REPT.BK.NO.76/11

TORRENS RIVER VALLEY -
GENERAL & ENVIRONMENTAL GEOLOGY

G.H. McNALLY

Department of Mines
South Australia ——

DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY
ENGINEERING DIVISION

TORRENS RIVER VALLEY -

GENERAL & ENVIRONMENTAL GEOLOGY

by

G.H. McNALLY
GEOLOGIST
ENGINEERING GEOLOGY SECTION

Rept.Bk.No.76/11
G.S. No. 5688
DM. No. 577/75
Eng.Geol.No. 75-33

6th February, 1976

CONTENTS

DEPARTMENT OF MINES
SOUTH AUSTRALIA

Rept.Bk.No.76/11
G.S. No. 5688
DM. No. 577/75
Eng.Geol.No. 75-33

TORRENS RIVER VALLEY - GENERAL & ENVIRONMENTAL GEOLOGY

SUMMARY AND CONCLUSIONS

A summary of the geology and geomorphology of the Torrens Valley west of the Gorge, has been compiled and the engineering and environmental characteristics of the geological materials present have been assessed.

The oldest rocks in the Adelaide area are the Proterozoic slates and quartzites exposed along the higher parts of the Eden and Para Fault blocks. Movement along these sub-parallel features since the Tertiary period has depressed the Proterozoic basement several hundred metres below sea level in the western suburbs, and a similar distance above sea level in the Mount Lofty Ranges. In the depressions created by this movement deposition has been successively fluviatile (Eocene sands of Highbury), Marine (Eocene-Miocene, not exposed) and fluviatile (Pleistocene to Recent alluvial deposits blanketing the present surface).

During the Pleistocene successive rises and falls in sea level filled and eroded the Torrens Valley. Alluvial fans formed and coalesced at the bases of the rising Para and Eden blocks. Higher discharges eroded broad valley meanders in the upper reaches of the Torrens between Paradise and Athelstone. Recent fluctuations in sea level are recorded by two lines of sand dunes at West Beach and Fulham.

The Torrens Valley has, in the past, been an important source of groundwater, brick clay, sand and gravel, but the reserves of these materials are no longer of practical significance, due to the location of alternative sources of supply and encroachment by residential and industrial land uses. Thus, no valuable construction material resources would be sterilized by the proposed development.

No foundation problems for light structures are expected, apart from the Black Earth areas where soils are expansive. Erosion of river banks does not appear to be active at the present time.

The geological environment is not likely to be affected by this development, provided groundwater recharge areas adjacent to the Hills Face are protected. A number of areas of particular geological interest have been specified, but there are no unique areas requiring special protection within the study area.

INTRODUCTION

It is proposed to develop sections of the Torrens Valley between Thorndon Weir, about 1 km upstream of Highbury, and West Beach as a recreational resource. The Adelaide City area and the Parklands have been excluded from the study, which is being carried out by Hassel and Partners, Architects, for the River Torrens Committee.

Initial discussions suggested that the following information would be required,

..... a slope analysis of the banks, and a geomorphological survey of the river,

..... Location of areas of bank that are eroding, or that are likely to erode if loaded,

..... Distribution of soil types, and depths to bedrock.

..... Identification of important geological features.

Further discussions lead to additional requirements being formulated. These included,

..... A summary of the geological history of the valley and of the stratigraphic units present,

..... The types and reserves of construction materials present, and their future utilization,

..... The distribution of groundwater, recharge areas, and present and future utilization,

..... The engineering properties of surface soils and geological units, including bearing capacity, erodability and shrinkage potential.

This report has been compiled from published and unpublished departmental reports, and from scores of water bore logs. Apart from minor reconnaissance, no original fieldwork was carried out by the writer. More detailed sources of geological information are listed in the References section. The bulletins by Taylor et al. (1974) and Miles (1952) are particularly recommended.

GEOMORPHOLOGY

Adelaide is situated on a coastal plain which has been uplifted to the east along a series of major faults, of which the most important are the Para and Eden-Burnside faults. The positions of these are marked by escarpments, the raised blocks behind forming stepped plateaus culminating in the summit of Mount Lofty at 772 m. Uplift along the faults has accelerated erosion along the escarpments, and lead to the deposition of alluvial fans, which have coalesced to form the Upper and Lower Outwash Plains illustrated in fig. 1. Paralleling the present coastline are two lines of sand dunes, with a band of low formerly-swampy ground intervening. This feature has been called the Estuarine Plain.

In following the course of the Torrens down-stream from Thorndon Weir, the first physiographic unit encountered is the Eden Fault Block through which the Torrens Gorge runs, and which is bounded on the west by the Eden fault. The escarpment at this point has a relief of about 200 m, and is composed largely of Proterozoic quartzite and slate. A second, much less conspicuous step, known as the Burnside Splinter Block occupies a zone about 2 km wide between the Eden and Burnside Faults (ie. through Athelstone and Highbury). Relief on the Burnside Fault escarpment is only about 30 m.

Emerging from its gorge, the Torrens flows between the Para Fault Block on the north side and the Upper Outwash Plain on the south. The former is the lowest "step" in the series, with a relief of only a few metres at North Adelaide (increasing northwards to about 130 m at Little Para. The Para Fault disappears under alluvium in the West Parklands, and the block is conspicuously tilted in a south westerly direction. Though movement occurred at more or less the same time on both the Para and Eden Faults, its magnitude was less along the Para Fault, so that alluvium from streams eroding the Eden and Burnside Blocks was deposited thinly on the Para Block.

This alluvium, forming a sloping apron between the Eden-Burnside Fault escarpments and the Torrens constitutes the Upper Outwash Plain. Its component sediments range between clay and boulder size, and result from the coalescing of alluvial fans and deltas of small tributary streams actively eroding the escarpment, along with sheetwash during floods and hill creep contributions.

To the west of Adelaide is a similar deltaic ramp, the Lower Outwash Plain, lying between the Para Fault and the 6 m contour. Because of the low relief along the fault and alluvial materials making up this feature are finer - mainly fine sand and silt - and slopes are flatter, only 2 - 4 m per kilometre, compared with more than 15 m/km over most of the Upper Outwash Plain.

The westernmost physiographic feature of the River Torrens course is the Estuarine Plain, the site of an early Recent marine incursion followed by dune building. It is nearly flat, and has been modified by drainage works and dune levelling during the present century.

GEOLOGICAL & GEOMORPHOLOGICAL HISTORY

For the purposes of this section the Torrens Valley is defined as that area marked as being underlain by Recent Alluvium on the geological map, although adjoining areas will be discussed where these throw light on the history of the valley.

