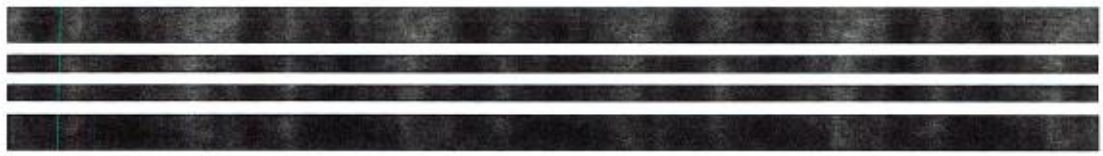

EIS 893

AB017867

Tobiway Crushing Pty. Ltd. : sand extraction, Lot 31 and lot 32 (access) DP634213, parish of Currandooly : environmental impact statement

NSW DEPT PRIMARY INDUSTRIES
AB017867

COFFEY

Coffey Partners International Pty Ltd

Consulting Engineers
in the Geotechnical Sciences

L92/0220

TOBIWAY CRUSHING PTY LTD

SAND EXTRACTION
LOT 31 AND LOT 32 (ACCESS)
DP 634213, PARISH OF CURRANDOOLY

ENVIRONMENTAL IMPACT STATEMENT

REPORT NO C5705/1-BA May 1992

DEPARTMENT OF
MAY 1992

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Date 15 May, 1992

The Manager
Tobiway Crushing Pty Ltd
PO Box 110
FYSHWICK ACT 2609

ATTENTION: Mr W Gregory

Dear Sir,

RE: ENVIRONMENTAL IMPACT STATEMENT, SAND EXTRACTION, LOT 31 AND LOT 32 (ACCESS), DP634213, PARISH OF CURRANDOOLY.

We are pleased to present the Environmental Impact Statement for the above project. Please do not hesitate to contact Mr Weeks White or the undersigned if you have any questions regarding this report.

For and on behalf of
COFFEY PARTNERS INTERNATIONAL PTY. LTD.

SUKUMAR PATHMANANDAVEL

Form 4
Environmental Planning and Assessment Act, 1979 (Section 77[3][d])

ENVIRONMENTAL IMPACT STATEMENT

This statement has been prepared by or on behalf Tobiway Crushing Pty Ltd being the applicant making the development application referred to below.

This Statement accompanies the development application made in respect of the development described as follows:

CONTINUATION OF SAND EXTRACTION OPERATION

The development application relates to the land described as follows:

Real property description:	**Lot 31 and Lot 32 (access)** **DP 634213,Parish of Currandooly** **Shire of Yarrowlumla**

The contents of this statement, as required by Clause 34 of the Environmental Planning and Assessment Regulation, 1980, are set forth in the accompanying pages.

Name, Qualifications and Address of person who prepared Environmental Impact Statement	Weeks White B.Sc, B.E., MIEAust, CPEng Coffey Partners International Pty Ltd 8C Wiluna Street Fyshwick ACT 2609

Certificate

I, Weeks White of Coffey Partners International Pty Ltd hereby certify that I have prepared the contents of this Statement in accordance with Clauses 34 and 35 of the Environmental Planning and Assessment Regulation, 1980.

15 May 1992

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SUMMARY

Tobiway Crushing Pty Ltd is applying to Yarrowlumla Shire Council for continuation of the existing development consent D3/85 for the sand extraction operation on Lot 31 (extractive site) and Lot 32 (access), DP 634213, Parish of Currandooly in order to:

* provide a medium sand known commercially as "all in sand" which is particularly suitable for concrete manufacture and related activities;
* provide continuity of employment for the present employees at the site and at associated depots in the ACT.

The site is located about 7km north of Bungendore between the Tarago Road (Main Road 268) and the eastern side of Lake George, just south of Butmaroo Creek. The site is presently within an area zoned 7(g) (Environmental Protection (Scientific)) under the Yarrowlumla Shire Local Environmental Plan 1986. Sand extraction has been carried out at the site since 1978, initially as a dry screening operation and as a wet and dry screening process since 1985. The existing development consent expires on 28 May 1992. The site is owned by the proponent and is currently partly used for sand extraction operations. This proposal is to continue the existing operations and to develop the site northwards to within 100 metres of Butmaroo Creek.

The proposed extraction would operate for the life of the site, estimated to be about 15 to 20 years. The total site area is about 80ha of which about half is used for mining operations at the present time. Sand extracted from the site is transported by truck mainly to nearby markets in Queanbeyan and the ACT.

A summary of the environmental issues associated with the proposal is as follows:

7(g) (Environmental protection (scientific)) Zoning. The site is located within the 7(g) zone as noted above. It appears that the boundary of this zone has been arbitrarily drawn,

excluding areas of intrinsic scientific worth and including other areas of lesser value. The site is located in an area identified as not being of particular scientific interest and occupies an area of about 1% of all similar deposits around the Lake George perimeter. Geological studies have indicated that the site contains no geological features unlikely to be found in the similar sediments surrounding the present and proposed workings. On this basis, restriction of sand mining operations on scientific grounds is assessed to be unreasonable.

Landform modifications. The landform changes would not be significantly different from those occurring due to the present mining. Ponds would be created having an average water depth of at least 2.5 metres and would cover the majority of the site. A buffer zone at least 100 metres wide would be created adjacent to Butmaroo Creek.

Hydrological impact. The site is currently and will continue to be protected by levee banks from flooding from Butmaroo Creek so that it is self-contained and isolated from the Creek. No feasible rainfall could cause the internal ponds to overflow the site and carry suspended solids into the Creek or over the surrounding countryside.

Effects on existing land use. The area of the site not presently part of the sand extraction operations is generally unused in anticipation of extension of the operations. Following rehabilitation, the land not forming part of the ponds would revert to agricultural use.

Effect on flora and fauna. No species of rare or endangered plants were observed on the site nor is it considered likely that any would be present. None of the regional fauna species known to be rare, endangered or of uncertain status were observed on the site or are likely to be present.

Effect on archaeological significance. The proposed development area is generally archaeologically similar in many respects to a number of the more recent sites found in the region. The area is, however, potentially more significant due to the number, type and

variation of the artefacts likely to be found on the site. The proposed buffer zone adjacent to Butmaroo Creek is generally likely to have the highest artefact densities and thus will protect a substantial portion of the relics on the site. Prior to any development outside the current fenced area of the site the developer will carry out archaeological investigations to generate a controlled sample of the part of the site which would be disturbed by the sand extraction operations and to assess the relationship between that part of the site and the area which would remain undisturbed within the 100 metre buffer zone. The developer will also fence the buffer zone so that machinery can not inadvertently move onto the area and potentially disturb near-surface archaeological sites. Permits will be obtained from National Parks and Wildlife Service as required by legislation.

Dust nuisance. The site is potentially a low dust generator as most of the operations are carried out on damp or wet material. No complaints have been received concerning dust problems from the present operations. Dust from truck movement along the access road to the site will be controlled by watering when required in hot windy conditions.

Water quality. As noted above the site is isolated from Butmaroo Creek and it is assessed that the proposed works are unlikely to have any effect on the water quality in the Creek due to overland flow or due to subsurface seepage.

Noise and vibration. The site is about 3km from the nearest residence and the operations at the site have been assessed to have negligible noise impact at the residence. Noise from trucks travelling to and from the site would not increase over that existing at the present time.

Visual impact. The site is hidden from view from the Tarago Road and will only impact the residents on the Lake George escarpment who will see an increase in the size and number of ponds at the site. Plantings on the southern and western boundaries will soften

the visual impact. The site is comparatively small compared to the area of other workings to the south-west and is also more distant from the escarpment.

Impact on road system. The proposed operations will not be different to the present operations and will not more severely impact the road system than at present. Discontinuation of the operations is likely to have a more significant effect on the road system as it is likely that in that situation road maintenance levies paid to the Shire would significantly decrease, without a corresponding decrease in associated truck traffic.

Economic and social impact. The site employs eleven full time staff and a number of associated truck operators. Continuation of the operations would continue this employment and the flow-on expenditure in the Shire and surrounding regions. Discontinuation of the operations would be unlikely to generate the same jobs at another location as other existing operations are likely to be able to increase production significantly with little increase in their workforce. It is also assessed that discontinuation of the operations would have little effect on the residents of Bungendore in respect of reduced truck traffic, as the product would be likely to be trucked either from other sites near Lake George or from the Shoalhaven River east of Bungendore.

In summary, continuation of the existing operation would have little adverse scientific, environmental or social impact. On the other hand, discontinuation of the operations could have significant social and economic impact on residents of the Shire and surrounding regions without commensurate improvement in the general amenity of the residents of Bungendore or of the Shire ratepayers generally.

1.0 INTRODUCTION

1.1 PURPOSE OF THE REPORT

This Environmental Impact Statement has been prepared as part of a Development Application being lodged by Tobiway Crushing Pty Ltd for continuation of an existing sand extraction industry located off the Bungendore - Tarago Road at Lot 31 (extractive site) and Lot 32 (access), DP 634213, Parish of Currandooly. The location of the site is shown in Figure 1.

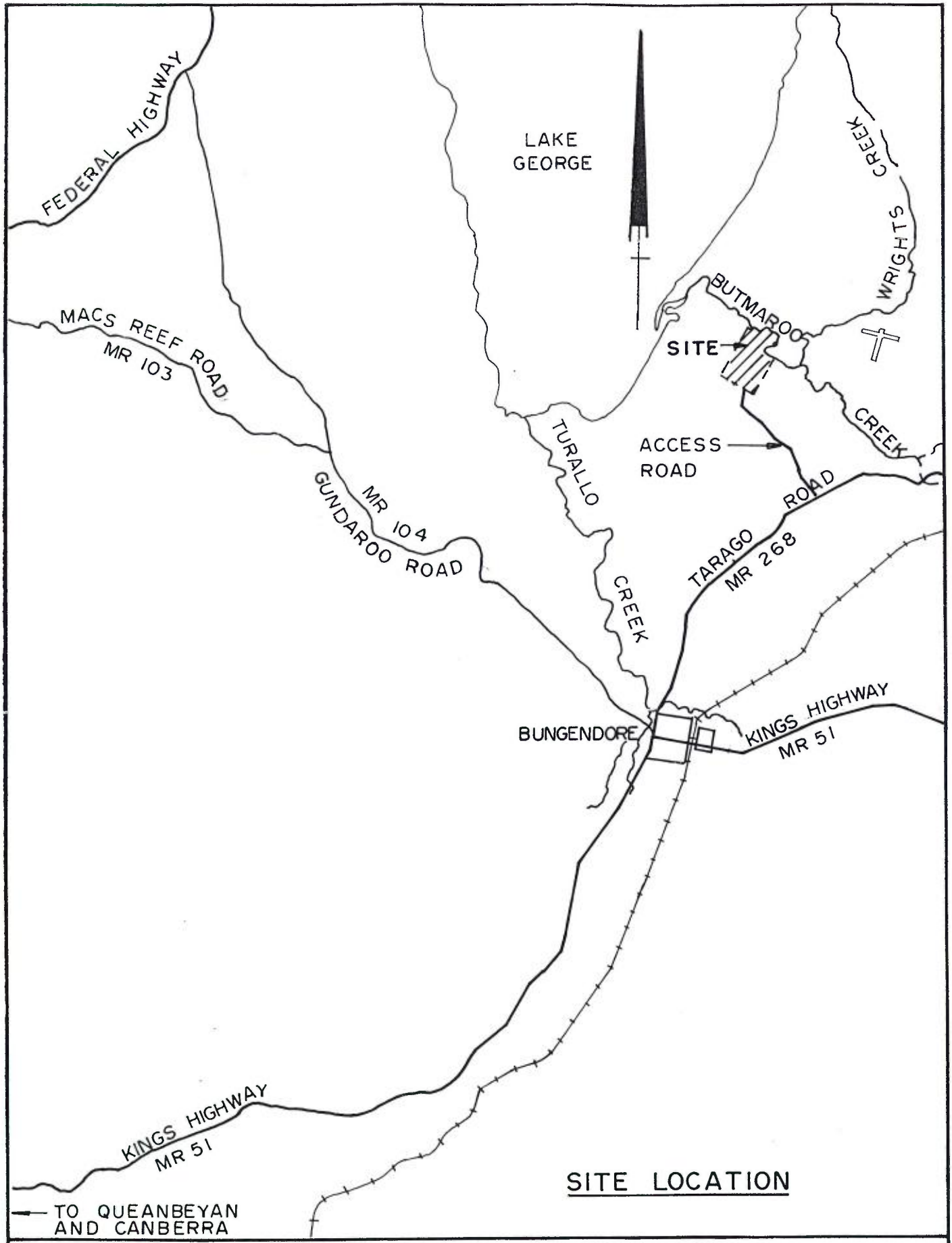
The Statement has been prepared in accordance with the principles and procedures for environmental impact assessment as established by the Environmental Planning and Assessment Regulations 1980, and takes into account matters specified by the Director, Department of Planning (see Appendix A).

Liaison was established with the Consent Authority, Yarrowlumla Shire Council, and comments and advice sought from the statutory and government bodies which are affected by the development proposal. Replies to correspondence are reproduced in Appendix A.

The definition of the existing environment of the site and access has been assembled from data obtained from the operator and from State Government Authorities, and from data obtained on site by this company.

The description of the proposed development and operation of the sand extraction has been compiled by this company in consultation with the present operator.

The evaluation of the environmental impact of the continuation of the existing operations encompasses the assessments made by this company, Mark Eisner & Associates Pty Ltd,



SITE LOCATION

Coffey Partners International Pty Ltd Consulting Engineers in the geotechnical sciences Incorporated in NSW

drawn	W.W./C.G.	TOBIWAY CRUSHING PTY. LTD.	drawing no: FIGURE 1
approved		ENVIRONMENTAL IMPACT STATEMENT SAND EXTRACTION, LOT 31, PART PORTION 9, PARISH OF CURRANDOOLY	
date	14-5-92		
scale	1:100,000		job no: C5705/1

COFFEY

Acoustical Consultants, Mr Paul Packard, Consulting Archaeologist, Mrs Alison Rowell, Biologist and Environmental Consultant and statutory and government bodies.

The development application relates to continued operation of sand extraction comprising dredging, screening and washing and transportation of up to about 200,000 cubic metres per year of sand from the Lake George alluvial basin about 7km north of Bungendore, NSW. The product is used in the building, construction and landscaping industries in the Canberra, Queanbeyan and surrounding regions.

1.2 THE COMPANY

Tobiway Crushing Pty Ltd, operating under the trading name Bungendore Sands, is the wholly owned subsidiary of Canberra Sand & Gravel Pty Ltd which has operated the sand and gravel extraction on Lot 31 for the past 8 years. Canberra Sand & Gravel Pty Ltd has been involved in sand and gravel production within the ACT and surrounding NSW for the past thirty years, during which time the company has gained extensive experience in the operation of dry and wet screening processes for sand and gravel extraction. Canberra Sand & Gravel Pty Ltd in Canberra and Tobiway Crushing Pty Ltd together employ about 40 people, including 11 full time employees and 4 company truck drivers at the existing site. Additionally 3 permanent sub-contract cartage contractors are employed to haul the product to end users.

1.3 HISTORY OF THE SITE

The site was initially developed as a dry screening operation only, extracting materials above the water table. Operations commenced in March 1978 in a joint venture agreement between Grantham Park Pty Ltd and Banora Nominees Pty Ltd, operating under the name Bungendore Sands. The joint venture continued operations at the pit until November 1983 when Portion 9 and the operations were purchased by International Resources and

Technology Ltd. Tobiway Crushing Pty Ltd entered into a lease agreement with International Resources and Technology Ltd to operate the mine on 1 February 1984.

An environmental impact statement was lodged by Tobiway Crushing Pty Ltd in February 1985 in support of an application to establish a wet screening operation at the site, permitting extraction of materials from below the water table. The application was approved by Yarrowlumla Shire Council on 28 May 1985, with approval being limited to a period of 5 years. On 28 April 1987 Council extended the period of approval from 5 years to 7 years, commencing from the date of consent, 28 May 1985. Present consent therefore expires on 28 May 1992.

In July 1987 Tobiway Crushing Pty Ltd purchased the site and operation from Giant Resources Ltd (formerly International Resources and Technology Ltd) and remains the current owner of the property. Under the Agreement for Sale of Land, Grantham Park Pty Ltd has an option to repurchase the property on 1 January 2008.

2.0 SITE ZONING AND GEOLOGY

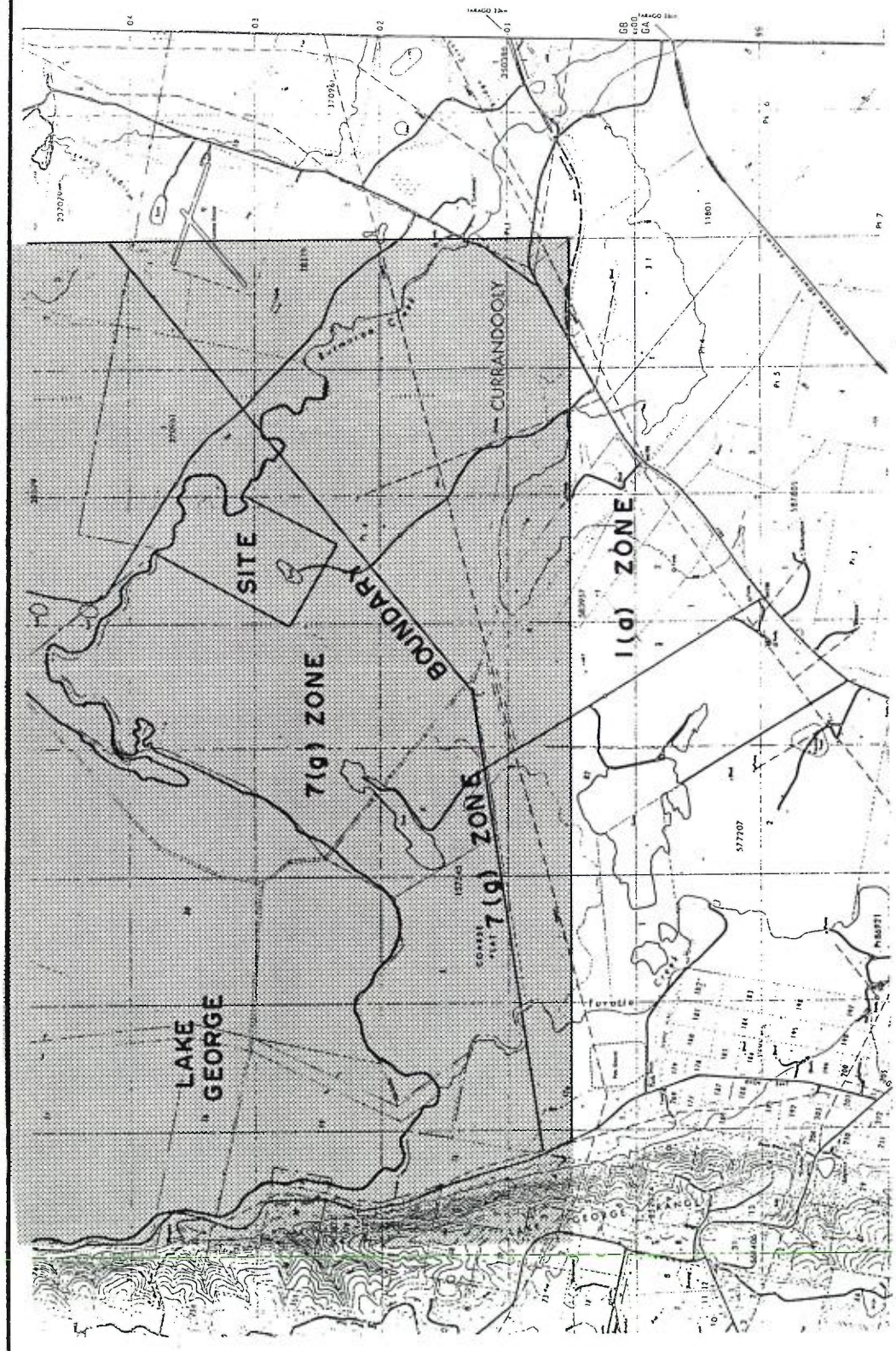
2.1 PRESENT ZONING

Presently the site occurs within an area zoned 7(g) (Environmental Protection (Scientific)) under the Yarrowlumla Shire Local Environmental Plan 1986 as shown on Figure 2, with the zone boundary passing within about 100 metres of the site. Extraction industries are prohibited in this zoning and it is understood this would therefore result in the closure of the present extraction operation on site at the end of its current development consent on 28 May 1992.

2.2 BASIS FOR 7(g) ZONING

It has not been possible to ascertain the basis on which the Zone 7(g) boundary determined by Council was established. However the zoning is understood to be based on recommendations concerning the geological significance of the area with respect to Lake George contained in Stevenson (Reference 4). In that reference the most geologically significant units in the Lake George basin were identified as the lacustrine, strandline and aeolian deposits and it was recommended that parts of these units be preserved so that sand mining did not completely remove any one of these units, enabling geomorphic and stratigraphic studies to be undertaken in the future. The report did not recommend cessation of mining activities in the area.

Figure 25 in the above report shows the Lake George locality and has an area shaded probably as being associated with the Lake George geological environment, although no specific mention is made of this in accompanying discussions. The lower boundary of the shaded area is also shown on Figure 2 and it may be seen that there is a significant variance between this area and the 7(g) boundary.



LEGEND

STEVENSON'S SHADED AREA

SITE ZONING

Coffey Partners International Pty Ltd — Consulting Engineers in the geotechnical sciences Incorporated in NSW

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TOBIWAY CRUSHING PTY. LTD.
ENVIRONMENTAL IMPACT STATEMENT
SAND EXTRACTION, LOT 31,
PART PORTION 9,
PARISH OF CURRANDOOLY

COFFEY

drawing no: FIGURE 2

job no: C 5705/ 1

2.3 GEOLOGY

The principal summary of the geology of the Lake George basin is BMR Record 1985/4 (Reference 3) which maps the site as being located within alluvial flood plain deposits which form the majority of the deposits around the basin. Desk and field studies carried out by Coffey Partners International Pty Ltd in March and April 1992 confirm this mapping. These studies are presented in Appendix C.

The site geology exposed on the existing pit walls and adjacent test pits may be summarised as consisting of a thin (average 0.3 metres to 0.7 metres thick) cover of generally fine aeolian (wind blown) sand, underlain by alluvial flood plain deposits of interbedded grey clays and moderately to poorly sorted fine to coarse sands. In some areas the alluvial sequence contains lenses of black clay and bands of well sorted fine sands.

The geological investigations also indicated that the alluvial flood plain deposits and thin aeolian sand cover extend outside the site into the surrounding areas, and that the site contains no geological features unlikely to be found in the similar alluvial flood plain sediments surrounding the present and proposed workings.

2.4 RELATIONSHIP TO LAKE GEORGE

The late Quaternary sediments and associated landforms in the Lake George basin have been grouped into five morphostratigraphic units by the Bureau of Mineral Resources (BMR) being colluvial, lacustrine, alluvial, strandline and aeolian (Reference 3). As noted in the previous section, the site has been mapped by the BMR and confirmed by geological investigation as being located within the alluvial flood plain unit around Butmaroo Creek. Similar alluvial deposits lie about Turallo Creek to the south, Taylors and Ailianoyonyiga Creeks to the east and Collector and Tarago Creeks to the north of the Lake. The site (Lot 31) occupies an area of about 1.2% of all alluvial deposits surrounding Lake George.

2.5 DISCUSSION

* The rationale for the current 7(g) zoning has not been established except that it lies within the area shaded in Reference 4.

* The 7(g) Zone excludes most of the alluvial deposits associated with Turallo Creek to the south-west and particularly areas of strandline and aeolian deposits adjacent to the Creek. The Zone also excludes significant geological deposits known as the "Stonevilla Embankment" west of Turallo Creek which have recently been approved by Council for mining for sand and gravel extraction and portion of a large aeolian deposit east of the present site.

* The current 7(g) Zone boundary can therefore be considered to be of an arbitrary nature and the inclusion of the present site within the Zone must also be considered to be arbitrary.

* It is noted that the current 7(g) Zone excludes areas of geologically significant strandline and aeolian deposits around the site as mapped by the BMR and that the present site is not located within the units of particular interest.

* The site occupies a very small area (about 1.2%) of the commonly encountered alluvial deposits around Lake George and the proposed future mining area occupies less than about 0.5% of these alluvial deposits.

* It is considered that allowing future mining to be carried out on the site to within 100 metres of Butmaroo Creek will not result in loss of recognised geologically significant units.

* It should be noted that much of the present scientific and archaeological understanding of the Lake George environs has been and will continue to be made possible by the significant exposures established in banks created by sand mining activities around the Lake.

* On the basis of geological considerations and the arbitrariness of the existing Zone boundary no environmental detriment is assessed to be likely to occur if the site is excluded from the 7(g) Zone.

3.0 MATERIAL SUPPLY AND DEMAND

3.1 NATURE OF THE DEPOSIT

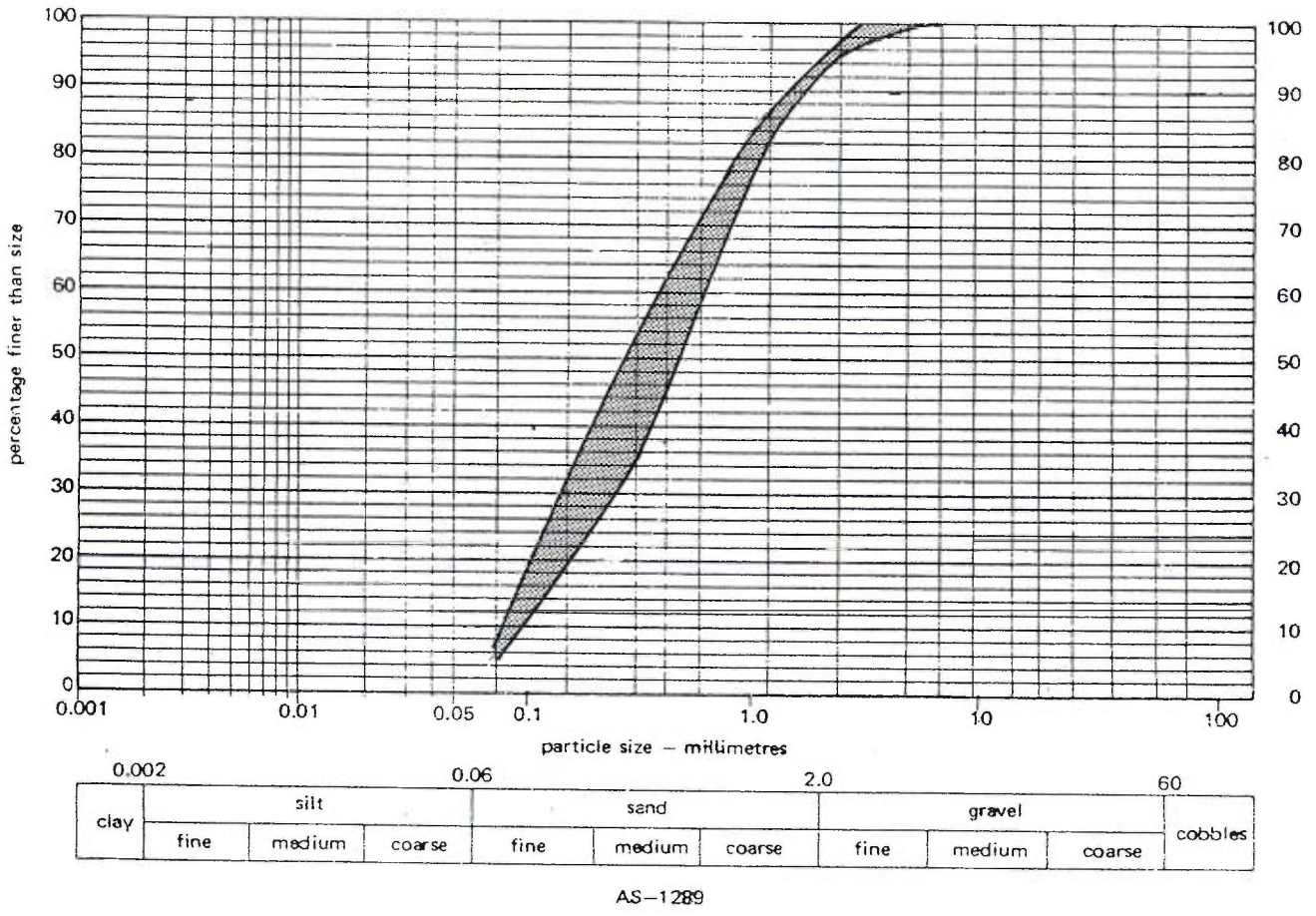
The geology of the site is described in Section 2 and Appendix C, and may be summarised as a fine wind blown sand deposit overlying a clay pan with medium to coarse, hard clayey sands at depth. The majority of the excavated materials are these deeper clayey sand deposits, which when washed produce a medium sized sand.

The medium sand produced is known commercially in the concrete industry as an "all in sand", having a range of sizes as shown in Figure 3. This product has been developed over the past years to replace the coarser river sands and fine wind blown sands which previously had to be blended to produce a suitable concrete sand. The "all in sand" is used by concrete manufacturers for structural concrete in the building and construction industry, for concrete products and for pipe and tile manufacturing and by the landscape industry.

3.2 DEMAND FOR THE MATERIAL

The demand for "all in sand" is closely related to the rate of development in the ACT, Queanbeyan and Yarrowlumla Shire regions. With the continuing development of the Tuggeranong and Gungahlin regions in the ACT, the expansion of Queanbeyan and the increase in housing and other developments in Yarrowlumla Shire it can be anticipated that the demand for building, construction and landscaping sands will continue into the next century.

The demand for materials from "self-contained" operations which do not discharge potentially dirty water to water courses, such as the site at Lot 31, will continue with the



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TYPICAL PRODUCT GRADING

Coffey Partners International Pty Ltd Consulting Engineers in the geotechnical sciences Incorporated in NSW				
drawn	W.W./C.G.	TOBIWAY CRUSHING PTY. LTD.	COFFEY	drawing no: FIGURE 3
approved		ENVIRONMENTAL IMPACT STATEMENT SAND EXTRACTION, LOT 31, PART PORTION 9, PARISH OF CURRANDOOLY		
date	14-5-92			job no: C5705 / 1
scale	—			

increasing community reluctance to use sand extracted from river and stream systems such as the Murrumbidgee River.

3.3 ALTERNATIVE SOURCES

Natural sands in the local region are a relatively rare commodity, both due to the inherent geological nature of the region (with deposits being restricted to river channels, narrow alluvial basins and the Lake George area) and to the increasing restrictions placed by the community on extraction processes due to the impact of the operations on the rural and urban environments.

Natural sands are obtained locally from three main areas, being the Lake George - Bungendore area, the Murrumbidgee River and the Shoalhaven River. Sand deposits in less than commercial quantities also occur on the Molonglo River and no extraction sites are in operation on this river. The major extractive sources in the Canberra region are summarised in Table 3.1, based on reports by the Department of Housing and Construction 1982 (Reference 1) and the National Capital Development Commission 1987 (Reference 2) and updated to reflect current knowledge.

For sand supply to the concrete industry, the sources listed in Table 3.1 which are currently supplying "all in sand" are those operated by Tobiway Crushing Pty Ltd (the subject of this report) and by Readymix Pty Ltd. These two sources supply the majority of all concrete sand to the local market. Should Bungendore Sands cease supplying sand to the market then the demand for the product would probably be initially taken up by Readymix Pty Ltd, and in the longer term it would be likely to lead to the establishment of a new pit for "all in sand" or, less favourably, a number of pits supplying coarse or fine sand for blending.

TABLE 3.1 - EXTRACTIVE SOURCES FOR NATURAL SAND AND GRAVEL IN THE CANBERRA REGION

LOCATION	COMPANY	MATERIAL	GEOLOGY	DISTANCE FROM CANBERRA CITY
Bungendore	Readymix (Corkhill Bros)	Fine to coarse sand	Fine windblown sand above clay pan, fine to coarse sands at depth	45km
Bungendore	Readymix	Fine to coarse sand	Fine windblown sand above clay pan, fine to coarse sands at depth	43km
Bungendore	Canberra Washed Sand	Fine to coarse sand	Fine windblown sand above clay pan, fine to coarse sands at depth	55km
Bungendore	Bungendore Sands (Tobiway Crushing Pty Ltd)	Fine to coarse sand	Fine windblown sand above clay pan, fine to coarse sands at depth	51km
Burkenburn	-	Fine	Dune sands, residual soils	55km
Shoalhaven River, Braidwood	Greiggs	Fine to coarse sand, medium to coarse gravel	Fine dune sands, coarse river sands and gravels	85km
Shoalhaven River, Braidwood	Jugiong Quarries	Medium to coarse sand	River bed	85km
Reedy Creek, Braidwood	X-Air	Coarse sand, medium to coarse gravel	River bed	80km (closed)
Collector, Lake George	Janton Sands	Medium to coarse sand, medium to coarse gravel	River channel and beach terrace	50km (not operating)

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LOCATION	COMPANY	MATERIAL	GEOLOGY	DISTANCE FROM CANBERRA CITY
Shoalhaven River, Braidwood	G.J. Schmidt	Medium to coarse sand	River bed	85km
Murrumbidgee River, Hall, Wallaroo Road	Canberra Sand & Gravel	Medium to coarse sand, medium to coarse gravel	River bed	35km (closed)
Murrumbidgee River, Hall, Wallaroo Road	Readymix	Medium to coarse sand	River bed	35km (closed)
Murrumbidgee River, Bresser Road Crossing	John Hyles	Medium to coarse sand	River bed	45km
Murrumbidgee River, Taemas Bridge	Besser (Boral)	Fine to coarse sand	River bed	55km (closed)
Murrumbidgee River, Uriarra	Canberra Washed Sand	Medium to coarse sand, medium to coarse gravel	River bed & terraces	20km (closed)
Molonglo River, Fyshwick	Canberra Sand & Gravel	Fine to coarse sand, medium to coarse gravel	River bed	10km (closed)

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4.0 EXISTING ENVIRONMENT

4.1 LOCATION

The site is located about 7km north of Bungendore, NSW, off the Bungendore - Tarago Road (Main Road 268) as shown on Figure 1. The property on which the sand extraction operates is in the Yarrowlumla Shire, Lot 31, part Portion 9, Parish of Currandooly, DP634213. Access to the site is via a private road from MR268 approximately 3km long.

4.2 TOPOGRAPHY AND LANDFORM

The site is located within the Lake George basin on a generally level alluvial plain extending about 5km southwest to the Lake George Range, about 5km southeast to the footslopes of Gibraltar Hill east of Bungendore, about 3km northeast to the footslopes of Governors Hill and about 1.3km northwest to Lake George. The northeastern boundary of the site is formed by Butmaroo Creek (also known as Deep Creek). Plates 1 and 2 show views of the site from Tarago Road and the Lake George escarpment.

4.3 CLIMATE AND HYDROLOGY

The climate of the area is temperate due to the elevation and inland location, being seasonal in temperature with generally an even distribution of average rainfall. Frosts are fairly common during late autumn, winter and early spring.

Data on the climate of the region has been obtained from the Bureau of Meteorology from the Bungendore Post Office and Canberra (Fairbairn) Stations. The Bungendore Station information is restricted to rainfall data over the period 1890 to 1985, and temperature and humidity data have been taken from the Canberra Station. The mean climate data from

Plate 1 View of site from Tarago Road

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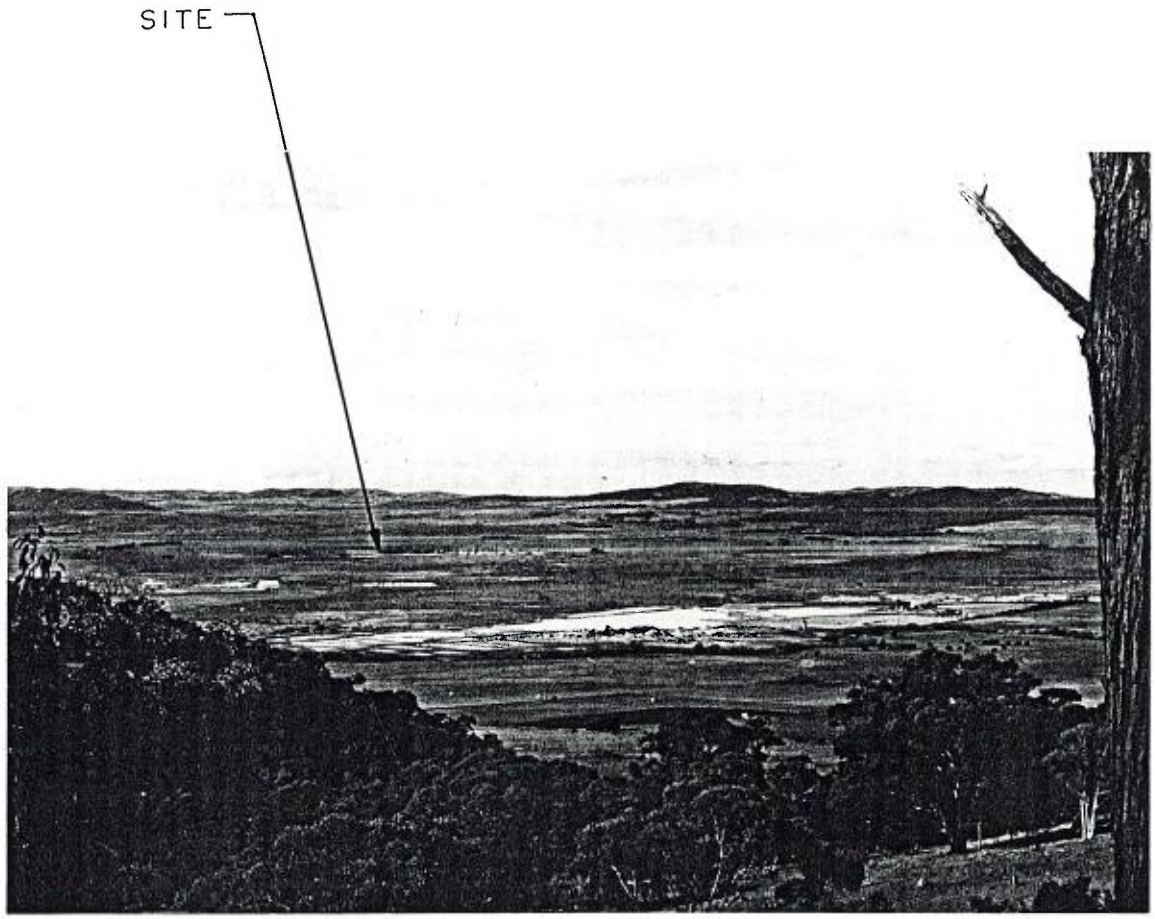

Plate 2 View of site from Lake George Escarpment

these two sources is summarised in Table 4.1. Temperature inversions can occur from early evening to mid-morning during the winter months.

The prevailing wind direction at the Canberra Station is northwesterly and westerly and tends to be strongest in the afternoons. Although it can be expected that the Lake George escarpment will modify the local wind pattern, that the overall pattern of prevailing westerly winds persists. Easterly winds are also common in the summer months.

Flooding in Butmaroo Creek is unlikely to enter the pit (Reference 5) and has not done so since operations commenced in 1978. Based on the current levee bank levels, flooding up to at least 1.0 metres above the level of the Creek bank at the upstream end of the site would be required to cause floodwaters to enter the pit. Water flooding from the creek follows a watercourse depression to the east of the site to Turallo Creek and thence to Lake George.

4.4 LAND USE AND OWNERSHIP

The site is currently owned by Tobiway Crushing Pty Ltd and covers an area of about 80.3ha. Approximately half the site is currently used for sand extraction, with the remaining area generally unused in anticipation of extension of the extraction area. The adjoining property, Grantham Park, owned by Mr H P Osborne, is used for grazing and surrounds the site on the east, south and west sides and fronts the northern boundary across Butmaroo Creek (Figure 4).

The nearest dwellings are Lakelands and Currandooley, approximately 2.8km east and 3.8km north-east, respectively, from the closest boundaries of the site (Figure 4).

TABLE 4.1 - MEAN CLIMATIC DATA

MONTH	RAINFALL (mm) AMOUNT	RAINDAYS	RELATIVE HUMIDITY (%)		TEMPERATURE (°C)		
			0900	1500	DAY	MIN	MAX
JAN	62	6	62	38	20.1	13.1	27.7
FEB	48	6	69	42	19.9	12.9	26.9
MAR	52	6	71	45	17.6	10.7	24.4
APR	47	6	77	50	13.1	6.5	19.6
MAY	49	6	85	59	9.0	2.9	15.0
JUNE	52	9	86	59	6.5	0.9	12.0
JULY	49	9	85	60	5.4	-0.4	11.1
AUG	53	9	81	57	6.8	0.8	12.8
SEPT	51	9	75	52	9.4	2.9	15.9
OCT	65	9	68	50	12.6	5.9	19.2
NOV	56	7	62	44	15.5	8.4	22.5
DEC	55	7	61	38	18.7	11.2	26.2
ANNUAL	639	90	73	49	12.9	6.3	19.4

Rainfall data from Bungendore Post Office, Station 070011, 95 year record.
Humidity and temperature data from Canberra (Fairbairn) Station, 44 year record.

C5705/1

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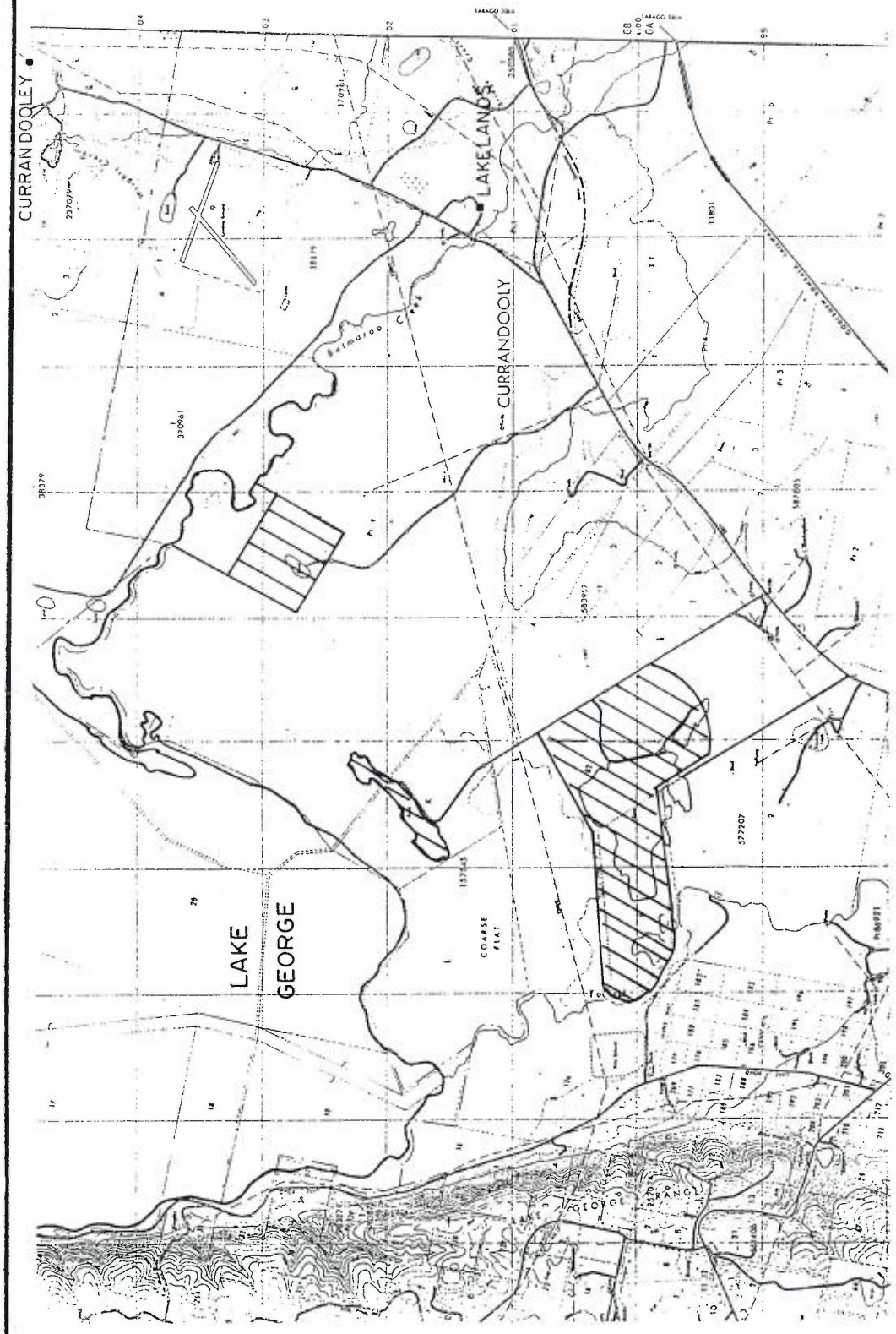


LEGEND

SAND EXTRACTION

RURAL

EXISTING LAND USE

Coffey Partners International Pty Ltd — Consulting Engineers in the geotechnical sciences Incorporated in NSW

drawn	W.W./C.G.
approved	
date	14-5-92
scale	1:50000

TOBIWAY CRUSHING PTY. LTD.
ENVIRONMENTAL IMPACT STATEMENT
SAND EXTRACTION, LOT 31,
PART PORTION 9,
PARISH OF CURRANDOOLY

COFFEY

drawing no: FIGURE 4

job no: C5705/1

4.5 EXISTING OPERATIONS

Tobiway Crushing Pty Ltd is currently operating the sand lease as a dry and wet screening operation under Yarrowlumla Shire Council development consent D3/85. A five year plan presented to Council in 1987 requested approval to extract up to 200,000 cubic metres per year. However economic conditions have limited the demand for material and consequently the extent of mining over the past 5 years has only been about 60% of that anticipated in 1987.

