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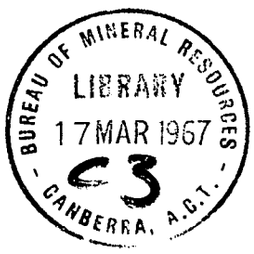

DUNE SAND IN THE MOLONGLO RIVER VALLEY, AUSTRALIAN CAPITAL TERRITORY.

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by

D.E. Gardner

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PLATES (Cont.)

DUNE SAND IN THE MOLONGLO RIVER VALLEY, AUSTRALIAN CAPITAL TERRITORY

SUMMARY

Fossil sand dunes along the Molonglo Valley near Canberra are thought to have formed in late Pleistocene and early Recent times from sand blown from river flats. Initial resources distributed at twenty four localities are estimated to amount to about 2,300,000 cubic yards. Some 900,000 cubic yards has been utilized, mainly in the building industry, and about 500,000 cubic yards are now available for exploitation.

The sand is well sorted, and the modal grain size ranges between 0.3 and 0.4 mm.; the sand from most deposits contains a small excess of fine-grained particles. Other deposits, which contain a large excess of silty and clayey fines, are not described in this report.

Several deposits which have been examined in some detail are described.

INTRODUCTION

Dunes* in the Molonglo River valley in and near Canberra provide sand for bricklaying, plastering and other purposes; they have been investigated at intervals since 1955, some in reconnaissance surveys and others in greater detail. The principal deposits occur within distances of 5½ miles to the west, and 6 miles to the south-east, of Commonwealth Avenue Bridge. Localities are shown on Plate 1.

Occurrences of dune sand at other localities are not considered in this report: They include deposits a short distance east of Canberra Airport, others near Burbong on the Molonglo River about 11 miles east-south-east of Canberra, a deposit near Pine Island on the Murrumbidgee River, and large deposits on the eastern side of Lake George.

The dunes on the Molonglo valley have been exploited at an increasing rate since about 1957, in pace with the quickening development of Canberra. Late in 1963, after Scrivener Dam had been built across the river to form Lake Burley Griffin, some of the dune-sand deposits were inundated - notably, a deposit north of Government House, and one in the former Royal Canberra golf course at Acton.

By the middle of 1966, the only large resources of dune sand remaining for exploitation in the Molonglo Valley were the deposits located 4 miles and 5½ to 6 miles south-east, 4¾ miles west-south-west, and 5½ miles west, of Commonwealth Avenue Bridge.

MODE OF OCCURRENCE OF DEPOSITS

Dune sand is widely distributed in the Molonglo Valley on slopes that are exposed to westerly winds. The sand, transported by the wind from river flats, has banked up against the slopes, filled hollows and spilled over divides, to form low dunes and blanket-like deposits that lack distinctive topographic expression. Some are elongated in the direction of the westerly winds, and some form topographic basins; some can be recognised by their sandy soil, by sand around animal burrows, and by the presence of a characteristic vegetation, including certain grasses and a thick-trunked, widely-spreading eucalypt. The deposits are not now being formed; the seasonal winds transport little or no sand from the river flats, and the dunes are stabilized by vegetation.

The largest deposits of dune sand are associated, geographically, with extensive river flats. The Molonglo valley is widest, and the river flats are broadest, along that stretch of the river that runs from about the confluence with the Queanbeyan River to about the confluence with Sullivans Creek (on Plate 1, from grid meridian 24 in the east to meridan 11 in the west). Upstream of the Queanbeyan River mouth the Molonglo flows through a gorge for about 3 miles from west of Burbong railway siding. Downstream from meridian 11, the valley narrows and deepens, but local flats, with large dunes, occur as far westwards as meridian 04.

Vertical sections of deposits were examined in pits in the Honeysuckle area (Plates 2 and 3). Judging by the degree of weathering,

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* All dunes in the A.C.T. are fossil dunes. Many have been greatly modified since formation and are not readily recognised.

as expressed by the proportions of clay and iron oxide in the sand, the deposits appear to be of three ages. The most recent sand, here termed D1 sand and the underlying sand of intermediate age (D2 sand) were exposed in the face of a pit (see inset of Plate 3). In Table 1, the section exposed in the pit is described, and the size gradings of selected samples are tabulated. The D1 sand is thought to extend down from the surface to a depth of 8 feet 10 inches and the D2 sand from 8 feet 10 inches to the bottom of the section. The D1 sand is generally medium-grained, except in the interval from 4 feet to 6 feet 4 inches where the sand is grey, and predominantly coarse-grained. Possibly the interval represents a temporary break in deposition, during which local re-distribution and winnowing by the wind took place.

The D1 sand has been modified by soil-forming processes. It has a distinct A-horizon of leached, pale-grey sand, two probable illuvial horizons, and a C-horizon which has apparently been little modified since it was deposited. The upper illuvial horizon, the B1 horizon, extends from the bottom of the A-horizon down to the top of the C-horizon, and is marked by a fine coating of iron oxide on the surfaces of the sand grains. The lower illuvial horizon, the B2 horizon, is below the C-horizon, and contains clay that washed down through the C-horizon.

The grey colour of the coarse-grained sand from 4 feet to 6 feet 6 inches suggests that an A-horizon developed here during the period of the supposed break in deposition.

The D2 sand contains larger porportions of iron oxide below 10 feet 5 inches, and a clayey illuvial horizon below 11 feet 3 inches; it is predominantly coarse-grained.

The compact clayey sand observed between 8 feet 6 inches and 8 feet 10 inches forms the bottom of the medium-grained sand throughout the pit; coarse sand has been observed beneath it at several localities. Disregarding this veneer of clayey medium-grained sand, the floor of the pit gives a true outline of the surface of the coarser sand. It is undulating, and shallow depressions lead down from depressions in the bedrock surface higher up the slope. The coarse sand was apparently the land surface at this locality prior to the deposition of the medium-grained sand. The shallow depressions were watercourses; one of them is shown in the inset of Plate 3. This interpretation is supported by the logs of auger holes UV31, V30 and W29 (Appendix 3). In these holes, loose medium-grained sand several feet thick rests on sandy clay or clayey sand; at the interface between the loose sand and the clayey sand are scattered rock-fragments, presumably detrital fragments that moved down-slope from exposed bedrock during a fairly prolonged period when the top of the clayey sand formed the land-surface.

Clayey sand which appears to be much more modified by weathering and soil-formation than the sand described in Table 1 is exposed in an erosion gully near the south-eastern edge of the Honeysuckle Area, at the locality marked S3, near grid-point X28. It has received much illuvial clay and iron oxide and contains pisolitic ironstone concretions; shrinkage cracks form when it dries. This is thought to be a remnant of sand dunes, here termed D3 dunes, older than the D2 dunes.

ORIGIN

The dunes were formed during the periods when the river-valley was occupied by broad alluvial flats that are now represented by remnants of river terraces. The supposed conditions of climate and of alluviation of the valley are described in a separate report titled "Alluvial Deposits of the Molonglo River Valley". River sediment deposited in broad sheets around braided channels was picked up by the strong winds that prevailed

TABLE 1 - Honeysuckle Sand Deposits, Southern Area: Vertical Sections* and Size Grading for Deposit Q

Depth (feet and inches)	Field Description	Remarks on soil horizon		Size Grading (percent by weight) ϕ					
				Sample (depth)	Field No. & Lab. No.	Coarse sand	Medium sand	Fine sand	Silt and Clay
0	Dark soil								
0'3"	merging into grey fine sand.	A horizon	D1 †						
0'9"	This merges into pale reddish sand; dull appearance; roots up to a few mm. diameter, and small patches darkened by humus.	B1 horizon. Feebly cemented when dry; loose when moist.							
2'3"	Reddish-yellow fine sand, showing traces of groundwater banding. Many fine roots, and small patches darkened by humus down to 3 feet; occasional roots and small dark patches down to 4 feet.	B1 horizon; more feebly cemented than the overlying sand.		2'6-3'	6F	30	53	16	1
4'	Greyish, coarser sand; shows groundwater banding.	Local leaching of B1 horizon; feebly cemented.		4'-4'4"	5E	29	46	22	3
				4'5"-4'10"	4D	57	31	10	2
6'4"	Reddish fine sand; contains more ferric oxide than does the overlying sand.	B1 horizon; loose when moist							
7'7"	Fine yellow sand.	C horizon							
8'6"	Compact layer of fine red sand; spaces between the sand grains are filled with buff clay.	B2 horizon of fine sand							Much clay
8'10"	Red, slightly clayey, coarse sand and moderately clayey sand, in alternating discontinuous layers about 2 inches thick.	Truncated B horizon of earlier dune sand which had been exposed to rain wash and winnowing by wind, with resulting loss of some of finer constituents. It has probably received illuvial clay from the finer sand above it.	D2 †	9'4"-9'7"	1C	42	29	18	11
				9'7"-9'10"	3B	47	23	23	7
10'1"	White, coarse, loose sand.			10'1"-10'3"	2A	57	20	16	7
10'5"	Coarse sand with poorly defined bands of red sand, approximately horizontal. Pale loose sand between the bands. Irregular patches of dark iron oxide.								Fairly large proportion of iron oxide
11'3"	Buff-brown, very clayey sand and clay.								Much clay
11'7"	This grades into weathered bedrock.								

* The section from 0 to 8'6" refers to locality S1 in the inset on Plate 3; from 8'6" to 11'7" refers to locality S2 and is projected to the section at S1. Size grading is derived from Appendix 5.

ϕ Size grades adopted are: Coarse sand 2 to $\frac{1}{2}$ mm.
Medium sand $\frac{1}{2}$ to $\frac{1}{4}$ mm.
Fine sand $\frac{1}{2}$ to 1/16 mm.
Silt and clay, below 1/16 mm.

Not more than 2 percent of the sample is larger than following size:

Sample	
A	1.6 mm.
B, C, D	1.3 mm.
E, F	1.0 mm.

† See Table 2

during frigid periods at the end of the Pleistocene and probably in early Recent times; the coarser grains were deposited as sand dunes and blanket deposits on the valley sides, and the finer material, silt and dust, was carried farther away.

During warmer periods the quantities of detrital material that were moved into the river valley were greatly reduced. The ground-surface was stabilized by re-growth of vegetation and weathering and soil-forming processes began to modify the dune material. Unstable minerals released small amounts of clay and iron oxide, which, along with original clayey components of the dune sand, were carried down in groundwater to form illuvial horizons.

Anemometer records in Canberra (Pryor, 1954) show that the strongest winds and those which record the highest mileages below from the west and north-west. The most extensive of the Canberra dune sands seem to have been deposited by winds from the west and north-west (or west-north-west), as would be expected if wind patterns in late Pleistocene to early Recent time were similar to present day patterns.

AGE OF THE DEPOSITS

Table 2 (based on suggested correlations in a separate report on alluvial deposits of the Molonglo River valley) gives a suggested chronology of the formation of the dunes.

Table 2. Canberra Sand Dunes: Suggested Correlations with Climatic Changes of Late Pleistocene and Recent Times.
(European and North American)

Dune +	Climate cooler than preceding interval	Climate warmer than preceding interval	Age (years)	Epoch
	Present		0	Recent
		Sea level +2 to +3 feet*	1,000	
		Sea level +5 to +6 feet*	2,500	
D1	Little Ice Age		4,000	
		Sea level +10 to +11 feet*	6,000	
		Warming	8,000	
D2	Mankato Glacial		11,000	Upper Pleistocene
		Allerŏd	13,000	
D3	Swedish end moraines		14,000	
		Glaciers recede	15,000	
	Langeland oscillation		16,500	
		Glaciers recede	18,000	
	Belt oscillation		19,000	
		Glaciers recede		
	Würm III Glaciation		22,000	

\+ Honeysuckle Area
* Above present sea level

Mineragraphic examination (Appendix 5) reveals distinct differences between the D1 and D2 sands, both in grain size and in the ratio of plagioclase feldspar to potash feldspar. The youngest sand, the D1 sand, contains a lower proportion of plagioclase than the older, D2, sand. If this is a result of more advanced weathering of the sediment from which the younger sand was derived, it suggests that, during the Little Ice Age, the river flats contained a lower proportion of unweathered sediment direct from the highlands, and more of the weathered colluvium from tributary creeks of the lower altitudes. The rain-washing and winnowing which, supposedly, resulted in an increase in the average grain size of the D2 sand presumably was accomplished during the warm and drier period that preceded the Little Ice Age.

DISTRIBUTION OF DEPOSITS

Recorded deposits are tabulated and briefly described in Appendix 1 and their localities are shown on Plate 1; additional information on some of the larger deposits is given under Descriptions of Deposits. A group of deposits formerly with large aggregate reserves, occurs within an area that extends from Block 163, at about the meridian of Queanbeyan Railway Station, north-westwards to Kallaroo Road, Pialligo. Other major deposits occurred in the Division of Parkes half a mile north of Parliament House, in the Royal Canberra Golf course, Division of Acton, at a locality one third of a mile north of the confluence of Sullivans Creek and the Molonglo River, and at another locality one quarter of a mile north-east of Government House.

Some of these deposits have been worked out, and others are not available for exploitation.

Downstream from Government House, topographic conditions have not been favourable for the development of dunes; the river valley is deeply entrenched and alluvial flats, the primary source of the dune sand, are not well developed. Two fairly substantial deposits occur, one in Green Hills Pine Plantation and the other about half a mile west of Coppins Crossing. Several small deposits have been recorded, and an additional one, not shown on Plate 1, occurs on either side of the Molonglo River where it is crossed by a ford, a quarter of a mile upstream from the junction with the Murrumbidgee River.