Twidale (1968) suggests that an ancestral Torrens laid down the lower Tertiary (Eocene) sands in the Windsor Gardens - Highbury area, and its history can certainly be traced back to the early Pleistocene. The oldest sediments deposited in the Torrens Valley are grouped as the Hindmarsh Clay, though the thickness of this formation and its very widespread occurrences make it certain that many streams contributed (see figs. 2 and 3).

During the Pleistocene large fluctuations in sea level, caused by melting and re-freezing of ice caps, would have resulted in the shoreline being at times far toø seaward of its present position. High rainfalls during pluvial phases, combined with rapid uplift of the Para and Eden-Burnside Blocks, resulted in softer Tertiary sediments being stripped off these blocks and redeposited in a sinking trough west of the Para Fault to a total thickness of at least 100 m.

That this process was interupted on at least one occasion is indicated by the presence of marine shelly sands and clays of the Glanville Formation, dated at 45 000 years B.P., which record an eastward advance of the sea. River deposition was resumed following the withdrawal of the sea, and a sheet of clayey sand and silt of the Pooraka Formation was laid down. This unit, of maximum thickness 6 m, is the most widespread surface formation in the Adelaide area, and blankets both Upper and Lower Outwash Plains as well as part of the Para Block. An age of at least 34 000 years has been established by radiocarbon dating.

It is believed that the sands and gravels in the lower portion of the Torrens channel fill (referred to in this report as the Lower Torrens Alluvium) are the same age as the Pooraka Formation, and extend beyond the present channel limits. At some stage in the late Pleistocene or early Recent, the Torrens flowed north west from Adelaide and directly into the Port River, as Lower Torrens Alluvium has been recorded from Kilkenny and elsewhere. The Lower Torrens Alluvium may be equivalent to the "Klemzig Sand" of Twidale.

There is evidence that the Pleistocene Torrens was much larger, and that it is now a "misfit" stream - too small for its valley. East of Adelaide, particularly between Paradise and Athelstone, valley meanders have been eroded in bedrock and Tertiary sands. These are much larger than those eroded by the present river in Recent Alluvium, and are indicative of much larger annual discharges during the Pleistocene.

The Recent epoch was initiated in the West Beach - Fulham area by a marine incursion, which extended 3 to 4 km inland from the present shoreline and resulted in deposition of 1.5 to 3 m of black shelly muds of the St. Kilda Formation. This event is believed to be related to the Flandrian Transgression, which inundated low-lying areas of Europe following the last glacial melting, about 10 000 years B.P.

This was followed by an arid phase, with two episodes of dune building, the earlier resulting in the red-brown Fulham Sand. Remnants of these dunes are preserved on golf links at Lockleys and elsewhere, along the Flandrian shoreline. Individual dunes attained a maximum height of 15 to 18 m, but have now largely been levelled as a consequence of land reclamation for residential use, and of quarrying as foundry and building sand.

The latest recession of the sea to its present shoreline - has given rise to a second, younger line of dunes, termed the Semaphore Sand. These sands are white, in contrast to the reddish Fulham Sand, have a more markedly linear form parallel to the modern beach, and are somewhat lower with a maximum height of 15 m.

Alluvial deposition continued along the Torrens throughout the Recent, though the material laid down was finer than that of the Pleistocene Lower Alluvium. This Upper Torrens Alluvium is composed of fine sand and silt, with silt predominating in the lower reaches west of Adelaide. Twidale has recognised several terraces in the Upper and Lower Torrens Alluvium, the oldest being the "Klemzig Sand" of possible late Pleistocene age, and certainly older than 6 350 years B.P.

Following the deposition of the Klemzig Sand, the Torrens proceeded to cut down into its own alluvium, creating a new and shallower channel within the Klemzig. This was partly filled with a younger, siltier and darker sand called the "Walkerville Sand", and dated as 5 860 B.P. or younger - that is, mid Recent. There is clear evidence that the Torrens has on several occasions during the past few thousand years alternately excavated and filled

its channel. Shifts in base level of erosion may be due to small uplift of the fault blocks, subsidence of coastal areas, climatic changes (wetter or drier) or a combination of these and other processes.

During late Recent the river has again cut down into its alluvium, in this case the Walkerville Sand, and redeposited the sand and silt as delta and levee material on the Lower Outwash Plain. It is believed that during mid Recent times the Torrens mouth was located near Glenelg, until this outlet was dammed by the buildup of coastal dunes (the Semaphore Sand) and swampy conditions developed in the Reedbeds (now Fulham Gardens) area. Behind the Reedbeds the River built up a delta with material previously carried out to sea, and this process was accelerated following European settlement and subsequent clearing and cultivation of the upper reaches east of Adelaide. The building of the Torrens Outlet Channel in 1937 eliminated the problem of winter flooding in the vicinity of the Reedbeds, and the construction of Kangaroo Creek Dam has further regulated peak discharges along the Torrens, so that at the present time delta building on land has ceased, though it may be taking place offshore.

STRATIGRAPHY AND ENGINEERING PROPERTIES

PROTEROZOIC

Quartzites, slates, schists and phyllites outcrop sporadically along the Torrens between Windsor Gardens and Highbury, and have been encountered at shallow depth in many water bores in the area. In the subsurface Proterozoic rocks may be deeply weathered and fractured, constituting a remnant of the pre-Tertiary erosion surface now largely buried under younger rocks.

East of Adelaide this surface dips South at about (1:50), under an average overburden thickness - west of Windsor Gardens - of 15 to 20 m (see fig. 5). West of the Para Fault - that portion of the valley between Hindmarsh and West Beach - the Proterozoic basement has been depressed to depths in excess of 600 m by movement along the Para Fault (Fig. 3).

TERTIARY

Overlying the Proterozoic, and in the western suburbs several hundred metres thick, are marine sands, limestones and silts of Eocene to Miocene (Tertiary) age. Dense red and orange sands, thought to be equivalent to the Eocene North and South Maslin Sand outcrop between Windsor Gardens and Athelstone, mostly on the north side of the river. These sands are of fluviatile or estuarine origin, include lignite seams, and may have been deposited by an ancestral Torrens. Their maximum thickness is about 30 m, and they have been extensively quarried as a source of building sand in the Highbury area.

HINDMARSH CLAY (Qph)

This formation is a stiff to very stiff mottled red, brown and grey clay with numerous sand and gravel layers. West of Adelaide, where it is exposed in the deeper brickpits its thickness is 100 - 110 m, but east of the city it is much thinner and occurs under younger alluvium (Pooraka Formation) on the Para Block and Upper Outwash Plain. In engineering terms it is an overconsolidated clay with a safe bearing capacity in the range 1.5 to 3 ton/ft^2 (150 - 300 kPa).

