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RECORD 77/61

STRATIGRAPHIC DRILLING OF STRANDED BEACH RIDGES, CENTRAL WESTERN VICTORIA, 1977

by

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SUMMARY

Stratigraphic drilling was undertaken in the Edenhope and Nhill-Kaniva areas of central western Victoria to investigate the stratigraphy and sedimentology of the Late Cainozoic sequence, parts of which form a series of regionally prominent, sub-parallel, strandline ridges. Ten holes ranging in depth from 46 to 101 m were drilled, intersecting several major units including the Woorinen and Coonambidgal Formations (Quaternary), the Parilla Sand (Pliocene), and the Bookpurnong Beds (Pliocene). Several holes bottomed in lower to middle Miocene sediments of the Duddo Limestone.

The Parilla Sand, which constitutes most of the sequence, has been studied in detail. It consists of a series of quartz sands with minor silt, clay, and gravel components. The sands in the upper (dune) part of the unit in the ridges are predominantly medium or medium to fine-grained, moderately well sorted, and fine skewed. In general these are underlain by a series of similar but texturally less uniform sands (typical beach deposits) containing thin layers of quartz gravel in their lower parts. In the Edenhope area these are in turn underlain by a series of fine to very fine-grained, well sorted, fine skewed sands of probable shallow marine or estuarine origin. All the sands are devoid of carbonate. Heavy-mineral concentrations are generally moderately low (usually less than 0.5 percent), although in the lower (beach) part of the sequence, laminae and thin bands of concentrated heavy minerals occur in a number of places. The suite is mineralogically mature and consists of between 50 and 70 percent opaques (mainly ilmenite and leucoxene), 10 to 30 percent tourmaline, 3 to 5 percent rutile, and 5 to 15 percent zircon.

INTRODUCTION

Between January and April 1977 stratigraphic drilling was carried out in the Edenhope and Nhill-Kaniva areas of central western Victoria. Ten holes ranging in depth from 45.9 to 101.5 m were drilled using a Mayhew 1000 rig. The drilling (for the most part continuous coring) was undertaken to obtain stratigraphic, sedimentological, and other information from a series of regionally prominent, sub-parallel, south-southeast-trending ridges west and northwest of Horsham. These ridges apparently form an inland (older) continuation to the Quaternary beach ridge sequence drilled in 1974 and 1975 in the adjacent area of southeastern South Australia (Cook et al., 1977).

The western Victorian ridges occur within the Parilla Sand of Firman (1965a,b) (Diapur Sandstone of Lawrence, 1966), a unit which forms a continuous extensive cover at the top of the Murray Basin sequence over wide areas of southwestern New South Wales, southeastern South Australia, and western Victoria. The Parilla Sand is believed to be Pliocene although its base may be diachronous and may include late Miocene units (Lawrence, 1975).

First mapped by Hills (1939) and subsequently in greater detail by Lawrence (1966) and Blackburn et al. (1967), the ridges vary considerably in height reaching a maximum of about 60 m above the adjacent inter-ridge flat in the Lawloit Range, 20 km west of Nhill. They are up to several kilometres wide and are separated by inter-ridge corridors which, except for minor rises and shallow depressions, are regionally flat. Lakes and swamps commonly occur in these areas, particularly to the south of the Little Desert.

Over the years the ridges have been studied by a number of workers including Fenner (1918), Hills (1939), Blackburn (1962), Lawrence (1966), Blackburn et al. (1967), and Lawrence (1975). Several hypotheses on the formation of the alternating ridge-corridor topography have been proposed. These include:
(i) formation related to the shape and tectonic deformation of

the basement Grampians Group (Hills, 1939), (ii) formation as a result of erosion, perhaps by a system of parallel flowing rivers (Fenner, 1918), and (iii) formation as a system of beach-dune coastal deposits associated with the retreat of a former Murravian Gulf (Blackburn, 1962; Blackburn et al., 1967; Lawrence, 1966, 1975). The last hypothesis is, as noted by a number of the workers, supported by: similarities in height, form, and direction of strike to the southeastern South Australia beach ridge sequence; approximate parallelism; and terminal curvature or convergence near basement outcrops. Features of the sediments constituting the ridges (this Record and elsewhere) appear to be consistent with the beach-dune strandline hypothesis.

In this Record initial results of the 1977 drilling program (including a fairly detailed description of the sediments) are presented.

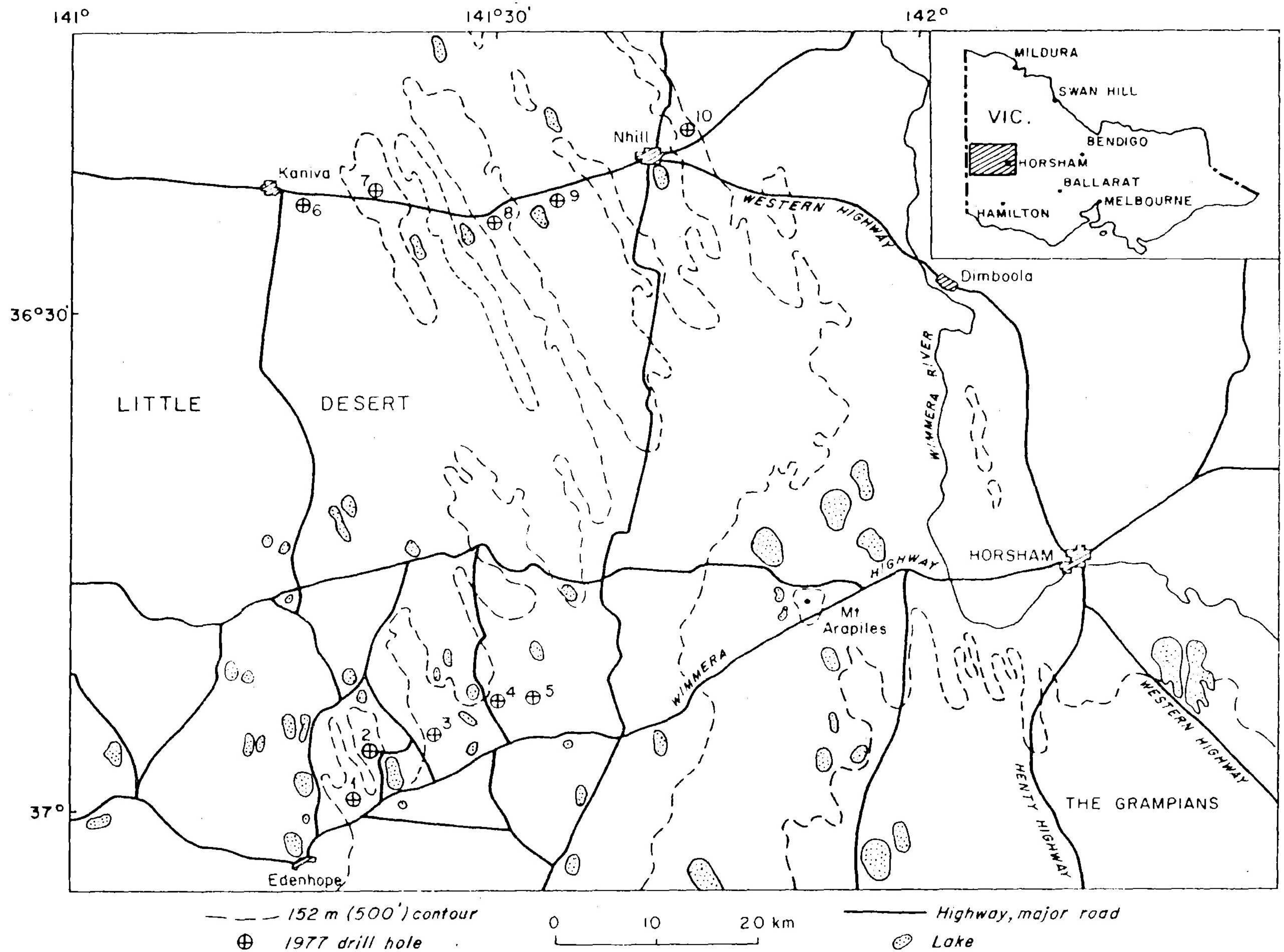
GENERAL DESCRIPTION OF THE STRATIGRAPHY

The Tertiary stratigraphy of the western part of the Victorian section of the Murray Basin is shown in Table 1, and is described by Lawrence (1966 & 1975). Boundaries between the units although shown as being synchronous may, at least in part, be diachronous (Lawrence, 1975).

The Tertiary sequence is overlain by Quaternary surficial deposits consisting of aeolian quartz-sands (Lowan Sand) and fluvial lacustrine-paludal and aeolian clays (Woorinen and Coonambidgal Formations).

RESULTS OF THE DRILLING

The locations of the holes drilled during the 1977 program are shown in Figure 1, five holes (Horsham 1-5) being located to the northeast of Edenhope, 4 holes (Horsham 6-9) between Nhill and Kaniva, and one hole (Horsham 10) immediately to the east of Nhill. All sites were levelled to the Australian Height Datum by staff of the Australian Survey Office, Department of Administrative Services.



Record 1977/61 Fig. 1 Location of drill holes, central western Victoria J54/A/15

TABLE 1. TERTIARY STRATIGRAPHY OF THE MURRAY BASIN IN WESTERN VICTORIA

EPOCH		STAGES	UNIT	
PLIOCENE	L		PARILLA SAND	
	E	KALIMNAN		
MIOCENE	L	MITCHELLIAN & CHELTENHAMIAN	MURRAY GROUP	BOOKPURNONG BEDS
		BAIRNSDALIAN		
	M	BALCOMBIAN		DUDDO LIMESTONE
	E	LONGFORDIAN		
OLIGOCENE	L			ETTRICK MARL
	M	JANJUKIAN		
	E			
EOCENE & PALAEOCENE		ALDINGAN	RENMARK GROUP	OLNEY FORMATION
				WARINA SAND

(After Lawrence, 1975)

Field logs of the holes form Appendix 1 of this report. Cross-sections and stratigraphic columns are given in Figures 2 and 3. Ages of the fossiliferous (pre-Parilla Sand) units were determined by C. Abele of the Victorian Geological Survey from the foraminiferal faunas. Several suggestions on stratigraphic nomenclature by Abele (1977) on the basis of these ages have been incorporated in this report. The resulting stratigraphic nomenclature differs somewhat to that shown by the Mines Department (1974) and Lawrence & Abele (1976) with both the Bookpurnong Beds and Duddo Limestone extending farther to the south than previously indicated.

DESCRIPTION OF THE SEDIMENTS

TERTIARY UNITS

Duddo Limestone

Holes 2, 6, 7, and 9 bottomed in early to middle Miocene, bryozoan sediments of the Duddo Limestone (Figs. 2 and 3). All other holes were too shallow to reach the formation.

The term Duddo Limestone was introduced by Lawrence (1966) for the mid-Tertiary limestone unit of the Murray Basin. It is equivalent to the Gambier Limestone of the adjacent Otway Basin and, as proposed by Lawrence (1975), incorporates the Morgan, Mannum, and Pata Limestones of Ludbrook (1957) and O'Driscoll (1960).

Where encountered in the Nhill-Kaniva and Edenhope areas, the formation consists of light grey (N7) to yellowish grey (5Y7/2) skeletal limestones. Bryozoans are the predominant fossil group. In several holes, the upper eroded surface of the formation is marked by a hard ferriginous crust 1 to 3 cm thick.

Bookpurnong Beds

Sediments here considered referable to the Bookpurnong Beds of Lukbrook (1957) and Lawrence (1966, 1975), a unit which disconformably overlies the Duddo Limestone (Table 1), were intersected in all but one of the holes drilled in the region. They appear, on the basis of their presence in holes in the Edenhope area (holes 1 to 5), to extend farther south than previously shown by the Mines Department (1974) and Lawrence & Abele (1976).

The sediments are Pliocene (Abele, 1977) and are lithologically variable, ranging from brown clayey silts and very fine-grained sands to grey, micaceous and glauconitic marls. They form 3 major lithological units.

(i) Calcareous quartz sands - quartzose calcarenites. These sediments, which were encountered only in hole 6, are fine or very fine-grained, dark yellowish orange, moderately well sorted, and slightly micaceous. Their carbonate content generally increases with increasing depth, and ranges from 10 to 30 percent in the upper part of the sequence (calcareous quartz sands) to 80 percent at the base of the unit (calcarenites). The carbonate is mainly biogenic and consists of fragments of molluscs, gastropods, bryozoans, and algae, with minor foraminiferal, echinoid, and other components. Secondary calcite cements parts of the sequence into thin hard layers.

The sediments appear to be partly leached and this probably largely accounts for their variable carbonate content. Quartz grains are typically iron-stained and fragments of biogenic carbonate are commonly partly replaced by iron oxides.

The composition and fragmented and abraded nature of the carbonate fraction suggest deposition either close to, or in, a high-energy environment such as a beach.

(ii) Clayey silts and very fine-grained quartz sands. These typically brown (5Y4/4 - 10YR 5/4) to olive grey (5Y 3/1) slightly micaceous sediments form part of the Bookpurnong Bed sequence in holes 5, 7, 9, and 10. They are of relatively unfirom quartzose lithology and in most places appear to have undergone fairly extensive weathering and leaching before the deposition of the overlying sediments. They may be weathered and leached equivalents of the calcareous sands, silts, and marls into which they grade with increasing depth.

(iii) Micaceous and glauconitic calcareous sands, silts, and marls. These sediments were intersected in holes 1, 2, 3, 4, 7, and 9 and are typically grey to greenish grey (N3.5 - 5GY 4/1). They are texturally varied and generally fossiliferous (mainly whole and fragmented bivalves and gastropods with fewer foraminiferal, bryozoan, and other components). The sediments are composed predominantly of varying proportions of quartz, biogenic carbonate and clay. Mica (mainly biotite), glauconite, and in some places pyrite, are also present.

A shallow water environment is suggested by the textural variability and by the nature and composition of the carbonate fraction.