SIZE COMPOSITIONS OF DUNE SAND

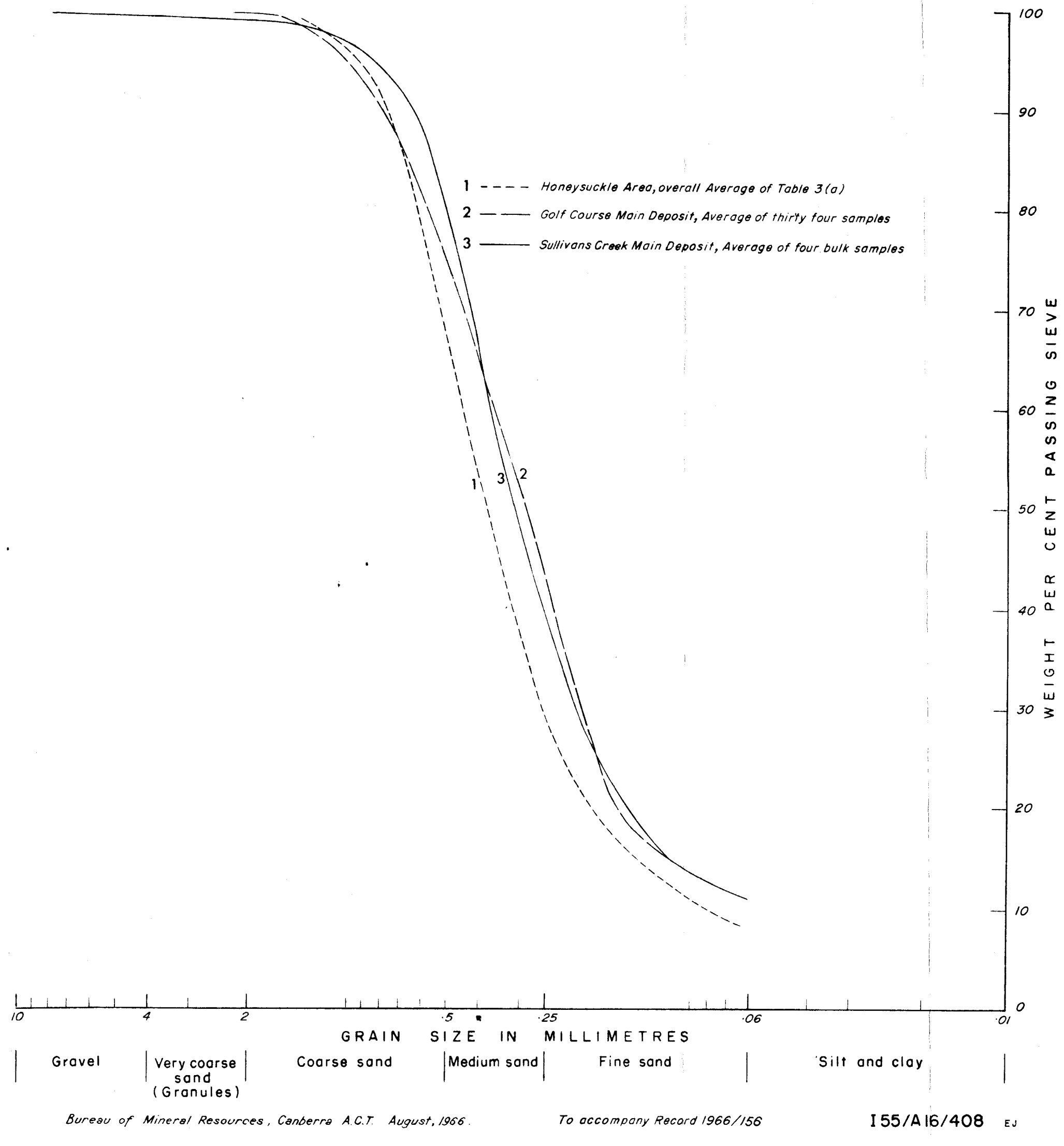
Averages of mechanical analyses of samples from three large deposits are given in Table 3(a); size composition cumulative and frequency curves appear in Figures 1 and 2, and sedimentary classifications and statistical analyses in Table 3(b).

The three deposits resemble one another closely in average size composition and in the distribution of the several size grades. All are fairly well sorted; two contain a small excess of fine-grained particles and the third has virtually a symmetrical size distribution. Modes range from about 0.38 and 0.3mm, within the size range of medium-grained sand, to slightly smaller than 0.2mm, near the upper size limit of fine-grained sand. Further details of the size compositions of sand from the Honeysuckle area are included in the descriptions of the deposits.

Extensive deposits of silt and very fine sand are known to occur at several localities, for example, on the north-west-facing slopes of the river valley west of the Zoological Reserve, and in Acton north and south of the river. The fine sand and silt has not been sought for industrial uses, and mechanical analyses are not available.

DUNE SAND
Size Composition Cumulative Curves

Fig.1



Bureau of Mineral Resources, Canberra A.C.T. August, 1966.

To accompany Record 1966/156

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Fig.2

DUNE SAND

Size Composition Frequency Curves

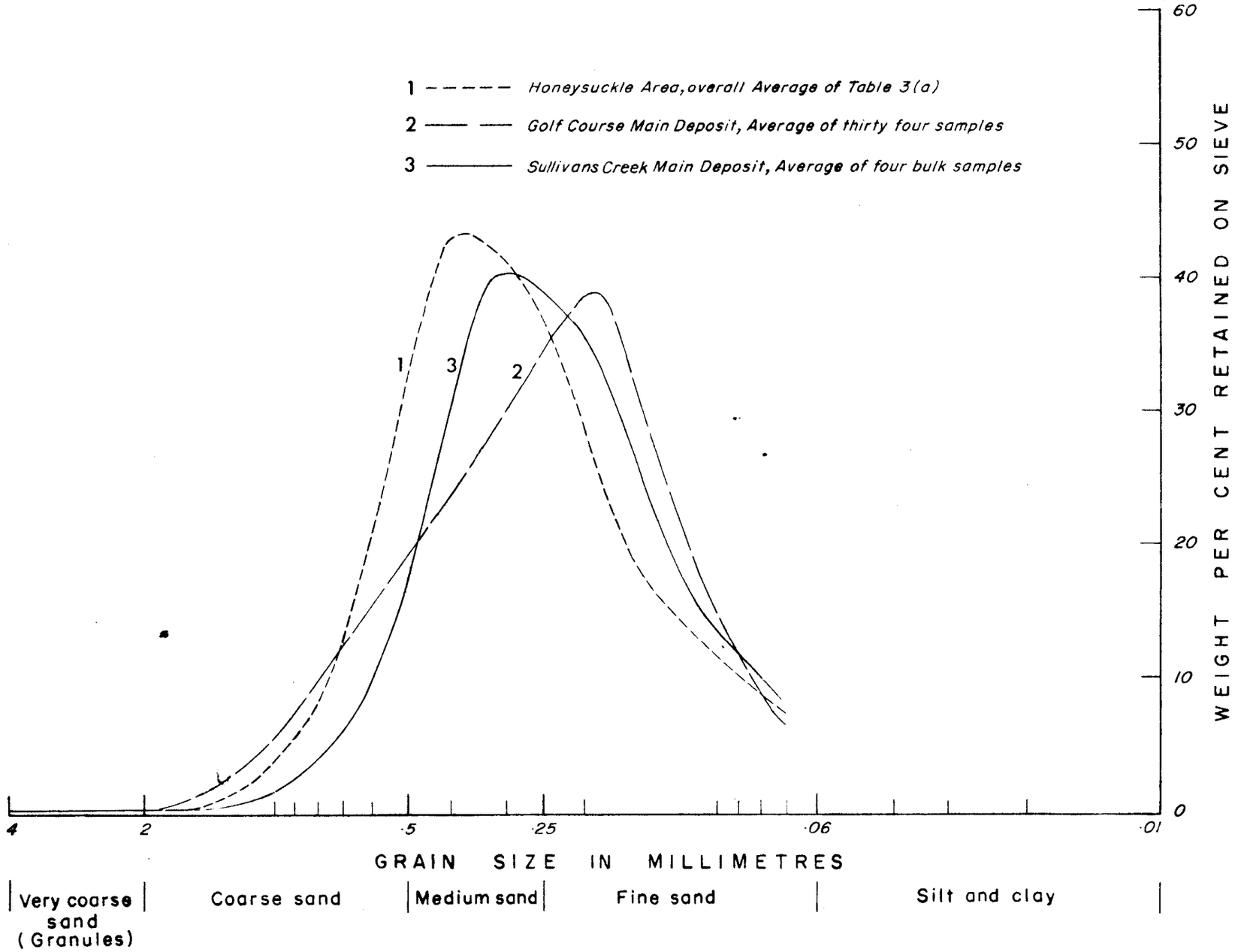

TABLE 3(a) - Average Mechanical Analyses for Dune Sand from Honeysuckle Area; Golf Links, Acton; Sullivans Creek Deposit.
(Analyses by Commonwealth Department of Works, Materials Testing Laboratory, Fyshwick, A.C.T.)

Sample	Designation in Figs. 1 and 2 and Table 3 (b)	Weight percent	British Standard Sieve Size and Nominal Aperture (mm)								
			$\frac{3}{4}$-inch 19.05	$\frac{3}{8}$-inch 9.52	3/16-inch 4.76	8 2.057	14 1.244	25 .599	52 .295	100 .152	200 .076
Honeysuckle Deposits, average of following:											
Southern Area, holes 1 to 28 of Appendix 3, 19 samples.											
Northern area, deposit J, average of 16 samples taken from pit, January, February, and March, 1964.											
Average of Honeysuckle samples, as above	1	passing				100	98.3	77.1	36	17.7	9.5
		retained				0	1.7	21.2	41.1	18.3	8.2
Acton, Golf Course, average of 34 samples taken from pit	2	passing				100	97.1	81.7	51.1	20	12.6
		retained				0	2.9	15.4	30.6	31.1	7.4
Sullivans Creek Deposit, average of 4 bulk samples	3	passing	100	99.7	99.1	98.2	88.4	48.2	21.8	12.6	
		retained	0	0.3	0.6	0.9	9.8	40.2	26.4	9.2	

TABLE 3 (b) - Sedimentary Classifications and Statistical Analyses

Sample (of Table 3 (a))	Sedimentary Classification (showing grain size in mm.)					Statistical Analysis				
	Very coarse sand 4 - 2 %	Coarse sand 2 - $\frac{1}{2}$ %	Medium sand $\frac{1}{2}$ - $\frac{1}{4}$ %	Fine sand $\frac{1}{4}$ - 1/16 %	Silt and clay <1/16 %	Quartiles Q3 mm	Quartiles Q1 mm	Median Md mm	Sorting $\sqrt{\frac{Q3}{Q1}}$	Skewness $\frac{Q1.Q3}{(Md)^2}$
1	0.1	33.9	37	21	8	.58	.22	.38	1.65	.88
2		25	32	32	11	.5	.17	.29	1.72	1.01
3	1	20	39	29	11	.47	.17	.31	1.66	.83

TABLE 4: SUMMARY OF QUANTITIES

Available for Exploitation			Worked Out			Not Available for Exploitation			Possibly Available in Future Years		
Deposit No. (see Plate 1)	Locality	Quantity Cubic Yards	Deposit No.	Locality	Quantity Cubic Yards	Deposit No. (see Plate 1)	Locality	Quantity Cubic Yards	Deposit No. (see Plate 1)	Locality	Quantity Cubic Yards
24	Kowen District, Block 23	5000+	20 B	Gungahlin Dist., Block 162		23	Woden District, Oaks Estate	10,000+	22	Gungahlin Dist., Block 163	50,000
				Eastern Deposit	100,000						
				Western Deposit	35,000 ϕ	14	Campbell Division		21	Woden Dist., Block 27	
							Duntroon Deposit	15,000 ##		Sewerage Farm	60,000+
20A	Gungahlin District Block 162										
	Western Deposit	50,000 ϕ	19	Woden District, Block 21							
				Abattoirs Deposit	30,000	13	Campbell Division		16B	Pialligo Div., Block 24	
							Australian-American Memorial	5,000 ##		Nursery	80,000+
16A	Pialligo Div., Block 66										
	Pine Plantation	115,000+		Gungahlin and City District Honeysuckle Deposits			Parkes Division			Belconnen Dist., Block 47	
15	Pialligo Div., Block 24		17	Northern Area	210,000	12A	Blundells Cottage	5,000 ##		Greenhills Pine Plantation	
	Dairy Farm	130,000+	18	Southern Area	230,000	12B	Deposit		4	Minor Deposit	3,000+
							Acton Division				
2	Stromlo Dist., Bl. 13 & 43		11	Parkes Division		10	Golf Course,		3A)	Major Deposit	180,000+
	Coppins Crossing	10,000*		Parliament House Deposit	100,000		Eastern Deposit	10,000	3B)		300,000+
						9	Main Deposit	70,000			
1	Belconnen Dist., Block 39	200,000 +	9	Acton Division Golf Course		7	Acton Division Sull. Creek				
				Main Deposit	100,000 ##		Minor Deposit	16,000			
				Acton Division Sullivans Ck.,		6	Belconnen Dist., Block 47				
				Main Deposit	110,000		Government House Deposit	57,000			
						5	Woden District Block 18, 20 Yarralumla Ck.				
							Deposit	7,000 ##			
	Total	510,000		Total	915,000		Total	195,000		Total	673,000

\+ Rough estimate based on inspection: Deposit not tested to ascertain thickness and quality
* A few thousand cubic yards already extracted should be subtracted from this figure
ϕ Approximate figure, June 1966. The deposit is being worked
Approximate

RESOURCES

Estimated initial resources of dune sand amounts to nearly 2,300,000 cubic yards. Following is a statement of estimated production and of the availability of the remaining resources for exploitation.

	Cubic Yards
Production (mainly since 1955)	900,000
Resources now available for exploitation	500,000
Resources possibly available in future years	670,000
Probably not available in forseeable future	200,000

A more detailed statement of resources is given in Table 4.

DESCRIPTIONS OF DEPOSITS

DEPOSITS THAT HAVE BEEN EXPLOITED

GENERAL

Recorded deposits are briefly described in Appendix 1. Further details are given below of two deposits on Block 162, Gungahlin District, and on some of the deposits that have been mapped and sampled - the Honeysuckle Deposits and the main Golf Course Deposit in Acton.

The standard specifications for fine aggregate referred to in the descriptions are given towards the end of this report, under the heading "Standard Specifications".

GUNGAHLIN DISTRICT, BLOCK 162

General

The deposits in Block 162 are about $\frac{1}{2}$ to $\frac{3}{4}$ mile east of the Honeysuckle Area, and probably consist of sand that was blown over and beyond the Honeysuckle area.

Two deposits occur within Block 162, an eastern deposit, and a western deposit; their localities are shown approximately on Plate 1. By April, 1966, the eastern deposit had been worked out, and an estimated 50,000 cubic yards remained in the western deposit.

Occurrence

The eastern deposit occurs on the eastern side of a low ridge of bedrock that trends about north. Sand apparently spilled over the crest and accumulated in the valley on the lee side of the ridge. The thickness of the deposit, tested by forty four auger holes, ranged from less than a foot at the crest of the ridge to, locally, more than the maximum depth of augering, 16.5 feet, in the valley.

The western deposit occurs mainly on the windward side of a low northerly-trending ridge, 1000 feet west of the eastern deposit. The sand that banked up against the low ridge was apparently sheltered from the direct force of the wind by a higher ridge several hundred feet farther west.

The thickness of the deposit, where augered, ranges from 2 feet near the crest of the low ridge to more than the maximum depth of augering, 15.5 feet, near the foot of the ridge.

Dimensions and Reserves

Table 5 gives a rough estimate of the dimensions of the deposits and the reserves of sand.

Table 5: Gungahlin District, Block 162. Sizes of Deposits

Deposit	Thickness (feet)		Area	Quantity of Sand
	Average	Range	Square Yards	Cubic Yards
Eastern	7.8	3 to more than 16.5*	38,000	100,000
Western	7.5	3 to more than 15.5*	34,000	85,000

* Maximum depth of augering

The figures of reserves are regarded as conservative, for two reasons: firstly, four auger holes in each deposit failed to reach the bottom of the deposit; secondly, the auger holes were more widely spaced in the thicker than in the thinner parts of the deposits and the results tend to give a lower figure for average thickness than the true average.