POORAKA FORMATION (Qpp)

The Pooraka occurs as a sheet of red-brown clayey and silty fine sand, generally up to 6 m thick, overlying the Hindmarsh Clay on the plains and slopes bordering the present Torrens Valley. It may be equivalent to the sands and gravels of the Lower Torrens Alluvium. Red-Brown Earths (RB soils) are developed on the Pooraka, except on the higher slopes of the Para Block where accumulations of lime have produced Brown Solonized (BS) soils.

ST. KILDA FORMATION (Qrk)

Above the Pooraka along the narrow Estuarine Plain is a belt of soft grey and dark grey silts and sands with organic accumulations. The area is flat and poorly drained, the winter water table being as shallow as 0.6 m in places. Foundation conditions are poor, but adequate for domestic buildings where drained or covered with dune sand.

FULHAM AND SEMAPHORE SANDS (Qrf & Qrs)

The older dunes (Fulham Sand) occur as discontinuous mounds of red-brown fine to medium windblown sand with traces of clay binder. The younger Semaphore Sand is white to light grey, clean, and possesses a distinctive linear dune form. These sands are of adequate bearing capacity for small buildings, except where present only as a thin veneer over soft muds.

TORRENS ALLUVIUM (Qra)

The Torrens Alluvium has, for the purposes of this report, been divided into Upper (silty and clayey fine sand) and Lower (sand and gravel) members. The Lower Alluvium may be of late Pleistocene age, but the Upper silty sand has been dated as Recent (less than 10 000 years old). Typical thicknesses in boreholes are:

Paradise, 6 m (4 m Lower Alluvium)
Vale Park, 9 m (7 m " ")
Underdale, 15 m (10 m " ").

Twidale (1968) has quoted a maximum thickness of 27 m for the Torrens Alluvium east of Adelaide, with average values in the range 12 - 18 m. His Klemzig Sand may be equivalent to the Lower Torrens Alluvium and the Pooraka Formation.

SOILS

RED-BROWN EARTHS

These are the most extensive of the Great Soil Groups occurring along the margins of the Torrens Valley. They are developed mostly on the sheet alluvium of the Pooraka Formation. They are characterised by a fine sandy or silty A horizon overlying, with a sharp change, a red-brown to red clayey B horizon which becomes browner and more calcareous with depth.

Type RB5 and Variants

Type RB5 is formed on fine outwash material deposited as minor alluvial fans and terraces at the edge of the present Torrens floodplain. The A and B horizons are sharply differentiated, the A being sandy or silty and the B clayey with a granular structure, becoming limy with depth. The B horizon is subject to moderate shrinkage and swelling with changes in moisture content, and is of adequate bearing capacity for footings of domestic buildings.

At the edge of the Recent Alluvium, sandy variants occur.

Type RB 6 - RB 7

Both types occur in close association on the Lower Outwasy Plain adjacent to Recent Alluvium, and are distinguished by degree of horizon differentiation (weaker in RB7). They suffer only small to negligible swelling, but may be subject to shallow water table conditions.

Type RB 4 - RB 8

These soil types are developed on Tertiary sands and on Proterozoic slates and siltstones, along the north bank of the Torrens, between Klemzig and Highbury, and are characterized by the presence of a moderately to highly expansive clayey B horizon, which is also highly calcareous. The calcareous layer in the RB8 soils is liable to softening when saturated, with consequent loss of bearing capacity.

BLACK EARTHS (BE)

The black earths group includes a number of dark coloured soils, with large to extreme expansion and shrinkage capacities. Their lime content is quite variable, but where large this may reduce bearing capacity. Some have developed on poorly drained fine alluvium, but elsewhere the parent material may be the determining factor in their formation. Black Earths occur patchily on both sides of the valley at Windsor Gardens, Dernancourt and Athelstone.

BROWN SOLONIZED SOILS (BS)

This group of highly calcareous soils is derived primarily from windblown material, and is characterised by the presence of lime-rich nodules and silt at shallow depth. The soil itself is not expansive, but may overlie a highly expansive clay. Where the content of aeolian silt is high the soil may be liable to "collapse" when saturated. BS soils are restricted to the slopes of the Para Fault Block at Gilberton and Medindie, upslope from RB5 soils.

ALLUVIAL SOILS

The alluvial soils, underlying the area mapped as "Qra" (Recent Alluvium) on the map are immature sediments, so juvenile that pedological horizons have not developed. These soils are not subject to shrinkage or expansion, and bearing capacity is adequate for most types of building.

GEOLOGICAL RESOURCES

The geological resources of the Torrens Valley comprise groundwater, brick clay, sand and gravel. In none of these categories is the valley - here taken to include a strip 0.5 km wide on either side - a significant producer at the present time, and no important reserves are likely to be sterilized by the area's dedication as a recreational reserve.

GROUNDWATER (Fig. 6)

Adjacent to the Torrens, groundwater may occur at depths of 4.5 to 6 m and occasionally shallower, in Recent alluvial gravels and sands in which individual beds are seldom thicker than 1 m and are discontinuous and lenticular within relatively impermeable clays. Between Torrensville and Fulham extensive shallow gravels have yields as high as 25 000 to 50 000 l/hr. Two main horizons, each 1.5 to 3 m thick, are encountered between depths of 10 and 18 m and between 28 and 36 m.

Deeper sand beds within the Hindmarsh Clay west of Adelaide, between about 50 and 100 m depth, are also lenticular and variable in thickness between about 0.30 m and 6 m. Yields are generally not above 5 000 l/hr, but are less subject to seasonal variation than the shallower beds which draw directly from the Torrens.

In the Paradise-Marden area, shallow Pleistocene-Recent alluvium overlies Tertiary sands and marine beds and Proterozoic bedrock. The base of this alluvium, at depths between about 9 and 20 m, consists of a bed of coarse water-bearing gravels. Yields are generally small (1 500-2 000 l/hr) and are subject to strong seasonal fluctuations. Supplies have, in the past, been augmented by extending bores and wells into bedrock, where yields averaging 7 000-9 000 l/hr have been obtained from fractured quartzites and slates, and up to 5 000 l/hr from Tertiary marine beds.

Salinity of shallow groundwater increases generally westward, commonly within the range 1 500-3 000 mg/l. . Very high salinities (in excess of 30 000 mg/l) are a feature of shallow groundwater on the estuarine plain adjacent to the Torrens outlet.

In the western suburbs deep subartesian Tertiary aquifers are overlain by up to 110 m of Hindmarsh Clay and Pleistocene-Recent alluvial deposits. The principal intake area for these aquifers are the Hills Face and the alluvial fans of the Upper Outwash Fan. A secondary source of recharge is the Torrens Lake, by percolation down the Para Fault.

BRICK CLAY

Brick clay, of the red plastic variety, was formerly extracted from numerous pits in the Hindmarsh-Torrensville-Thebarton area, adjacent to the Torrens. In 1971, of 42 000 tons of red clay produced in the Metropolitan area, about half came from three pits in this area. However, reserves are small, and at the present time production is believed to be nil or very little. Clay is trucked in from as far afield as the Barossa Valley and fired at the existing kilns, while the adjacent clay pits are now derelict.