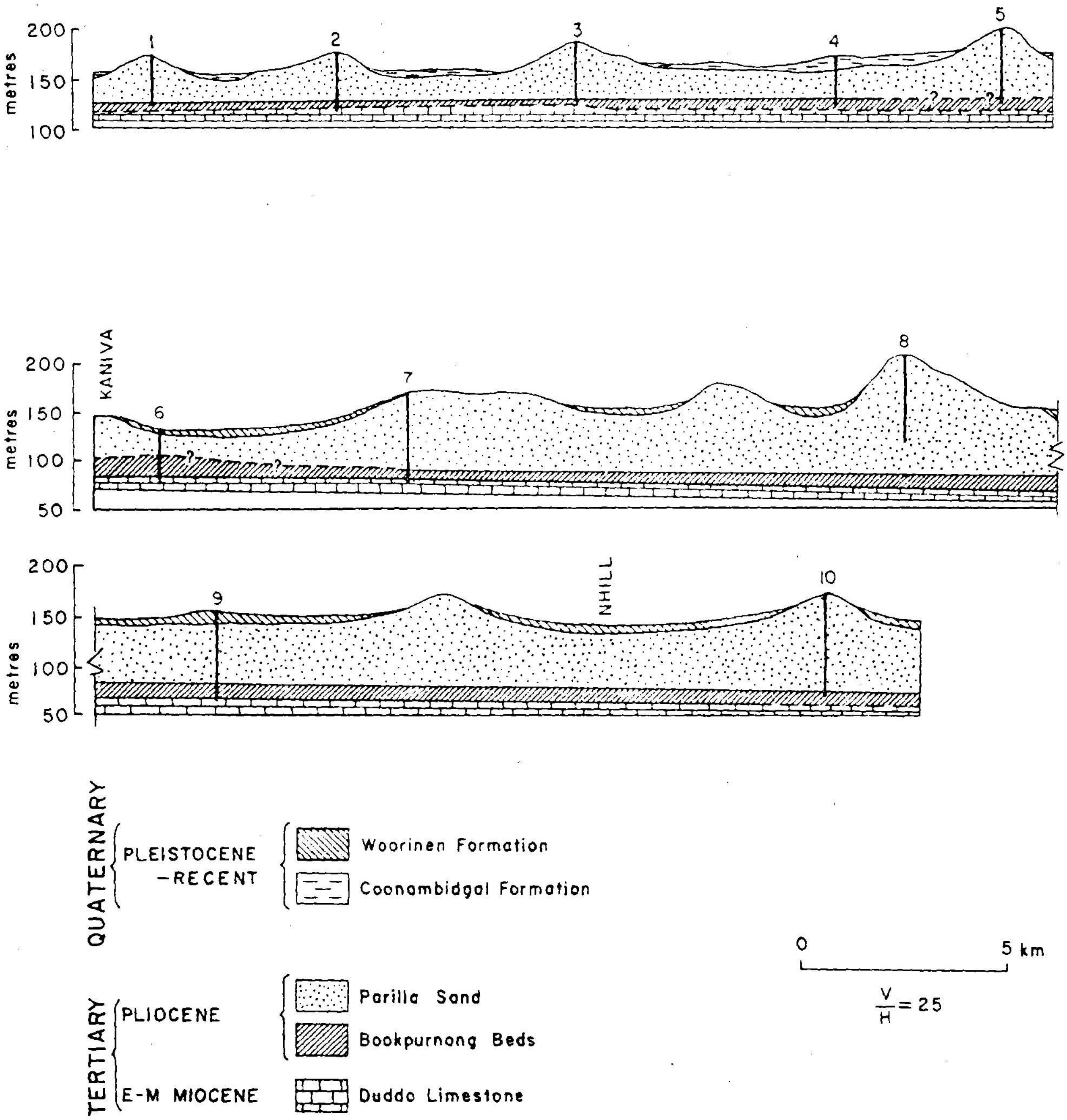


Fig.2 Cross-sections showing the major Late Cainozoic units

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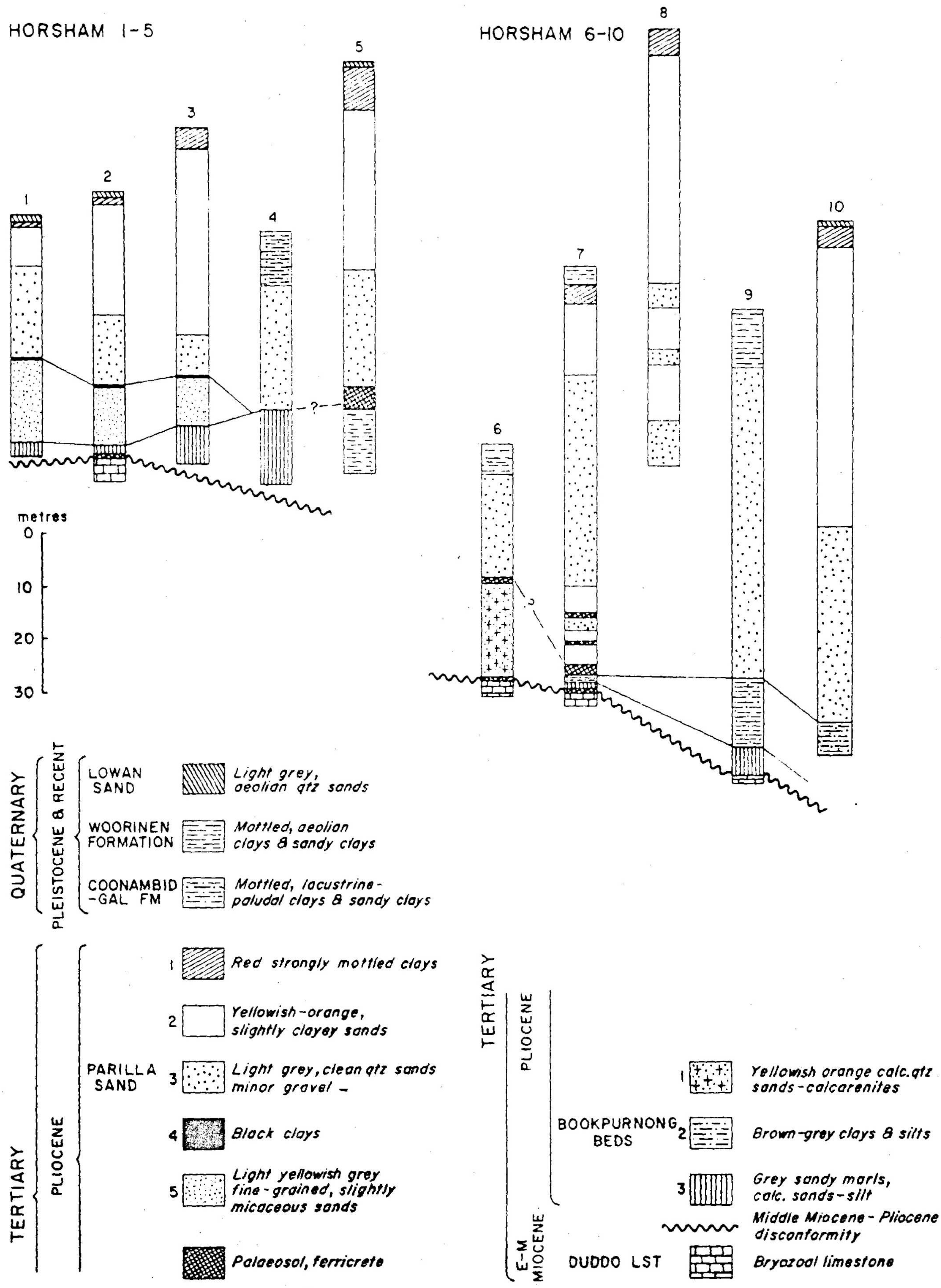

Fig.3 Stratigraphic columns of the Late Cainozoic geology

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Parilla Sand

The Parilla Sand, as defined by Firman (1965 a,b), is equivalent to the Diapur Sandstone of Lawrence (1966), and is a correlative of the Dorodong Sand of the Otway Basin (Kenley, 1971). It consists of quartz sand and sandstone (clayey in parts) and minor silt, clay and gravel. The unit forms a series of regionally prominent, sub-parallel ridges separated by inter-ridge corridors.

Sediments referable to the Parilla Sand were encountered in all holes drilled in the region. Unlike the younger ridge-forming sediments of southeastern South Australia, the Parilla Sand extends beneath the inter-ridge corridors. The sediments, although predominantly quartzose sands, vary in lithology owing to weathering profile development and changes in depositional environment. The following zones and units can be recognised on lithological grounds in the sections of the formation intersected by the drill holes.

(i) A highly weathered zone. This zone, which forms the B horizon of the lateritic soil profile described by Blackburn et al. (1967), is present on all of the ridges drilled. It consists of strongly mottled, moderate reddish brown and dark yellowish orange clay, sandy clay, and clayey sand with well-developed peds. Solution pipes and iron oxide accretionary structures are present in many of the sediments; primary sedimentary structures are obscured. Ironstone pisolites (0.5 to 1 cm in diameter) commonly occur, usually as a thin (2 to 4 cm) layer within the top metre of sediment. The sediments generally contain 40 to 70 percent clay plus silt. The sand fraction is typically medium-grained, moderately sorted, and fine skewed.

The thickness of the zone ranges from less than 1 m in holes 1 and 2 to 9 m in hole 5. It is probably significant that the thinnest non-truncated development occurs in holes 1 and 2 which are situated on the westernmost, and therefore presumably youngest, ridges.

(ii) A zone of less intense, but still moderately strong, weathering underlies the highly weathered zone on the ridges (holes 1, 2, 3, 5, 7, 8, and 10). It is characterised by mottled (moderate reddish brown and dark yellowish orange) clayey sandstone and dark yellowish orange to moderate reddish brown slightly clayey sand.

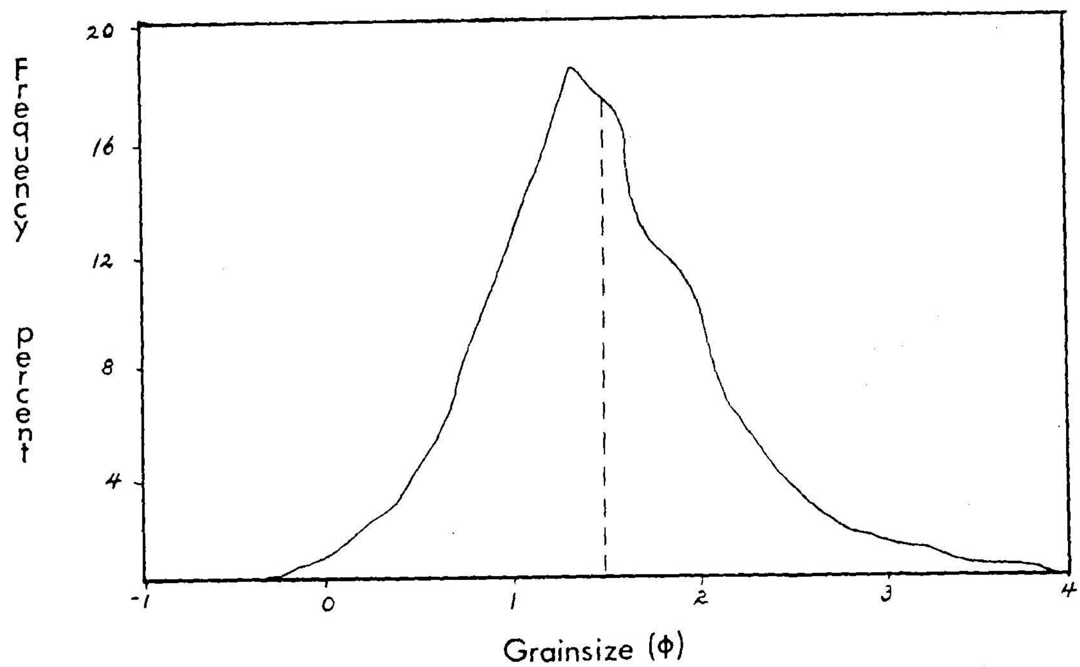
The sediments in this zone are moderately to weakly cemented by iron oxides (limonite) and clay minerals (mainly kaolinite). Quartz grains are typically coated and stained with iron oxides and this, together with the iron oxides in the clay matrix, impart the characteristic yellowish orange to reddish brown colour to the sediments. Total iron values determined for 30 samples range from 1.1 to 6.3 percent and average 2.7 percent.

In general, sedimentary structures have been obscured by the weathering, iron mobilisation etc. Only at one locality (a quarry near the Nhill Pistol Club) were sedimentary structures (cross-stratification on an angle of 15 to 25 degrees) observed.

The framework of the sediments is composed almost entirely of sub-angular to angular grains of monocrystalline quartz. Polycrystalline quartz occurs as a relatively minor component; feldspar, lithic fragments, and heavy minerals occur in trace amounts. Carbonate is absent.

Grainsize analyses were undertaken on approximately 110 samples of the sediments. Results indicate that the sediments generally contain 10 to 20 percent clay plus silt. Gravel size ($>$ 2 mm) material is absent. The sand fraction is relatively uniform and has a mean grainsize generally within the 1.3 to 2.0 Ø range (Table 2). The sands are typically moderately well sorted *(σ_I generally between 0.5 and 0.8) are fine skewed (Fig. 4).

* Inclusive graphic standard deviation of Folk (1968)



Mean : 1.56
Sorting : 0.69
Skewness : 0.71
Kurtosis : 0.84

Figure 4 Typical example of the grainsize frequency distribution within the sand fraction of the moderately weathered zone

TABLE 2. SUMMARY OF THE GRAINSIZE DATA OF SANDS IN THE MODERATELY WEATHERED ZONE OF THE PARILLA SAND.

Hole	No. of samples	Range of mean grainsizes (Ø)	Average mean grainsize (Ø)	Sorting (6_I)
1	8	1.8 - 2.2	1.9	0.6 - 0.8
2	6	1.3 - 2.0	1.7	0.6 - 0.7
3	12	1.3 - 1.9	1.8	0.5 - 0.7
5	23	1.4 - 1.8	1.5	0.5 - 0.6
7	17	1.9 - 2.0	1.9	0.6 - 0.7
8	32	1.3 - 2.0	1.7	0.6 - 0.8
10	14	1.4 - 1.8	1.6	0.5 - 0.8

(iii) Loose, relatively clean, light yellowish grey quartz sands underlie at depth the weathered sands of the ridges and the clays and sandy clays of the inter-ridge corridors (see Fig. 3). The transition from the oxidised weathered zone to the underlying clean, light-coloured sands is, as indicated by Lawrence (1966), probably largely a function of water-table depth; oxidised iron compounds occur above the water-table, reduced compounds below.

In their upper part, the sands generally have the same grainsize characteristics as the overlying sands of the weathered zone i.e. they are medium or medium to fine-grained (mean grainsizes for 50 samples range between 1.2 and 2.2 Ø), moderately well sorted (6_I 0.5 to 0.8), and fine skewed. Unlike the overlying sands, matrix clay and silt constitute less than 10 percent by weight of the sediment. Quartz grains are typically subangular to angular, monocrystalline and unstained.

At depths below 23 m in hole 1, 31 m in hole 2, 30 m in hole 3, 29 m in hole 4, 40 m in hole 5, 45 m in hole 7, 30 m in hold 9, and 76 m in hole 10, the sands become less uniform in texture and increase slightly in overall grainsize. Coarse-grained (mean grainsize generally between 0.3 and 1.0 Ø in the 55 samples examined), moderately sorted quartz sands alternate with finer-grained sands. In a number of places (notably in holes 7, 9, and 10) thin layers of quartz gravel (mainly of granule size) occur interspersed with the other sediments towards the base of the unit. In holes 5, 6, 7, and 9, thin bands and laminae of concentrated heavy minerals also occur towards the base of the unit in fine, very fine and/or medium-grained sediments.