Quality and grain - Size of the Sand

The sand was not sampled; estimates of quality and grain size were made visually by examining the sand that had been placed around the auger holes, and are subjective. In general, the sand resembles that obtained from the Honeysuckle deposits; locally it appears to be clean and in other parts of the deposit it contains small proportions of silt and clay. The sand near the bottom of the deposit contains much clay.

In the eastern deposit from the crest of the ridge eastwards for a few hundred feet the sand is medium-grained; farther east, downslope, the average grain size decreases to that of a predominantly fine-grained sand. The western deposit consists of fine- to medium-grained sand.

HONEYSUCKLE DEPOSITS

General

The Honeysuckle deposits, named after a grazing property that formerly included the deposits, occur in two groups: a northern area, and a southern area. Each area is covered by a veneer of sand that thickens to workable deposits in sub-surface depressions, and on the windward and leeward sides of low ridges of bedrock. The two areas are separated by a stretch of country about 1400 feet wide, on which only thin deposits of sand occur.

The locality of the Honeysuckle area is shown in Plate 1.

The northern area was examined in a reconnaissance survey during 1955, when several pits were dug; in 1958 it was augered and sampled to a maximum depth of 10 feet. The southern area was augered and sampled in 1957 to the same depth with a truck-mounted power auger. Separate samples of the sand recovered from the auger holes were taken on the basis of colour, apparent clay content, and in some instances, apparent grain size.

With the exception of deposit J, in the northern areas, which had been reserved for the Department of Works, the Honeysuckle deposits were

virtually exhausted by the end of 1962. Supplies during 1963 were obtained from the main Golf Course Deposit. When this source became unavailable towards the end of 1963 because of rising lake waters, deposit J was made available for general exploitation.

Northern Area

The northern area contained twelve workable deposits; they are shown in plan in Plate 2 where they are designated A to M inclusive. Figures of reserves and approximate average thickness of each deposit are summarized in Table 6.

Apart from deposit J no detailed records are available of the size composition of the sand in the northern area, or of its quality in relation to standard specifications.

Average figures obtained by sieving 16 samples taken from deposit J, from January to March, 1964, are as follows:-

B.S. sieve	7	14	25	52	100	200
weight percent passing	100	98	72	32	15	8

The quantity of sand passing B.S. sieve No.52 exceeds the upper specification limit for fine aggregate (30 percent by weight). The weight percent that would be lost in the decantation test would be close to the weight percent of material that passes B.S. sieve No.200; the specification limit is 3 percent.

Table 6: Honeysuckle Deposits: Summary of Reserves, and Average thicknesses of Deposits

Deposit	Approximate Average Thickness (feet)	Estimated Reserves, August 1956 (cubic yards)
Northern Area (Plate 2)		
A	5	6,000
B	4	18,000
C	6	10,000
D	3	5,000
E	6	12,000
F	3	5,000
G	3	1,500
H	5	10,000
J	7	70,000
K	3	8,000
L	7	35,000
M	6	33,000
Total		213,000
Southern Area (Plate 3,4)		
N	3.4	20,000
O	5.7	46,000
P	4	29,000
Q	5.4	76,000
R	4	12,000
S	4	8,000
T	7	39,000
Total		230,000

Southern Area

General

The southern area contained deposits N to T inclusive, shown in plan in Plate 3. The deposits were inspected periodically while being excavated, and the information obtained provided the basis for the interpretation of the origin and age of the dunes.

Reserves

Figures of reserves and approximate average thicknesses of deposits are summarized in Table 6.

Size Compositions

Mechanical analyses of auger samples obtained during the early investigation of the Honeysuckle area provided the figures of Appendix 2, which are averaged in Table 3(a). Cumulative and frequency curves were plotted in Figures 1 & 2 from these averages; others, compiled in the course of study of the origin and age of the dunes, appear in Appendix 5. Sedimentary classifications and statistical analyses are given in Table 3(b).

The cumulative curves and the statistical parameters show that the sands are fairly well sorted, but contain an excess of fine-grained particles. The deposits consist predominantly of medium and coarse-grained sand, with 21 percent of fine sand; the quartiles show that 25 percent by weight has a grain size exceeding 0.58mm and 25 percent a grain size smaller than 0.22mm. The median is 0.38mm, which is within the size range of medium-grained sand. Silt and clay constitute 8 percent by weight of the samples. Mechanical analyses of samples taken at intervals vertically in the pit face of deposit Q (Table 1), together with size cumulative and frequency curves, are included in Appendix 5.

Quality in Relation to Standard Specifications

The appropriate standard specifications at the time when the deposits were exploited are embodied in the Standards Association of Australia Code No. CA.2-1937* Rule 6, (grading for fine aggregate), Appendix III (determination of the total quantity of dust or other fine material) and Appendix II (an approximate test for the presence of injurious compounds). Table 7 summarizes the results of laboratory work on samples from deposit Q, Honeysuckle area.

Appendix II of Code. Approximate Test for the Presence of Injurious Organic Compounds

In the colorimetric tests for organic compounds (Appendix 2) the samples that were wet sieved, from auger holes 1 to 28, were reported to give a constant colour slightly above colour No.1; this is the maximum permitted in the specification for fine aggregate.

The samples that were dry sieved, from holes 48 to 78, gave colour numbers ranging from 1 to 3; a summary of the results is:-

Colour No.	Number of Samples
1	3
2	12
3	6

Apparently the deposit as a whole contains organic matter in excess of the specified limit for fine aggregate, but selective working would yield sand within the specification limit.

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*Now superseded by S.A.A. Code No. A77-1957.

Table 7: Honeysuckle Area, Deposit Q: Summary Analysis of Laboratory Results

A. Average of the figures obtained by wet sieving of 19 smaples from auger holes Nos. 1 to 28.

B.S. Sieve No.	3/16-inch	8	14	25	52	100	200
Weight percent passing	100	99.9	98.6	82.2	40.0	20.4	11.0

Proportion of sample passing B.S. sieve No. 52	30% or less	Between 30% and 35%	Between 35% and 40%	Between 40% and 50%	Over 50%
Number of samples (19 samples tested)	2	5	5	3	4

B. Results of decantation tests (12 samples)

Weight percent lost by decantation	Not over 3%	Not over 6%	Not over 9%	Over 9%
Number of samples	Nil	1	9	2

Table 7A shows that only two of the nineteen samples tested satisfy the Code's grading specification; some sand could be selected that would be close to the specification limit, but the deposit as a whole contains an excess of particles that pass B.S. sieve No. 52.

Table 7B shows that little, if any, of the sand would meet the requirements of the decantation test; the specification for fine aggregate allows a maximum loss of 3%.

FORMER GOLF COURSE, ACTON: (Hill, 1962)

General

The main deposits of dune sand in the former Royal Canberra Golf Course at Acton extends east-west across the site of the links 1000 to 1500 feet north of the Molonglo River. The deposit was investigated by hand augering during 1962. The locality is shown on Plate 1, the positions of the auger holes in Plate 5 and sections in Plate 6.

Since the end of 1963 the deposit has been covered by Lake Burley Griffin.

Reserves

Reserves proved by augering amount to 170,000 cubic yards of sand. The estimate is restricted to the rectangular area, 1500 feet long by 300 feet wide, outlined by the auger holes; the holes around the perimeter penetrated considerable thicknesses of dune sand, and the actual reserves may substantially exceed the figure estimated.

Nearly all the auger holes showed that a layer of very fine to medium sand with silty fines, generally 4 to 6 feet thick, underlies the shallow surface soil. Most of the remainder of the sand penetrated was fine to very coarse (some with granules or small pebbles) but without any significant amounts of silty fines. Most holes stopped at a layer of compact clayey silt which the auger could not penetrate.

Size Composition

Average figures of mechanical analyses obtained by sieving thirty four samples from the pit are given in Table 3(a). Size composition, cumulative and frequency curves are plotted on Fig. 1 and 2, and a sedimentary classification and statistical analyses appear in Table 3(b).

The sand is not quite as well sorted as sand in the other major deposits referred to in Table 3 and Figs. 1 and 2 - the Honeysuckle and Sullivans Creek Deposits. Although it contains a fairly large proportion of very fine-grained sediment, the size grades are distributed almost symmetrically, with a very slight excess of the coarser sand. The size compositions of other dune sands are distinctly skewed towards the finer grades. Probably the coarser particles on the samples came from river alluvium beneath the dune sand.

Quality in Relation to Standard Specifications

Excessive quantities of the sand pass the B.S. No. 52 sieve - 51 percent in comparison with the 30 percent maximum allowed in the standard specification for fine aggregate. The quantity of very fine material that would be removed in the decantation test would probably be of the order of 10 percent - the specification permits a maximum of 3 percent. Figures for the colorimetric test for organic material are not available.

DEPOSITS THAT HAVE NOT YET BEEN EXPLOITED

GENERAL

Descriptions are given of several deposits for which some information is available on dimensions and possible resources. Other deposits with possible large resources of sand, which have only been briefly examined in reconnaissance investigations, are not described here. These deposits, on Block 27 (Sewerage Farm) Woden District, and on Blocks 39 and 47, Belconnen District, are briefly described in Appendix 1.

DEPOSITS BETWEEN HONEYSUCKLE AREA AND KALLAROO ROAD, PIALLIGO

General

The dunes that have been worked in the northern part of the Honeysuckle area extend to the west-north-west into a plant nursery, a small pine plantation, and a dairy farm. Low ridges which are regarded as probable dunes are indicated by the contours on Plate 6.

Brief notes are given below on the probable dunes in each area, with rough estimates of possible sand resources. The estimates are thought to give the order of magntitude of the quantities of sand that might occur; the existence of the deposits and figures of actual reserves could be checked by drilling or augering.

Pine Plantation

Three or four probable dunes occur within the pine plantation. One of them, dune D is an extension to the west-north-west of deposit A

of the Honeysuckle area, in which the sand is at least 9 feet thick. Dune E is not as well defined, and does not conform to the general direction of elongation of the dunes. The probable dunes marked A2 and A1 form a continuous ridge and may consist of a single dune.

Rough estimates of dimensions and possible sand resources are given in Table 8.

Table 8: Probable Dunes in Pine Plantation, Pialligo: Rough Estimates of Dimensions and Resources

Dune (Plate 6)	Length (feet)	Width (feet)	Possible Sand Resources (cubic yards)
D	1000	100 to 200	30,000
E	500	100 to 150	15,000
A2	1000	200 to 300	70,000
A1	1000	200 to 300	
Total			115,000

The sand in the pine plantation is undoubtedly penetrated to a considerable depth by tree roots.

Plant Nursery

Three probable dunes underlie much of the plant nursery. They are in part planted with seedlings and in part prepared for planting.

Rough estimates of dimensions and possible sand resources are given in Table 9.

Table 9: Probable Dunes in Plant Nursery, Pialligo: Rough Estimates of Dimensions and Resources

Dune (Plate 6)	Length (feet)	Width (feet)	Possible Sand Resources (cubic yards)
C1	1000	100 to 300	35,000
C2	400	100 to 200	10,000
B	800	100 to 150	35,000
Total			80,000

Dairy Farm

Five low ridges on the dairy farm are interpreted as probable dunes. Rough estimates of dimensions and possible sand resources are as in Table 10.

Table 10: Probable Dunes in Dairy Farm, Pialligo: Rough Estimates of Dimensions and Resources

Dune (Plate 6)	Length (feet)	Width (feet)	Possible Sand Resources (cubic yards)
F	500	100 to 200	10,000
G	1500	100 to 200	80,000
H	900	About 200	
J	700	50 to 150	40,000
K	800	About 100	
Total			130,000

The terrain in the dairy farm is flatter than in the other areas. Possibly blanket deposits lie between and around the dune crests; if so, possible resources would be larger than those given in the rough estimates.

BLOCK 163, GUNGAHLIN DISTRICT

Introduction

A low spur running south-westerly to the Molonglo River in Block 163, Gungahlin District, slightly more than ¼ mile north-west of the Queanbeyan railway station, contains deposits of fine and medium-grained dune sand and deposits of river sand and gravel.

A contour map was made of the spur, using plane table and alidade. Later, numerous test pits were sunk in the deposits, eleven of them in the dune sand, by means of a back-hoe. Results of this work are shown in Plate 7.

Dune Sand

OCCURRENCE. Red, wind-blown, fine and medium-grained sand covers nearly all the north-western side of the spur, from the southern end to about 1500 feet northwards. The deposit is thickest and cleanest near test pits 13, 8, and 5. At test pit 9 the sand is slightly cemented; north of hole 18 it is finer grained, slightly silty, and weakly cemented.

ESTIMATE OF QUANTITIES. Estimates of quantities have been made for the area that encloses the thickest and cleanest of the windblow sand. Figures given in Table 11, are considered to be approximate, because of the small number of test holes.

Table 11: Dune sand, Block 163, Gungahlin District: Dimensions and Resources of Deposit

Block (Plate 7)	Average thickness (feet)		Area (sq. yds.)	Quantity (cubic yards)
	Sand	Overburden		
A	4.5	0.75	3,200	4,800
B	6.8	0.8	2,900	6,600
C	9.5	0.6	9,700	30,600
D	6.3	0.6	3,300	6,900
Total				48,900

Assuming that the deposit of clean fine sand extends a short distance beyond the boundary shown, particularly towards the north-west, reserves amount to about 50,000 cubic yards.

POSSIBLE EXPLOITATION. Reference to Plate 7 shows that the deposit of dune sand is crossed by electric power transmission lines; unless these lines are re-routed at some future date, the deposit will not be available for exploitation.

DUNE SAND IN LOCAL INDUSTRY

STANDARD SPECIFICATIONS

General

Sand and gravel that is being used in concrete aggregate is continuously sampled and submitted to standard tests by the Commonwealth

Department of Works. The standards that applied in earlier years when many of the deposits were worked were those embodied in the Standards Association of Australia Code for concrete in building, Code No. CA.2-1937. This has been superseded by Code No. A77-1957; for uniformity the quality of the sand is discussed in reference to the earlier code.

Grading

Grading requirements for fine aggregate (Rule 6 of Code No. CA.2-1937) are as follows:-

Passing through 3/16-inch sieve - not less than 85%
Passing through No.52 B.S. sieve - not more than 30%
not less than 10%

The grading requirements of Australian Standards Association Code No. A77-1957 are given in Table 12:

Table 12: Grading Specifications of S.A.A. Code No. A77-1957

Sieve Size (Mesh Size or Number)			Percentage by Weight Passing
B.S.	A.S.T.M.	Tyler	
$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	100
3/16	No. 4	No. 4	90-100
No. 7	8	8	60-100
14	16	14	30-100
25	30	28	15-100
52	50	48	5-50
100	100	100	0-15

Dust and Other Fine Material: Decantation Test

The test, Appendix III of S.A.A. Code No. CA.2-1937, applies to the determination of the total quantity of dust or other fine material in fine aggregate. A representative sample about 500 grams in weight after drying is covered with water, agitated vigorously for 15 seconds, allowed to settle for 15 seconds, and the water is poured off. This process is repeated until the wash-water is clear; loss in weight, percent, is calculated.