The three operational pits referred to above are:

Barrey's Bricks, Torrens Avenue, West Hindmarsh
(Section 373, Hd. Yatala),
Hallett Brick Industries, Hallet Street,
Allenby Gardens (Section 390, Hd. Yatala),
Hallett Brick Industries, South Road, Torrensville
(Section 47, Hd. Adelaide).

The brick clays are extracted from the Hindmarsh and Pooraka Clays, and selective working may be required to avoid limey, sandy and gravelly portions.

SAND AND GRAVEL

For many years the principal source of sand for the metropolitan area was the banks of the Torrens between St. Peters and Paradise. This source is now practically exhausted, but until recent times several remaining washing plants were in operation, using Torrens water and sand brought in from Golden Grove and Highbury. In 1964- the latest year from which figures are available - only 571 tons of sand and gravel were extracted from the Torrens, compared with 516 000 tons from Golden Grove - Highbury.

The following sand pits along the south bank of the Torrens have been noted in Departmental records. These were operated by the Estate of G.R.C. Bide up to the mid 1960's, and all are believed to be inoperative at

the present time.

Sec. 258 (Player Ave., St. Peters)	Hundred of Adelaide
Sec. 310, 311, 333 (east of Darley Road, Paradise)	
Sec. 284 (Harris St., Marden)	

The sand and gravels occur as point bar deposits within the Recent alluvium. The sand is generally too fine for use unblended in concrete, and small boulders up to 30 cm diameter require crushing prior to screening.

PRESERVATION OF GEOLOGICAL FEATURES

In the area under study there appear to be no unique geological features (such as stratigraphic type-sections, fossil localities and rare rocktypes) whose preservation is imperative. However, a number of exposures might well be highlighted for the information of the public. These could include:

(a) Outcrops of Proterozoic basement rocks on the north bank of the Torrens, between Windsor Gardens and Paradise.

(b) Tertiary sands visible in cliff sections in the same area. The contact between the Tertiary and the Proterozoic, if exposed, would be of particular interest.

(c) Hindmarsh Clay sections in the Torrensville-Hindmarsh brick pits.

(d) Recent sands and gravels in abandoned pits between Marden and Paradise, along the south bank.

(e) The Burnside Fault line, which crosses the Torrens 100-200 m downstream of the intersection with Fifth Creek, about 1 km north of Thorndon Park Reservoir.

Information on these features could well be included in an information leaflet available to the public. As development of the area proceeds the opportunity to expose and signpost points of geological interest should be taken.

PRESERVATION OF GROUNDWATER RESOURCES

As mentioned in the groundwater section, the alluvial fans between the Torrens Gorge and Paradise constitute the main intake areas for the deep aquifers in the western suburbs (see Fig. 6). For this reason it is desirable that suburban development in this locality be curtailed if possible, to ensure maximum recharge. Similarly, the same area is particularly unsuited to effluent or waste disposal due to the possibility of groundwater pollution.

The shallow alluvial aquifers along the Torrens are of limited value at the present time, but could be used for park irrigation adjacent to the river during summer. This may be restricted to the section east of Adelaide where salinities are lower.

EROSION CONTROL

Scouring and erosion does not appear to be a serious problem at the present day. Minor slumping of meander scars was observed in the Underdale area, where limited slope protection could be desirable. Loading of banks is not likely to accelerate erosion, the rate of erosion being largely a factor of stream velocity and discharge. Should the need arise in the future, a few low weirs would probably suffice to regulate discharge and to create ornamental ponds.

FOUNDATION

The surface soils and underlying alluvial deposits along the Torrens are of adequate bearing capacity for one to two storey structures, and minor cuttings for bicycle and foot paths should be stable. Exposed sandy slopes would require grassing to prevent ravelling.

Weirs constructed for flood control or ornamental purposes could be expected to leak if no subsurface cutoff is provided. If placed on silt there is a risk of piping failure and for this reason such sites should be properly investigated prior to design.

REFERENCES

Clothier, E., 1956. Paradise Bridge Foundation Test Drilling. S.A. Dept. Mines Rept. Bk. 43/90.

Fenner, C., 1927. Adelaide, South Australia - A Study in Human Geography. Trans. R. Soc. S.A., Vol. 51, p. 193-256.

Hiern, M.N., 1975. Construction Material Resources of the Adelaide Area. SADM Min. Rev. No. 137, p.19-39.

Lindsay, J.M., 1969. Cainozoic Foraminifera and Stratigraphy of the Adelaide Plains Sub-basin, South Australia. Bull. Geol. Surv. S.A. No. 42.

Miles, K.R., 1952. Geology and Underground Water Resources of the Adelaide Plains area. Bull. Geol. Surv. S.A., No. 27.

Olliver, J.G. and Weir, L.J., 1967. The Construction Sand Industry in the Metropolitan Area. Geol. Surv. S.A., Rept. Inv. No. 30.

Parkin, L.W. (Ed.), 1969. Handbook of South Australian Geology. Geol. Surv. S. A.

Selby, J., 1973. Foundation Borings, Torrens College of Advanced Education. SADM Rept. Bk. 73/131.

Steel, T.M., 1962. Subsurface Stratigraphy of the Western Suburbs of Adelaide. Quart. Geol. Notes, Geol. Surv. S.A., No. 2.

Taylor, J.K., et al., 1974. The Soils and Geology of the Adelaide Area. Bull. Geol. Surv. S.A., No. 46.

Trudinger, J., 1968, Vale Park Bridge, Geological Investigations. SADM Rept. Bk. 66/29.

Twidale, R., 1968. Geomorphology. Nelson, Melbourne, Appendix B.

Willington, C.M., 1954. Rock, Sand and Gravel Resources of the Metropolitan Area. SADM Min. Rev., No. 97, p.142-167.

Willington, C.M., 1956. The Brick Manufacturing Industry in South Australia. SADM Min. Rev., No. 101, p.88-112.