The operations at the site provide 11 full time positions together with the employment of four company truck drivers and three permanent sub-contract cartage contractors. Additionally, operations of Canberra Sand & Gravel Pty Ltd in Canberra are very dependent on the extraction works at this site for the supply of washed and screened sands. Of the 11 people employed at the site, nine are permanent residents within Yarrowlumla Shire.

The existing operations directly provide wages in excess of $650,000 and cartage of $550,000 per year. The total wage income for Tobiway Crushing Pty Ltd and Canberra Sand & Gravel Pty Ltd is in excess of $1,200,000 per year. All staff employed are either residents of the Yarrowlumla Shire, Queanbeyan or Canberra who would spend a large percentage of that income in the region.

Direct expenditure by Tobiway Crushing Pty Ltd within the Yarrowlumla Shire - Queanbeyan region is in excess of $2,500,000 per year. Total expenditure by Tobiway Crushing Pty Ltd and Canberra Sand & Gravel Pty Ltd exceeds $6,100,000 per year. Additional employment provided by the present operations also occurs in areas such as fuel supplies, mechanical and engineering services and hardware.

4.6 FLORA AND FAUNA

Assessment of the flora and fauna regimes at the site between the present workings and Butmaroo Creek has been made by Mrs Alison Rowell, Biologist and Environmental Consultant, as required by the National Parks and Wildlife Service and the assessment is presented in Appendix G. The assessment indicates that the site is covered in improved pasture, with Phalaris and clovers (Trifolium species) and has a wide variety of introduced weeds, especially thistles. There is also minor representation of native Spear Grasses Stipa spp., Wallaby grasses Danthonia spp., and native Tussock Grass Poa labillardieri on the lower flats adjoining the Creek. No species of rare or endangered plants were observed on the site, nor is it considered likely that any would be present.

The species of mammals, birds, reptiles and amphibians that were recorded from the site are common and typical of local pastoral areas, as well as showing the influence of the nearby Lake George wetland habitat. None of the fauna species known to be rare, endangered or of uncertain status in the region were observed on the site, and on the basis of habitats present it is considered unlikely that populations of any such species would be present.

4.7 ARCHAEOLOGY

Archaeological assessment of the portion of the site northeast of the existing workings has been made by Mr Paul Packard, Consulting Archaeologist, as required by the National Parks and Wildlife Service and the assessment is presented in Appendix E. The assessment indicates that the site is archaeologically similar in many respects to a number of the more recent sites found in the region, but does have some aspects making it potentially more significant:

* it has a relatively high density of artefacts, particularly towards Butmaroo Creek, of which a relatively high proportion are retouched;

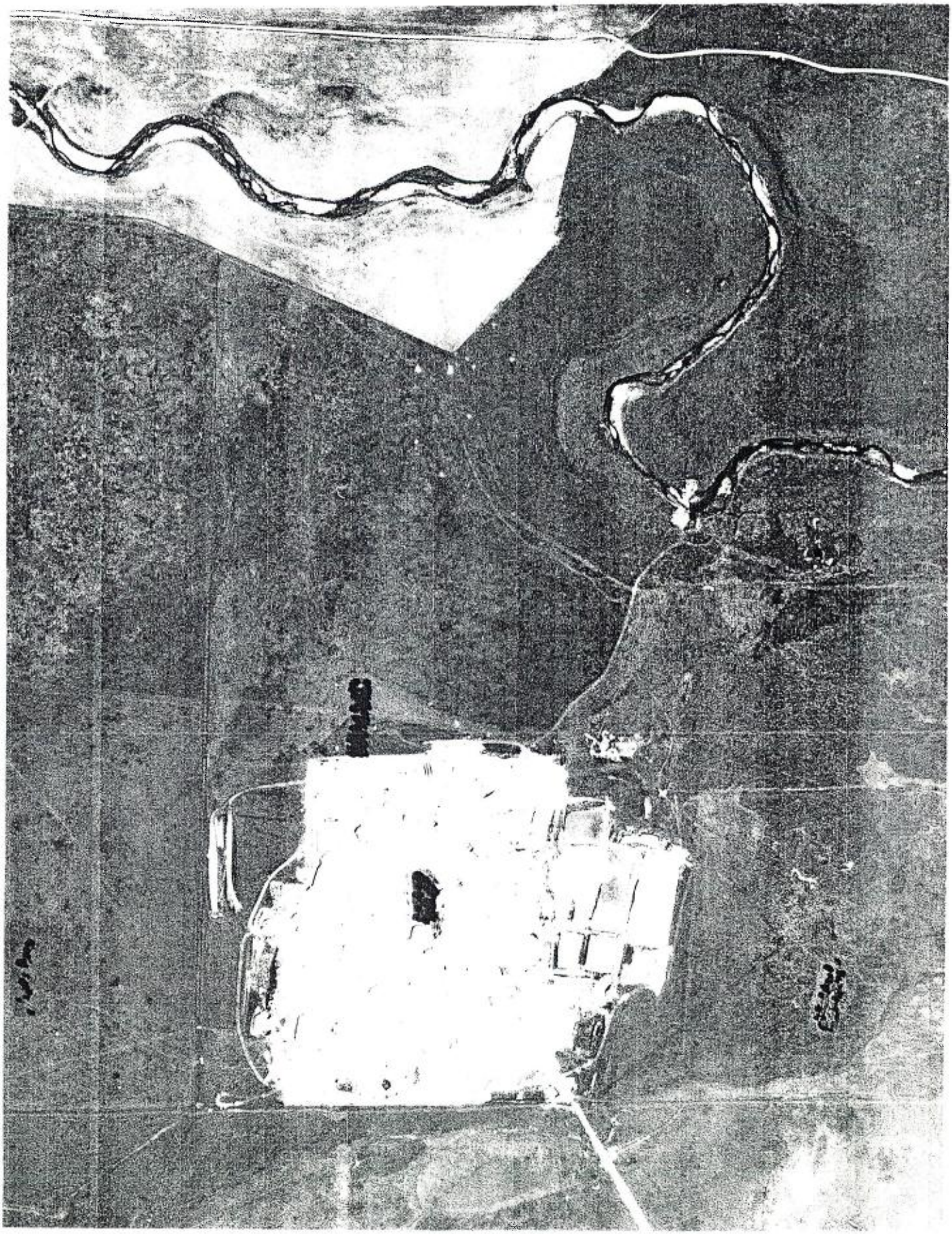


Plate 3 Aerial view of the site, 1987

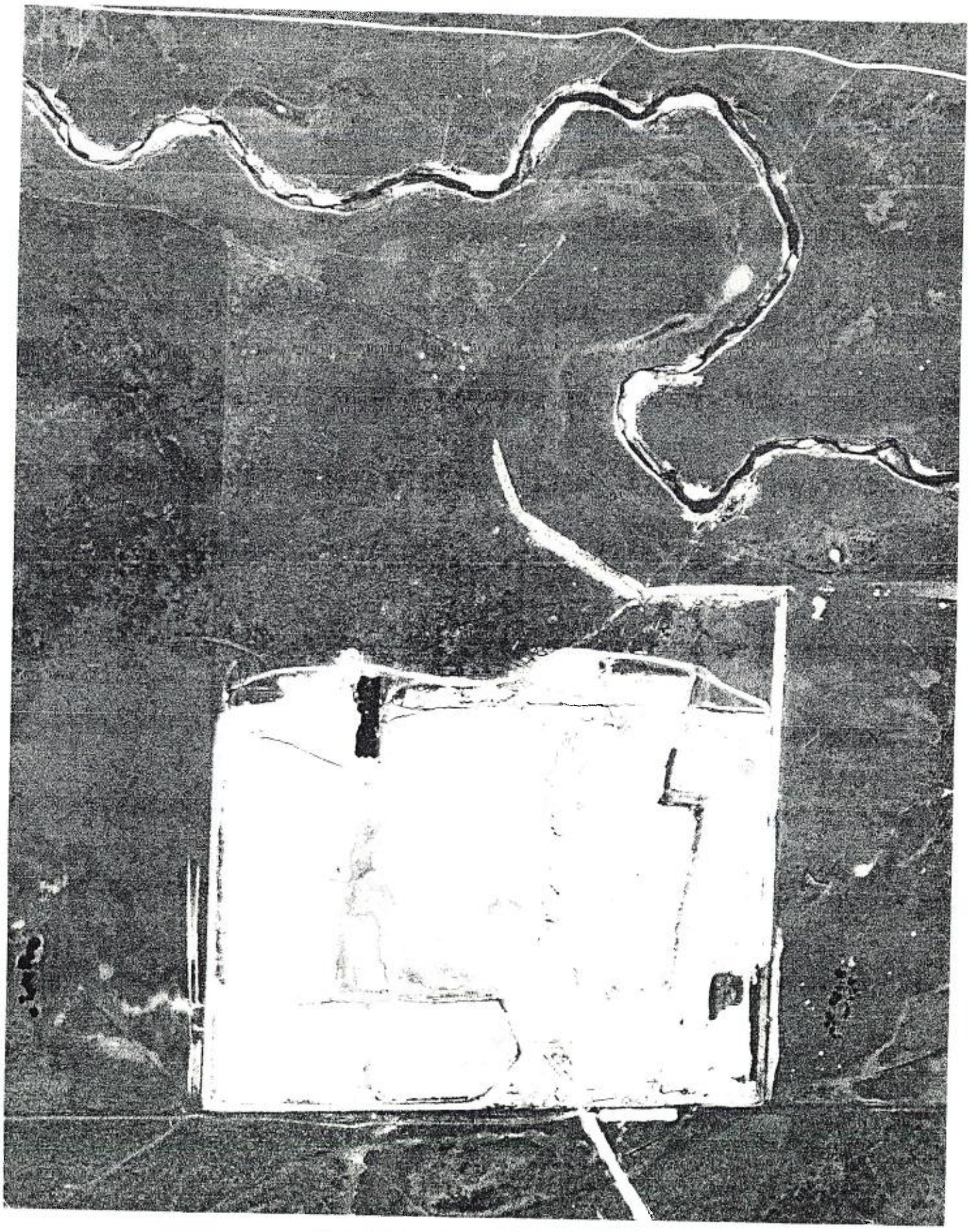


Plate 4 Aerial view of the site, 1991

* it displays internal variations in assemblage composition (raw materials);
* the artefacts are located across a relatively wide depth range with apparent variations in vertical displacements of the main concentration level across the site;
* the site does not generally exhibit any significant amount of post-European disturbance and is located on a deposit parts of which could potentially date from the early Holocene.

4.8 AIR QUALITY

The air quality in the region should generally be very good due to the absence of significant population centres in the near vicinity, but can be affected during dry periods by windblown dust and smoke. Dust can be generated from the dry lake bed of Lake George, from existing extractive industries in the region and from traffic on unsealed roads. Consideration of dust generation by the existing operations is presented in Section 5.7.

4.9 WATER QUALITY

Flow in Butmaroo Creek is generally intermittent. As discussed in Section 5.6, water from site operations is not discharged into the Creek and the quality of water in the Creek and in Lake George is not affected by the extraction processes.

Water in ponds formed by the sand extraction operations generally has suspended solids present due to the nature of the operations.

4.10 NOISE QUALITY

Ambient noise levels in the area can be variable depending on the density and type of traffic flow on the Tarago Road. A noise survey carried out by Mark Eisner & Associates Pty Ltd is presented in Appendix F. Background noise levels measured at the closest

residence was 35 dB(A), being dominated by nearby traffic and other activities closer to the residence than the existing workings.

4.11 VISUAL AMENITY

The site is located about 3km from the Tarago - Bungendore Road and is obscured from the road by natural terrain, rows of pine trees and distance (Plate 1). The general landscape is gently undulating with tall weeds and natural grasses and not visually significant.

The site is visible from the escarpment (Plate 2), but is less dominant in the landscape than other sand workings closer to the escarpment (see Figure 4). Trees are planted along the southern and western boundaries to lessen the visual impact. Plates 3 and 4 show aerial views of the site in 1987 and 1991 respectively, and the visual effect of the change from predominantly dry screening to predominantly wet screening operations can be clearly seen.

4.12 ROAD SYSTEM

The transportation route from the site to the Canberra, Queanbeyan and Yarrowlumla Shire regions is via Main Road MR268 (Tarago Road) along the western extremity of Bungendore and then along Main Road MR51 (Kings Highway) to Queanbeyan and Canberra (see Figure 1). The distance from the property exit to MR268 is about 3km, and the distance from this intersection to Bungendore is about 6km. From Bungendore to the centre of Canberra the distance is 42km.

Based on data published by the Roads and Traffic Authority (RTA) of New South Wales, the latest (1988) road usage figures around Bungendore village as measured at four stations is summarised in Table 4.2 below.

TABLE 4.2 - AVERAGE ANNUAL DAILY TRAFFIC

STATION NO.	LOCATION	AVERAGE ANNUAL DAILY TRAFFIC (1988)
94.515	MR51, east of Bungendore	2422
94.143	MR268, north of Bungendore	2414
94.144	MR51, south of Bungendore	4150
94.478	Road 104, west of Bungendore	1537

No information is available for percentages of heavy vehicles within the above traffic data. It was assessed by RTA in 1988 that about 15% of the traffic along MR51 could be heavy vehicles, with heavy vehicles being all trucks with two axles and dual wheels, and upwards. Hence, trucks on MR51 to the south of Bungendore could average about 620 daily, decreasing to about 360 trucks on MR51 and MR268 to the east and north of Bungendore.

The truck traffic on MR51 between Bungendore and Canberra to the south is approximately 70% greater than the traffic on MR51 to the east of Bungendore. Contributions to this increased vehicle traffic between Bungendore and Canberra are assessed to be derived from transportation of sand and gravel from the three existing extraction sites off the Tarago Road, the existing mining operation near Tarago, and the small industrial and commercial activities in the Bungendore village. Truck traffic originating from the existing sand extraction operation averages about 35 to 40 loads per day.

4.13 HERITAGE

The site is not listed by the Heritage Council of NSW or Yarrowlumla Shire Council as having heritage value. Based on the absence of European homesteads or other structures, it is assessed that the site contains no items of European cultural heritage. The significance of the site for Aboriginal and natural area items has been discussed in Sections 4.7 and 4.6 respectively.

5.0 CURRENT AND PROPOSED OPERATION

5.1 INTRODUCTION

As outlined in Section 1, Tobiway Crushing Pty Ltd currently extract sand from the site using dry and wet screening processes. The application to Yarrowlumla Shire Council is for continuation of the existing workings and thus proposed future operations will be essentially similar to those currently used. This Section therefore reviews current operations and procedures and notes where future operations will vary, as applicable.

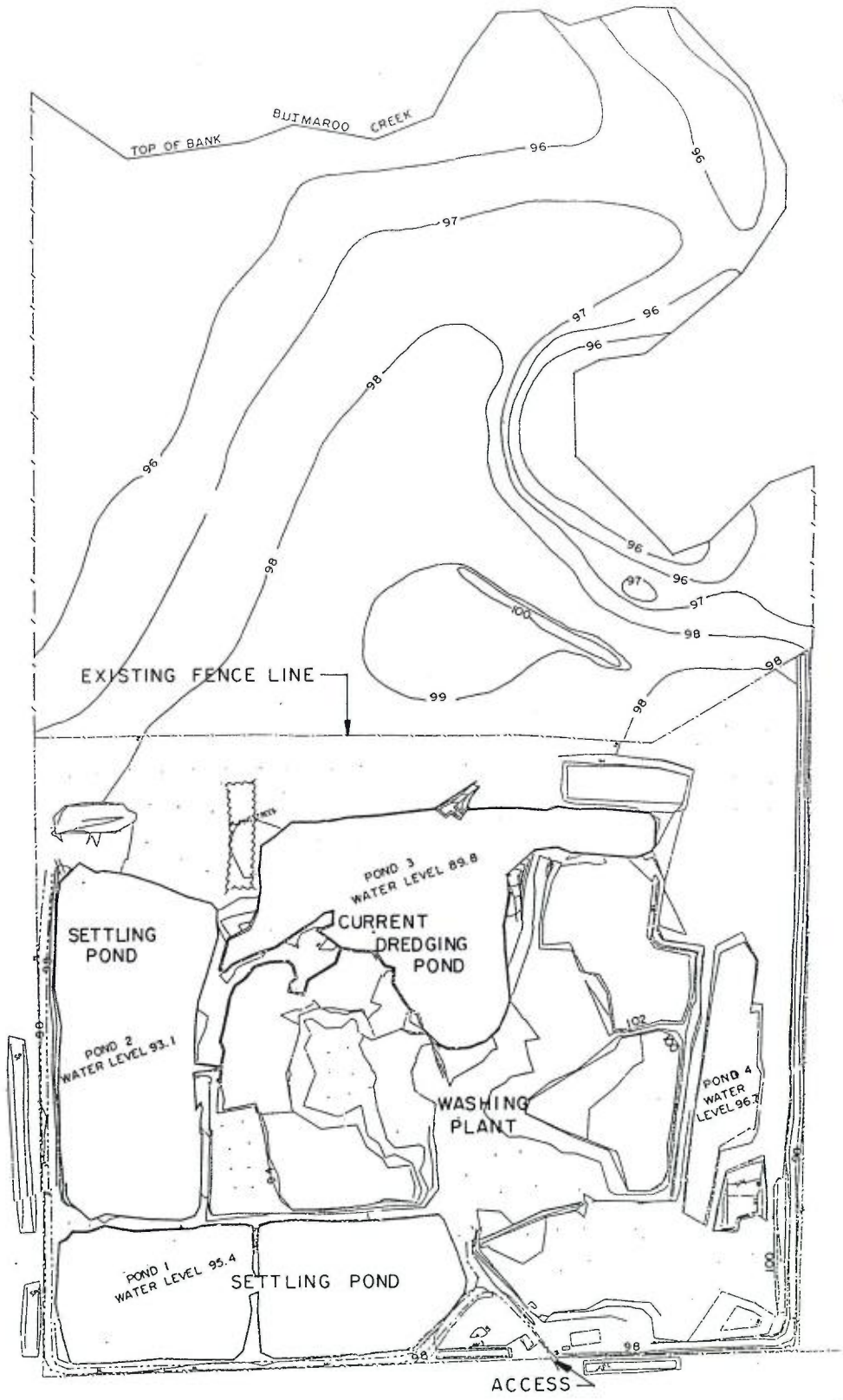
Materials produced at the site have been described in Section 3. The geology of the site is presented in Section 2 and Appendix C. The employment, economic and social aspects of the current operation are presented in Section 4.5.

5.2 ACCESS

The site is accessed by an existing gravel road off Tarago Road about 6km north of Bungendore, with the length between the main road and the entrance gate being concrete paved. The left turn access from Tarago Road will be upgraded as required by the Roads and Traffic Authority. The road from the gate to the pit is about 3km long, and is graded and maintained about every 6 to 8 weeks to ensure all-weather capability.

5.3 SITE PREPARATION

The current plan of the extraction operations is shown in Figure 5. The proposed future development plan is presented in Figure 6 and indications of staging are presented in Appendix H. The works area and location of the screening plant and stockpiles will remain towards the southern end of the site until ponds are developed at the north end



NOTE
LEVEL DATUM
APPROXIMATELY 583 m A.H.D.

SITE PLAN AND CURRENT OPERATIONS

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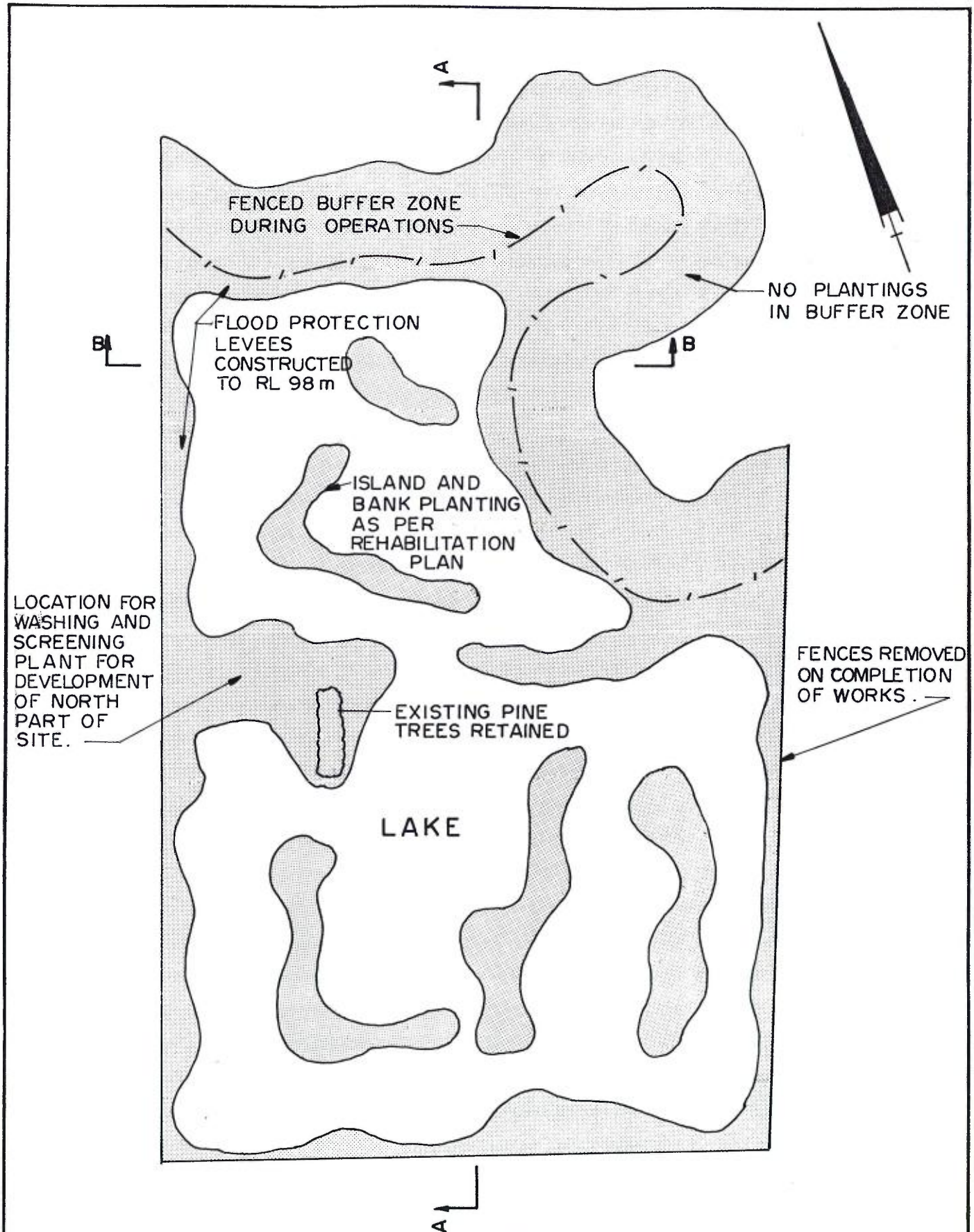
drawn	W.W./C.G.	TOBIWAY CRUSHING PTY. LTD.
approved		ENVIRONMENTAL IMPACT STATEMENT
date	14-5-92	SAND EXTRACTION, LOT 31,
scale	1:6000	PART PORTION 9,
		PARISH OF CURRANDOOLY

COFFEY

drawing no: FIGURE 5

job no: C 5705 / 1



PROPOSED DEVELOPMENT PLAN

Coffey Partners International Pty Ltd Consulting Engineers in the geotechnical sciences Incorporated in NSW

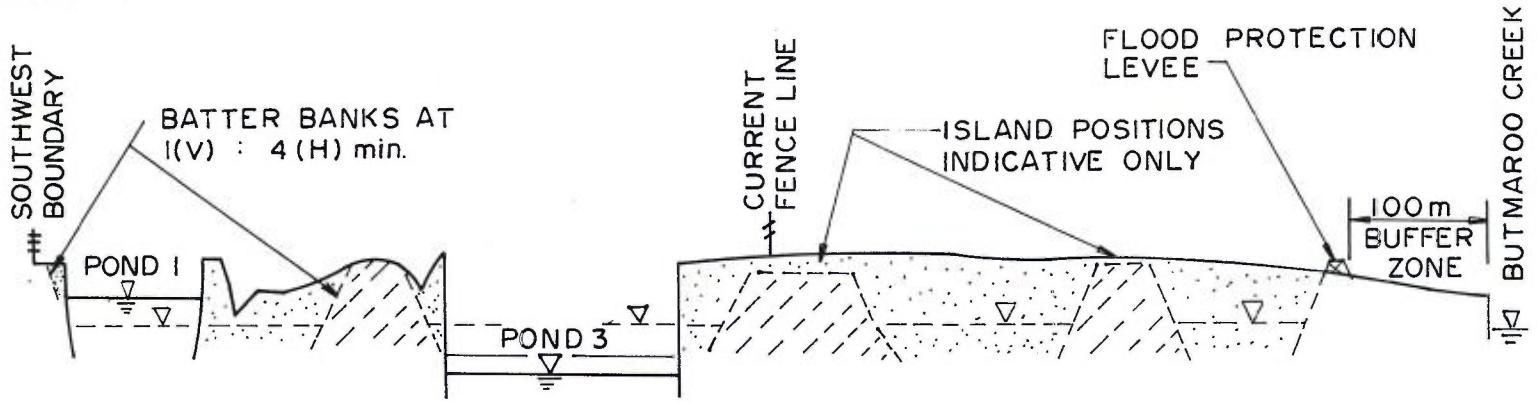
drawn	W.W./C.G.
approved	
date	14-5-92
scale	1:6000

TOBIWAY CRUSHING PTY. LTD.
ENVIRONMENTAL IMPACT STATEMENT
SAND EXTRACTION, LOT 31,
PART PORTION 9,
PARISH OF CURRANDOOLY

COFFEY

drawing no: FIGURE 6(a)

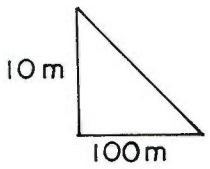
job no: C 5705 / 1



SECTION A-A

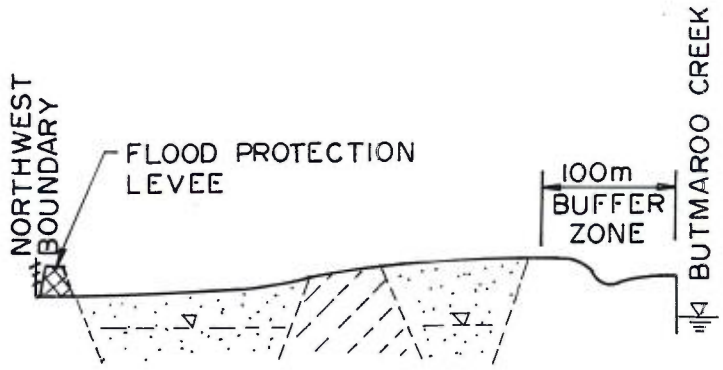
(SOUTHWEST TO NORTHEAST)

VERTICAL EXAGGERATION 10 : 1



LEGEND

- MATERIAL TO BE REMOVED
- FILLING REQUIRED
- MATERIAL TO BE REMOVED AND ISLANDS RECONSTRUCTED
- PRESENT WATER LEVELS
- FINAL LAKE LEVEL



SECTION B-B

(NORTHWEST TO SOUTHEAST)

PROPOSED DEVELOPMENT PLAN (SECTIONS)

Coffey Partners International Pty Ltd
Consulting Engineers in the geotechnical sciences
Incorporated in NSW

drawn: W.W. / C.O.
approved:
date: 4-5-92
scale: —

TOBIWAY CRUSHING PTY. LTD.
ENVIRONMENTAL IMPACT STATEMENT
SAND EXTRACTION, LOT 31,
PART PORTION 9,
PARISH OF CURRANDOOLY

COFFEY

drawing no: FIGURE 6(b)
job no: C 5705 / 1

when the plant will be relocated as shown in Figure 6. Development of the pits towards the north also involves movement of the dredging and excavation equipment.

Prior to excavation for extension of the pit the area will be fenced as required to prevent stock access, the surface vegetation removed and material suitable for topsoil stockpiled for landscape rehabilitation works. Levee banks will be constructed as development proceeds towards Butmaroo Creek as required up the level of the land at the edge of the existing workings to exclude potential flood waters from the Creek flooding into the site and to prevent water flowing from the site into the Creek.

Site works comprising fuel storage, power generator, site offices, weighbridge and ablution facilities are already in place and are unlikely to be moved.

5.4 EXTRACTION METHODS AND STOCKPILING

The current wet screening operation uses a barge mounted suction dredge with a feed hopper positioned at the front of the dredge. Material is excavated and fed into the hopper by a E300B Caterpillar excavator.

The dredged material, comprising a sand and water slurry is pumped from the dredge to a sand washing plant, comprising a Trumble screen and feed tank. A sand pump at the bottom of the feed tank transfers the sand to a dewatering cyclone which in turns feeds the sand into a stockpile and returns the water through a discharge into the settling ponds. Approximately 30% of the material in the settling ponds is extracted by an excavator and placed into stockpiles to be processed through a dry screening operation. The dry screening process comprises a front-end loader feeding a Commander Powerscreen from stockpiles dug by the excavator.

A schematic of the excavation process and water flow is presented in Figure 7. The average stockpile volume is about 5000 cubic metres, comprising 4 to 5 stockpiles about 3 metres high.

5.5 PROCESSING PLANT

The processing plant currently used for the works comprise:

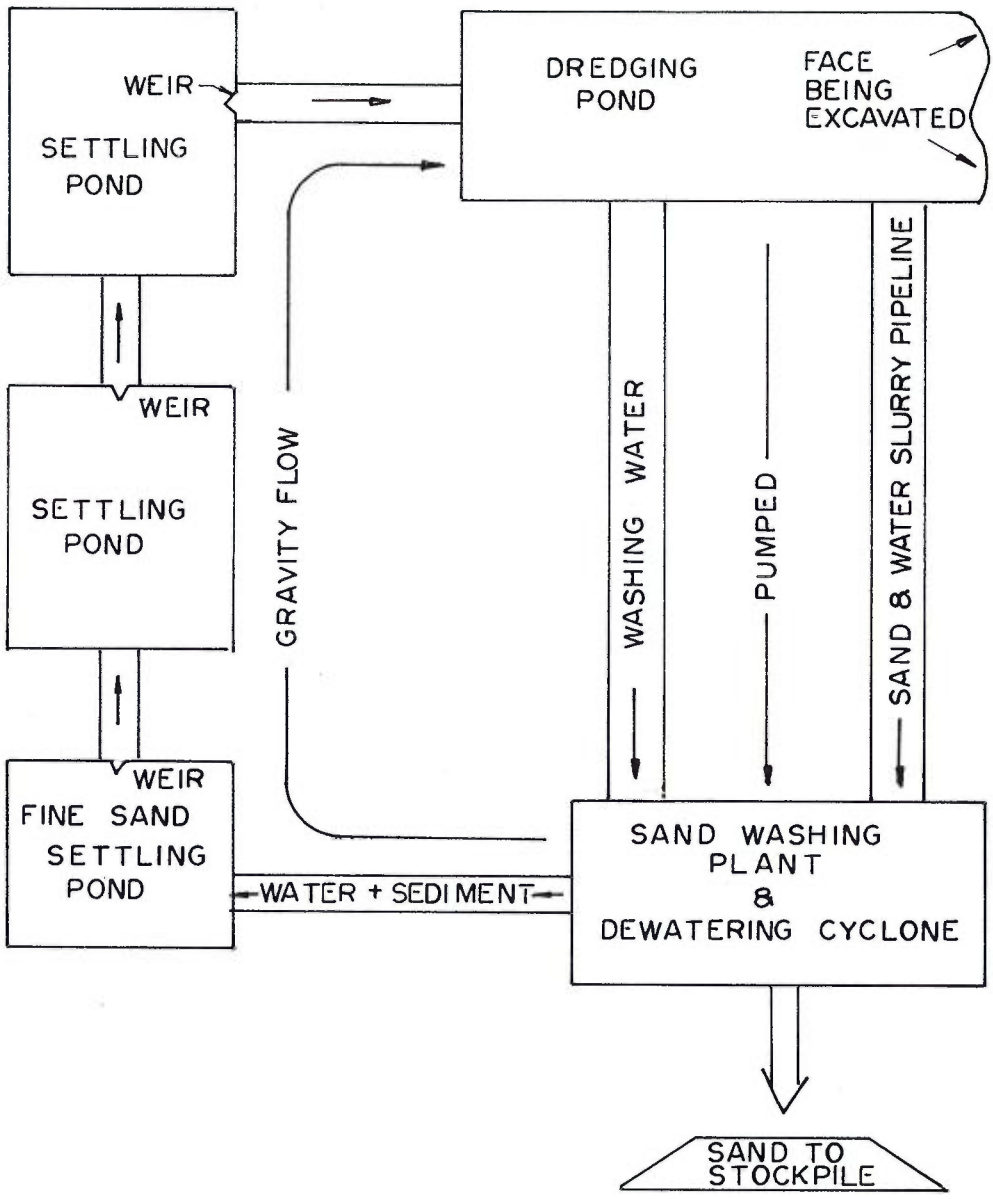
- suction dredge
- excavators, 1 - E300B Caterpillar, 1 - EL300 Caterpillar
- front end loaders, 1 - 950B Caterpillar, 1 - L120 Volvo
- sand washing plant
- screen, Commander Powerscreen
- generator, 250 kVA Caterpillar
- grader, Mitsubishi
- buildings, site office and workshop

All equipment used on the site is relatively new, with no moving machinery used in production being older than about 3 to 4 years.

5.6 WATER TREATMENT

A schematic of the water flows at the site is presented in Figure 7. It can be seen that operations comprise a closed circuit system so that water containing suspended solids does not leave the site. Settling ponds are used to settle the fine sand, silt and clay fractions. As the various areas of the site are worked, new ponds are created as required.

The Company does not use any chemical products as part of the production processes, and settling of the fines in the settling ponds is by gravity only. A licence issued by the



SAND AND WATER FLOW (SCHEMATIC)

Coffey Partners International Pty Ltd — Consulting Engineers in the geotechnical sciences Incorporated in NSW

drawn	W.W./C.G.	TOBIWAY CRUSHING PTY. LTD.	drawing no: FIGURE 7
approved		ENVIRONMENTAL IMPACT STATEMENT SAND EXTRACTION, LOT 31, PART PORTION 9, PARISH OF CURRANDOOLY	
date	4-5-4L		
scale	—		job no: C5705/1

COFFEY

Department of Water Resources is held to pump water from Butmaroo Creek but this facility has not been used for some years.

The State Pollution Control Commission has made regular inspections of the site and have issued annual licences for operation of the site (Appendix B).

5.7 EROSION CONTROLS

All surface water run-off from the access road and hardstand areas is directed into the works area and into settling ponds. It should be noted that all stockpiles and vehicle manoeuvring areas are contained within the works area.

To minimise erosion of dry materials, topsoil and overburden stripped prior development of new areas is stockpiled on the boundary of the pit in rows at about 90 degrees to the prevailing wind direction where possible. The stockpiles are constructed to a maximum batter slope of 3 horizontal to 1 vertical and sown to Soil Conservation Service guidelines to reduce wind and water erosion.

Wind erosion of dry materials potentially causing dust problems is minimised as operations, apart from the processing of the thin surficial wind-blown sand deposit, require wet processing and consequently stockpiles and the general works area are constantly damp. Furthermore materials are not generally moved within the site by truck but rather pumped by the dredge as a water / soil slurry. Consequently the only significant dust producing operation is transport from the site along the access road to the Main Road. In times of dry and windy conditions a water truck will be available to suppress dust generated from this source. It is understood that no complaints have been received by the operators or by Council concerning dust generated from operations on this site over the past five years.

All processed product material is stockpiled on the floor of the pit workings so that water run-off is directed back into the settling ponds. Product stockpiles are not subject to wind erosion as they have a significant moisture content arising from the method of production.

It should be noted that inspections of the site have been carried out over the past five years by the State Pollution Control Commission (now the Environment Protection Authority), the Department of Water Resources, The Department of Minerals and Energy (now the Department of Mineral Resources) and the Soil Conservation Service and licences and permits have been granted and reissued as required (Appendix B).

5.8 NOISE CONTROLS

Equipment used in the pit is manufactured to meet statutory requirements for noise and emission controls and no further noise control attachments are used. Most of the plant operates below the surrounding ground level and as manufacturers continue to reduce sound levels from new machinery, noise intrusion into the surrounding areas should reduce further from the present levels.

5.9 TRANSPORT OF PRODUCT

The product is dominantly transported from the site in trucks carrying about 25 tonnes of material and loaded to 38 to 42.5 tonnes gross weight. Excess load permits are purchased as required. The trucks comprise bogey drive prime movers with either a tri-axle tipping trailer or a rigid tipping body pulling a tri-axle dog trailer. Each load is weighed before leaving the site. An average of about 35 to 40 truck loads per day is hauled from the site, with peak movements of up to 60 truck loads per day.

The Company trucking policy is that trucks must not leave the pit overloaded and that all loads must be covered as required by authorities. Failure by a Company driver or

subcontractor to cover loads can result in dismissal. Company truck drivers are required to comply with road traffic regulations and tachographs have been installed in all Company trucks and are viewed each day to ensure compliance with the regulations.

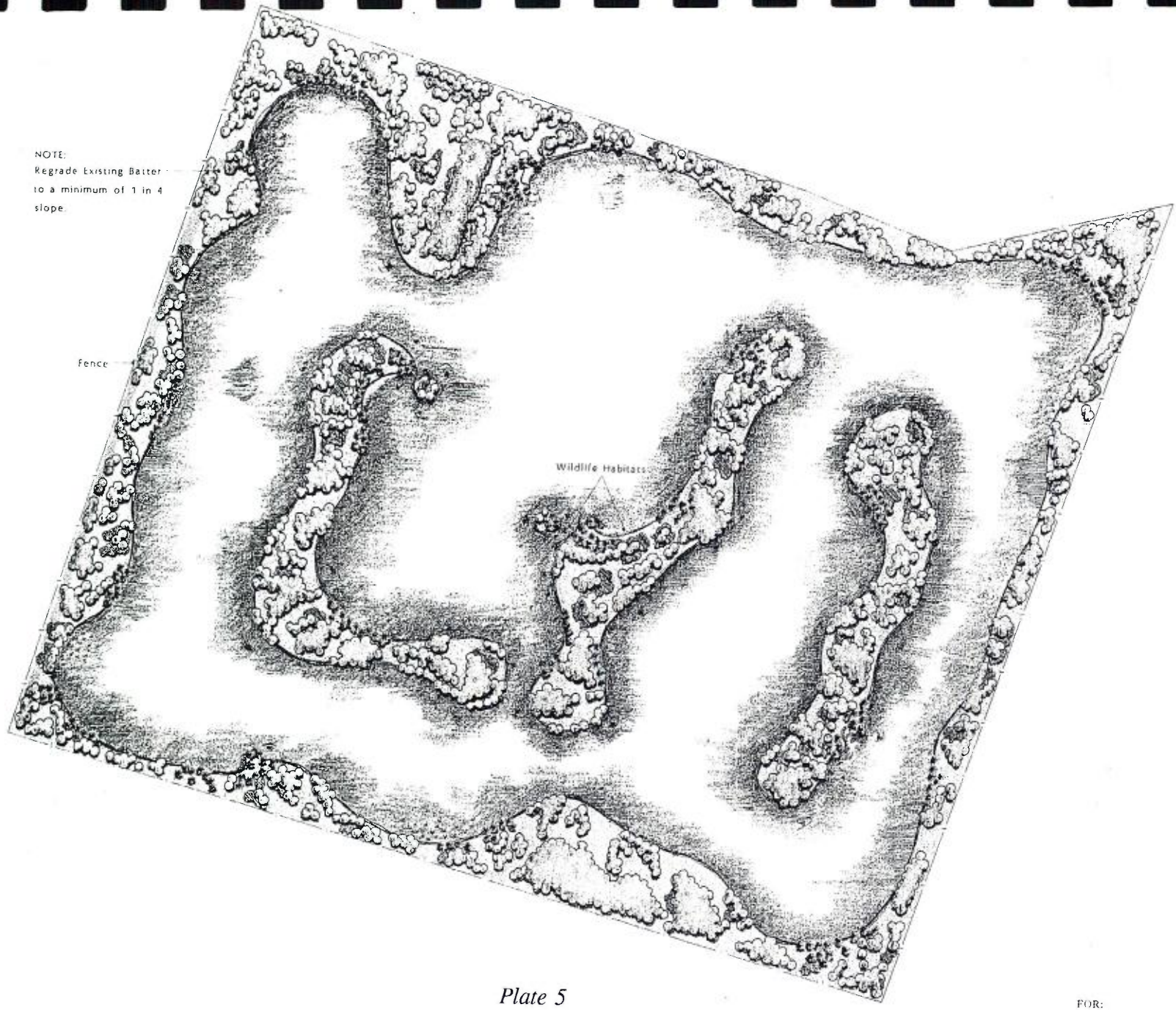
Tobiway Crushing Pty Ltd pays a road maintenance levy to the Yarrowlumla Shire of 29.7 cents per cubic metre which is increased annually in accordance with CPI adjustments.

5.10 WASTE MATERIAL DISPOSAL AND REHABILITATION

The major "waste" product from the operation comprises the fine sands, silts and clay particles extracted during the processing. As noted above, this material is disposed of by returning to the settling ponds.

Rehabilitation of the mined areas of the site will be twofold. Firstly, approximately 80% of the excavated areas will form settling ponds, which will have an average water depth of at least 2.5 metres. Secondly, the pond surrounds and areas which have been disturbed by the operations are being and will be rehabilitated in accordance with recommendations made by the Soil Conservation Service and NSW Agriculture. Final water levels in the ponds are only established in equilibrium with the surrounding groundwater regime once their use as settling ponds is complete, so that final treatment of the surrounds is delayed until that stage. The final water levels will fluctuate due to variations in environmental conditions.

Plate 5 shows a landscape plan of final rehabilitation of the present works area and a staging plan of the proposed rehabilitation measures is presented in Appendix H. Temporary rehabilitation (Plate 6) is carried out on the banks and surrounds when it is anticipated that banks will not be disturbed for a significant period of time. Plate 7 shows plantings forming part of the rehabilitation works at the former Fyshwick extraction site operated by the parent Company.



LEGEND

- Existing pine trees to be retained
- Proposed Tree Planting Species:
  - Eucalyptus blakelyi
  - Eucalyptus bridgesiana
  - Eucalyptus elata
  - Eucalyptus mellidora
  - Casuarina cunninghamiana
- Proposed Native Shrub Planting Species:
  - Acacia boormanii
  - Acacia floribunda
  - Acacia pravissima
  - Banksia ericifolia
  - Callistemon viminalis
  - Melaleuca ericifolia
  - Melaleuca laterita
- Proposed planting of macropyhytes to edges of ponds
- Dryland grassing
- Sandy shoreline

C5705/1

SCALE (METRES)

DATE: MAY 1992

PREPARED BY:

MARGULES GROOME POYRY PTY LTD

FOR:

CANBERRA SAND & GRAVEL PTY LTD

Plate 5

LANDSCAPE MASTERPLAN

t 31 Portion 9
rish of Currandooly
ire of Yarrowlumla

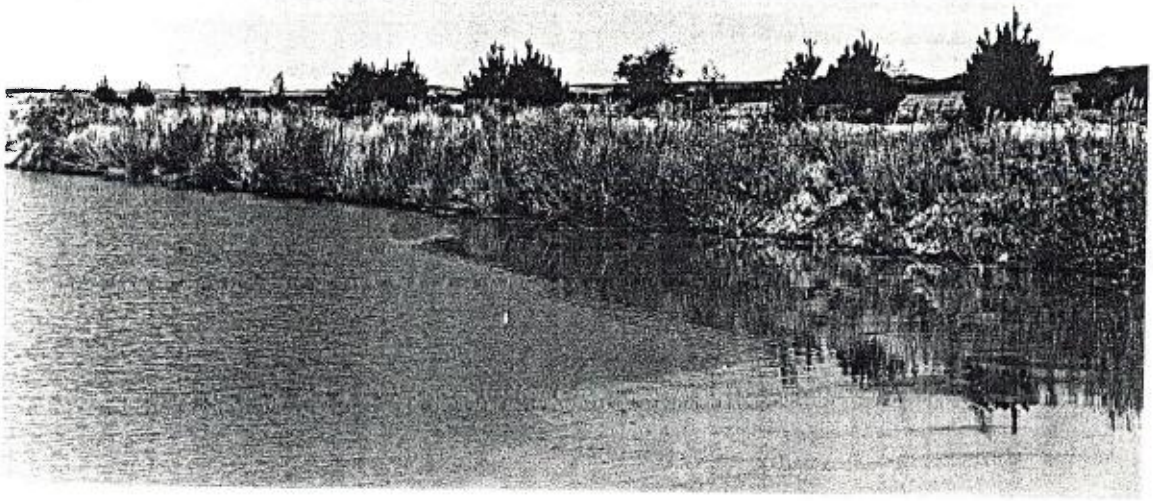


Plate 6 Temporary bank stabilising measures

Plate 7 Rehabilitation plantings at Fyshwick site

5.11 EMPLOYMENT

Employment and wage incomes arising from the existing operations have been presented in Section 4.5. Employment arising from the proposed future operations is likely to be similar to that at present.

5.12 HOURS OF OPERATION

The hours of operation under the existing development consent and for the future proposed operation are 6.00am to 6.00pm, Monday to Saturday inclusive with the exception of public holidays.

5.13 LIFE OF DEPOSIT

Based on operational knowledge of the site, projected growth rates in the region and geological and geotechnical investigations summarised in Appendices C and D, it has been assessed by the operators that the site has sufficient reserves to maintain a viable operation for a further 15 to 20 years at the present rate of development.

5.14 ENERGY REQUIREMENTS

Energy requirements for the operations comprise about 30000 litres per month of diesel fuel used for powering plant and machinery and 240 volt electricity from the county council electricity grid used for office power and lighting. The fuel is mostly stored in overhead tanks of about 15000 litre storage capacity which are enclosed within a bund to contain potential spillages. The dredge carries its own onboard fuel storage. The principal energy conservation measure comprises regular planned maintenance of plant and machinery to minimise operating costs.