The test requires that not more than 3 percent will decant, through B.S. sieve No. 200.

The test described in Appendix H of Australian Standards Association Code No. A77-1957 requires that water be poured off immediately after agitating vigorously.

Organic Matter: Colorimetric Test

The test, Appendix II of S.A.A. Code No. CA.2-1937 is an approximate test for the presence of injurious organic compounds in natural sands for cement mortar or concrete. The principal value is

in detecting sands on which further tests are necessary before they may be used in concrete.

A standard quantity of the sample is placed in a standard volume of 3% solution of sodium hydroxide for 24 hours. The colour of the clear liquid above the fine aggregate or sand is then compared either with standard colour solutions, prepared by adding a solution of tannic acid in alcohol to a 3% solution of sodium hydroxide, or with glasses of similar colours.

For sand that is to be used in high grade concrete a colour slightly darker than No.1 is permissible; for unimportant work a colour very slightly darker than No.2 is allowed.

The test for organic impurities described in Appendix K of Code No. A77-1957 is essentially the same as the test given on Code CA.2-1937.

QUALITY IN RELATION TO STANDARD SPECIFICATIONS

The figures of Table 3(a) show that the principal deposits that have been worked contain larger proportions of sand that passes B.S. sieve No.52 than is permitted in the specification for fine aggregate; in addition they contain excessive amounts of clay and silt, and hence fail to meet the specification requirements of the decantation test. The material that passes No.52 sieve ranges from 36 to 51 percent by weight; clay and silt, that passes No. 200 sieve, ranges from 9.5 to 12.6 percent.

Colour numbers obtained in colorimetric tests for organic compounds in Honeysuckle sands are given in Appendix 2 (wet sieved samples), and the results are summarized under Descriptions of Deposits: Honeysuckle Deposits. In general the Honeysuckle sands give colour No.2, which is slightly above the specification limit for fine aggregate that is to be used in high grade concrete. Washed samples gave a colour slightly darker than No.1.

USES

The dune sand is used in mortar for bricklaying, in plasterer's cement, in concrete, in hot-mix bitumen surfacing for roads and for miscellaneous purposes such as filling, top dressing of lawns, and stabilization of the sub-grades of roads in new suburbs.

For bricklayers' mortar, the upper two feet of sand seems to be preferred; it contains a small proportion of humus which retains moisture and prevents rapid drying of the mortar.

For plastering, cleaner sand more than two feet below the surface is used. Commonly this sand and the bricklayers sand contain a small proportion of clay, sufficient to bind it when dry. As a result, unbroken lumps may remain in the plaster and mortar during mixing. In damp weather, the slightly moist sand is loose and this trouble is not encountered.

The cleanest of the fine sand is mixed with washed and screened river sand to improve the size grading of concrete aggregate.

As noted under "Quality in Relation to Standard Specifications", the dune sand contains higher proportions of material that passes B.S. No.52 and No.200 sieves and slightly higher proportions of organic compounds than is permissable in the specification for fine aggregate. Presumably the aggregate produced by mixing selected dune sand with clean, washed river sand falls within specification limits.

Dune sand from the main deposit at the former site of the Golf Course, Acton, was found to contain too high a proportion of silt and clay for use in hot-mix bitumen mixtures. The sand was beneficiated by elutriation in a bin. Following are average mechanical analyses of samples of the sand as won from the pit, and of washed samples:-

Table 13: Average sieve analyses for untreated and washed sand from the Golf Course Deposit, Acton

Samples	British Standard Sieve, No.					
	7	14	25	52	100	200
	Weight percent passing					
Average of 34 samples from pit	100	97.1	81.7	51.1	20.0	12.6
Average of 39 washed samples	100	97	78	39	8	3

Most of the older sand, described earlier as D2 sand, is too coarse and too clayey to be acceptable for mortar and plaster. Some of it is used for filling and for bedding sand.

For roadmaking small quantities of dune sand have been mixed in with base-course material to reduce the plasticity index to specified limits.

PRODUCTION

In former years, many of the deposits near the centre of Canberra must have been worked in a small way, but records are not available. Parliament House Deposit, which contained at least 100,000 cubic yards, was exhausted by the end of 1957. Random working by private interests entailed considerable wastage of the resources of the deposit. Since then deposits have been worked under the supervision of the Department of the Interior. The deposits are fenced and worked in sections to ensure effective utilization of the available sand. The sand is loaded onto trucks by a front-end loader, owned and operated by a private contractor. With the exception of deposit J in the Northern Area, which had been reserved for the Department of Works, the Honeysuckle area was virtually exhausted of dune sand by the end of 1962. Deposit J was released to provide supplies for private users early in 1964, when the other available sources of dune sand had been worked out, or were no longer accessible because of the rising lake waters; this deposit was exhausted during 1964.

The main deposit in the Acton Golf Course was exploited mainly during 1963; it was abandoned at the end of that year, when the lake water began to encroach upon it; substantial quantities of dune sand remain there.

The deposits in Block 162, Gungahlin, became available for exploitation during 1965; in April, 1966, it was estimated that the remaining reserves would maintain supplies for a few months only.

Production of dune sand was at the rate of 50,000 cubic yards per annum between 1958 and 1962, and 60,000 to 80,000 cubic yards per annum in 1963-64.

Estimated production between 1955 and April 1966 amounts to nearly 950,000 cubic yards.

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APPENDIX 1: SUMMARY DESCRIPTIONS OF DEPOSITS

Index Number on Plate 1	Locality	Coordinates on Plate 1 East	Coordinates on Plate 1 North	Estimate of Resources (cubic yards)	Remarks
1	Block 39, Belconnen District	042	417	Rough estimate 200,000	Area inspected, but thickness and quality of sand not tested
2	Coppins Crossing Deposit	048	418	Probable 10,000	Deposits on eastern side of road being worked for ready-mixed concrete. Smaller deposit on western side, in grazing land, is not available.
	Green Hills Pine Plantation, Belconnen District				
3A	Main) In	061	382	Rough estimate 180,000	These deposits are situated in a pine plantation and are not available for exploitation. The area has been inspected, but thickness and quality of sand not tested.
3B	Deposits) Block	067	382	" " 300,000	
4	Minor deposit) 47	073	387	" " 3,000	
5	Blocks 18 and 20, Woden District	084	399	Rough estimate 7,000	"Yarralumla Creek Deposit". Extensive but thin. Excess fines, locally clean.
6	Block 47, Belconnen District	091	406	57,000	"Government House Deposit". Now covered by lake water.
	Sullivans Creek Deposits, Div. of Acton				
7	Minor deposit	109	416	16,000	Deposited on windward side of same ridge as main deposit. At lake edge and not available.
8	Main deposit	113	418	110,000	Deposited by westerly winds on lee side (eastern side) of ridge. Maximum thickness 30 feet. Worked out in 1958-59.
	Golf Course Deposits, Div. of Acton				
9	Main deposit	127	411	170,000	On the former site of the Royal Canberra Golf Course. The deposits became available when the Golf Course was removed to permit development of the lake. Main deposit worked 1963-64, after which it was inundated.
10	Eastern deposit	135	408	10,000	
11	Half a mile north-north-west of Parliament House, Div. of Parkes	141	407	100,000	"Parliament House Deposit". Worked out between 1955 and 1957.
12A	Near Blundell's Cottage,	155	409)		
12B	Division of Parkes	156	405)	Rough estimate 5,000	In improved area around lake edge, and partly inundated. Not available for exploitation.
13	Near Australia-American Memorial, Div. of Campbell	164	405	Rough estimate 5,000	In built-up area (Russell Defence Buildings). Not available for exploitation.
14	Duntroon Deposit, in Military College area, Div. of Campbell	169	403	Rough estimate 15,000	Not available for exploitation.
	Between Honeysuckle Area and Kallaroo Road, Div. of Pialligo				
15	Dairy Farm Deposits, Block 24	198	383	Rough estimate 130,000	Dunes extend a short distance into market garden in Block 3.
16A	Pine Plantation Deposits, Block 66	204	379	" " 115,000	Tree roots penetrate deeply into sand.
16B	Plant Nursery Deposits, Block 24	202	376	" " 80,000	Nursery operated by Parks and Gardens Section, Dept. of the Interior.
	Honeysuckle Deposits, Gungahlin and City Districts				
17	Northern Area, Blocks 245, 178	210	373	210,000	Worked out between 1959 and 1962, with the exception of Deposit J, Northern Area, which was worked out during 1965.
18	Southern Area, Blocks 229, 161	212	361	230,000	
19	Block 21, Woden District	217	352	30,000	"Abattoirs Deposit". Worked out between 1958 and 1962.
	Block 162, Gungahlin District				
20A	Western Deposit	222	368	85,000	In April, 1966, an estimated few months supply remained in deposit.
20B	Eastern Deposit	226	368	100,000	Worked out.
21	Woden District Block 27(Sewerage Farm)	230	362	Rough estimate 60,000	
22	Gungahlin District, Block 163	235	360	50,000	Sampled by pitting. Crossed by overhead power transmission lines. Not available.
23	Woden District, Oaks Estate	240	357	Rough estimate 10,000	Small deposits in built-up area; not available for exploitation.
24	Kowen District, Block 23	253	368	Rough estimate 5,000	Small deposit, probably thin.

APPENDIX 2: HONEYSUCKLE SAND: MECHANICAL ANALYSES AND COLORIMETRIC TESTS FOR ORGANIC IMPURITIES TESTED IN ACCORDANCE WITH S.A. A. CODE NO. CA.2-1937 - FINE AGGREGATE (See Text, Standard Specification) WORKS DEPARTMENT MATERIALS TESTING LABORATORY, BARTON, CANBERRA.

A. Samples Wet Sieved

Coordinates (Plate 3)		ST23	T28	TU23	TU26	U29	UV24	V23	V23	V26	VW25	VW25	W24	WX25	X20	X22	X27	XY24	XY24	Y26
Sample depth	From	0'3"	0'3"	0'3"	0'6"	0'3"	0'3"	0'3"	5'	0	0'3"	5'	2'6"	0	1'	3'	0'6"	0'6"	6'	3'
	To	8'	7'	5'	10'	10'	5'	5'	7'	5'	5'	6'	4'6"	8'	5'	10'	7'	6'	9'	8'
Grade per cent passing B.S. sieve No.	3/8"												100							
	3/16"			100							100	100	99.4	100						
	8	100	100	99.7	100	100	100	100	100	100	99.8	99.7	98.8	99.7	100	100	100	100		100
	14	99.1	99.8	97.7	98.8	99.5	99.1	99.3	99.5	99.1	99.2	90.0	98.2	99.3	99.1	98.3	98.5	99.6	100	99.1
	25	79.1	85.3	75.7	74.2	75.3	83.1	83.8	81.0	82.6	86.1	88.8	89.5	91.7	81.6	70.0	71.3	82.8	94.9	84.8
	52	32.8	37.7	39.6	30.3	30.2	51.9	41.2	36.3	34.7	39.6	50.2	51.9	47.8	38.2	26.8	29.5	34.3	64.6	42.9
	100	14.4	19.6	23.0	13.5	14.1	32.6	20.3	17.3	14.6	18.8	26.1	29.0	19.4	20.7	12.0	14.9	17.4	38.6	20.9
	200	7.7	12.6	14.7	7.8	6.8	8.2	12.5	9.7	8.6	11.2	12.5	19.8	9.6	11.5	6.4	6.9	10.4	21.2	11.4
Decantation		7.5	8.8	10.0	6.6	7.2	7.5		8.7	7.9	8.4				10.0	5.9				
Colorimetric		Consistent Colour level for all samples, 1.25																		

B. Samples Dry Sieved

Coordinates (Plate 3)		RS17	S13	S15	ST17	TU19	UV2	UV2	UV31	V5	V5	V22	V30	W16	W20	W29	WX10	WX10	X12	X18	XY15	Y17
Sample depth	From	0'6"	0	0	0'6"	0'6"	0'6"	5'	0'6"	0	7'	2'	1'6"	0	1'	1'	0'6"	4'	1'	0'6"	0'6"	0
	To	5'	2'6"	3'	3'6"	4'	5'	10'	5'	7'	10'	5'	5'6"	5'	5'	5'	4'	6'	3'6"	4'	5'	4'
Grade per cent passing B.S. sieve No.	3/4"			100																		
	3/8"			97.8	100			100			100		100	100	100			100	100	100		100
	3/16"	100	100	97.8	99.3	100	100	99.0	100		99.3	100	99.9	99.7	99.1	100	100	91.6	99.3	99.7	100	98.8
	8	99.8	99.6	97.4	98.8	99.8		99.0	99.5	100	98.8	99.5	99.7	99.4	98.6	99.7	99.6	89.5	98.3	99.4	99.8	98.1
	14	98.9	97.9	94.8	96.9	98.4	95.6	98.0	98.5	99.0	95.5	97.9	98.8	98.5	95.8	98.9	98.8	88.0	84.7	98.1	98.9	96.6
	25	79.7	70.2	73.4	71.6	72.6	90.3	74.2	71.0	66.6	90.6	56.4	77.8	75.7	64.2	72.9	77.3	70.5	55.0	57.3	76.4	74.0
	52	24.3	21.8	36.7	26.4	21.9	39.2	30.4	30.0	25.9	60.3	16.5	28.1	27.8	20.8	21.7	33.4	40.4	22.4	15.8	31.4	58.7
	100	5.8	8.1	16.2	9.8	5.8	19.6	14.6	13.3	11.4	19.3	5.3	9.0	9.7	8.2	6.8	15.2	24.2	11.5	5.4	11.3	17.6
	200	1.6	4.5	7.9	4.7	1.8	9.3	5.6	5.2	4.2	9.0	3.2	2.7	2.9	3.3	2.2	5.7	12.0	5.5	1.6	3.0	7.8
Colorimetric		2	2	2	3	2	2	1	2	2	2	2	1	3	2	2	3	1	3	2	3	3

Appendix 3: Honeysuckle Deposits, Southern Area.

Logs of Auger Holes (compiled by the sampler while augering was in progress).