TABLE I - STRATIGRAPHIC SUCCESSION, TORRENS VALLEY

AGE	GEOLOGICAL UNIT	MAX. THICKNESS	DESCRIPTION	REMARKS
Recent	Upper Torrens Alluvium (Qra)	About 5 m	Grey silty and clayey fine sand.	Believed to be equivalent to "Walkerville Sand" of Twidale (dated at 5860 years B.P.)
Recent - Late Pleistocene	Lower Torrens Alluvium (Qra-Qpa)	4-18 m	Reddish yellow sand and gravel, with occasional boulders.	Believed to be equivalent to the "Klemzig Sand" of Twidale, and possibly the Pooraka Formation as well. Shallow aquifer.
Mid Recent	Semaphore Sand (Qrs)	15 m	Clean white sand.	Dune sands - present shoreline.
Early Recent	Fulham Sand (Qrf)	18 m	Reddish sand, traces of silt.	Dune sands - older (higher sea level) shoreline.
Early Recent	St. Kilda Formation (Qrk)	4 m	Soft grey estuarine silt, shell beds, stranded beach sands.	Covers Estuarine Plain between Fulham and Semaphore Sands. Ground water very saline, poor foundation material.
Late Pleistocene	Pooraka Formation	About 6 m	Red-brown clayey and silty sand with limey horizon.	Younger sheet alluvium of fans and plains. Dated at 34 000 years B.P.
Late Pleistocene	Glanville Formation	3 m	Shelly sands and marine clays.	Late Pleistocene marine incursion.
Pleistocene	Hindmarsh Clay	110 m	Stiff, mottled clay, with sand and gravel layers.	Occurs widely in subsurface very thick in western suburbs. Several thin discontinuous aquifers.

AGE	GEOLOGICAL UNIT	MAX. THICKNESS	DESCRIPTION	REMARKS
Pliocene (Late Tertiary)	Hallett Cove Sandstone and Dry Creek Sand	68 m	Calcareous sand, limestone	Marine, fossiliferous. Aquifer A.
Miocene to Eocene (Mid to Early Tertiary)	Port Willunga Beds	230 m	Calcareous sands and limestone.	Marine, fossiliferous. Aquifers A and B.
Eocene (Early Tertiary)	Blanche Point Marls		Marl, siltstone, limestone.	Confining bed.
Eocene	North and South Maslin Sands	110 m	Sand, gravel, and clay.	Marine, estuarine and fluviatile. Aquifer C.

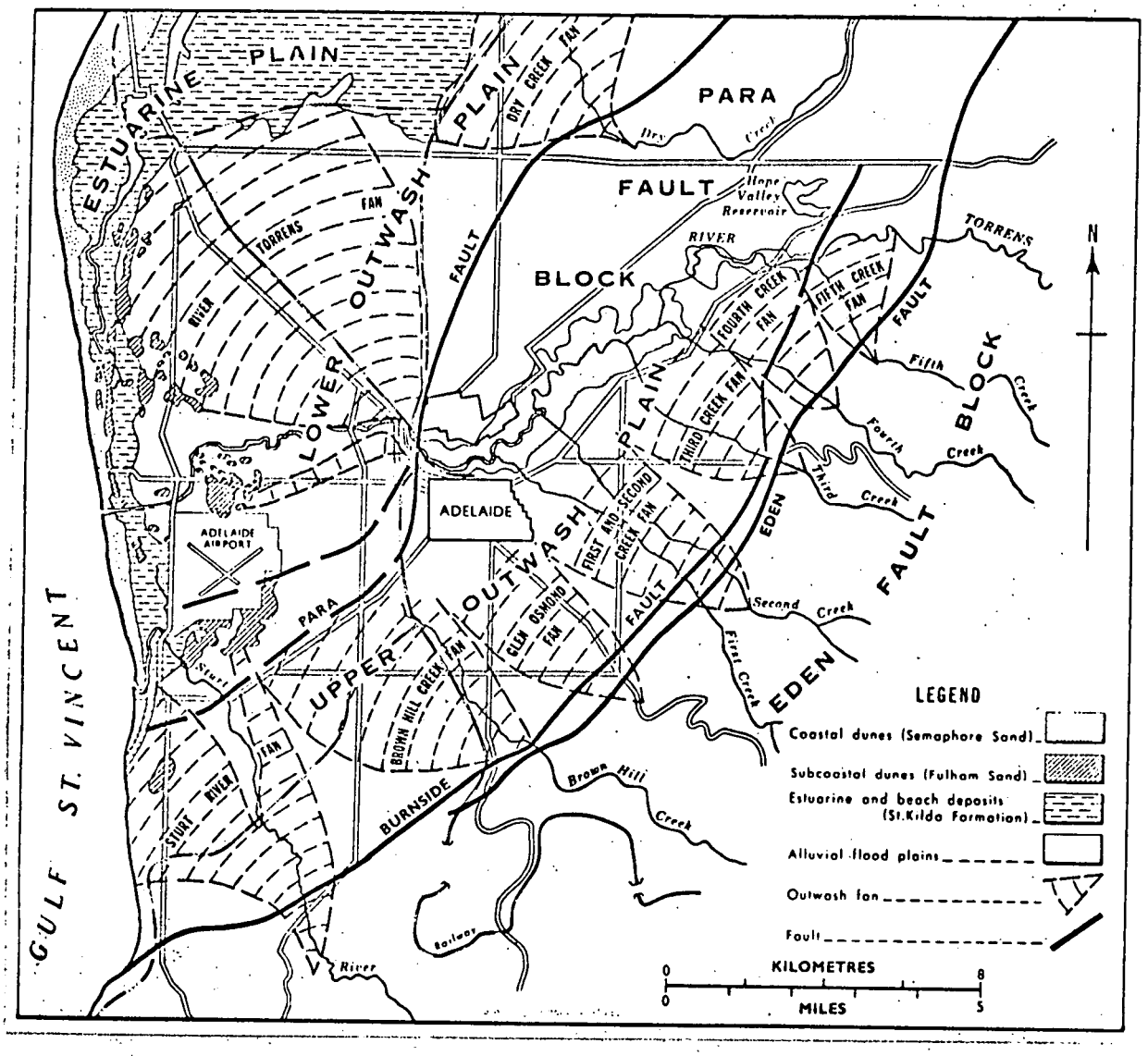

Fig 1.

	DEPARTMENT OF MINES — SOUTH AUSTRALIA	Scale :
Compiled :	ADELAIDE AND TORRENS VALLEY - GEOMORHOLOGICAL FEATURES	Date : 10 · 1 · 76
Drn. / Ckd.		Drg. No. S 12075

