DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

Rept.Bk.No. 84/27

BRICK SHALE RESOURCES OF THE GAWLER-CONCORDIA AREA

GEOLOGICAL SURVEY

by

E.A. DUBOWSKI

and

W.S. McCALLUM

MINERAL RESOURCES SECTION

APRIL 1984

D.M.E. No. 202/82

CONTENTS

	PAGE
ABSTRACT	1
INTRODUCTION	1
LOCATION, ACCESS AND TOPOGRAPHY	2
MINERAL TENURE	3
CLAY AND SHALE PRODUCTION	5
PREVIOUS INVESTIGATIONS	6
DRILLING	6
GEOLOGICAL SETTING	7
GEOLOGY OF GAWLER-CONCORDIA	7
Adelaidean	7
Tertiary	11
Quaternary	11
RESULTS OF DRILLING	12
FIRING TESTS	15
CONCLUSIONS	16
REFERENCES	17

APPENDIX A: Logs of Auger Drill Holes, 1982-1983.
B: Results of Firing Tests.
C: Previous SADME Drilling, 1961-1976.
D: Logs of Water Bores.

PLANS

Fig. No.	Title	Plan No.
1.	Locality plan.	S17135
2.	Geological plan and location of drillholes.	83-628
3.	Geological sections.	83-629

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

Rept.Bk.No.:84/27
D.M.E. No.:202/82
Disk No.: 161

BRICK SHALE RESOURCES OF THE GAWLER-CONCORDIA AREA

ABSTRACT

In 1982-1983, 69 auger holes with a total depth of 453.6 m outlined large areas of Woolshed Flat Shale, part of the Adelaidean Burra Group sediments, which are weathered and suitable for brick manufacture between Gawler and Concordia, 45 km northeast of Adelaide. Thickest development is under and marginal to outliers of Tertiary sediments suitable only as fill.

Quaternary red clay is also suitable as the plastic component in brick blends.

Further east, 24 859 tonnes of weathered shale have been mined between 1973 and 1982 from two pits in weathered shale interbeds in sandy and dolomitic Woolshed Flat Shale and Undalya Quartzite which contain further reserves of brickmaking material.

Follow-up drilling is required to determine reserves and select quarry sites.

INTRODUCTION

From reconnaissance surveys of the Gawler to Rowland Flat area by Pain (1975 and 1976), deeply weathered Woolshed Flat Shale potentially suitable for brick manufacture is known to underlie much of the area between Gawler and Concordia. Pain (1976) recommended drilling to delineate the limits of this material to ensure future supplies.

Elsewhere this unit is an important source of weathered shale for brick manufacture, being mined at One Tree Hill (Pain and Scott, 1984), Mitchell clay pit at Houghton (Keeling, 1980), and PGH clay pit at Anstey Hill (Russ and Tarvydas, 1969).

Investigation of the Gawler-Concordia district was initiated in 1982 after a request from a brick manufacturer for assistance in locating weathered shale deposits near Adelaide.

Sixty-nine shallow auger holes were drilled from 2 July to 15 July 1982 and from 14 February to 24 February 1983. Drilling was concentrated between Gawler and Concordia where shale crops out sparsely, with a lesser number of holes between Concordia and Sandy Creek. Drill Logs are contained in Appendix A, and clay firing tests by Australian Mineral Development Laboratories (AMDEL) on four samples from drill holes are included in Appendix B.

In March and April 1983, Adelaidean rocks exposed in the banks of the North Para River were mapped by the authors and A.M. Pain (Principal Geologist, Extractive Minerals) to provide outcrop data to supplement poor exposures within the area drilled to the south.

LOCATION, ACCESS AND TOPOGRAPHY

The area of approximately 30 km^2 under investigation, is 45 km by road north-northeast of Adelaide (Fig. 1), in hundred Barossa, county Adelaide and hundred Nuriootpa, county Light in District Council of Barossa, part of the Outer Metropolitan Planning Area. The area is bounded by North Para River to the north and west, Sturt Highway to the south, and the Sandy Creek-Rosedale road to the east (Fig. 2). Access is via Sturt Highway east from Gawler with unsealed roads extending from the highway.

The town of Gawler adjoins the area to the southwest. The small township of Sandy Creek is on Sturt Highway, 5.5 km east of Gawler, near the southern limit. Sturt Highway is a major tourist route for visitors to the Barossa Valley.

Concordia township comprises a number of farmhouses, with the historic Concordia Homestead 1.5 km to the southeast.

The small township of Rosedale is in the extreme northeast, with Turrettfield Agricultural Research Centre 1 km to the west.

Undulating topography with infilled drainage channels showing weakly developed terraces in the southern half of the area contrasts with the deeply incised North Para River to the north. Nearly all the area has been cleared for cropping or grazing, with some vineyards adjacent to the Sturt Highway. Terrain has slightly higher relief in the east, with quartzite and sandstone forming north-south ridges.

MINERAL TENURE

The area under investigation is freehold land. Clay and shale are classed as extractive minerals, and under the Mining Act, 1971 as amended, extractive minerals may only be pegged by the freehold landowner.

Eight Private Mines (PM) within the map area are included in Table 1. All are south of the Sturt Highway and have been worked exclusively for sand, with the exception of PM94 which has produced weathered shale and plastic clay.

Four Extractive Mineral Leases (EML) have been granted. Three produce foundry sand; only EML 4506 is worked for weathered shale.

Abandoned quartzite quarries on Sturt Highway have no mineral tenure.

Loam is not classed as a mineral under the Mining Act and consequently does not require mineral tenure. Loam pits in the North Para River, section 20, hundred Nuriootpa, are operated by Hayden and Sons Pty Ltd.

TABLE 1

PRIVATE MINES AND EXTRACTIVE MINERAL LEASES, Hd. BAROSSA

Private Mines

No.	Applicant	Section	Proclaimed	Operator	Products
28	J. & T.D. Guley	482,483, 3081,3084	11.01.73	Readymix	Construction Sand
94	A.J. & M.N. Geue	475,476	19.04.73	Mineral Holdings P/L.	Brick shale, Plastic clay
113	J.J. Williams	pt 86	3.05.73	J.J. Williams & Sons P/L.	Foundry Sand
204	Yaringa Pty. Ltd.	478,3100 3060, pt 3094	8.11.74	Readymix	Construction Sand
208	E.M. Taylor and P.H. Jewis	3082, pt 3087	15.11.74	Readymix	Construction Sand
229	B. & H.V. Lee	pt 69	18.04.74	Quarry Industries Ltd.	-
274	M.J. & J.L. Berrett	pt 68	10.04.75	Concrete Industries (Monier) Ltd.	Foundry Sand
276	D.E. & C.M. Marsters	pts 67,86	15.05.75	J.J. Williams and Sons P/L.	-

Extractive Mineral Leases

No.	Leaseholder	Section	Expires	Operator	Products
4506	D.A. Kies	720,726	22.03.90	Quarry Industries Ltd.	Brick Shale
4115	McKechnie Iron Foundry P/L.	318	23.08.87	McKechnie	Foundry Sand
4879, 4880	McKechnie Iron Foundry P/L.	318	16.10.87	McKechnie	Foundry Sand

CLAY AND SHALE PRODUCTION

The earliest recorded production of brick shale is 285 tonnes in 1973 from a pit in section 475, hd. Barossa, in the extreme western end of PM 94, 1 km east of Sandy Creek. Between 1973 and 1976, 13 242 tonnes of pale weathered shale was mined.

Following the discovery of Tertiary white plastic clay during a Departmental drilling programme (Pain, 1976) a small pit was opened in section 476 (just east of Fig. 2) by Mineral Holdings Pty Ltd during 1977. Production totalled 9 280 tonnes to the end of 1982.

EML 4506 was operated by L.R. and M. Sands Pty Ltd until acquired by Quarry Industries Ltd in 1979. Total production of white weathered shale to the end of 1982 was 11 617 tonnes.

Clay and shale production for PM 94 and EML 4506 is presented in Table 2.

TABLE 2

CLAY AND SHALE PRODUCTION (tonnes)

	EML 4506	PM 94		TOTAL SHALE
	SHALE	TERTIARY CLAY	SHALE	
1973	-	-	285	285
1974	-	-	4 015	4 015
1975	-	-	3 025	3 025
1976	1 071	-	5 917	6 988
1977	4 298	2 322	-	4 298
1978	2 457	4 092	-	2 457
1979	2 755	-	-	2 755
1980	-	1 331	-	-
1981	322	945	-	322
1982	714	590	-	714
Total	11 617	9 280	13 242	24 859

PREVIOUS INVESTIGATIONS

The regional geology of Gawler map sheet area was mapped by Campana (1953) and Tertiary sediments of the Barossa Valley were investigated in more detail by Dalgarno (1961).

During the early 1960's, deposits of Tertiary sand east of Gawler and south of Sturt Highway became important sources of construction sand for metropolitan Adelaide. Three sand pits were opened between 1960 and 1967 and drilling programs are documented by Johns (1961), Nixon (1961), Olliver (1961, 1962 and 1963) and Cramsie (1965). A summary of drilling results is presented with additional drilling data and revised surface mapping in Pain (1976). The area was included in a search for road rubble for the District Council of Barossa by Pain (1975). Martins (1979) described mineral resources of Barossa District Council, and designated most of the present study area as a potential source of red-firing brick shale.

Loam pits in the valley of North Para River were documented by Harris and Day (1982).

DRILLING

Reconnaissance drilling to delineate areas of weathered shale was undertaken in July 1982 and February 1983 using a Gemco auger rig of 10.5 m depth capacity mounted on a Daihatsu four wheel drive light truck. All holes were logged on site by E.A. Dubowski and representative samples are stored at Glenside Core Library Complex.

Between 2 July and 15 July 1982, 38 holes (field numbers GC1-GC34, GC2A, 3A, 17A and 32A) were drilled along road reserves. A further 31 holes (GC35-GC65) were drilled between 14 February and 24 February 1983 within paddocks and along road reserves. Total depth of drilling was 453.6 metres. The chronological field numbering system was abandoned and in this report holes were renumbered from west to east as Drill Holes (DH) 1 to 69. Locations are shown on Figure 2. Drill logs are detailed in Appendix A and summarised in Table 3.

In addition to these 1982-83 holes, information from previous drilling is included in this report. Adelaidean basement lithologies intersected in 34 holes south of Sturt

Highway are reported by Nixon (1961), Olliver (1962 and 1963) and Pain (1976) and included in Appendix C. Drill hole locations are shown on Figure 2. Logs of 7 boreholes drilled between 1940 and 1978 are included in Appendix D, with locations on Figure 2.

GEOLOGICAL SETTING

The oldest rocks exposed are shale and quartzite with thin dolomite interbeds, part of Burra Group of Adelaidean age. Sediments were folded, faulted and subjected to low grade regional metamorphism in early Palaeozoic times.

Weathering and leaching of Adelaidean sedimentary rocks in pre-Tertiary times resulted in a deep weathering profile producing material suitable for brick manufacture. Weathering is common to depths of more than 20 m.

A Tertiary sequence of interbedded gravel, silt and clay was deposited in a system of fresh water lakes between Gawler and the Barossa Valley. The precise age of Tertiary sediments near Concordia is uncertain. Fossil spores from a Rowland Flat sand pit are Miocene or Lower Pliocene (Harris and Olliver, 1967), but deeper sediments in the Barossa Valley are Oligocene to Miocene (Cobb, 1982).

Uplift and subsequent Quaternary erosion stripped much of the Tertiary sediments and soft weathered Adelaidean. Tertiary sediments protected underlying units from erosion and weathering profiles are now preserved around the margins of Tertiary basins and remnant outliers.

Pleistocene alluvial clay, some probably suitable for red plastic brick clay, was deposited in valleys incised into Tertiary sediments and Adelaidean metasediments.