6.0 ASSESSMENT OF ENVIRONMENTAL IMPACT OF FUTURE WORKS

6.1 TOPOGRAPHY AND LANDFORM

The existing development has created a number of ponds and stockpiles, together with an access road and associated works area. The proposed future works will construct a number of additional ponds extending the site towards Butmaroo Creek to the north. These ponds will have an average water depth of at least 2.5 metres and the surrounds will have been rehabilitated as shown in Plate 5 and discussed in Appendix H.

Levee banks will be constructed to maintain the existing ground surface level around the outside of the workings to prevent floodwater access to the site. No new access roads external to the existing site will be created. Following progressive completion of the works, existing access roads will be removed and the banks of ponds will be reshaped and regraded for rehabilitation as discussed in Appendix H to form a single lake with a number of islands. The access road external to the site will be removed and vegetated.

6.2 HYDROLOGY

As noted in Section 4.3, the site is self-contained and essentially isolated from Butmaroo Creek. Consequently the proposed works will have no impact on the hydrology of Butmaroo Creek except that some flood waters which would otherwise extend further than 100 metres from the edge of the Creek will be diverted around the southern portion of the site.

The pond levels and works area are sufficiently low with respect to the boundaries of the site that rainfall exceeding at least 2 metres over a short period of time would have to fall

before the potential for outflow from the site would exist. This amount can be compared with the largest mean monthly rainfall of about 0.065 metres (Table 4.1).

6.3 LAND USE

The proposed development will have no effect on existing land use as the site is presently reserved wholly for the extraction operations. No stock will be at risk from the proposed development as the area will be fully fenced to prevent stock access.

Following completion of the sand extraction, the land will revert to agricultural use except for the lake which will be a permanent feature.

6.4 FLORA AND FAUNA

Based on the assessment presented in Appendix G, extension of the operations towards Butmaroo Creek will not result in loss of rare or endangered plants or loss of habitat for rare or endangered fauna species. Rehabilitation of the site as presented in Section 5.10 and Appendix H will enhance the value of the area as a wetland habitat which should be used by some of the fauna species which currently exploit the nearby Lake George area.

6.5 ARCHAEOLOGICAL VALUE

Extension of the operations into the area north of the current workings towards Butmaroo Creek will generally result in the loss of the archaeological relics present on the site. Consequently, in line with the Consultant's recommended procedure, the following actions will be undertaken:

* Following Council approval for continued operations at the site and prior to any development north of the fence line defining the current limit to

development (the "five year plan" boundary), the developer will carry out controlled archaeological investigations to National Parks and Wildlife Service requirements with the aim of generating a controlled sample of the part of the site which would be destroyed through the sand extraction operations. This investigation would also assess the relationship between that part of the site and the area which would remain undisturbed within the 100 metre buffer zone to the creek.

* Following the archaeological assessment and submission of the report to National Parks and Wildlife Service, the developer would apply to the Service for permission to destroy sites outside the 100 metre buffer zone. It is understood that such permits are valid for a period of two years only and as the duration of the extraction works could be up to 15 or 20 years it could be anticipated that this application would be renewed at two-yearly intervals. The developer does not anticipate that further archaeological assessment would be required each time renewal of the permit was required.

* Prior to any extraction works being carried out between the current fence line and the buffer zone adjacent to Butmaroo Creek, the developer would fence the buffer zone so that machinery could not inadvertently move onto the area and potentially disturb near-surface archaeological sites.

It should be noted that the buffer zone represents about 35% of the area of the site between the current fence line and the creek, and due to the apparent increasing artefact density towards the creek the zone will protect intact a substantial portion of the archaeological relics on the site.

6.6 AIR QUALITY

As noted in Section 5.7, the site is potentially a low dust generator as most of the operations are carried out on wet or damp material, and no complaints have been received concerning dust problems. As the proposed method of operations for future works is the same as that presently used it is assessed that air quality will not be reduced by continuation of the sand extraction operations at the site.

6.7 WATER QUALITY

As noted in Sections 4.3, 4.9, 5.6 and 6.2 the site is isolated from Butmaroo Creek and water is unlikely to ever overflow from the site into the Creek. The proposed works are therefore unlikely to have any impact on the water quality in Butmaroo Creek due to overland flow.

It should be noted that geological conditions at the site are such that operations are easily able to maintain differences in pond water levels up at least 3 metres when the ponds are separated by about 12 metres. Based on the geological investigations indicating that geological conditions do not appreciably change outside the site (Appendices C & D), the subsurface conditions encountered in the investigations, and the fact that extraction operations will not be carried out within 100 metres of Butmaroo Creek, it is assessed that subsurface seepage carrying suspended solids are unlikely to enter the Creek.

6.8 NOISE QUALITY

The noise assessment prepared by Mark Eisner & Associates Pty Ltd (Appendix F) indicated that the noise contribution of the site at the nearest residence is probably less than 30 dB(A). This is due to the distance of the site from the residence, the location of most of the plant below the surrounding ground level and the presence of sound barriers formed

by stockpiled material around the site. It was assessed that, based on proposed operations being similar to those existing at the present time, that future site workings would have a negligible noise impact at the nearest residences.

The average frequency of truck movements should not increase in the future above the levels which have occurred from time to time during the past five years, and therefore there should not be any increase in noise levels associated with future works above those previously experienced.

6.9 VISUAL AMENITY

The present visual amenity is discussed in Section 4.11. Due to the location of the site, the extension of the works will not significantly alter this amenity except for residents on the Lake George escarpment who may see an increased area of ponds. Planting on the western and southern boundaries as part of Stage 1 of the rehabilitation works will significantly shield the view of the ponds for these residents.

It should be noted that Plates 3 and 4 indicate significant improvement in the visual appearance of the site over the period 1987 to 1991 directly as a result of wet working.

6.10 ROAD SYSTEM

The proposed operation is similar to the existing operation, and it is unlikely that heavier loads will be transported in the future. The impact on the road system will therefore be similar to that presently occurring indicated in Section 4.12.

The applicant presently contributes to maintenance costs of Shire roads as indicated in Section 5.9 and purchases heavy load permits as required.

6.11 ECONOMIC SIGNIFICANCE

The economic significance of the proposed operations are likely to continue at the same or higher level as the present operations, as outlined in Section 4.5. These operations provide direct employment for residents of the Shire and surrounding areas and are a source of revenue for Shire businesses as discussed previously.

6.12 SOCIAL DISTURBANCE AND BENEFITS

At the present time the operations provide employment for a number of Shire residents and other persons from the region as indicated in Section 4.5, and follow on benefits in assisting employment in businesses supporting the work. Continuation of the industry is supported by the Bungendore Chamber of Commerce (Appendix B).

The existing trucking operations are acknowledged to cause disturbance to the residents on the western edge of Bungendore, particularly in Molonglo Street. However continuation of the workings will not affect these residents more adversely than at present, and it should be noted that stopping of the present operations may not necessarily improve the amenity for these residents, as discussed in Section 7.

7.0 CONSEQUENCES OF NOT CONTINUING OPERATIONS

It is understood that exemption of the site from the 7(g) Zoning will be required for the application for further development is to succeed. As noted in Section 2, there does not appear to be valid scientific reasons why this exemption should not be granted. However if the exemption is not approved or future development is rejected for other reasons, then the following consequences are likely to occur:

* The immediate effect would be the loss of 11 jobs at the site workings. It is considered unlikely that these would be generated wholly at alternative sand suppliers, for example Readymix Pty Ltd, as these operations are assessed to have significant spare capacity and could increase production significantly with little increase in the workforce.

* Associated with this loss of employment would be the associated loss to the local businesses that supply goods and services to the present operations, and the loss of spending of the employees (nine of whom are Shire residents) within the Shire. The possibility also exists that as a consequence of the loss of employment, some families may become dependent on community and services provided by the Council and other organisations.

* It is also likely that up to eight positions would be lost at the Canberra operations of Canberra Sand & Gravel Pty Ltd.

* If the existing operations were closed the demand for the product would still continue, and would probably be supplied by the operations of Readymix Pty Ltd in the short term and by other operators, possibly from outside the Shire, in the longer term. This would have a significant effect on Council revenue for road maintenance as the current operations contribute 29.7 cents per cubic metre to the

Shire, compared to 3.23 cents per cubic metre for sand extracted from other current operations within the Shire and 0 cents per cubic metre paid by operators from outside the Shire.

* If the demand were taken up by operations from outside the Shire, then this is likely to come from operations on the Shoalhaven River in Tallaganda Shire. The increased truck movements from these operations would increase the truck traffic through the centre of Bungendore, adversely affecting more residents than in the current situation.

* If the demand were taken up by Readymix Pty Ltd or other operators adjacent to Lake George, then the truck traffic within Bungendore would remain little changed.

8.0 REFERENCES

1. Department of Housing and Construction (1982), "A summary of Information on the Performance of Building Materials in the Canberra Environment".

2. National Capital Development Commission (1987), "Outline of Topsoil, Sand Gravel and Rock Resources in the A.C.T. and Sub-Region".

3. Abell, R.S. (1985), "Geology of the Lake George Basin, N.S.W.", Bureau of Mineral Resources, Geology and Geophysics, Record 1985/4.

4. Stevenson, B. (1981), "The Geological Heritage of New South Wales - Lake George", Geological Society of N.S.W., **II**, Chapter 9.

5. Letter from Mr H.G.P Osborne to Yarrowlumla Shire Council, dated 22 November 1984.

APPENDIX A

APPENDIX A

REPLIES TO CORRESPONDENCE

REPLIES TO CORRESPONDENCE

From

* NSW Department of Planning, in relation to requirements and scope of the EIS;

* Yarrowlumla Shire Council, in relation to requirements and scope of the EIS;

* NSW National Parks and Wildlife Service, in relation to archaeological requirements and assessment of flora and fauna regimes;

* Environment Protection Authority, in relation to air, water and noise impacts and pollution control requirements;

* Soil Conservation Service, in relation to soil erosion control and rehabilitation procedures;

* Department of Water Resources, in relation to management of water associated with the mine operations;

* NSW Agriculture, in relation to agricultural use of the land and the effect of mining operations on adjacent lands;

* Department of Mineral Resources, in relation to mineral resources, land use, mine operations and safety;

* NSW Roads and Traffic Authority, in relation to truck movements on and access to MR268;

* Heritage Council of NSW, in relation heritage items in the site.

Department of Planning

Remington Centre
175 Liverpool Street, Sydney 2000
Box 3927 G.P.O. Sydney 2001
DX . 15 Sydney

Telephone : (02) 391 2000 Ext: 2083
Fax No : (02) 391 2111
Contact : M. Beveridge

Our reference : Q92/00028

Your reference :

Coffey Partners International Pty Ltd
PO Box 152
FYSHWICK 2609

Dear Sirs,

PROPOSED SAND EXTRACTION: LOT 31, PART PORTION 9, PARISH OF CURRANDOOLY.

Thank you for your letter of April 2nd 1992 indicating that you are consulting with the Director with regard to the preparation of an environmental impact statement (EIS) for the above development.

2. It is the Department's understanding that the proposal involves the expansion of an existing quarry presently operating under existing use rights. It is also understood that the existing quarry and proposed expansion is not permissible under the present zoning of the site, but that Council has advised the applicant to obtain Director's requirements for an EIS before it would be willing to consider rezoning the site.

3. As the proposal is designated development within the meaning of Schedule 3 of the Environmental Planning and Assessment Regulation, 1980, as amended, an EIS must accompany any development application to the Yarrowlumla Shire Council. The EIS shall be prepared in accordance with clause 34 of the Regulation and shall bear a certificate required by clause 26(1)(b) of the Regulation.

4. In addition, pursuant to clause 35 of the Regulation, the Director requires that the following matters be specifically addressed in the EIS:

- assessment of the environmental performance of the existing quarrying operations and an assessment of the need for additional environment protection measures;
- proposals for rehabilitation of the existing and proposed expanded quarry;
- noise, dust and visual impacts to nearby rural residential land uses and proposed mitigation measures;
- traffic impacts, including impacts on Bungendore and implications for Truck Road 51. Assessment of the need for any road upgrading works;

../2

- assessment of impact on archaeological sites, and an assessment of the need for an archaeological watching brief;

- water quality impacts, including impacts on Lake George and Butmaroo Creek and proposed mitigation measures;

- results of consultation with:

  - Environment Protection Authority,
  - Roads and Traffic Authority,
  - Department of Conservation and Land Management (Soil Conservation Service),
  - National Parks and Wildlife Service.

5. Attachment No. 2 is a guide to the type of information most likely to be relevant to the development you propose; not all of the matters raised therein may be appropriate for consideration in the EIS for your proposal; equally, the guide is not exhaustive.

6. In preparing your EIS you should approach the Yarrowlumla Shire Council and take into account any comments Council considers may apply to its determination of the proposal.

7. Should you require any further information regarding this matter please do not hesitate to contact us again.

Yours faithfully,

B Adams 1-5-92

B. Adams
Manager
Assessments and Resources Branch
As Delegate for the Director

DEPARTMENT OF PLANNING
ATTACHMENT NO. 1

STATUTORY REQUIREMENTS FOR ENVIRONMENTAL IMPACT STATEMENTS

In accordance with Part IV of the Environmental Planning and Assessment Act, 1979, an environmental impact statement (EIS) must meet the following requirements.

Pursuant to clause 34 of the Environmental Planning and Assessment Regulation, 1980, as amended, the contents of an EIS shall include the following matters:

(a) full description of the designated development proposed by the development application;
(b) a statement of the objectives of the proposed designated development;
(c) a full description of the existing environment likely to be affected by the proposed designated development, if carried out;
(d) identification and analysis of the likely environmental interactions between the proposed designated development and the environment;
(e) analysis of the likely environmental impacts or consequences of carrying out the proposed designated development (including implications for use and conservation of energy);
(f) justification of the proposed designated development in terms of environmental, economic and social considerations;
(g) measures to be taken in conjunction with the proposed designated development to protect the environment and an assessment of the likely effectiveness of those measures;
(g1) details of energy requirements of the proposed development and measures to be taken to conserve energy;
(h) any feasible alternatives to the carrying out of the proposed designated development and reasons for choosing the latter; and
(i) consequences of not carrying out the proposed development.

The EIS must also take into account any matters required by the Director of Planning pursuant to clause 35 of the Regulation, which may be included in the attached letter.

The EIS must bear a certificate as required by clause 26(1)(b) of the Regulation.

DEPARTMENT OF PLANNING
ATTACHMENT NO 2

ADVICE ON THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR AN EXTRACTIVE INDUSTRY

A definition of extractive industry may be found in paragraph (n) to Schedule 3 of the Environmental Planning and Assessment Regulation, 1980, (as amended). These industries are operations undertaken for the purpose of mining sand, gravel, clay, turf, soil, rock, stone or similar substances. The definition of extractive industry specifically excludes coal, petroleum or minerals which are prescribed under the Mining Act, 1973. Extractive industries may take the form of dredging operations, quarrying operations, turf farms or various forms of land excavation etc. Processing of extracted material on the same site as the winning of the material may also constitute an extractive industry.

Extractive industries have prompted considerable public controversy in the past since, among other things, they affect visual amenity, generate heavy vehicle movements, raise dust and cause disturbance through noise and blasting. This is the prime reason for designation of extractive industries under the Environmental Planning and Assessment Act, 1979.

The purpose of this paper is to outline various issues relevant to the preparation and consideration of an EIS for extractive industries. It is intended to assist the preparation of the EIS. However, it is the applicant's responsibility to identify and address as fully as possible the matters relevant to the specific development proposal in complying with the requirements for EIS preparation (see Attachment No 1).

The matters nominated in this paper are not intended as a comprehensive identification of all issues which may arise in respect of an extractive industry. Some of the issues nominated may not be relevant to a specific proposal. On the other hand, there may be other issues, not included, that are appropriate for consideration in the EIS.

Information provided should be clear, succinct and objective and where appropriate be supported by maps, plans, diagrams or other descriptive detail. The purpose of the EIS is to enable members of the public, the consent authority (usually the Council) and the Department of Planning to properly understand the environmental consequences of the proposed development.

1. Description of the proposal.

The description of the proposal should provide general background information on the location and extent of the works proposed, an indication of adjacent developments, and details of the site, land tenure, zonings and relevant forward planning proposals and any other land use constraints.

2/...

The EIS should address the compatibility of the proposal with any regional strategy for extractive industries in the area and with the provisions of the Local Environmental Plans for existing and proposed development.

This section should provide specific information on the nature, intent and form of the development. It should, as far as possible, include such details as the processes involved (highlighting any proposed crushing or blasting), disposal of wastes, landscaping and site rehabilitation. A description should also be provided of associated operations such as the transport of materials and use of the end product if likely to have environmental implications.

Particular details that may be relevant include:

- Characteristics and economic significance of the resource.
- Possible availability of alternative resources.
- Quantity of materials to be extracted.
- Details of any blasting and/or crushing.
- Effects of vibrations.
- Type of machinery and equipment to be used for dredging and stockpiling operations and for any processing plant.
- Expected life of the operation.
- Hours of operation.
- Details of necessary stockpiling.
- Access arrangements - truck routes, truck numbers etc.
- Site drainage and erosion controls.
- Proposals for rehabilitation.

2. Description of the Environment.

This should provide details of the environment in the vicinity of the development site and also of aspects of the environment likely to be affected by any facet of the proposal. In this regard, physical, natural, social, archaeological and economic aspects of the environment should be described to the extent necessary for assessment of the environmental impact of the proposed development.

3. Analysis of Environmental Impacts.

Environmental impacts usually associated with extractive industries are listed below. Where relevant to the specific proposal, these should be addressed in the EIS, taking into account the adequacy of safeguards proposed to minimise them.

- The flow of any affected rivers or watercourses.
- The effect of the extraction on the sediment transport rate of any affected rivers or watercourses.
- The bed and bank stability of any affected rivers during and after completion of the operations and any need for recurrent maintenance dredging.
- Any possible siltation, sedimentation or downstream effects of the operation.
- Any likely cumulative effects of the proposed operation when considered together with other operations in the vicinity.

- Details of floods and any likely effects of the operation on flood liability of surrounding lands.
- The possible effects of flooding on the operation.
- Effects on flora and fauna.
- The agricultural viability of the landholding.
- Likely noise/vibration disturbance caused by the operations, including transport operations, on nearby residences.
- Other impacts of trucking movements, including access over railways and onto highways.
- Dust nuisance likely to be caused.
- Effects on water quality of nearby watercourses.
- Disposal of waste material.
- Effects on the visual environment.
- Any likely affectation of sites of Aboriginal archaeological or European heritage value if located in the vicinity of operations.
- Impact of the operations on navigation aspects for all types of shipping (commercial, recreational, etc).

In addition, any potential for hazard or risks to public safety and any proposals to monitor and reduce environmental impacts should be included.

4. Contact with relevant Government Authorities.

In preparing the EIS, it is suggested that authorities, such as those listed below, should be consulted and their comments taken into account in the EIS.

- The Environmental Protection Authority in regard to air, water and noise impacts and relevant pollution control legislation requirements;
- The Department of Mineral Resources concerning its responsibilities under Sydney REP No 9 Extractive Industry;
- The Department of Water Resources concerning the implications of the proposal on their jurisdiction;
- The Department of Conservation and Land Management (Soil Conservation Service) regarding appropriate erosion control and rehabilitation procedures;
- The Department of Agriculture if prime agricultural land may be affected by the proposal;
- The Heritage Council of NSW if the proposal is likely to affect any place or building having heritage significance for the State; the National Parks and Wildlife Service if aboriginal places or relics are likely to be affected.
- The Maritime Services Board in relation to navigational aspects of shipping; and
- The Public Works Department in relation to hydrological impacts and relevant legislative requirements.

It is the responsibility of the person preparing the EIS to determine those Departments relevant to the proposed development.

YARROWLUMLA SHIRE COUNCIL

ALL COMMUNICATIONS TO BE
ADDRESSED TO THE SHIRE CLERK

CONTACT:

OUR REFERENCE:

YOUR REFERENCE: Town Planning
D3/85 ID
WW:C5705/1-AY

COUNCIL ADMINISTRATIVE OFFICE:
11 FARRER PLACE, QUEANBEYAN 2620

POSTAL ADDRESS:
P.O. BOX 112, QUEANBEYAN 2620
TELEPHONE (06) 297 1311
FAX (06) 297 5854

SHIRE OF YARROWLUMLA • PERSEVERANTIA ET LABORE •

RECEIVED
APR 1992

30 April 1992

Mr S Pathmanandavel
Coffey Partners International Pty Ltd
PO Box 152
FYSHWICK ACT 2609

Dear Sir

RE: **PREPARATION OF ENVIRONMENTAL IMPACT STATEMENT LOT 31 (EXTRACTIVE SITE) AND LOT 32 (ACCESS) DP 634213, PARISH OF CURRANDOOLY**

Reference is made to your letter dated 16 April 1992 concerning the above-mentioned matter.

Generally speaking, it would appear that the proposed EIS will address the main issues of concern to Council.

Should you wish to discuss this matter further please contact Council's Town Planning Department on (06) 297 6113.

Yours faithfully

D R ROUSE
Manager Planning Services

for

R J MORGAN
Shire Clerk/Chief Officer

YARROWLUMLA SHIRE COUNCIL

ALL COMMUNICATIONS TO BE
ADDRESSED TO THE SHIRE CLERK

CONTACT:

OUR REFERENCE:

YOUR REFERENCE: Town Planning
D3/85 ID

COUNCIL ADMINISTRATIVE OFFICE:
11 FARRER PLACE, QUEANBEYAN 2620

POSTAL ADDRESS:
P.O. BOX 112, QUEANBEYAN 2620
TELEPHONE (06) 297 1311
FAX (06) 297 5854

30 April 1992

Mr Wayne Gregory
Tobiway Crushing Pty Limited
PO Box 110
FYSHWICK ACT 2609

Dear Sir

RE: **CONTINUATION OF SAND EXTRACTION OPERATION**

Please be advised that Council at its meeting on 14 April 1992 resolved that it would be prepared to consider a development application supported by an environmental impact statement for the continuation of the sand extraction on Lot 31, DP 634213, Parish of Currandooly.

Should you wish to discuss this matter further please contact Council's Town Planning Department on (06) 297 6113.

Yours faithfully

D R ROUSE
Manager Planning Services

for

R J MORGAN
Shire Clerk/Chief Officer

File No.: F2074

Our Ref.: SF0026:KN

NSW
NATIONAL
PARKS AND
WILDLIFE
SERVICE

Coffey Partners International Pty Ltd
PO Box 152
FYSHWICK ACT 2609

10 April 1992

Dear Sir

Re: Sand Extraction, Lot 31, Pt Portion 9, Parish Currandooly

I refer to our recent telephone conversations concerning this matter and correspondence to Canberra Sand and Gravel, date 24 March 1992 (copy attached). I stated in this letter archaeological investigations will be required if sand extraction is to occur outside the boundaries of the "five year plan". The brief for this work is attached.

Thank you for your co-operation.

Yours faithfully

Sue Feary
Regional Archaeologist
for Director

South Eastern Region
Level 1, 34 Lowe St
Queanbeyan NSW
2620 Australia
P.O. Box 733
Queanbeyan 2620
Fax: (06) 297 4851
Tel: (06) 297 6144

Faxed 10.4.92

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BRIEF FOR ARCHAEOLOGICAL FIELDWORK - LOT 31, PT 9, PARISH CURRANDOOLY

1. Determine from initial field reconnaissance and aerial photographs, the location of original intact land surfaces.

2. Of these, identify those areas with potential for containing archaeological sites.

3. Undertake field survey in those areas with the highest potential for containing sites. At least one area with a low potential should also be surveyed.

   Some investigation should be carried out along the creek-line each side of the subject area to provide data for comparative analysis.

4. Where appropriate, on landforms with high potential a backhoe/bobcat can be used to strip off the overburden to reveal any cultural deposits that are present on original land surfaces, which have been subsequently covered with aeolian sands.

5. Consult with the relevant Aboriginal Land Council.

6. Record all sites according to NPWS guidelines, assess significance and provide recommendations for management/protection of all sites found. For sites of considerable significance, this may involve further controlled excavation to determine antiquity and technological change.

7. The survey should also include any areas likely to be impacted by roading, stock-piling or infrastructure such as crushers etc.

8. The report must analyse the location and contents of the sites in the context of other sites in sand deposits on the eastern side of Lake George.

Sue Feary
NPWS.
10.4.92.

File No.: F2074

Our Ref.: PP0012:KN

Faxed 27/3/92

NSW
NATIONAL
PARKS AND
WILDLIFE
SERVICE

Mr Wayne Gregory
Canberra Sand and Gravel Pty Ltd

27 March 1992

Dear Sir

Re: Sand Extraction in Lot 31, part Portion 9, Parish Currandooly

The pit and immediately adjoining areas were inspected by the Regional Archaeologist accompanied by yourself and Mr Sukumar Pathmanandavel on 16 March 1992.

The existing and proposed operations of the quarry were explained to the Archaeologist and this enabled an on-site assessment of the archaeological implications of the quarry as it stands and as it is proposed.

No sites were observed within the existing quarry, however, this may well reflect the nature of the extraction works and resulting disturbance as much as reflecting a real absence of sites.

The area to the north-east of the existing pit face up to the "five year plan" boundary, was cursorily inspected and it was determined that on the basis of the substantial disturbance which has already occurred allied with the lack of any sites there were no archaeological objections to continuation of quarrying up to the "five year plan" boundary.

However, any proposed development or extraction works north-east of the fenceline which roughly defines the "five year plan" boundary will require a comprehensive survey to be undertaken by a qualified archaeologist.

This work would be intended to assess the archaeological/Aboriginal significance of the area and to make recommendations regarding the most appropriate management for any sites which may be found.

If and when your company wishes to pursue a proposal to extract from the area beyond the "five year plan" the

South Eastern Region
Level 1, 34 Lowe St
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Service will advise you more fully of its requirements and would assist by drawing up a brief for the archaeological work required.

Yours faithfully

P Packard
A/Regional Archaeologist
for Director

cc Sukumar Pathmanandavel

File No.: F2074

Our Ref.: ED0001:KN

Your Ref: WW:VS C5705/1-AN

NSW NATIONAL PARKS AND WILDLIFE SERVICE

Coffee Partners International Pty Ltd
PO Box 152
FYSHWICK ACT 2609

ATTENTION: Sukumar Pathmanandavel

22 April 1992

Dear Sir

Re: EIS Sand Extraction at Lot 31, Parish of Currandooly

Thank you for your letter of 9 April, in relation to our telephone discussion of that date regarding this matter.

I wish to clarify my comments of that date. I was discussing the requirements for fauna assessment in relation to the need for preparation of a Fauna Impact Statement (FIS) under the provisions of the Endangered Fauna (Interim Protection) Act 1991. The comments, that I considered that a separate FIS would not be required, were not meant to imply that an assessment of flora and fauna, or a statutorily required component of an EIS under the provisions of the Environmental Planning and Assessment Act 1979, would not be necessary. Preparation of such as assessment is a standard component of an EIS, and especially necessary in this case as the proposed extension of operations to the north-east is into land of potentially greater environmental sensitivity adjacent to Butmanoo Creek.

I understand that you will also be undertaking an archaeological assessment of the areas.

I will look forward to the opportunity to review the EIS in due course.

Yours faithfully

Liz Dovey

Liz Dovey
Natural Resources Co-ordinator
for Director

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Authority
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Telephone .062. 99 3330
Facsimile .062. 99 3525

Mr Sukumar Pathmanandavel
Coffey Partners International Pty Ltd
PO Box 152
FYSHWICK ACT 2609

Our Reference:

Your Reference: 290,192A/1
BK:SM

Dear Sir,

Environmental Impact Statement - Canberra Sand and Gravel Pty Ltd

The Environment Protection Authority requests that the environmental impact statement for the extension of Canberra Sand and Gravel Pty Ltd's sand quarry near Bungendore, address the following issues:

Water Pollution

It is recognised that the existing quarry is a closed system, with the pond not open to any watercourse, and that the extension area will be similarly developed. While it is not expected that siltation will be an immediate problem, the following aspects require attention:

* adequacy of buffer strips around ponds;
* establishment of suitably contained areas for storage of fuels, oils etc.
* rehabilitation measures proposed for areas previously mined, and in the longer term, the rehabilitation proposed for the extension area.

Noise Pollution

The proposal being an extension of an existing industry regime is unlikely to significantly increase background noise levels, particularly as the extension area is in a direction away from residential development. However it is scheduled premises under the Noise Control Act, and the following aspects should be addressed:

* limits on the hours of operation of the quarry, and access to and from the quarry.
* compliance with noise control objectives of the Environmental Noise Control Manual ie. the intrusive noise level of the machinery and vehicle operations on site should not exceed the background (L_{90}) noise level by more than 5 dB(A) at any potentially affected residence.

Air Pollution

Steps to be taken to minimise dust within the plant area, and on the access roads and covering of vehicle loads are all issues which need to be addressed.

Please contact Bill Knight on (06)2993330 in regard to enquiries of the Authority relating to this matter.

Yours faithfully,

T J KNOWLES
for Director-General

12 MAY 1992

New South Wales Government

Soil Conservation Service

QUEANBEYAN DISTRICT OFFICE

2nd Level, Morrissett House
7-9 Morrissett Street, Queanbeyan.
Postal Address: PO Box 189, Queanbeyan. 2620
Phone: (06) 2976477 & 2976677 Fax: (06) 2972280

Our reference:
Your reference:

Mr S. Pathmanandavel
Coffey Partners
PO Box 152
FYSHWICK ACT 2609

Dear Sir,

ENVIRONMENTAL IMPACT STATEMENT, SAND EXTRACTION, LOT 31, PARIS OF CURRANDOOLY.

Thank you for the opportunity to comment on the preparation of the above EIS.

As a rule, this Department requires that the following general areas be covered in an EIS:

1. the characteristics of the land and soil resources of the site, highlighting existing and potential erosion problems;

2. temporary erosion control measures to be employed during the operation of the mine;

3. permanent erosion control and revegetation measures to rehabilitate the site.

Following a site inspection on April 29, I make the following points:

* I reiterate the points made by Mr Clifton in his letter dated 8/8/91. He pointed out that the internal draining nature of the operation means there is little risk of erosion during the extraction operation.

* The main area that will need to be covered is the stabilisation of the batters of the pit. Particular attention will need to be given to the batter angles such that rilling does not occur, and a stable vegetative cover can be established. It would also be necessary to specify grass species and rates, and tree species suitable for the

site, particularly in light of the results of past plantings. (see attachment).

* It will also be necessary to detail the staging of the rehabilitation to ensure maximum effectiveness.

* It has been normal practice for Council to recommend the preparation of a sediment and erosion control plan as a condition of approval. Such a document becomes the working guide for rehabilitation. It should be possible to provide sufficient detail in the EIS on the techniques and the scheduling of rehabilitation, possibly as an appendix, to satisfy this requirement of council.

I trust these points will be of some value in preparing the EIS.

Yours faithfully,

10.4.92.

Peter Fogarty,
Soil Conservationist.

Recommended Seed Mix.

rye corn.....10kg/ha
Australian phalaris.....8kg/ha
Triumph fescue.....5kg/ha
Victorian rye.....2kg/ha
Haifa white clover.....4kg/ha
Karridale sub clover.....4kg/ha (autumn sowing)
Red clover.....4kg/ha (spring sowing)

Fertiliser application: Starter 15 at 100 kg/ha and Mo Super at 100 kg/ha.

Tree species

The trees that have been planted along the pit edge have shown varying success. The eucalypts appear to be growing poorly while the Acacias, willows and exotics have established quite well. It is recommended that the following species should be considered:

* Acacias decurrens, rubida and melanoxylon at quite high planting densities. These species will grow quickly and introduce nitrogen into the soil. They are however relatively short lived.

* Willows; there are a number of rapid growing hybrids available and these would be suitable for plantings along the lower margins of the batter.

* Casuarinas are suited to wet, low nutrient situations and also introduce nitrogen into the soil.

New South Wales Government
ARTMENT OF CONSERVATION AND LAND MANAGEMENT
Soil Conservation Service
P O BOX 189 QUEANBEYAN NSW 2620

Canberra Sand & Gravel
P O Box 110
FYSHWICK ACT 2609

Contact:
Our reference: 23/1/III
Your reference:

SAND MINING OPERATION - BUNGENDORE

I undertook an inspection of your mining operation on 5 August 1991 with Wayne Gregory.

The operation is carried out in such a way that no erosion or sedimentation occurs outside the pits because the system is internally draining.

Some rehabilitation has been commenced. This has been perimeter tree planting and some small areas of revegetation.

Reclamation works should be undertaken in stages as each area is "worked out". There is scope for more rehabilitation of mined out areas in the south and west of the operation.

The area that needs attention is the band of exposed soil between top water level in the pits and natural ground level. This area should be reshaped to a stable gradient and revegetated.

A simple plan and calender for rehabilitation should be prepared by your company for your use. This will highlight area that are ready to be reclaimed, waste material that can be respread and slack times when machinery is available to do this work.

Please contact me if this Service can be of any more assistance.

8/8/91

G R Clifton
District Soil Conservationist
QUEANBEYAN

New South Wales Government

Water Resources

Telex: 69013
Facsimile: (069) 53 4468
Telephone: (069) 53 3677
Ext:
Contact Name:
Our Reference:

Coffey Partners International Pty Ltd
PO Box 152
FYSHWICK ACT 2609

Attention: Sukumar Pathmanandavel

Dear Sukumar,

RE; PROVISION OF ENVIRONMENTAL IMPACT STATEMENT, SAND EXTRACTION AT LOT 31, PARISH OF CURRANDOOLY
Your WW:VS C5705/1-AM dated 9 April 1992

In confirmation of my verbal advice of 5 May 1992, please note the following.

As the operation, as proposed, will not encroach closer than 100m to Butmaroo Creek a permit under Part 3A of the Rivers and Foreshores Improvement Act will not be required. Under the Act a permit is required to excavate in a river, lake or estuary or within 40m of it.

As the Department of Water Resources is responsible for the quality of fresh waters in New South Wales it is requested that the EIS contain details of the water management plan for the operation. While it is understood that the operation is intended to be a closed system, as with the existing operations, details should include management of natural runoff onto and within the site and preventative measures for site discharges.

Licensing for abstraction of water from streams is administered by the Leeton office. If you need detail regarding the current Licence no L45011 (valid to 20 August 1995) please contact Steve Webb on phone (069) 533677.

If further comment is required please contact Barry Starr on 2971187.

Yours sincerely

Barry Starr
Catchment Officer, Queanbeyan
for; Geoff Fishburn, Manager
Murrumbidgee Region
8 May 1992

DEPARTMENT OF MINERAL RESOURCES

NEW SOUTH WALES GOVERNMENT

MINERALS AND ENERGY HOUSE
29-57 CHRISTIE STREET
CORRESPONDENCE: PO BOX 536
ST LEONARDS NSW 2065
DX 3324 ST LEONARDS
TELEPHONE (02) 901 8888
FACSIMILE (02) 901 8777

Mr S Pathmanandavel
Coffey Partners International Pty Ltd
PO Box 152
Fyshwick Canbera 2609

Dear Mr Pathmanandavel

RE: Environmental Impact Statement, Sand Extraction at Lot 31, Parish of Currandooley

I refer to your letter of 9th April concerning the EIS being prepared for sand extraction at a site north of Bungendore.

It should be noted that as sand is not classified as a mineral under the Mining Act, 1973, this Department has no statutory control over the mining of this commodity other than the responsibility, under the Mines Inspection Act, 1901, for ensuring the safe conduct of mining operations. However the Department is the principal government authority responsible for assessing the State's construction material resources and for advising State and local government on the planning and management of these resources.

The normal issues of concern to this Department which should be addressed in the EIS include the following.

* The characteristic of the sand resource, particularly its size and quality.

* Details of the exploration methods used in determining the resource size (with reference to any supporting documentation.

* Quantity of material to be extracted and the rate of extraction.

* Proposed operation period.

* A Mine Plan including methods of extraction and final pit shape.

* Location and size of stockpiles and the disposal of waste materials.

* Proposed transport routes.

* An assessment of noise, vibration, dust and visual impacts and details of measures proposed to minimize such impacts.

* Proposed rehabilitation procedures, during and after completion of extraction operations. The proposed final use for the site.

* Discussion of alternative sources, their availability and the justification for approval of the proposal. The need for the proposed operation in a regional and local context.

* The document should demonstrate that the proponents are aware of their responsibilities under the Mines Inspection Act 1901, as amended.

In your letter you refer to a visit by a Mines Inspector. This visit was conducted by Mr Ivanovic who was conducting a routine safety inspection. Please note that the Mines Inspector with responsibility for this site is Mr Paul Raferty, who is based in Wollongong (telephone 042-26 8359).

As this proposal is an extension of a nearby operation no specific items need to be addressed other than those listed above. If you have any further enquiries then please contact Peter Lewis, Senior Geologist/Southern Region, telephone 02-901 8372.

Yours faithfully,

Mr I. Paterson/Acting Programme Manager
for Director General

*

Roads and Traffic
Authority
Southern Division

514.5351 - WS:GM
Smart - (048) 231564

RTA

211 Bourke Street
Goulburn
New South Wales 2580
Telephone (048) 21 1133
Facsimile (048) 23 1567
PO Box 183 & 479
Goulburn NSW 2580
DX 5362

Sukumar Pathmanandavel
Coffey Partners International Pty Ltd
PO Box Box 152
FYSHWICK ACT 2609

EIS Sand Extraction Lot 31 Parish of Currandooly Main Road No 268 Yarrowlumla Shire.

Dear Sir

I refer to your letter dated 10 April 1992 regarding the preparation of an EIS for the continuation of the existing sand mining operations adjacent to Butmaroo Creek.

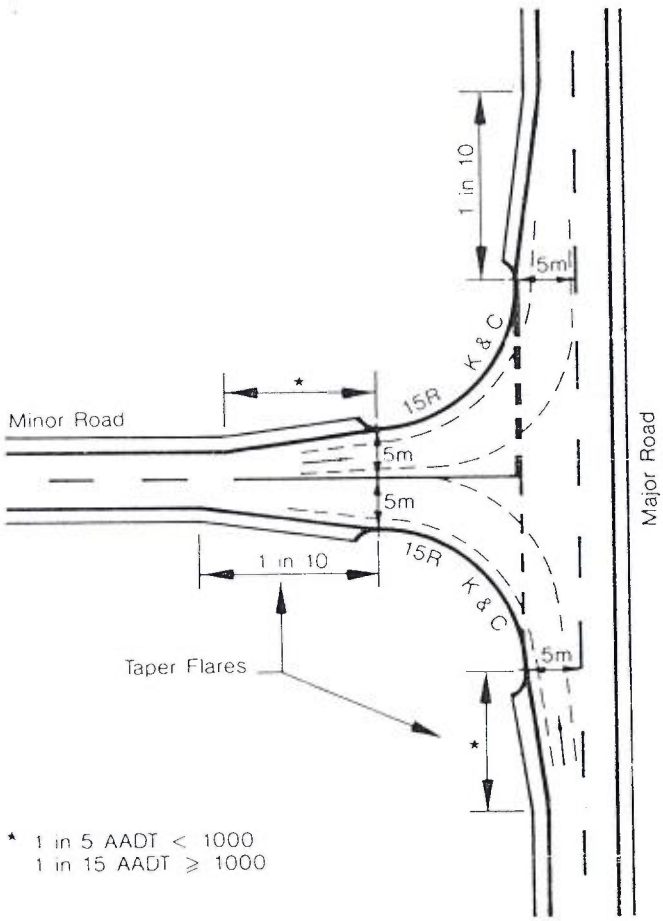
The RTA have no objections to the continuation of the existing sand mining operations provided that the access road junction with MR 268 is upgraded. The road junction should be upgraded to the standard shown on the attached drawing. However as almost all the truck movements are left in and right out, the treatment can be limited to the south western corner only. Kerb and channel are not required however, the access road should be sealed for a distance of 5 m back from MR 268 to avoid loose gravel from being tracked onto the main road.

The adjustments are considered necessary so as to provide adequate safety for traffic at the junction of MR 268 and the access road to the sand mining operation.

Yours faithfully

for R G Style
Divisional Engineer

CLICK CLACK
Front'n'Back



* 1 in 5 AADT < 1000
1 in 15 AADT ⩾ 1000

New South Wales Government

Department of Planning

Remington Centre
175 Liverpool Street, Sydney 2000
Box 3927 G.P.O. Sydney 2001
DX . 15 Sydney

Telephone : (02) 391 2000 Ext:
Fax No : (02) 391 2111
Tel 391 2082
Contact : B Edgar
Our reference : S92/00028/001
Your reference : C 5705/1

Coffey Partners International Pty Ltd
PO Box 152
Fyshwick, ACT 2609

Attn: Mr S Pathmanandavel

RE: DRAFT ASSESSMENT EIS FOR SAND EXTRACTION AT LOT 31, PARISH OF CURRANDOOLY

I refer to your letter to the Secretary of the Heritage Council concerning the above matter.

We do not have the resources to carry out a thorough investigation of the area concerned, however we have enclosed a printout for Yarrowlumla Shire Council area. It lists the items which the Heritage Council currently has an involvement and you should carry out your own assessment to ensure if there are any more heritage items in the subject area.

It is suggested that you consult with the local council for any requirements it may have in relation to buildings and properties which may be identified as heritage items by way of listing in a local environmental plan heritage schedule. In addition, the National Trust of NSW, the Australian Heritage Commission and any local historical societies should be approached to comment on items of cultural heritage in the area affected. Aboriginal and natural area items should be referred to the National Parks and Wildlife Service.

In relation to proposed development in the subject area, under Section 146 of the Heritage Act, 1977, if relics are discovered, it should be reported to the Heritage Council. A relic is defined as any deposit, object or material evidence which is 50 or more years old and relates to the settlement of the area (not being aboriginal settlement).

Also, under Section 140 of the Act, if any disturbance to a relic or site known or suspected to contain relics is proposed an excavation permit must be obtained from the Heritage Council.

If you have any queries and would like to discuss this matter further please contact Bruce Edgar of the Heritage Branch on the above number.

Yours sincerely

pp Rob Power 14/5/92.
Manager, Heritage Branch.

ALL CURRENT ITEMS FOR ALL SECTIONS
FOR LGAS: YARR,

Local Government Area: YARROWLUMLA

PROPERTY INFORMATION

Property Name: MICALAGO HOMESTEAD
Address:
MICHELAGO 2620

Property Desc:

Current Statutory Status

Section 21(c) - Nomination received
Start Date 15-APR-1988 Expiry Date
Reference No. Ref. Part.

PROPERTY INFORMATION

Property Name: PARKWOOD HOUSE & CHURCH ON CINNINCERRA CREEK
Address: PARKWOOD RD
YARROWLUMLA

Property Desc:

Current Statutory Status

Section 21(c) - Nomination received
Start Date 13-APR-1988 Expiry Date
Reference No. Ref. Part.

PROPERTY INFORMATION

Property Name: CARWOOLA HOMESTEAD
Address:
BUNGENDORE 2621

Property Desc: LOT 30 DP 596573
MURRAY COUNTY, PARISH OF CARWOOLA

Current Statutory Status

Section 44 - Making of a PCO
Start Date 21-DEC-1979 Expiry Date
Gazette No. 184 Order No. 36

APPENDIX B

APPENDIX B

CORRESPONDENCE AND CURRENT LICENCES

CORRESPONDENCE AND CURRENT LICENCES

(a) 1992 Correspondence

- Letter from Bungendore Chamber of Commerce

(b) 1991 Correspondence

- Department of Minerals and Energy 15 July 1991
- Soil Conservation Service 8 August 1991

(c) Licences for

- Department of Water Resources commencing 20 August 1990 to 20 August 1995
- State Pollution Control Commission NSW commencing 12 August 1991 to 12 August 1992

Bungendore Chamber of Commerce

PO Box 139 Bungendore NSW 2621

May 8, 1992.

Mr. W. Gregory,
Tobiway Crushing,
(Bungendore Sands)
P.O. BOX 110,
FYSHWICK A.C.T. 2609

Dear Wayne,

Sandmining in the Bungendore area has been one of the businesses and industries that has supplied the local community in both employment and financial input over many years.

In support of the application for the renewal of Bungendore Sands' licence to continue sand removal, we wish to advise the Council that it is felt that the continuation of such industries is essential to Bungendore, particularly since they employ seven local persons.

A recent survey has shown that the particular area being mined by Bungendore Sands has been, in comparison to the other operators, treated reasonably sensitively and their reclamation programme is commended.

As Bungendore continues to grow so does it's need for employment and the Bungendore Chamber of Commerce must encourage and support businesses that have a continuing capability to employ local persons and inject capital into the immediate area and the Yarrowlumla Shire.

Yours Sincerely,

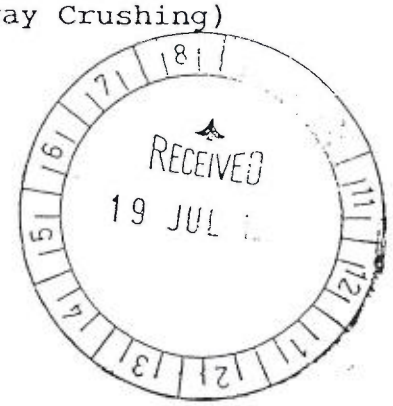
ROGER WEATHERSTONE,
PRESIDENT.

Department of Minerals and Energy

NEW SOUTH WALES GOVERNMENT

MINERALS AND ENERGY HOUSE
29–57 CHRISTIE STREET
CORRESPONDENCE PO BOX 536
ST LEONARDS NSW 2065
DX 3324 ST LEONARDS
TELEPHONE (02) 901 8888
FACSIMILE (02) 901 8777

Mr Wayne Gregory
Canberra Sand and Gravel (Tobiway Crushing)
PO Box 110
FYSHWICK ACT 2609



15 July, 1991

Dear Sir

Regular inspections have been conducted todate at your sand mining operation at Bungendore. All raised matters are being addressed and it is understood that any concerns raised in the future will be dealt with in a similar manner.