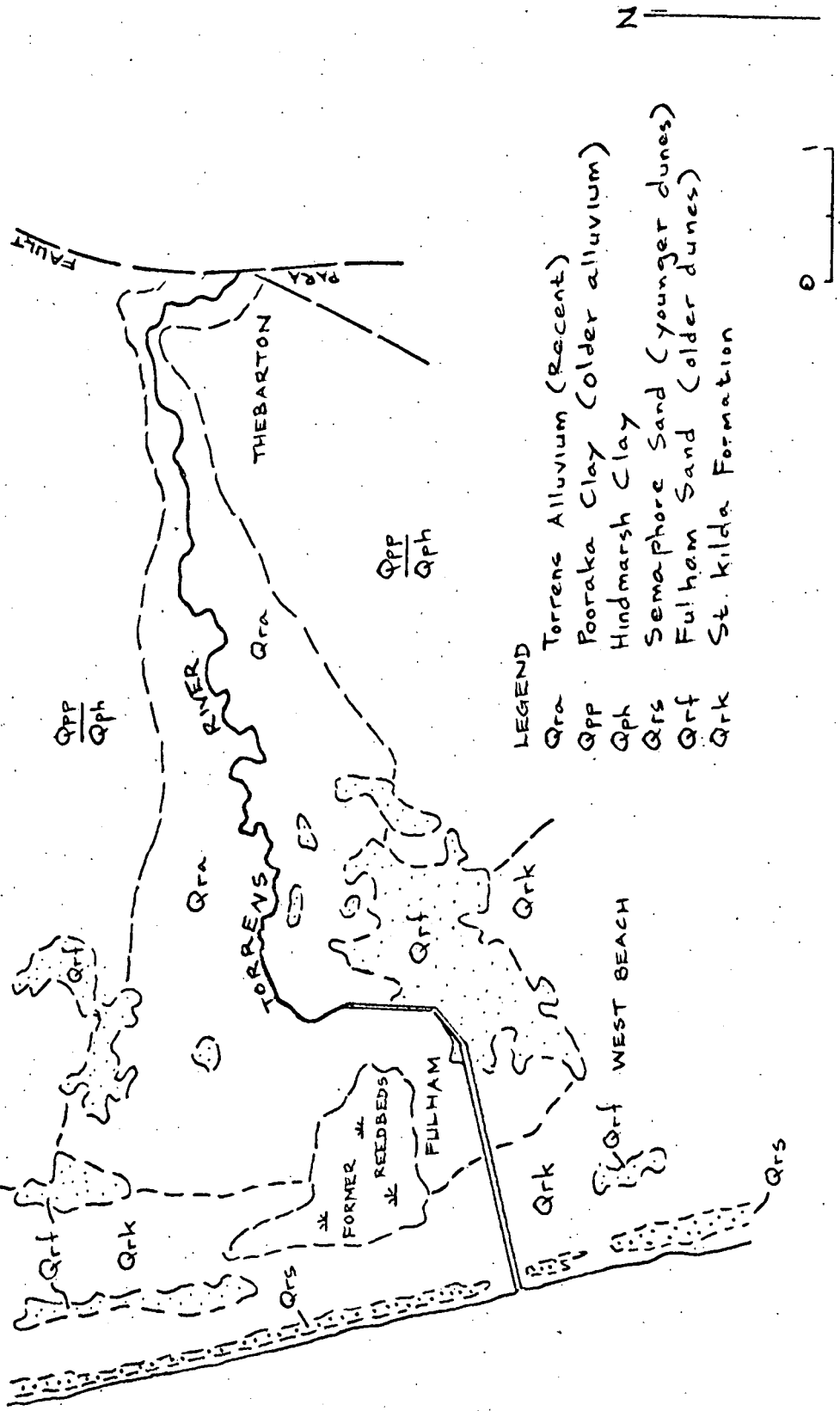

Fig. 2

	DEPARTMENT OF MINES — SOUTH AUSTRALIA	Scale : 1 : 50 000
Compiled :	GEOLOGICAL MAP - TORRENS VALLEY WEST BEACH - THEBARTON	Date : 28 · 1 · 76
Drn. GM.N Ckd.		Drg. No. S12076

IM—27 A1810

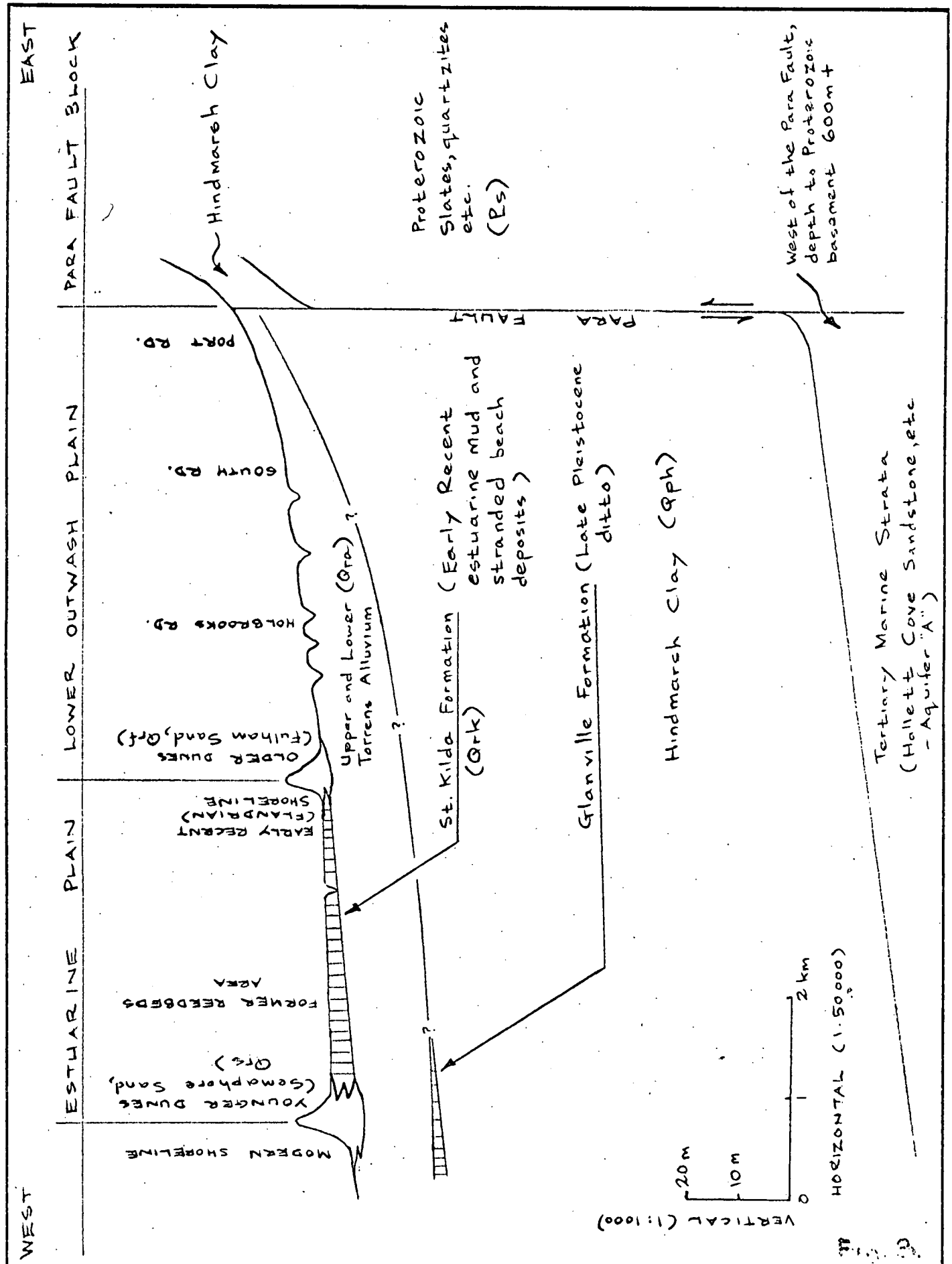

Fig. 2.