Three palaeosols, including ferricrete layers containing iron oxide casts of whole and fragmented bivalves, occur near the base of the sand sequence in hole 7. Truncation, erosion, and weathering of the sequence are clearly indicated.

(iv) A 30 to 60 cm thick layer of dark grey-black clay occurs in the 3 westernmost holes of the Edenhope area. The clay layer, which is approximately flat-lying (intersected at a depth of 27 m in hole 1, 39 m in hole 2, and 48 m in hole 3) occurs at the top of the sequence of fine and very fine-grained, slightly micaceous quartz sands described below. Deposition probably occurred under restricted estuarine - lacustrine conditions.

(v) Light yellowish grey, fine, and very fine-grained micaceous quartz sands occur over a 10 to 15 m interval at the base of the Parilla Sand sequence in holes 1, 2, and 3. The sands, which are possible equivalents of the micaceous Loxton Sands of Ludbrook (1957), are unconsolidated and relatively clean, although they become slightly more clayey towards the base of the unit. Mean grainsize ranges between 2.0 and 3.4 Ø and sorting between 0.4 and 1.1 (moderately to well sorted) (Table 3).

The sands consist of angular, equant grains of monocrystalline quartz, flakes of clear mica, and traces of heavy mineral. Carbonate is absent.

TABLE 3. SUMMARY OF GRAINSIZE DATA OF SANDS IN THE BASAL UNIT OF THE PARILLA SAND (HOLES 1, 2, AND 3)

Hole	No. of samples	Range of mean grainsizes (Ø)	Average mean grainsize (Ø)	Sorting (6_I)
1	7	2.6 - 2.7	2.6	0.5 - 0.9
2	8	2.0 - 3.0	2.7	0.7 - 1.0
3	5	2.1 - 3.4	2.7	0.4 - 1.1

<u>Discussion</u>: Interpretation of the environments of deposition of the Parilla Sand sequence is made difficult by its unfossiliferous nature, by the presence of highly weathered zones in its upper part, and by the general lack of sedimentary structures. The following depositional environments are suggested on the bases indicated.

(i) An estuarine or shallow marine environment for the fine and very fine-grained micaceous quartz sands occurring at the base of the sequence in holes 1, 2, and 3. Basis - lithology, similarity to the Loxton Sands which are described as estuarine by Firman (1969).

(ii) A lacustrine or restricted estuarine environment for the clays overlying the micaceous sands in holes 1, 2, and 3. Basis - lithology.

(iii) A beach environment for the sands of variable texture occurring in the lower part of the sequence (holes 1, 2, 3, 4, 5, 7, 9, and 10). Basis - lithology (including the presence of thin layers of quartz gravel and bands and laminae of concentrated heavy minerals), occurrence of casts of fragmented bivalves, etc.

(iv) A beach passing into aeolian dune environment for the relatively uniform (medium to medium-fine grained, moderately well sorted) sands forming the upper part of the sequence (holes 1, 2, 3, 5, 7, 8, 9, and 10). Basis - lithology, nature and form of the ridges.

Based upon these interpretations of the depositional environments, the complete sequence appears to reflect a transition with time and changing position of the shoreline, from estuarine-shallow conditions, to restricted estuarine-lacustrine conditions, to beach conditions, to aeolian dune conditions. Laterally, contemporaneous deposition would have rapidly changed from one depositional environment to another.

The absence of carbonate in the sequence and its occasional replacement by iron oxides is, as has been suggested by Lawrence (1966) and other workers, probably the result of (i) the deep weathering which the sediments have undergone, and (ii) groundwater solution; similar processes leading to the complete removal of the carbonate are reported by Smart (1976) in beach ridges on Cape York Peninsula.

The marked difference in composition between the siliceous sediments of the Parilla Sand sequence, and the calcareous sediments of the younger southeastern South Australia strandline sequence probably reflects a number of factors. These may include: (i) a significant age difference between the two sequences, perhaps as much as a million years; (ii) Pliocene weathering and 'lateritization' of the Parilla Sand; and (iii) differences in initial sediment composition. The relative importance of these factors is difficult to determine. It seems unlikely, in view of the absence of carbonate and the infrequent occurrence of shell casts, that the western Victorian sediments were originally as calcareous as those deposited at a later stage in southeastern South Australia. If they were, then their volume must have been reduced as a result of total weathering and solution of the carbonate by about 50 to 70 percent. In the light of the overall evidence it seems most probable that the two sequences had significantly different initial compositions, the western Victorian sequence containing a much higher proportion of terrigenous material derived from highland areas around the margins of the basin. Heavy-mineral studies (Colwell, 1976) have shown the terrigenous fraction of southeastern South Australian sediments to be largely derived from local source areas such as the Padthaway Ridge.

QUATERNARY UNITS

Lowan Sand

The Lowan Sand is defined by Lawrence (1966) and is part equivalent to the Molineaux Sand of Firman (1965a). It consists of white to yellow aeolian quartz sands which occur mainly as extensive dune fields (characterised by parabolic dune chains, teardrop longitudinal dunes, and sand plans) within the Little, Big, and Sunset Deserts (Lawrence, 1975). Within the Nhill-Kaniva and Edenhope areas it forms the Little Desert and surficial sand layers associated with the prominent south-southeast-trending ridges of the region (Fig. 5).

The unit was intersected in holes 1, 2, 5, and 10 where it occurs as a thin (generally less than 60 cm) highly leached layer of loose white to light yellowish grey quartz sand. It occurs on the flanks and crests of most of the region's ridges (particularly those south of the Little Desert) although in places localised stripping (e.g. at the site of hole 3) has occurred leaving a pisolitic ironstone gravel layer exposed at the surface.

The Lowan Sand forms the A horizon of the lateritic podzolic profile described by Blackburn et al. (1967) as the major soil type developed on the ridges. The close association of the unit with the ridges in the areas drilled reflects the sand's derivation by localised erosion and leaching of the underlying sand sequence.

TABLE 4. SUMMARY OF GRAINSIZE DATA OF SAMPLES OF THE LOWAN SAND

MEAN GRAINSIDE (Ø)		SORTING (6_I)		SKEWNESS (SK_I)	
Range	No. of samples	Range	No. of samples	Range	No. of samples
1.2 - 1.4	1	0.5 - 0.6	6	-0.3 - -0.2	2
1.4 - 1.6	7	0.6 - 0.7	24	-0.2 - -0.1	3
1.6 - 1.8	10	0.7 - 0.8	14	-0.1 - 0	4
1.8 - 2.0	13	0.8 - 0.9	7	0 - 0.1	6
2.0 - 2.2	17	0.9 - 1.0	4	0.1 - 0.2	8
2.2 - 2.4	6			0.2 - 0.3	7
2.4 - 2.6	1			0.3 - 0.4	7
				0.4 - 0.5	6
				0.5 - 0.6	4
				0.6 - 0.7	3
				0.7 - 0.8	3
				0.8 - 0.9	2
	Total 55		Total 55		Total 55

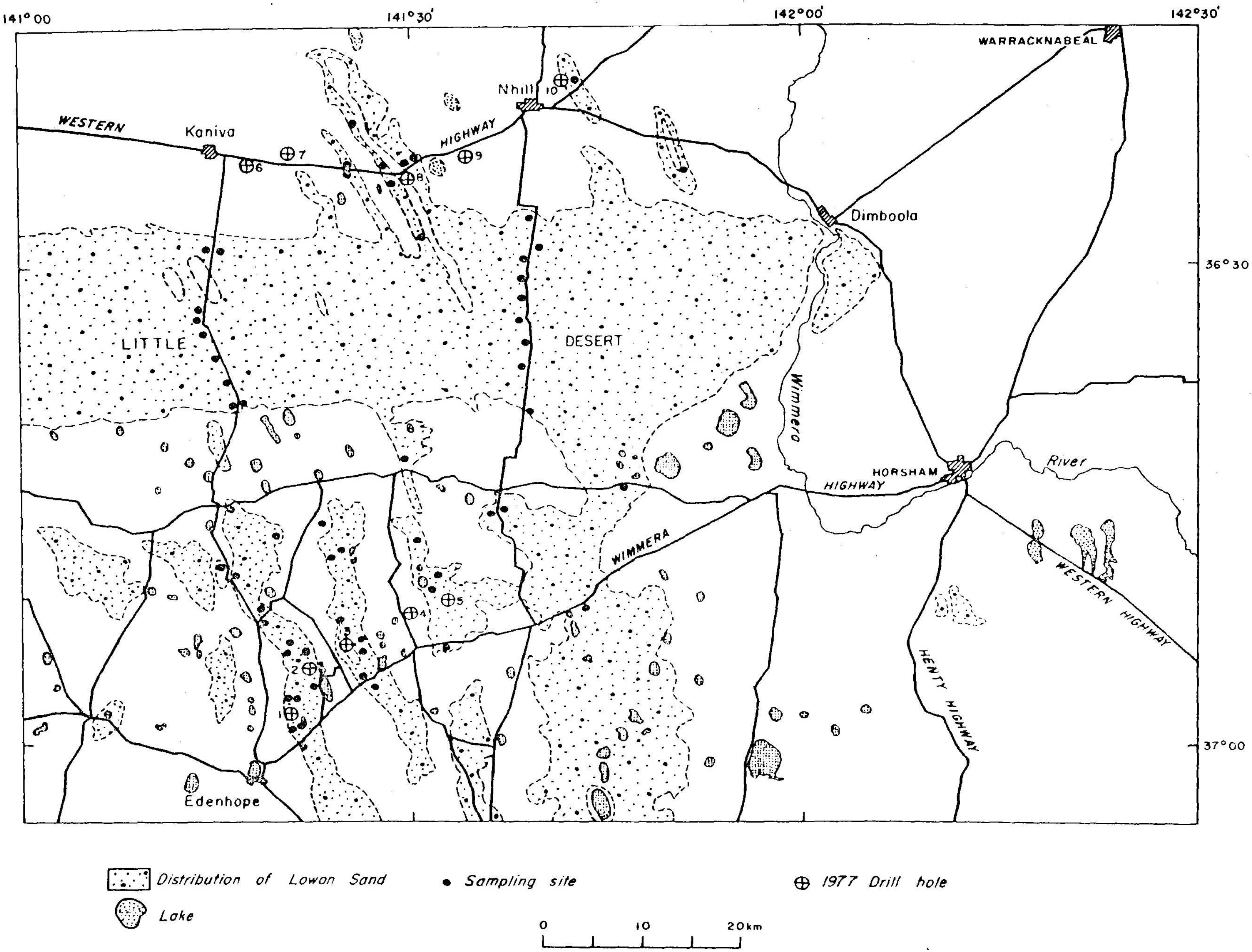


Fig.5 Distribution and location of sampling sites of the Lowan Sand

Mean grainsize, sorting, and other data from 55 samples of the Lowan Sand collected throughout the region (Fig. 5) are shown in Table 4. The sands are medium or medium to fine-grained, fairly well or moderately sorted, and generally strongly to moderately fine skewed. Grains are generally subangular. Contrary to the suggestion of Blackburn et al. (1967), no regional trend in grainsize is apparent within the area sampled.

Woorinen and Coonambidgal Formations

Throughout the region, the lowland areas and inter-ridge corridors are covered by surficial deposits of either the Woorinen or Coonambidgal Formations. Both formations were defined by Lawrence (1966) and consist of clays with minor sandy clay and calcilutite components.

The Coonambidgal Formation occurs south of the Little Desert (Mines Department, 1974) where it is associated with the lakes, swamps, and ephemeral streams of the inter-ridge corridors. It was intersected in hole 4 where it is approximately 12 m thick. In its upper part it consists of olive-black and olive-grey clays, and sandy clays with minor calcilutite components. These are underlain by a sequence of moderately-strongly mottled yellowish grey, dark grey and yellowish orange slightly sandy clays grading into strongly mottled clays at the base. The upper part of the sequence forms part of a lunette, the remainder of the sequence being of probable lacustrine and paludal origin.

The Woorinen Formation occurs in the lowland areas north of the Little Desert where it consists of aeolian clays with minor lacustrine and paludal components (Mines Department, 1974). It was intersected in holes 6, 7, and 9. In hole 6 (4.5 m thick), it consists of brown clays passing into a mottled clay/calcilutite (40/60) zone which is in turn underlain by mottled (light grey, reddish brown, and dark yellowish orange) slightly sandy clays. In hole 7 the formation is 6 m thick and consists of grey clays and mottled (light grey, dusky yellow, and reddish brown) slightly sandy clays. These appear to have been carried onto the ridge by aeolian movement from the adjacent western inter-ridge corridor.

In hole 9 the formation is 12 m thick and consists of 3 m of light grey to yellowish grey clays and calcilutites underlain by a sequence of slightly sandy mottled (light grey, yellowish orange, reddish brown) clays.

In all cases the clays are moderately well differentiated into grey soils of heavy texture similar to those described by Blackburn et al. (1967).

HEAVY MINERALS

The heavy-mineral fraction of the quartz sands and silts, which form much of the Late Cainozoic sequence, has been investigated. This follows a similar study made on the heavy-mineral fraction of the younger, southeastern South Australian, strandline sediments by Colwell (1976). Although the abundance of heavy minerals in the southeastern South Australian sediments was uniformly low, the much higher terrigenous component in the western Victorian sediments substantially increases the likelihood of concentrations of heavy minerals occurring. Disseminated and concentrated heavy minerals have been noted in parts of the Parilla Sand by Lawrence (1966, 1975) and Macumber (1969), attracting some company interest.

Within the sediments intersected by the BMR drilling heavy minerals occur with variable abundance. Concentrations are generally moderately low (less than 0.5 percent total heavies), although in parts of the sequence thin bands and laminae of concentrated heavy mineral occur. None of the concentrations appear to be of potential economic importance. Details are given below.

TABLE 5. AVERAGE COMPOSITION OF HEAVY-MINERAL FRACTIONS

Hole	Cores	No. of samples	Opaques	Brown Tourmaline	Rutile	Zircon	Blue-Green Tourmaline	Andalusite	Others
5	16-19	14	72.3 (7.5)	16.5 (5.6)	4.2 (3.2)	5.2 (4.6)	0.3 (0.3)	0.4 (0.3)	0.6 (0.4)
5	24-26	10	69.1 (4.4)	18.4 (3.6)	3.3 (1.4)	7.1 (3.6)	0.8 (0.3)	0.4 (0.2)	0.5 (0.3)
6	6-11	18	51.3 (6.4)	32.2 (8.4)	3.5 (1.1)	5.9 (4.1)	1.4 (0.5)	2.4 (1.2)	0.7 (0.4)
7	18,19, 20, 28-36	39	66.4 (5.0)	13.2 (6.7)	3.9 (1.0)	12.6 (5.4)	1.0 (0.6)	1.3 (0.7)	1.0 (0.5)
9	25-34	23	70.5 (4.2)	13.0 (6.5)	2.6 (0.8)	9.2 (5.3)	1.1 (0.6)	1.4 (0.8)	0.7 (0.4)

(STANDARD DEVIATION IN PARENTHESES)

HORSHAM 1 : Lowan Sand and Parilla Sand - trace amounts only (less than 0.2 percent).