GEOLOGY OF GAWLER-CONCORDIA

Adelaidean

Basement rocks at Gawler-Concordia comprise Burra Group sediments of Torrensian age. An easterly dipping sequence is exposed along the banks of North Para River between Gawler and Turrettfield and in creek channels draining into the river. Elsewhere, outcrop is poor with only the more resistant units cropping out in road embankments and ridges.

Ten rock units have been recognized along North Para River; eight in Woolshed Flat Shale (Thomson, 1969) and two in the lower part of the overlying Undalya Quartzite.

Lithology and thickness are detailed below in ascending stratigraphic order.

Woolshed Flat Shale

Unit 1 (270^{+}m): Shale, laminated, grey to orange-brown, fissile, silty, and micaceous, with interbeds of tightly folded quartzite up to 30 cm thick; and tightly folded, dark grey to black, micaceous and carbonaceous shale near base.

Unit 2 (780 m): Shale; uniform, finely laminated grey to brown micaceous shale with strongly developed crenulation cleavage.

Unit 3 (140 m): Shale, fine-grained, light grey, laminated, dolomitic.

Unit 4 (700m): Shale; uniform, fissile, laminated grey to dark grey shale, phyllitic in part; minor dolomite beds up to 30 cm thick near centre of unit.

Unit 5 (560m): divided into 3 sub-units;

5A: Shale, grey, phyllitic, slightly silty, with rare buff and grey dolomite bands up to 20 cm thick.

5B: Shale, laminated, grey, dolomitic, dolomite and shale interbeds.

5C: Shale, grey, micaceous, with rare buff dolomite bands up to 5 m thick.

Unit 6 (380m): Shale, grey, laminated, fissile, phyllitic, dolomitic in part; rare interbeds of buff and grey dolomite up to 10 m thick; rare dolomitic siltstone and thin carbonaceous bands.

Unit 7 (1000m): divided into 2 sub units;

7A: Shale, dolomitic, grey to dark grey, and grey dolomite, with interbedded carbonaceous shale; separated from Unit 7B by tightly folded, medium-grained massive light grey quartzite, 10 to 20 m thick.

7B: Shale and dolomitic phyllitic shale, light to dark grey, with minor quartzite interbeds up to 5 m thick.

Unit 8 (260m): Dolomitic sandstone and sandstone, buff to brown; minor interbeds of sandy shale, dolomitic shale, buff dolomite, and cross-bedded sandstone and quartzite with cross bedding amplitude of 1-2 m; pyrite cubes up to 5 mm in shale and quartz veins.

Undalya Quartzite

Unit 9 (400^{+}m): Shale, orange-brown, sandy in part; interbeds of fine to medium grained massive buff sandstone, slightly dolomitic in part; silicified white, blocky siltstone in a rubble pit north of North Para River in section 50, hd Nuriootpa.

Unit 10 (70^{+}m): Sandstone, massive cross-bedded feldspathic.

Where weathered, Units 1 to 6 have greatest potential for brick shale, since dolomite and dolomitic shale interbeds are comparatively rare, particularly in Units 1 to 4.

An increasing abundance of dolomite, dolomitic shale, quartzite and sandstone makes Units 7 to 10 less attractive for brick shale, despite the shale pits on PM 94 and EML 4506 being within Units 7 or 8. Selected non-dolomitic shale within these units may be suitable.

Sediments along North Para River dip moderately eastwards, and strike changes gradually from north-south near Gawler, to northwest-southeast near Turrettfield.

Small scale tight to isoclinal folds of several metres or less are seen in most units, but are particularly prominent in quartzite and dolomite bands. Axes of minor folds are generally 20° or less to north or south. Phyllitic shale often displays strong crenulation cleavage, striking sub-parallel to bedding and near vertical.

The westerly dipping limb of a larger fold is visible for approximately 50 m across strike in section 473, hd. Barossa, in buff dolomite within Unit 6. A similar smaller fold is exposed on the southern bank of North Para River, 1 km to the north.

Owing to sparse outcrop away from North Para River valley, correlation of stratigraphic units is difficult.

The boundary of Unit 6/Unit 7 was extended southeasterly by:

- extrapolation parallel to the prominent quartzite band in Unit 7, which crops out over a distance of 2.5 km,
- correlation of buff dolomite in the river near the top of Unit 6 with folded buff dolomite 1 km to the south,
- correlation of carbonaceous shale in DH56 on the southern boundary of section 275, hd Barossa with carbonaceous and partially dolomitic shale of Unit 7A exposed in North Para River.

Further east, sandstone in the south of section 272, northeast of DH59, is correlated with the central sandstone of Unit 8.

A number of quartzite and sandstone units are exposed in quarries along Sturt Highway west of Sandy Creek, and crop out north of Sandy Creek. The structural and stratigraphic relationship of these to units along North Para River was not resolved.

No field evidence was found for the following previously published interpretations:

- Quartzite in quarries in sections 722, 3024 and 726 hd Barossa does not appear to be on opposite limbs of an anticline as shown on Gawler (Campana, 1953) but is assumed to be separate beds. Quartzite in sections 722 and 3024 has been folded into an isoclinal syncline.
- The western boundary of Undalya Quartzite has been folded on ADELAIDE (Thompson, 1969) to include sandstone and quartzite in sections 3049 and 3052. This outcrop is correlated with similar outcrop, 0.7 km to the north, of sandstone in Unit 8 near the top of Woolshed Flat Shale.

Small hydrothermal quartz veins and stringers are widespread, paralleling or cross cutting bedding, and were intersected in 15 of 52 drillholes penetrating Adelaidean rocks. The largest quartz vein, in section 20, hd Nuriootpa, in Unit 6, near North Para River, was 130 m long and 1 to 2 m wide. Evaluation of potential quarry sites should determine distribution of quartz veins.

Tertiary

Gravel, sand, clay and clayey sand were deposited on an undulating surface of weathered Adelaidean rocks (Figure 3) under fluvio-lacustrine conditions.

Important deposits of construction sand and gravel are worked south of Sturt Highway where thickness exceeds 30 m in places.

North of Sturt Highway, maximum recorded thickness is 10.5 m in DH20. Ferruginous limonitic staining and cementing of Tertiary sediments has formed ferricrete in many outcrops, and siliceous cementation has formed silcrete.

The following areas of Tertiary sediments have been outlined by drilling and surface mapping:

- DH27, 28 intersected 9.1 and 3.6 m respectively. This outlier is inferred to extend over an area of about 1.5 km in diameter to include Tertiary silcrete in section 469, Tertiary float in sections 3042, 468, and 472, and possible silcrete float in section 3038.
- DH19, 20 and 21 intersected 3.5, 10.5 and 2.0 m respectively. This outlier is inferred to extend over 1.6 km by 0.4 km to include silcrete float in sections 261 and 3040, hd Barossa.
- DH61 intersected 3 m and represents a hill capping 600 m long and up to 200 m wide.
- DH69 intersected 4.7 m of probable Tertiary sediments within a topographic low inferred to extend over 400 m by 300 m.
- A further 17 smaller outliers are shown on Figure 2 but have not been drilled.

Quaternary

Quaternary alluvium infills valleys and underlies river terraces adjacent to creek banks, e.g. DH16 and 22 in Bergen Gully, sections 263 and 264, hd Barossa.

Alluvial brown clayey sand, at least 6 m thick, is exposed in the creek bank south of section 12, hd Nuriootpa and in North Para River to the west. Similar Quaternary alluvium is mined as loam in section 20, hd Nuriootpa and is exposed in river banks along much of North Para River.

Much of the area is overlain by a veneer of red-brown clay with patchy calcrete developed near the surface. Quaternary units were intersected in most drill holes, exceeding 2 m thickness in 31 holes, and exceeding 4 m in 15 holes.

RESULTS OF DRILLING

Drilling has delineated areas of Tertiary sediments and limits of underlying deeply weathered Adelaidean rocks (Fig. 2). Intersections are summarized in Table 3.

In the west, Tertiary outliers are surrounded by weathered shale of Units 1 to 6, tested by 51 drillholes (DH1 to DH51) with the following results:

- 8 bottomed in Quaternary units (DH 1, 8, 10, 16, 22, 23, 33 and 45).
- 5 bottomed in Tertiary units (DH 9, 19, 20, 21, and 28).
- 5 intersected fresh or partly weathered Adelaidean shale near the margin of the weathered zone (DH 2, 3, 4, 12, and 17), highlighting the irregular nature of this contact.
- 28 intersected weathered shale but none penetrated the full depth of weathering.
- 5 intersected fresh shale or siltstone southeast of the weathered zone (DH 47 to 51).

Base of the weathered zone to the north and west, near North Para River varies from 65 m RL to 105 m RL and is locally variable. Eastern and southern boundaries are approximate, being either gradational or obscured beneath Quaternary cover.

Base of weathering appears to follow present topography and is as high as 170 m RL to the east near DH61.

The main western zone of weathering extends onto Unit 7A, delineated by DH56, 57, 58, 61 and 62 which intersected either weathered shale with some carbonaceous bands, sandstone or Tertiary sediments.

Weathering to the north near DH53 appears to be restricted to an area of 700 m by 500 m, separate from the main zone, as DH54 and 55 intersected fresh rock.

TABLE 3
SUMMARY OF DRILL HOLE INTERSECTIONS

Drill Hole	Q (m)	T (m)	Precambrian (m)	Precambrian Type	Drill Hole	Q (m)	T (m)	Precambrian (m)	Precambrian Type	Drill Hole	Q (m)	T (m)	Precambrian (m)	Precambrian Type
1	6.0	-	-	-	24	1.4	-	9.1	W.Sh	47	1.5	-	5.2	Sltst
2	1.0	-	0.5	F.Sh	25	1.5	-	9.0	W.Sh*	48	3.0	-	4.0	Sltst
3	1.0	-	0.5	F.Sh	26	5.0	-	5.5	W.Sh	49	1.0	-	5.0	F.Sh
4	0.8	-	0.7	F.Sh	27	1.0	9.1	0.4	W.Sh	50	1.0	-	3.5	F.Sh
5	1.8	-	8.7	W.Sh	28	2.4	3.6	-	-	51	1.5	-	4.5	F.Sh
6	3.0	-	6.0	W.Sh	29	5.5	-	5.0	W.Sh	52	-	-	2.5	F.Sh
7	4.0	-	6.5	W.Sh*	30	0.4	-	10.1	W.Sh	53	0.7	-	9.3	W.Sh
8	2.5	-	-	-	31	0.5	-	1.7	W.Sh	54	2.0	-	-	-
9	3.4	1.7	-	-	32	5.0	-	2.0	W.Sh	55	0.5	-	-	-
10	1.0	-	-	-	33	5.1	-	-	-	56	1.5	-	9.0	W.Sh*
11	3.2	-	7.3	W.Sh	34	2.4	-	6.6	W.Sh	57	1.5	-	9.0	Sst
12	1.0	-	1.0	F.Sh	35	0.7	-	9.8	W.Sh	58	2.5	-	0.9	Sst
13	1.0	-	2.0	W.Sh	36	2.2	-	6.4	W.Sh	59	0.2	-	1.8	F.Sh
14	1.0	-	0.2	W.Sh	37	1.7	-	6.2	W.Sh*	60	2.0	-	-	-
15	4.0	-	5.0	W.Sh	38	4.0	-	2.0	W.Sh	61	1.0	2.0	6.0	Sst
16	7.0	-	-	-	39	1.8	-	1.7	W.Sh	62	1.5	-	9.0	Sst
17	2.3	-	1.2	F.Sh	40	1.5	-	4.5	W.Sh	63	1.1	-	2.9	Sst
18	2.3	-	8.2	W.Sh	41	5.5	-	5.0	W.Sh	64	6.0	-	1.9	Sst
19	3.5	3.5	-	-	42	-	-	10.5	W.Sh	65	1.5	-	6.0	Sst
20	-	10.5	-	-	43	4.5	-	6.0	W.Sh	66	1.6	-	7.4	Sltst
21	-	2.0	-	-	44	3.3	-	7.2	W.Sh	67	3.1	-	0.9	W.Sh
22	4.5	-	-	-	45	4.5	-	-	-	68	1.0	-	6.0	Sltst
23	1.7	-	-	-	46	1.0	-	6.5	W.Sh	69	5.3	3.7	-	-

Total Depth 453.6 m

Note: Q = Quaternary T = Tertiary * indicates firing test
W.Sh = weathered shale F.Sh = fresh shale Sst = sandstone Sltst = siltstone

In the east, deep weathering in Units 7 to 10 is probably confined to silty and clayey beds which have not been mapped owing to lack of outcrop, rather than comprising broad zones.

