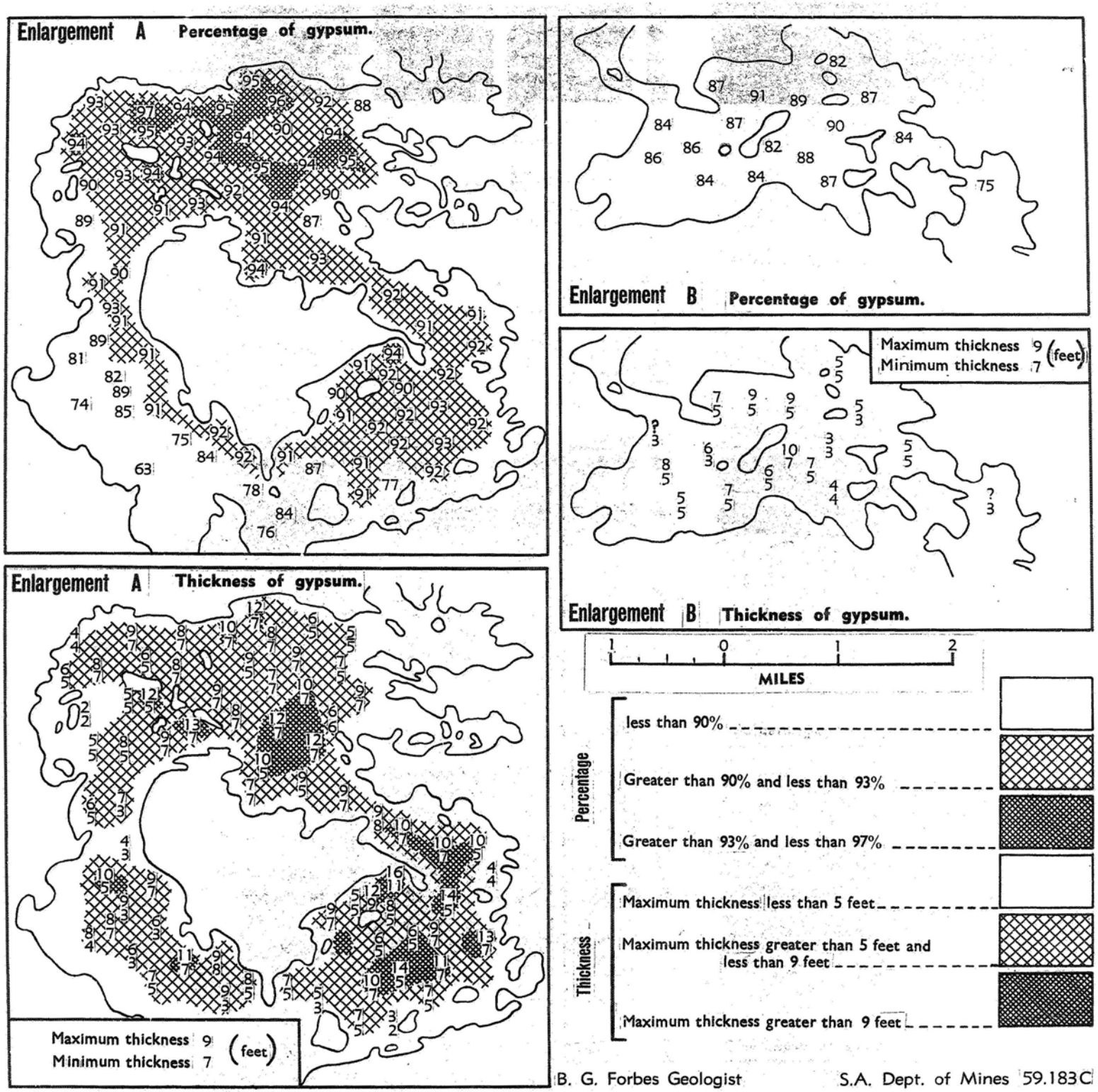
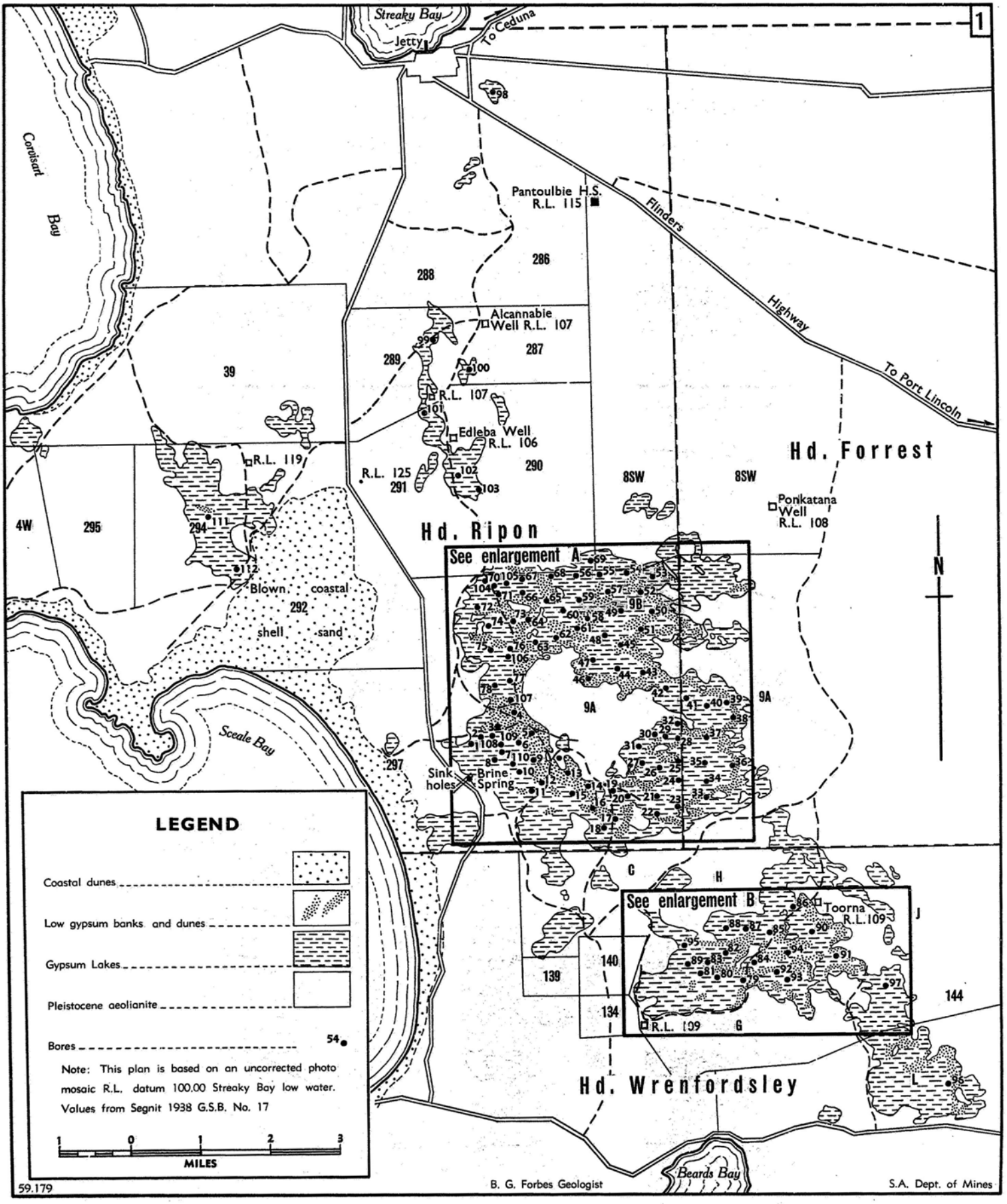


B. G. Forbes Geologist S.A. Dept. of Mines 59.183C


Streaky Bay
Jetty
To Ceduna
1
Corrisart Bay
Pantoulbie H.S.
R.L. 115
Flinders
Highway
To Port Lincoln
Alcannabie Well R.L. 107
Edleba Well R.L. 106
R.L. 107
R.L. 119
R.L. 125
Ponkatana Well R.L. 108
Hd. Forrest
Hd. Ripon
Hd. Wrenfordsley
See enlargement A
See enlargement B
Toorna R.L. 109
R.L. 109
Blown coastal shell sand
Sceale Bay
Sink holes
Brine Spring
Beards Bay
N
LEGEND
Coastal dunes
Low gypsum banks and dunes
Gypsum Lakes
Pleistocene aeolianite
Bores
Note: This plan is based on an uncorrected photo mosaic R.L. datum 100.00 Streaky Bay low water. Values from Segnit 1938 G.S.B. No. 17
1 0 1 2 3
MILES
59.179
B. G. Forbes Geologist
S.A. Dept. of Mines