HORSHAM 2 : Lowan Sand and Parilla Sand - trace amounts only.

HORSHAM 3 : Parilla Sand - trace amounts only.

HORSHAM 4 : Parilla Sand - trace amounts only.

HORSHAM 5 : Lowan Sand - trace amounts only.
Parilla Sand - trace amounts except in cores 18 and 19 (30.8 to 34.9 m) where thin bands and laminae of concentrated heavy minerals occur in medium-grained sands. In this zone heavy-mineral abundances (average over a 30 cm interval of core) range from 0.4 to 5.5 percent by weight, and over the entire 4 metre interval the average abundance is 1.6 percent.

Bookpurnong Beds - numerous thin (2-5 mm thick) laminae of concentrated heavy minerals occur at the top of the brown, clayey, quartz sand - silt sequence (cores 24 and 25, 67.1 to 70.5 m). In this zone heavy-mineral abundances range from 0.6 to 5.6 percent and have an average value over the entire interval of 3.4 percent.

HORSHAM 6 : Parilla Sand - generally low abundances (less than 0.2 percent) except in cores 9 and 10 (14.0 to 17.0 m) where thin laminae and several bands of concentrated heavy minerals occur in fine-grained sands. Within these cores samples taken over a 30 cm interval contain 0.9 to 4.8 percent total heavies. Individual bands (up to 2 cm thick) contain 15 to 20 percent heavy minerals.

HORSHAM 7 : Parilla Sand - low concentrations (generally less than 0.2 percent) except in the lower part of the sequence (cores 31, 32, and 34; intervals 60.0 to 64.0 m, and 68.0 to 69.0 m) where numerous thin bands and laminae of concentrated heavy minerals occur in very fine-grained sands. In this part of the sequence, heavy-mineral concentrations calculated over a 30 cm interval range from 0.1 to 12 percent. The overall average abundance is 1.5 percent. The thin bands (1.3 cm thick) contain up to 20 percent total heavies.

HORSHAM 8 : Parilla Sand - trace amounts only.

HORSHAM 9 : Parilla Sand - generally low concentrations (less than 0.3 percent) except in cores 26 and 30 (intervals 58.5 to 61.0 m, and 65.0 to 67.0 m) where thin laminae of concentrated heavy minerals occur in fine and very fine-grained sands. Abundance ranges up to 2.8 percent.

HORSHAM 10 : Lowan Sand and Parilla Sand - trace amounts only.

Heavy-mineral separations were carried out using standard heavy liquid (bromoform) techniques as outlined by Carver (1971).

The heavy mineral assemblage (determined by 'ribbon' counting of approximately 300 grains in each of 104 samples) remains relatively uniform in all samples examined. It is mineralogically mature and consists of 50 to 70 percent opaques, 10 to 30 percent brown tourmaline, 3 to 5 percent rutile, 5 to 15 percent zircon, 0.5 to 1.5 percent blue-green tourmaline, and 0.5 to 1.0 percent andalusite (Table 5). Other minerals present in very low abundances in some assemblages include garnet, kyanite, staurolite, sillimanite, and monazite. The opaque fraction (examined in reflected light and by XRD) consists predominantly of leucoxene and ilmenite with lesser amounts of magnetite, hematite, and limonite. Zircon and tourmaline grains range from well rounded to euhedral.

Specific sources areas are difficult to identify although sialic igneous (tourmaline, rutile, zircon, monazite, etc), ?mafic igneous (ilmenite), and metamorphic components (andalusite, garnet, etc.) appear to be present. The well rounded nature of many zircon and tourmaline grains suggests a partial multicyclic source.

The mineralogical maturity of the suite may be partly due to the removal of less stable components by weathering and intrastratal solution.

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APPENDIX

LOGS OF THE DRILL HOLES

LEGEND

Quartz sand & sst.

Calcareous sand

Clay – non-calc.

Calcilutite

Shell grit

Quartz granules & pebbles

"Ironstone" pisolites

Bryozoal limestone

Ferruginised layer; ferricrete

Calcrete

Mica

Gl Glauconite

Macrofossils; whole, fragmented

Microfossils

N.B. IN MOST CASES A MIXING OF THE LITHOLOGICAL SYMBOLS HAS BEEN NECESSARY.
GRAINSIZE, SORTING & SHAPE ARE ESTIMATES MADE IN THE FIELD USING A BINOCULAR MICROSCOPE

J54/A/17

HOLE NAME: HORSHAM 1

LAT. 36°58'S	LONG. 141°21'E	RL. 168.3 m	TD. 45.9 m	SPUDDED 10-2-77 / COMPLETED 12-2-77

Columns: DEPTH m | CORE | SECTION | CUTTINGS | GRAPHIC LOG | COLOUR | GRAINSIZE (CLAY, SILT, SAND: VF, F, M, C, VC, GRANULE, PEBBLE) | SORTING | SHAPE (ROUND, S.R., S.A., ANGULAR) | CORING (V SOFT – V HARD) | REMARKS | STRAT. UNIT

Depth (m)	Core	Sections	Colour	Remarks	Strat. unit
0	—	—	5Y 8/1	Aeolian sand	LOWAN SAND
– 1.22	1	1, 2, 3	10R4/6 & 10YR6/6	Strongly mottled Clay 20-25%	
1.22 – 1.84	2	1, 2			
1.84 – 2.44	3	1, 2		Mottled. Clay 15-20%	
2.44 – 3.05	4	1, 2	10R4/6 & (50%) 10YR6/6	Qtz Fe stained	
3.05 – 6.25	5	1–11	10YR 6/6 & 10R 4/6	Trace of [illegible] & [illegible]	
6.25 – 7.60	6	1–5	10YR7/4		
7.60 – 10.67	7	1–10	10YR6/6; 10R4/6; 10YR 6/6; 10R4/6; 5Y7/2; 5Y 7/6	Clay 5-10%	
10.67 – 12.19	8	1–5	5Y7/2		
12.19 – 15.24	9	1–5	5Y7/2	Yellowish grey ~5% clay	PARILLA SAND
15.24 – 16.76	10	1, 2	5Y7/2		
16.76 – 19.81	11	—			
19.81 – 21.34	12	—			
21.34 – 22.86	Cuttings C1		5Y7/2	Loose qtz sands	
22.86 – 24.38	Cuttings C2		5Y7/2		
24.38 –	Cuttings C3				

154/A/19

HOLE NAME HORSHAM 1 (CONT)

LAT.	LONG.	RL	TD	SPUDDED / COMPLETED

DEPTH m	CORE	SECTION	CUTTINGS	COLOUR	REMARKS	STRAT. UNIT
			C3	5Y7/2	Loose yellowish grey qtz sands	PARILLA SAND
25.91			C4			
27.43	13	1		N1	Lignitic clay	
		2				
28.03	14	1?			Micaceous in part (muscovite ?).	
			C5	5Y7/2		
31.09			C6		slightly micaceous	
32.61			C7	5Y7/2		
34.14			C8			
35.66			C9		Sands are clean micaceous in parts	
37.19			C10	5Y7/2		(? LOXTON SANDS)
38.71			C11			
40.24			C12	10YR 6/2		
41.77			C13	5Y 7/2		
43.28	15	1		5GY 4/1	[illegible] colour change	BOOKPURNONG BEDS
		2		G1		
45.00	16			5GY4/1	Glauconitic	
45.87		1				

Column headings: GRAPHIC LOG; GRAINSIZE (CLAY, SILT, SAND: VF, F, M, C, VC, GRANULE, PEBBLE); SORTING; SHAPE; CORING (V. SOFT, V. HARD).

HOLE NAME HORSHAM 2

LAT. 36°56'S	LONG. 141°22'E	AL 173.8 m	TD 57.2 m	SPUDDED 14-2-77 / COMPLETED 16-2-77

DEPTH m	CORE	SECTION	COLOUR	REMARKS	STRAT. UNIT
0.61			N7 5Y8/1	Loose aeolian sand	LOWAN SAND
1.22	1	1	10R4/6 & 5Y7/6 5Y7/2	Strongly mottled, pisolites.	PARILLA SAND
1.83	2	1, 2			
2.44	3	1, 2	10R4/6 & 5Y7/2		
3.05	4	1, 2			
5.94	5	1–10	10R4/6 & 10YR6/6	Mottled. Clay 10-15% [illegible] Trace of [illegible]	
7.62	6	1–5	10YR6/6		
	7				
10.67		1, 2			
12.19	8	1–5	10YR6/6	Clay 10-15%	
	9				
15.24		1			
16.76	10	1–5	10YR6/6; 10YR6/6 & 10YR7/4	Slight mottling. Clay < 5%	
18.29	11	1–5	5Y8/4; 10YR6/6 & 10YR7/4	Grains clear or translucent.	
19.81	12	1, 2	10R7/4 & 5YR7/4		
21.34	13	1–5	10R5/6; 5Y7/2		
22.86	14				
24.38	15	1	5YR4/6	Clay < 5%	
	16		10YR7/4		

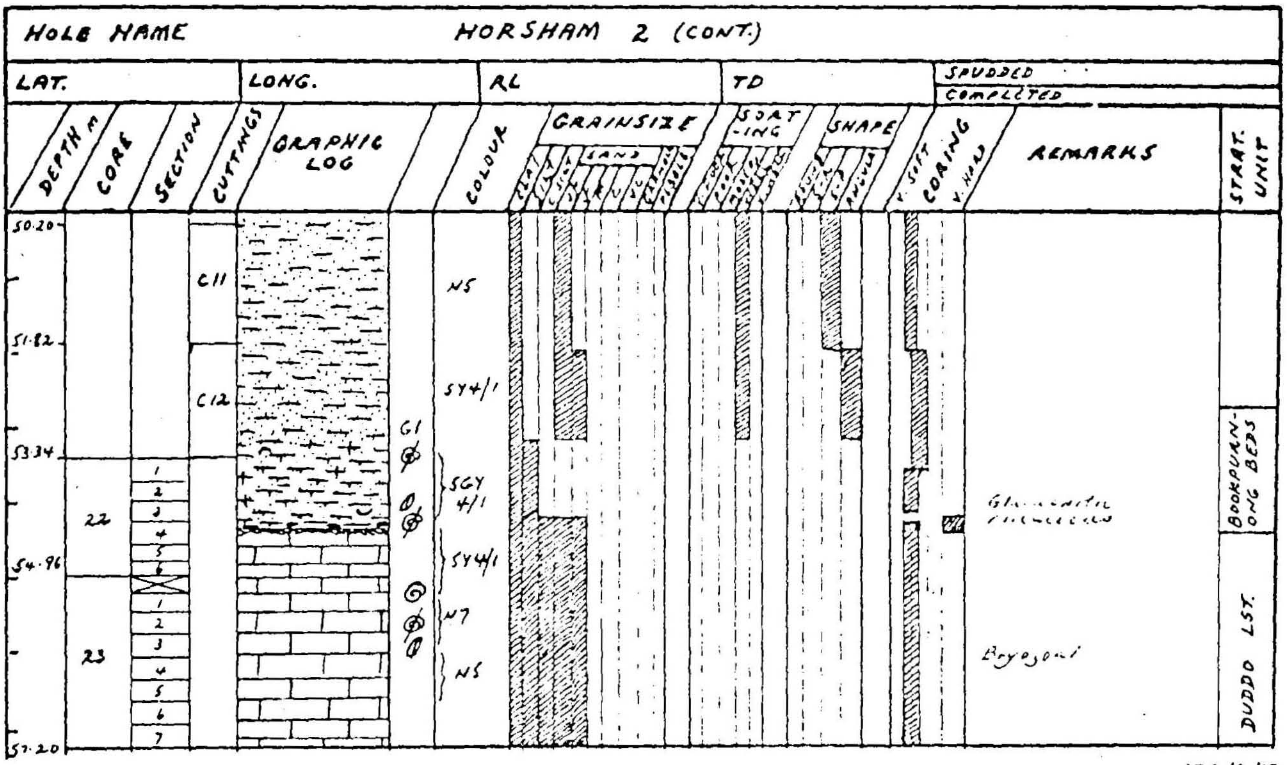
J54/A/19

HOLE NAME HORSHAM 2 (CONT.)

LAT.	LONG.	RL	TD	SPUDDED / COMPLETED

DEPTH m	CORE	SECTION	CUTTINGS	COLOUR	REMARKS	STRAT. UNIT
	16	2, 3, 4		10YR 7/4		PARILLA SAND
25.91	17	1, 2, 3, 4, 5		5Y7/2	Trace of heavies; V. slightly clayey	
27.43	18	1, 2, 3, 4, 5				
28.96	19	1		N7 & 5Y7/2		
30.48	20	1		N7 & 5Y7/2		
32.00	21					
33.53			C1			
35.06			C2	5Y7/2	Qtz grains clear; Clay < 5%	
36.58			C3			
38.10			C4	N4		(? LOXTON SANDS)
39.62			C5	5Y7/2	Slightly micaceous	
41.15	22					
42.67			C6	5Y7/2		
44.20			C7	N5	Clayey 20-25%	
45.75			C8	5Y7/2		
47.24			C9		Slightly micaceous	
48.77			C10	N3	Grey clayey sand	

J54/A/19


HOLE NAME
HORSHAM 2 (CONT.)
LAT.
LONG.
RL
TD
SPUDDED
COMPLETED
DEPTH m
CORE
SECTION
CUTTINGS
GRAPHIC LOG
COLOUR
GRAINSIZE
SAND
SORT-ING
SHAPE
CORING
REMARKS
STRAT. UNIT
50.20
51.82
53.34
54.96
57.20
C11
C12
22
23
N5
5Y4/1
5GY 4/1
5Y4/1
N7
N5
G1
BOOKPURN-ONG BEDS
DUDDO LST.