This appendix consists of three sections:-

A. Logs of holes shown in Appendix 2A (samples wet sieved)
B. Logs of holes shown in Appendix 2B (samples dry sieved)
C. Logs of holes not included in Appendix 2

Coordinates and hole No. (Plate 3)	Depth (feet and inches) From	To	Description	Sample
A. Logs of Holes Shown in Appendix 2A				
UV 24				
1	0'0	0'3	Soil	
	0'3	5'0	Clean red sand	1
	5'0	7'0	Sand, slightly clayey and cemented	
V 23				
2	0'0	0'3	Soil	
	0'3	5'0	Red sand; contains scattered cemented aggregates	1
	5'0	7'0	Yellow sand	2
	7'0	8'0	Clayey and cemented sand	
	8'0	10'0	Clay; decomposed porphyry	
VW 25				
3	0'0	0'3	Soil	
	0'3	5'0	Red sand	1
	5'0	6'0	Yellow sand	2
	At 6'0		Clayey, cemented sand	
WX 25				
5	0'0	0'6	Soil	
	0'6	3'0	Red sand	1
	3'0	8'0	Yellow sand containing slightly cemented patches	
W 24	0'0	0'6"	Soil	
6	0'6	2'6	Red sand	
	2'6	4'6	Yellow sand with slightly cemented patches	1
	Below 4'6		Sandy clay	
X 22	0'0	1'	Sandy soil	
8	1'	3'	Red sand	
	3'	10'	Yellow sand; coarser than in earlier holes; clean	1
X 20	0'	0'3"	Soil	
9	0'3"	1'	Red sand	1
	1'	5'	Yellow sand	
	5'	6'	Yellow sand and fragments of porphyry	

Coordinates and hole No. (Plate 3)	Depth (feet and inches) From	To	Description	Sample
XY 24 13	0'	0'6"	Soil	
	0'6"	4'	Red sand	1
	4'	6'	Yellow sand, slightly cemented at 6 feet	1
	6'	9'	Yellow sand	2
	9'	10'	Yellow sand, slightly clayey at 10'	2
Y 26 14	0'	0'6"	Soil	
	0'6"	3'	Red sand	1
	3'	8'	Yellow sand, in places slightly cemented	1
X 27 15	0'	0'6"	Soil	
	0'6"	3'	Red sand	1
	3'	7'	Yellow clean sand, coarser than average	1
V 26 17	0'	0'6"	Soil	
	0'6"	3'	Red sand	1
	3'	5'	Yellow sand	1
	At 5'		Bedrock	
U 29 18	0'	0'3"	Soil	
	0'3"	3'	Red sand	1
	3'	10'	Clean yellow sand	1
			Sand continues below 10'	
T 28 19	0'	0'3"	Soil	
	0'3"	3'	Red sand	1
	3'	7'	Yellow sand	1
			Weathered porphyry at 7'	
TU 26 23	0'	0'6"	Soil	
	0'6"	3'	Red sand	1
	3'	9'	Clean yellow sand	1
	9'	10'	Clayey yellow sand	2
TU 23 28	0'	0'3"	Soil	
	0'3"	5'	Red-yellow sand	1
			Hard porphyry at 5'	
B. Logs of Holes Shown in Appendix 2B				
RS 17 60	0'	0'6"	Brown sandy soil	
	0'6"	4'	Yellow-red sand	1
	4'	5'	Yellow sand	1
	At 5'		Slightly cemented sandy clay	
S 13 62	0'	0'6"	Yellow-brown sand	
	0'6"	2'6"	Red sand	1
	Below 2'6"		Slightly cemented, stony	
S 15 59	0'	1'	Yellow-brown sand	
	1'	3'	Clayey, light red sand	1
	Below 3'		Sandy clay	
ST 17 61	0'	0'6"	Dark soil	
	0'6"	4'	Yellow-red sand	1
	4'	5'	Yellow sand	1
	At 5'		Slightly cemented sandy clay	

Coordinates and hole No. (Plate 3)	Depth (feet and inches) From	To	Description	Sample
TO 19	0'	0'6"	Brown soil	
57	0'6"	4'	Yellow sand	1
	At 4'		Bedrock	
UV 2	0'	0'6"	Brown, sandy soil	
66	0'6"	5'	Yellow-red sand, fairly coarse	1
	5'	8'	Yellow sand, freer	
	8'	10'	Yellow sand, slightly clayey	2
UV 31	0'	0'6"	Soil	
49	0'6"	4'	Red sand	1
	4'	5'	Yellow sand	
	At 5'		Band of rock-fragments on top of clayey sand	
V 5	0'	7'	Dark red sand; coarser than average	1
65	7'	10'	Yellow-red sand, becoming slightly cemented at depth	2
	At 10'		Weathered rock	
V 22	0'	2'	Yellow-brown sand	
78	2'	5'	Red sand	1
	5'	6'	Slightly cemented clayey sand	
	At 6'		Weathered rock	
V 30	0'	1'6"	Dark soil	
48	1'6"	5'6"	Red sand, fairly fine	1
	At 5'6"		Rock-fragments	
	5'6"	7'	Sandy clay	
W 16	0'	5'	Yellow-brown sand	1
73	At 5'		Sandy clay	
W 20	0'	1'	Dark soil	
76	1'	3'	Red sand	1
	3'	5'	Yellow sand	
	At 5'		Bedrock	
W 29	0'	1'	Brown soil	
50	1'	4'6"	Red sand	1
	4'6"	5'	Yellow-red sand	
	Below 5'		Rock-fragments on sandy clay	
WX 10	0'	0'6"	Brown sandy soil	
67	0'6"	4'	Red sand, fairly fine	1
	4'	6'	Red sand, slightly cemented	
	At 6'		Weathered rock	
X 12	0'	1'	Yellow-brown sandy soil	
69	1'	3'6"	Yellow sand	1
	At 3'6"		Sandy clay	
X 18	0'	0'6"	Black soil	
72	0'6"	3'6"	Red sand	1
	3'6"	4'	Red sand, clayey	
	At 4'		Bedrock	

Coordinates and hole No. (Plate 3)	Depth (feet and inches) From	To	Description	Sample
XY 15	0'	0'6"	Light sandy soil	
70	0'6"	3'	Yellow-red sand	
	3'	5'	Red sand	1
	At 5'		Bedrock	
Y 17	0'	4'	Yellow sand	1
71	Below 4'		Sandy clay	
C. Logs of Holes Not Shown in Appendix 2				
R 13	0'	1'	Yellow-brown sand	
63	1'	2'6"	Yellow-brown sand, clayey	1
S 22	0'	2'6"	Clayey sand	
27	Below 2'6"		Porphyry	
S 28	0'	3'	Red clay	
22				
ST 11	0'	0'6"	Brown sandy soil	
64	0'6"	2'6"	Yellow-red soil	
	Below 2'6"		Clayey	
ST 24	0'	0'3"	Soil	
26	0'3"	2'6"	Red sand	
	2'6"	8'	Yellow sand	
	Below 8'		Clayey	
T 16	0'	1'	Yellow-brown sand	
58	1'	3'	Red sand	1
	At 3'		Bedrock	
T 29	0'	0'6"	Soil	
21	0'6"	1'	Slightly cemented grey clay	
TU 25	0'	0'6"	Dark soil	
55	0'6"	2'	Yellow sand	1
	Below 2'		Grey-red sandy clay	
TU 28	0'	0'6"	Soil	
20	0'6"	2'6"	Red sand	
	2'6"	9'	Yellow sand; in part slightly cemented; fairly coarse	
	At 9'		Slightly clayey	
U 22	0'	0'6"	Dark soil	
56	0'6"	3'6"	Red sand	1
	Below 3'6"		Yellow sand and rock	
U 26	0'	2'	Grey clayey sand passing to yellow sandy clay	
24				
U 28	0'	0'6"	Soil	
47	0'6"	3'	Clayey sand, grey	
	3'	5'	Clayey sand with red patches	1
	5'	8'	Clayey sand, slightly cemented. Clay band at 8'	
	8'	10'	Slightly cemented grey and red clayey sand	2
	At 10'		Sandy clay	

Coordinates and hole No. (Plate 3)	Depth (feet and inches) From	To	Description	Sample
V 28 25	0' 1'	1' 2'	Grey clayey sand Yellow sandy clay	
W 14 74	0' 0'6" At 2'	0'6" 2'	Soil Yellow sand Thin red clayey sand resting on weathered rock	1
W 24 54	0' 1' Below 4'	1' 4'	Dark soil Yellow sand, fairly dark Clayey sand	1
W 25 4	0' 1' 1'6"	1' 1'6" 2'6"	Grey loamy sand Yellow clayey sand Yellow sandy clay	
W 27 16	0' 2'6"	2'6" 3'6"	Grey sand; some clay Yellow sandy clay	
WX 16 75	0' 1' Below 4'	1' 4'	Dark soil Yellow-red sand, with patches of slightly cemented sand Weathered rock	1
WX 23 7	0' 0'3" 3' At 8'	0'3" 3' 8'	Soil Red sand Yellow sand Becomes clayey	
X 18 77	0' 1' At 2'	1' 2'	Brown soil Yellow-brown sand Clayey sand and weathered rock	1
X 25 52	0' 0'6"	0'6" 2'	Soil Sandy clay	
XY 11 68	0' 0'6" At 2'	0'6" 2'	Brown sandy soil Sandy clay Weathered rock	
XY 21 53	0' 1' Below 1'6"	1' 1'6"	Brown soil Clayey sand Sandy clay	
Y 20 10	0' 0'6" At 2'6"	0'6" 2'6"	Soil Clayey sand Slightly cemented sandy clay	
Y 22 11	0' 0'6" At 2'6"	0'6" 2'	Soil Red sand and some clay Weathered porphyry	
YZ 23 12	0' At 2'	2'	Sandy clay Slightly cemented sandy clay	
YZ 24 51	0' 0'6"	0'6" 2'	Soil Sandy clay	

Appendix 4: Honeysuckle Sand Deposits, Northern Area.

Logs of Auger Holes (written by the sampler while augering was in progress)

Coordinates and Hole No. (Plate 2)	Depth (feet and inches) From	To	Description	Sample
D7	0'	0'6"	Dark soil	
35	0'6"	5'	Red sand	1
	5'	6'	Yellow sand, coarser, slightly cemented	
	Below 6'		Greyish clay	
D 19	0'	1'	Dark soil	
33	1'	5'	Red sand becoming coarser with depth; iron staining at 2'	1
	5'	9'	Yellow sand	2
	9'	10'	Clayey yellow sand	
E11	0'	1'	Soil	
34	1'	5'	Red sand, coarser below 4'	1
	5'	9'	Yellow sand, slightly cemented	2
	9'	10'	Grey clayey sand	
EF 6	0'	0'6"	Dark soil	
36	0'6"	5'	Red sand, coarser below 4'	
	5'	7'	Yellow sand	
	At 7'		Grey sandy clay	
F9	0'	0'6"	Dark soil	
37	0'6"	4'	Red sand	
	4'	9'	Yellow sand, clean below 7'	
	At 9'		Sandy clay	
F18	0'	0'6"	Dark soil	
32	0'6"	4'	Red sand	1
	4'	7'	Yellow sand; clayey patches and iron staining at 6'; rock fragments at 7'	
	6'	7'		2
F31	0'	0'6"	Dark soil	
30	0'6"	1'	Yellow sand	1
	1'	4'	Red sand; rock fragments at 4'	
F33	0'	1'	Dark soil	
29	1'	5'	Red sand	1
	At 5'		Rock fragments	
GH15	0'	0'6"	Soil	
39	0'6"	2'6"	Red soil	
	At 2'6"		Rock fragments	
GH29	0'	0'6"	Dark soil	
31	0'6"	1'	Yellow sand	1
	1'	4'	Red sand	
	At 4'		Rock fragments	
H18	0'	1'	Soil	
38	1'	4'	Red sand (dark red), slightly clayey. Clay below 4'	1

Coordinates and Hole No. (Plate 2)	Depth (feet and inches) From	To	Description	Sample
I38	0'	1'	Soil	
46	1'	4'	Red sand	1
	4'	10'	Yellow sand, coarser, damp, slightly clayey in patches below 9'	2
I40	0'	1'	Yellow sand	
45	1'	4'	Red sand	
	4'	7'	Fine yellow sand	1
	7'	10'	Fine yellow sand, slightly cemented	2
IJ11	0'	1'	Dark soil	
40	1'	4'	Red sand)	1
	4'	5'6"	Yellow sand)	
	At 5'6"		Grey sandy clay	
K22	0'	0'6"	Soil	
44	0'6"	6'	Red sand, slightly clayey; slightly cemented patches	1
	6'	7'	Yellow sand changing to grey sandy clay	
JK14	0'	1'	Soil	
41	1'	4'	Red sand, finer than in) hole 40 (IJ11))	1
	4'	5'6"	Yellow sand)	
	5'6"	10'	Yellow sand, free, clean. Slightly cemented band at 5'6"	2
LM17	0'	0'6"	Soil	
42	0'6"	4'	Fine red sand	1
	Below 4'		Fine red sand slightly cemented with iron oxide	
MN20	0'	1'	Soil	
43	1'	7'	Red sand, slightly clayey; slightly cemented	1
	7'	10'	Red sand, fairly fine, slightly cemented in patches	

APPENDIX 5

GRAIN SIZE AND MINERALOGICAL ANALYSES OF NINE SAND SAMPLES FROM THE HONEYSUCKLE DEPOSITS AND TWO SAND SAMPLES FROM DUNTROON

by

C.M. Gregory

Sand samples representative of a stratigraphic column in the Honeysuckle deposit were subjected to grain size and mineralogical analyses following a standard pattern. The process was:

1. Mechanical dispersion of a weighed sample with a rubber pestle and mortar.

2. Sieving into eleven fractions using a mechanical shaker for the six finer fractions. For two samples a twelfth fraction was separated by difference in settling rate in a water column.

3. Each fraction was weighed and treated with concentrated hydrochloric acid and stannous chloride until all the free iron had gone into solution.

4. After complete washing, during which care was taken to avoid loss of insoluble material, especially in the finer fractions, the samples were dried and weighed again.

5. A small amount of each cleaned sample was then mounted on a glass slide using a mixture of black Bostik and carbon tetrachloride as a thinner.

6. Each slide was etched with hydrofluoric acid fumes then stained with sodium cobaltinitrate followed by Malachite Green.

7. After washing and air drying the slides the mineral grains were counted and the percentage weights calculated.

This staining method helps in the identification of the feldspars. Potassium feldspars stain yellow with sodium cobaltinitrate and when over-stained with Malachite Green turn blue-green, (care must be taken to stop this process before the yellow stain is obliterated). The other aluminosilicates are stained blue. Grains counted as plagioclase may be either fresh or weathered plagioclase, or, less probably, weathered potash feldspar. Rock fragments, plagioclase and mica may be readily distinguished from each other by cleavage or texture. Quartz is not stained by these chemicals.

A grain size cumulative frequency curve was drawn for each sample and from these frequency distribution curves were constructed. The figures 1 to 11 show cumulative and sample frequency curves for each sand sample. A-J are from Honeysuckle deposit and K and L from the Duntroon deposit.

The finer sieves are known to be oversize to some extent so an allowance has been made by drawing the cumulative frequency curve below the plotted points.