Eighteen holes (DH 52 to 69) are inferred to intersect the southerly extent of Units 7 to 10 as follows:

- 7 sandstone (DH 57, 58, 61 to 65),
- 2 siltstone (DH 66 and 68),
- 2 fresh shale (DH 52, and 59),
- 3 weathered shale (DH 53, 56 and 67),
- 4 failed to penetrate Tertiary or Quaternary cover.

Borehole 1687 drilled for water on section 3052, 300 m to the northeast of DH63 intersected the following sequence, inferred to be Unit 7B or 8:

0-40 m soft sandstone
40-46 m interbedded sandstone and slate
46-134 m slate
134-162.3 m quartz (quartzite?)

Borehole 6891, on section 1716, 2 km to the east-northeast towards Rosedale, intersected grey clay (weathered slate?) and slate with rare quartzite interbeds, and is inferred to be stratigraphically above Unit 10.

Another broad weathered zone confined to a north-south topographic low in the southeast, including white to cream weathered shale in pits in PM94 and EML 4506, and in DH67 abuts Tertiary sediments to the south, and surrounds the Tertiary outlier in DH69. Northern extent is unknown.

Previous drill holes south of Sturt Highway intersected shale, slate or phyllite with varying degrees of weathering:

- To the east and southeast of Sandy Creek, Tertiary sediments are underlain by grey shale and siltstone weathered to white and light grey clay (Pain 1976).
- In the southwest, Nixon (1961) recorded greyish green partly weathered slate, weathered to fawn in places, underlying and adjacent to Tertiary sediments in PM28.
- In the west in PM208, Olliver (1963) recorded grey weathered phyllite, silty in part, and weathered to yellow-brown.
- Boreholes 1794, 1797, 1803, 1804 recorded variously coloured slate, whereas borehole 1634 in section 3076 in Gawler intersected 12.8 m of Quaternary over weathered shale.

In general, Tertiary sediments north of Sturt Highway are either too fine, silty, ferruginous, or siliceous to be suitable for either garden sand (loam) or construction sand.

Red plastic clay within Quaternary alluvium is more than 2 m thick in 31 holes. Similar material from nearer Adelaide has been used in brick blends and here could be mined in conjunction with underlying shale.

FIRING TESTS

AMDEL results for four samples of weathered shale are summarized in Table 4 from details in Appendix B.

TABLE 4
SUMMARY OF FIRING CHARACTERISTICS

	DH7	DH25	DH37	DH56
Interval(m):	4.0-10.5	2.0-10.5	2.0-7.9	1.5-8.5
Description of weathered Shale:	Orange-brown to green-brown	Orange-brown to green-brown	Buff to orange-brown	Yellow-brown, slightly carbonaceous
Sample No:	R742	R743	R741	R744
Hundred:	Nuriootpa	Barossa	Barossa	Braossa
Section:	13	3043	470	275
Rock Unit:	2	2 or 3	5	7A
Fired Colour:	Red	Pale	Pale	Red
Plasticity:	Low	Low to medium	Low to medium	Low
Shrinkage:	Low	Low	Moderate	Moderate
Comments:	Cracking	Slight cracking & scumming	Slight cracking & scumming	-

All samples are suitable for brick manufacture.

Samples R741 and R744 could be used in significant proportions in brickmaking blends, whereas samples R742 and R743 require blending to overcome scumming and cracking.

CONCLUSIONS

Woolshed Flat Shale, part of Burra Group sediments of Adelaidean age is an important source of brick shale for Metropolitan Adelaide. From 1973 to 1982, 24 859 tonnes was mined from two pits near Sandy Creek.

Of the 10 rock units identified by mapping and 69 auger drillholes at Gawler-Turrettfield, Units 1 to 8 are Woolshed Flat Shale, and Units 9 and 10 belong to the lower part of overlying Undalya Quartzite.

Units 1 to 6, between Gawler and Concordia, comprise shale with minor dolomite and quartzite interbeds and contain large reserves of weathered shale suitable for brickmaking below and on the margins of Tertiary outliers. The weathered zone, covering 7.5 km^2 was drilled to a maximum depth of 10.5 m. Tertiary sediments, up to 10.5 m thick, have no economic use other than as low quality fill.

Sandy and dolomitic beds of Units 7 to 10 include suitably weathered shale interbeds east of Concordia.

Quaternary red plastic clay, more than 4 m thick in places, is also useful in brick blends, and can be mined with the underlying weathered shale.

All land is freehold, and under the Mining Act 1971 and as amended, mining title for extractive minerals such as clay and shale may be granted only to the freehold landowner.

Further drilling is required to outline potential shale deposits in the east and detailed drilling to select quarry sites and prove reserves in the west.

EAD-WMcC:GU

E.A. DUBOWSKI
GEOLOGIST

WAYNE McCALLUM
SENIOR GEOLOGIST

REFERENCES

Ambrose, G.J., 1972. Sand and Clay Deposits, Gawler-Sandy Creek Area. S. Aust. Dept. Mines report 72/36 (unpublished).

Campana, B., 1953. Gawler Map Sheet, Geological Atlas of South Australia, 1:63 360 series. Geol. Surv. S. Aust.

Campana, B., 1955. The geology of the Gawler Military Sheet. Rept. Invest. geol. Surv. S. Aust., 4.

Cobb, M.A., 1982. Groundwater resources of the Barossa Valley. S. Aust. Dept. Mines and Energy report 82/67 (unpublished).

Cramsie, J.N., 1965. Test Drilling, Sand and Gravel Deposit South-East of Gawler. Section 3058, Hundred Barossa. (Screenings Pty. Ltd.). Min. Rev. Adelaide 124:126.

Dalgarno, C.R., 1961. Geology of the Barossa Valley. M.Sc. Thesis. Univ. of Adelaide (Unpub.).

Harris, W.K. and Olliver, J.G., 1965. The Age of the Tertiary Sands at Rowland Flat, Barossa Valley. Geol. Surv. S. Aust., Quart. Geol. Note No. 13.

Harris, R.J., and Day, L.J., 1982. Sampling, testing and classification of Adelaide Loam. S. Aust. Dept. Mines and Energy report 82/13 (unpublished).

Johns, R.K., 1961. Sand Deposits 3 Miles East of Gawler. Hd. Barossa Sects. 478, 479, 3094, 3060, etc. (Jayworth Besser Ltd.). S. Aust. Dept. Mines report 52/154 (unpublished).

Keeling, J.L., 1980. Mitchells' Houghton clay pit (Private Mine 57). S. Aust. Dept. Mines and Energy report 79/158 (unpublished).

Keeling, J.L., 1982. Sand, gravel and clay resources, Rowland Flat to Tanunda. Reconnaissance drilling, 1979. S. Aust. Dept. Mines and Energy report 82/62 (unpublished).

Martins, J.J., 1979. Mineral Resources of the Barossa District Council Area. S. Aust. Dept. Mines and Energy report 79/123 (unpublished).

Mason, M.G., 1966(a). Sand Deposit at Sandy Creek. Sect. 71, Hd. Barossa (R.M. Measday and Co.). Min. Rev. Adelaide, 124:126-129.

Mason, M.G., 1966(b). Supplementary Report on Sand Deposit at Sandy Creek. Sec. 71, Hd. Barossa (R.M. Measday and Co.). S. Aust. Dept. Mines report 63/29 (unpublished).

Nixon, L.G., 1961. Tertiary Sand Deposit. Secs. 482, 483, 3081, 3084, Hd. Barossa, Co. Adelaide. (Ready Mixed Concrete (S.A.) Pty. Ltd.). S. Aust. Dept. Mines report 52/113 (unpublished).

Olliver, J.G., 1961. Test Drilling of a Tertiary Sand Deposit. Secs. 3035, 3036 Hd. Barossa (J.A. Jenssen). S. Aust. Dept. Mines report 53/41 (unpublished).

Olliver, J.G., 1962. Test Boring of a Tertiary Sand Deposit near Kalbeeba. Sects. 478, 3035, 3060, 3094, 3100 Hd. Barossa. (Yaringa Ltd.). Min. Rev. Adelaide, 116:93-98.

Olliver, J.G., 1963. Test Boring of a Sand Deposit near Gawler, Sects. 3082, 3083, Hd. Barossa (F.A. Taylor). Min. Rev. Adelaide, 118:134-144.

Olliver, J.G., and Weir, L.J., 1967. The Construction Sand Industry in the Metropolitan Area. Rept. Invest. Geol. Surv. S. Aust., 30.

Pain, A.M., 1975. Road making material survey, Western part of the Barossa District Council area. S. Aust. Dept. Mines report 75/56 (unpublished).

Pain, A.M., 1976. Sand, gravel and clay resources of the Barossa district, Gawler to Rowland Flat. S. Aust. Dept. Mines report 76/109 (unpublished).

Pain, A.M., 1979. The assessment of sand resources of the Barossa district, Gawler to Rowland Flat. S. Aust. Dept. Mines and Energy report 79/39 (unpublished).

Pain, A.M. and Scott, D.C., 1984. Clay and sand resources, One Tree Hill. S. Aust. Dept. Mines and Energy report (unpublished).

Russ, P.J. and Tarvydas, R.K., 1969. Anstey Hill white clay deposit. Min. Rev. Adelaide 126:97-100.

Thomson, B.P., 1969. ADELAIDE map sheet, Geological Atlas of South Australia, 1:250 000 series. Geol. Surv. S. Aust.

APPENDIX A

LOGS OF AUGER DRILL HOLES
1982-1983

DEPTH(m) From	To	DESCRIPTION	AGE
Drill Hole 1, section 13, hd Barossa, 74 m RL.			
0	2.0	SOIL, brown, with shale fragments.	QUATERNARY
2.0	3.0	SOIL, brown, silty.	
3.0	4.0	No sample return.	
4.0	4.5	SOIL, silty, with fragments of weathered shale and quartz.	
4.5	5.1	No sample return.	
5.1	5.7	SOIL, dark brown.	
5.7	6.0	CLAY, red-brown, with some weathered shale fragments.	
6.0		End of Hole.	
Drill Hole 2, section 13, hd Barossa, 94 m RL.			
0	1.0	CALCRETE	QUATERNARY
1.0	1.5	SHALE, fresh, grey, quartz veining	ADELAIDEAN
1.5		End of Hole.	
Drill Hole 3, section 13, hd Barossa, 98 m RL.			
0	0.4	SOIL, brown	QUATERNARY
0.4	1.0	CALCRETE, with shale fragments.	
1.0	3.3	SHALE, moderately weathered, pale-brown to brown, with minor quartz veining @ 2.5 metres; some moderately fresh grey shale @ 3.2 m.	ADELAIDEAN
3.3		End of Hole.	
Drill Hole 4, section 13, hd Barossa, 105 m RL.			
0	0.8	SOIL, red-brown, calcreted.	QUATERNARY
0.8	1.5	SHALE, slightly weathered, red-brown to brown.	ADELAIDEAN
1.5		End of Hole.	
Drill Hole 5, section 13, hd Barossa, 106 m RL.			
0	0.2	SOIL, brown.	QUATERNARY
0.2	1.0	CALCRETE, minor quartz and lithic fragments.	
1.0	1.8	SOIL, red-brown.	
1.8	2.0	SHALE, weathered, brown.	ADELAIDEAN
2.0	10.5	SHALE, weathered, pale-brown.	
10.5		End of Hole.	

Drill Hole 6, section 13, hd Nuriootpa, 106 m RL.