Yours faithfully

Dobro Ivanovic

DOBROSAV IVANOVIC
A/Regional Inspector of Mines

New South Wales Government

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

Soil Conservation Service

P O BOX 189 QUEANBEYAN NSW 2620

Canberra Sand & Gravel
P O Box 110
FYSHWICK ACT 2609

Contact:

Our reference: 23/1/III

Your reference:

SAND MINING OPERATION - BUNGENDORE

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Reclamation works should be undertaken in stages as each area is "worked out". There is scope for more rehabilitation of mined out areas in the south and west of the operation.

The area that needs attention is the band of exposed soil between top water level in the pits and natural ground level. This area should be reshaped to a stable gradient and revegetated.

A simple plan and calender for rehabilitation should be prepared by your company for your use. This will highlight area that are ready to be reclaimed, waste material that can be respread and slack times when machinery is available to do this work.

Please contact me if this Service can be of any more assistance.

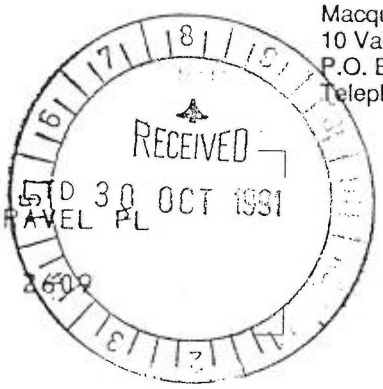
8/8/91

G R Clifton
District Soil Conservationist
QUEANBEYAN

Department of Water Resources

Macquarie Tower
10 Valentine Avenue, Parramatta
P.O. Box 3720, Parramatta 2124
Telephone: 895 6211

L45011



TOBIWAY CRUSHING PTY LTD
C/ CANBERRA SAND & GRAVEL PL
PO BOX 110
FYSHWICK

LEETON
~~SYDNEY~~

RENEWAL CERTIFICATE No. 030604

Licence No. L45011 , issued under Section 12 of the Water Act, 1912, is hereby renewed for a period of 5 years, commencing 20 AUGUST , 1990 subject to the terms, limitations and conditions attached.
By direction of the Department of Water Resources.

22 OCT 1991

Water Administration Manager

Details of Licensed Works

River or Lake BUTMAROO CREEK 792406 00064

Portion PT9

Parish CURRANDOOLY

County MURRAY

Nature and Description 1 PUMP: 1X100C

Purpose INDUSTRIAL

W.R. 127

CONDITION STATEMENT REFERRED TO ON RENEWED LICENSE NO.L45011

ISSUED UNDER PART II OF THE WATER ACT, 1912.

1. The holder of the license shall within three months of being called upon by the Department of Water Resources to do so, install to the satisfaction of the Department in respect of location, form, type and construction, an appliance or appliances for the measurement of the quantity of water diverted or taken by means of the licensed works, such appliance or appliances to consist of either a measuring weir or weirs with automatic recorder or meter or meters of the Dethridge type, or such other class of meter or means of measurement as may be approved by the Department, and shall continuously maintain such appliance or appliances in good working order and condition, and shall, after the installation of such appliance or appliances, record the measurements of all water diverted or taken by means of the licensed works and supply particulars of such measurements to the Department at such intervals as shall be directed by the Department. Whenever called upon to do so a test certificate furnished either by the manufacturer concerned or by some person or authority duly qualified shall be supplied by the holder of the license as to the accuracy of the appliance or appliances installed.

2. Water, after having been used shall be discharged into suitable settling ponds outside of the watercourse as approved by the Department.

3. The ponds referred to in Condition (2) shall be of sufficient capacity of effect removal of fine materials through settling.

4. Tailwater drainage shall not be allowed to discharge onto adjoining roads, crown land or other persons land, or into any river as defined under the Water Act, or any groundwater aquifer, by surface or sub-surface drains or pipes or any other means.

5. Works used for the purpose of conveying, distributing or storing water taken by means of the licensed works shall not be constructed or installed so as to obstruct the free passage of floodwaters flowing in, to or from a river.

STATE POLLUTION CONTROL COMMISSION
NEW SOUTH WALES

State Pollution Control Commission Act, 1970.

ORIGINAL

LICENCE

Licence Number : 00009
Granted on : 12 AUG 91
In force until : 12 AUG 92

Name and Address of Licensee :
TOBIWAY CRUSHING PTY LTD

P.O. BOX 110
FYSHWICK
ACT 2609

Name and Address of Premises the subject of this licence :
BUNGENDORE SANDS

CURRANDOOLEY
BUNGENDORE
NSW 2621

This licence under the State Pollution Control Commission Act 1970 ("the Act") is granted to:
TOBIWAY CRUSHING PTY LTD
("the licensee") in respect of premises situated at:
CURRANDOOLEY BUNGENDORE
and known as:
BUNGENDORE SANDS
("the premises") subject to the conditions specified below:

Other than in accordance with section 17B of the Act this licence is not transferable.
The conditions of this licence may be varied or revoked, or new conditions attached, at any time by notice in writing given to the licensee.

DEFINITIONS
In this licence except in so far as the context or subject matter otherwise indicates or requires -
"Commission" means the State Pollution Control Commission.
"Certificate" means the form entitled Certificate of Compliance with Licence Conditions", (copies of which are available from the Commission)
"head office", for the purpose of correspondence means The Secretary
State Pollution Control Commission
PO BOX 367 BANKSTOWN NSW 2200
"regional office" means

State Pollution Control Commission	Postal address
Unit 1 30 Lowe Street QUEANBEYAN NSW 2620	PO BOX 622
phone (062) 99 3330 Fax (062) 99 3525	QUEANBEYAN NSW 2620

"after hours pollution line" means the phone answering service on
(02) 793 0123
"dry weather conditions" means less than 10 millimetres of rain falling within a 24 hour period.

CONDITIONS
For the purpose of preventing, controlling or mitigating the pollution of the environment, this licence is granted subject to the following conditions:

STATE POLLUTION CONTROL COMMISSION
NEW SOUTH WALES

State Pollution Control Commission Act, 1970.

ORIGINAL

LICENCE

Name and address of premise
BUNGENDORE SANDS

CURRANDOOLEY
BUNGENDORE
NSW 2621

Licence Number : 00009
Granted on : 12 AUG 91
In force until : 12 AUG 92

L1. This licence shall be made available at the premises for reference by any person concerned in the activities to which it relates and be produced on demand to a member or officer of the Commission.

L2. Except as may be provided in any other condition of this licence, the licensee shall comply with section 16(1), (2), (3) and (4) of the Clean Waters Act 1970.

L3. Where wastes are discharged to waters in accordance with the conditions of this licence, a record shall be kept of the volume of wastes discharged which may be either ascertained daily or determined by measurement, certified plant production or authorised discharges to a sewerage system.

L4. Pollution control equipment, fuel burning equipment or industrial plant installed in or on the premises shall be maintained in an efficient condition and operated in a proper and efficient manner.

L5. Any activities conducted in or on the premises that, if carried out incompetently, may adversely affect the environment, in a manner that could be prevented, shall be carried out in a proper manner by a competent person in accordance with the conditions of this licence.

L6. Matter and substances on the premises shall be processed, handled, moved and stored in a proper and efficient manner.

L7. No alteration or modification to the place or method of disposal of wastes or pollutants, or to the method of operation of plant, works, fuel burning equipment or pollution control equipment, which is likely to cause or increase air or water pollution or noise being emitted from the premises shall be made without approval in writing from the Commission.

L8. Any record required to be kept by a condition of this licence shall be kept in a legible form at the premises and retained for a period of not less than two years following measurement or recording and produced on demand to a member or officer of the Commission.

L9. The tests for any monitoring required by a condition of this licence shall be carried out in accordance with the methods prescribed in the Clean Air Regulations 1964, Clean Waters Regulations 1972, Noise Control Regulations 1975 or as otherwise specified or approved by the Commission in writing.

STATE POLLUTION CONTROL COMMISSION
NEW SOUTH WALES

State Pollution Control Commission Act, 1970.

ORIGINAL

LICENCE

ame and address of premise
UNGENDORE SANDS

URRANDOOLEY
UNGENDORE
SW 2621

Licence Number : 00009
Granted on : 12 AUG 91
In force until : 12 AUG 92

0 The occurrence of any event which causes or is likely to cause substantial pollution of the environment shall be notified to the Commission's regional office, head office or after hours Pollution Line as soon as practicable after it becomes known to the licensee or by one of its agents or servants.

1. Where required by the Commission, a written report shall be supplied to the Commission within 21 days of any event described in condition L10. Such a report shall include full details known to the licensee (or those details that may be discovered after reasonable enquiry undertaken by the licensee) of the cause, time and duration of the event, the type, volume and concentration of any pollutants, any remedial action taken and any measures taken or to be undertaken by or on behalf of the licensee to prevent or mitigate against a recurrence of such an event.

2. The licensee shall not discharge substances which may pollute waters, at a point not authorised by this licence.

3 Any licensee that has not forwarded the completed Compliance Certificate in respect of the previous licence period shall do so within 30 days of the granting of this licence. The licensee shall state in the Certificate -

L13.1 the extent to which conditions of the preceding licence have been complied with; and

L13.2 identify any conditions not complied with; and

L13.3 the reasons for any non-compliance referred to in paragraph L13.2 for the period covered by the Certificate.

The period to which the Certificate relates shall be from the date of grant of the preceding licence to the date at which the preceding licence expired.

The Certificate for this licence shall be supplied to the Commission within 30 days of the date at which this licence expires or is terminated or revoked.

STATE POLLUTION CONTROL COMMISSION
NEW SOUTH WALES

State Pollution Control Commission Act, 1970.

ORIGINAL

LICENCE

Further conditions with respect to the Clean Air Act 1961

Name and address of premise
BUNGENDORE SANDS

CURRANDOOLEY
BUNGENDORE
NSW 2621

Licence Number : 00009
Granted on : 12 AUG 91
In force until : 12 AUG 92

Classification : Grinding and Milling Works; processing material in quantities per annum of -

Operational Scale : more than 50 kilotonnes but not more than 200 kilotonnes.

CONDITIONS :

1. Loaded sand-carrying trucks shall have their loads fully covered before leaving the premises in a manner which prevents any sand from being lost from the load and such covering shall be maintained until the trucks are unloaded.
2. The tail gates of all loaded trucks leaving the premises shall be securely fastened adequate to prevent any loss of material.

J. NILAND
DIRECTOR

APPENDIX C

APPENDIX C

GEOLOGICAL SIGNIFICANCE OF THE SITE

CONTENTS

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PLATES

FIGURE C1 - Location of Exposures and Test Pits
FIGURE C2 - Geology of the Site and Surrounds
FIGURE C3 - Geological Section AB
FIGURE C4 - Geological Section CD

APPENDIX C1 Geological logs of excavations

1.0 INTRODUCTION

This report presents the results of a geological study of the sedimentary deposits currently being mined by the sand extraction operation located at Lot 31, Part Portion 9, Parish of Currandooly, Shire of Yarrowlumla, NSW. The study was undertaken at the request of Tobiway Crushing Pty Ltd to form part of the Environmental Impact Statement being prepared to accompany an application to Yarrowlumla Shire Council for continuation of the existing operation.

1.1 Background

Presently the sand extraction operation occurs within Zone 7(g) (Environmental Protection (Scientific) Zone) of the Yarrowlumla Local Environmental Plan, 1986. It is understood the principal reason for this zoning is the geological significance of the area, in particular its relationship to Lake George as described by Stevenson in "The Geological Heritage of New South Wales", Volume II, Chapter 9 - Lake George, dated April 1981 (Reference 4 in EIS). The basis for the actual location of the 7(g) zoning line have not been provided to us.

The purpose of this report is to consider the appropriateness of the Zone 7(g) classification to the above site by reference to Stevenson's recommendations, to other published literature relating to the site, and to the results of geological investigation.

2.0 STEVENSON'S RECOMMENDATIONS

Stevenson indicated that the geological significance of the banks adjoining Lake George lies in the many depositional features found in the banks. These include six abandoned strandlines (lacustrine) around Lake George and four aeolian stratigraphic units on the eastern side of Lake George. In his conclusions and recommendations (Section D Page

59) he notes that a large portion of the Lake George area is used for pastoral purposes which pose no threat to the area's geology. However, he is concerned that "uncontrolled" sand mining can reduce the usefulness of the lake area for geomorphic stratigraphic studies and recommends some form of regulatory system. He suggests that the regulatory system could be such that the mining activities do not completely remove any one of the lacustrine and aeolian units (such as those indicated above) in the area. The purpose of this is to leave representative samples intact, enabling further studies to be taken in the future. It should be noted that he does not recommend cessation of mining activities in the area.

Figure 25 in the volume shows the Lake George locality and has an area shaded, possibly as being associated with the Lake George Geological environment, although no specific mention is made of this in the accompanying discussions.

For comparison with the Council's 7(g) zone boundary, the lower boundary of the shaded area is shown on Figure 2 of the EIS and it may be seen that the area zoned by the Council is significantly at variance with the lower shaded area in Stevenson's figure.

3.0 FIELDWORK

3.1 Objectives

Geological studies were carried out to examine the geology exposed in the banks of the existing excavation and to provide site-specific data to supplement the available literature. In particular, the principal objectives were to:

* describe the sedimentary deposits exposed in the existing banks and the environment of deposition;

* compare the deposits in the existing workings with the immediately surrounding area; and

* assess the relative geological significance of the deposits within the context of the Lake George basin.

3.2 Scope of Work

The scope of work for geological investigations comprised:

* a walk-over viewing of exposures in the banks of the existing excavations;

* geological logging of five exposures at selected locations,

* excavation and geological logging of three test pits located on land immediately adjacent to the quarry site,

* geological interpretation of data.

The location of the exposures and test pits logged are shown on Figure C1. Geological logs of the exposures and test pits are presented in Appendix C1 together with explanations of the geological terminology used.

4.0 GEOLOGICAL DESCRIPTION OF SEDIMENTARY DEPOSITS

4.1 The Site

The site occupies an area of about 80ha (0.8 km^2) and is located on the southwest side of Butmaroo Creek where the surface sediments comprise alluvial gravel, sand, silt and

clay. Of this area, about half has already been mined as permitted by the development consent of 1985. An area of minimum 100m width along the banks of Butmaroo Creek has to be left unaffected by the mining operations. The following discussion therefore concerns the remaining area of about 26ha which potentially can be further mined.

4.2 Quaternary Sediments in the Lake George Basin

The geology of the Lake George basin has been described by the Bureau of Mineral Resources (BMR) Record 1985/4 (Reference 3 in the EIS) which presents an overall description of the geology and geomorphology of the Lake George Basin. The late Quaternary sediments and associated landforms in the basin were grouped into five morphostratigraphic units by the BMR:

a) colluvial
b) lacustrine
c) alluvial
d) strandline, and
e) aeolian

The alluvial deposits at the site were laid down as recent Quaternary sediments as stream channel and associated flood plain deposits. The stream channel of Butmaroo Creek has incised into the surrounding flood plain and the deposition process in the channel is still continuing as evidenced by small deposits of point bar sands in the convex portions of the meander loops on the northwest edge of the site. Figure C2 (Figure 4 in Reference 3) shows the location of the site in the Quaternary alluvial soils marked "TQa". This deposit lies about Butmaroo Creek, and the figure shows that similar stream channel deposits occur about Turallo Creek to the south, Taylors and Ailianoyonyiga Creeks to the east and Collector and Tarago Creek to the north of the Lake. The total area of

these stream channel and flood plain alluvial deposits is estimated from the figure to be about 65km^2.

Additional alluvial deposits shown as "TQa" on the figure comprise alluvial fans along the Lake George escarpment to the west where streams flow onto alluvial flood plains bordering the Lake.

4.3 Geology of Site Surrounds

Figure C2 shows that the site, while lying wholly within the large area of alluvial deposits, is proximate to both wind blown (aeolian) deposits of fine sand ("Qdp") and strandline (Lacustrine) deposits of coarse sand and gravel ("Qcb"). The closest strandline features, about 1km from the site, are beach ridges formed as the Lake level has receded and are strongly influenced by beach drift and the prevailing westerly winds. The strandlines often form terraces and provide important data on the interaction of seasonal and long term climatic changes.

The aeolian deposits occur about 200m from the other side of Butmaroo Creek to the site, and typically occur as relatively thin, patchy undulating sand sheets and low linear dunes, apparently derived from strandline and river deposits around the eastern margin of the Lake.

4.4 Description of Site Deposits

The northern walls of Ponds 2 and 3 (Figure C1) provided a cross-sectional coverage through the site. Four exposures located along this wall were trimmed and cleaned by an excavator and geologically logged. A fifth exposure was logged on the southern side of Pond 3 in an area of black clay. Plates C1 to C6 show the five exposures logged.

Three test pits were excavated on land immediately adjacent to the site (Figure C1). The test pits were located to investigate the continuity of the deposits on the site into surrounding areas.

A geological section along the northern walls of Ponds 2 and 3 is shown on Figure C3 and a north-south geological section on Figure C4. The geological sections show some lateral and vertical variability between exposures logged which is typical of an alluvial flood plain deposit. However, four broad units can be interpreted, typically comprising:

* Unit 1 (CLAY) - predominantly dark grey to black or dark olive-grey clay with some interbedded grey or light grey, moderately to poorly sorted, mostly sub-rounded very fine to very coarse sand.

* Unit 2 (SAND and GRAVEL) - light grey or light brown, poorly developed centimetre or decimetre bedded, moderately to poorly sorted, sub-angular to sub-rounded fine to very coarse sand with some granule to pebble gravel.

* Unit 3 (CLAY and SAND/CLAY) - predominantly dark grey and yellow brown clay or 50% clay - 50% sand with some interbedded yellow-brown, red-brown, orange-brown well sorted to poorly sorted very fine to medium sand with some coarse sand.

* Unit 4 (SAND and SILT) - cream, friable, massive, poorly sorted very fine to fine sand with some coarse silt and medium to coarse sand.

Note that Unit 1 is the deepest layer.

In general the structure of the deposits was massive or poorly developed millimetre to decimetre planar bedded sands. Some normal graded bedding was observed with a

decrease in grain-size and improvement in sorting upwards typical of a "dumped" mixture (Plate C1b). Tabular cross-bedding was observed in Exposure 4 in two bands of well sorted fine sand (Plate C6). The dip direction of the internal layers of cross-bed sets indicates the direction of paleocurrent flow was approximately 260^0 to 290^0 magnetic North.

An aeolian sand infilled paleo-dessication crack structure was observed near the surface at Exposure 2 (Plate C7). The dessication crack has formed on a former ground surface on the alluvial flood plain in clayey sand and has subsequently been infilled with wind blown sand.

From observation of the banks of the excavation, the only major difference observed from the above general sequence was the occurrence of lenses of black clay (Figure C1). The clay at Exposure 5 (Plate C8) was very dark grey to black, massive and overlain by a massive, poorly sorted sub-rounded medium to very coarse sand with some sub-angular pebble gravel fragments. This was overlain by a sequence of grey, bedded, well sorted very fine or fine sand with thin dark grey clay bands. The clay lens comprised a concave shaped base with a planar upper surface.

4.5 Environment of Deposition

In summary the vertical stratigraphic sequence exposed in the existing workings comprises interbedded grey clays and moderately to poorly sorted, sub-angular to sub-rounded fine to coarse sands. In some areas the sequence contains lenses of black clay and bands of cross-bedded well sorted fine sands. This sequence is interpreted to be that of an alluvial flood plain deposit with a thin undulating cover of aeolian sand.

Units 1 to 3 described in Section 3.4 comprise the alluvial flood plain deposit. The clay bands and massive to poorly developed horizontal bedding indicate intermittent

deposition from suspension or deposition in the lower flow regime. The occasional normal graded bedding with improving sorting upwards may indicate "dumping" of sediment on the alluvial plain by a flood event. The generally moderately to poorly sorted nature of the sands indicates the low activity of currents on the flood plain and the sub-angular to sub-rounded character of the sands reflects the moderate amount of abrasion the particle may have experienced on the plain.

The areas of cross-bedded, well sorted fine sand reflect a more rapid current and were probably deposited in a stream channel on the alluvial plain. The lenses of black clay were probably deposited in swampy depressions on the alluvial surface. The black colours generally reflect the presence of organic matter and suggest the depositional environment within the swamp was not oxidising. The generally horizontal upper contact with the overlying poorly sorted fine to coarse sand layer suggests burial of the swamp deposits by sediments in flood event with subsequent normal flood plain sedimentation.

Unit 4 in the observed sequence comprises aeolian or wind blown sand. These sands form a thin and patchy sheet-like cover over the flood plain deposits. In the exposures and test pits logged they do not appear to form significant dune deposits and were observed to be less than 1.4m thick and generally 0.3 to 0.7m thick.

5.0 GEOLOGICAL SIGNIFICANCE OF THE DEPOSITS

5.1 Importance of Lake George Deposits

The river-lake depositional sequences at Lake George presents a relatively accessible record that provides a guide to the evolution of continental environments and a reference section for the history of the Late Cainozoic geological times in southeastern Australia.

It is thus of special geological interest, particularly as the basin represents an interface between natural geological processes and resource development resulting from human culture. The Lake is an intermittent lake which is sensitive to climatic change with water level fluctuations responding mainly to rainfall, evaporation and runoff. In "lakefull" conditions sediment may be distributed by currents in the lake while in dry lake bed conditions sediment may be redistributed by wind until grass cover is established. The resulting processes have formed the lake margins as outlined briefly in the previous sections. It is these lake margins that are of particular geological interest.

5.2 Comparison with Adjacent Deposits

Test pits TP1 to 3 were excavated on adjacent land to compare the sediments observed in the existing workings with the deposits in surrounding land to the depth of the test pits (4.8 - 6.1m depth).

Test pits TP1 and 3 are plotted on the geological section on Figure C3 and test pit TP2 on the geological section on Figure C4. The geological sections indicate the continuation of the alluvial flood plain deposits to the west, north and east of the existing quarry with Units 2 and 3 correlated in all test pits. The thin aeolian sand cover is also present in all test pits.

The correlation of Units 2 to 4 from the quarry exposures to the test pits in the surrounding areas confirms the presence of the same alluvial flood plain morphostratigraphic unit around the quarry site. The investigations carried out also show the description of the alluvial deposits in the quarry is similar to the sediments outside the quarry site and the site contains no features not likely to be found in sediments outside the site.

5.3 Significance of Site Geology

The geological investigations undertaken have confirmed the site is located in the alluvial flood plain morphostratigraphic unit as defined and shown by the BMR in BMR Record 1985/4. In addition no unusual geological features were observed on the site during the course of this study and the geological features observed in the site and described here are likely to be found in similar alluvial flood plain deposits immediately surrounding the site.

The site is thus located in the most commonly occurring geomorphological area and covers about 1.2% of that area. The proposed future mining area within the site is less than about 0.5% of that area. The depositional environment to be affected by mining at the site is associated with flood plain and stream channel deposition which is not unique to this area, and is not associated with the beach features or sediment movement in the Lake area which is of particular interest for the geology and geomorphology of the area and is specifically referred to in Stevenson's work.

Based on the recommendations of Stevenson and the above conclusions it is considered that further mining at the site as proposed will not result in loss of recognised geologically significant units.

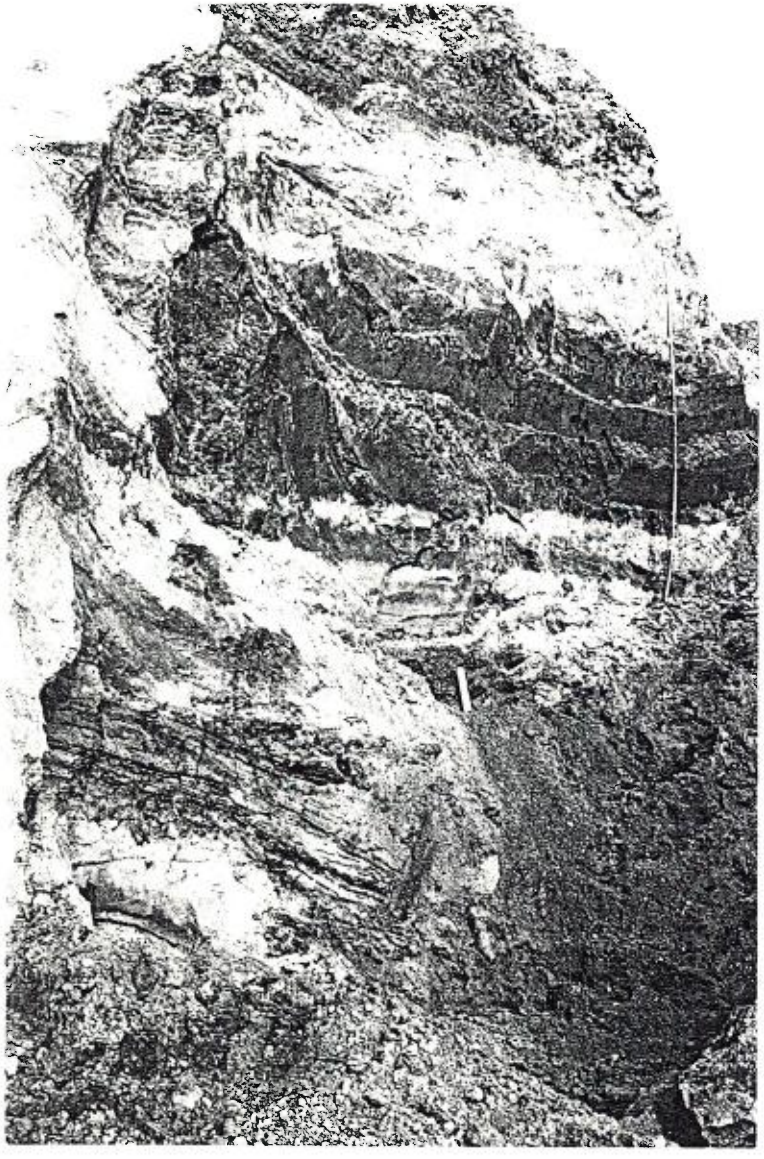

Plate C1a Exposure 1, east end of north wall, Pond 3. (White folded rule is 0.25m long)

Plate C1b Exposure 1 - normal graded bedding, 3.7 to 4.9 metres depth.

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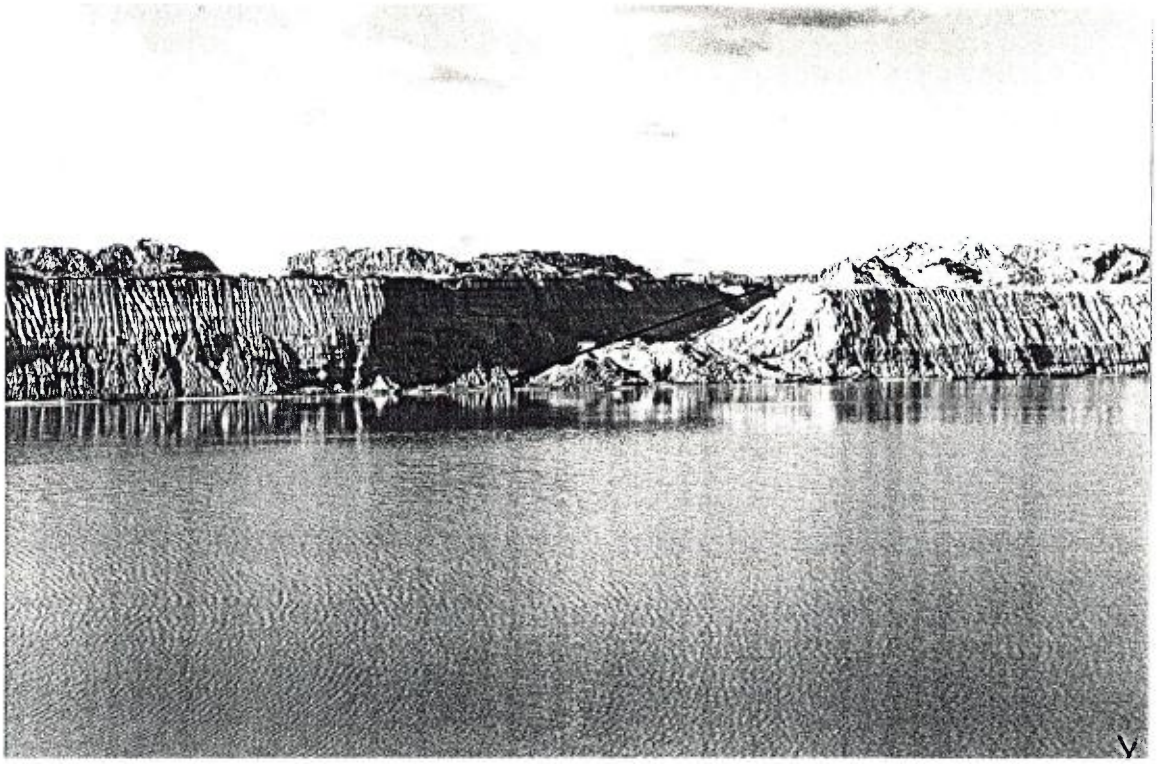

Plate C2 Exposure 2 (indicated) near centre of north wall, Pond 3. (Wall 10 - 11 metres high)

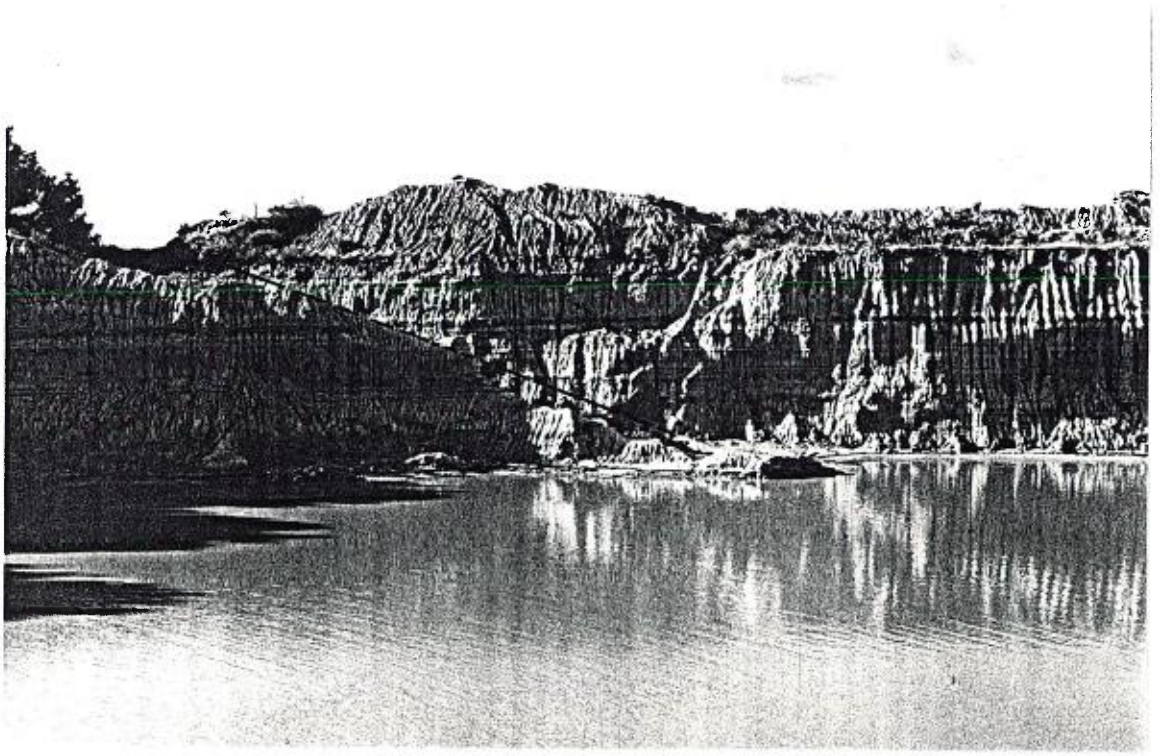

Plate C3 Exposure 3 (indicated) near western end of north wall, Pond 3. (Wall approximately 10 metres high)

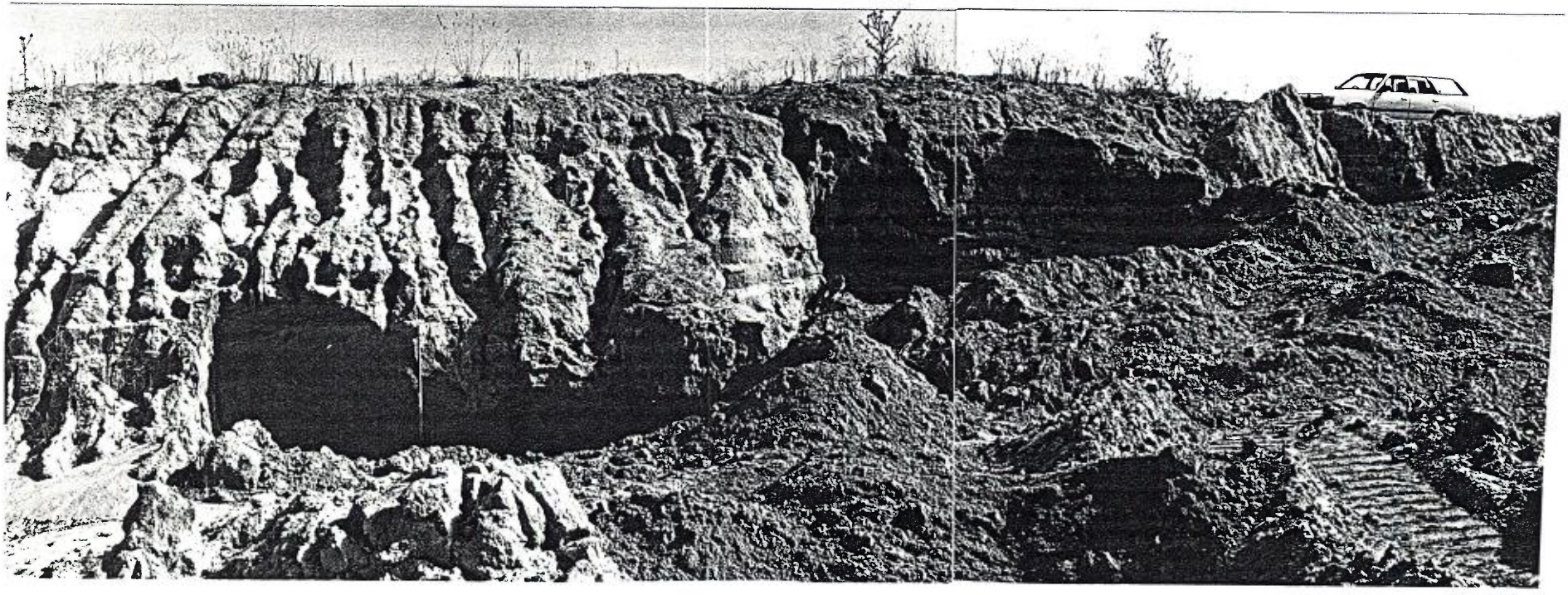

Plate C4 Exposure 4, west end of north wall, Pond 2.
(Shovel handle is about 1.55 metres long)

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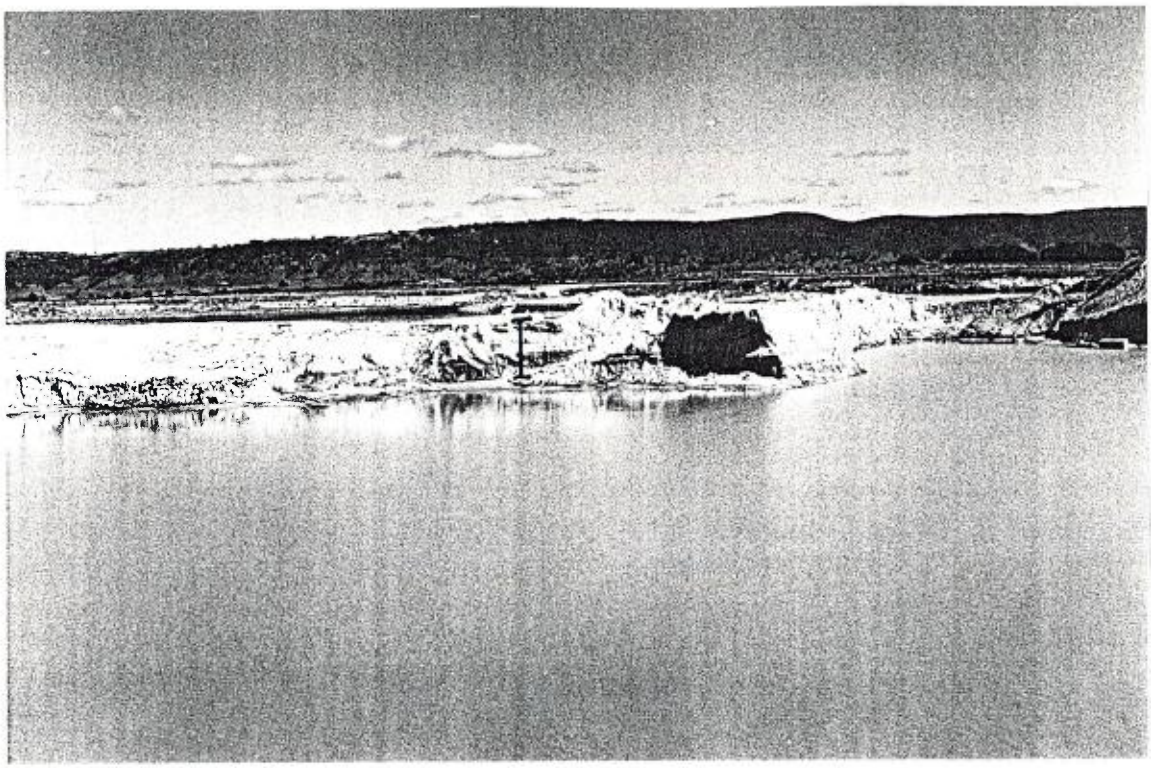

Plate C5 Exposure 5 (indicated) through black clay lens, south side of Pond 3. (Total height of exposure approximately 5 metres)

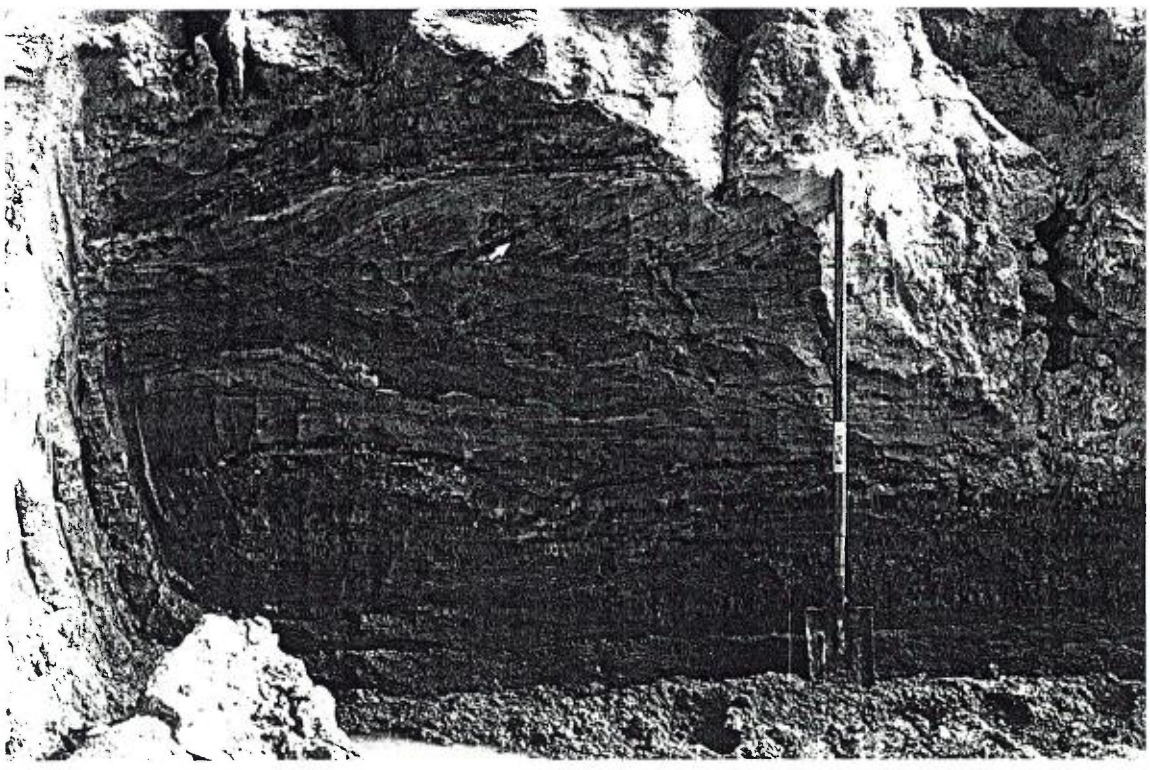

Plate C6 Exposure 4 - Tabular cross bedding band, 3.35 to 3.6 metres depth, south end of exposure at location shown in Plate C4. Arrow marks internal layers of cross-bed sets. (Shovel is about 1.55 metres long)

Plate C7 Exposure 2 - aeolian sand infilled dessication crack, 0.7 to 1.8 metres depth.