J54/A/19

HOLE NAME HORSHAM 3

LAT. 36°55'S	LONG. 141°26'E	RL 185.7m	TD 65.5m	SPUDDED 17-2-77 COMPLETED 20-2-77

DEPTH m	CORE	SECTION	CUTTINGS	COLOUR	REMARKS	STRAT. UNIT
0.61	1	1, 2		5Y5/6		
1.22	2	1, 2		5Y6/4 & 5Y7/2		
1.83	3	1, 2		10R4/6 N7 & 5Y6/4		
2.43	4	1, 2				
2.90	5	1, 2			Mottled	
3.50	6	1, 2		N7 & 10R4/6		
4.11	7	1, 2, 3, 4, 5				
5.64	8	1, 2, 3, 4, 5, 6, 7, 8		10YR6/6 & 10R4/6	Slightly clayey	
7.92	9	1, 2, 3, 4		10YR6/6 & 10R4/6	Clay grains iron stained	
10.97	10	1, 2		10YR6/6 & 10R4/6		
12.50	11	1, 2, 3, 4, 5, 6		10YR6/6	Slightly clayey 10% clay	PARILLA SAND
15.54	12					
17.07	13	1				
18.59			C1	10YR6/6		
19.81	14	1, 2, 3		10YR6/6	Trace of heavies	
21.34	15	1, 2, 3		10YR6/6		
22.86	16	1		10YR6/6		
24.38			C2	10YR6/6		

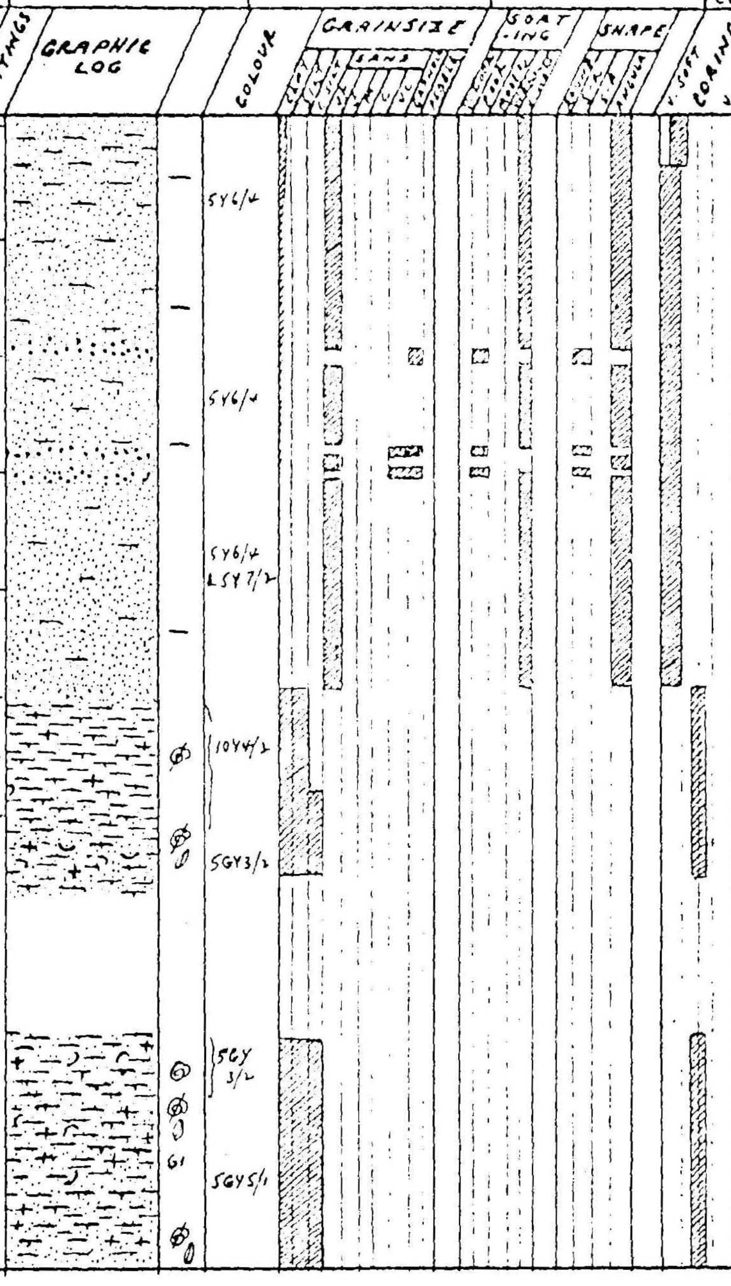
J54/A/20

HOLE NAME	HORSHAM 3 (CONT.)			
LAT.	LONG.	RL	TD	SPUDDED / COMPLETED

DEPTH m	CORE	SECTION	CUTTINGS	GRAPHIC LOG	COLOUR	GRAINSIZE (CLAY, SILT, SAND: VF, F, M, C, VC, GRANULES, PEBBLES)	SORTING	SHAPE	V SOFT / V HARD	CORING	REMARKS	STRAT. UNIT
			C2									PARILLA SAND
25.91			C3									
27.43			C4		10YR6/6						Slightly clayey. Traces of feldspar & [illegible].	
28.95			C5									
30.48			C6		10YR6/6							
32.00			C7									
33.53			C8		10YR6/6							
35.05			C9									
36.58			C10		10YR6/6							
38.10			C11									
39.62			C12		10YR7/6						[illegible] brown [illegible] grading to lighter colour	
41.15			C13		5Y8/4 10YR7/6							
42.67			C14									
44.20			C15		10YR 7/4							
45.72			C16		5Y7/2							
47.24			C17		N2						Black, lignitic?	
48.77			C18		5Y5/6						Clay 30-40% [illegible]	

J54/A/20

HOLE NAME	HORSHAM 3 (CONT.)			
LAT.	LONG.	RL	TD	SPUDDED / COMPLETED



DEPTH m	CORE	SECTION	CUTTINGS	COLOUR	REMARKS	STRAT. UNIT
50.29			C19	5Y6/4	Slightly micaceous & clayey. 20% clay	PARILLA SAND (?LOXTON SANDS)
51.82			C20			
53.34			C21	5Y6/4		
54.86			C22	5Y6/4, 5Y7/2	Slightly micaceous	
56.39			C23			
57.91			C24	10Y4/2	Greyish olive. Marly in parts. Glauconitic? Biogenic earth.	BOOKPURNONG BEDS
59.44	17	1, 2, 3		5GY3/2		
62.48	18	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11		5GY 3/2, G1, 5GY5/1	Glauconitic. Calcilutite 40%. Arenite Qtz 65%, Carb. 35%. Shells, forams, bryozoa	
65.53						

HOLE NAME	HORSHAM 4				
LAT. 36°53'S	LONG. 141°30'E	RL 166.4 m	TD: 50.0 m	SPUDDED 21-2-77	COMPLETED 24-2-77

DEPTH m	CORE	SECTION	CUTTINGS	COLOUR	REMARKS	STRAT. UNIT
0.61				5Y2/1		COONAMBIDGAL FORMATION
1.22	1	1, 2				
1.83	2	1, 2		5Y6/1		
2.44	3	1, 2				
3.05	4	1, 2		N8; 5Y6/1	Increase in calcite matrix	
6.10	5	1, 2, 3, 4, 5, 6, 7, 8, 9, 10		5Y7/1 & 10YR6/6; 5Y7/1 & N8	Some mottling	
7.62	6	1, 2, 3, 4, 5		5Y6/1 & 10YR6/6; 5Y6/1		
8.84	7	1, 2, 3, 4		5Y8/1; 5Y6/1	Calcrete layer	
11.58	8	1, 2, 3, 4, 5, 6, 7, 8, 9		10YR6/6 & 5Y6/1; 10YR6/6 & 5Y8/1	Mottled; Strongly mottled	
14.63	9	1				PARILLA SAND
16.74	10					
19.81			C1	5Y8/1	Loose qtz sands. Only v. minor Fe staining on grains; Trace of feldspar & kaolinite	
21.34			C2	5Y7/1		
22.86			C3			
24.38			C4	5Y7/1		

J54/A/21

HOLE NAME HORSHAM 4 (CONT.)

LAT.	LONG.	RL	TD	SPUDDED / COMPLETED

DEPTH m | CORE | SECTION | CUTTINGS | GRAPHIC LOG | COLOUR | GRAINSIZE (SAND) | SORTING | SHAPE | COHESION (V SOFT – V HARD) | REMARKS | STRAT. UNIT

DEPTH m	CORE	SECTION	CUTTINGS	COLOUR	REMARKS	STRAT. UNIT
			C5			PARILLA SAND
25.91			C6	5Y7/1	Trace of leaves	
27.43			C7			
28.96			C8			
30.48			C9			
32.00			C10	5Y8/2		
33.53			C11			
35.05	11	1–8		5Y4/4	Qtz 70% Carb with Shelly in parts Slightly micaceous & glauconitic. Clay ~20%	BOOKPURNONG BEDS
38.10	12	1–3		5Y4/4		
39.62	13	1–6		5Y4/4; G1 N1	20% carb. Some calcilutite Micaceous	
42.67	14	1–5		5Y4/4; N1; N1		
44.20	15	1–5		N4	Extremely micaceous in parts Glauconitic Strongly reduced	
45.75	16	1–9		10Y4/2; G1; 5GY3/2	Slightly micaceous Calcareous, glauconitic. 90% Sand ~60% Qtz, 40% Carb. Shell fragments Some diatoms, sponge spicules, coral bryozoa, minor forams etc	
48.46	17			5Y3/2		

J54/A/21

HOLE NAME: HORSHAM 5

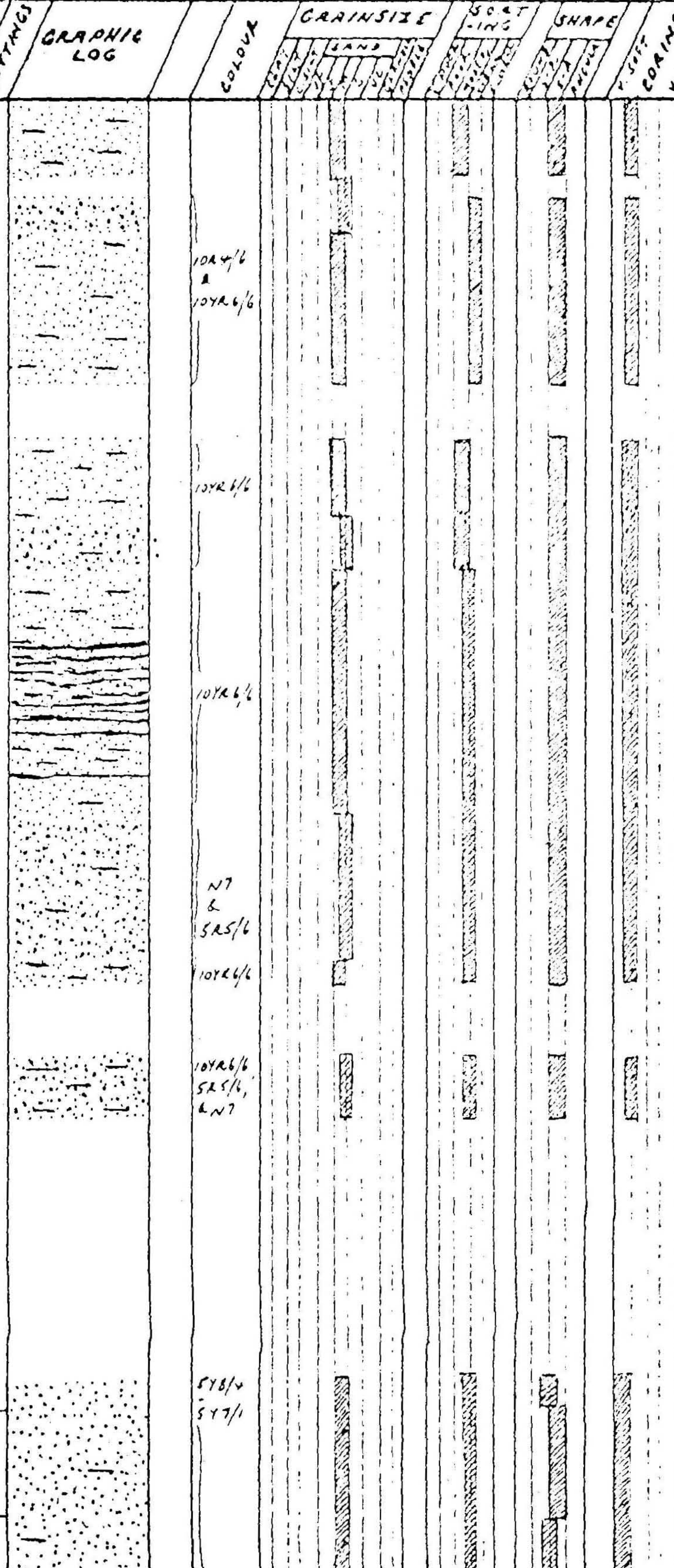
LAT. 36° 52'S	LONG. 141° 35'E	RL 198.2 m	TD 79.2 m	SPUDDED 24-2-77 / COMPLETED 28-2-77

DEPTH m	CORE	SECTION	COLOUR	REMARKS	STRAT. UNIT
0.61			5Y7/2		LOWAN SAND
1.22	1	1, 2	5Y7/2 & 5YR5/6	Well cemented (silcrete) Minor mottling, minor silcrete	PARILLA SAND
1.83	2	1, 2			
2.28	3	1, 2	10YR6/6 / 5YR5/6		
2.89	4	1, 2	N7 & 10R4/6		
3.50	5	1, 2			
4.88	6	1, 2, 3, 4, 5	10R4/6 10YR6/6 & N7	Mottled. 50% clay	
7.12	7	1, 2, 3, 4, 5, 6, 7	10YR6/6 & 10R4/6	Strongly mottled clayey 20-30%	
9.45	8	1, 2, 3, 4	10YR6/6 & 10R4/6	Mottled, 15% clay Trace of kaolinised feldspar	
12.50	9	1, 2, 3, 4	10R4/6 & 10YR6/6	V minor mottling clay content ~20%	
15.54	10	1, 2, 3, 4, 5, 6, 7	10R4/6; 10YR6/6 & 10R4/6		
17.07	11				
20.12	12	1, 2, 3, 4, 5, 6, 7	10R4/6 & 10YR6/6	Mottled, slightly clayey. Grains iron stained - coated	
21.64	13	1, 2			
24.69	14	1, 2, 3, 4, 5, 6, 7, 8	10R4/6 & 10YR6/6	Slightly clayey 10-15%	

J54/A/22

HOLE NAME	HORSHAM 5 (CONT.)			
LAT.	LONG.	RL	TD	SPUDDED / COMPLETED

DEPTH m	CORE	SECTION	CUTTINGS	COLOUR	REMARKS	STRAT. UNIT
	15	1, 2, 3, 4				
26.21	16	1, 2, 3, 4, 5, 6, 7, 8, 9		10R 4/6 & 10YR 6/6	Slightly clayey (10%)	
29.26	17	1, 2, 3		10YR 6/6		
30.78	18	1, 2, 3, 4				
31.85	19	1, 2, 3, 4, 5, 6, 7, 8, 9, 10		10YR 6/6	Thin laminae and bands of concentrated heavy minerals	
34.90	20	1, 2, 3, 4, 5, 6, 7, 8, 9, 10		N7 & 5R 5/6; 10YR 6/6	Marked colour change. No iron oxides → grains clean	PARILLA SAND
37.95	21	1, 2, 3		10YR 6/6, 5R 5/6, & N7		
39.93	22					
40.84	23	1		5Y 8/4 – 5Y 7/1	Clean qtz sands clay << 5%	
44.20			C1			
45.72			C2	10YR 7/4		
47.24			C3			
48.77			C4			



J54/A/22

HOLE NAME: HORSHAM 5 (CONT.)