	DEPARTMENT OF MINES — SOUTH AUSTRALIA	Scale: HS 1:50 000 VS 1:1000
Compiled: GHMcN	GEOLOGICAL SECTION-TORRENS VALLEY	Date: 27 · 1 · 76
Drn. GH McN | Ckd.	WEST BEACH - THEBARTON	Drg. No. S12077

IM= 270 A1810

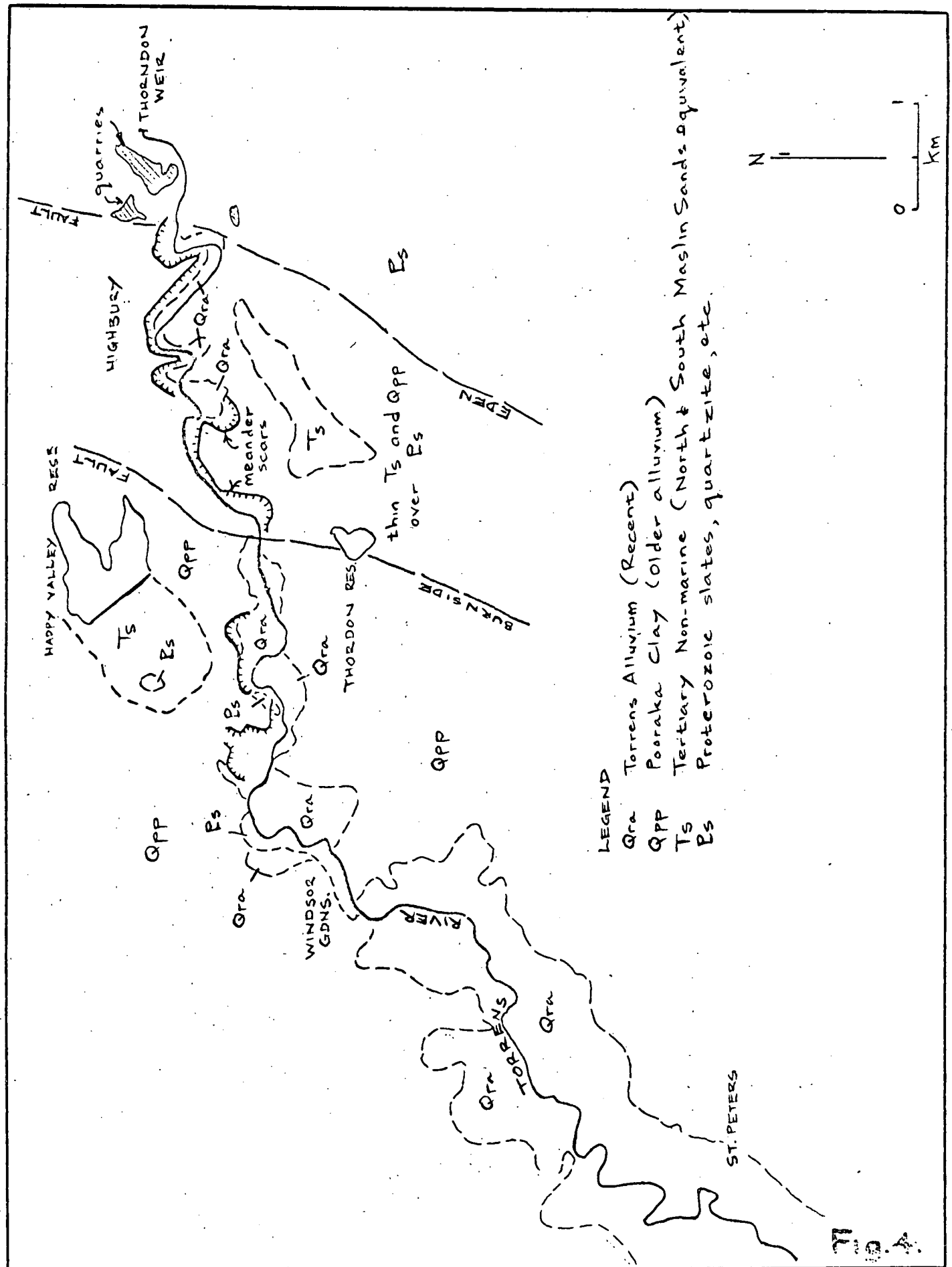

Fig. 4.

	DEPARTMENT OF MINES–SOUTH AUSTRALIA	Scale: 1:50 000
Compiled:	GEOLOGICAL MAP - TORRENS VALLEY ST. PETERS - THORNDON WEIR	Date: 28.1.76
Drn. / Ckd.		Drg. No. S12078