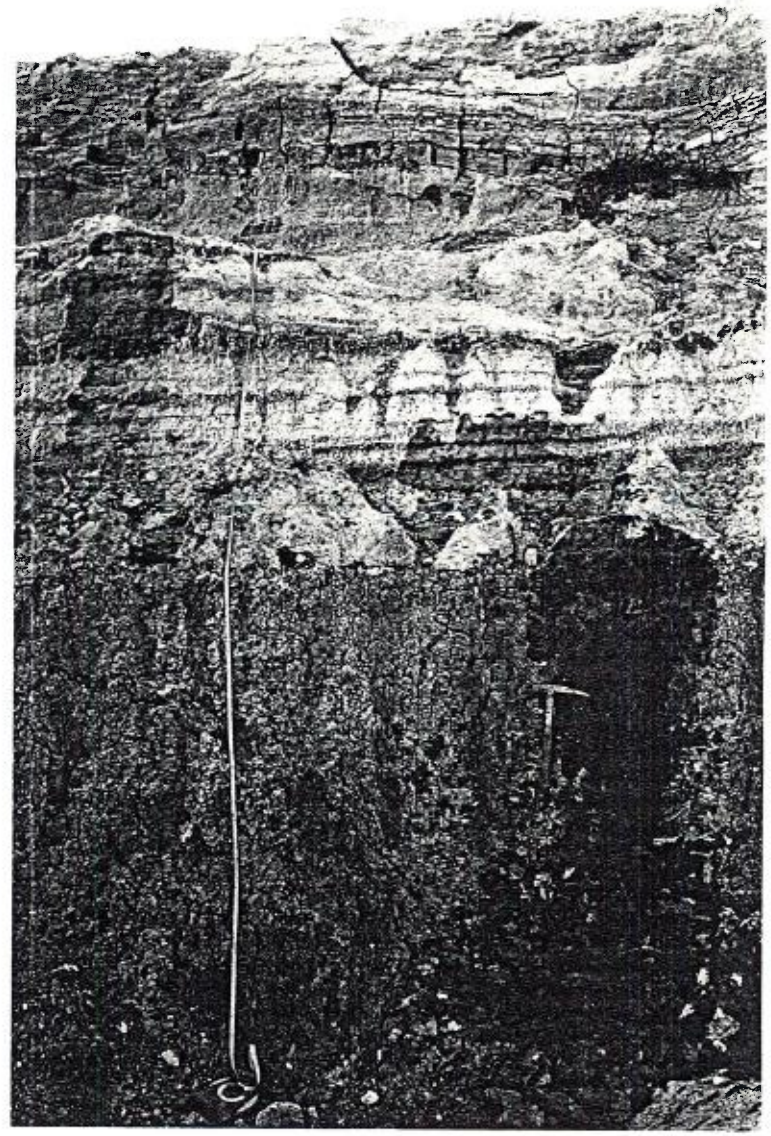

Plate C8 Exposure 5 - black clay overlain by horizontal bedded sands. (Total height of exposure about 5 metres)

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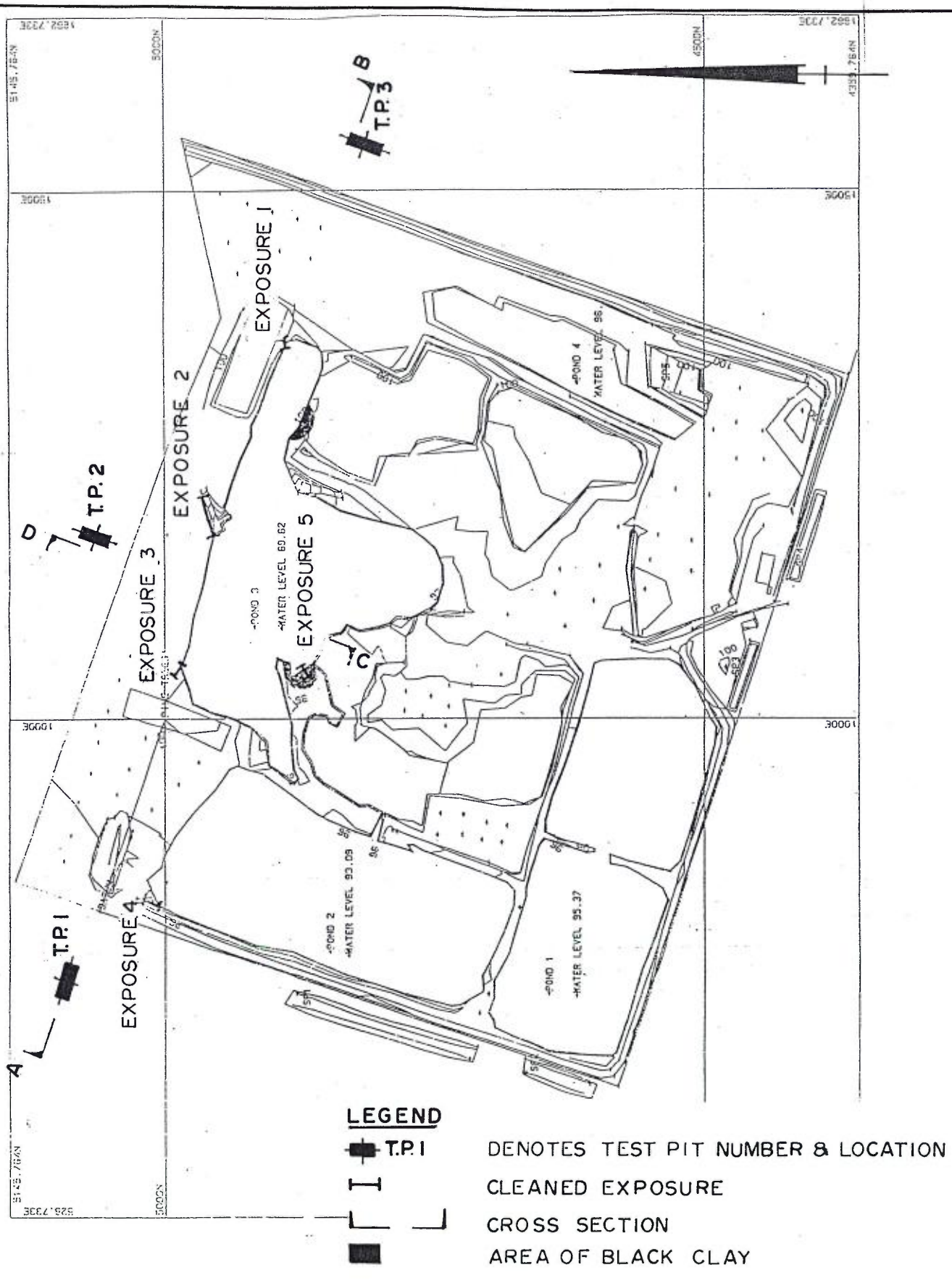

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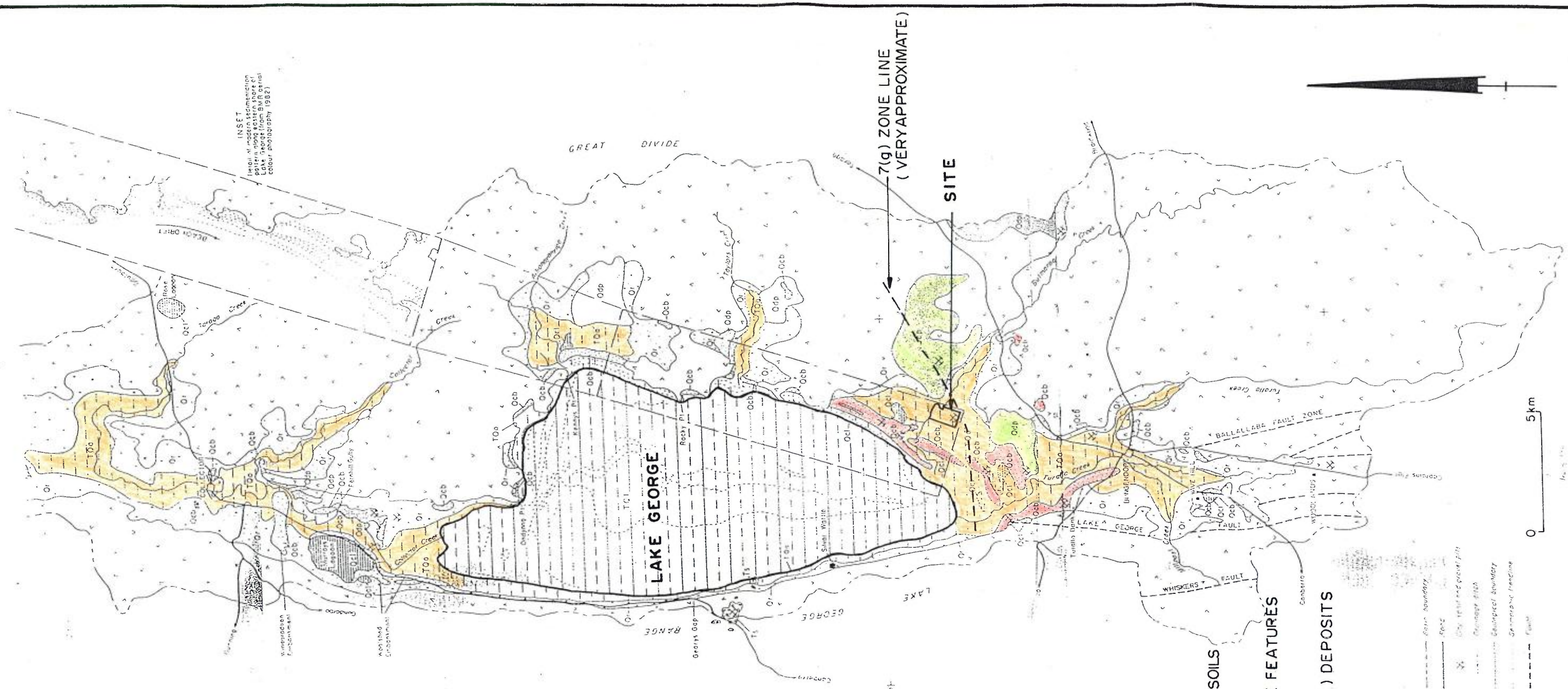
drawn	M.E./C.G.	TOBIWAY CRUSHING PTY. LTD.
approved		GEOLOGY OF QUARRY DEPOSITS LOCATION OF EXPOSURES AND TEST PITS
date	15-4-92	
scale	1:5000	

COFFEY

drawing no: FIGURE C1

job no: C5705/1



MAP REPRODUCED FROM BMR GEOLOGY AND GEOPHYSICS RECORD 1985/4 "GEOLOGY OF THE LAKE GEORGE BASIN N.S.W." BY Dr. R.S.ABELL

SEE FIGURE C2(a) FOR LEGEND ON GEOLOGICAL UNITS

GEOLOGY OF THE SITE & SURROUNDS

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scale (metres)

revision	description	drawn	approved	date

drawn	S.P./C.G.
checked	
date	14/5/92

TOBIWAY CRUSHING PTY. LTD.
ENVIRONMENTAL IMPACT STATEMENT
LOT 31, PART PORTION 9
PARISH OF CURRANDOOLY
SHIRE OF YARRALUMLA

COFFEY

drawing no. FIGURE C2

job no. C 5705/1

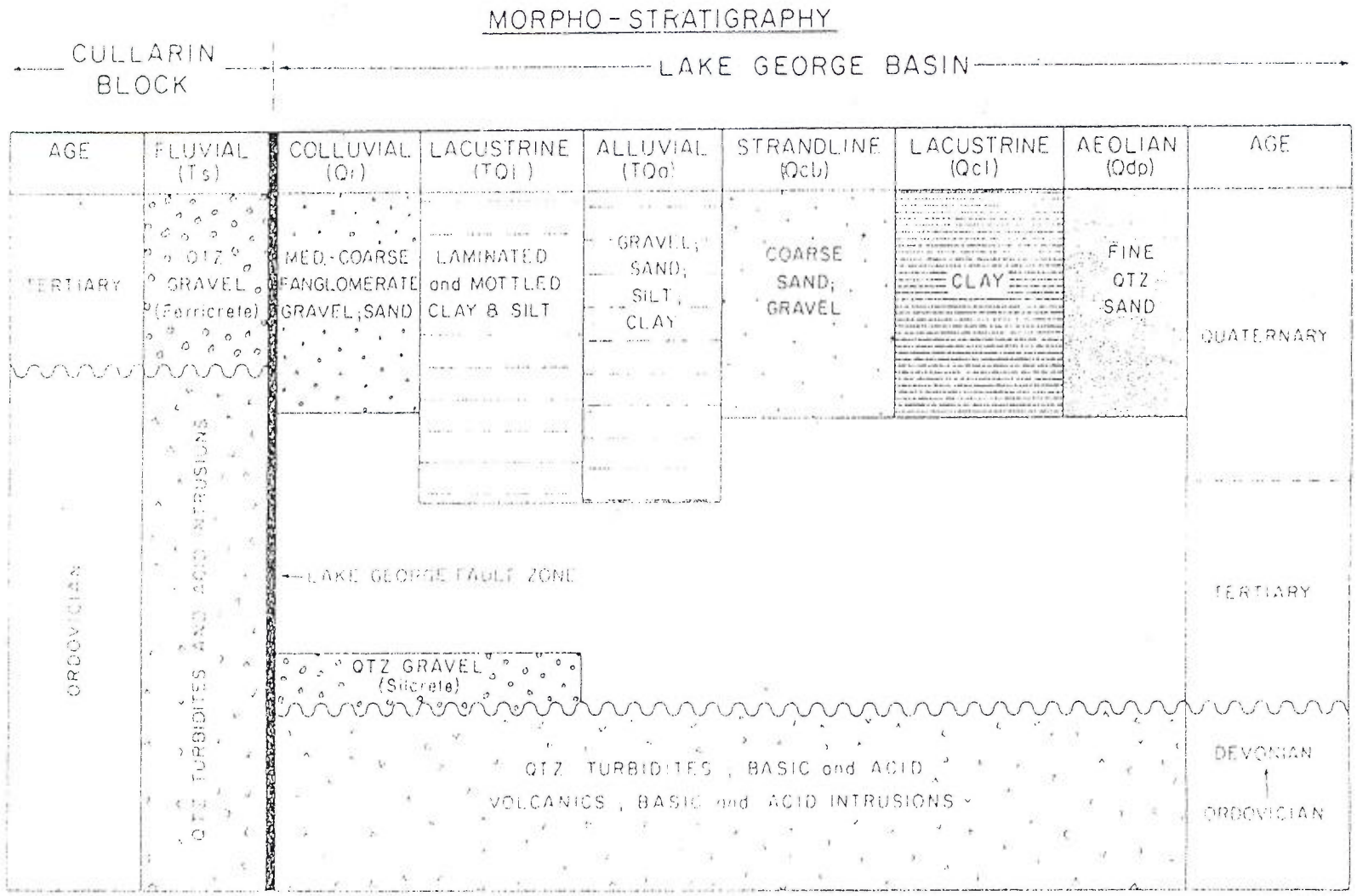

Fig. 4 Cainozoic geology

LEGEND FOR FIGURE C2

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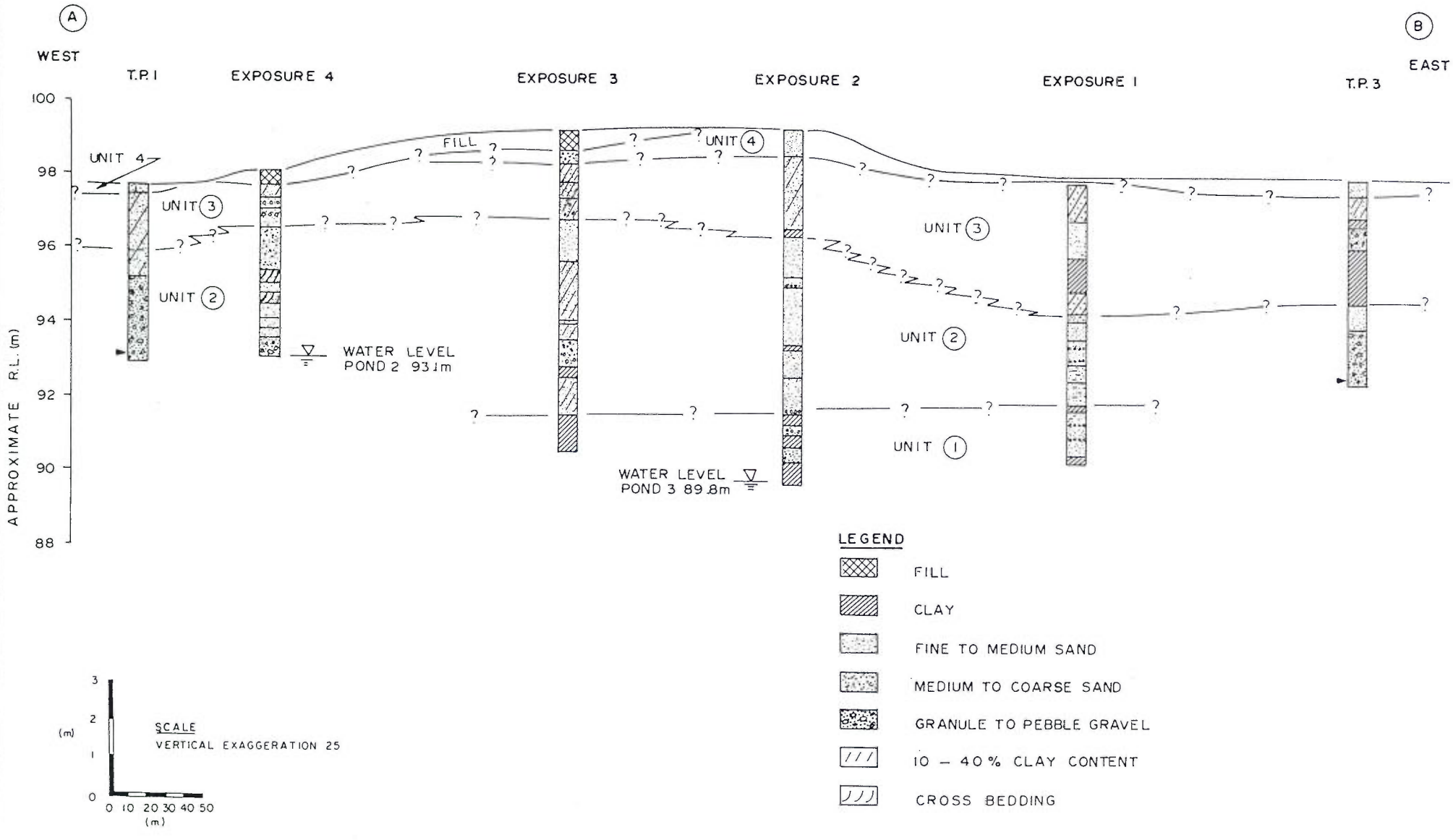
drawn: S.P./G.G.
approved:
date: 24-3-92
scale:

TOBIWAY CRUSHING PTY. LTD.
ENVIRONMENTAL IMPACT STATEMENT
LOT 31, PART PORTION 9
PARISH OF CURRANDOOLY
SHIRE OF YARRALUMLA

COFFEY

drawing no: FIGURE C2(a)
job no: C5705/1



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scale (metres)

revision	description	drawn	approved	date

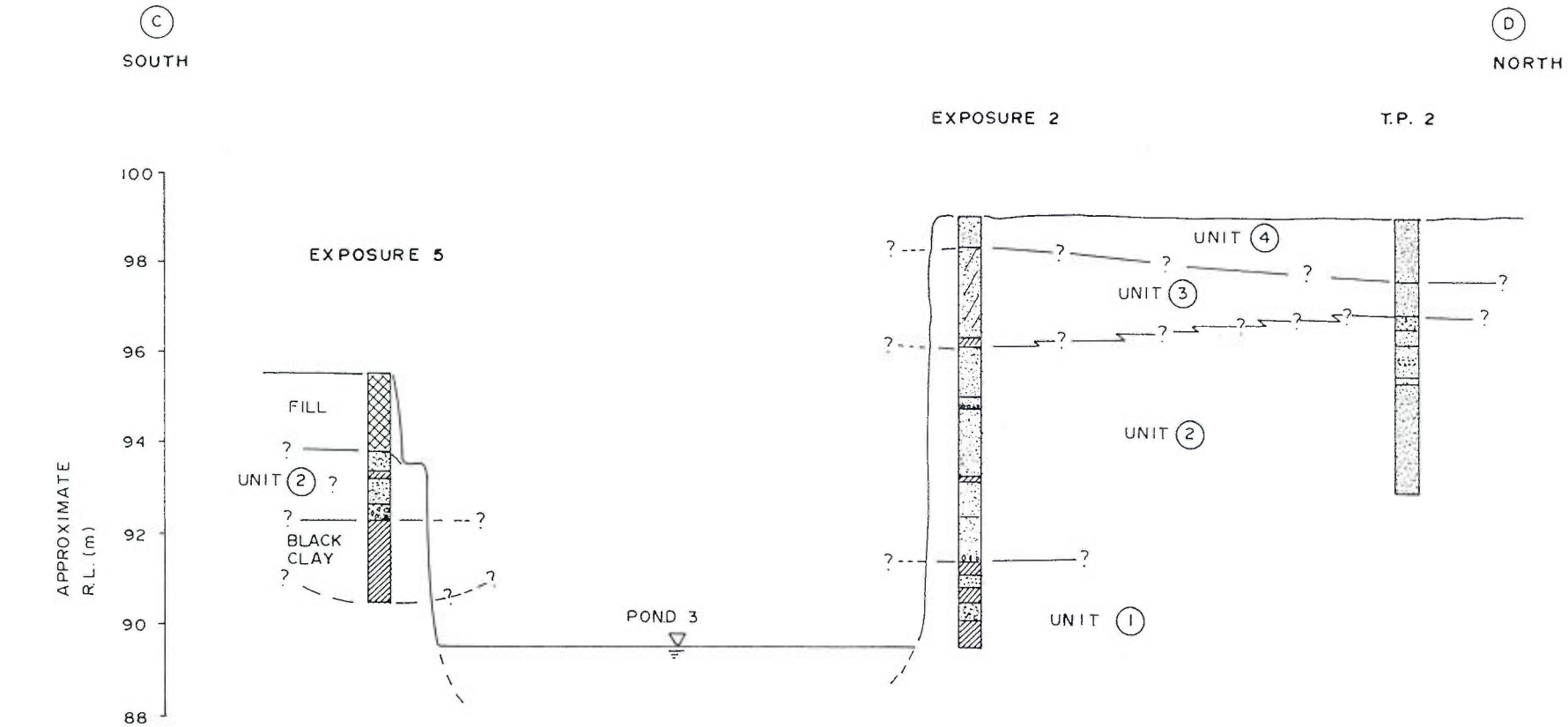
drawn	M.E/C.G.
checked	
date	14/5/92

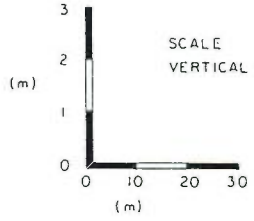
TOBIWAY CRUSHING PTY. LTD.
GEOLOGY OF QUARRY DEPOSITS
GEOLOGICAL SECTION A B

COFFEY

drawing no.
FIGURE C3

job no. C 5705 / 1





SCALE
VERTICAL EXAGGERATION 10

NOTE: SEE FIGURE C3 FOR LEGEND

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GEOLOGY OF QUARRY DEPOSITS
GEOLOGICAL SECTION C D

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drawing no. FIGUREC4
job no. C5705/1

APPENDIX C1

GEOLOGICAL LOGS OF EXCAVATIONS

EXPLANATION OF GEOLOGICAL TERMS

C1.0 General Description of Sedimentary Deposits

The sedimentary deposits logged during this study have been described using the following geological system.

* colour
* induration
* structure
* texture, and
* composition

This sequence allows description of the more distinctive and important features. It is not comprehensive and further description of other features observed are made where necessary. Explanation of the terms used to describe the listed features is given below and is largely based on Lewis, D.W. 1981, "Practical Sedimentology".

C2.0 Colour, Induration and Structure

C2.1 Colour

Colour is described in the moist condition using simple terms such as grey, red, brown etc. These terms may be modified as necessary by using "light" or "dark". Borderline colours may be described as a combination of these colours (e.g. red-brown).

C2.2 Induration

Induration describes the hardness of the deposit. The following terms provide an approximate standard:

* loose: grains are free flowing when disturbed by slight finger pressure;
* friable: grains break free with finger pressure;
* poorly indurated: grains break free with hand pressure;
* indurated to well indurated: grains not broken when rock is broken;
* very well indurated: grains break when rock is broken.

C2.3 Structure

Structure relates to the internal sedimentary structure formed by mechanical, chemical and biogenic processes during sedimentation or shortly after. The most common sedimentary structure is probably stratification or bedding. Thickness of bedding is described as follows:

Term	Thickness
millimetre bedded	1mm - 1cm
centimetre bedded	1cm - 10cm
decimetre bedded	10cm - 100cm
metre bedded	1m - 10m

Cross bedding is a series of inclined bedding planes having some relationship to the direction of current flow. A normal graded bed is a unit which displays a sorting effect with the coarsest material at the base and the finest material at the top.

There are many other sedimentary structures possible. A full description of the range of structures possible is beyond the scope of this study.

C3.0 Texture and Composition

C3.1 Texture

Texture is the relationship between the grains forming the deposit. Texture is described by the following basic properties:

* grain size
* sorting, and
* roundness

Grain Size is described by the Udden - Wentworth grain size scale which is shown in Table C1-1. Note this scale is a geological system and differs from the engineering classification of soil components.

Sorting refers to the size distribution of the sand and coarse silt fraction. Three classes of sorting have been used:

* well sorted - central two thirds of the grain size range falls within less than the equivalent of one Udden - Wentworth size grade,

* moderately sorted - central two thirds ranges over the equivalent of one to two Udden - Wentworth size grades,

* poorly sorted - central two thirds ranges over more than the equivalent of two Udden - Wentworth grades.

Roundness indicates the extent of abrasion the grains have undergone. Roundness is estimated visually in comparison with standard silhouette charts (e.g. Figure C1-1 for sand grains).

In more detailed studies other textural properties such as shape (sphericity), grain surface features and fabric would also be described.

C3.2 Composition

Composition refers to the mineralogical makeup of the grains. Most detrital sand grains are either quartz, feldspar or rock fragments.

Composition of detrital sediments reflects the influence of provenance, tectonism and climate. As such, composition was not described in this field study as the objective was to primarily assess the depositional environment of the quarry sedimentary deposits and hence the morphostratigraphic unit on which the site is situated. Structure and texture mostly provide information on these aspects.

TABLE C1-1

(after Lewis, D.W. 1981, Practical Sedimentology, Aptegx Books)

GRAIN-SIZE SCALE AND ϕ/mm CONVERSION CHART

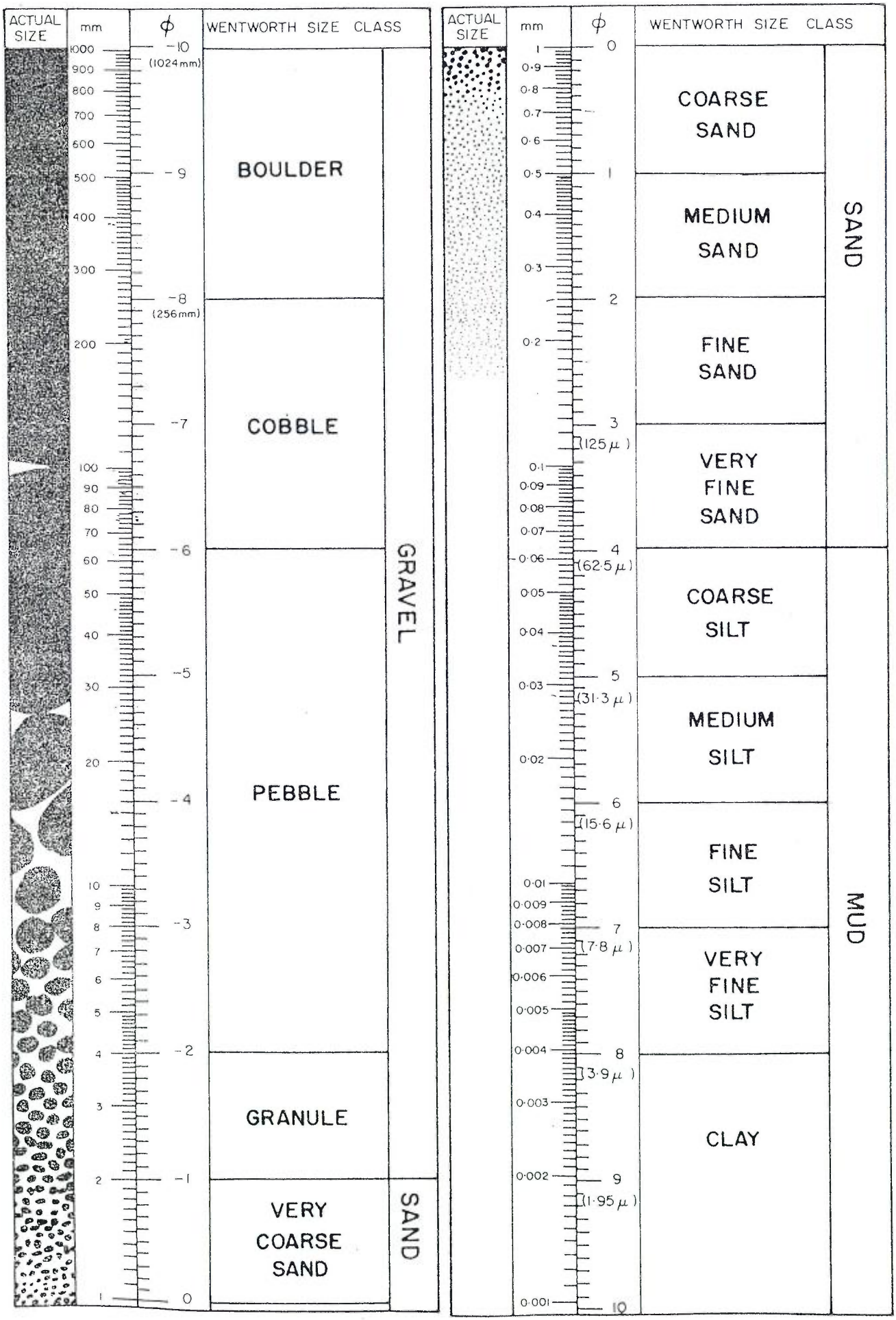
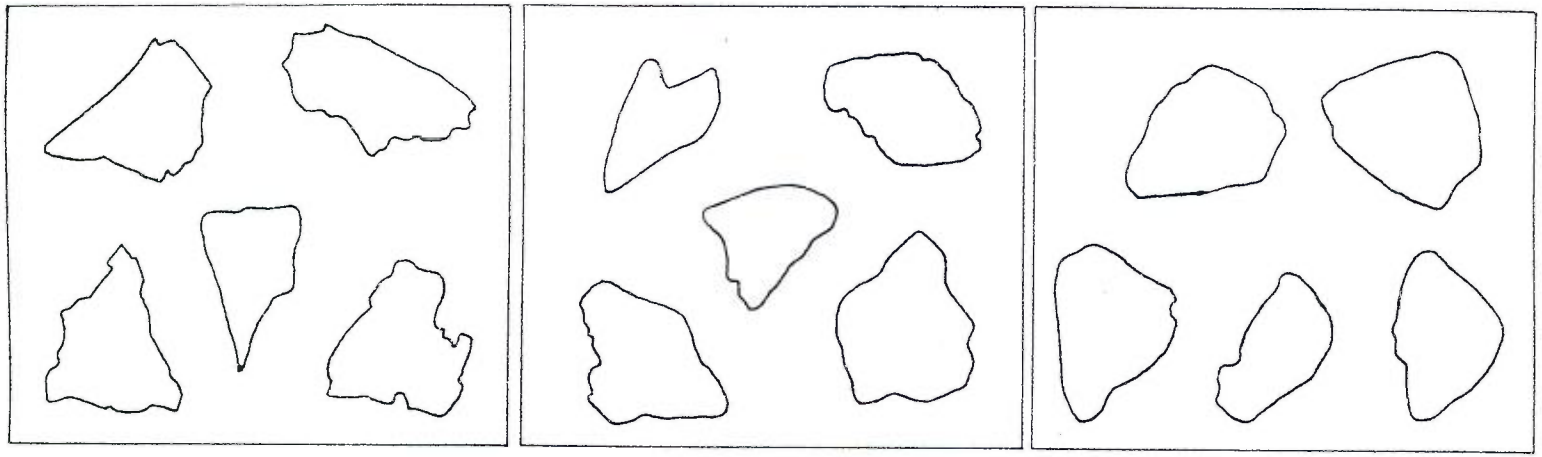


FIGURE C1-1



SILHOUETTE COMPARISON CHART FOR SAND GRAIN ROUNDNESS

(after Shepard and Young, 1961, J. Sed. Petrology, 31:199)

Coffey Partners International Pty Ltd
Incorporated in NSW

geological log excavation

COFFEY

pit no: Exposure 1
sheet 1 of 2

office and job no: CANBERRA C5705/1

Client: TOBIWAY CRUSHING PTY LTD
project: SAND EXTRACTION OPERATION, CURRANDOOLY NSW
pit location: SEE FIGURE C1

pit commenced:
pit completed:
logged by: MJE 8.4.92
log checked by: SP

equipment type and model:
excavation dimensions: m long, m wide

R.L. surface: m
datum:

method	penetration 1 2 3	support	water	notes samples, tests, etc.	R.L. depth metres	graphic log	classification symbol	material	moisture condition	consistency, density index	hand penetrometer 100 200 300 400 kPa	structure and additional observations
QUARRY WALL		NIL					CL	Yellow-brown and dark olive-grey, massive to mm-bedded CLAY 60% and moderately sorted fine and medium SAND 40%	D / M	VSt		ALLUVIAL DEPOSIT
				Sample 1	1		SP	Light grey and orange-brown, massive, moderately sorted very fine and fine SAND, sub-angular		Fb		contains lenses of poorly sorted very fine to medium SAND, sub-angular
					2		CL	Dark grey CLAY 95% and very fine SAND and SILT 5%		VSt		50mm band on contact of moderately sorted binodal very fine and fine SAND and granule GRAVEL
					3		CL	Dark grey and mottled yellow-brown CLAY 60% and moderately sorted fine and medium SAND 40% becoming poorly sorted, fine to coarse SAND				
				Sample 2			SP / SW	Light grey to white with some mottled yellow-brown, dm-bedded, poorly sorted fine to coarse SAND		Fb		
					4		SP					
							SP					

key

method: N natural exposure; E existing excavation; BH backhoe bucket; B bulldozer blade; R ripper

support: T timbering

penetration 1 2 3 — nc resistance ranging to refusal

water: 10 Jan 78 water level on date shown; water inflow; water outflow

notes: samples and tests; U50 undisturbed sample 50 mm diameter; D disturbed sample; N standard penetration test: figure = result; N* SPT + sample; Nc cone penetrometer

classification symbols and soil description based on unified classification system

moisture: D dry; M moist; W wet

consistency/density index: VS very soft; S soft; F firm; St stiff; VSt very stiff; H hard; Fb friable; VL very loose; L loose; MD medium dense; D dense; VD very dense

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geological log excavation

COFFEY

pit no: Exposure 1
sheet 2 of 2

office and job no: CANBERRA C5705/1

Client: TOBIWAY CRUSHING PTY LTD
project: SAND EXTRACTION OPERATION, CURRANDOOLY NSW
pit location: SEE FIGURE C1

pit commenced:
pit completed:
logged by: MJE 8.4.92
log checked by: SP

equipment type and model:
excavation dimensions: m long, m wide

R.L. surface: m
datum:

method	penetration 1 2 3	support	water	notes samples, tests, etc.	R.L. depth metres	graphic log	classification symbol	material	moisture condition	consistency, density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
QUARRY WALL		NIL			4		SP	Dark grey, dm-bedded, well sorted fine SAND	M	Fb		Normal graded bed- Plate C1b
				Sample 3			SP	Light grey to white becoming grey, moderately sorted fine to medium SAND, sub-rounded				
								Grey to dark grey, faintly cm-bedded, poorly sorted coarse SAND and granule GRAVEL, sand sub-rounded, gravel angular to sub-angular				colour becomes orange-brown with some grey
					5		SP		W	L		
							SP	Grey with some dark grey bands, faintly cm-bedded, moderately sorted fine to medium SAND, sub-rounded	M			contains dark grey to black beds of clay 1cm thick
								Light grey to white, dm-bedded, well sorted coarse SAND				
					6		CL	Dark grey to black CLAY		VSt		
								Light grey, cm-bedded, poorly sorted medium to very coarse SAND, sub-rounded		Fb		
								contains some bands of clay to 2cm thick and bands of pebbles and cobbles, sub-rounded				
			8.4.92		7							
								Dark olive-grey CLAY		VSt		
								Base of Exposure 1 approximately 0.5m above water level in Pond 3				
					8							

key
method
N natural exposure
E existing excavation
BH backhoe bucket
B bulldozer blade
R ripper

support
T timbering
penetration 1 2 3 — nc resistance ranging to refusal
water
10 Jan 78 water level on date shown
water inflow
water outflow

notes
U50 undisturbed sample 50 mm diameter
D disturbed sample
N standard penetration test: figure = result
N* SPT + sample
Nc cone penetrometer

classification symbols and soil description based on unified classification system

moisture
D dry
M moist
W wet

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

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geological log excavation

COFFEY

pit no: Exposure 2
sheet 1 of 3

office and job no: CANBERRA C5705/1

Client: TOBIWAY CRUSHING PTY LTD
project: SAND EXTRACTION OPERATION, CURRANDOOLY NSW
pit location: SEE FIGURE C1

pit commenced:
pit completed:
logged by: MJE 8.4.92
log checked by: SP

equipment type and model:
excavation dimensions: m long, m wide

R.L. surface: m
datum:

method	penetration 1 2 3	support	water	notes samples, tests, etc.	R.L. / depth metres	graphic log	classification symbol	material	moisture condition	consistency, density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
QUARRY WALL		NIL					SP	Cream, massive, moderately sorted very fine to fine SAND	M	Fb		AEOLIAN DEPOSIT
					1		SC	Yellow-brown and some mottled red-brown, massive, mostly well sorted fine SAND with lenses of moderately sorted very fine to fine or fine to medium SAND, sub-rounded 70% and CLAY 30%	D	H		ALLUVIAL DEPOSIT Plate C7 Aeolian sand infilled dessication crack
					2		CL	As above, CLAY 70%, SAND 30%				
					3		SW	Light brown-grey with some mottled yellow-brown, massive poorly sorted fine to coarse SAND, sub-angular to sub-rounded 90% and CLAY 10%	M			Weakly cemented contains lenses of white, friable, massive well sorted medium SAND, sub-rounded up to 0.7m wide & 0.35m thick
					4							

key
method
N natural exposure
E existing excavation
BH backhoe bucket
B bulldozer blade
R ripper

support
T timbering
penetration 1 2 3 — nc resistance ranging to refusal
water
10 Jan 78 water level on date shown
water inflow
water outflow

notes
U50 undisturbed sample 50 mm diameter
D disturbed sample
N standard penetration test: figure = result
N* SPT + sample
Nc cone penetrometer

classification symbols and soil description
based on unified classification system

moisture
D dry
M moist
W wet

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

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geological log excavation

COFFEY

pit no: Exposure 2
sheet 2 of 3

office and job no: CANBERRA C5705/1

Client: TOBIWAY CRUSHING PTY LTD

project: SAND EXTRACTION OPERATION, CURRANDOOLY, NSW
pit location: SEE FIGURE C1

pit commenced:
pit completed:
logged by: MJE 8.4.92
log checked by: SP

equipment type and model:
excavation dimensions: m long, m wide

R.L. surface: m
datum:

method	penetration 1 2 3	support	water	notes samples, tests, etc.	R.L. depth metres	graphic log	classification symbol	material	moisture condition	consistency, density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
QUARRY WALL		NIL		Sample 4	4		SP	Grey-brown, cm-bedded, moderately sorted, coarse to very coarse SAND, sub-angular becoming poorly sorted, coarse to pebble GRAVEL, sub-rounded	M	L		normal graded bedded band is continuous for over 15m
							SP	Light grey with some yellow-brown, very faintly cm-bedded, moderately sorted medium to coarse SAND, sub-rounded 90% and CLAY 10%		Fb		ALLUVIAL DEPOSIT
					5		SP	Light grey & yellow-brown, dm-bedded, moderately sorted, coarse with some medium SAND, sub-rounded				
							CL	with some rounded Dark grey CLAY		VSt		
					6		SP	Light grey and dark red-brown, faintly cm-bedded, moderately sorted coarse to very coarse SAND, sub-rounded and rounded		L/ Fb		
							SW	Dark grey, massive, poorly sorted fine to very coarse SAND, sub-angular to sub-rounded				
					7			100mm thick pebble and cobble band, quartzose, sub-angular to rounded				
							CL/ CH	Dark olive-grey CLAY		VSt/ H		
					8							

key
method
N natural exposure
E existing excavation
BH backhoe bucket
B bulldozer blade
R ripper

support
T timbering
penetration 1 2 3 — nc resistance ranging to refusal
water
10 Jan 78 water level on date shown
water inflow
water outflow

notes
U50 undisturbed sample 50 mm diameter
D disturbed sample
N standard penetration test: figure = result
N* SPT + sample
Nc cone penetrometer

classification symbols and soil description
based on unified classification system

moisture
D dry
M moist
W wet

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

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geological log excavation

COFFEY

pit no: Exposure 2
sheet 3 of 3

office and job no: CANBERRA C5705/1

Client: TOBIWAY CRUSHING PTY LTD

project: SAND EXTRACTION OPERATION, CURRANDOOLY, NSW
pit location: SEE FIGURE C1

pit commenced:
pit completed:
logged by: MJE 8.4.92
log checked by: SP

equipment type and model:
excavation dimensions: m long, m wide

R.L. surface: m
datum:

method	penetration 1 2 3	support	water	notes samples, tests, etc.	R.L. depth metres	graphic log	classification symbol	material	moisture condition	consistency, density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
QUARRY WALL		NIL	8.4.92 ▽	Sample 5	8		SP	Grey, massive, moderately sorted coarse to very coarse SAND with some quartzose granules to cobble size GRAVEL	M/W	L		ALLUVIAL DEPOSIT
							CL/CH	Dark grey to black CLAY	M	St		
					9		SP	Grey, massive, moderately sorted coarse to very coarse SAND, sub-rounded and rounded	W	L		
							CL/CH	Dark olive-grey CLAY	M	VSt		
					10			Base of Exposure 2 at water level in Pond 3				

key
method
N natural exposure
E existing excavation
BH backhoe bucket
B bulldozer blade
R ripper

support
T timbering
penetration 1 2 3 — nc resistance ranging to refusal
water
10 Jan 78 water level on date shown
water inflow
water outflow

notes samples and tests
U50 undisturbed sample 50 mm diameter
D disturbed sample
N standard penetration test: figure = result
N* SPT + sample
Nc cone penetrometer

classification symbols and soil description based on unified classification system

moisture
D dry
M moist
W wet

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

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geological log excavation

COFFEY

pit no: Exposure 3
sheet 1 of 3

office and job no: CANBERRA C5705/1

Client: TOBIWAY CRUSHING PTY LTD.

project: SAND EXTRACTION OPERATION, CURRANDOOLY NSW
pit location: SEE FIGURE C1

pit commenced:
pit completed:
logged by: MJE 9.4.92
log checked by: SP

equipment type and model:
excavation dimensions: m long, m wide

R.L. surface: m
datum:

method	penetration 1 2 3	support	water	notes samples, tests, etc.	R.L. depth metres	graphic log	classification symbol	material	moisture condition	consistency, density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
QUARRY WALL		NIL					CL, SC	SAND 50%, CLAY 50%	D	H		FILL
							SP	Cream, massive, poorly sorted, very fine to coarse SAND, sub-angular to rounded	M	Fb		AEOLIAN DEPOSIT
					1		SC	Brown and yellow-brown, massive, poorly sorted, very fine to medium SAND, subrounded, 90% and CLAY 10%		H		Weakly cemented ALLUVIAL DEPOSIT
							CL	Dark green.-grey, massive, CLAY 60% and poorly sorted fine to coarse SAND, sub-angular 40%	D			
					2		SC	As above, colour becomes light brown, SAND 70% with some granule GRAVEL and CLAY 30%				
							SP	Cream to light brown, massive, moderately sorted very fine and fine SAND with some medium SAND, sub-angular	M	H		
							SP	Light brown to light green-brown, massive, well sorted fine SAND		Fb		Normal graded bed (coarse tail grading)
					3		SP	As above becoming moderately sorted very fine and fine SAND				
							SC	Light brown to light green-brown with mottled yellow-brown, massive, moderately sorted fine and medium SAND, sub-angular 70% and CLAY 30%		VSt		
					4							

key

method: N natural exposure; E existing excavation; BH backhoe bucket; B bulldozer blade; R ripper

support: T timbering

penetration: 1 2 3 — nc resistance ranging to refusal

water: 10 Jan 78 water level on date shown; water inflow; water outflow

notes: U50 undisturbed sample 50 mm diameter; D disturbed sample; N standard penetration test: figure = result; N* SPT + sample; Nc cone penetrometer

classification symbols and soil description based on unified classification system

moisture: D dry; M moist; W wet

consistency/density index: VS very soft; S soft; F firm; St stiff; VSt very stiff; H hard; Fb friable; VL very loose; L loose; MD medium dense; D dense; VD very dense

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geological log excavation

COFFEY

pit no: Exposure 3
sheet 2 of 3

office and job no: CANBERRA C5705/1

Client: TOBIWAY CRUSHING PTY LTD
project: SAND EXTRACTION OPERATION, CURRANDOOLY NSW
pit location: SEE FIGURE C1

pit commenced:
pit completed:
logged by: MJE 9.4.92
log checked by: SP

equipment type and model:
excavation dimensions: m long, m wide

R.L. surface: m
datum:

method	penetration 1 2 3	support	water	notes samples, tests, etc.	R.L. depth metres	graphic log	classification symbol	material	moisture condition	consistency, density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
QUARRY WALL		NIL			4		SC	As above	M	VSt		ALLUVIAL DEPOSIT
					5			some coarse SAND towards the base				Normal graded bed (coarse tail grading)
							SP	Light brown-grey, massive, moderately sorted very coarse SAND and granule to pebble GRAVEL		Fb		Plate C3
							SC			VSt		
							SC	As above becoming moderately sorted coarse SAND with some medium SAND, sub-angular 70% and CLAY 30%		Fb		
							SP					
					6		SP	As above becoming poorly sorted fine to coarse SAND, sub-angular 70% & CLAY 30%				
							SP					
							CL	As above becoming moderately sorted coarse and very coarse SAND with some granule & pebble GRAVEL, sub-angular		VSt		
							SC					
					7			As above becoming poorly sorted coarse SAND to cobble GRAVEL, quartose, sub-angular to sub-rounded				
								Grey-brown, massive, poorly sorted coarse SAND to granule GRAVEL, sub-angular				
							CL/ CH	Grey & mottled dark red-brown CLAY				
					8			As above becoming moderately sorted very fine SAND 70% & CLAY 30%, SAND becomes fine to medium towards base				

key
method
N natural exposure
E existing excavation
BH backhoe bucket
B bulldozer blade
R ripper

support
T timbering
penetration 1 2 3 nc resistance ranging to refusal
water
10 Jan 78 water level on date shown
water inflow
water outflow

notes
U50 undisturbed sample 50 mm diameter
D disturbed sample
N standard penetration test: figure = result
N* SPT + sample
Nc cone penetrometer

classification symbols and soil description based on unified classification system

moisture
D dry
M moist
W wet

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

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geological log excavation

COFFEY

pit no: Exposure 3
sheet 3 of 3

office and job no: CANBERRA C5705/1

Client: TOBIWAY CRUSHING PTY LTD

project: SAND EXTRACTION OPERATION, CURRANDOOLY NSW
pit location: SEE FIGURE C1

pit commenced:
pit completed:
logged by: MJE 9.4.92
log checked by: SP

equipment type and model:
excavation dimensions: m long, m wide

R.L. surface: m
datum:

method	penetration 1 2 3	support	water	notes samples, tests, etc.	R.L. depth metres	graphic log	classification symbol	material	moisture condition	consistency, density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
QUARRY WALL		NIL	▽ 9.4.92		8		CL/CH	Dark grey CLAY	M	VSt		
					9			Base of Exposure 3 approximately 0.7m above water level in Pond 3				

key

method
- N natural exposure
- E existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper

support
- T timbering

penetration 1 2 3 — nc resistance ranging to refusal

water
- 10 Jan 78 water level on date shown
- water inflow
- water outflow

notes
- U50 undisturbed sample 50 mm diameter
- D disturbed sample
- N standard penetration test: figure = result
- N* SPT + sample
- Nc cone penetrometer

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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geological log excavation

COFFEY

pit no: Exposure 5
sheet 1 of 2

office and job no: CANBERRA C5705/1

Client: TOBIWAY CRUSHING PTY LTD
project: SAND EXTRACTION OPERATION, CURRANDOOLY NSW
pit location: SEE FIGURE C1

pit commenced:
pit completed:
logged by: MJE 9.4.92
log checked by: SP

equipment type and model:
excavation dimensions: m long, m wide

R.L. surface: m
datum:

method	penetration 1 2 3	support	water	notes samples, tests, etc.	R.L. depth metres	graphic log	classification symbol	material	moisture condition	consistency, density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
QUARRY WALL		NIL			1			CLAY and SILT - settled tailings	M	S		FILL
								Fine to coarse SAND and CLAY - dumped overburden ?		H		
					2		SP	Light grey, dm-bedded, well sorted bimodal very fine SAND and medium SAND				ALLUVIAL DEPOSIT
							SP	Orange-brown mm-bedded well sorted fine SAND		VSt		
							CH	Dark grey CLAY				
							SP	Light grey, massive to cm-bedded well sorted fine SAND				contains 1-2cm clay bands
							SP	Grey, cm-bedded & dm-bedded well sorted very fine SAND		Fb		
					3		SP	Light grey, massive, poorly sorted medium to very coarse SAND, sub-rounded contains quartz pebble GRAVEL, angular to sub-rounded.		H		weakly cemented randomly packed fabric
				Sample 13			CL	Very dark grey to black CLAY		VSt		SWAMP DEPOSIT
					4							

key

method
- N natural exposure
- E existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper

support
- T timbering

penetration 1 2 3 — nc resistance ranging to refusal

water
- 10 Jan 78 water level on date shown
- water inflow
- water outflow

notes
- U50 undisturbed sample 50 mm diameter
- D disturbed sample
- N standard penetration test: figure = result
- N* SPT + sample
- Nc cone penetrometer