0	0.5	SOIL, brown topsoil.	QUATERNARY
0.5	1.0	CLAY, moderately sandy, calcreted, pale brown; minor quartz fragments.	
1.0	3.0	CLAY, compact plastic, red-brown, slightly gritty.	
3.0	3.7	SHALE, highly weathered, brown, mottled white to off-white.	ADELAIDEAN
3.7	4.6	SHALE, weathered, pale orange-brown.	
4.6	5.0	SHALE, weathered, pale red-brown.	
5.0	6.7	SHALE, moderately weathered, pale greenish-brown.	
6.7	7.5	SHALE, moderately weathered, greenish grey, ferruginous staining.	
7.5	9.0	SHALE, weathered, brown.	
9.0		End of Hole.	

Drill Hole 7, section 13, hd Barossa, 106 m RL.

0	1.0	SOIL, calcreted.	QUATERNARY
1.0	4.0	CLAY, plastic, red-brown.	
4.0	6.0	SHALE, highly weathered, pink-brown, cream, orange or grey.	ADELAIDEAN
6.0	8.0	SHALE, weathered, brown, orange-brown, or grey-green.	
8.0	9.0	SHALE, weathered, green-brown.	
9.0	10.5	SHALE, weathered, red-brown.	
10.5		End of Hole.	
		Clay Firing Test, sample R742, 4.0 to 10.5 m.	

Drill Hole 8, section 3044, hd Barossa, 113 m RL.

0	0.5	SOIL, brown.	QUATERNARY
0.5	1.0	CALCRETE.	
1.0	2.5	CLAY, compact, red-brown, mottled green-brown.	
2.5		End of Hole, Difficult drilling.	

Drill Hole 9, section 3044, hd Barossa, 113 m RL.

0	1.5	SOIL, calcreted, brown.	QUATERNARY
1.5	3.4	CLAY, friable plastic, red-brown, mottled cream.	
3.4	5.1	SAND, f-m, clayey, orange-white; thin siliceous indurated seam @ 4.4 m.	TERTIARY
5.1	5.1	SAND, m, white, indurated, siliceous.	
5.1		End of Hole, Difficult drilling.	

Drill Hole 10, section 3043, hd Barossa, 103 m RL.

0	0.4	SOIL, brown.	QUATERNARY
0.4	1.0	CALCRETE, very hard.	
1.0		End of Hole.	

Drill Hole 11, section 261, hd Barossa, 97 m RL.

0	1.5	CLAY, blocky, brown, slightly calcreted.	QUATERNARY
1.5	2.0	SOIL, silty, calcareous, brown.	
2.0	3.2	CLAY, blocky, brown, red-brown.	
3.2	6.5	SHALE, weathered, brown.	ADELAIDEAN
6.5	9.5	SHALE, weathered, red-brown.	
9.5	10.5	SHALE, weathered, slightly, micaceous, greyish brown.	
10.5		End of Hole.	

Drill Hole 12, section 3044, hd Barossa, 95 m RL.

0	1.0	CALCRETE.	QUATERNARY
1.0	2.0	SHALE, weathered, brown, with some fresh grey-brown fragments.	ADELAIDEAN
2.0		End of Hole.	

Drill Hole 13, section 3044, hd Barossa, 98 m RL.

0	0.5	SOIL, dark brown.	QUATERNARY
0.5	1.0	CALCRETE, with high quartz content.	
1.0	3.0	SHALE, slightly micaceous, weathered brown, high quartz vein (?) content.	ADELAIDEAN
3.0		End of Hole. Drilling stopped by hard quartz vein.	

Drill Hole 14, section 3044, hd Barossa, 103 m RL.

0	1.0	SOIL, very fine, calcreted.	QUATERNARY
1.0	1.2	SHALE, weathered brown, with high quartz vein (?) content.	ADELAIDEAN
1.2		End of Hole, drilling stopped by quartz vein.	

Drill Hole 15, section 3040, hd Barossa, 97 m RL.

0	1.1	CLAY, calcreted.	QUATERNARY
1.1	4.0	CLAY, plastic, red-brown.	
4.0	5.7	SHALE, highly weathered, orange-brown.	ADELAIDEAN
5.7	6.4	SHALE, weathered, pale brown.	
6.4	8.0	SHALE, weathered, pale orange-brown.	
8.0	9.0	SHALE, weathered, pale red-orange, brown.	
9.0		End of Hole.	

Drill Hole 16, section 3040, hd Barossa, 83 m RL.

0	2.4	CLAY, compact, dark brown.	QUATERNARY
2.4	7.0	CLAY, red brown, with quartz and lithic fragments.	
7.0		End of Hole.	

Drill Hole 17, section 3078, hd Barossa, 104 m RL.

0	0.1	SOIL, grey-brown.	QUATERNARY
0.1	1.0	CALCRETE.	
1.0	2.3	CLAY, brown.	
2.3	3.5	SHALE, moderately weathered, grading to slightly-weathered, brownish green.	ADELAIDEAN
3.5		End of Hole.	

Drill Hole 18, section 264, hd Barossa, 114 m RL.

0	2.3	CALCRETE.	QUATERNARY
2.3	3.5	SHALE, weathered, brown, with quartz veining.	ADELAIDEAN
3.5	4.0	SHALE, micaceous, weathered, with very thin white and pale greyish-brown silty lenses.	
4.0	9.5	SHALE, micaceous, weathered, pale brown to pale orange-brown; minor ferruginous induration.	
9.5	10.5	SHALE, weathered, pinkish brown.	
10.5		End of Hole.	

Drill Hole 19, section 263, hd Barossa, 99 m RL.

0	1.0	GRAVEL, sandy (?road fill material).	
1.0	3.5	CLAY, plastic, compact, brown.	QUATERNARY
3.5	6.5	SAND, f, orange, becoming clayey and gritty with depth.	TERTIARY
6.5	7.0	SAND, f, gravelly, orange.	
7.0		End of Hole.	

Drill Hole 20, section 263, hd Barossa, 110 m RL.

0	0.1	GRAVEL, f, in brown topsoil.	TERTIARY
0.1	1.0	SAND, f, pink, with rock and quartz gravels.	
1.0	3.0	SAND, f, pink, with sub- to well-rounded v.c. gravels; Sand vf @ 2-3m.	
3.0	8.5	SILT, sandy, moderately clayey, brown-cream.	
8.5	10.5	SILT, buff coloured.	
10.5		End of Hole.	

Drill Hole 21, section 263, hd Barossa, 110 m RL.

0	2.0	GRAVEL, m-c, sub-angular to sub-rounded.	TERTIARY
2.0		End of Hole, Difficult drilling.	

Drill Hole 22, section 264, hd Barossa, 112 m RL.

0	4.5	CLAY, red-brown alluvial, with reworked Tertiary fragments.	QUATERNARY
4.5		End of Hole.	

Drill Hole 23, section 3043, hd Barossa, 103 m RL.

0	1.0	SOIL, brown, clayey.	QUATERNARY
1.0	1.7	CLAY, friable, calcreted, pinkish brown hard quartz fragments @ 1.7 m.	
1.7		End of Hole, Difficult drilling.	

Drill Hole 24, section 3043, hd Barossa, 103 m RL.

0	0.4	SOIL, brown.	QUATERNARY
0.4	1.4	CLAY, calcreted.	
1.4	2.1	SHALE, highly weathered, brown.	ADELAIDEAN
2.1	3.8	SHALE, weathered, white to pinkish-white.	
3.8	10.5	SHALE, pale grey, grading to cream and orange with depth; quartz veining from 9.1 m.	
10.5		End of Hole.	

Drill Hole 25, section 3043, hd Barossa, 103 m RL.

0	1.0	CALCRETE.	QUATERNARY
1.0	1.5	CLAY, sandy, red, minor quartz pebbles.	
1.5	3.0	SHALE, highly weathered, pinkish-brown, or cream.	ADELAIDEAN
3.0	6.0	SHALE, weathered, brown, brownish-cream.	
6.0	9.0	SHALE, weathered, red-brown.	
9.0	10.5	SHALE, weathered, cream-brown.	
10.5		End of Hole.	
		Clay Firing Test, Sample R743, 2.0 to 10.5 m.	

Drill Hole 26, section 3043, hd Barossa, 103 m RL.

0	5.0	CLAY, compact, plastic, red-brown.	QUATERNARY
5.0	6.3	SHALE, highly weathered, orange; quartz veining @ 6.0 m.	ADELAIDEAN
6.3	9.5	SHALE, weathered, white-grey; quartz veining @ 9.0 m.	
9.5	10.5	SHALE, weathered, pale grey-brown.	
10.5		End of Hole.	

Drill Hole 27, section 3042, hd Barossa, 108 m RL.

0	0.4	SOIL, brown.	QUATERNARY
0.4	0.9	CALCRETE.	
0.9	1.0	CLAY, compact brown.	
1.0	1.2	SAND, f-m, white, indurated.	TERTIARY
1.2	1.5	CLAY, sandy, orange.	
1.5	2.0	SAND, f, orange, with indurated clay seams.	
2.0	2.1	CLAY, sandy, orange.	
2.1	3.5	SAND, f, pale orange to orange.	
3.5	4.1	SAND, vf, cream-orange.	
4.1	10.1	SILT, cream to buff; quartz ?gravel 9.1-10.1 m.	
10.1	10.5	SHALE, weathered orange.	ADELAIDEAN
10.5		End of Hole.	

Drill Hole 28, section 3042 hd Barossa, 108 m RL.

0	1.0	CLAY, compact, plastic, dark brown.	QUATERNARY
1.0	1.5	CLAY, compact plastic, brown.	
1.5	2.4	CLAY, compact plastic, orange-brown.	
2.4	3.0	SAND, m, with quartz fragments, orange.	TERTIARY
3.0	4.0	SAND, f, with quartz fragments, buff-coloured.	
4.0	4.4	SAND, c, orange.	
4.4	6.0	GRAVEL, with coarse orange sand.	
6.0		End of Hole, Difficult drilling.	

Drill Hole 29, section 3038, hd Barossa, 121 m RL.

0	1.5	CLAY, pink-brown, calcreted.	QUATERNARY
1.5	5.5	CLAY, compact plastic, red-brown.	
5.5	6.5	SHALE, highly weathered, orange-brown.	ADELAIDEAN
6.5	10.5	SHALE, weathered, pale brown.	
10.5		End of Hole.	

Drill Hole 30, section 468, hd Barossa, 98 m RL.

0	0.4	SOIL, brown.	QUATERNARY
0.4	2.0	SHALE, weathered, pale cream-brown.	ADELAIDEAN
2.0	3.0	SHALE, weathered, cream.	
3.0	5.8	SHALE, weathered, cream-brown to brown; some quartz veining.	
5.8	9.0	SHALE, slightly micaceous, weathered, purplish red.	
9.0	10.0	SHALE, weathered, red-brown to brown; thin silty bands and large quartz vein(?) fragments.	
10.0	10.5	SHALE, weathered, brown; thin bands of cream shale, some quartz veining.	
10.5		End of Hole.	

Drill Hole 31, section 3045, hd Barossa, 110 m RL.

0	0.5	SOIL, calcreted.	QUATERNARY
0.5	2.0	SHALE, slightly weathered, pale yellow-brown.	ADELAIDEAN
2.0	2.2	SHALE, weathered, brown to cream, some ferruginous induration.	
2.2		End of Hole, hard ferruginous induration.	

Drill Hole 32, section 3045, hd Barossa, 103 m RL.

0	0.4	SOIL, dark brown.	QUATERNARY
0.4	2.5	CALCRETE.	
2.5	5.0	CLAY, plastic, brown, red-brown.	
5.0	7.0	SHALE, slightly micaceous, weathered, with fragments of fresher grey-green shale.	ADELAIDEAN
7.0		End of Hole.	

Drill Hole 33, section 31, hd Nuriootpa, 100 m RL.

0	5.1	CLAY, red-brown.	QUATERNARY
5.1		End of Hole.	

Drill Hole 34, section 3045, hd Barossa, 100 m RL.