In the grain size analysis the most significant variation is in the percentage of clay and silt size grains. The older sands taken from the bottom of the pit have up to 14% clay and silt, much of which was probably formed by weathering and chemical breakdown of feldspar in situ. Clay

material may also have been introduced by washing down from the younger sands above.

The modes occur in the small range between 0.9 and 0.4 mm. with one sample having a bimodal distribution. The general shape of the frequency distribution curve is a fairly sharp rise to the mode from the coarse material, then an equally sharp decline with a shelf at about 4 to 8 percent lower than the mode, then with a more gentle falling-off and finally a very gentle slope in the finest material range.

Mineralogically the quartz percentage by weight is the most constant (about 54%). Rock fragments range from 10 to 3% and muscovite from 2 to 0.02%. Material soluble in concentrated hydrochloric acid (largely iron oxide), ranges from 10 to 2%. The greatest range is shown by feldspar with figures falling between 23 and 36%. The ratio of potassium feldspar to plagioclase ranges from 0.53 to 2.18. Generally in the older sands the ratio of potassium feldspar to plagioclase is less than one.

The increase in potassium feldspar in the younger sands is difficult to explain without introducing the idea of a change in the provenance. In both the older and younger sands from the Honeysuckle deposit the potassium feldspar grains are coarser than the plagioclase so that the idea of winnowing out of the finer potash feldspar is not tenable. A weathering in the provenance with a subsequent relative increase in the potash feldspar available for transport as sand is suggested as the cause of the increase. In other words the older sands were derived from fresher material than were the younger sands.

Two sands collected from Duntroon and thought to be of similar age to the younger of the Honeysuckle sands, contrast markedly in their frequency distribution diagrams with those of the Honeysuckle sands. From the coarse fraction the slope to the mode is gentle; there is then a sharp break in slope and a sharp rise to the mode with a similar falling off to the fine fraction. The mode fraction is between 30 and 35% of the sample weight. Mineralogically the percentage of mica, quartz and soluble material is very similar to the younger of the Honeysuckle sands. The potassic feldspar to plagioclase ratio is slightly greater than 1, (1.13 - 1.06), and total feldspar is approximately 21%.

The sand deposits at Honeysuckle are on gentle slopes compared with those at Duntroon. The method of transport of sand into these two areas probably differed because of this. In the Honeysuckle area particles were transported both by rolling or saltation along the surface and by suspension in clouds a few inches above ground level. The coarse fraction gives the broad modal peak and the fine fraction the shelf on the frequency distribution curve. The Honeysuckle sands are coarser than the Duntroon sands - apparently transport by rolling was an important factor while at Duntroon the mode is a sharp peak on the frequency distribution curve suggesting transport very largely by suspension in low clouds of dust and sand.

If the grain size difference can be accounted for by the method of transport then the younger sands from the Honeysuckle deposit can be correlated with the two samples from Duntroon.

From their distribution in the pit at Honeysuckle the sands increase in age from laboratory sample letter A to J.

TABLE 1 (Appendix 5)

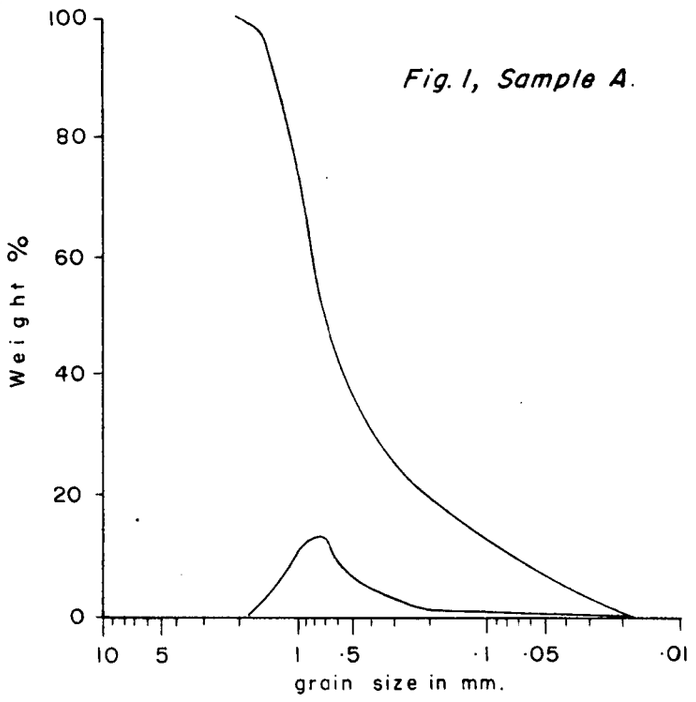
These values are percentages of each mineral present in each sieved fraction. From these figures a qualitative estimate can be made of the relative degrees of coarseness of the minerals.

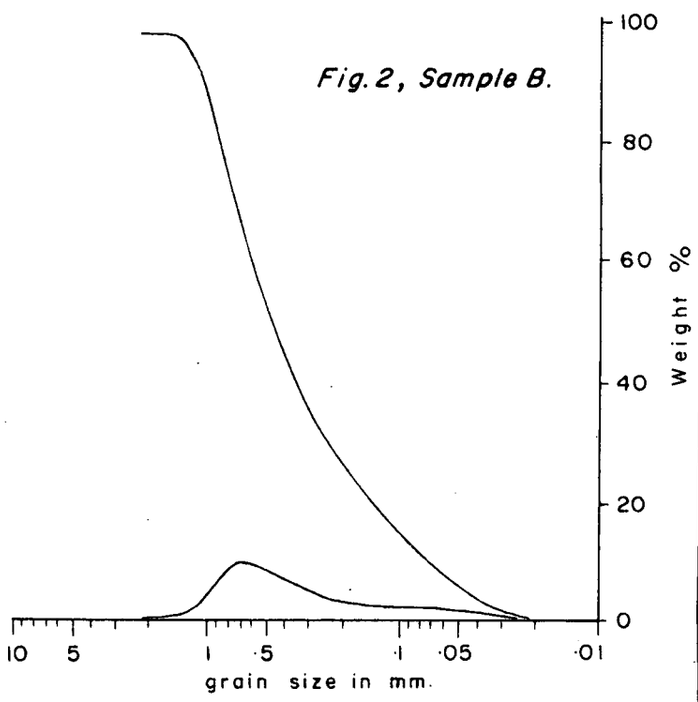
	Sample A			Sample C			Sample G			Sample J		
Fraction	quartz.	K-felds.	plag.	quartz.	K-felds.	plag.	quartz.	K-felds.	plag.	quartz.	K-felds.	plag.
1	.73	1.38	.54	.03	-	-	.01	-	-	.01	-	-
2	43.75	34.52	21.16	12.73	9.37	3.22	8.31	2.58	3.39	13.03	14.19	15.94
3	25.17	10.04	24.45	26.64	14.73	18.15	15.78	14.40	15.55	20.30	32.47	22.71
4	13.35	32.62	16.10	34.39	49.15	28.89	40.37	58.26	36.61	45.43	31.13	32.65
5	1.75	1.25	7.83	5.79	7.76	4.92	11.84	13.52	8.87	7.50	8.93	10.84
6	5.36	1.15	5.90	11.74	13.25	16.62	16.45	9.62	21.62	11.13	10.04	12.15
7	0.45	0.71	0.91	0.77	0.73	1.88	.64	.22	1.22	.44	.73	.52
8	2.35	4.86	2.64	4.67	4.38	10.62	3.13	.19	5.56	12.68	1.67	1.54
9	3.02	6.37	5.77	1.83	.27	10.42	1.44	.51	1.74	.33	.51	1.57
10	2.15	1.93	4.93	0.70	.27	1.89	.97	.58	2.67	.12	.23	1.00
11	1.33	1.84	2.41	0.64	.09	3.38	.58	.13	1.36	.17	.04	.41
12	0.59	3.34	7.18	-	-	-	.54	-	1.41	.26	.06	.66

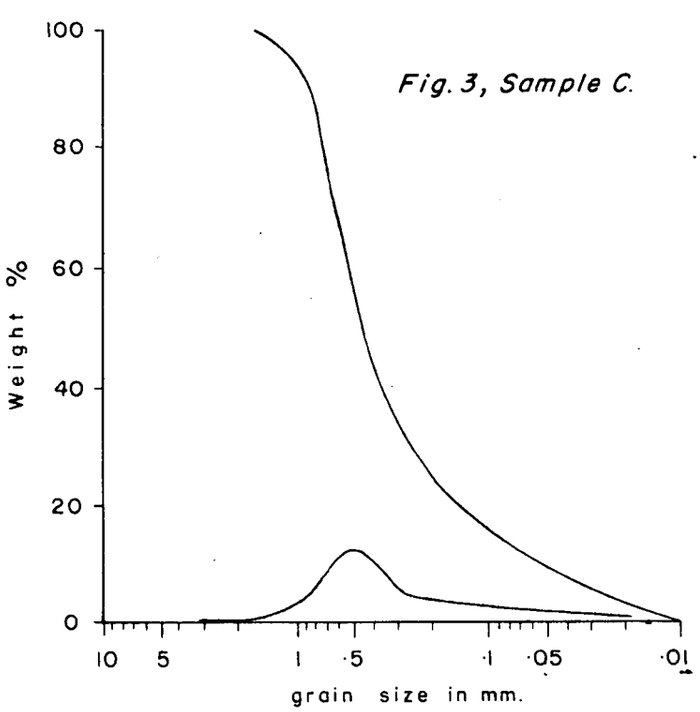
TABLE 2 (Appendix 5)

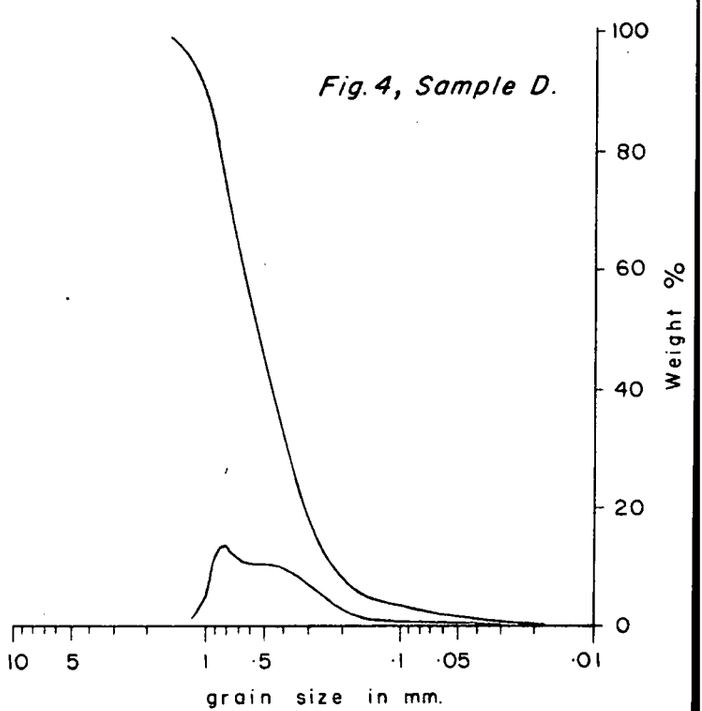
		HONEYSUCKLE SANDS							DUNTROON SANDS			
Field No.		CG2	CG3	CG1	CG4	CG5	CG6	CG9	CG7	CG8	CG10	CG11
Laboratory Letter		A	B	C	D	E	F	G	H	J	K	L
Grading: per cent passing Sieve	5	100	100	100	100	100	100	100	100	100	100	100
	10	99.2	99.7	99.9	99.7	99.9	99.95	99.9	99.95	99.9	100	99.8
	18	65.5	81.8	91.0	75.5	91.5	96.8	93.8	83.4	85.8	99.8	97.2
	25	43.3	61.2	69.4	53.2	81.2	83.0	78.6	55.7	62.8	98.1	85.1
	44	28.6	39.2	39.3	24.6	47.2	42.8	34.6	18.2	22.3	68.4	44.5
	52	25.8	34.4	34.1	16.1	32.6	27.3	23.3	10.6	14.1	39.9	32.2
	85	20.4	24.5	22.4	6.4	10.8	8.3	7.6	1.7	3.2	10.7	10.2
	100	19.8	23.4	21.5	5.6	9.8	6.8	6.9	1.5	2.7	7.4	8.1
	150	16.4	14.8	16.8	3.9	4.9	2.5	3.9	0.3	1.3	2.3	3.3
	200	12.8	9.4	13.9	2.6	2.8	1.2	2.5	0.2	0.8	0.9	1.5
	240	10.3	5.0	13.0	2.4	2.4	0.5	1.2	0.1	0.5	0.6	1.1
	300	8.7	3.6	12.0	1.7	1.1	0.3	0.6	0.1	0.3	0.2	0.5
	1/256mm.	5.6	2.8	N O T	D E T E R M I N E D							
Sorting Geometrical		1.82	2.01	1.79	2.39	2.19	1.86	2.04	1.90	1.95	1.58	2.46
Skewness		0.60	0.63	0.07	0.03	0.32	0.40	0.38	0.38	0.41	0.41	0.56
% Weight of												
Quartz		54	53	54	53	60	52	57	52	54	58	56
K-feldspar		8	12	10	18	19	13	20	24	20	18	18
Plagioclase		15	12	15	12	9	23	15	11	12	16	17
Rock fragments		10	10	7	9	4	5	3	9	9	4	5
Mica		2	0.5	0.5	0.5	2	1	0.25	1	0.02	1	0.7
Soluble Material in HCl		5	10	2	5.5	5	4	5	3	5	3	3
Claysize fraction		6	2.5	8	2	1	1	0.4	0.05	0.2	0.1	0.3
K Na/Na Ca feldspar		.53	1	.67	1.50	2.11	0.57	1.33	2.18	1.66	1.13	1.06