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet

consistency/density index
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

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geological log excavation

COFFEY

pit no: Exposure 5
sheet 2 of 2

office and job no: CANBERRA C5705/1

Client: TOBIWAY CRUSHING PTY LTD

project: SAND EXTRACTION OPERATION, CURRANDOOLY NSW
pit location: SEE FIGURE C1

pit commenced:
pit completed:
logged by: MJE 9.4.92
log checked by: SP

equipment type and model:
excavation dimensions: m long, m wide

R.L. surface: m
datum:

method	penetration 1 2 3	support	water	notes samples, tests, etc.	R.L. depth metres	graphic log	classification symbol	material	moisture condition	consistency, density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
QUARRY WALL		NIL	9.4.92 ▽		4		CL	Very dark grey to black CLAY				SWAMP DEPOSIT
					5							
					6			Base of Exposure 5 at water level in Pond 3				

key

method
- N natural exposure
- E existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper

support
- T timbering

penetration 1 2 3 — nc resistance ranging to refusal

water
- 10 Jan 78 water level on date shown
- water inflow
- water outflow

notes
- U50 undisturbed sample 50 mm diameter
- D disturbed sample
- N standard penetration test: figure = result
- N* SPT + sample
- Nc cone penetrometer

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet

consistency/density index
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

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geological log excavation

COFFEY

pit no: TP1
sheet 1 of 2

office and job no: CANBERRA C5705/1

Client: TOBIWAY CRUSHING PTY LTD

project: SAND EXTRACTION OPERATION, CURRANDOOLY NSW

pit location: SEE FIGURE C1

pit commenced: 9.4.92
pit completed: 9.4.92
logged by: MJE
log checked by: SP

equipment type and model: Excavator Komatsu PC300

excavation dimensions: 9 m long, 2 m wide

R.L. surface: m
datum:

method	penetration 1 2 3	support	water	notes samples, tests, etc.	R.L. / depth metres	graphic log	classification symbol	material	moisture condition	consistency, density index	hand penetrometer 100 200 300 400 kPa	structure and additional observations
EXCAVATOR		NIL		Sample 9			SP	Cream, friable, massive, poorly sorted, coarse silt to fine SAND with some fine SAND	D/M	Fb		Topsoil AEOLIAN OR SLOPEWASH
							SC	Dark yellow-brown & dark brown, hard, massive, moderately sorted, very fine and fine SAND 70% and CLAY		H		ALLUVIAL DEPOSIT
				Sample 10	1		SC	As above becoming yellow brown, well to moderately sorted fine sand with some very fine and medium sand becoming SAND 90% and CLAY 10%	M			
					2		SP	Gradual change to mottled dark olive-grey and dark yellow-brown, massive, well sorted fine SAND 95% and CLAY 5%		VSt		
				Sample 11	3		SP	Grey-brown, with some dark yellow-brown, massive, moderately sorted medium to coarse SAND with some very coarse SAND and granule GRAVEL, subrounded becomes coarse to very coarse SAND with depth		Fb		
					4							

key

method
- N natural exposure
- E existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper

support
- T timbering

penetration 1 2 3 — nc resistance ranging to refusal

water
- 10 Jan 78 water level on date shown
- water inflow
- water outflow

notes
- U50 undisturbed sample 50 mm diameter
- D disturbed sample
- N standard penetration test: figure = result
- N* SPT + sample
- Nc cone penetrometer

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet

consistency/density index
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

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geological log excavation

COFFEY

pit no: TP1
sheet 2 of 2

office and job no: CANBERRA C5705/1

Client: TOBIWAY CRUSHING PTY LTD
project: SAND EXTRACTION OPERATION, CURRANDOOLY NSW
pit location: SEE FIGURE C1

pit commenced: 9.4.92
pit completed: 9.4.92
logged by: MJE
log checked by: SP

equipment type and model: EXCAVATOR KOMATSU PC300
excavation dimensions: 9 m long, 2 m wide

R.L. surface: m
datum:

method	penetration 1 2 3	support	water	notes samples, tests, etc.	R.L. depth metres	graphic log	classification symbol	material	moisture condition	consistency, density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
EXCAVATOR		NIL	▽ 9.4.92		4		SP	Grey-brown with some dark yellow brown, massive, moderately sorted, coarse to very coarse SAND with granule GRAVEL	M	Fb		ALLUVIAL DEPOSIT
					5			Test pit TP1 terminated at water level due to collapsing side walls				

key

method
- N natural exposure
- E existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper

support
- T timbering

penetration 1 2 3 — nc resistance ranging to refusal

water
- 10 Jan 78 water level on date shown
- water inflow
- water outflow

notes
- U50 undisturbed sample 50 mm diameter
- D disturbed sample
- N standard penetration test: figure = result
- N* SPT + sample
- Nc cone penetrometer

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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geological log excavation

COFFEY

pit no: TP2
sheet 1 of 2

office and job no: CANBERRA C5705/1

Client: TOBIWAY CRUSHING PTY LTD
project: SAND EXTRACTION OPERATION, CURRANDOOLY NSW
pit location: SEE FIGURE C1

pit commenced: 9.4.92
pit completed: 9.4.92
logged by: MJE
log checked by: SP

equipment type and model: EXCAVATOR KOMATSU PC300
excavation dimensions: 8 m long, 2 m wide

R.L. surface: m
datum:

method	penetration 1 2 3	support	water	notes samples, tests, etc.	R.L. depth metres	graphic log	classification symbol	material	moisture condition	consistency, density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
EXCAVATOR		NIL	NONE OBSERVED		1		SP	Cream, massive, moderately sorted, very fine to fine SAND with some medium SAND, sub-angular Contains bands to 0.5m thick of yellow-brown & dark brown hard, massive, well to moderately sorted fine SAND with some medium SAND	D/M	Fb		TOPSOIL AEOLIAN DEPOSIT
					2		SP	Orange-brown becoming grey-brown, massive, moderately sorted, very fine and fine SAND	M	VSt		normal graded bed ALLUVIAL DEPOSIT
							SP	becoming grey-brown, massive, moderately sorted, medium and coarse SAND, sub-rounded				
							SP	Grey-brown, massive, well sorted fine SAND		Fb		
					3		SP	becoming grey-brown, massive, moderately sorted, medium to coarse SAND				
							SP	Dark brown-grey, massive, well sorted very coarse SAND, sub-rounded		L		
							SP	Light grey-brown, massive, moderately sorted medium to coarse SAND, sub-rounded		Fb		
							SP	Cream, massive, well sorted very fine SAND with some fine SAND				
					4			As below				

key
method: N natural exposure; E existing excavation; BH backhoe bucket; B bulldozer blade; R ripper

support: T timbering
penetration 1 2 3 — nc resistance ranging to refusal
water: 10 Jan 78 water level on date shown; water inflow; water outflow

notes: samples and tests
U50 undisturbed sample 50 mm diameter
O disturbed sample
N standard penetration test: figure = result
N* SPT + sample
Nc cone penetrometer

classification symbols and soil description based on unified classification system

moisture: D dry; M moist; W wet

consistency/density index: VS very soft; S soft; F firm; St stiff; VSt very stiff; H hard; Fb friable; VL very loose; L loose; MD medium dense; D dense; VD very dense

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T79-002

Coffey Partners International Pty Ltd
Incorporated in NSW

geological log excavation

COFFEY

pit no: TP2

sheet 2 of 2

office and job no: CANBERRA C5705/1

Client: TOBIWAY CRUSHING PTY LTD

project: SAND EXTRACTION OPERATION, CURRANDOOLY NSW

pit location: SEE FIGURE C1

pit commenced: 9.4.92
pit completed: 9.4.92
logged by: MJE
log checked by: SP

equipment type and model: EXCAVATOR KOMATSU PC300

excavation dimensions: 8 m long, 2 m wide

R.L. surface: m

datum:

method	penetration 1 2 3	support	water	notes samples, tests, etc.	R.L. depth metres	graphic log	classification symbol	material	moisture condition	consistency, density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
EXCAVATOR		NIL	NONE OBSERVED		4		SP	Grey-brown, massive, moderately sorted medium and coarse SAND, sub-rounded	M	Fb		ALLUVIAL DEPOSIT
					5			Light grey with some yellow-brown & red-brown, massive, moderately sorted medium SAND with some fine and coarse SAND				
					6			As above, becoming moderately sorted medium and coarse SAND with some fine SAND				
					7			Test pit TP2 terminated at excavator reach				

key

method: N natural exposure; E existing excavation; BH backhoe bucket; B bulldozer blade; R ripper

support: T timbering

penetration: 1 2 3 — nc resistance ranging to refusal

water: 10 Jan 78 water level on date shown; water inflow; water outflow

notes: samples and tests
U50 undisturbed sample 50 mm diameter
D disturbed sample
N standard penetration test: figure = result
N* SPT + sample
Nc cone penetrometer

classification symbols and soil description based on unified classification system

moisture: D dry; M moist; W wet

consistency/density index: VS very soft; S soft; F firm; St stiff; VSt very stiff; H hard; Fb friable; VL very loose; L loose; MD medium dense; D dense; VD very dense

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Coffey Partners International Pty Ltd
Incorporated in NSW

geological log excavation

COFFEY

pit no: TP3
sheet 1 of 2

office and job no: CANBERRA C5705/1

Client: TOBIWAY CRUSHING PTY LTD
project: SAND EXTRACTION OPERATION, CURRANDOOLY NSW
pit location: SEE FIGURE C1

pit commenced: 9.4.92
pit completed: 9.4.92
logged by: MJE
log checked by: SP

equipment type and model: EXCAVATOR KOMATSU PC300
excavation dimensions: 12 m long, 2 m wide

R.L. surface: m
datum:

method	penetration 1 2 3	support	water	notes samples, tests, etc.	R.L. depth metres	graphic log	classification symbol	material	moisture condition	consistency, density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
EXCAVATOR		NIL					SP	Very light grey to cream, massive, poorly to moderately sorted very ~~fine and fine~~ SAND	D/M	VSt		Topsoil AEOLIAN DEPOSIT
							SC	Dark yellow-brown and dark brown, massive, moderately sorted fine and medium SAND 70% and CLAY 30%		H		ALLUVIAL DEPOSIT
					1		CH	Dark yellow-brown and dark grey, CLAY 90% and SAND 10%				
							SP	Brown, massive, poorly sorted coarse and very coarse SAND with some granule GRAVEL, sub-rounded	M	Fb/L		
					2		CH	Light grey, CLAY 95% and SAND 5%		VSt		
					3			colour becomes dark grey				
							SP	Light grey, massive, moderately sorted fine and medium SAND, sub-rounded		Fb		
					4							

key
method: N natural exposure; E existing excavation; BH backhoe bucket; B bulldozer blade; R ripper

support: T timbering
penetration: 1 2 3 — nc resistance ranging to refusal
water: 10 Jan 78 water level on date shown; water inflow; water outflow

notes: U50 undisturbed sample 50 mm diameter; D disturbed sample; N standard penetration test: figure = result; N* SPT + sample; Nc cone penetrometer

classification symbols and soil description based on unified classification system

moisture: D dry; M moist; W wet

consistency/density index: VS very soft; S soft; F firm; St stiff; VSt very stiff; H hard; Fb friable; VL very loose; L loose; MO medium dense; D dense; VD very dense

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T79-002

Coffey Partners International Pty Ltd
Incorporated in NSW

geological log excavation

COFFEY

pit no: TP3

sheet 2 of 2

office and job no: CANBERRA C5705/1

Client: TOBIWAY CRUSHING PTY LTD

project: SAND EXTRACTION OPERATION, CURRANDOOLY NSW

pit location: SEE FIGURE C1

pit commenced: 9.4.92
pit completed: 9.4.92
logged by: MJE
log checked by: SP

equipment type and model: EXCAVATOR KOMATSU PC300

excavation dimensions: 12 m long, 2 m wide

R.L. surface: m
datum:

method	penetration 1 2 3	support	water	notes samples, tests, etc.	R.L. depth metres	graphic log	classification symbol	material	moisture condition	consistency, density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
EXCAVATOR		NIL	▽ 9.4.92		4		SP	As above, becoming poorly sorted, medium to very coarse SAND, sub-rounded contains some quartz cobble GRAVEL, sub-rounded and rounded with some angular	M	Fb		ALLUVIAL DEPOSIT
					5							
					6			Test pit TP3 terminated at water level due to collapsing side walls				

key

method
- N natural exposure
- E existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper

support
- T timbering

penetration 1 2 3 — nc resistance ranging to refusal

water
- 10 Jan 78 water level on date shown
- water inflow
- water outflow

notes
- U50 undisturbed sample 50 mm diameter
- D disturbed sample
- N standard penetration test: figure = result
- N* SPT + sample
- Nc cone penetrometer

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet

consistency/density index
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

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T79-003

Coffey Partners International Pty Ltd
Incorporated in NSW

geological log excavation

COFFEY

pit no: Exposure 4
sheet 1 of 2

office and job no: CANBERRA C5705/1

Client: TOBIWAY CRUSHING PTY LTD
project: SAND EXTRACTION OPERATION, CURRANDOOLY NSW
pit location: SEE FIGURE C1

pit commenced:
pit completed:
logged by: MJE 9.4.92
log checked by: SP

equipment type and model:
excavation dimensions: m long, m wide

R.L. surface: m
datum:

method	penetration 1 2 3	support	water	notes samples, tests, etc.	R.L. / depth metres	graphic log	classification symbol	material	moisture condition	consistency, density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
QUARRY WALL		NIL					SC	Light brown, massive, poorly sorted fine to coarse SAND 40%, CLAY 40% and granule GRAVEL 20%	D	H		FILL
							SC	Dark brown, massive, poorly sorted fine to coarse SAND, sub-angular 70% and CLAY 30%	M	VSt		Buried topsoil ALLUVIAL DEPOSIT
					1		SP	Light brown, faintly dm-bedded, poorly sorted very coarse SAND and granule GRAVEL with pebble bands, sub-rounded		H		Weakly cemented possibly poorly defined, normal graded bedded 100-150mm thick from pebbles to very coarse sand
							SP	Light brown, dm-bedded, well sorted fine SAND, contains bands of coarse SAND and pebble GRAVEL, quartzose, sub-rounded				Weakly cemented some faint cm-bedding
				Sample 8	2		SP	Light brown, massive, moderately sorted medium and coarse SAND, sub-angular				
					3		SP	Light brown & light yellow-brown, cross-bedded and cm bedded, well sorted fine SAND, sub-angular to sub-rounded		Fb		Cross bedding 40-45° towards 290° MN
							SP					Plate C6
				Sample 7			SP	Light brown, cm-bedded, moderately sorted bimodal fine to medium SAND and very coarse SAND to granule GRAVEL, sub-rounded				Cross bedding 25° towards 260° MN
							SP			H		Weakly cemented
					4			Light grey, well sorted very fine SAND.				

See below

key
method: N natural exposure; E existing excavation; BH backhoe bucket; B bulldozer blade; R ripper

support: T timbering
penetration 1 2 3 — nc resistance ranging to refusal
water: 10 Jan 78 water level on date shown; water inflow; water outflow

notes: samples and tests; U50 undisturbed sample 50 mm diameter; D disturbed sample; N standard penetration test: figure = result; N* SPT + sample; Nc cone penetrometer

classification symbols and soil description based on unified classification system

moisture: D dry; M moist; W wet

consistency/density index: VS very soft; S soft; F firm; St stiff; VSt very stiff; H hard; Fb friable; VL very loose; L loose; MD medium dense; D dense; VD very dense

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T79 002

Coffey Partners International Pty Ltd
Incorporated in NSW

geological log excavation

COFFEY

pit no: Exposure 4
sheet 2 of 2

office and job no: CANBERRA C5705/1

Client: TOBIWAY CRUSHING PTY LTD

project: SAND EXTRACTION OPERATION, CURRANDOOLY NSW
pit location: SEE FIGURE C1

pit commenced:
pit completed:
logged by: MJE
log checked by: SP

equipment type and model:
excavation dimensions: m long, m wide

R.L. surface: m
datum:

method	penetration 1 2 3	support	water	notes samples, tests, etc.	R.L. depth metres	graphic log	classification symbol	material	moisture condition	consistency, density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
QUARRY WALL		NIL	▽ 9.4.92	Sample 6	4		SP	Light brown, light grey and dark yellow-brown, cross-bedded, well sorted fine SAND, sub-rounded becoming moderately sorted fine to medium SAND towards base	M/W	Fb		ALLUVIAL DEPOSIT
							SP					
					5		SP	Brown, massive to cm-bedded, moderately sorted, medium to coarse SAND, sub-angular to sub-rounded				
								Light brown, mm-bedded, moderately sorted fine to medium SAND, sub-rounded				
					6			Light grey, massive, moderately sorted medium to coarse SAND, coarse sand sub-angular, medium sand sub-rounded to rounded.				
								As above becoming grey-brown, with some quartz pebble GRAVEL, sub-rounded.				
								Base of Exposure 4 at water level in Pond 2				

key

method
- N natural exposure
- E existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper

support
- T timbering

penetration 1 2 3 — nc resistance ranging to refusal

water
- 10 Jan 78 water level on date shown
- water inflow
- water outflow

notes
- U50 undisturbed sample 50 mm diameter
- D disturbed sample
- N standard penetration test: figure = result
- N* SPT + sample
- Nc cone penetrometer

classification symbols and soil description
based on unified classification system

moisture
- D dry
- M moist
- W wet

consistency/density index
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

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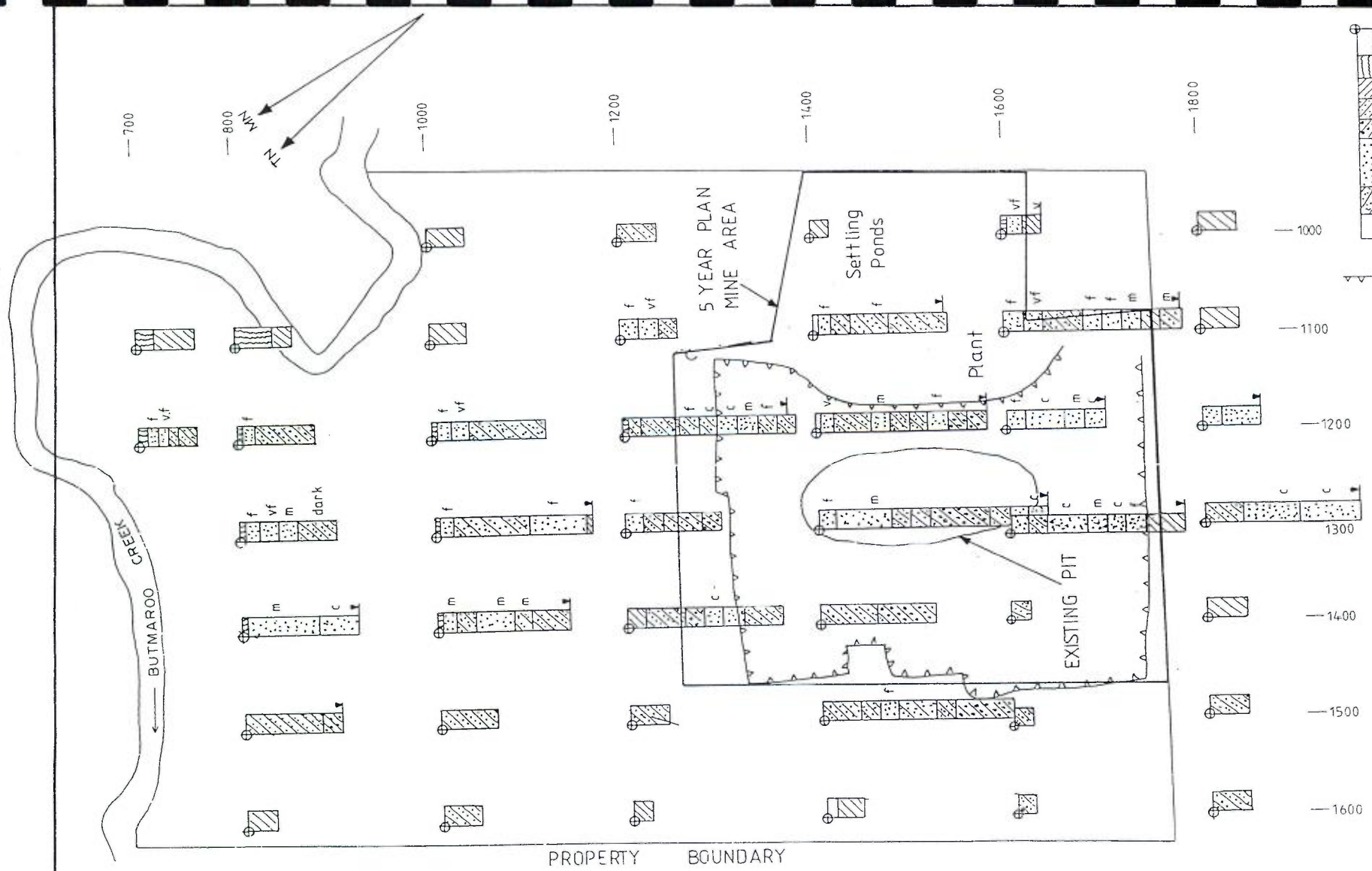
T79

APPENDIX D

APPENDIX D

SUMMARY OF LOGS OF BOREHOLES DRILLED IN 1977



SUMMARY OF SUBSURFACE CONDITIONS
ENCOUNTERED IN BOREHOLES, 1977 INVESTIGATION

Coffey Partners International Pty Ltd Consulting Engineers in the geotechnical sciences
Incorporated in NSW

BOREHOLE 0 1 2 3 4 5
PLAN: 0 40 80 120 160 200
scale (metres)

revision	description	drawn	approved	date

drawn	W.W./C.G.
checked	
date	14/5/92

TOBIWAY CRUSHING PTY. LTD.
ENVIRONMENTAL IMPACT STATEMENT
SAND EXTRACTION, LOT 31,
PART PORTION 9,
PARISH OF CURRANDOOLY

COFFEY

drawing no. FIGURE D1

job no. C5705/1

APPENDIX E

APPENDIX E

ARCHAEOLOGICAL STUDIES

ARCHAEOLOGICAL INVESTIGATION OF PROPOSED SAND QUARRY EXTENSION LOT 31 PORTION 8, PARISH CURRANDOOLY, NEAR SE LAKE GEORGE, NSW

A Report to Canbera Sand and Gravel Pty Ltd and
Coffey Partners International

Paul Packard
May 1992

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1. SUMMARY

This study of a proposed extension to an existing sand and gravel extraction area recorded an Aboriginal site.

An initial archaeological survey suggested there was a strong possibility that there would be a site located below the surface of the low ridge covered by the development area. Archaeological investigation of the material removed from a number of deposit testing pits dug by the quarry operator established the presence of a site of variable density across much of the ridge. No intensive controlled archaeological investigations were undertaken. On the basis of the artefacts found it is probable the site dates to with the last 5,000 years.

Mr A. Williams a representative of the Ngunnawal Local Aboriginal Land Council has visited the proposed quarry extension area and felt the area as such held no particular significance in Aboriginal culture.

It is recommended consent to destroy part of the site be granted conditional upon limited further salvage work to determine the relationship of the part of the site within the the 100 m buffer zone to the rest of the site.

2. INTRODUCTION

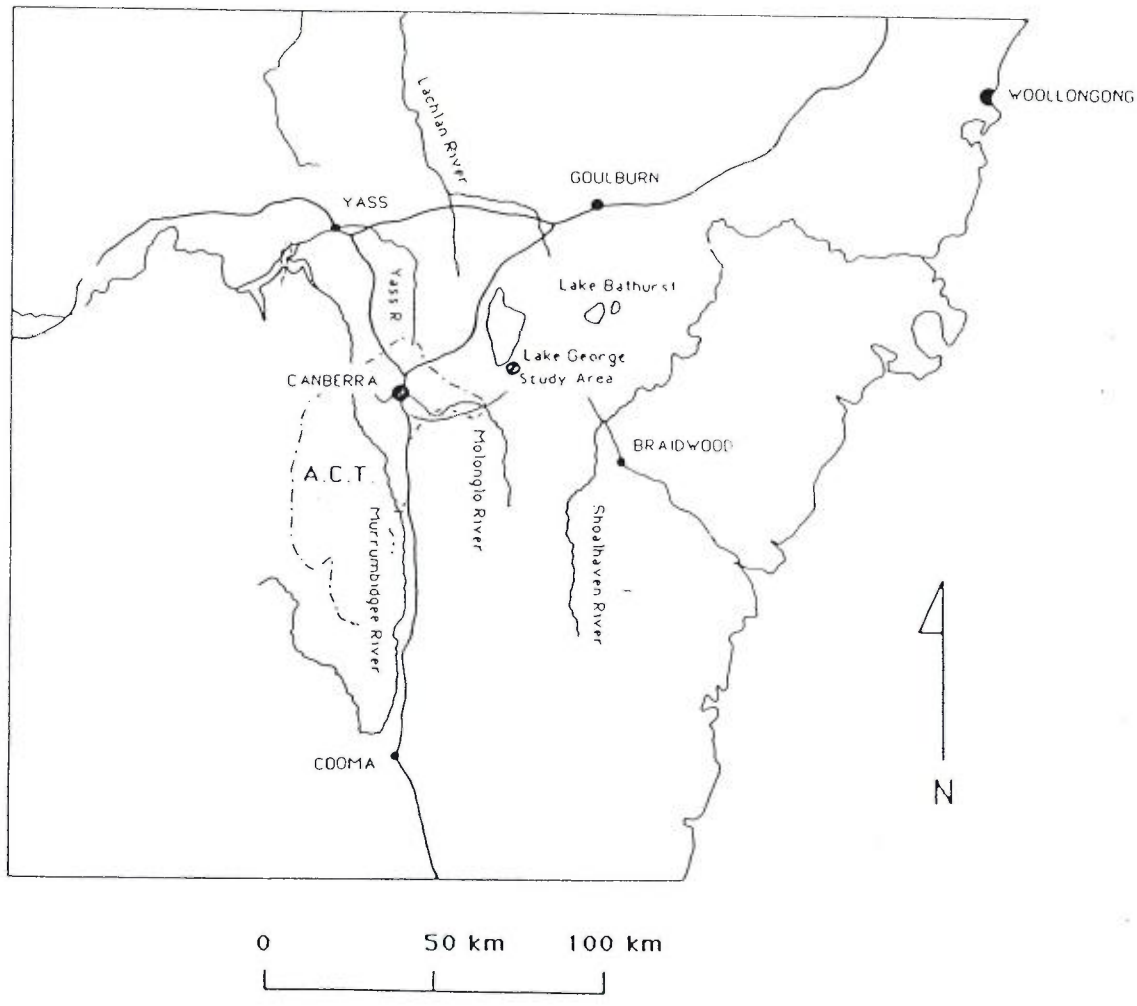
This report presents the results of an archaeological investigation for Aboriginal sites in proposed extension areas to the existing "Bungendore Sands" quarry at the southeastern end of Lake George near Bungendore, NSW (see Figure 1). The study was conducted for Canberra Sand and Gravel Pty Ltd and Coffey Partners International.

The area is on Lot 31 Part Portion 8, Parish of Currandooly (see Figure 2). The total area of Lot 31 is about 80 ha of which half has already been mined. Allowance of a 100 m buffer from Butmaroo Creek leaves approximately 30 ha of relatively undisturbed ground over which quarrying is being considered ie. the study area (see Figure 3). The proposed development would consist of quarrying the deposits using the same combination of dry excavation and dredging techniques applied in the existing quarry. All ancillary developments such as stockpile dumps and access tracks will utilise those already located within the existing quarry area and access from the area will be via the existing gravel access road.

The field survey was conducted over one day by P. Packard accompanied by Mr Arnold Williams of the Ngunnawal Local Aboriginal Land Council. Subsurface investigations consisting of examination and sieving the deposit

Figure 1

Location of the Study Area



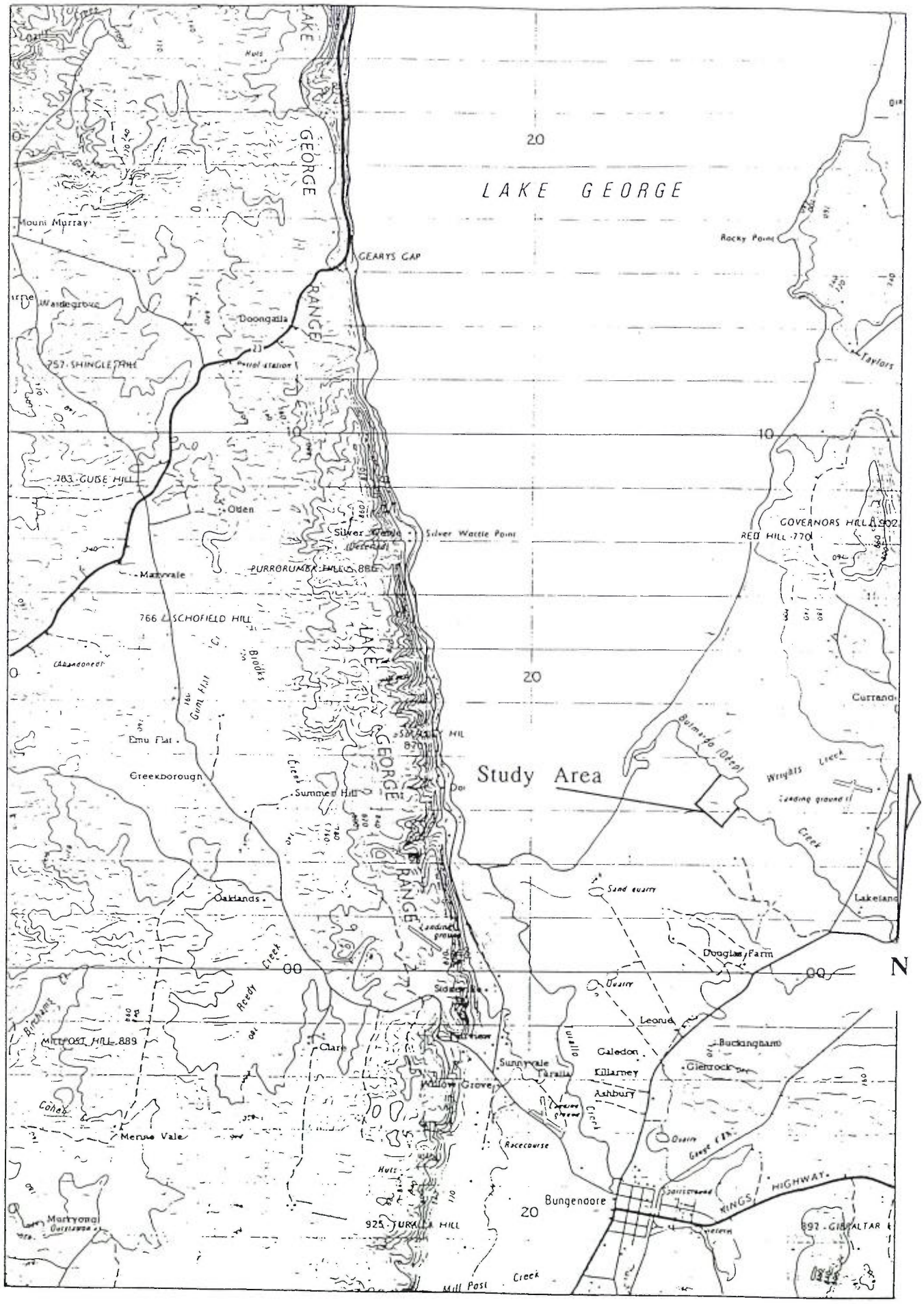


FIGURE 2

Location Of The Study Area

Scale 1:100,000

which had been removed from a number of deposit testing trenches by the quarry operators was conducted over two days by P. Packard and M. Behr.

3. BACKGROUND INFORMATION

3.1 Location

The "Bungendore Sands" property is situated 8 km north of Bungendore, 3 km to the north of the Bungendore-Tarago road and 1.5 km to the east of the 'modern' shoreline of Lake George. The northeastern boundary of Lot 31 is defined by Butmaroo Creek although all proposed quarrying activities will be excluded from a 100 metre buffer paralleling the banks of the creek.

3.2 Environmental Setting

The study area lies within the Lake George internal drainage basin which is on the Southern Tablelands. The basin consists of rolling and hilly country, similar to elsewhere on the Tablelands, and more notably a relatively flat and extensive yet elevated floor which contains the intermittently wet and dry Lake George. The Great Dividing Range approximately 8 km to the east of the study area is locally steep and hilly.

The basin is located within the Central and Southern Highlands Fold Belt geological province, an area of mixed sedimentary, metamorphic and igneous rocks. The development area is situated on one of the raised deposits which are part of the extensive group of Quarternary deposits along the floor of the Lake George basin (see 3.3 below for further discussion). To the west of the development area are the strongly folded Ordovician sediments and metasediments of greywacke, slate, shale and sandstone which are exposed along the fault line which forms the Lake George scarp. To the east towards the Dividing Range are Silurian acid volcanics and Siluro-Devonian granites. There are also localised outcrops of Ordovician quartz-rich greywackes, shales and slates. Although this sequence has been geologically mapped as including minor amounts of chert no outcrops or cobbles of chert have been found in creeks or elsewhere during previous surveys by the Consultant.

Little unmodified vegetation remains in the Lake George basin although it is still possible to recognize some of the broader patterns. The main formations are dry sclerophyll open forests, woodlands and open grasslands. The presence of individuals and remnant stands of mature frost tolerant eucalypts (*Eucalyptus pauciflora* and *E. stellulata*) fringing the basin floor in places indicates that the flat plains were probably open grasslands due to extremes of cold air drainage. Good examples of this inverted tree line can be seen in the

areas between "Lakelands" and "Currandooley" homesteads 3 - 4 km to the east of the study area. Thus it is most likely the study area would have been open grasslands of *Themeda* and *Poa*.

The rocky, elevated slopes of the Lake George Scarp to the west are still relatively well vegetated with dry sclerophyll forest of the *Eucalyptus rossii* - *E. mannifera* community. Generally the more elevated slopes throughout the area would have been *Eucalyptus rossii* - *E. macrorhyncha* - *E. mannifera* subsp. *maculosa* open forest and woodlands. At present the actual development area is treeless, apart from exotic pine windbreaks, and there is a well developed pasture of dominantly exotic grasses and tall thistles.

3.3 Palaeoenvironment and Geomorphology

Temperatures and precipitation (as well as evaporation rates) were reduced during the period 27,000 - 21,000 yBP and this is seen in the highest levels for Lake George (Coventry, 1973; 1976; Coventry and Walker, 1977). Pollen evidence also shows that the treeline lowered during the period 25,000 - 20,000 yBP (Singh 1981:41).

Although there is some dispute regarding the actual degree of cooling during the period of maximum glaciation around 18,000 yBP it is generally suggested that temperatures in the region were 6-10°c lower than at present and that the treeline at Lake George was 1200-1500m lower (Singh, 1983; Coventry,1973, 1976). This would put the Lake George basin (at 673 m asl) at or above the treeline calculated on its modern level and the vegetation of the basin was dominated by liliaceous herbs and grasses (Singh 1983:66). The fact that Lake George was low at the same time as the period of lowest temperatures indicates that precipitation had dropped drastically (Singh, 1983; Coventry,1973, 1976).

The period 15,000-10,000 yBP experienced a more humid phase with reduced stresses in temperature, wind regimes and general hydrology. Gradually increasing temperatures and precipitation are shown by brief phases of slightly higher lake levels at Lake George as well as other lakes in southeastern Australia. This period also shows reduced rates of erosion and sedimentation (Singh, 1983).

Eucalypts began to re-appear on the grasslands of the Lake George basin around about 8,000 years ago, but it was not until around 5,500 yBP that *Eucalyptus* forests and woodlands became established near their pre-European impact levels (Singh, Kershaw and Clark 1981; Singh and Geissler 1985).

Temperatures rose to close to the present level by roughly 7,000 yBP and with smaller scale fluctuations than those experienced earlier have remained in that range since (Climanz 1983). Within the last ten thousand years minor fluctuations in the precipitation and evapotranspiration rates in the Lake George basin have resulted in at least three short phases of relatively high lake levels (Coventry 1973, 1976; Coventry and Walker 1977). The highest Holocene lake level attained, which was roughly 11 metres lower than the highest Pleistocene levels, occurred at some time between about 10,000-7,500 yBP. Following this there were two progressively shallower high lake levels, one at around 5500 yBP and another between 4,000-3,000 yBP (Coventry 1973, 1976; Coventry and Walker 1977). All of these more recent higher lake stands could have had some role in the development of the subdued ridge on which the development is focused as they would have encroached upon or come very close to it.

The floor and slopes of the basin near the southeastern end of Lake George display a number of extensive aeolian sand deposits which are thought to have blown from the lake area between 2,000-4,000 years ago. Some also exhibit subdued dune forms which indicate they were deposited by west-northwesterly winds, the same direction as modern dominant sand-shifting winds (Galloway, 1969; Coventry,). It is over part of one of these deposits that the proposed development is located.

Geological investigations conducted on behalf of the quarry operators and examination of existing exposures in the active pits reveal the depositional sequence of the ridge. The strata exposed in the pit to 7 m depth have been interpretted as river channel and deltaic deposits formed in association with prior courses of Butmaroo Creek which are overlain by 1 - 2 m of sandy clay with some gravels and then an uppermost layer of aeolian sand and topsoil 40 -110 cm thick (internal Coffey and Partners International report).

The relationship of the bedding identified and the sequence of late Pleistocene - Holocene lake levels has not been determined. However it is possible that one or more of the Holocene high lake stands is represented in the strata possibly in the guise of the gravelly-sandy clay and clayey sands which underlie the uppermost aeolian sands in the ridge.

3.4 Archaeological Background

3.4.1 General

The substantial majority of sites recorded in the Tablelands are open scatters of stone artefacts (Byrne and Smith 1988). Some of these sites have displayed internal patterning identified as 'workshops', or broader lateral variations in

artefact types and raw materials. However, the sites in the Tablelands have only rarely displayed other archaeological features such as hearths or cooking pits.

The numbers of artefacts found at sites and the sizes of the sites in the region have varied widely, due certainly as much to post-depositional factors such as variable conditions of surface visibility as to the inherent factors of Aboriginal occupation at the sites. Surface artefact densities of between 1/100 m^2 (which has been considered by some researchers as the level of non-site 'background scatter' of artefacts) and up to 100/1 m^2 have been recorded in the region. Investigations at specific sites have shown that surface artefact densities are often much lower or negligible compared with subsurface densities. Table 1 lists the surface and subsurface artefact densities recorded at a number of sites in the region (NB. subsurface densities have been calculated here as if from a two dimensional lag of the volume and area of the deposit).

The Lake George basin has been one of the focal points within discussion of the landscape history and palaeoenvironments of southeastern Australia. There have been studies of the regional environments of substantial antiquity including suggestions of human occupation at Lake George 128,000 years ago or earlier (Singh et al, 1981; Singh and Geissler, 1985, Flood, 1980). However, the interpretations and dating have been questioned. While this issue remains problematic and its resolution is far beyond the scope of this study it does highlight the significance and scale of questions relating to palaeoenvironments and the antiquity of human occupation in Australia which have been posed in the Lake George basin.

The foregoing suggestions of great antiquity notwithstanding most sites in the region are considered to date from some time within the last 4,000 years or so, although there have been some sites (both open sites and rockshelters) investigated such as Birrigai (Flood *et al* 1987) which date to earlier than this. A burial of an Aboriginal man and a woman near Cooma on the Monaro to the south of the study area was recently investigated. This burial returned a C14 age nearly 7000 yBP which represents the oldest established age for any form of "open site" in the region and helps to emphasize the need for workers to consider the possibility of sites with greater antiquity than the more normally accepted age limit of 5000 years for open sites in the region.

A "riverine" focused settlement pattern has been suggested for the Tablelands in which most sites were located on elevated, well drained ground close to but not immediately beside major water sources such as rivers and lakes (Flood 1980:158-66). More recently work in the region has shown that sites often occur near rivers and other water sources but also that locational factors and site patterning on the Tablelands are far more complex than Flood (1980)

Table 1

SELECTED ARCHAEOLOGICAL SITES IN SAND DEPOSITS IN THE REGION

SITE NAME	LANDFORM	DENSITIES (ARTEFACTS/SQM) SURFACE	EXCAVATION	REFERENCE
GIL1	beach ridge	0.02-0.07	4	Baker, et al (1984)
GIL2	aeolian dune	0.03	-	Baker, et al (1984)
Windermere	lacustrine spit	0.04-43	43	Baker + Feary (1984)
Nardoo	aeolian sheet	0.1	2	Flood (1980)
Butmaroo 1	aeolian dune	up to 100	up to 100	Jones (pers. comm.)
ELG1	beach ridge	0.1	2	Hughes, et al (1984)
Currandooley	aeolian dune	-	40	Lance (1985)
Mt Pleasant 1	alluvial terrace	0.001	33-76	Hughes + Koettig (1983)
Lake Bathurst	beach ridge	3	-	McBryde (1975)
G17	alluvial terrace	0.1-1	291	Koettig (1983)
RYR1	alluvial terrace	-	10	Packard (1986a)
GYR1	alluvial terrace	-	26	" " " "
GYR2	alluv. terr./dune	-	12	" " " "
RL1	beach ridge	0.02-0.1	up to 400	Packard + Muhlen-Schulte(1987)

originally modelled (eg Attenbrow, 1984; Attenbrow and Hughes, 1983; Koettig, 1981, 1982, 1983, 1984; Packard, 1984, 1986b; Witter, 1980, 1981; Witter and Hughes, 1983). Byrne and Smith (1988:55-7) quantified this pattern and found that 67% of open sites in the region are located within 100m of watercourses, lakes or swamps. The likelihood that this apparent site location pattern is skewed towards watercourses because of biases in the locations of environmental impact studies and sampling strategies of other projects must be kept in mind (Byrne and Smith 1988).

There are two broadly defined flaked stone assemblages recognized throughout most of the region. Commonly found assemblages that consist almost entirely of small unretouched quartz flakes, occasionally include evidence of bipolar quartz reduction and which do not normally include backed blades are generally thought to date from within the last 1,000 years or so. This assemblage is often termed the "post-bondaian".

The other stone assemblage frequently found in the region is characterised by small flakes made on a variety of raw materials, although predominantly out of quartz and fine grain siliceous rock. Particular tool types such as backed blades and other geometric microliths with secondary working in the form of retouching or backing are most diagnostic of this stone assemblage. It is generally considered that these assemblages date from the period 4,000 - 1,000 yBP in the Southern Tablelands although there are a few sites where this assemblage is considered to date outside of this time range (eg. Koettig, 1983; Packard, 1986b).

This relatively distinctive assemblage is often termed "Bondaian" after Bondi points, artefacts which typify the assemblage on the coast and in some other regions. Some researchers in the Southern Tablelands have used the term "microblade" to describe these assemblages which contain large numbers of small elongate focal-platformed flakes, distinctive styles of core preparation on generally small cores and occasional backed and retouched pieces. In this typology it is not necessary to have backed blades present to identify a "microblade assemblage".

So far very little evidence of stone assemblages dating to earlier than the "microblade" period has been recorded or analysed. Thus it is only valid to suggest in general terms that any assemblages found in the Southern Tablelands dating before approximately 5000 yBP would probably broadly resemble elements from assemblages from elsewhere in the country. Thus it might be expected that early Holocene or Pleistocene assemblages if found in the region could resemble in some sense elements of the 'Core Tool and Scraper Tradition'.

The paucity of burial sites in the Southern Tablelands in general and in sand deposits in particular is in direct contrast with experience in other parts of NSW such as the Riverina-Murray River area where sand deposits are common and a very high proportion of them contain Aboriginal burials, or on the coast where sandy middens sometimes include burials.

However, ethnohistorical records of burials in the region (eg. Wright 1923, Helms 1895, and Howitt 1904, all in Flood 1980) do mention graves being dug into rocky, clayey and 'gritty' (ie sandy) deposits. Further, skeletal material found near of Lake George some years ago has recently been examined by Helen Cooke and found to be Aboriginal (Cooke pers comm). Although the exact original location of this burial is unknown it came from a sand quarry on one of the beach ridges of the lake approximately 3 km to the north of the study area. Excavation of a sand deposit site near Goulburn (G17) has also revealed a very small amount of fragmented human bone (Paton 1990). Finally, the discovery of the ancient burial near Cooma which was located in an alluvial deposit suggests that burials may yet be found in a wide range of substrates and situations. Littleton (1990) has argued that the lack of evidence for burials in the region is probably more a factor of poor conditions for preservation and recovery than evidence for absence of burials.

Aboriginal sites have been recorded in a substantial majority of the sand deposits in the Southern Tablelands which have been investigated. So far in all those cases relating to proposed quarrying it has been decided that the development can proceed with little or no modification (Packard 1986b, and more recent archaeological reports held by NPWS). At the same time it has been found that a small proportion of sand deposits contain scientifically significant archaeological sites and that these sites have the potential for elucidating the regional and local prehistories.

3.4.2 Local Area

The continued demand for aggregates and sands in the Canberra region has meant there have been a number of archaeological investigations of both proposed and active quarries as well as academic studies conducted in the area around Lake George.

The closest site recorded to the study area is ELG1. Hughes, Barz and Hiscock (1984) investigated this site when it was reported in an active sand quarry 1.5 km to the west of the present study area. The quarry area covered part of a relict beach ridge 500 m wide, 2.5 km long and 2 m high. The main deposit of medium and coarse, white to dark yellow sands with some gravels was capped by a poorly developed humic soil 2 cm - 5 cm thick. The beach ridge was thought to be of mid - late Holocene age.

Artefact densities across the site were low ($2/m^2$ - $1/10m^2$) and it was considered likely that artefacts were scattered over the entire length of the beach ridge. Virtually all the artefacts recorded came from the surface or the thin topsoil. If artefacts did occur in the underlying sands they were in extremely low concentrations and were archaeologicaly invisible at the level of investigation conducted.

The artefacts were mostly flakes and flaked pieces, small numbers of cores and retouched flakes were also found. Bipolar cores represented a small proportion of the cores recorded. Quartz was the main raw material with smaller amounts of volcanics, metasedimentary rocks, silcrete and quartzite. Considering the predominance of quartz, the lack of any definite backed blades the seemingly fresh fractures on the artefacts and the maximum possible age of the deposit the assemblage was assigned an age of less than 1,000 years. Interestingly, a purely surface-survey investigation of a proposed sand quarry immediately adjoining the ELG1 site to the southwest failed to find any artefacts (Thomas and Gillieson, n.d.) suggesting that the artefacts from this beach ridge were situated near but not at the surface.