0	0.3	SOIL, dark brown.	QUATERNARY
0.3	1.8	SILT, calcareous.	
1.8	2.4	CLAY, plastic, red.	
2.4	6.1	SHALE, weathered, brown, yellowish-green.	ADELAIDEAN
6.1	9.0	SHALE, silty, weathered, grey-green.	
9.0		End of Hole.	

Drill Hole 35, section 469, hd Barossa, 97 m RL.

0	0.6	SOIL, red-brown.	QUATERNARY
0.6	0.7	CALCRETE.	
0.7	2.5	SHALE, weathered, brownish, grey-green.	ADELAIDEAN
2.5	10.5	SHALE, silty, weathered, slightly micaceous, brown-green or green-brown.	
10.5		End of Hole.	

Drill Hole 36, section 469, hd Barossa, 106 m RL.

0	0.3	SOIL, f, red-brown.	QUATERNARY
0.3	1.0	CALCRETE.	
1.0	2.2	CLAY, friable, plastic, red-brown.	
2.2	4.0	SHALE, weathered, yellowish orange-brown.	ADELAIDEAN
4.0	6.0	SHALE, silty, weathered, greenish yellow-brown and brown.	
6.0	8.6	SHALE, silty, brownish green.	
8.6		End of Hole.	

Drill Hole 37, section 470, hd Barossa, 115 m RL.

0	1.0	SOIL, clayey, dark brown.	QUATERNARY
1.0	1.7	SOIL, clayey, red-brown, minor quartz pebbles.	
1.7	2.0	SHALE, sandy, clayey, yellow.	ADELAIDEAN
2.0	5.7	SHALE, weathered, buff-coloured, quartz veining, from 3.5 m.	
5.7	6.0	SHALE, weathered, orange, quartz veining.	
6.0	7.9	SHALE, weathered, yellow to yellow-brown, some quartz veining.	
7.9		End of Hole.	
		Clay Firing Test, Sample R741, 2.0 to 7.9 m.	

Drill Hole 38, section 472, hd Barossa, 120 m RL.

0	1.0	SOIL, dark brown.	QUARTERNARY
1.0	1.5	CLAY, plastic, dark reddish brown.	
1.5	4.0	CLAY, plastic, red-brown.	
4.0	5.5	SHALE, weathered, brown to orange-brown.	ADELAIDEAN
5.5	6.0	SHALE, weathered, brown with some ferruginous induration.	
6.0		End of Hole.	

Drill Hole 39, section 472, hd Barossa, 125 m RL.

0	0.4	SOIL, brown.	QUATERNARY
0.4	1.8	CALCRETE, with quartz pebbles, poor return from 1.5 to 1.8 metres.	
1.8	3.5	SHALE, micaceous, weathered, brown to cream-brown.	ADELAIDEAN
3.5		End of Hole.	

Drill Hole 40, section 472, hd Barossa, 137 m RL.

0	0.5	SOIL, dark brown.	QUATERNARY
0.5	1.0	CALCRETE.	
1.0	1.5	CLAY, plastic, brown.	
1.5	6.0	SHALE, fairly micaceous, weathered, brown with some grey-green fragments.	ADELAIDEAN
6.0		End of Hole.	

Drill Hole 41, section 465, hd Barossa, 138 m RL.

0	5.5	CLAY, plastic, pale brown.	QUATERNARY
5.5	6.4	SHALE, highly weathered, brown-orange.	ADELAIDEAN
6.4	10.5	SHALE, weathered, yellow.	
10.5		End of Hole.	

Drill Hole 42, section 472, hd Barossa, 130 m RL.

0	0.5	SHALE, highly weathered, reddish orange-brown.	ADELAIDEAN
0.5	1.0	SHALE, highly weathered, pale brown.	
1.0	1.5	SHALE, highly weathered, orange brown.	
1.5	2.0	SHALE, highly weathered, buff-coloured.	
2.0	3.0	SHALE, highly weathered, orange.	
3.0	4.2	SHALE, highly weathered, yellow.	
4.2	5.0	SHALE, weathered, green.	
5.0	5.2	SHALE, weathered, pale green brown.	
5.2	7.0	SHALE, weathered, yellow-green brown.	
7.0	10.5	SHALE, weathered, red-brown.	
10.5		End of Hole.	

Drill Hole 43, section 465, hd Barossa, 130 m RL.

0	4.5	CLAY, compact plastic, red-brown,	QUATERNARY
4.5	6.0	SHALE, highly weathered, orange-brown.	ADELAIDEAN
6.0	7.0	SHALE, highly weathered, cream-brown.	
7.0	8.0	SHALE, weathered, cream-brown.	
8.0	10.5	SHALE, weathered, green-brown.	
10.5		End of Hole.	

Drill Hole 44, section 725, hd Barossa, 152 m RL.

0	1.0	CLAY, dark brown.	QUATERNARY
1.0	3.3	CLAY, plastic, red-brown.	
3.3	6.0	SHALE, highly weathered, orange-brown.	ADELAIDEAN
6.0	10.5	SHALE, weathered, yellow-orange brown.	
10.5		End of Hole.	

Drill Hole 45, section 264, hd Barossa, 112 m RL.

0	4.5	CLAY, compact-plastic, red-brown.	QUATERNARY
4.5		End of Hole.	

Drill Hole 46, section 264, hd Barossa, 125 m RL.

0	1.0	CALCRETE.	QUATERNARY
1.0	4.0	SHALE, silty, weathered, red-brown to brown.	ADELAIDEAN
4.0	6.5	SHALE, silty, slightly micaceous, weathered, brown.	
6.5	7.5	SHALE, silty, weathered, brown.	
7.5		End of Hole.	

Drill Hole 47, section 264, hd Barossa, 144 m RL.

0	0.5	CLAY, dark brown.	QUATERNARY
0.5	1.5	CLAY, plastic, red-brown.	
1.5	6.0	SILTSTONE, clayey, yellow-brown, with quartz veining.	ADELAIDEAN
6.0	6.7	SILTSTONE, clayey, green brown, with quartz veining; hard.	
6.7		End of Hole, Difficult drilling.	

Drill Hole 48, section 265, hd Barossa, 140 m RL.

0	1.0	CLAY, blocky, brown to dark red-brown.	QUATERNARY
1.0	1.5	SOIL, brown.	
1.5	3.0	CLAY, compact, plastic, red-brown.	
3.0	3.5	SILTSTONE, micaceous, weathered red-brown to pale brown.	ADELAIDEAN
3.5	7.0	SILTSTONE, micaceous, weathered, pale pinkish brown, grading to red, very pale brown and orange brown; minor ferruginous induration @ 5.0-6.0 m.	
7.0		End of Hole.	

Drill Hole 49, section 723, hd Barossa, 145 m RL.

0	0.6	SOIL, gravelly, brown.	QUATERNARY
0.6	1.0	CALCRETE.	
1.0	6.0	SHALE, micaceous, fresh, dark grey, brown-grey, brown with depth, quartz-veins.	ADELAIDEAN
6.0		End of Hole.	

Drill Hole 50, section 265, hd Barossa, 157 m RL.

0	0.4	SOIL, dark brown.	QUATERNARY
0.4	1.0	CALCRETE.	
1.0	4.5	SHALE, brown-green grading to a (fresh) green.	ADELAIDEAN
4.5		End of Hole.	

Drill Hole 51, section 723, hd Barossa, 158 m RL.

0	0.6	SOIL, brown, gravelly.	QUATERNARY
0.6	1.0	CALCRETE.	
1.0	1.5	No sample return.	
1.5	2.0	SHALE, weathered, yellow-green.	ADELAIDEAN
2.0	3.6	SHALE, yellow-green.	
3.6	6.0	SHALE, green, greyish green; quartz fragments.	
6.0		End of Hole.	

Drill Hole 52, section 473, hd Barossa, 129 m RL.

0	2.5	SHALE, slightly to moderately weathered, grey, grey-green, with quartz veining, becoming fresh, some fragments of ?silty shale.	ADELAIDEAN
2.5		End of Hole.	

Drill Hole 53, section 471, hd Barossa, 141 m RL.

0	0.3	SOIL, clayey, dark brown.	QUATERNARY
0.3	0.7	CLAY, plastic, red-brown.	
0.7	1.5	SHALE, highly weathered, pale brown.	ADELAIDEAN
1.5	5.0	SHALE, highly weathered, orange brown, minor quartz veining.	
5.0	6.0	SHALE, highly weathered, greenish-brown.	
6.0	7.0	SHALE, weathered, pale yellow-brown.	
7.0	8.0	SHALE, weathered, green, yellow-brown.	
8.0	10.0	SHALE, highly weathered, brown-green.	
10.0		End of Hole.	

Drill Hole 54, section 275, hd Barossa, 142 m RL.

0	1.0	SOIL, clayey, dark brown.	QUATERNARY
1.0	2.0	CLAY, and quartz pebbles, calcreted, hard.	
2.0		End of Hole, Difficult drilling.	

Drill Hole CG 55, section 275, hd Barossa, 140 m RL.

0	0.5	SOIL, clayey, brown.	QUATERNARY
0.5		End of Hole, Difficult drilling.	

Drill Hole 56, section 725, hd Barossa, 170 m RL.

0	1.5	CALCRETE.	QUATERNARY
1.5	4.8	SHALE, weathered, yellow-brown to orange-brown; minor quartz veining.	ADELAIDEAN
4.8	5.0	SHALE, greenish-grey, minor quartz veining.	
5.0	8.5	SHALE, weathered, orange-yellow brown, minor quartz veining.	
8.5	8.6	SHALE, weathered, black, carbonaceous.	
8.6	10.5	SHALE, grey-green to dark grey, becoming fresh.	
10.5		End of Hole.	
		Clay Firing Test, sample R744, 1.5 to 8.5 m	

Drill Hole 57, section 464, hd Barossa, 176 m RL.

0	0.2	CLAY, light brown.	QUATERNARY
0.2	1.5	CALCRETE.	
1.5	5.0	SANDSTONE, f, silty, white.	ADELAIDEAN
5.0	7.0	SANDSTONE, silty, highly weathered, white.	
7.0	10.5	SANDSTONE, silty, weathered, white-grey.	
10.5		End of Hole.	

Drill Hole 58, section 464, hd Barossa, 176 m RL.

0	1.0	SOIL, dark-brown.	QUATERNARY
1.0	2.5	CLAY, grey-brown, compact.	
2.5	3.0	SAND, f, gritty, pink, calcreted.	ADELAIDEAN
3.0	3.4	No sample return.	
3.4		End of Hole, Difficult drilling.	

Drill Hole 59, section 3051, hd Barossa, 170 m RL.

0	0.2	CLAY, plastic, red-brown.	QUATERNARY
0.2	2.0	SHALE, fresh, cream-brown to brown-grey.	ADELAIDEAN
2.0		End of Hole, Difficult drilling.	

Drill Hole 60, section 3051, hd Barossa, 176 m RL.

0	1.0	SOIL, dark brown.	
1.0	2.0	No sample return.	
2.0		End of Hole, difficult drilling.	

Drill Hole 61, section 723, hd Barossa, 180 m RL.

0	0.3	CLAY, dark brown.	QUATERNARY
0.3	1.0	CALCRETE.	
1.0	2.0	SAND, f-m, red, and gravel.	TERTIARY
2.0	3.0	SAND, f, gravelly, yellow-brown.	
3.0	7.0	SANDSTONE, highly weathered, cream.	ADELAIDEAN
7.0	9.0	SANDSTONE, weathered, pale-brown.	
9.0		End of Hole.	

Drill Hole 62, section 723, hd Barossa, 177 m RL.

0	1.5	CLAY, brown.	QUATERNARY
1.5	4.0	SANDSTONE, f, weathered, brown-cream.	ADELAIDEAN
4.0	5.0	SANDSTONE, weathered, pink.	
5.0	10.0	SANDSTONE, weathered, grey to off-white.	
10.0	10.5	SILTSTONE, slightly sandy, weathered, pale-brown.	
10.5		End of Hole.	