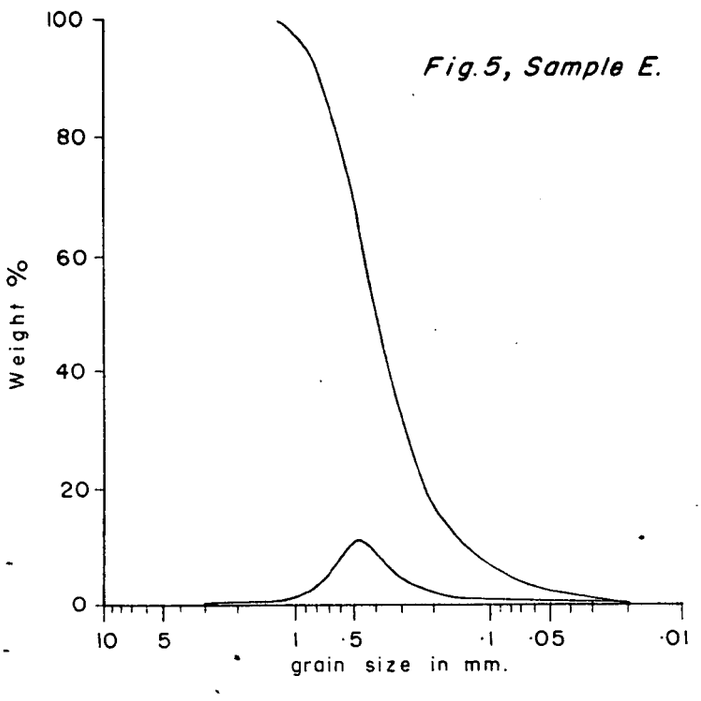
CUMULATIVE AND FREQUENCY DISTRIBUTION CURVES

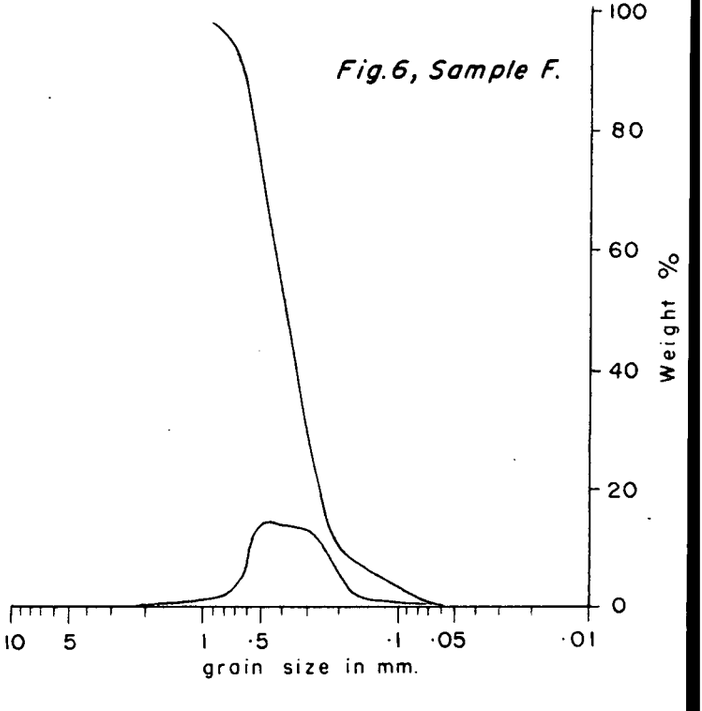












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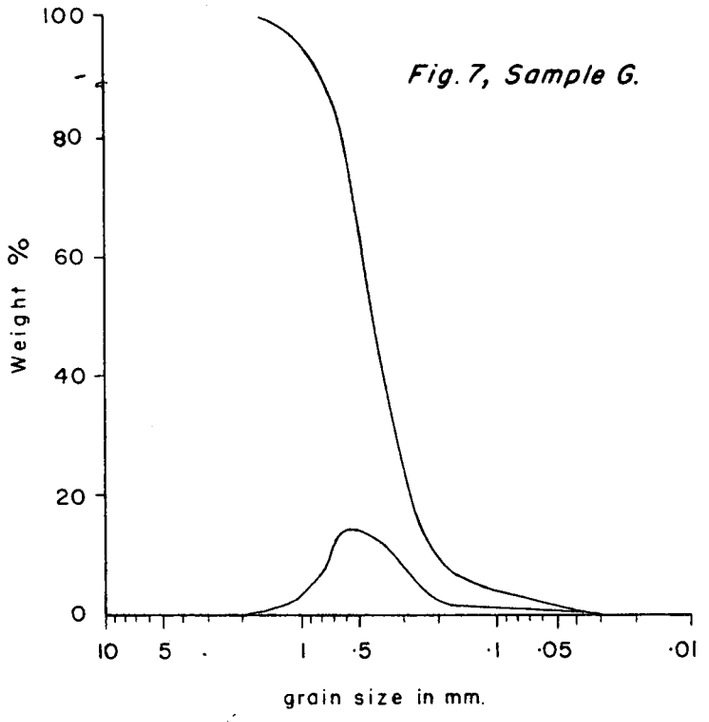


Fig. 7, Sample G.

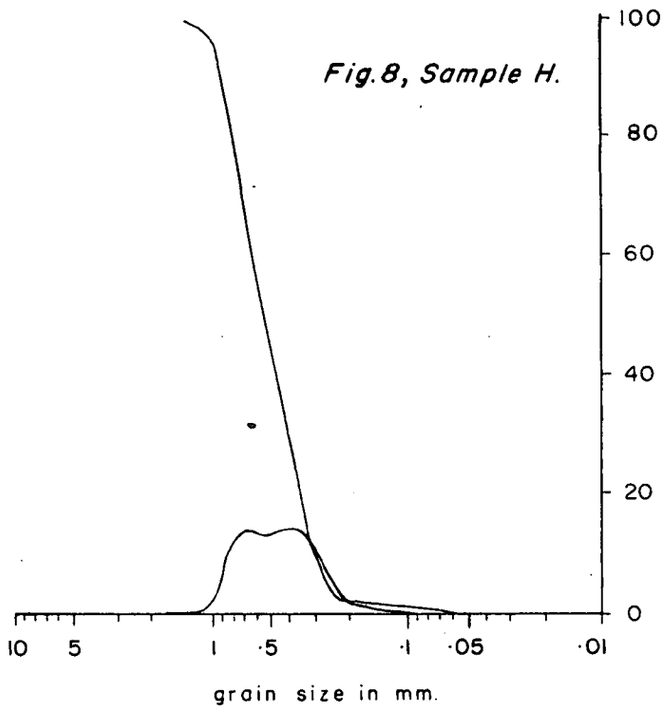


Fig. 8, Sample H.

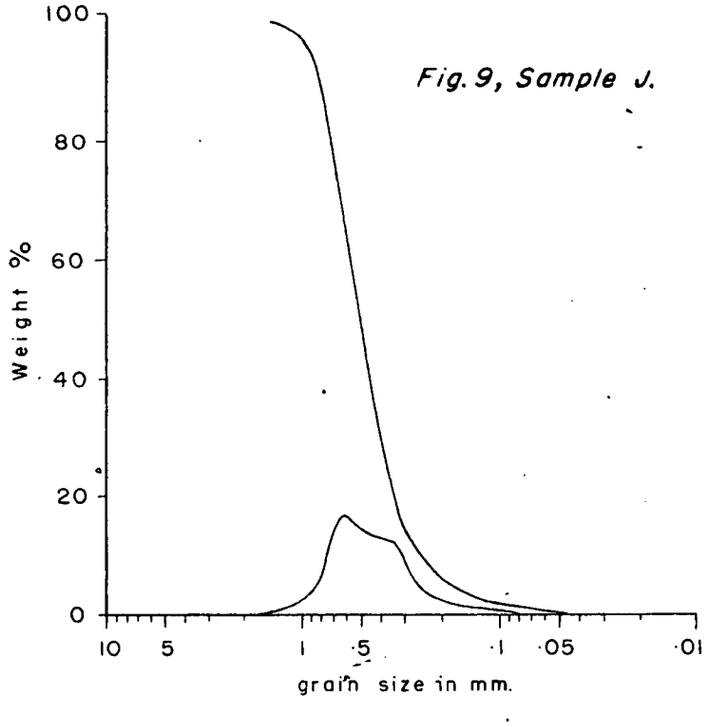


Fig. 9, Sample J.

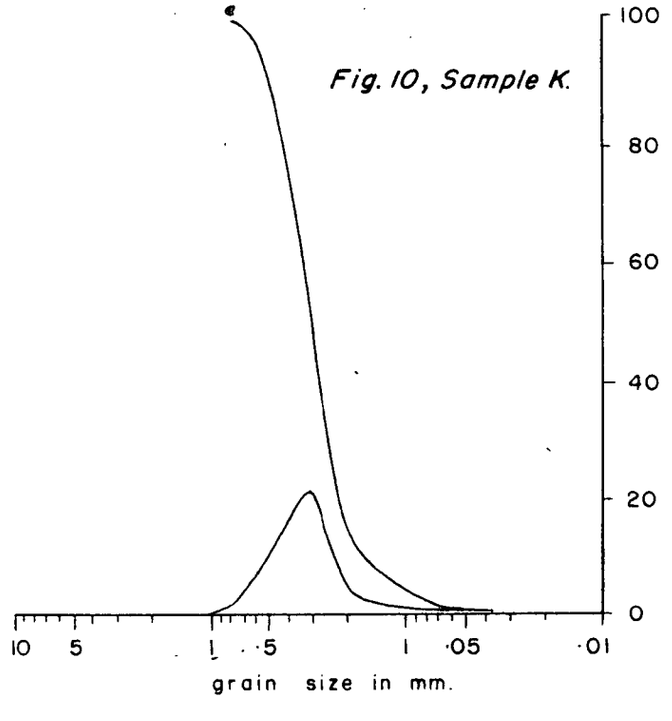


Fig. 10, Sample K.

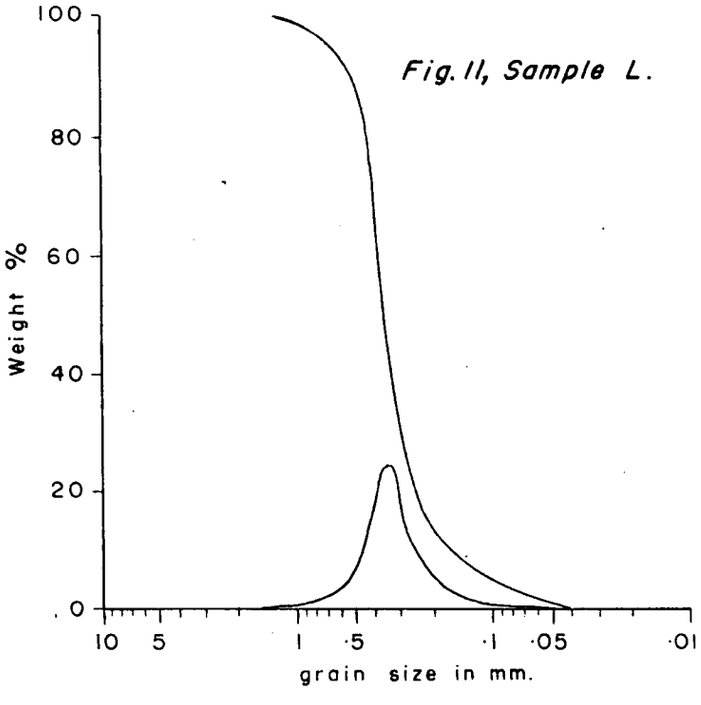


Fig. 11, Sample L.

To accompany Record 1966/156

I 55/A16/411

DUNE SAND NEAR CANBERRA IN THE MOLONGLO RIVER VALLEY
AUSTRALIAN CAPITAL TERRITORY
Locality Map
Based on Canberra 1: 50,000 Sheet

PLATE 1

REFERENCE

▼ Minor deposit

▼ Large deposit; at least 50,000 cubic yards

Index to Localities

1 Block 39 Deposit, Belconnen District

2 Coppins Crossing Deposits, Stromlo District

Green Hills Pine Plantation, Belconnen District

3A Main deposits

3B Main deposits

4 Minor deposit

5 Yarralumla Creek Deposit, Woden District

6 Government House Deposit, Belconnen District

Sullivans Creek Deposits, Acton

7 Minor deposit

8 Main deposit

Acton Golf Course Deposits, Acton

9 Main deposit

10 Minor deposit

11 Parliament House Deposit, Parkes

12A Blundell's Cottage Deposits, Parkes

12B Blundell's Cottage Deposits, Parkes

13 Australian-American Memorial Deposit, Campbell

14 Duntroon Deposit, Campbell

Between Honeysuckle Area and Kallaroo Road, Pialligo

15 Dairy Farm Deposits, Blocks 24 and 3

16A Pine Plantation Deposit, Block 66

16B Nursery Deposit, Block 24

Honeysuckle Area, City and Gungahlin District

17 Northern Deposits

18 Southern Deposits

19 Abattoirs Deposits, Woden District

Block 162, Gungahlin District

20A Western Deposit

20B Eastern Deposit

21 Block 27 (Sewage Farm) Deposit, Woden District

22 Block 163 Deposit Gungahlin District

23 Oaks Estate Deposits, Woden District

24 Sutton Road Deposit, Kowen District

Scale

1 0.5 0 1 2 3 MILES

Bureau of Mineral Resources, Geology and Geophysics. July 1966

To accompany Record 1966/156

I 55/A16/413

NORTHERN AREA OF
HONEYSUCKLE SAND DEPOSITS
BLOCKS 245 & 178
DISTRICTS OF GUNGAHLIN & CITY, A.C.T.

PLATE 2

based on plane table survey by G M Burton and others, 1955

SCALE OF FEET
200 100 0 200 400 600 FEET

Pine plantation

Power line

Sand & clay

District Boundary

Rock

Clay & sand

Position Approximate

Sand dit (worked out 28.4.55)

Power line

Plantation

Rock & soil

Rock

Worked out 28.5.58

No sand

No sand

No sand

No sand

CANBERRA CITY DISTRICT

GUNGAHLIN DISTRICT

True North

Mag North

Sand, 0-3 feet thick

Sand, more than 3 feet thick

L Designation of deposit in text of report

37 / 9' Auger hole showing thickness of sand intersected, in feet

85 / 8 Test pit, showing thickness of sand intersected

Approximate sand boundary

1920 Topographic contour

Fence

Track

LOCALITY MAP

N.S.W.

A.C.T.