Stone (1988) conducted investigations of an extensive site on the eastern side of Turallo Creek 3 km to the southwest of the study area. He found a relatively low density of artefacts both on the surface and stratified within the sediments of a low terrace of Turallo Creek. The artefacts mostly came from 15-40 cm below the surface and densities were greatest closer to the creek. Quartz was the dominant raw material and flakes were the most common artefact type with cores comprising 7.4% of the total recorded. The combination of raw materials, artefact types and their dispositions lead Stone (1988) to interpret the site as dating from within the last 5,000 years.

Excavations at Butmaroo 1, a site located in an active sand quarry 9 km to the southeast of the proposed development area revealed a sequence of occupation beginning at some time before 6,000 years ago (Jones pers. comm.; Packard in prep). All levels of the fine sandy deposit displayed quartz dominated assemblages. Carbon 14 dates for the upper levels ranged from 500 - 1,000 yBP. Underlying this was a faint buried soil which contained an assemblage of silcrete and quartz artefacts with backed blades made on both materials. Dates for this part of the deposit were in the range of 3,000 - 4,000 yBP. However, relative numbers of non-quartz artefacts were low overall and silcrete only showed an increase at the very top of this level and in the uppermost level. Below this layer a few quartz artefacts were found and underlying this again, charcoal dated to approximately 6,000 yBP was found above a lag of pebbles which contained a single quartz artefact.

The Consultant has undertaken intensive investigations at the Bridge Creek 1 site 4 km to the east of the study area as part of his doctoral research program. In the course of quarrying operations the developers had removed the topsoil over a 50 m x 100m area of the aeolian sand deposit near where Lance (1985) had identified a site which displayed no surface exposed artefacts. The quarrying had in effect created a large 'open area excavation' with part of the site exposed in plan.

Artefacts were found over the more than 1,800 m^2 intensively studied area at a mean density of 3/m^2. However, the area studied included archaeologically sterile areas and the majority of the archaeological material was more 'clumped' and at significantly higher densities than this might suggest. More than 15 discrete 'workshops' were also found over this area with artefact densities reaching more than 300/m^2 at some.

The majority of artefacts from both the exposed surface and from excavations dug into the deposit were of silcrete with quartz being the only other significant raw material. The assemblage recovered was strongly 'microblade' with backed blades and other retouched geometrics comprising more than 1.7% of the total. No other archaeological evidence such as distinctive hearths, definite groups of firestones, cooking pits, soil marks or signs of burials were found. Although no reliable C14 dates have been received evidence suggests the site is somewhat older than the original estimate made by Lance (1985) and is probably somewhere between 1,000 - 4,000 years old.

Slightly further afield Baker and Feary (1984) investigated the "Windermere" site on one of the northern relict shoreline features of Lake George. This deposit has been identified as a 'spit' which would have protruded into a backwater of the lake during the phase of highest lake levels 27,000 - 21,000 years ago. The deposit consisted of a core of coarse sands and gravels (the 'spit' deposit) which was capped by finer sands and silts of possibly aeolian origin. This capping was thinnest along the top of the 'spit', in some places being only 30 cm thick, and thickest along the flanks especially the north facing flank.

Although the 'spit' area had apparently never been ploughed the deposit had been partly disturbed by a sand and gravel quarry. Artefact densities (43/m2) were much higher than at ELG1 and higher than at other sites such as those on the shoreline features of Lake Bathurst. Artefacts were concentrated mainly in the eastern tip area of the 'spit' (ie. towards the local creek) although a sparse scatter was found over the whole of the 'spit'.

Subsurface artefact densities were higher than surface densities. Artefacts were dominantly made on quartz, non-quartz raw materials were more common at depth than near or on the surface. Artefacts were found down to

35 cm depth, one artefact was found lying in the top 5 cm of the gravel layer. Bands of charcoal (possibly hearth material) were found in one test pit, one dense band lay at a depth of 20 cm. No diagnostic artefacts were recorded and it was concluded that the site was probably less than 1,000 years old. It was suggested that the tip of the 'spit' would have been a focus for human activities as it offered elevated, well drained ground with swamp and creek resources close by.

4. METHODS

4.1 Surface Survey

An initial survey of the area was undertaken by P. Packard and Arnold Williams from the Ngunnawal LALC. The generally thick pastures and in some areas the dense, tall thistles prevented the whole area from being examined. Recent air-photos were used to identify areas of exposed ground and survey was concentrated on them. These exposed areas were mostly bare stock tracks, vehicular tracks and areas near gates etc where stock movements are concentrated. The whole of the creek banks and immediately adjoining low, terrace-like landform were examined within Lot 31 as well as for approximately 250 m along the creek line both directions beyond the Lot 31 boundaries.

4.2 Subsurface Investigation

During the course of the field program the quarry operator excavated a number of trenches to test the deposit over the proposed extension to the quarry. The trenches were dug by a large Komatsu excavator and the deposit removed had been laid out consistently for geological sampling purposes in a manner such that the original depths of the deposit forming the mounds was able to be determined by the archaeological team. A total of eleven trenches had been excavated although only eight trenches offered suitable conditions for archaeological investigation.

The mounds of deposit and the walls of the trenches were examined for archaeological content. Where possible a sample of controlled volume from each of the levels which had been excavated was sieved by the field team using 5 mm mesh sieves. In general it was found possible to sieve 75 - 90% of the deposit from each level which had been excavated. No sieving using this method was possible once the deposits reached the strongly clayey bed which was usually found at 50 - 100 cm depth.

All artefacts from Trench 1 were recorded for raw material, artefact type, length in mm (for flakes taken along percussion axis, for cores along core face unless multi-platform in which case maximum length was taken, for flaked pieces, broken flakes etc. maximum length), width in mm (for flakes midway along percussion axis taken from the margins, for cores etc perpendicular to length axis), thickness in mm (for all artefacts taken at the cross point of length and width axes). Specific information regarding aspects of flaking technology such as platform type, size, surface and angle, the presence or absence of overhang removal, evidence of core rotation, and the type of flake termination were recorded for whole flakes. Comments were recorded regarding such things as core shape, retouch type and location, edge damage etc.

Time constraints prevented the artefacts from the remaining seven trenches examined from being recorded in detail. Information recorded for these trenches consisted of artefact raw material, artefact type, general depth of artefact, and any other comments relevant. This level of information was taken to enable comparisons between trenches and in particular comparison with Trench 1.

5. RESULTS

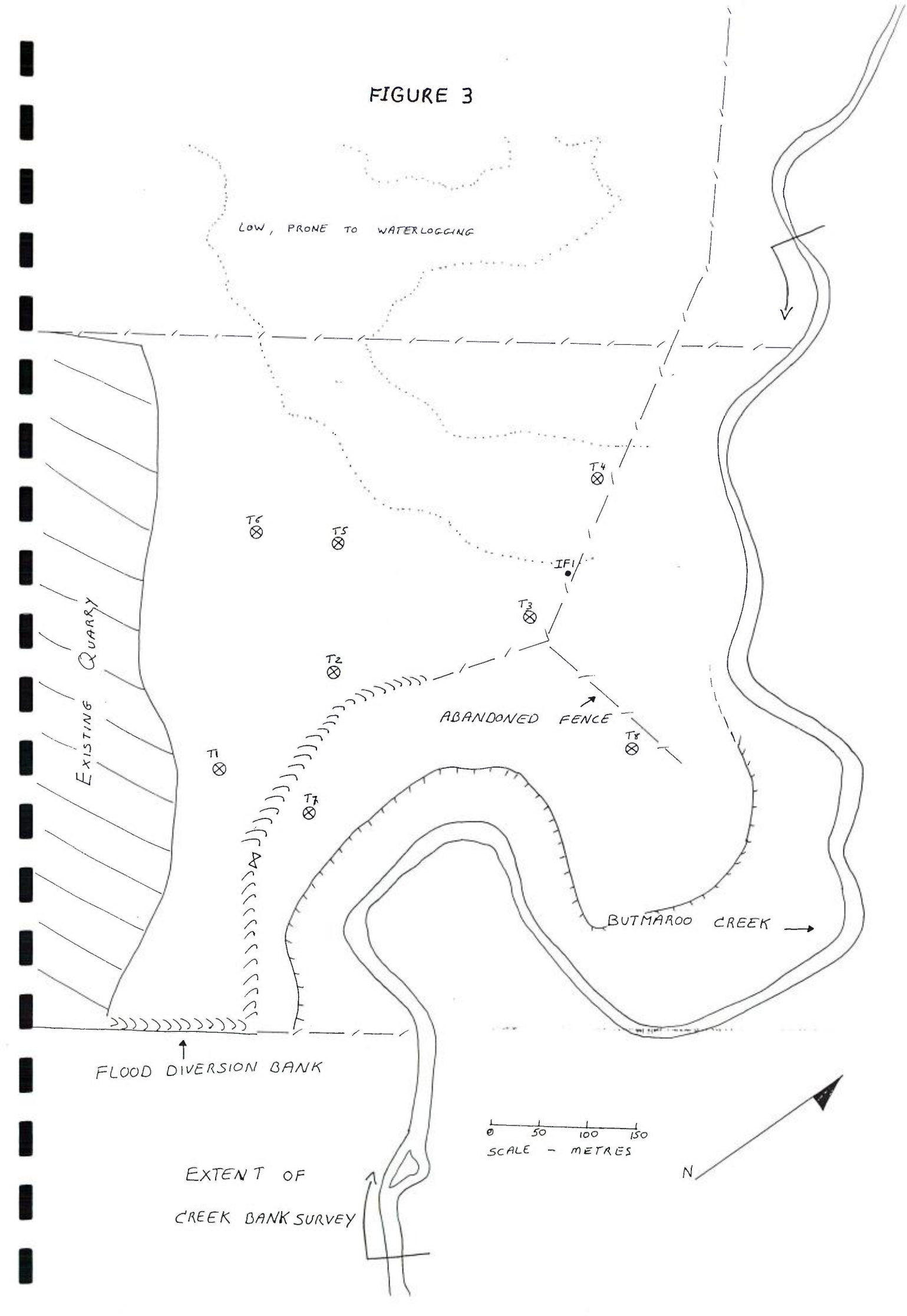
5.1 Surface Survey

The initial survey found proportionately very little exposed ground which offered good conditions for site detection. The largest areas of exposed ground were those created by truck and heavy earthmoving equipment traffic associated with the building of the flood diversion bank where Butmaroo Creek lies closest to the existing quarry (see Figure 3). Unfortunately there was a relatively high density of freshly fractured quartz gravels which had contaminated the surface here through the dumping of the clays and gravels to form the diversion bank so unequivocal artefact detection was problematic.

The next largest area of bare ground was found along an abandoned fence-line which runs towards the creek at its large northeastern meander (see Figure 3). However, the fence posts in this area protrude only 50 cm from the ground and this allied with the unconsolidated sandy ground suggests there has been substantial recent aeolian deposition in the immediate area of the fence. No definite artefacts were found in the approximately 500 m^2 of bare ground (75% or more surface visibility) associated with the abandoned fence.

One isolated artefact consisting of a broken quartz flake (15 mm x 13 mm x 7 mm) was found in coarse sandy deposit exposed in a cattle wallow beside a fence. No other definite artefacts were found in this area.

FIGURE 3


LOW, PRONE TO WATERLOGGING
T4
T6
T5
IF1
T3
T2
ABANDONED FENCE
T8
T1
T7
EXISTING QUARRY
BUTMAROO CREEK
FLOOD DIVERSION BANK
0 50 100 150
SCALE - METRES
N
EXTENT OF
CREEK BANK SURVEY

No artefacts or subsurface features such as charcoal lenses were located in the exposed vertical banks of the creek.

5.2 Subsurface Investigations

The eight trenches examined in detail are shown on Figure 3. Varying amounts of flaked stone artefacts were found in the excavated material from seven of the eight trenches archaeologically investigated, Trench 6 was found to be archaeologically sterile. Only four trenches (1, 3, 7 and 8) held any significant density of artefacts. The distribution of these trenches suggests that greatest artefact densities are found on the raised sandy ground closest to the creek. Only low density was found in the clayey subdued drainage area around Trench 4 and only low densities or sterile ground was found on the ridge away from the creek (Trenches 2, 5 and 6). However, it is possible that this apparent pattern is more a product of the chance placement of trenches within a "lumpy" density pattern found across the site such as was revealed by the excavations at Bridge Creek 1.

Highest artefact densities were found at Trenches 1 and 3, Trenches 7 and 8 had medium densities and Trenches 2, 4 and 5 had very low artefact densities. The volumetric artefact densities for the trenches are graphed in Appendix 1. The imprecise nature of the sampling process allied with the broad comparative and research questions being addressed in this study mean that an analysis of artefact densities etc per volumetric measure and depth is the most appropriate approach. However, for comparison with densities reported for previously investigated sites (see Table 1) the artefact densities per square metre for the trenches are listed below:

Table 2
Artefact densities from trenches
expressed per square metre

Trench 1	65.0/m^2
Trench 2	8.88/m^2
Trench 3	55.05/m^2
Trench 4	2.0/m^2
Trench 5	7.87/m^2
Trench 6	sterile
Trench 7	57.24/m^2
Trench 8	38.33/m^2

Quartz was found to be the most commonly occuring raw material in all trenches except Trench 4 although the variation in this instance can explained

by the very small total number of artefacts from this trench. Silcrete constituted a significant proportion of artefacts (40%) in two of the richer trenches. Artefacts from the "other" category, which covered raw materials such as quartzite, medium quality cherts, fine grain acid volcanics and sandstones were found in all artefact bearing trenches although they only constitute a sizeable proportion in trenches with low densities and numbers of artefacts. Trench 3 was atypical of the archaeologically richer trenches in that it virtually contained only quartz while the others have at least a substantial proportion of silcrete and/or other artefacts.

Table 3

Artefact numbers, raw materials and proportions

Trench	Total Artefacts	Silcrete number	Silcrete %	Quartz number	Quartz %	Other number	Other %
1	203	81	40%	102	50%	20	10%
2	33	6	18.1%	22	66.6%	5	15.1%
3	213	3	1.4%	206	96.7%	4	1.9%
4	7	3	42.8%	2	28.6%	2	28.6%
5	33	6	18.1%	21	63.6%	6	18.1%
6	-	-	-	-	-	-	-
7	203	81	40%	119	58.6%	3	1.4%
8	107	15	14%	78	72.9%	14	13.1%

From the graphs in Figure 5 and 6 it can be seen that artefacts were found in two trenches (1 and 7) down to 100 cm depth and down to 40 cm or more in all the other trenches. These graphs also serve to display the vertical disposition of artefacts through the sandy upper deposit. It should be pointed out that the varied thicknesses and depths of the sample units plotted in Figures 5 to 10 are a product of the relatively imprecise manner by which the samples were achieved. The pattern of vertical distributions of the artefacts varies considerably between some of the trenches although overall the bulk of artefacts from all trenches come from 20 - 45 cm depth. It is possible that much of the pattern of vertical distribution of artefacts can be explained in taphonomic terms.

It was not possible under the circumstances to sieve or consistently examine the deposit removed from the lower lying clayey sand or sandy clay layers. Thus it is not possible to say definitively whether or not artefacts continue into this deposit. Very small numbers of artefacts were found in some trenches in removed deposit which included parts of the uppermost levels of the clayey deposit. However this could be due to vertical mixing of layers due the imprecision of excavation at the time the trenches were dug and to the investigation method used. It is significant to note that in the trenches which contained substantial artefact densities the densities in all cases were

markedly reduced before the clay layer was reached. This suggests the clay layer is unlikely to contain significant amounts of archaeological material.

The vertical distributions of the different raw materials encountered are graphed in Figures 7 to 10. A regression analysis showed no significant change in size of artefacts as depth changed. The spread of artefacts through the soil column in Trenches 1 and 3 appears similar to the "battleship" distributions described at the G17 site near Goulburn (Paton 1990). These distributions have been interpretted as resulting from originally surface lying artefacts being relocated within the soil through worm sorting. The argument is that the depth at which the artefacts are located suggests the length of time over which they have been operated on by worm sorting until they reach the base of the worm activity layer at which point they begin to concentrate (Paton 1990).

Thus it could be suggested that the artefacts at Trench 1 have been in the soil for a longer time than have those at Trench 3. This would fit with the generally recognised pattern for sites in the region that a quartz dominated phase post-dates a phase in which silcretes and quartz were exploited. The differential depths and distribution curves also suggests the site represents smaller return occupations of the low ridge over a long period of time rather than a single intensive phase or occupation event.

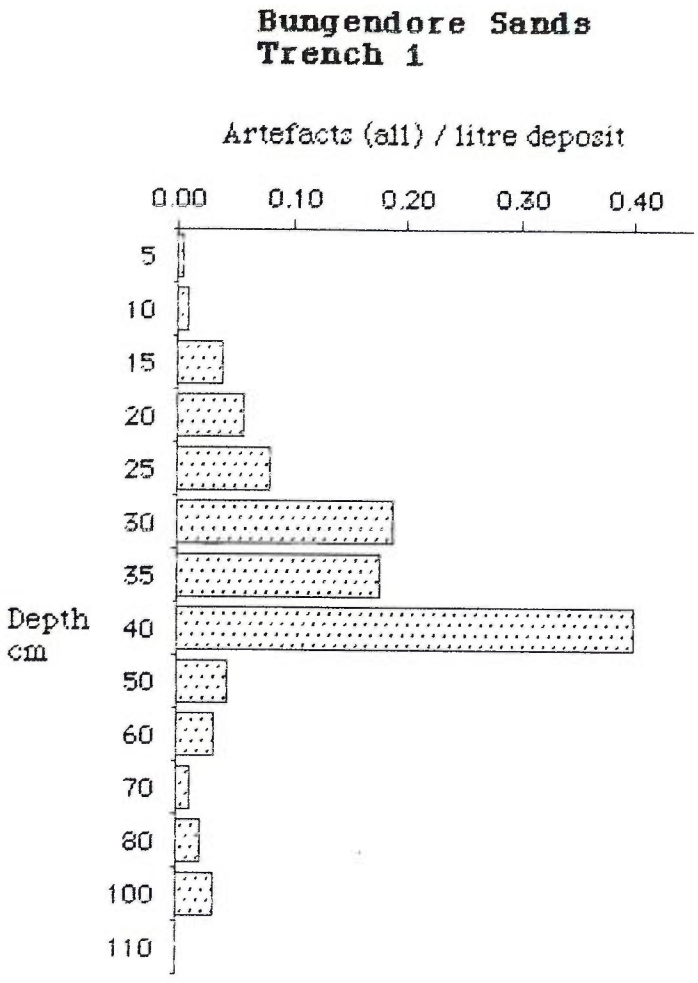
Breakdowns of the artefact types and raw materials are given for the four archaeologically richest trenches in Table 4. The complete catalogue of artefacts recorded from Trench 1 is given in Table A1 in Appendix 1.

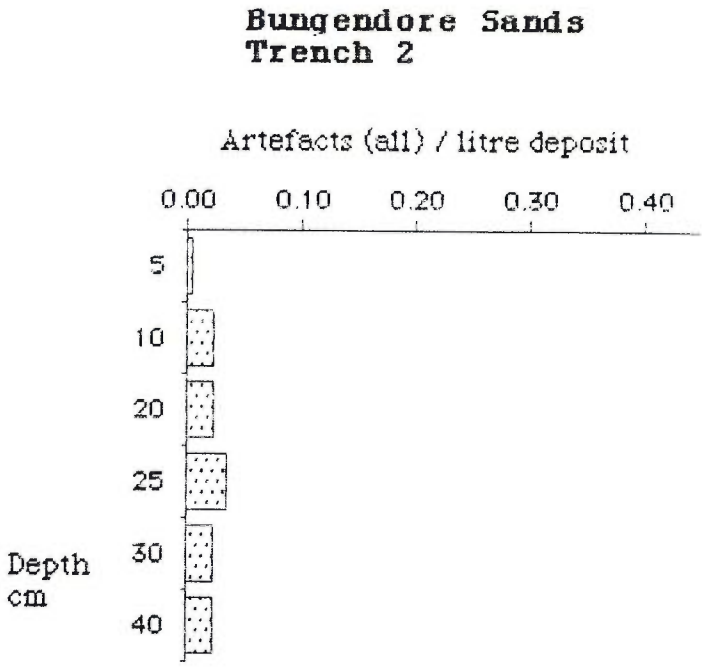
Combined, the trenches have a relatively high proportion of retouched artefacts (4.1% of all artefacts), all trenches contained at least some retouched pieces. Interestingly there are a number of very small, finely retouched quartz geometric microliths. In fact at Trench 3 a total of 7 quartz geometric microliths constituting 3.4% of all quartz artefacts were found. These triangular and roughly crescentic shaped microliths all fell within a very small size range and were found in deposit originating from 20 - 40 cm depth below the surface. At Trench 1 there were 3 quartz retouched geometric microliths (3% of all quartz) found originating from 40 -50 cm depth.

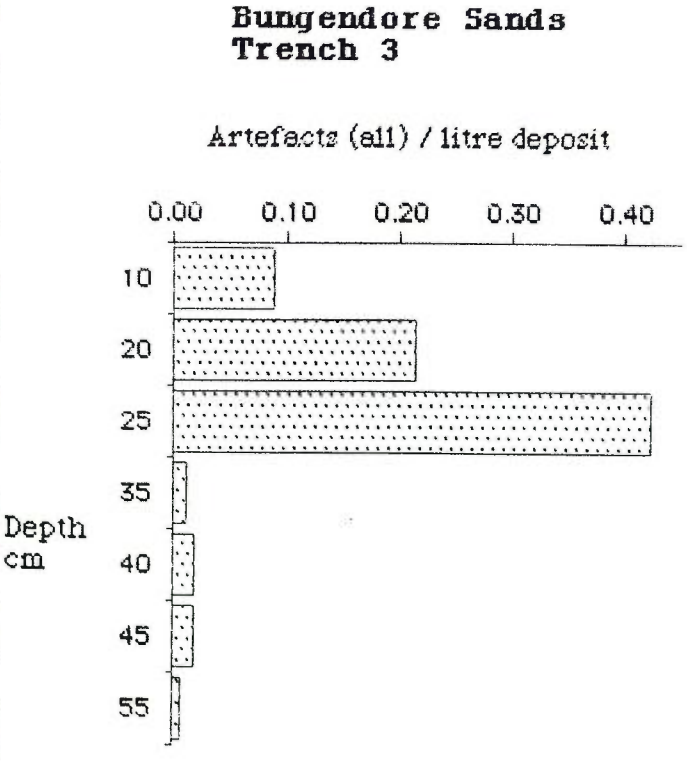
At Trench 1 there were also high proportions of steeply retouched silcrete artefacts (generally termed "scrapers"). These were mostly what would be traditionally termed endscrapers and sidescrapers and constituted 11.1% of all silcrete artefacts.

The ratios of backed blades and geometric microliths to scraping implements varied substantially were they were located in significant numbers. At Trench 1 irrespective of raw materials the ratio of backed blades, etc to scraping implements was 3:11 while at Trench 3 it was 7:1 and at Trench 8 it was 2:1.

Figure 5


Bungendore Sands
Trench 1
Artefacts (all) / litre deposit
0.00
0.10
0.20
0.30
0.40
5
10
15
20
25
30
35
40
50
60
70
80
100
110
Depth
cm


Bungendore Sands
Trench 2
Artefacts (all) / litre deposit
0.00
0.10
0.20
0.30
0.40
5
10
20
25
30
40
Depth
cm


Bungendore Sands
Trench 3
Artefacts (all) / litre deposit
0.00
0.10
0.20
0.30
0.40
10
20
25
35
40
45
55
Depth
cm

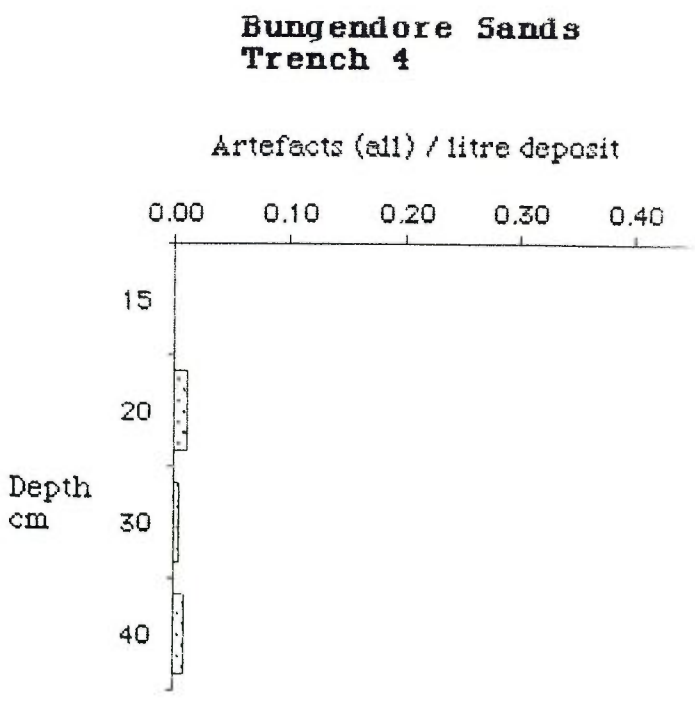
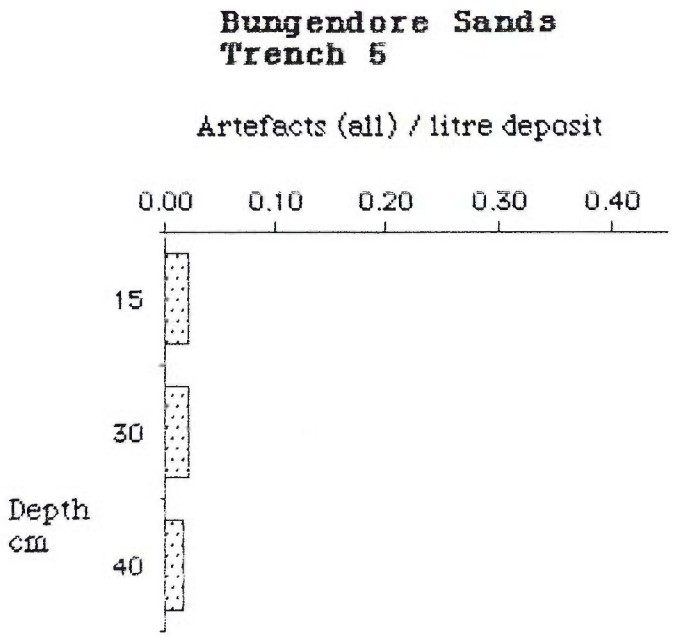
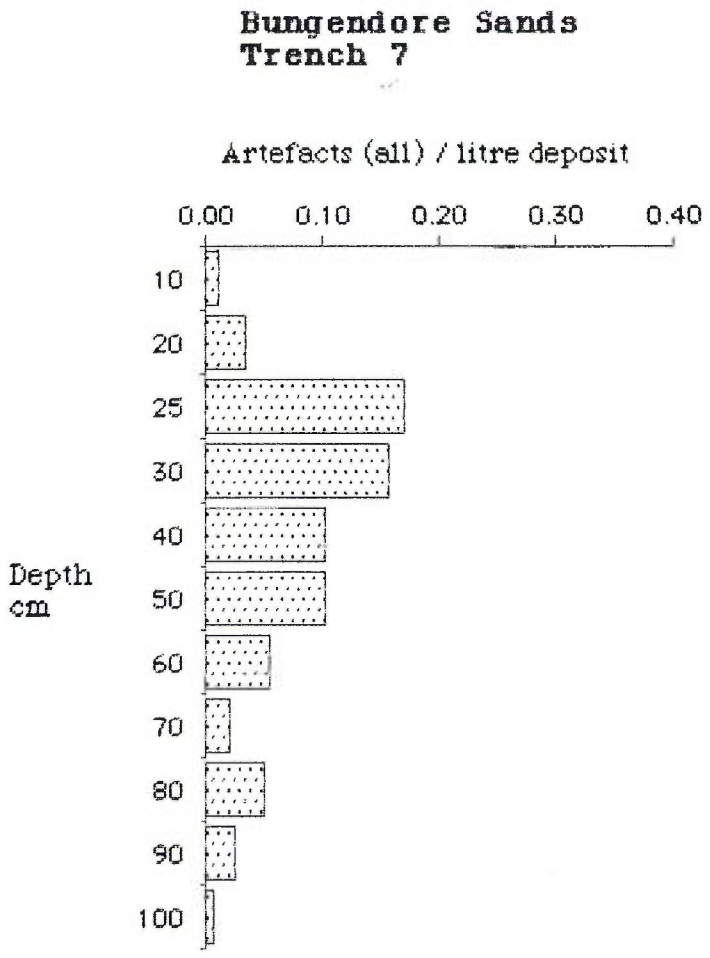

Bungendore Sands
Trench 4
Artefacts (all) / litre deposit
0.00
0.10
0.20
0.30
0.40
15
20
30
40
Depth
cm

Figure 6


Bungendore Sands
Trench 5
Artefacts (all) / litre deposit
0.00
0.10
0.20
0.30
0.40
15
30
40
Depth
cm


Bungendore Sands
Trench 7
Artefacts (all) / litre deposit
0.00
0.10
0.20
0.30
0.40
10
20
25
30
40
50
60
70
80
90
100
Depth
cm

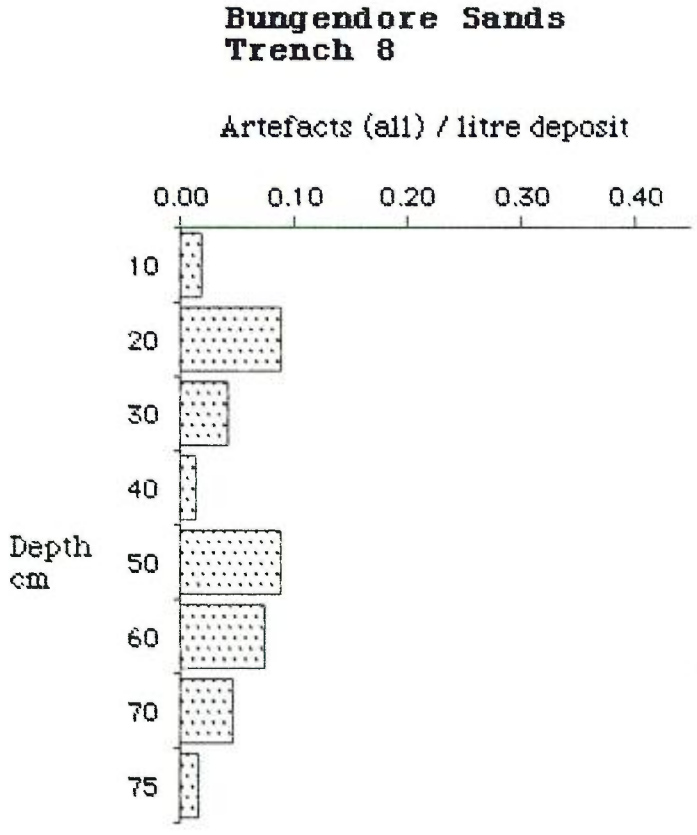

Bungendore Sands
Trench 8
Artefacts (all) / litre deposit
0.00
0.10
0.20
0.30
0.40
10
20
30
40
50
60
70
75
Depth
cm

Figure 7

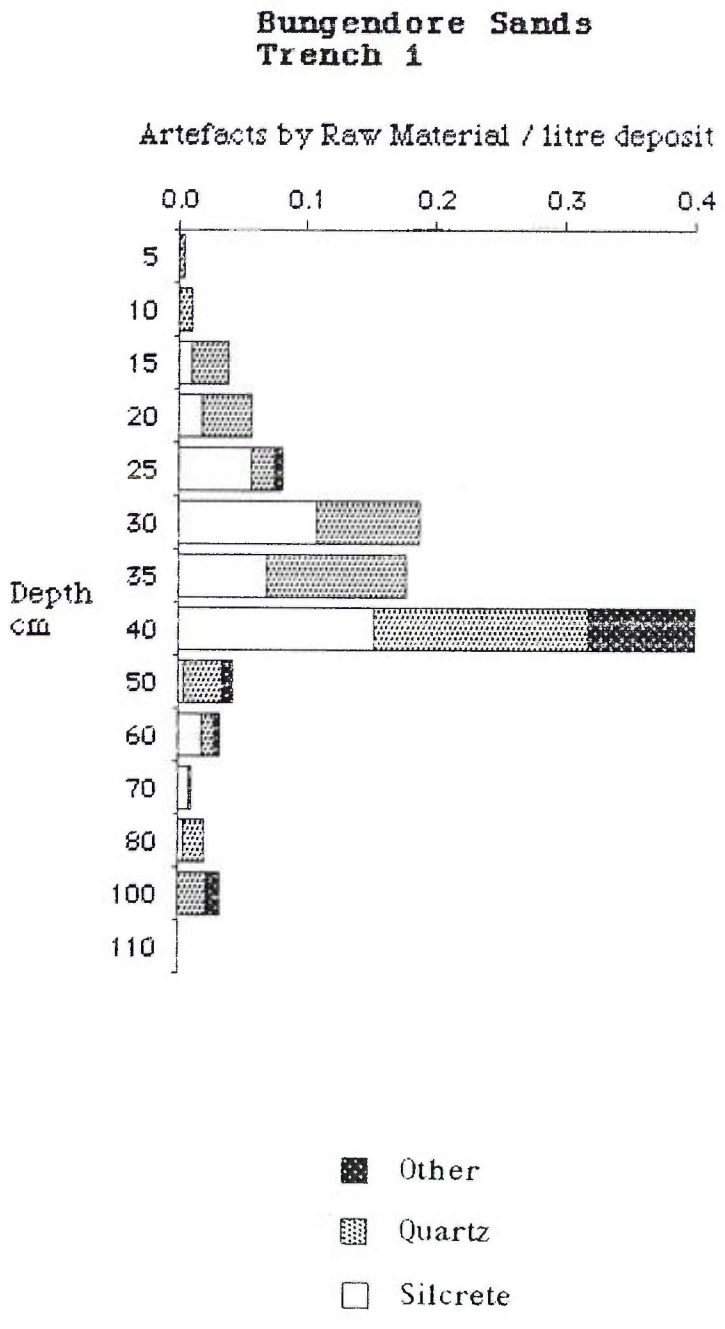

Bungendore Sands
Trench 1
Artefacts by Raw Material / litre deposit
0.0
0.1
0.2
0.3
0.4
Depth
cm
5
10
15
20
25
30
35
40
50
60
70
80
100
110
Other
Quartz
Silcrete

Figure 8

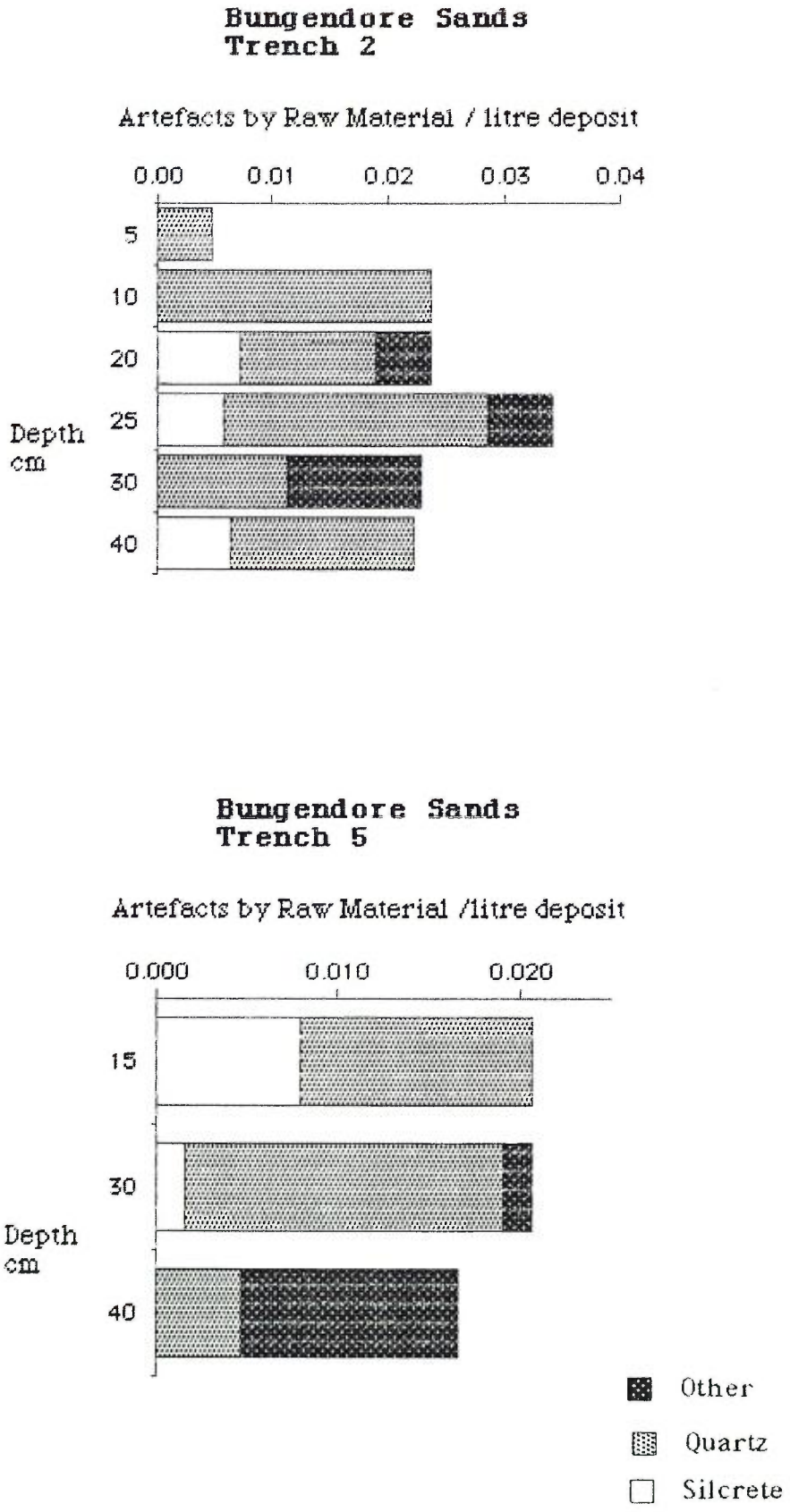

Bungendore Sands
Trench 2
Artefacts by Raw Material / litre deposit
0.00
0.01
0.02
0.03
0.04
5
10
20
25
30
40
Depth
cm
Bungendore Sands
Trench 5
Artefacts by Raw Material /litre deposit
0.000
0.010
0.020
15
30
40
Depth
cm
Other
Quartz
Silcrete

Figure 9

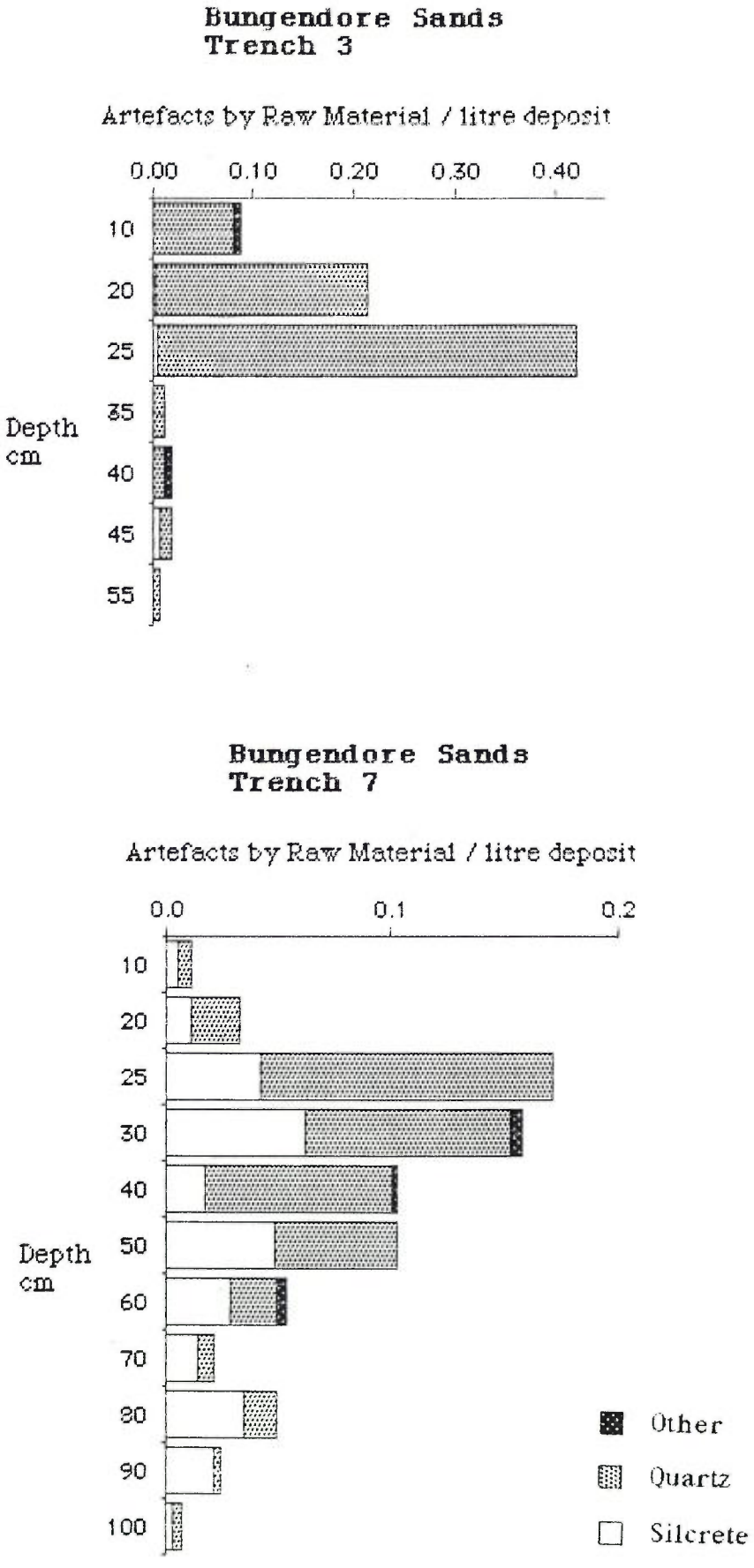

Bungendore Sands
Trench 3
Artefacts by Raw Material / litre deposit
0.00
0.10
0.20
0.30
0.40
10
20
25
35
40
45
55
Depth
cm
Bungendore Sands
Trench 7
Artefacts by Raw Material / litre deposit
0.0
0.1
0.2
10
20
25
30
40
50
60
70
80
90
100
Depth
cm
Other
Quartz
Silcrete

Figure 10

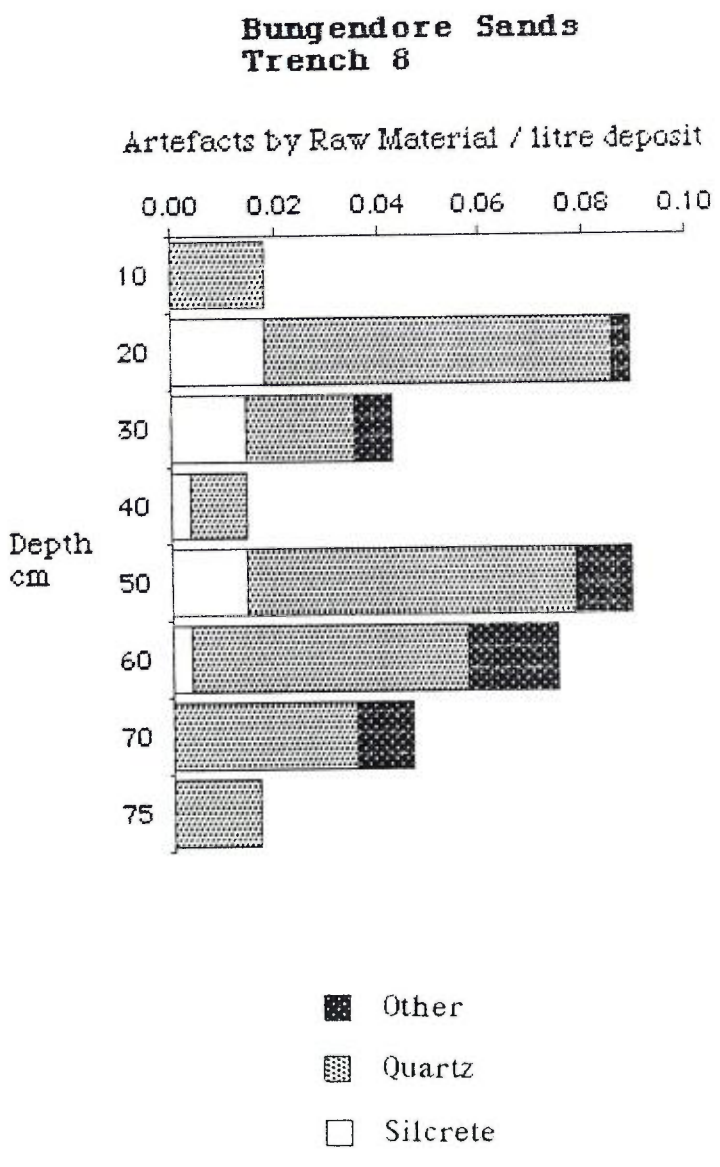

Bungendore Sands
Trench 8
Artefacts by Raw Material / litre deposit
0.00
0.02
0.04
0.06
0.08
0.10
Depth
cm
10
20
30
40
50
60
70
75
Other
Quartz
Silcrete

TABLE 4

Trench 1

Raw Material	Flaked Piece		Flake		Broken Flake		Core		Retouch		Utilised		H-stone	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Silcrete	19	23.0	33	40.7	16	19.7	3	3.7	9	11.1	1	1.2	-	-
Quartz	71	69.6	11	10.7	13	12.7	3	2.9	4	3.9	-	-	-	-
Other	6	30.0	9	45.0	3	15.0	-	-	1	5.0	-	-	1	5

Trench 3

Raw Material	Flaked Piece		Flake		Broken Flake		Core		Retouch		Utilised		H-stone	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Silcrete	-	-	1	33.3	2	66.6	-	-	-	-	-	-	-	-
Quartz	108	52.4	36	17.5	48	23.3	6	2.9	8	3.9	-	-	-	-
Other	1	25.0	2	50.0	-	-	-	-	-	-	-	-	-	-

(also included 1 "other" manuport)

Trench 7

Raw Material	Flaked Piece		Flake		Broken Flake		Core		Retouch		Utilised		H-stone	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Silcrete	20	24.7	28	34.6	28	34.6	-	-	5	6.2	-	-	-	-
Quartz	76	63.8	23	19.3	18	15.1	2	1.7	-	-	-	-	-	-
Other	1	33.3	-	-	2	66.6	-	-	-	-	-	-	-	-

Trench 8

Raw Material	Flaked Piece		Flake		Broken Flake		Core		Retouch		Utilised		H-stone	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Silcrete	4	26.6	3	20.0	5	33.0	-	-	3	20.0	-	-	-	-
Quartz	55	70.5	7	9.0	9	12.0	6	8.0	-	-	-	-	-	-
Other	1	7.1	3	21.4	6	42.8	-	-	-	-	-	-	2	14.3

(also included 2 "other" manuports)

Only two definite bipolar reduced artefacts were found. Both of these were small bipolar flakes on quartz. Interestingly these came from the same level (20 cm depth) in Trench 3 as two finely retouched quartz geometric microliths.