Drill Hole 63, section 3051, hd Barossa, 171 m RL.

0	0.1	SOIL, dark brown.	QUATERNARY
0.1	0.2	CLAY, sandy, red.	
0.2	1.1	CALCRETE.	
1.1	3.3	SANDSTONE, f, weathered, grey-white.	ADELAIDEAN
3.3	3.5	SADNSTONE, f, weathered, brown.	
3.5	4.0	SANDSTONE, f, red, moderately fresh.	
4.0		End of Hole, Difficult drilling.	

Drill Hole 64, section 723, hd Barossa, 178 m RL.

0	1.0	SOIL, clayey, dark brown.	QUATERNARY
1.0	4.0	CLAY, plastic, brown.	
4.0	5.0	CLAY, plastic, red-orange-brown.	
5.0	6.0	CLAY, sandy, orange.	
6.0	7.9	SANDSTONE, weathered, hard.	ADELAIDEAN
7.9		End of Hole.	

Drill Hole 65, section 720, hd Barossa, 158 m RL.

0	0.5	CLAY, dark brown.	QUATERNARY
0.5	1.5	CLAY, brown.	
1.5	2.4	SANDSTONE, fine, weathered, purplish-brown.	ADELAIDEAN
2.4	6.0	SADNSTONE, fine, weathered, orange; minor quartz veining.	
6.0	7.5	SANDSTONE, fine, slightly weathered, hard, red-orange.	
7.5		End of Hole.	

Drill Hole 66, section 720, hd Barossa, 178 m RL.

0	1.6	CLAY, plastic, brown, orange-brown, orange-red.	QUATERNARY
1.6	9.0	SILTSTONE, clayey, weathered, cream to cream-brown.	ADELAIDEAN
9.0		End of Hole.	

Drill Hole 67, section 720, hd Barossa, 144 m RL.

0	1.0	CLAY, dark brown.	QUATERNARY
1.0	3.1	CLAY, plastic, red-brown.	
3.1	4.0	CLAY, wet, white to off-white.	ADELAIDEAN
4.0		End of Hole. Wet clay, Difficult drilling.	

Drill Hole 68, section 720, hd Barossa, 150 m RL.

0	1.0	SOIL, clayey, dark to reddish-brown.	QUATERNARY
1.0	3.0	SILTSTONE, highly weathered, pinkish brown; minor quartz veining.	ADELAIDEAN
3.0	4.0	SILTSTONE, weathered, clayey, cream brown; minor quartz veining.	
4.0	6.0	SILTSTONE, weathered, clayey, buff-coloured, with thin sandy laminations.	
6.0	7.0	SILTSTONE, weathered, clayey, orange brown.	
7.0		End of Hole.	

Drill Hole 69, section 720, hd Barossa, 146 m RL.

0	1.0	SOIL, vf, sandy, dark to grey-brown.	QUATERNARY
1.0	1.5	CLAY, sandy, brown-grey.	
1.5	5.3	CLAY, compact plastic, red-brown.	
5.3	8.0	SILT, slightly clayey, pale orange-brown.	?TERTIARY
8.0	9.0	SILT, wet, slightly sandy, clayey pale orange-brown.	
9.0		End of Hole.	

APPENDIX B

RESULTS OF FIRING TESTS
Samples R741 to R744
AMDEL report MD 2812/83 by L.J. Day.

1. INTRODUCTION

Four samples of clay labelled A2352-A2355/82 were submitted for preliminary firing tests to determine their potential as brick clays. The samples were designated as follows:-

Sample	Amdel Identification
A2352/82	R744
A2353/82	R742
A2354/82	R743
A2355/82	R741

2. PROCEDURE

Each sample was dried and ground to the nominal size of -1.2 millimetres, (-14 mesh B.S.S.). About two kilograms of this material was moistened and worked to maximum workability (plasticity). It was then sealed in a polythene bag and allowed to mature for a period of days.

Samples were extruded using a Boulton laboratory de-airing extruder, producing a cylindrical column of diameter about 25 millimetres. Extrusion properties were noted and moisture contents determined by moisture balance. Specimens for firing were obtained by wire-cutting the extruded column. Green specimens were dried under moderate (40°C) and severe (105°C) conditions and their shrinkages and behaviour determined.

Specimens for firing were air-dried for a period of days, oven-dried at 40°C and finally oven-dried at 105°C for twelve hours. They were then fired in an oil-fuelled Major kiln over the temperature range 800-1200°C in 50°C intervals with a 30 minute soak at each temperature. Specimens were removed from the furnace to a holding kiln at 600°C. After all specimens had been fired, the holding kiln was switched off and the samples allowed to cool overnight to room temperature.

Shrinkages for dried and fired specimens were determined by measurement with a travelling microscope of the spacing of a set of marks inscribed immediately after extrusion with a pair of knife edges set 20 millimetres apart. Water absorption properties of the fired specimens were determined by weighing specimens dry and after soaking for 24 hours in water with removal of surface water. The general quality of the specimens was determined by visual inspection. Colours were assessed using a Munsell Rock Colour Chart.

3. RESULTS

R741

The material was extruded at a moisture content of 19.9%. It produced a smooth, soft column of low to medium plasticity. The extrusion rate was fast and the column wire cut with a slightly rough finish.

Drying at 40°C was satisfactory and produced a shrinkage of 4.3%. Drying at 105°C was also satisfactory and produced a shrinkage of 3.8%.

The grayish orange clay fired to a very pale orange colour at 800°C which became slightly darker after 1100°C. The fired specimens showed evidence of minor scumming on their top surfaces and some minor external cracking. Specimens fired to 1000°C were of moderate hardness with a water absorption of 23.2% and a fired shrinkage of 5.7%.

Full details are given in Table 1.

This clay is suitable for brick making. It is a pale burning, high maturing clay of low to medium plasticity which could be used in significant proportions in blends. Its slight cracking and scumming tendencies are judged to be of little consequence and should not be a problem in blends.

R742

The material was extruded at a moisture content of 17.1%. It produced a smooth, hard column of low plasticity. The extrusion rate was fast and the column wire cut cleanly.

Drying at 40°C produced external cracking and a shrinkage of 2.6%. Drying at 105°C produced external cracking and a shrinkage of 2.5%.

The pale yellowish brown clay fired to a light brown colour at 800°C which become darker and redder with increasing temperatures. The fired specimens were of good appearance except for some external cracking. Samples fired at 1200°C showed evidence of severe bloating. Specimens fired at 1000°C were of moderate hardness with a water absorption of 17.8% and a fired shrinkage of 3.2%.

Full details are given in Table 2.

This material is suitable for brickmaking, but would need to be blended with other materials to lower its firing range and decrease its tendency toward cracking on drying. It is a red burning, low plasticity clay which self glazes and bloats on firing at 1200°C.

R743

The material was extruded at a moisture content of 20.2%. It produced a soft, smooth column of low to medium plasticity. The extrusion rate was fast and the column wire cut cleanly.

Drying at both 40°C and 105°C produced minor external cracking and a shrinkage of 2.0%.

The very pale orange clay fired to a moderate orange pink at 800°C which became paler and whiter up to 1050°C after which it became slightly darker and more yellow in colour. The fired specimens showed evidence of minor external cracking and some scumming on the top surfaces. Specimens fired at 1000°C were of moderate hardness with a water absorption of 25.8% and a shrinkage of 2.1%.

Full details are given in Table 3.

This material is suitable for brickmaking. It is a pale burning, high maturing clay which would contribute low shrinkage and some plasticity to a blend. Its tendency toward scumming and cracking is of a minor nature and should not be a problem when it is used in blends.

R744

The material was extruded at a moisture content of 18.9%. It produced a smooth, medium hard column of low plasticity. The extrusion rate was fast and the column wire cut slightly rough.

Drying at 40°C was satisfactory and produced a shrinkage of 4.8%. Drying at 105°C was also satisfactory and produced a shrinkage of 4.4%.

The grayish orange clay fired to a moderate reddish orange colour at 800°C becoming less red with increasing temperature. The fired specimens were all satisfactory in appearance and those fired to 1200°C were self-glazed. Specimens fired at 1000°C were of moderate hardness with a water absorption of 15.9% and a fired shrinkage at 4.9%.

Full details are given in Table 4.

This material is suitable for brickmaking. It is a red burning clay of low plasticity which could be used in significant proportions in blends to which it would contribute good fired colour and low shrinkage.

TABLE 1 : DRYING AND FIRING PROPERTIES

Sample No. A2355/82 (R741)

Temperature °C	% Total Shrinkage	% Absorption	Relative Hardness	Munsell Colour	Comments
40	4.3	-	-	Grayish Orange 10 YR 7/4	Satisfactory
105	3.8	-	-	Grayish Orange 10 YR 7/4	Satisfactory
800	5.1	23.5	Moderate	Very Pale Orange 10 YR 8/2	Scummed. Cracked.
850	5.6	23.5	Moderate	Very Pale Orange 10 YR 8/2	Scummed. Cracked.
900	5.6	23.4	Moderate	Very Pale Orange 10 YR 8/2	Scummed. Cracked.
950	5.3	23.4	Moderate	Very Pale Orange 10 YR 8/2	Scummed. Cracked.
1000	5.7	23.2	Moderate	Very Pale Orange 10 YR 8/2	Scummed. Cracked.
1050	6.0	22.8	Moderate	Very Pale Orange 10 YR 8/2	Scummed. Cracked.
1100	7.1	19.9	Moderate	Pale Grayish Orange 10 YR 8/4	Scummed. Cracked.
1150	8.0	18.1	Moderate	Pale Grayish Orange 10 YR 8/4	Scummed. Cracked.
1200	8.6	15.9	F. Hard	Grayish Orange 10 YR 7/4	Scummed. Cracked.

TABLE 2 : DRYING AND FIRING PROPERTIES

Sample No.A2353/82 (R742)

Temperature °C	% Total Shrinkage	% Absorption	Relative Hardness	Munsell Colour	Comments
40	2.6	-	-	Pale Yellowish Brown 10 YR 6/2	External Cracking
105	2.5	-	-	Pale Yellowish Brown 10 YR 6/2	External Cracking
800	2.3	20.2	Moderate	Light Brown 5 YR 5/6	External Cracking
850	2.5	20.0	Moderate	Light Brown 5 YR 5/6	External Cracking
900	2.7	19.8	Moderate	Light Brown 5 YR 5/6	External Cracking
950	2.6	19.4	Moderate	Light Brown 5 YR 5/6	External Cracking
1000	3.2	17.8	Moderate	Moderate Reddish Orange 10 R 6/6	External Cracking
1050	4.5	14.9	Moderate	Moderate Reddish Brown 10 R 4/6	External Cracking
1100	8.1	7.4	F. Hard	Moderate Reddish Brown 10 R 4/6	External Cracking
1150	12.0	1.2	Hard	Moderate Brown 5 YR 3/4	External Cracking
1200	7.3	0.2	Hard	Grayish Brown 5 YR 3/2	Bloated. Self Glazed.

TABLE 3 : DRYING AND FIRING PROPERTIES

Sample No. A2354/82 (R743)

Temperature °C	% Total Shrinkage	% Absorption	Relative Hardness	Munsell Colour	Comments
40	2.0	-	-	Very Pale Orange 10 YR 8/2	Cracked
105	2.0	-	-	Very Pale Orange 10 YR 8/2	Cracked
800	2.2	26.4	Moderate	Moderate Orange Pink 5 YR 8/4	Cracked. Scummed.
850	2.1	26.6	Moderate	Moderate Orange Pink 5 YR 8/4	Cracked. Scummed.
900	2.2	26.2	Moderate	Grayish Orange Pink 10 R 8/2	Cracked. Scummed.
950	2.1	25.5	Moderate	Grayish Orange Pink 10 R 8/2	Cracked. Scummed.
1000	2.1	25.8	Moderate	Pinkish Gray 5 YR 8/1	Cracked. Scummed.
1050	3.0	23.2	Moderate	Very Pale Orange 10 YR 8/2	Cracked. Scummed.
1100	4.7	18.7	Moderate	Very Pale Orange 10 YR 8/2	Cracked. Scummed.
1150	6.3	14.3	F. Hard	Grayish Orange 10 YR 7/4	Cracked. Scummed.
1200	8.3	8.5	Hard	Grayish Orange 10 YR 7/4	Cracked. Scummed.