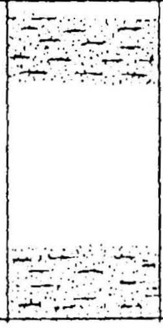
LAT.	LONG.	RL	TD	SPUDDED / COMPLETED

DEPTH m	CORE	SECTION	CUTTINGS	COLOUR	REMARKS	STRAT. UNIT
50.29			C5			PARILLA SAND
51.82			C6		Clean	
53.34			C7			
54.86			C8	10YR7/4		
56.39			C9			
57.91			C10			
59.44			C11	10YR7/4		
60.96			C12			
62.48			C13			? BOOKPURNONG BEDS
64.01			C14	10R5/6		
65.53			C15		"Ironstone" ferri-crete band	
67.06	24	1, 2, 3, 4, 5, 6, 7		5Y4/4 - 5Y5/6		
69.19	25	1, 2, 3, 4, 5, 6, 7, 8, 9			many thin laminae of contorted heavy minerals; Clayey sand-stones	
71.78	26	1, 2, 3, 4, 5, 6		5Y5/6	Very slightly mica-ceous	
7?.06						

Column headings: GRAPHIC LOG; GRAINSIZE (CLAY, SILT, SAND); SORTING; SHAPE; V. SOFT – CORING – V. HARD

J54/A/22

HOLE NAME	HORSHAM 5 (CONT.)			
LAT.	LONG.	RL	TD	SPUDDED / COMPLETED

DEPTH m	CORE	SECTION	CUTTINGS	GRAPHIC LOG	COLOUR	GRAINSIZE (CLAY, SILT, SAND, GRAVEL)	SORTING	SHAPE	CORING (V. SOFT – V. HARD)	REMARKS	STRAT. UNIT
	27	1, 2, 3			5Y5/6					Olive brown clayey sand - silts	?BOOKPURNONG BEDS
76.20											
	28	1, 2, 3			5Y5/6						
79.25											

J54/A/22

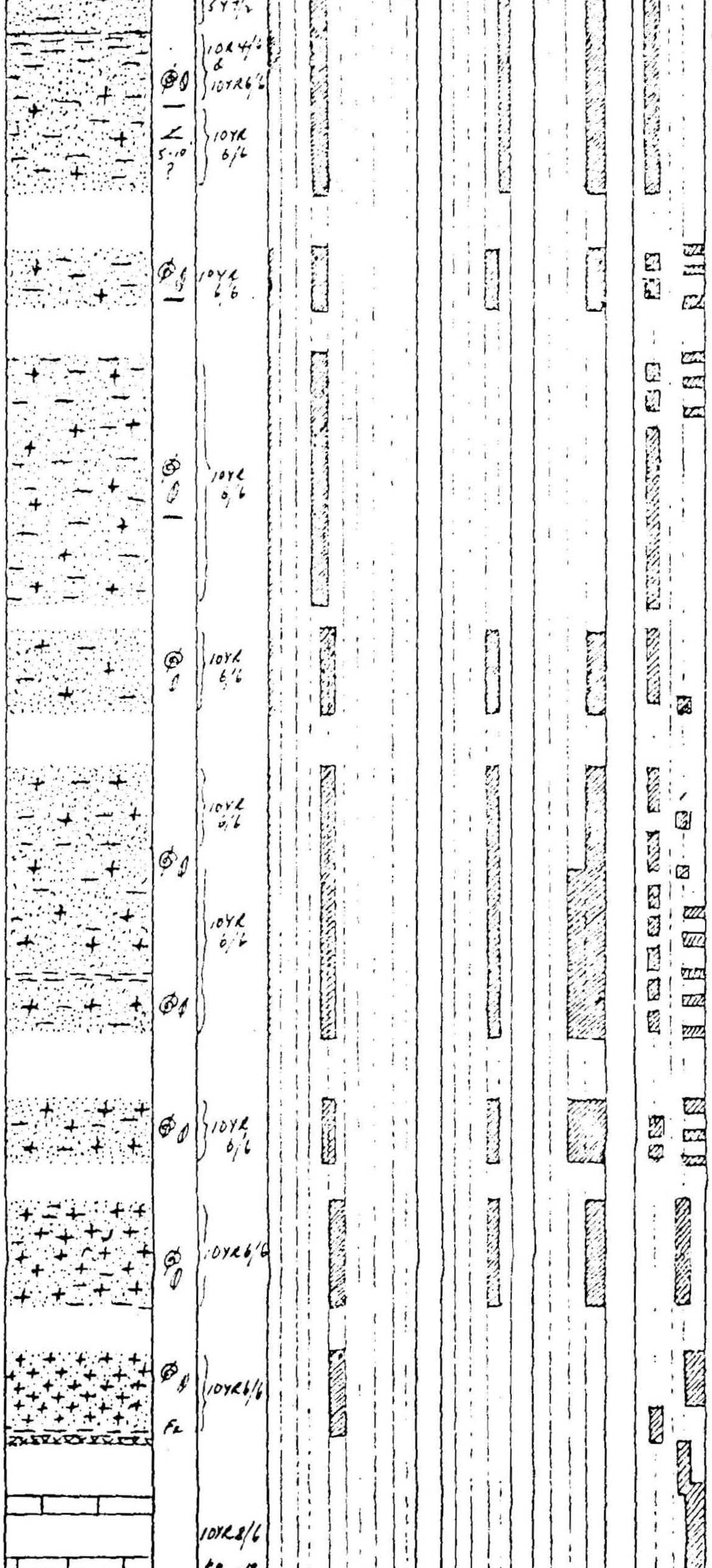
HOLE NAME	HORSHAM 6			
LAT. 36°24'S	LONG. 141°17'E	RL 123.6 m	TD 48.3 m	SPUDDED 11-3-77 / COMPLETED 16-3-77

CORE	SECTIONS	COLOUR	REMARKS	STRAT. UNIT
1	1–2	5YR4/4		WOORINEN FM.
2	1–2	5YR4/4 & N5	Calcilutite 60% of Clay. Mottled	WOORINEN FM.
3	1–2	10YR7/4 & N7		WOORINEN FM.
4	1–2			WOORINEN FM.
5	1–10	10YR6/6 & N7; 10YR7/6; 10YR6/6 & N7	Mottled; Clay 15-20%	WOORINEN FM.
6	1–2	N7 & 10YR6/6	Mottled, v. slightly clayey. Some kaolin, traces of feldspar	PARILLA SAND
7	1–8	N7; 10YR 6/6		PARILLA SAND
8	1–7	N7	Soft, light grey. Clay matrix 10-15%. Qtz grains - clear, angular	PARILLA SAND
9	1–5	10YR 6/6; 5Y7/2	Thin bands and laminae of conc. heavy mineral. Up to 2 cm thick	PARILLA SAND
10	1–3	10YR4/6; N7		PARILLA SAND
11	1	N7	Trace only of kaolin	PARILLA SAND
12				PARILLA SAND
13	1–3	N7	Clay <15%	PARILLA SAND
14	1–5	5Y7/2	Flat bedding	PARILLA SAND
15	1			PARILLA SAND

J54/A/23

HOLE NAME HORSHAM 6 (CONT.)

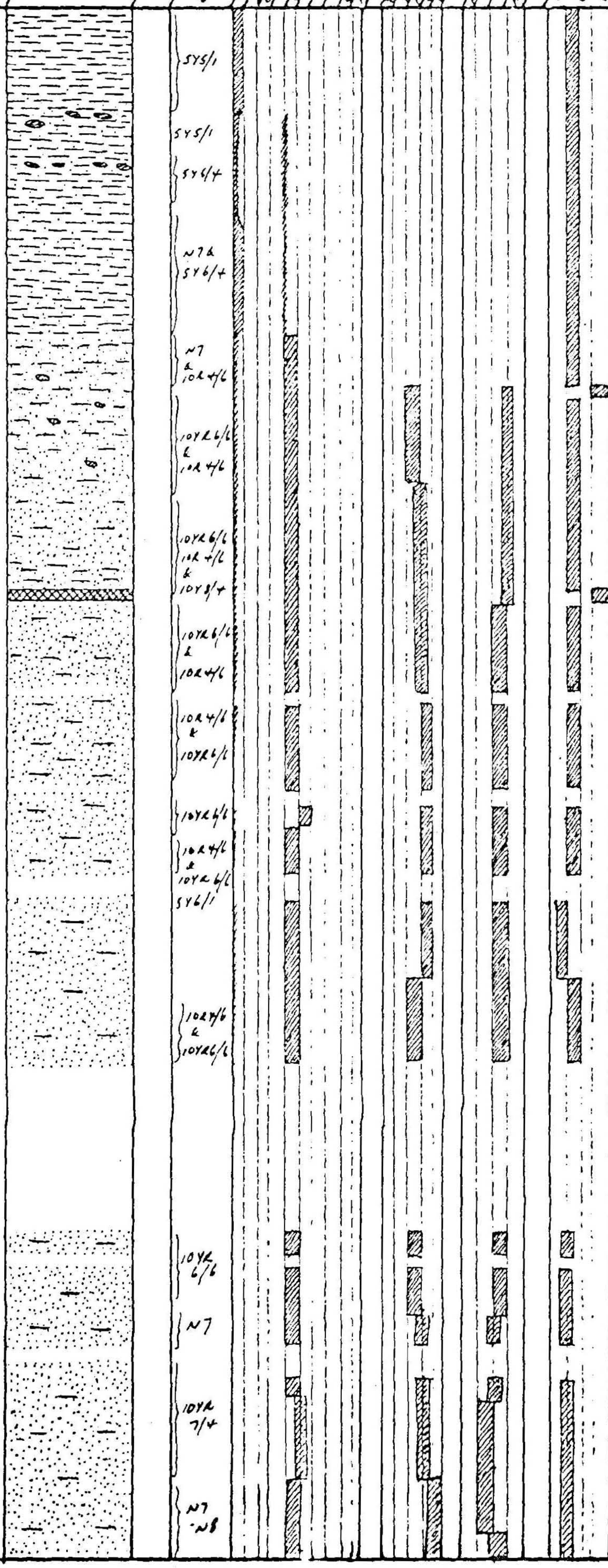
LAT.	LONG.	RL	TD	SPUDDED / COMPLETED



DEPTH m	CORE	SECTION	CUTTINGS	COLOUR	REMARKS	STRAT. UNIT
	15	2, 3, 4, 5, 6		5Y 7/2	Marked colour change	P.S.
26.21	16	1, 2, 3, 4, 5, 6		10R 4/6 & 10YR 6/6; 10YR 6/6	Mottling. Iron oxides & matrix ~15%. Bryozoic & Indeterm. carb. Qtz 30%	BOOKPURNONG BEDS
28.04	17	X, 1, 2, 3		10YR 6/6	Alternating hard & soft layers. Well cemented - calcite	
29.72	18	X, 1, 2				
30.78	19	1, 2, 3, 4, 5, 6, 7, 8, 9, 10		10YR 6/6	Clay matrix 20-25%. Detrital: Qtz 50%, Carb 20%. V. slightly micaceous. Trace of Kaolinite. Grains iron-oxide stained - coated	
33.83	20	X, 1, 2, 3, 4		10YR 6/6		
35.36	21	X, 1, 2, 3, 4, 5		10YR 6/6		
37.19	22	1, 2, 3, 4, 5, 6, 7, 8		10YR 6/6	Alternating cemented and uncemented layers	
39.79	23	X, 1, 2, 3		10YR 6/6	Qtz 70%. Bryozoic carb 30%	
41.60	24	X, 1, 2, 3, 4, 5		10YR 6/6		
43.59	25	X, 1, 2, 3, 4		10YR 6/6	Bioclastic carb. ~70%. Forams, bryozoa, broken shells etc.	
45.41	26	X, 1				DUDDO LMST.
46.48	27	X, 1, 2, 3, 4		10YR 8/6 to N9	Bryozoal limestone	
48.31						

HOLE NAME	HORSHAM 7			
LAT. 36° 23'S	LONG. 141° 21'E	RL 159.4m	TD 85.6m	SPUDDED 5-3-77 / COMPLETED 10-3-77

DEPTH m	CORE	SECTION	CUTTINGS	GRAPHIC LOG	COLOUR	GRAINSIZE (CLAY, SILT, SAND: VF, F, M, C, VC, GRANULE, PEBBLE)	SORTING	SHAPE	CORING (V. SOFT – V. HARD)	REMARKS	STRAT. UNIT
0.61					5Y5/1					Loamy soil	WOORINEN FORMATION
1.22	1	1, 2									
1.83	2	1, 2			5Y5/1					Ironstone pisolitic pebbles	
2.03	3	1									
2.44	4	1, 2			5Y6/4						
3.05	5	1, 2									
3.35	6				N7 & 5Y6/4					Mottled	
	7	1–10			N7 & 10R4/6						
6.40	8	1–5			10YR6/6 & 10R4/6					Strongly mottled	
7.62	9	1–10			10YR6/6, 10R4/6 & 10Y8/4; 10YR6/6 & 10R4/6						PARILLA SAND
10.97	10	1–5			10R4/6 & 10YR6/6						
12.50	11	1–4			10YR6/6; 10R4/6 & 10YR6/6; 5Y6/1					Clay <10%	
14.02	12	1–9			10R4/6 & 10YR6/6					Mottled	
17.07	13										
20.12	14	1–5			10YR 6/6; N7					Qtz grains iron-stained-coated. Mottled colour change	
21.64	15	1–10			10YR 7/4; N7-N8					Clean. Grains are clear. Trace of feldspar & heavies	
24.69											



HOLE NAME	HORSHAM 7 (CONT.)			
LAT.	LONG.	RL	TD	SPUDDED / COMPLETED

DEPTH m	CORE	SECTION	COLOUR	REMARKS	STRAT. UNIT
	16	1–8	N7 - N8	Clean qtz sands	
27.74	17	1–4	N7-N8		
30.78	18	1–10			
33.83	19	1–5	N7 to 5Y8/1 10R7/4		
35.36	20	1–8	5YR7/2 N7 & 5Y8/1	Clean qtz sands Some heavies	PARILLA SAND
38.40	21	1			
39.93	22	1	5Y8/4		
40.84	23				
43.89	24	1–7	10R 7/4; 5Y6/4		
46.17	25	1, 2	5Y8/4		
47.39	26	1	5Y8/4		
49.07	27				

Column headings: DEPTH m, CORE, SECTION, CUTTINGS, GRAPHIC LOG, COLOUR, GRAINSIZE (CLAY, SILT, SAND: VF, F, M, C, VC, GRANULE, PEBBLE), SORTING, SHAPE, V. SOFT – CORING – V. HARD, REMARKS, STRAT. UNIT