500—9.75 F9882 O

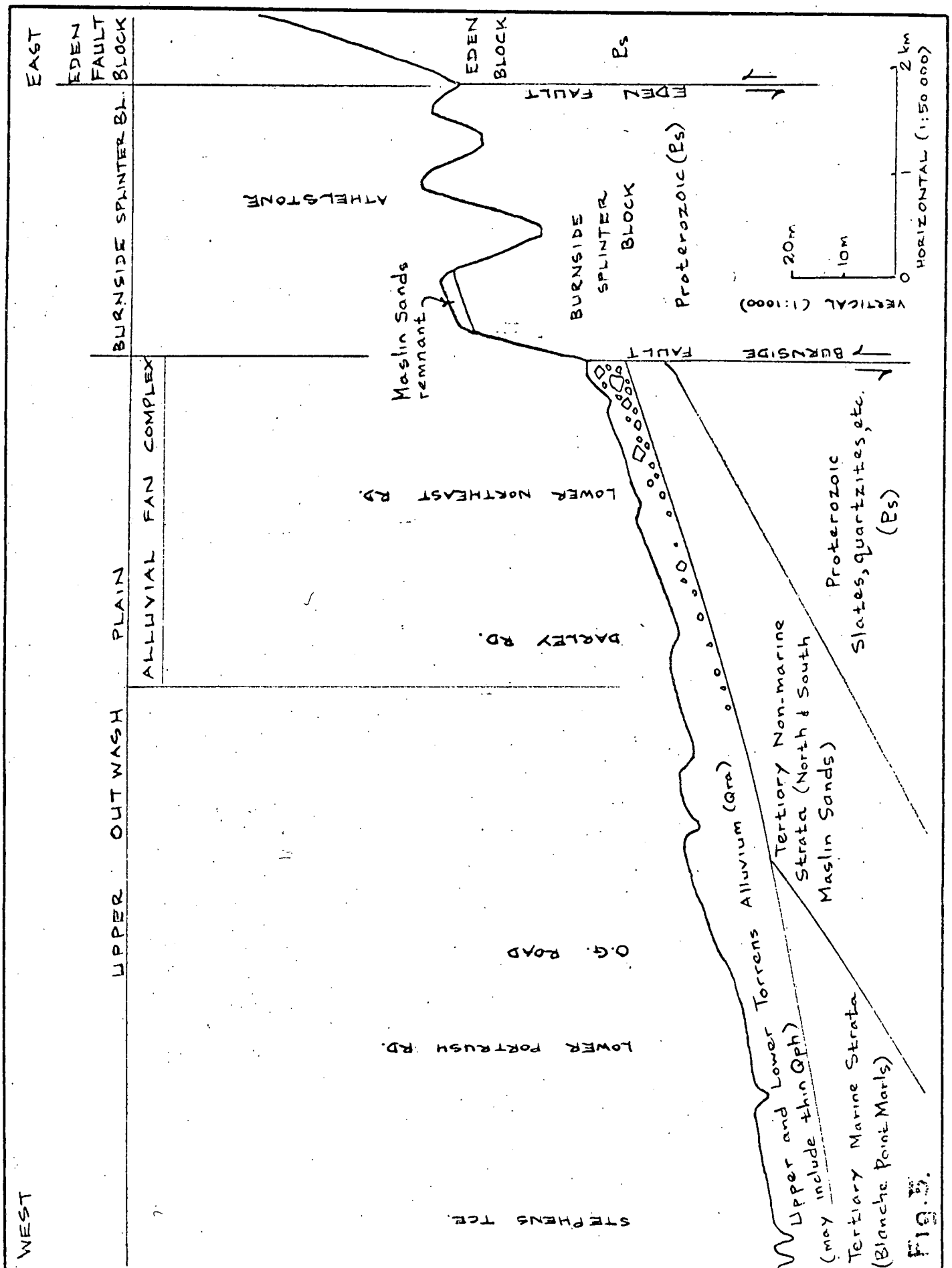

FIG. 5.

	DEPARTMENT OF MINES—SOUTH AUSTRALIA	Scale: HS 1:50 000 VS 1:1000
Compiled: GHMcN	GEOLOGICAL SECTION - TORRENS VALLEY ST. PETERS - THORNDON WEIR	Date: 27.1.76
Drn. GH McN | Ckd.		Drg. No. S12079

500—975 F9882 O

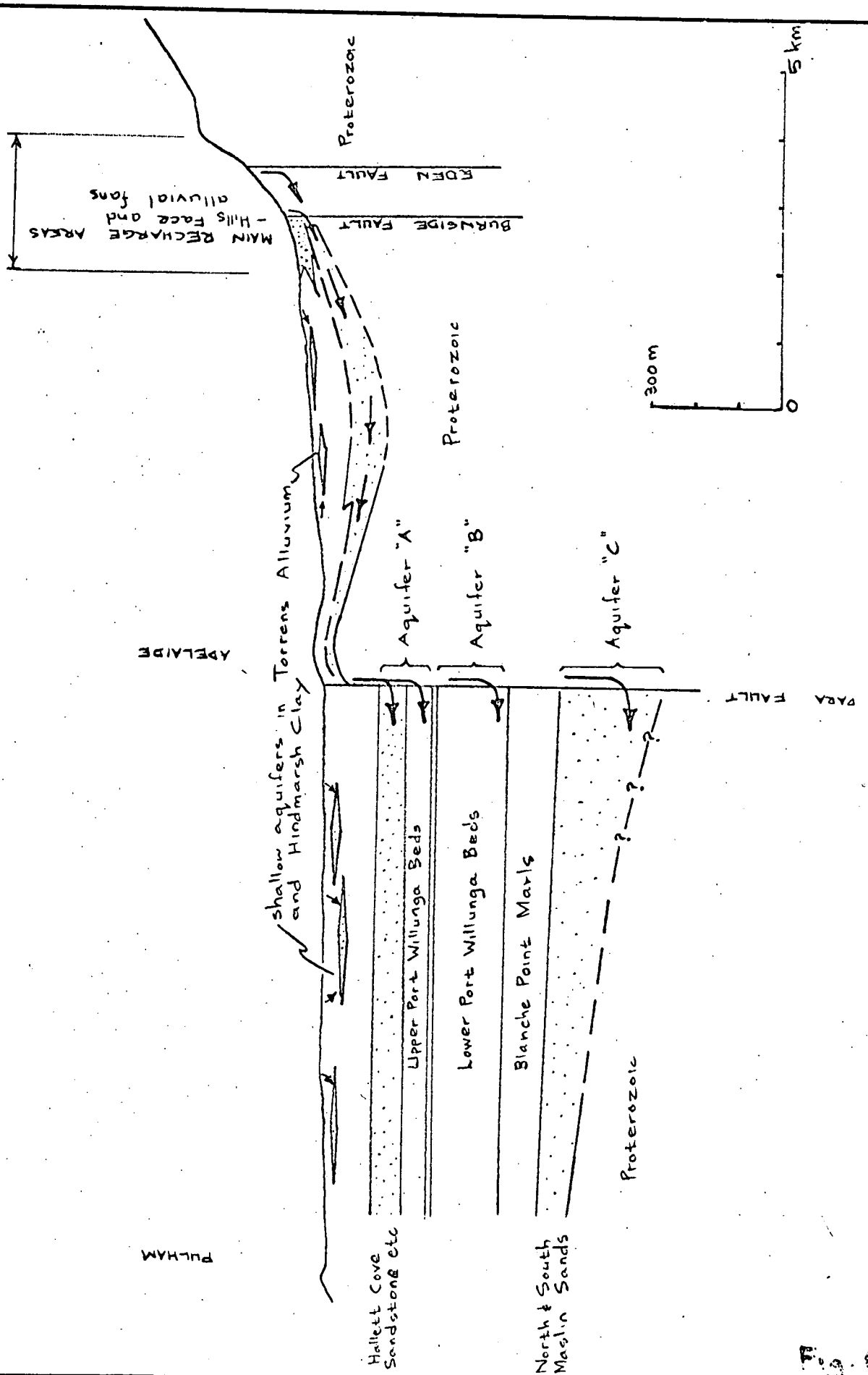

Fig. 5

	DEPARTMENT OF MINES—SOUTH AUSTRALIA	Scale: as shown
Compiled: GHMcN JML	TORRENS VALLEY - HYDROGEOLOGY	Date: 27.1.76
Drn. GH MCN Ckd.		Drg. No. S12080

500—9.75 F9882 O