TABLE 4 : DRYING AND FIRING PROPERTIES

Sample No.A2352/82 (R744)

Temperature °C	% Total Shrinkage	% Absorption	Relative Hardness	Munsell Colour	Comments
40	4.8	-	-	Grayish Orange 10 YR 7/4	Satisfactory
105	4.4	-	-	Grayish Orange 10 YR 7/4	Satisfactory
800	4.0	17.0	Moderate	Moderate Reddish Orange 10 R 6/6	Satisfactory
850	4.7	17.2	Moderate	Moderate Reddish Orange 10 R 6/6	Satisfactory
900	4.2	17.1	Moderate	Moderate Reddish Orange 10 R 6/6	Satisfactory
950	4.6	16.6	Moderate	Moderate Orange Pink 5 YR 8/4	Satisfactory
1000	4.9	15.9	Moderate	Moderate Orange Pink 5 YR 8/4	Satisfactory
1050	6.2	14.9	Moderate	Grayish Orange 10 YR 7/4	Satisfactory
1100	8.6	8.6	Hard	Moderate Yellowish Brown 10 YR 5/4	Satisfactory
1150	11.7	2.3	Hard	Light Olive Gray 5 Y 5/2	Satisfactory
1200	11.4	0.8	Hard	Olive Gray 5 Y 3/2	Self glazed

APPENDIX C

PREVIOUS SADME DRILLING, 1961-1976
Description of Precambrian rock units intersected in drillholes; generally overlain by Tertiary sediments.

Bore Hole No. (original hole number in brackets)	Depth (m)	Description of Basement Rock Type
From Olliver, 1963, section 3082, 3083, hd Barossa, PM 208		
1832 (24)	9.7-17.0	Clay, silty and slightly sandy.
1834 (33)	2.4- 3.7	Grey weathered phyllite.
1835 (34)	3.7- 4.9	Light-brown, yellow and white, mottled, very slightly sandy to silty clay - probably represents weathered bedrock.
1836 (37)	0.6- 1.8	Grey to yellow brown weathered phyllite.
1837 (38)	1.2- 3.1	Yellow-brown, brown and grey weathered phyllite.
1838 (39)	0.3- 1.2	Grey weathered phyllite.
1840 (41)	0.3- 1.8	Pale grey-green weathered phyllite.
1841 (42)	1.2- 1.8	Light yellow-green weathered phyllite.
1842 (44)	0.3- 1.2	Grey weathered phyllite.
From Nixon, 1961, section 3081, 483, hd Barossa, PM 28.		
1849 (6)	14.6-15.3	White and grey shales, possibly weathered Torrensian slates.
	15.3-25.6	Weathered Torrensian slates, greyish-green in colour.
1851 (8)	17.7-22.0	Grey green weathered Torrensian slates.
1853 (10)	1.2- 9.2	Grey green bedrock slates of the Torrensian series.
1854 (11)	1.2- 6.1	" "
1855 (12)	14.9-16.5	" "
1862 (19)	19.5-21.4	Greenish slates. Bedrock.
1863 (20)	11.0-12.2	Red and greenish red clayey shales. Probably bedrock.
1867 (24)	11.6-12.2	White silt and clay, possibly weathered bedrock.
1868 (25)	11.6-12.2	Fawn to white coloured shales. Possibly weathered bedrock.
1870 (27)	10.4-12.2	Fawn to green coloured bedrock shales.
1871 (28)	1.2- 4.9	Red brown clay grading to weathered slate.
	4.9- 9.2	Greenish grey weathered bedrock slates.
1874 (31)	1.8- 6.1	Grey green weathered bedrock slates.
1875 (32)	5.5- 7.3	Light red brown to white clay and weathered shale.
	7.3-12.2	Light green weathered bedrock slate, grading to green at depth.
1876 (33)	3.1- 4.3	Off white weathered bedrock slates grading to darker grey green colour at depth.
1878 (35)	0- 6.1	Pink to brown coloured bedrock slates.
1879 (36)	3.1- 8.5	Off white weathered slates, grading to green colour at depth.
1882 (39)	4.9- 7.3	Weathered bedrock slates.
From Olliver, 1962, section 478, 3094, hd Barossa, PM 204.		
1884 (1)	7.9- 8.5	Chips of white and light brown weathered bedrock.
1886 (3)	17.1-17.7	Chips of brown weathered bedrock.

From Pain, 1976, hd Barossa, south east of Sandy Creek.

11003 (3)	19.6-22.6	Clay, white and orange mottled.
11004 (4)	22.0-25.1	Clay, mottled grey, white and orange.
11015 (15)	11.7-10.9	Clay, white, grey and brown; Grey weathered shales and siltstones; Pyrite; Thin quartz veins.
11016 (16)	15.6-19.8	Clay, grey. Pyritic in part. Weathered shales, becoming harder, less weathered with depth.
11024 (24)	8.6- 9.8	Clay, grey. Weathered basement shale and siltstone.
11035 (35)	2.4- 6.7	Clay, laminated white and grey. Weathered basement shales.

APPENDIX D

LOGS OF WATER BORES
Bore Holes 1634, 1687, 1794, 1797, 1803, 1804, 6891.

Depth (m)	Description

Borehole 1634, sec 3076, hd Barossa, Gawler East.
Drilled by SADM; logged by C. Bleys (geologist).

0-3.1	Shaft.
3.1-6.1	Red brown clay with pebbles and gravel.
6.1-12.8	Partly clay with pebbles and gravel.
12.8-18.3	Pale pink clays.
18.3-21.4	Yellowish cream sericitic clay with some grit.
21.4-23.8	White and some pink sericitic clay with some grit.
23.8-32.0	Grey blue highly sericitic clay.
32.0-39.7	Light brown sericitic clay with some mica.
39.7-41.8	Vari decomposed shale and gravel.
41.8-45.5	Parti clay with some grit.
45.5-48.8	Pale brown decomposed shale with quartz vein.
48.8-56.4	Parti decomposed shale.
56.4-62.5	Parti decomposed shale with quartz veins.
62.5-70.2	Green grey decomposed shale with quartz veins.
70.2	End of Hole.

Borehole 1687, sec 3052, hd Barossa. 2.7 km north of Sandy Creek.
Drilled April and June, 1940, by G. Cooke, drilling contractors.
Logged by driller.

0-2.4	Soil and marl.
2.4-18.3	Soft white sandstone.
18.3-25.9	Soft, pinkish sandstone.
25.9-39.7	Soft yellow sandstone.
39.7-45.8	Yellow slate and sandstone mixed.
45.8-48.8	Quartz and yellow slate.
48.8-134.2	Blue, clayey slate.
134.2-162.3	Hard quartz, blue and white patches.
162.3	End of Bore.

Borehole 1794, sec. 3094, hd Barossa,
4.3 km east-southeast of Gawler.
Drilled August-September 1971, by Readymix Group.
Logged by driller.

0-3.1	Black sandy loam.
3.1-25.6	Yellow shale and quartz gravel.
25.6-93.9	Hard blue slate.
93.9	End of Bore.

Borehole 1797, sec 735, hd Barossa. 2.8 km east of Gawler.
Drilled 6 to 7 November 1973 by Seidel Bros.
Logged by driller.

0-6.1	Clay.
6.1-12.2	Soft slate.
12.2-30.5	Hard slate.
30.5-36.9	Broken slate.
36.9-57.0	Soft slate.
57.0-68.6	Broken slates.
68.6	End of Bore

Borehole 1803, sec 737, hd Barossa. 3.8 km east of Gawler.
Drilled 8-9 July 1976 by Seidel Bros.
Logged by driller.

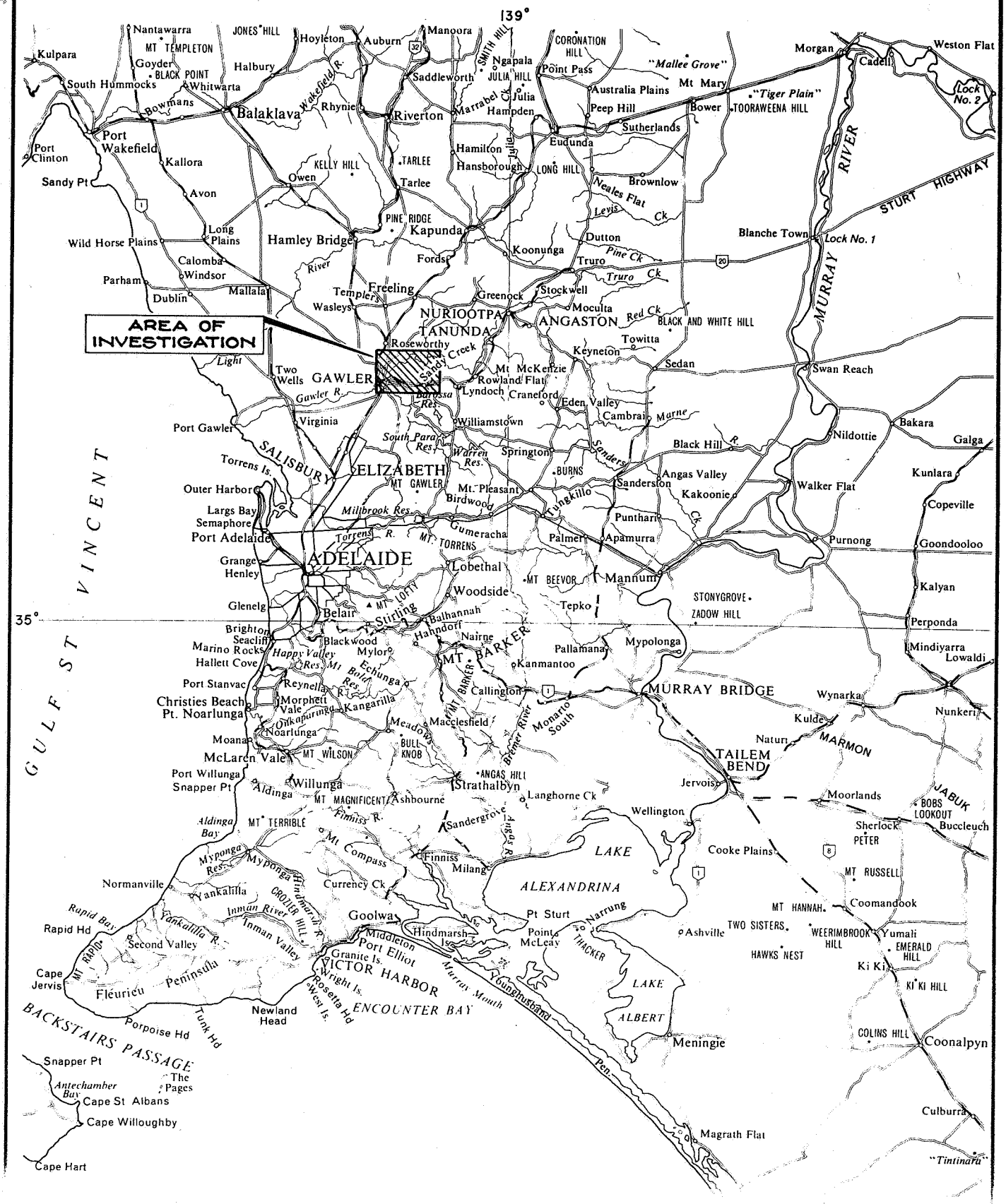
0-7	Clay.
7-8.5	Creek bed gravel.
8.5-15.5	Soft slate.
15.5-17	Slate and quartz.
17-23	Slate.
23-23.5	Quartz.
23.5-68.22	Slate with some small patches of quartz.
68.22	End of Bore.