J54/A/24

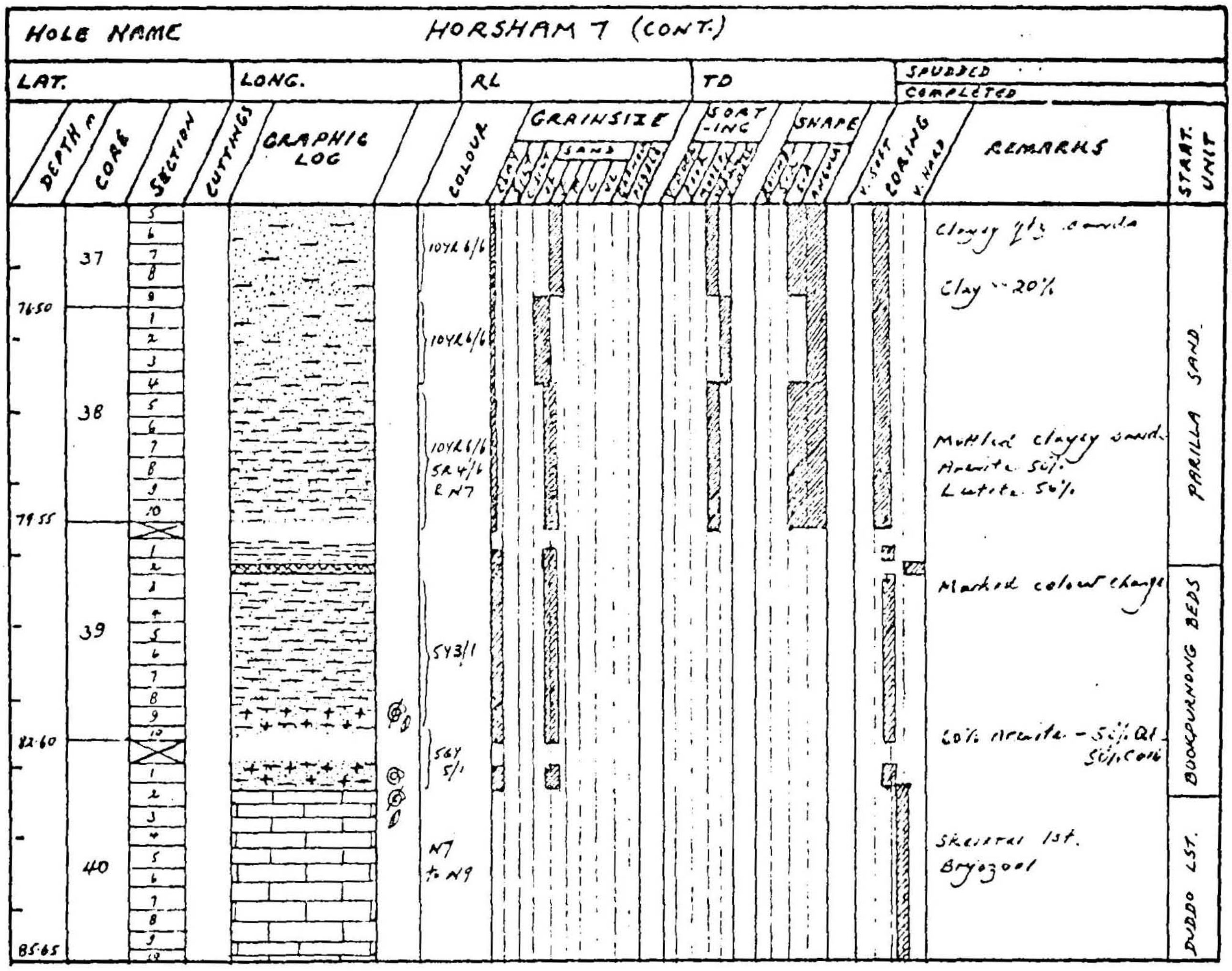
HOLE NAME: HORSHAM 7 (CONT.)

LAT.	LONG.	RL	TD	SPUDDED / COMPLETED

DEPTH m	CORE	SECTION	COLOUR	REMARKS	STRAT. UNIT
52.43	27	1–5	5Y8/4	Clean qtz sands	PARILLA SAND
53.64	28	1–4	5YR7/1		
56.69	29	1–10		Matrix 5-10% Some gravel Trace of feldspar Qtz grains - equant clear	
59.74	30	1–10	5Y7/2 to 5YR7/1		
62.79	31	1–8	5Y8/1 10YR7/4 N7 10YR 7/6	Colour more pronounced downwards Thin bands and laminae of conc. heavy minerals	
65.23	32	1–8	5Y7/6	Very slightly micaceous. Yellow - reddish brown	
67.36	33	1–5	5Y7/6 5Y8/1 10YR6/6 & 5YR 5/6		
70.41	34	1–10	5Y7/1 5YR4/4 5Y7/2 5Y6/4	CASTS Weathered (paleosol) profile Shell casts Heavy minerals	
71.63	35	1–4	5YR 4/4	Few little clasts of grey clay.	
73.76	36	1–4	5YR 4/4	CASTS Weathered profile Paleosol.	
	37	1–4	10YR 6/6		

Column headings: DEPTH m, CORE, SECTION, CUTTINGS, GRAPHIC LOG, COLOUR, GRAINSIZE (CLAY, SILT, SAND: VF, F, M, C, VC, GRANULE, PEBBLE), SORTING, SHAPE, CORING (V. SOFT – V. HARD), REMARKS, STRAT. UNIT

J54/A/24


HOLE NAME
HORSHAM 7 (CONT.)
LAT.
LONG.
RL
TD
SPUDDED
COMPLETED
DEPTH m
CORE
SECTION
CUTTINGS
GRAPHIC LOG
COLOUR
GRAINSIZE
SAND
SORT-ING
SHAPE
V. SOFT
CORING
V. HARD
REMARKS
STRAT. UNIT
76.50
79.55
82.60
85.65
37
38
39
40
10YR 6/6
10YR 6/6
10YR 6/6
5R 4/6
& N7
5Y3/1
5GY 5/1
N7 to N9
Clay ~ 20%
Mottled clayey sand.
Arenite 50%
Lutite 50%
Marked colour change
60% Arenite - 50% Qtz
50% Carb
Skeletal lst.
Bryozoal
PARILLA SAND
BOOKPURNONG BEDS
DUDDO LST.

J54/A/24

HOLE NAME HORSHAM 8

LAT. 36° 25' S | LONG. 141° 29' E | RL 205.3m | TD 85.3m | SPUDDED 17.3.77 | COMPLETED 22.3.77

DEPTH m	CORE	SECTION	CUTTINGS	COLOUR	REMARKS	STRAT. UNIT
0.51						
1.22	1	1, 2		10YR6/6 & 10R 4/6	Clayey, strongly mottled	
1.83	2	1, 2				
2.13	3	1				
2.74	4	1, 2		10R 4/6 & 10YR6/6		
3.35	5	1, 2				
4.27	6	1, 2		10YR 6/6 & 10R 4/6	Clay ~ 15%	
5.79	7					
7.92			C1	10R 4/6 & 10YR6/6		
9.45	8	1, 2, 3, 4		10YR 6/6 - 5YR5/6 & 10R 4/6	Mottled.	
9.90	9	1, 2				
	10					
12.50		1, 2		10YR 6/6	Grains iron-oxide stained-coated	PARILLA SAND
13.41	11	1, 2, 3		10R 4/6 & 10YR 6/6	Trace of heavies Typical mottling Clay ~ 15%	
16.76	12	1, 2, 3, 4, 5, 6, 7, 8, 9, 10		10YR6/6 & 10R4/6; 10R 4/6		
19.81	13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10		10R 4/6		
	14	1		10R 4/6 & 10YR6/6		
22.86		2				
	15			10R 4/6		

J54/A/25

HOLE NAME	HORSHAM 8 (CONT.)				
LAT.	LONG.	RL	TD	SPUDDED	COMPLETED

DEPTH m	CORE	SECTION	CUTTINGS	COLOUR	REMARKS	STRAT. UNIT
	15	2, 3, 4		10R4/6	Slightly clayey < 10% Trace only of heavies	
25.91	16	1				
28.86	17					
30.78		1	C2	10R 4/6		
32.31	18	1, 2, 3, 4		10R4/6 & 10YR6/6		
33.83			C3			
34.75	19	1, 2		10R4/6 5YR5/6		
35.36	20	1, 2, 3		10R4/6 - 5YR5/6	Clay matrix 5-10% Trace of heavies & feldspar	PARILLA SAND
36.88			C4			
38.40	21	1, 2, 2		5YR5/6		
39.93			C5			
41.45	22	1, 2		5YR5/6 10R4/6		
42.98	23	1		10YR 6/6		
44.50	24	1, 2, 3, 4, 5, 6		10YR 6/6 5YR5/6		
46.23	25	1, 2, 3, 4, 5		5YR5/6 10R4/6	Clay matrix < 10%	
47.67	26	1, 2		5Y8/1	Marked colour chang	

GRAPHIC LOG — GRAINSIZE (CLAY, SILT, SAND: VF, F, M, C, VC, GRANULE, PEBBLE) — SORTING — SHAPE — CORING (V. SOFT, V. HARD)

HOLE NAME	HORSHAM 8 (CONT.)			
LAT.	LONG.	RL	TD	SPUDDED / COMPLETED

DEPTH m	CORE	SECTION	CUTTINGS	GRAPHIC LOG	COLOUR	GRAINSIZE (CLAY, SILT, SAND, GRAVEL)	SORTING	SHAPE	CORING (V. SOFT – V. HARD)	REMARKS	STRAT. UNIT
	26	4, 5, 6, 7, 8			5Y8/1					Clean – no iron oxide stains on grains	
51.51	27										
53.64	28	1			10YR 6/6					Colour change. Increase in matrix. Iron oxides present	
54.25	29										
57.30			C6								
58.83			C7		10YR6/6						
60.35			C8								
61.87	30	1, 2, 3, 4, 5, 6, 7, 8, 9			10YR 7/4					Matrix < 5%. Relatively clean. Grains are equant. Trace only of heavies	PARILLA SAND
64.92	31	1, 2, 3, 4, 5, 6, 7			10YR6/6 – 10R6/6						
67.06	32	1, 2, 3, 4			10YR 6/6					Matrix 10–15%	
68.27	33	1, 2, 3, 4, 5, 6, 7			10YR6/6 – 10R 7/6					Iron oxide cement + clay. Increasing colour down core	
71.32	34	1, 2, 3, 4, 5, 6, 7			10YR 6/6 – 5YR 5/1 – 5Y8/1					Matrix – clay + iron oxides < 10%	
74.37	35	1									

J54/A/25

HOLE NAME	HORSHAM 8 (CONT.)			
LAT.	LONG.	RL	TD	SPUDDED / COMPLETED

DEPTH m	CORE	SECTION	CUTTINGS	GRAPHIC LOG	COLOUR	GRAINSIZE (CLAY, SILT, C.SILT, SAND: VF, F, M, C, VC, GRANULE, PEBBLE)	SORTING	SHAPE	CORING (V. SOFT – V. HARD)	REMARKS	STRAT. UNIT
	35	2, 3, 4, 5			10YR 6/6 & 5Y 7/6						
76.20	36	1, 2, 3			5Y 8/4					Clean · matrix ~ 5%	
79.25	37										PARILLA SAND
80.70	38									LOST CIRCULATION	
83.82	39	1, 2			5Y 8/4					Hole collapsing-in	
85.34											

J54/A/25

HOLE NAME	HORSHAM 9			
LAT. 36° 24'S	LONG. 141° 33'E	RL 151.6 m	TD 92.6 m	SPUDDED 23-3-77 COMPLETED 28-3-77

DEPTH m	CORE	SECTION	COLOUR	REMARKS	STRAT. UNIT
			5Y 2/1		
1.22	1	1	5Y 8/1	40% calcilutite 40% lutite 20% arenite	WOORINEN FORMATION
1.83	2	1	N9		
2.44	3	1	N9 & 5YR 6/1		
3.05	4	1, 2	5Y 6/1 & 5YR 6/4	Mottled. Sand ~15%	
4.57	5	1, 2	5Y 6/1 & 5YR 6/4	Mottled clays Sand ~10%	
7.62	6	1, 2, 3, 4, 5, 6, 7	N7, 10YR 4/6 & 10YR 6/6 N7 10R 4/6 N7, 10YR 6/6 & 10R 4/6		
8.23	7	1, 2			
10.67	8	1, 2, 3, 4, 5, 6, 7	N7 & 10YR 4/6 N9 N7 & 10YR 6/6	Slightly mottled	
12.19	9	1, 2, 3, 4, 5	N7 & 10YR 6/6	Sand ~15%	
15.24	10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	N7 - N9 (10YR 6/6)	Clay ~20% Trace of feldspar & heavies	PARILLA SAND
16.76	11				
19.81	12	1, 2, 3, 4	N8 (10YR 6/6)	Clay 20-25% Grains - clear & opaque	
21.34	13				
24.38	14	1, 2, 3	N8		

J54/A/26

HOLE NAME HORSHAM 9 (CONT.)

LAT.	LONG.	RL	TD	SPUDDED / COMPLETED

DEPTH m	CORE	SECTION	CUTTINGS	COLOUR	REMARKS	STRAT. UNIT
27.43	15	1, 2, 3, 4		N8 (10YR6/3)		PARILLA SAND
30.48	16	1, 2, 3, 4		10YR6/6 & 5Y8/1; 10YR6/6 & 10R4/6	Marked colour change. Iron staining, mottling	
33.53	17	1		10YR6/6		
36.58	17A					
39.62	18	1		5Y8/1		
42.67	19	1, 2				
44.20			C1			
45.72			C2	5Y8/1	Clean. Matrix 5%.	
47.24			C3			
48.77	20	1		5Y8/1		
	21	1, 2, 3, 4		N7 5Y8/1	Slightly clayey (15%) Slightly micaceous	

Column headings: GRAINSIZE (CLAY, SILT, SAND: VF, F, M, C, VC, GRANULE, PEBBLE); SORTING; SHAPE; CORING (V. SOFT – V. HARD)