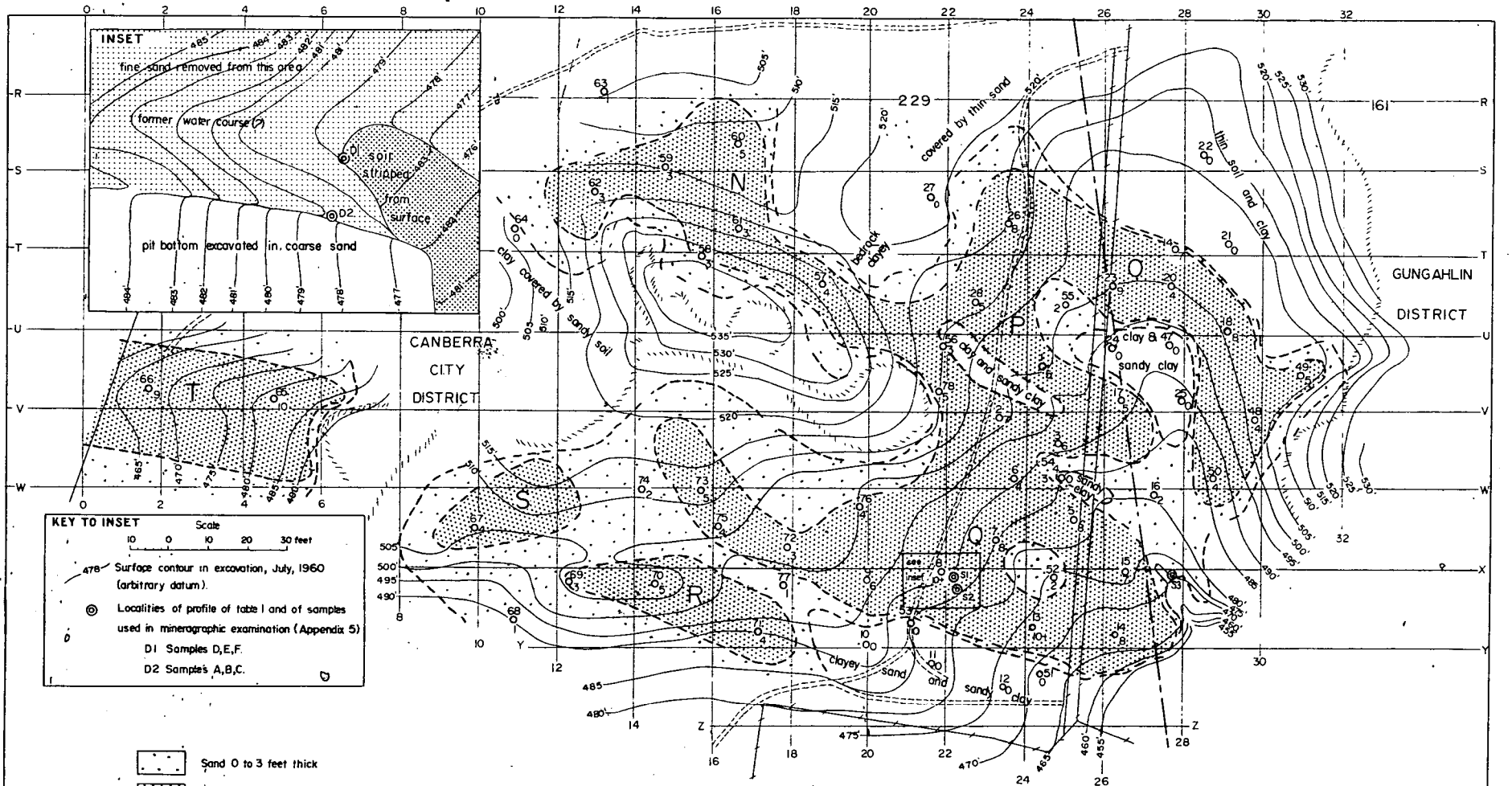
CANBERRA

N.S.W.

To accompany Record 1966/156

Bureau of Mineral Resources, Geology & Geophysics August, 1966

155/116/405



SOUTHERN AREA OF HONEYSUCKLE SAND DEPOSITS BLOCKS 229 & 161 DISTRICTS OF GUNGAHLIN & CITY, A.C.T.

200 100 0 200 400 600 FEET

Plane table survey by J.T.Harding and D.E. Gardner, August 1958

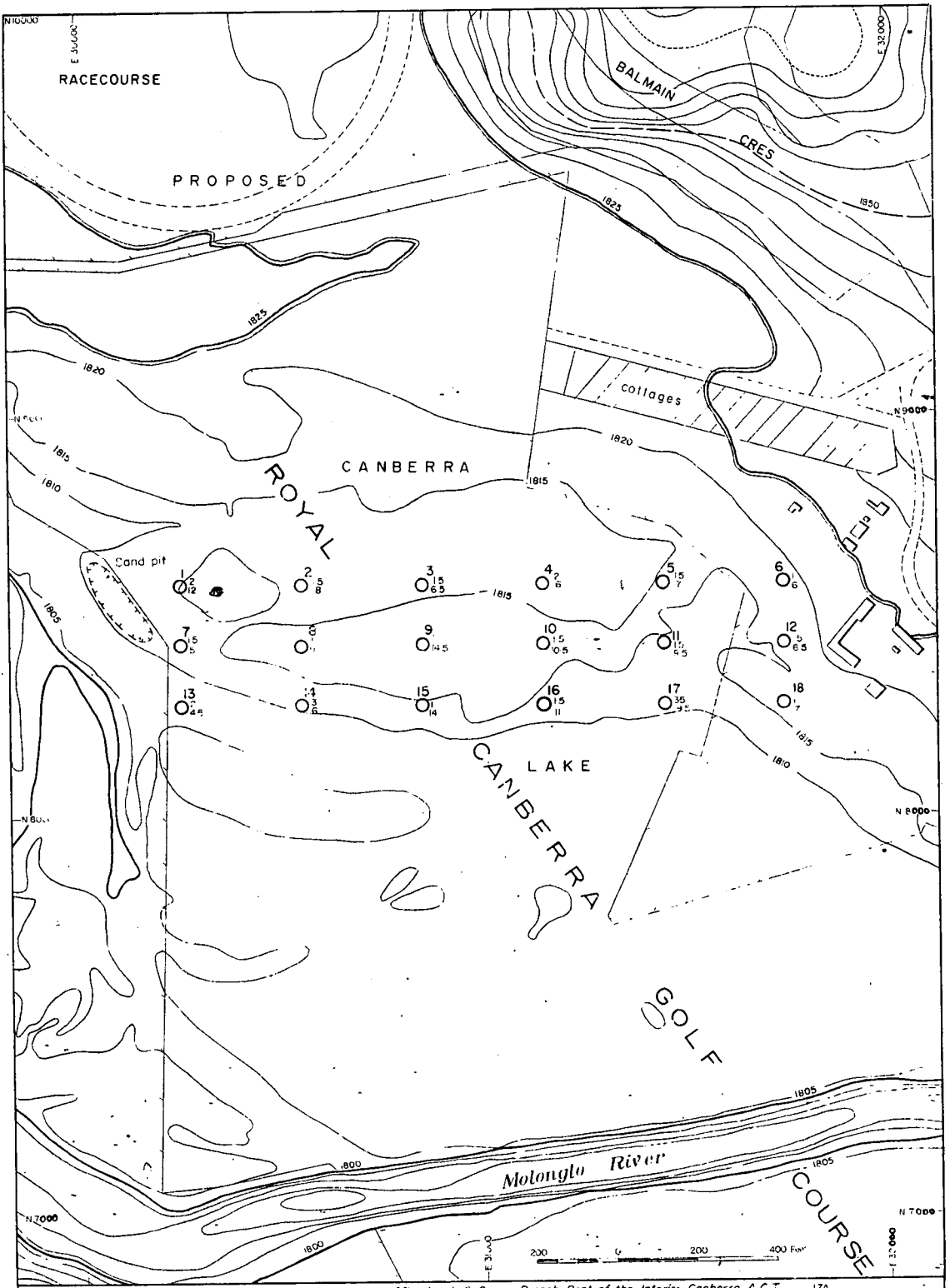
Bureau of Mineral Resources, Canberra, A.C.T. August, 1966

To accompany record 1966/156

I55/A16/406

MAIN SAND DEPOSIT AT GOLF LINKS, ACTON

As mapped in June, 1962



AUSTRALIAN CAPITAL TERRITORY
CONTOUR SERIES

Reference

- Fence
- 1825 — Edge of proposed Canberra Lake (1825 Contour)
- 1805 — Contour
- 7 O 1.5 / 5 — Proposed Auger hole showing thickness of overburden and thickness of sand, in feet
- Building
- Road

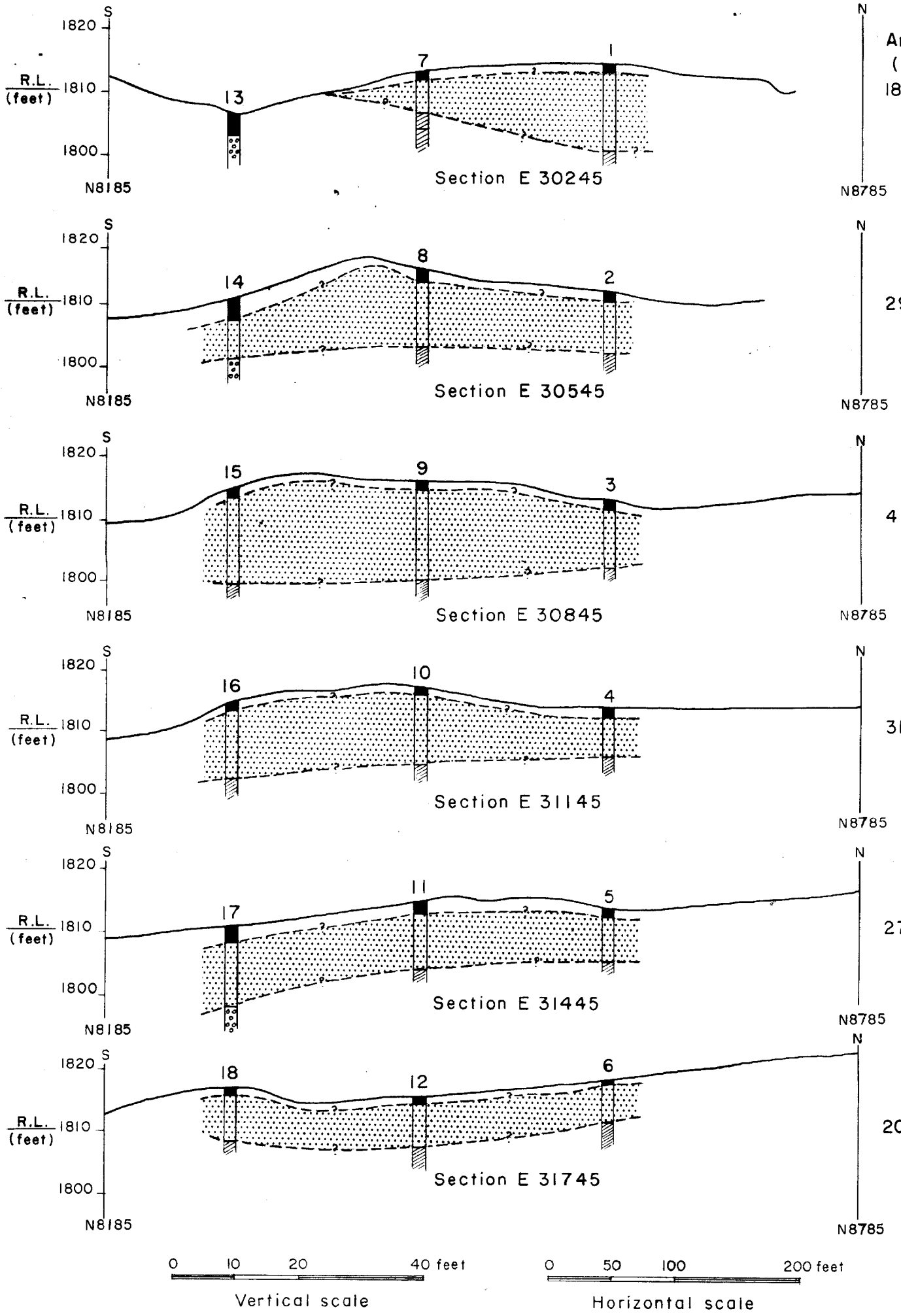
To accompany Record 1966/156

Bureau of Mineral Resources, Geology and Geophysics July 1962

PLATE 5

MAIN SAND DEPOSIT AT GOLF LINKS, ACTON

Cross sections through deposit showing results of augering



REFERENCE

6 — 3" hand auger hole.

Silty or sandy soil.

Very fine to very coarse sand with proportions of silty fines

Clayey silt.

Gravel.

Inferred boundary.

NOTE: Cross sections have a vertical exaggeration of 5 x.

Bureau of Mineral Resources, Geology and Geophysics. August 1962.

To accompany Record 1966/156

1/55/16/42 EJ

PLATE 6

DUNE SAND BETWEEN HONEYSUCKLE AREA AND KALLAROO ROAD, PIALLIGO A.C.T.

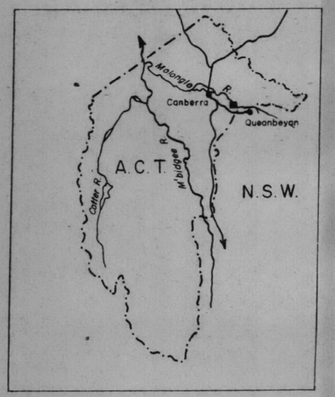
Scale

200 0 200 400 600 800 1000 feet

REFERENCE

- J. Dune
- 1900 Contour, based on Canberra datum
- Fence
- Road
- Vehicle track
- 66 Block number
- Boundary of Block

Base Map: Survey Branch, Department of the Interior, Sheet K8B



■ Area mapped

To accompany record 1966/156

155/A16/415

PLATE 7

SAND INVESTIGATION

BLOCK 163 GUNGAHLIN DISTRICT A.C.T.

SCALE 0 50 100 200 300 FEET

MAPPED BY PLANE TABLE AND ALIDADE

MAPPING BY J. WALTON AND B. KOOREY 24/11/1963

SAMPLED FROM BACK-HOE PITS

TRUE NORTH

MAGNETIC NORTH APPROX

TO FAIRBAIRN AVENUE

TRANSMISSION LINE

SOUTH OF STREET

BRIDGE

MOLONGLO

RIVER

TO OAKS ESTATE

EXCAVATION FOR SAND

EXCAVATION FOR SAND AND GRAVEL

A

B

C

D

REFERENCE

- FENCE AND GATE
- ROAD
- 25 CONTOUR — ASSUMED DATUM 0' AT BRIDGE ABUTMENT
- 50 CONTOUR
- EXCAVATION
- POWER POLE
- L ORGANIC SILT AND SAND
- ST SILT
- S SAND
- B BEDROCK
- F.S. FINE WINDBLOWN SAND
- R.G.S. RIVER GRAVEL AND SAND SHOWN AS R.S.G. WHERE SAND PREDOMINATES
- C. CEMENTED
- BOUNDARY OF MAIN DEPOSIT OF FINE SAND (NOV, 1963)
- BOUNDARY OF AREA TESTED FOR LOOSE RIVER SAND AND GRAVEL } NOV, 1963
- POWER TRANSMISSION LINE
- ISOPACH (approx) SHOWING DEPTH TO BEDROCK
- 16 — 6" 2' F.S. 4' G.F.S. — TEST PIT SHOWING THICKNESS OF OVERBURDEN AND SAND & GRAVEL. HOLE NUMBERS MARKED BY SUFFIX "A" WERE EXCAVATED IN JUNE, 1964 AND THE OTHERS IN NOVEMBER, 1963

FOOTNOTES

- 0 to (2-5) feet of black silty fine sand (2-5) feet to 8 feet, grey silty sand
- 0-4-5 feet, dark to black silt and sandy silt 4-5-10 feet, river sand and gravel

AREAS INCLUDED IN ESTIMATES OF RESERVES JUNE, 1964

- RIVER FLAT
- LOW SPUR

BUREAU OF MINERAL RESOURCES, CANBERRA. A.C.T.

NOVEMBER 1963
AMENDED JUNE 1964

PLAN No. I55/A16/305

To accompany Record 1966/156