Borehole 1804, sec 737, hd Barossa. 3.8 km east of Gawler.
Drilled 12-14 July 1976 by Seidel Bros.
Logged by driller.

0-6	Clay.
6-9	Creek bed with layers of clay.
9-10	Cappy rock.
10-17	Green slate.
17-67	Grey slate with some layers of quartz.
67-75.5	Grey slate with a lot of quartz.
75.5-76.3	Grey slate.
76.3	End of Bore.

Borehole 6891, sec 1716, hd Barossa.
3.7 km north-northeast of Sandy Creek.
Drilled 25 March 1978 to 8 May 1978, by P.D. Gruhl, drilling contractor.
Logged by driller.

0-3	Brown clay.
3-4.5	Limestone.
4.5-12.5	Grey clay.
12.5-36	Yellow clay, some stones.
36-42	Stripey clay.
42-46	Blue mud.
46-56	Quartz, clay and slate, falls in.
56-97	Slate.
74&76	Small clay bands.
97-107	Quartzite or quartz veins.
104.5&106	Thin clay bands, otherwise slate.
107	Discontinued.



SCALE IN KILOMETRES

Figure..... 1

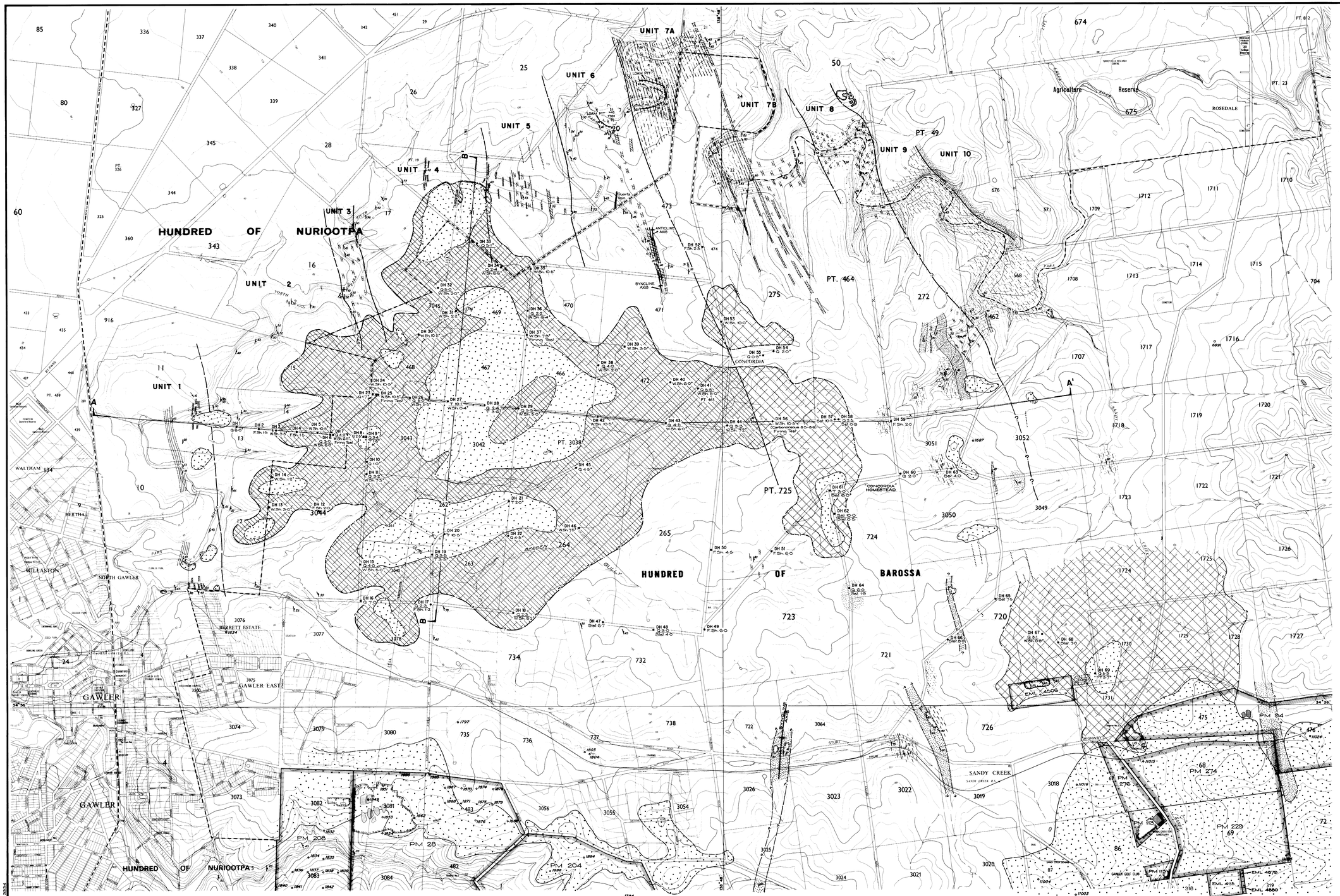
DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

GAWLER - CONCORDIA BRICK SHALE RESOURCES

LOCALITY PLAN

COMPILED E.A.D.	C D O DATE
DRAWN M.R.	SCALE 1:1 000 000
DATE Nov '83	PLAN NUMBER S 17135
CHECKED	

3334



REFERENCE

TERTIARY

- Orange brown, brown or cream sand and gravel, dark brown, ferruginous staining and cementing in places. Silcrete.
- Zone of deep weathering in shale. Zone of deep weathering in dolomite, dolomitic shale and sandstone etc.

TORRENSIAN, BURRA GROUP — Sequence exposed along North Para River, Tunnel Flat to Gawler Woolshed Flat Shale

UNDIFFERENTIATED QUARTZITE

- UNIT 10 — Massive cross bedded Feldspathic sandstone.
- UNIT 9 — Interbedded orange brown sandstone and shale, slightly dolomitic in part. (POTENTIAL BRICK SHALE)
- UNIT 8 — Buff to brown sandstone, dolomitic sandstone, and dolomite.
- UNIT 7B — Light to dark grey shale, dolomitic shale, minor quartzite. Prominent quartzite at base.
- UNIT 7A — Grey to dark grey dolomitic shale, carbonaceous in part, minor grey dolomite.
- UNIT 6 — Grey phyllitic shale, dolomitic in part, minor dolomite and carbonaceous shale.
- UNIT 5 — Grey micaceous shale, minor dolomite.
- UNIT 4 — Grey dolomitic shale, dolomite and shale. Grey phyllitic shale, minor dolomite.
- UNIT 3 — Grey to dark grey shale, rare dolomite beds.
- UNIT 2 — Light grey dolomitic shale.
- UNIT 1 — Grey to brown micaceous phyllite shale. Grey to orange brown silty, slightly micaceous shale. Minor quartzite bands and black carbonaceous shale at base.

(POTENTIAL BRICK SHALE)

- Geological boundary: mapped, indicated and inferred.
- Boundary of area of weathering mapped, indicated and inferred.
- Strike and dip of bedding.
- Strike and dip of foliation.
- Plunge of fold axis measured on minor fold.
- Trend observed on aerial photography, probably bedding.
- 1682-83 auger drill hole with rock type and thickness in metres. Qt Quaternary alluvium. T Tertiary. W.Sh Weathered shale. F.Sh Fresh shale. Sst Sandstone. Slst Siltstone.
- Previously drilled well.
- A — A' Geological section (see Fig 3, plan no 83-628)
- Road
- Closed road.
- River, creek.
- Topographic contour in metres (A.H.D.).
- 1716 Section number.
- Hundred boundary.
- Quarry.
- PM 276 Private Mine.
- EML 4506 Extractive Mineral Lease.

NOTE: Geology south of Sturt Highway is adapted from Parr, 1976.

SCALE

200 0 200 400 600 800 1000 metres

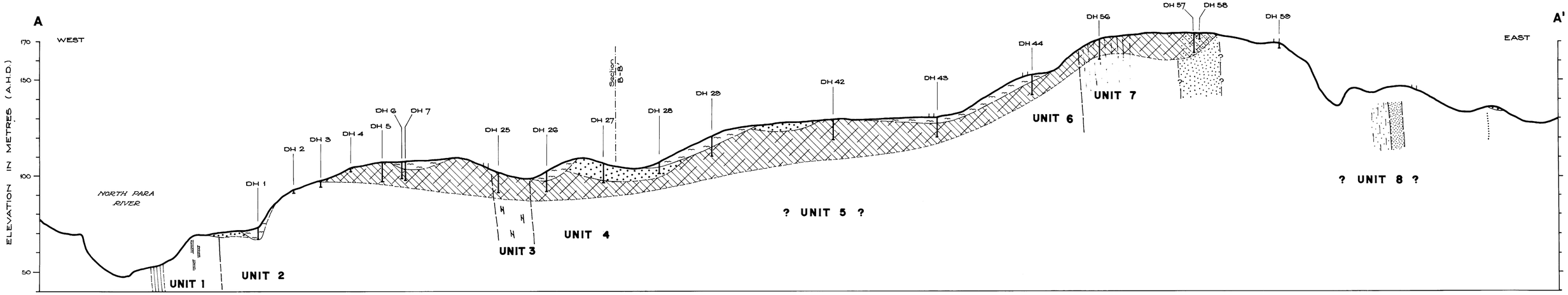
Figure 2

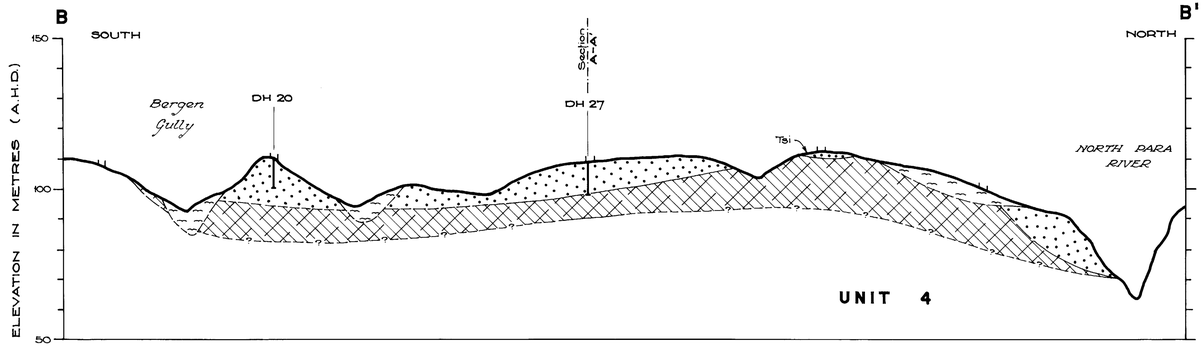
DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

GAWLER-CONCORDIA BRICK SHALE RESOURCES

GEOLOGICAL PLAN AND LOCATION OF DRILLHOLES

COMPILED	E.D.W.M.
DRAWN	M.R.
DATE	Nov '83
CHECKED	
DATE	
SCALE	1 : 10000
PLAN NUMBER	83-628





REFERENCE

- QUATERNARY: Alluvium
- TERTIARY: Sand, gravel, ferricrete and silcrete (Tsi)
- Weathered zone
- ADELAIDEAN: Woolshed Flat Shale: Shale, Sandstone, Dolomite, Carbonaceous shale, Sandstone and shale
- Road
- DH 27 ..... Drill hole

UNIT 7 ..... For details see Fig. 2 (plan no. 83-628)

SCALE

200 0 200 400 600 800 1000

metres

Vertical Exaggeration.....10 times

For location of sections see Fig. 2 (plan no. 83-628).

Figure.....3

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

GAWLER-CONCORDIA
BRICK SHALE RESOURCES

GEOLOGICAL SECTIONS

COMPILED W.S.M.	C.D.O. 26-4-84 DATE
DRAWN M.R.	SCALE 1:10000
DATE Nov '83	PLAN NUMBER 83-629
CHECKED	

3324