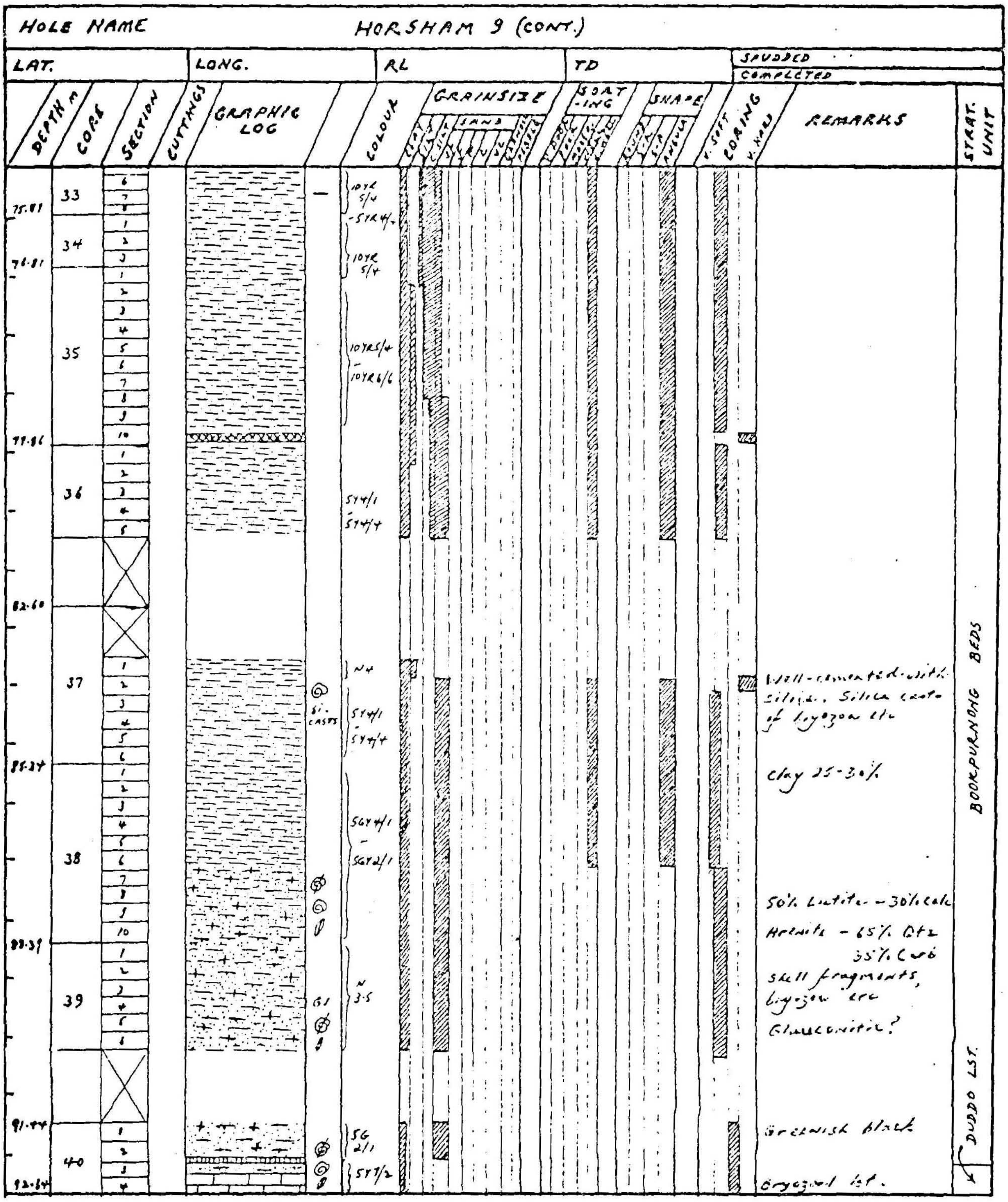
J54/A/26

HOLE NAME	HORSHAM 9 (CONT.)			
LAT.	LONG.	RL	TD	SPUDDED / COMPLETED

DEPTH m	CORE	SECTION	COLOUR	REMARKS	STRAT. UNIT
	21	5, 6, 7, 8	N7 - 5Y8/1	Slightly clayey & micaceous	PARILLA SAND
51.21	22				PARILLA SAND
53.03	23	1	5Y8/1	Most qtz grains are equant & clear	PARILLA SAND
53.64	24				PARILLA SAND
56.69	25	1, 2, 3	5Y8/1	Trace only of heavies	PARILLA SAND
57.91	26	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	10YR7/4 - 10YR6/6	Slightly micaceous - muscovite & biotite. Thin laminae of heavy minerals	PARILLA SAND
60.96	27	1		H.M. suite: Opaques P, Leucoxene C, Zircon C, Rutile C, + others	PARILLA SAND
62.48	28	1, 2, 3, 4, 5, 6	10YR 7/4; N7		PARILLA SAND
64.62	29	1, 2, 3, 4, 5, 6	N7 (10YR6/6)	Qtz grains clear	PARILLA SAND
67.07	30	1, 2, 3, 4, 5, 6	5Y7/2; 10R5/6	Slightly micaceous	PARILLA SAND
70.10	31	1, 2	5Y7/2		PARILLA SAND
71.63	32	1, 2, 3, 4	N7 - 5Y7/2; 5YR 4/4	Mottled colour change	PARILLA SAND / BOOKPURNONG BEDS
73.45	33	1, 2, 3, 4	10YR 5/4		BOOKPURNONG BEDS

Columns: DEPTH m, CORE, SECTION, CUTTINGS, GRAPHIC LOG, COLOUR, GRAINSIZE (CLAY, SILT, SAND: V. FINE, FINE, MED, COARSE, V. COARSE, GRAVEL), SORTING, SHAPE, CORING (V. SOFT – V. HARD), REMARKS, STRAT. UNIT

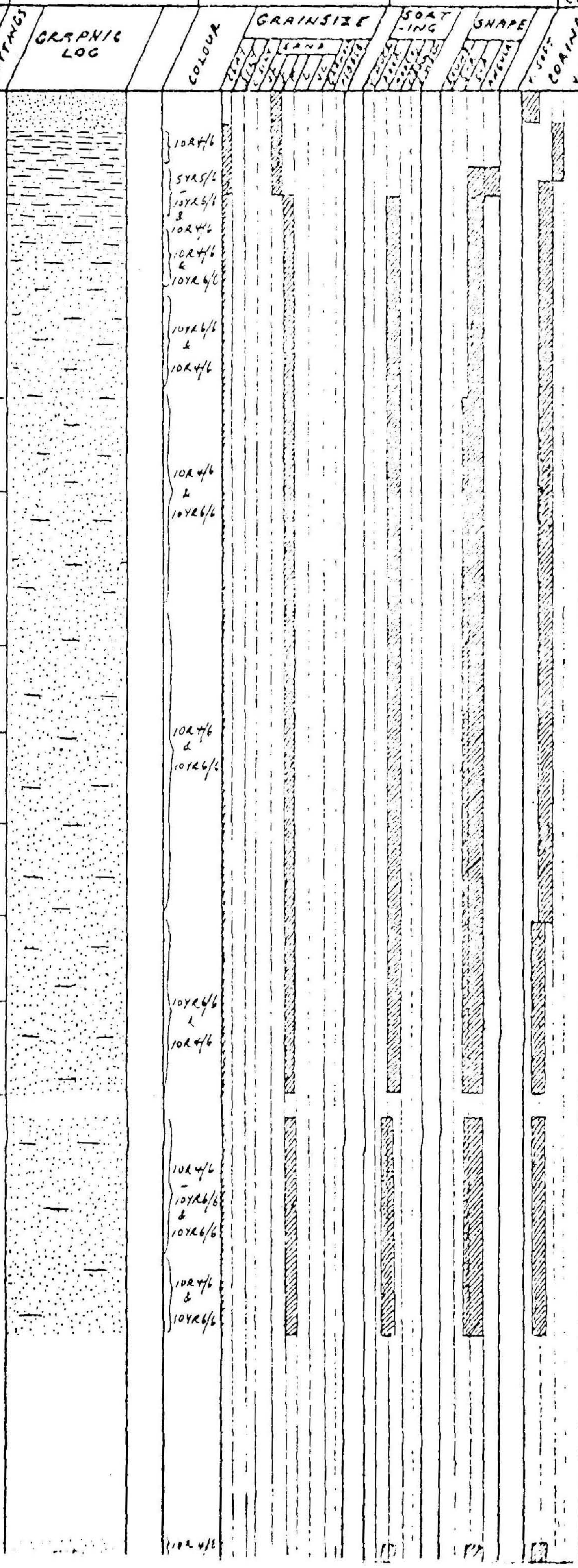
J54/A/26


HOLE NAME
HORSHAM 9 (CONT.)
LAT.
LONG.
RL
TD
SPUDDED
COMPLETED
DEPTH m
CORE
SECTION
CUTTINGS
GRAPHIC LOG
COLOUR
GRAINSIZE
SAND
SORTING
SHAPE
CORING
REMARKS
STRAT. UNIT
75.81
76.81
79.86
82.60
85.34
88.39
91.44
92.64
33
34
35
36
37
38
39
40
10YR 5/4
5YR 4/4
10YR 5/4
10YR5/4
10YR6/6
5Y4/1
5Y4/4
N4
5Y4/1
5Y4/4
5GY4/1
5GY2/1
N 3.5
5G 2/1
5Y7/2
Si. CASTS
Well-cemented with silica. Silica casts of bryozoa etc
Clay 25-30%
50% Lutite - 30% Calc
Arenite - 65% Qtz
35% Carb
Shell fragments, bryozoa etc
Glauconitic?
Greenish black
Bryozoal lst.
BOOKPURNONG BEDS
DUDDO LST.

J54/A/26

HOLE NAME	HORSHAM 10			
LAT. 36°19'S	LONG. 141°41'E	RL 167.1 m	TD 101.5 m	SPUDDED 30-3-77 COMPLETED 1-4-77

DEPTH m	CORE	SECTION	CUTTINGS	COLOUR	REMARKS	STRAT. UNIT
0.60					Loose, aeolian sand	LOWAN SAND
1.21	1	1, 2		10R4/6	Lutite 45% Arenite 55%	
1.83	2	1, 2		5YR5/6 - 10YR6/6	Mottled.	
2.44	3	1, 2		10R4/6		
3.05	4	1, 2		10R4/6 & 10YR6/6		
5.33	5	1, 2, 3, 4, 5, 6, 7		10YR6/6 & 10R4/6		
6.86			C1	10R4/6 & 10YR6/6	Mottled, clay & iron oxides ~ 10%. Qtz grains iron oxide stained - coated.	
			C2			
9.45						
10.97			C3			
12.50			C4	10R4/6 & 10YR6/6		PARILLA SAND
14.02			C5			
15.54			C6			
17.07			C7	10YR4/6 & 10R4/6		
19.96	6	1, 2, 3, 4, 5, 6, 7, 8		10R4/6 - 10YR6/6 & 10YR6/6	Slightly mottled clay - 10%.	
21.79	7	1, 2, 3, 4		10R4/6 & 10YR6/6		
24.69	8			10R4/6		



HOLE NAME HORSHAM 10 (CONT.)

LAT.	LONG.	RL	TD	SPUDDED / COMPLETED

DEPTH m	CORE	SECTION	CUTTINGS	GRAPHIC LOG	COLOUR	GRAINSIZE (CLAY, SILT, SAND: VF, F, M, C, VC, GRAVEL, PEBBLE)	SORTING	SHAPE	CORING (V. SOFT – V. HARD)	REMARKS	STRAT. UNIT
			C8							Clay matrix - iron oxides ~ 10%	
25.91			C9								
27.43			C10		10R4/6 - 10YR6/6						
28.96			C11							Matrix 20%. Qtz grains equant, iron oxide stained coated	
30.48			C12								
32.00	9	1–8			10R4/6					Matrix ~10%	
35.05	10	1–9			10R4/6 - 10YR 6/6 ; 10R4/6					Slightly clayey 15% Grains are iron oxide coated - stained	PARILLA SAND
38.10			C13								
39.62			C14		10R4/6 - 10YR6/6						
41.15			C15								
42.67			C16								
44.20			C17								
45.72			C18								
47.24			C19		5YR6/4 - 10R4/6						
48.77			C20							Clay matrix 10% Most qtz grains are clear	

J54/A/27

HOLE NAME	HORSHAM 10 (CONT.)			
LAT.	LONG.	RL	TD	SPUDDED / COMPLETED

DEPTH m	CORE	SECTION	CUTTINGS	GRAPHIC LOG	COLOUR	GRAINSIZE (CLAY, SILT, SAND, GRANULE, PEBBLE)	SORTING	SHAPE	CORING (V. SOFT – V. HARD)	REMARKS	STRAT. UNIT
50.29			C21								
51.82			C22		10YR 6/6 – 10R 4/6					Clay ~10% Qtz grains are mainly clear	
53.34			C23								
54.86	11	1, 2, 3, 4, 5, 6, 7, 8			5YR 6/4 – 10R 6/6						
57.91	12	1, 2, 3, 4			10R 6/6 & 5Y 8/1; 5Y 7/2					Clean No iron-oxide stains	
60.96	13	1, 2, 3, 4			N9 – 5Y 8/4					Relatively clean matrix ~5%	PARILLA SAND
62.48	14	1, 2, 3, 4, 5			10YR 7/4						
65.53	15										
67.06			C24							Increase in clay matrix ~20%	
68.58			C25		N9 – 5Y 8/4					Some thin layers of white clay	
70.10			C26								
71.63			C27								
73.10			C28								
74.68											

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HOLE NAME: HORSHAM 10 (CONT.)

LAT.	LONG.	RL	TD	SPUDDED / COMPLETED

DEPTH m	CORE	SECTION	CUTTINGS	COLOUR	REMARKS	STRAT. UNIT
50.29 – 51.82			C21			PARILLA SAND
51.82 – 53.34			C22	10YR6/6 – 10R4/6	Clay ~10%. Qtz grains are mainly clear	
53.34 – 54.86			C23			
54.86 – 57.91	11	1–8		5YR6/4 – 10R6/6		
57.91 – 60.96	12	1–4		10R6/6 & 5Y8/1; 5Y7/2	Clear. No iron-oxide stains	
60.96 – 62.48	13	1–4		N9 – 5Y8/4	Relatively clear matrix ~5%	
62.48 – 65.53	14	1–5		10YR 7/4		
65.53 – 67.06	15					
67.06 – 68.58			C24		Increase in clay matrix ~20%	
68.58 – 70.10			C25	N9 – 5Y8/4	Some thin layers of white clay	
70.10 – 71.63			C26			
71.63 – 73.15			C27			
73.15 – 74.68			C28			

Column headings: DEPTH m; CORE; SECTION; CUTTINGS; GRAPHIC LOG; COLOUR; GRAINSIZE (CLAY, SILT, SAND: VF, F, M, C, VC, GRANULE, PEBBLE); SORTING; SHAPE; CORING (V. SOFT – V. HARD); REMARKS; STRAT. UNIT

HOLE NAME HORSHAM 10 (CONT.)

LAT.	LONG.	RL	TD	SPUDDED / COMPLETED

Columns: DEPTH m | CORE | SECTION | CUTTINGS | GRAPHIC LOG | COLOUR | GRAINSIZE (CLAY, SILT, SAND, GRANULE, PEBBLE) | SORTING | SHAPE | V. SOFT / CORING / V. HARD | REMARKS | STRAT. UNIT

DEPTH m	CORE	SECTION	CUTTINGS	COLOUR	REMARKS
			C29		
76.20			C30	5Y8/1	Qtz grains are clear translucent.
77.72	16	1, 2, 3, 4		5Y8/1	
80.47	17				
		1, 2		10YR 6/6, 10YR7/4	Trace of opaque(?) feldspar
83.51	18	1, 2, 3		10YR8/1, 5YR4/4	
86.87			C31	N9	Qtz gravel
88.39			C32	5Y8/1	
89.92			C33	N9	
91.44			C34		
92.96			C35		
94.49			C36		
96.01			C37	N9	
97.54			C38	5Y4/4, N4	Marked colour change to medium dark grey. Very slightly micaceous. Pyrite? Glauconite.
100.0	19		1-5		

STRAT. UNIT: PARILLA SAND; BOOKPURNONG BEDS.

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