Most cores found were on quartz and overall they constituted 2.1% of the total assemblage. Cores were relatively evenly divided between single platform and multiplatform types with only a small proportion of alternating platform biface cores.

The numbers of whole flakes from any one raw material found at any trench are not large enough to support a detailed technological analysis of the flaking techniques and reduction sequence/s used at the site. However, a total of 33 whole silcrete flakes were recovered from Trench 1 (see Table A 2 in Appendix 1) and from this it is possible to say that flake production was not strongly blade oriented, platforms were dominantly focal (73%) and unprepared with moderate platform angles (mean 77.5°) and displayed only limited evidence of core rotation.

Hammerstones or anvils constituted only a very small proportion of the total artefacts recorded and there were virtually no unmodified manuports found.

There was some evidence of the depth of post-European ground disturbance in the form of glass fragments and small pieces of very rusted iron found down to 25 cm depth at Trench 7.

6. DISCUSSION

The artefactual material recovered from the proposed development area would seem to fit well within the stone assemblages found in the region. The artefacts were dominantly unretouched quartz flaked pieces and flakes although relatively high proportions of finely retouched quartz artefacts were recorded. A smaller but significant proportion of artefacts had been made on other fine grained materials, principally silcrete. The number of backed blades and geometric microliths along with the general technological affinities of the flaked material suggests the site dates to within the microblade period. The limited flake analysis able to be conducted accords with this.

The association of 2 quartz bipolar flakes and 2 finely retouched quartz geometric microliths at the same level in Trench 3 supports an interpretation that microblade/Bondaian technology and bipolar reduction were not mutually exclusive and occurred together as part of a general suite of techniques used at a certain period. The shallower depth and possibly younger age of the almost wholly quartz assemblage from Trench 3 as compared with the deeper and

possibly proportionately older mixed silcrete and quartz assemblage from Trench 1 is in keeping with general models for the region

The densities of artefacts recorded at this site fit well within the ranges found at some other sand deposit sites in the region. Most of the individual trench densities are substantially higher than those reported from ELG1 to the such southwest and Nardoo to the north. The degree of internal variation in density as seen in the trenches accords well with the results from BC1 to the east.

The fact that virtually no artefacts were located at the surface yet relatively high densities were found below the ground surface is in keeping with the general pattern for sites in sand deposits in the region. However, this site is in contrast with the neighboring ELG1 site as most artefacts were found concentrated at greater depths (20 - 40 cm here as compared with 0 - 15 cm at ELG1). The ELG1 site and the ridge on which it is located are suggested to be younger than the possible age for this site and ridge so an explanation for the different stratigraphic levels of the sites may lie in this.

Proximity to water and riverine resources is a factor thought to have influenced occupation patterns. The site lies on a broad, slightly elevated area adjoining Butmaroo Creek which is one of the main creeks feeding Lake George and is only 1.5 km from the modern shoreline of the lake. These would have been significant resource areas in the past and may have acted to draw Aboriginal settlement and activity to the area. The greater artefact densities found at those trenches located closer to the creek could reflect the tendency for sites to focus on water sources.

The question of whether Aboriginal occupation of sand deposits in the area was contemporaneous with the geomorphic development of the sand bodies or whether it post-dates them can not be fully resolved at this site on the basis of the work conducted so far.

No evidence for Aboriginal burials was found in the study area. This is in keeping with the general experience for sand deposits in the region although the existence of a burial 3 km to the north points to the possibility of the remaining archaeologically undetected.

The significance of Aboriginal archaeological sites needs to be assessed on the basis of archaeological/scientific significance, Aboriginal significance and educational/aesthetic significance.

Archaeological/scientific significance is generally considered in terms of the site's representativeness, its integrity, structure, contents and converse to representativeness its uniqueness. Given the level of investigation conducted so far most of these issue can only be broadly considered for the site located in the development area. The geomorphological context of the low ridge within

the late Quarternary history of the basin means the associated archaeological site has the potential to have high scientific significance.

Although the evidence so far suggests the site is not stratified in the traditional sense it does suggest that occupation phases spanning some length of time may be represented. The relatively high densities of artefacts at the site also tend to enhance its scientific potential.

The educational/aesthetic significance of the site is harder to determine although the proximity of the area to two tertiary institutions teaching and researching prehistory and geoarchaeology mean that the site and the deposits of the ridge offer great potential for teaching and research.

7. ABORIGINAL CONSULTATION

The development area and much of the surrounding Tablelands lies within the Ngunnawal tribal area as defined by Tindale (1974). This area is now within the Ngunnawal Local Aboriginal Land Council jurisdiction. Members of this Land Council are increasingly interested and involved with matters of site management in the region. Arnold Williams from the Land Council was contacted, and he accompanied P. Packard on the initial survey of the area. He knew of no particular Aboriginal significance to the area or to the isolated artefacts which were located in the course of the initial survey. The results of this study were discussed and a copy of this report has been sent to the Land Council for comment. The Land Council is greatly concerned that Aboriginal sites in the Lake George area were being steadily destroyed by developments and quarrying.

8. CONCLUSIONS AND RECOMMENDATIONS

The site located within the development area is similar in many respects to many of the more recent sites found in the region. However, it has some aspects which render it potentially more significant than many others:
1) it has a relatively high density of artefacts which although dominantly comprised of unretouched quartz flakes and flaked pieces also includes a significant proportion of other raw materials;
2) it contains relatively high proportions of retouched artefacts (backed blades etc and scraping implements) made on all raw materials and notably on quartz;
3) it displays internal variations in assemblage composition (raw materials);
4) it has artefacts located across a relatively wide depth range with apparent variations in vertical displacements of the main concentration level across the site;

5) it does not generally exhibit any significant amount of post-European disturbance;
6) it is located on a discrete deposit parts of which could potentially date from the early Holocene.

The greatest artefact densities were found in the areas closest to the creek. The developer is required in their development plans to leave untouched a 100m wide zone from the creek throughout Lot 31. This zone would include the area around Trench 7 and would almost include Trench 6. Given that the highest artefact densities are located near the creek it is likely that this buffer zone will include and thereby preserve a sample of the site. However, the greatest overall densities and assemblage variations are located slightly further back from the creek than the buffer zone (Trenches 1 and 3). The level of variation within the site means that it would have to be established how representative of the whole site is the part of the site which would be protected within the buffer zone.

The options which can be defined are:

1) the development be allowed to proceed and consent to destroy that part of the site to be quarried be granted conditional upon the completion of controlled archaeological salvage investigations (possibly with equipment assistance from the developer), with the aim of generating a controlled sample of the part of the site which would be destroyed through quarrying to complement the part of the site which would be preserved in the buffer zone, and to further assess the nature of the site and the relationship between the part of the site within the buffer zone and the part of the site which would be destroyed;

2) the development be allowed to proceed with archaeological monitoring/salvage during the development process;

3) no further archaeological work required and the development allowed to proceed.

Given the potential scientific significance of the site option 3 is not recommended.

Arrangements involving monitoring and salvage of developments are difficult to administer at the best of times. Given the relatively long period over which the area would be quarried the problems of administering a monitoring/salvage project over a long period (as well as the inflationary increases in costs of the work) option 2 is not recommended.

The most satisfactory option is Option 1. This would enable a rational salvage under controlled conditions. The problem of investigating a large open site such as this is most economically addressed using light earthmoving equipment to assist in archaeological excavations. This equipment could be used to sample vertically as well as horizontally across the site.

The developers attention is drawn to sections of the National Parks and Wildlife Act 1974 under which it is an offence to disturb or destroy a site or relic without the written consent of the Director.

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APPENDIX A

TABLE A1

TRENCH 1

All Artefacts

	Depth cm	Raw Mat	Artefact Type	Length mm	Width mm	Thick mm	Comments
1	5	2	3	9	6	1	•
2	10	2	1	25	17	8	•
3	10	2	1	7	5	5	•
4	15	2	1	8	7	3	•
5	15	2	1	10	4	3	•
6	15	2	1	8	4	1	•
7	15	2	1	12	6	4	•
8	15	1	1	10	5	3	•
9	15	1	3	11	6	1	•
10	15	2	1	12	7	5	•
11	15	2	1	11	7	3	•
12	20	2	1	5	5	2	•
13	20	2	1	6	5	1	•
14	20	2	1	6	5	2	•
15	20	2	2	8	7	2	•
16	20	2	1	5	2	2	•
17	20	2	1	7	4	1	•
18	20	1	2	10	7	1	•
19	20	1	2	6	8	1	•
20	20	1	1	16	7	4	•
21	20	2	1	10	7	1	•
22	20	2	1	12	7	4	•
23	20	1	3	7	8	2	•
24	25	1	7	17	17	4	•
25	25	2	1	12	6	2	•
26	25	1	3	9	10	3	•
27	25	1	6	21	15	7	•
28	25	2	3	6	5	1	•
29	25	5	1	20	18	2	•
30	25	2	1	7	5	1	•
31	25	2	1	10	3	1	•
32	25	1	1	12	7	6	•
33	25	1	1	11	7	5	•
34	25	1	1	18	11	7	•
35	25	1	1	13	9	6	•
36	25	1	2	24	22	8	•
37	25	1	2	7	4	1	•
38	25	1	3	5	16	2	•
39	25	1	2	19	9	4	•
40	25	1	2	8	5	1	•
41	30	2	1	16	8	3	•
42	30	2	1	11	11	2	•
43	30	2	1	6	5	1	•
44	30	2	1	12	4	1	•
45	30	2	1	27	22	13	•
46	30	1	6	12	6	2	steep ret
47	30	2	1	18	5	3	•
48	30	2	1	20	11	4	•
49	30	2	3	11	4	1	•
50	30	2	3	12	9	3	•
51	30	1	2	12	13	4	•
52	30	2	5	15	12	7	multiplat
53	30	2	1	7	3	2	•
54	30	2	1	9	5	2	•
55	30	2	2	6	10	2	•
56	30	2	2	10	12	2	•
57	30	1	2	25	16	5	•
58	30	1	2	28	15	3	•
59	30	1	2	18	20	4	•
60	30	1	2	25	18	10	•
61	30	1	1	22	21	5	•
62	30	1	1	17	7	2	•
63	30	1	1	12	3	1	•
64	30	1	1	13	5	3	•
65	30	1	2	17	7	3	•
66	30	1	6	21	16	6	Endscraper
67	30	1	5	18	10	7	•
68	30	1	6	19	19	7	Endscraper
69	30	1	6	30	20	9	Endscraper
70	30	1	2	10	6	1	•
71	30	1	2	9	6	1	•
72	30	1	3	8	5	2	•
73	30	1	2	6	6	1	•
74	35	2	1	8	5	2	•
75	35	2	1	9	4	1	•
76	35	2	1	10	5	1	•
77	35	2	1	8	8	1	•
78	35	2	1	12	6	2	•
79	35	2	1	10	5	2	•
80	35	2	1	7	7	1	•
81	35	2	3	9	4	1	•
82	35	2	3	6	4	1	•
83	35	2	3	10	5	1	•
84	35	2	1	5	5	1	•
85	35	2	3	8	15	2	•
86	35	2	3	12	10	3	•
87	35	2	1	8	6	1	•
88	35	1	2	20	15	4	•
89	35	1	2	22	19	5	•
90	35	1	2	5	6	1	•
91	35	1	1	8	4	1	•

	Depth cm	Raw Mat	Artefact Type	Length mm	Width mm	Thick mm	Comments
92	35	1	1	13	8	2	•
93	35	1	1	8	6	3	•
94	35	1	1	6	5	2	•
95	35	2	1	10	10	4	•
96	35	2	1	11	9	3	•
97	35	2	1	11	7	3	•
98	35	1	6	13	15	3	Endscraper
99	35	1	3	7	12	1	•
100	35	1	3	4	10	3	•
101	35	1	3	28	6	2	•
102	40	2	2	23	18	5	•
103	40	2	1	10	2	1	•
104	40	2	1	7	4	2	•
105	40	2	2	16	15	3	•
106	40	2	3	10	7	2	•
107	40	2	6	9	6	1	Geom Micro
108	40	2	2	19	8	4	•
109	40	2	1	5	5	1	•
110	40	2	1	8	7	3	•
111	40	2	1	10	8	3	•
112	40	2	1	12	5	2	•
113	40	2	1	12	7	2	•
114	40	2	1	7	6	1	•
115	40	2	1	8	4	1	•
116	40	2	1	8	7	2	•
117	40	2	2	7	7	1	•
118	40	4	2	6	6	1	•
119	40	4	2	5	7	1	•
120	40	4	2	7	8	1	•
121	40	4	2	6	5	1	•
122	40	4	6	17	7	2	steep ret
123	40	4	3	8	4	1	•
124	40	4	3	7	6	1	•
125	40	4	2	8	7	1	•
126	40	4	1	19	11	5	•
127	40	2	6	56	32	18	Sidescraper
128	40	2	6	8	5	2	Geom Micro
129	40	4	1	16	9	3	•
130	40	4	2	7	9	1	•
131	40	4	2	14	15	1	•
132	40	4	1	16	7	2	•
133	40	1	2	14	8	1	•
134	40	1	2	25	17	5	•
135	40	1	2	19	7	4	•
136	40	1	2	17	5	3	•
137	40	1	2	4	8	1	•
138	40	1	2	6	5	1	•
139	40	1	2	15	8	1	•
140	40	1	2	8	8	2	•
141	40	1	1	15	13	6	•
142	40	1	1	12	7	1	•
143	40	1	1	25	21	8	•
144	40	1	1	10	9	3	•
145	40	1	2	26	13	2	•
146	40	1	2	22	21	4	•
147	40	1	1	14	7	1	•
148	40	1	2	32	16	4	•
149	40	2	1	21	13	4	•
150	40	2	1	14	11	6	•
151	40	2	1	26	13	9	•
152	40	2	1	26	12	3	•
153	40	2	1	12	8	3	•
154	40	2	1	13	7	4	•
155	40	2	1	16	7	2	•
156	40	2	1	10	8	2	•
157	40	1	3	7	16	2	•
158	40	1	6	22	20	7	steep ret
159	40	1	2	6	11	7	•
160	40	1	3	26	16	4	•
161	40	1	4	23	22	9	biface
162	40	1	3	10	4	1	•
163	40	1	6	18	15	5	Sidescraper
164	40	1	6	15	10	3	steep ret
165	50	2	4	32	27	11	singleplat
166	50	2	3	13	10	3	•
167	50	2	6	9	6	2	Geom Micro
168	50	4	3	17	8	3	•
169	50	4	1	11	5	3	•
170	50	2	3	15	9	1	•
171	50	2	1	7	3	5	•
172	50	2	1	16	10	3	•
173	50	1	3	17	12	5	•
174	50	2	2	14	8	3	•
175	50	2	2	26	15	3	•
176	50	2	2	22	14	4	•
177	60	2	1	18	7	3	•
178	60	2	1	25	15	11	•
179	60	5	8	66	40	6	•
180	60	2	1	12	7	4	•
181	60	1	2	15	9	2	•
182	60	1	2	20	12	2	•

	Depth cm	Raw Mat	Artefact Type	Length mm	Width mm	Thick mm	Comments
183	60	1	2	7	9	4	•
184	60	1	3	23	22	5	•
185	60	1	3	20	15	3	•
186	70	2	2	7	7	1	•
187	70	1	3	9	9	4	•
188	70	1	3	15	9	3	•
189	80	2	1	11	5	1	•
190	80	2	1	8	4	1	•
191	80	2	1	15	8	3	•
192	80	1	5	22	14	8	multiplat
193	80	2	1	26	16	8	•
194	80	2	1	10	10	4	•
195	100	4	1	9	4	2	•
196	100	2	4	26	18	15	amorphous
197	100	4	2	21	24	3	•
198	100	4	2	27	32	6	•
199	100	2	1	11	7	2	•
200	100	2	1	24	11	4	•
201	100	2	1	11	5	2	•
202	100	2	3	19	17	3	•
203	100	2	1	7	5	2	•

TABLE A 2

TRENCH 1

Whole Flakes

	Depth cm	Raw Mat	Length mm	Width mm	Thick mm	Plat Width mm	Plat Thick mm	Plat Angle	Plat Type	Plat Surf	OHR	Plat Rem	M&D Scars	Term
1	40	1	4	8	1	7	1	80	1	3	0	0	0	3
2	40	1	8	8	2	7	3	60	2	3	0	0	0	1
3	40	1	22	21	4	21	3	75	2	3	0	0	0	1
4	40	1	17	5	3	5	2	•	1	4	0	0	0	1
5	35	1	22	19	5	4	3	80	1	2	0	1	0	1
6	35	1	5	6	1	2	1	•	1	•	0	0	0	1
7	40	1	32	16	4	13	8	80	1	4	0	0	1	1
8	35	1	20	15	4	3	2	90	1	3	0	0	2	1
9	40	1	6	11	7	5	1	100	1	2	0	0	0	1
10	40	1	15	8	1	2	1	•	1	•	0	0	0	2
11	40	1	14	8	1	8	2	85	2	4	0	0	0	1
12	40	1	19	7	4	6	4	65	2	2	0	0	0	1
13	40	1	6	5	1	4	1	75	1	2	0	0	0	1
14	60	1	15	9	2	4	1	75	1	2	1	0	2	1
15	40	1	26	13	2	9	1	75	1	3	1	0	0	1
16	60	1	20	12	2	8	2	90	1	4	0	0	0	1
17	60	1	7	9	4	9	6	55	2	2	1	0	0	1
18	30	1	6	6	1	3	1	•	1	•	0	0	0	1
19	25	1	7	4	1	4	1	•	1	•	0	0	0	1
20	25	1	8	5	1	•	•	•	1	•	0	0	0	1
21	30	1	28	15	3	5	1	85	1	2	0	0	0	1
22	30	1	9	6	1	7	1	75	1	2	1	0	0	1
23	20	1	6	8	1	5	1	•	1	•	0	0	0	1
24	20	1	10	7	1	4	1	•	1	•	0	0	0	1
25	25	1	24	22	8	7	2	105	1	2	1	0	3	1
26	25	1	19	9	4	11	2	60	2	2	0	0	1	1
27	30	1	25	18	10	12	4	90	1	3	0	1	2	1
28	30	1	25	16	5	16	4	65	2	3	0	0	0	1
29	30	1	18	20	4	7	4	90	2	3	0	0	0	1
30	30	1	10	6	1	4	1	•	1	3	1	0	0	1
31	40	1	25	17	5	6	2	80	1	2	0	0	1	1
32	30	1	17	7	3	5	2	80	1	4	0	0	0	1
33	30	1	12	13	4	12	8	45	2	3	0	0	1	1
34	50	2	14	8	3	7	4	85	2	3	0	0	1	1
35	50	2	26	15	3	6	3	85	1	2	0	0	0	1
36	40	2	7	7	1	6	1	•	1	•	0	0	0	1
37	40	2	23	18	5	23	4	75	2	3	0	0	0	3
38	30	2	6	10	2	8	3	60	2	2	0	0	0	1
39	20	2	8	7	2	9	3	65	2	3	0	0	0	1
40	30	2	10	12	2	15	8	60	2	3	0	0	0	1
41	40	2	19	8	4	12	4	75	2	3	0	0	0	3
42	70	2	7	7	1	6	2	55	1	2	0	0	0	1
43	50	2	22	14	4	10	3	65	1	3	1	0	1	1
44	40	2	16	15	3	11	4	85	2	4	0	0	0	3
45	100	4	21	24	3	6	1	65	1	2	1	0	0	1
46	100	4	27	32	6	10	1	80	1	2	0	0	0	1
47	40	4	6	6	1	5	1	•	1	1	0	0	0	1
48	40	4	7	8	1	4	1	45	1	2	1	0	0	1
49	40	4	8	7	1	9	3	50	2	2	0	0	0	1
50	40	4	5	7	1	6	1	80	1	2	0	0	0	1
51	40	4	7	9	1	9	1	70	1	3	1	0	0	1
52	40	4	14	15	1	11	2	85	1	3	1	0	0	1
53	40	4	6	5	1	6	1	•	1	2	1	0	0	1

APPENDIX F

APPENDIX F

NOISE EFFECTS ASSESSMENT

REPORT

April 1992

Attention:Mr Weeks White
Coffey Partners International
8c Wiluna Street
Fyshwick ACT 2609

Re:PROVISION OF ENVIRONMENTAL IMPACT STATEMENT, SAND EXTRACTION AT LOT 31, PARISH OF CURRANDOOLEY FOR CANBERRA SAND AND GRAVEL PTY LTD NOISE EFFECTS ASSESSMENT

1.0 INTRODUCTION

In response to a request Reference:WW:VS C5705/1-A1 dated 6 April 1992, an environmental effects assessment was made as part of a development consent application to the Yarrowlumla Shire Council for the proposed continuation of sand extraction at the above site.

2.0 NOISE SURVEY

Noise measurements were made on 9 April 1992, from 0800 to 1000 hours, at the site of the present extraction operations. Noise levels of major plant and equipment were measured at specified distances and at two locations c. 120 metres from the plant within the property to gauge the overall noise emmision at the site. Background noise levels were also measured close to a nearby residential property, c.3 km from the equipment at the site.

The noise levels were read on the "A" weighted selector of a sound level meter and in contiguous octave band frequencies from 63Hz to 4000Hz (where specified). It appeared that generally near individual equipment, the noise level emmited by that equipment was dominant and was not effected by other equipment operating elsewhere on the site.

The noise measuring equipment was as follows:

Bruel & Kjaer integrating precision sound level meters type 2231 with statistical analysis modules type BZ7101
Bruel & Kjaer calibrator type 4230
IVIE precision sound level meter and Spectrum analyser type 30A.

Mark Eisner and Associates
PO Box 3278
Manuka ACT 2603
Phone:(06)2957787
Fax:(06)2951992

Eric Taylor Acoustics Pty Ltd
PO Box 334
Curtin ACT 2605
Phone:(06)2811148
Fax:(06)2811206

3.0 RESULTS

The results of the noise survey are presented below in summary form. A glossary of terms used, detailed results and plans etc. are presented in the Appendix. The residential property was not identified but it was probably "Lakelands".

3.1 Summary of Noise Readings

Table 1

DESCRIPTION	NOISE LEVELS
Wet Screen Plant # 1 at c.30m	70 dB(A)
Facing generator intake direct at c.7.5m	86 dB(A)
Side wall of generator enclosure at c.7.5m	79 dB(A)
Wet Screen Plant # 2 at c.15m	86 dB(A)
Dry Screen Plant at c.10m	84 dB(A)
Dredge + Cat Backactor at c.30m	80 dB(A)
Tractor – Volvo L120 Ops. c.15–30m	76 dB(A)
Cat Backactor E300B Ops. c.7.5–10m	83 dB(A)
Plant measured at SE of Site c.120m	60 dB(A)
Plant measured at SW of Site c.120m	60 dB(A)
Nearby Residential Property c.3km	35 dB(A)

3.2 Estimated Background Noise Levels at Nearest Residences

The background noise level at a residence which was approximately 3 km from the extractive plant was 35 dB(A). This noise was dominated by nearby traffic and other activities closer to the residence than the plant. This activity was audible, the plant operations were not. It is therefore estimated that the contribution of the plant was **probably less than 30 dB(A).**

4.0 COMMENTS

4.1 Plant Operation

The times of operation at extraction site is notionally set from 6a.m. to 6 p.m.

4.2 Estimation of Noise Impact at Nearest Residences

It was apparent from observation that the plant is partially shielded by high mounds of extractive material, providing a form of sound barrier to the exterior of the plant. The dredge is located in a deep pit, which also provides a noise barrier to the exterior. It is expected that these conditions will apply in any other future location of the plant at the site.

It also appears that the plant is located (and in future will be located) at distances of at least 3 kilometres from the nearest occupied Residences. The estimated noise intrusion in the future is expected to be similar to the existing one and should result in a **Negligible Noise Impact** at the nearest residences.

The noise levels at site were measured under normal climatic conditions and future noise level estimates were made under these conditions. Under adverse climatic conditions such as favourable wind propagation or temperature inversion, the noise emitted from the site may be higher. The intrusive noise level contributed by the plant is still expected to be generally less than 35 dB(A) at the nearest residences. It is also probable that other activities and operations not connected to the Currandooly extractive operation may also be higher and therefore further mask its operations.

4.3 Truck Movement

It has been stated by the operator of the extractive operations that the average frequency of truck movement to and from the site should not increase above the levels which have occurred in the past 5 years, therefore there should not be any increase in noise levels contributed by trucks associated with the site.

Mark Eisner

for

Acoustical Consultants in Association

APPENDIX

DESCRIPTORS

The following is a glossary of descriptors and noise ratings used in the tables of results and the body of the report.

dB(A) Sound level measured on a sound level meter with a specified weighting network and displayed on the "A" weighted scale. A reading on the "A" weighted scale is a single number value of noise which appears to correspond reasonably well with human response to that noise level.

L_1 1% sound exceedence level, when a sound continuously varying in amplitude is analysed statistically, it is the noise level in dB(A) which is exceeded 1% of the time during the observation period. It is sometimes termed the "peak" noise level.

L_{10} 10% sound exceedence level, when a sound continuously varying in amplitude is analysed statistically, it is the noise level in dB(A) which is exceeded 10% of the time during the observation period. It is sometimes termed the "intrusive" noise level.

L_{50} 50% sound exceedence level, when a sound continuously varying in amplitude is analysed statistically, it is the noise level in dB(A) which is exceeded 50% of the time during the observation period. It is sometimes termed the average noise level.

L_{90} 90% sound exceedence level, when a sound continuously varying in amplitude is analysed statistically, it is the noise level in dB(A) which is exceeded 90% of the time during the observation period. It is sometimes termed the "background" noise level.

L_{eq} A suggested rating in ISO 1996, is termed the "energy mean sound level" of a varying sound source. The L_{eq} is measured directly by the instruments used in this survey.
However it may be calculated by the following formula:

$$L_{eq} = 10 \log_{10} \left[1/100 \sum f_i \, 10^{Li/10} \right]$$

Where:

L_{eq} is the equivalent sound level in dB(A)

L_i is the sound level in dB(A) corresponding to the class midpoint of the class i for class intervals not greater than 5 dB(A) the arithmetic mean can be used; for larger intervals logarithmic averaging should be used);

f_i is the time interval (expressed as a percentage of the relevant time period) for which the sound level is within the limits of class i.

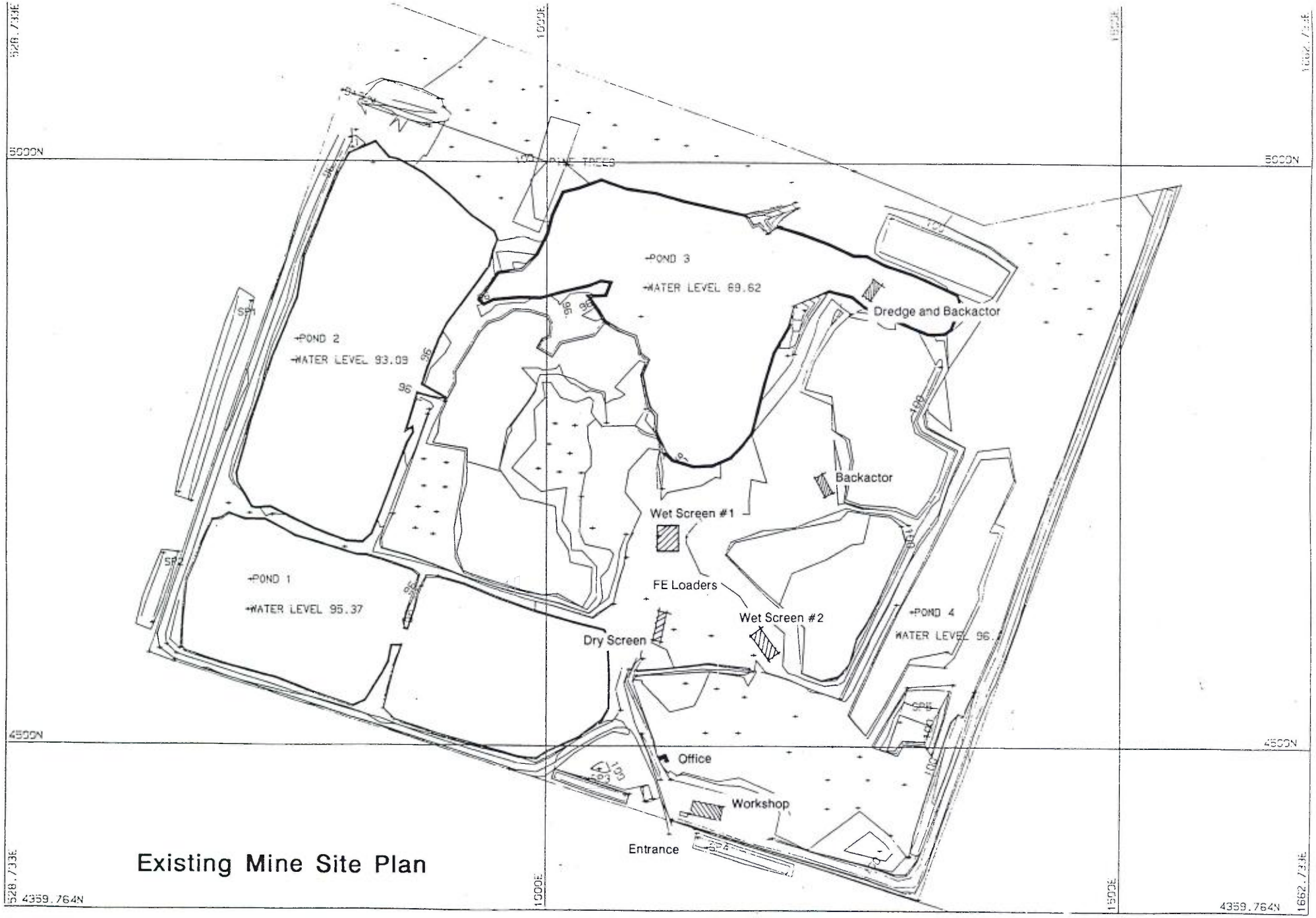
Noise Level Readings Currandooley Sand Extraction Site

Table 1A

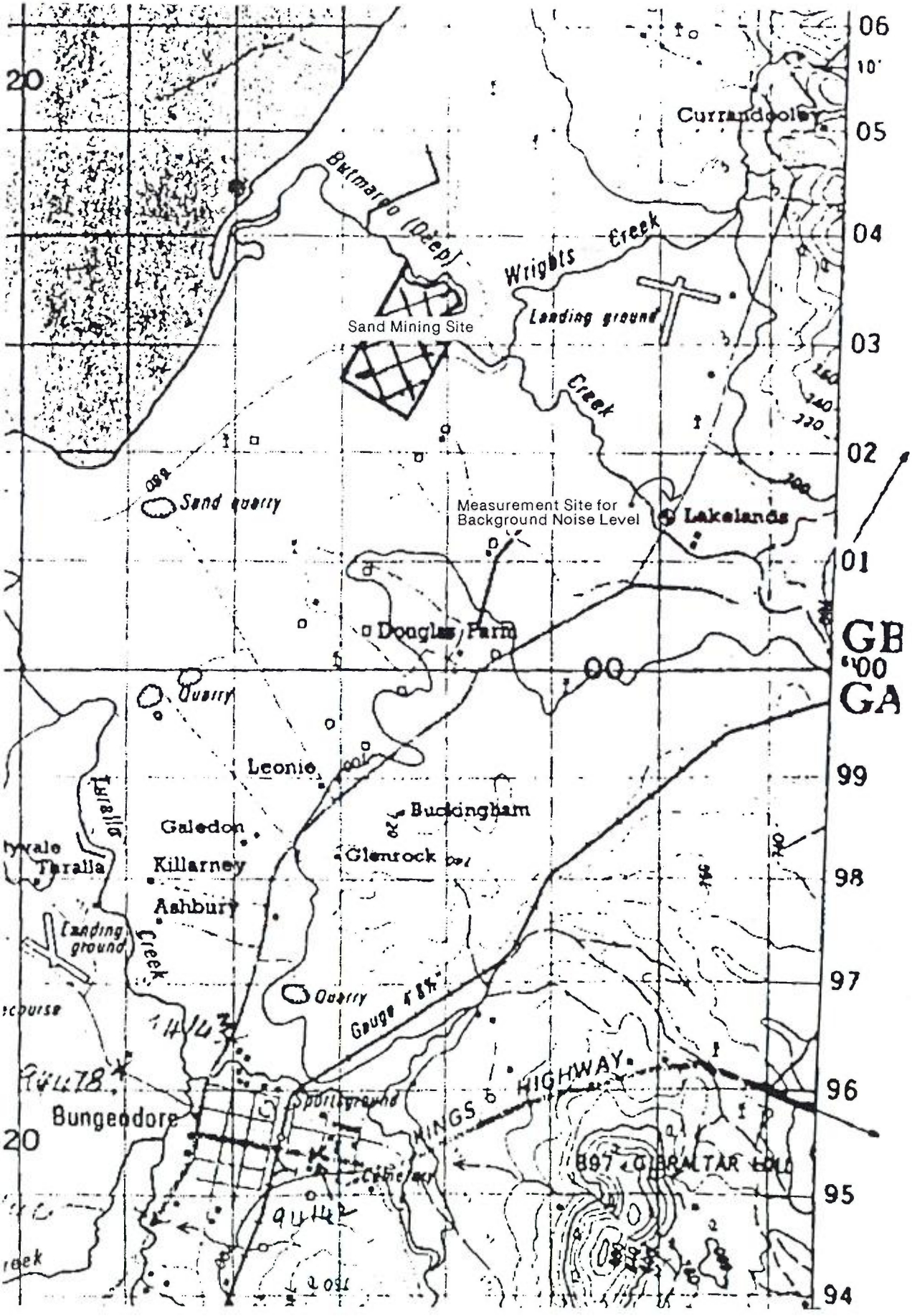
Description	distance from noise source	Noise Levels											
		dB(A)					Octave Band Centre Frequency Hz						
		L1	L10	L50	L90	Leq	63	125	250	500	1000	2000	4000
Wet screen # 2	c.15m	86	86	86	86	86	92	92	80	80	80	76	70
Tractor Volvo L120	c.15 - 30m	81	76	72	67	74	84	80	74	68	70	66	60
Dry screen plant	c.10m	84	84	83	82	83	90	84	72	76	78	76	68
Wet screen # 1	c.30m	70	70	69	69	69	82	72	64	60	62	58	54
Gen for above-open	c.7.5m	86	86	86	85	86	92	86	78	82	80	76	70
Gen enclosure/side	c.7.5m	80	79	79	79	79	Not measured						
Dredge/Cat Backacter	c.30m	83	80	77	75	78	80	74	80	70	74	70	64
Cat Backacter E300B	c7.5 - 10m	86	83	80	79	81	76	74	76	76	78	70	60
Plant - SE of Site	c.120m	61	60	60	59	60	Not mesured						
Plant - SW of Site	c.120m	62	61	59	59	60	Not measured						
Nearby Property	c.3km from plant	Background noise level 35 dB(A) - Plant at Mining Site not audible											

Climatic Conditions

Temperature varied from 12^{0}C to 17^{0}C; Wind speed varied from calm to less than 1 m/s; Barometer 1024



Existing Mine Site Plan

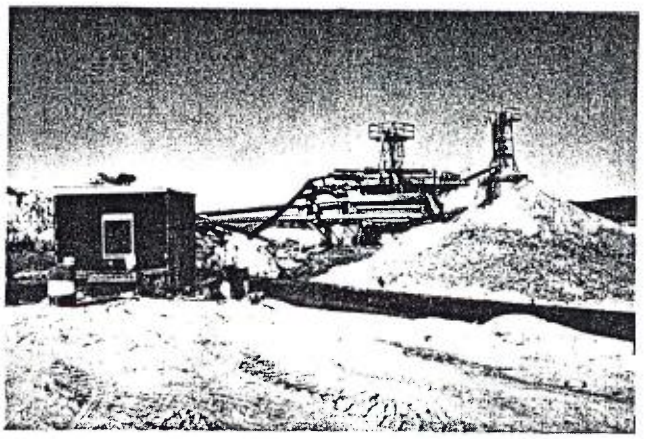


Locality Map

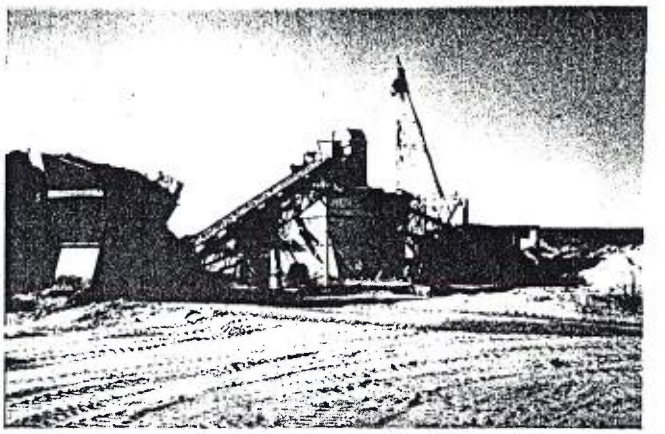
Scale - 1 : 50000

CAT 950B - Front End Loader

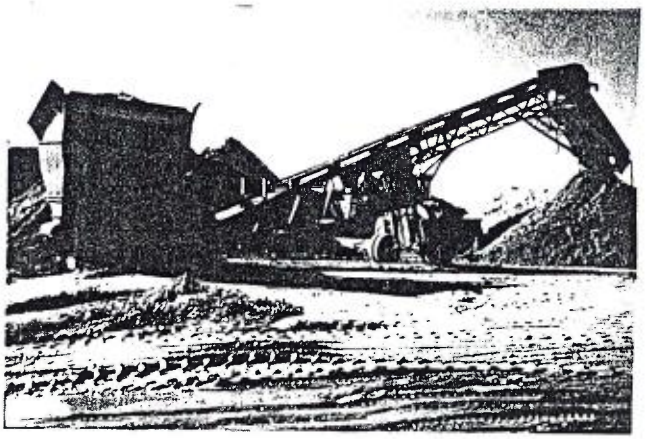
Volvo BM - L120 Front End Loader



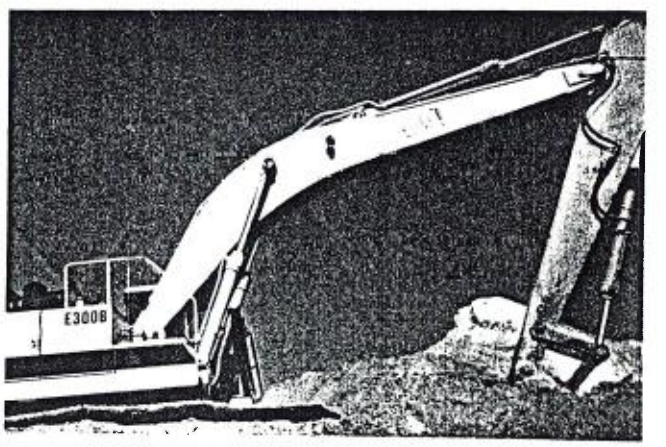
Wet Screen #1 and Compressor Shed



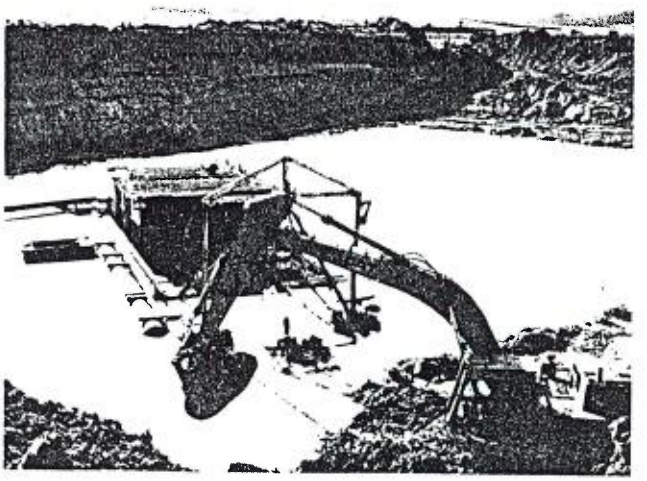
Wet Screen #2



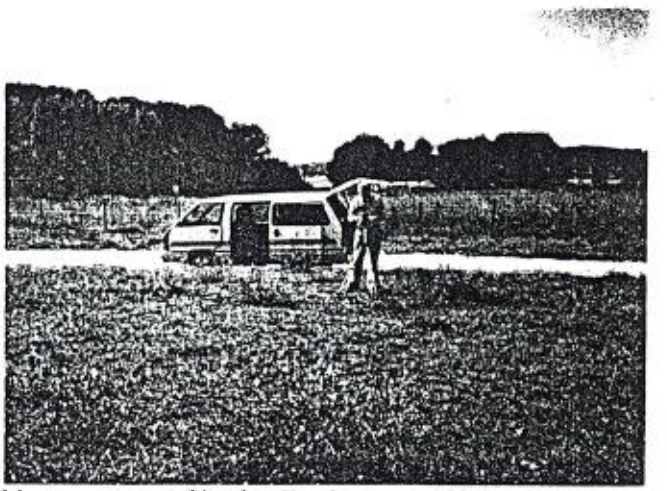
Dry Screen



CAT E300B Backactor



Sand Dredge and CAT EL300B Backactor



Measurement Site for Background Noise Level
Nearest Residence to existing Mining Area

APPENDIX G

APPENDIX G

FLORA AND FAUNA ASSESSMENT

ALISON ROWELL
BIOLOGIST AND ENVIRONMENTAL
CONSULTANT
PO BOX 777
DICKSON ACT 2602
Ph : 06-2477390
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PROPOSED EXTENSION OF MINING AREA BY BUNGENDORE SANDS LOT 31, PARISH OF CURRANDOOLY

FLORA AND FAUNA SURVEYS - SUMMARY

Brief flora and fauna surveys were carried out on the above site on two days in May 1992, and the habitats were assessed. Local wildlife and botanical experts were consulted before and after the surveys. The time of year (late autumn) and the condition of the site (fairly heavily grazed by sheep and cattle) made it difficult to identify all the plant species present.

The site is covered in improved pasture, with Phalaris and clovers (Trifolium species), and has a wide variety of introduced weeds (especially thistles). There is a minor representation of native Spear Grasses Stipa spp., and Wallaby Grasses Danthonia spp. There is some native Tussock Grass Poa labillardieri on the low-lying flats adjoining Butmaroo Creek. The creek, which runs along the northeast border of the site, is fairly eroded at this point, with somewhat unstable banks. Associated with the creek are a few species of rushes and sedges, as well as introduced weed species.

No species of rare or endangered plants were observed on the site, nor is it considered likely that any would be present.

The species of mammals, birds, reptiles and amphibians that were recorded from the site are common, and typical of local pastoral areas, as well as showing the influence of the nearby Lake George wetland habitat.

None of the fauna species known to be rare, endangered or of uncertain status in the region were observed on the site. On the basis of the habitats present, it is considered unlikely that populations of any such species would be present.

The creek area supports a number of native plant and animal species, and should be protected during any future developments from disturbance, particularly run-off of turbid waters.

Rehabilitation of the existing mine site could be directed at enhancing its value as wetland habitat, which should be readily used by some of the fauna species which currently exploit the nearby Lake George area.

INTRODUCTION

The Bungendore/Lake George district has been settled by Europeans for about 150 years, and the plant and animal communities which were present before this time have been significantly modified or lost due to clearing of trees, grazing, pasture improvement and changes in burning patterns, and introduction of exotic species of plants and animals.

The original plant communities on the site under consideration were probably Yellow Box Eucalyptus melliodora/Apple Box E. bridgesiana savannah woodland, and frost-hollow grassland dominated by Kangaroo Grass Themeda triandra with Snow Gum E. pauciflora and Candlebark E. rubida on the borders. Tussock Grass Poa labillardieri was probably found on the creek flats, with rushes and sedges in the waterlogged areas (CSIRO 1969).

No original tree species now occur on the site. Kangaroo Grass would have been reduced by grazing, whereas the Tussock Grass tends to persist as it is less palatable to stock. The Spear Grasses and Wallaby Grasses probably then became dominant, until pasture improvement with applications of fertilizers, seeding with introduced species such as Phalaris and further grazing produced the situation seen today.

The creek bed is now probably wider and deeper than originally, and the banks less stable, due to changes brought about by clearing and grazing in its catchment.

METHODS

The site was traversed on foot to examine the plant communities and to search for any rare plant species (Briggs and Leigh 1988). Potential fauna habitat was identified, and animals present were assessed by hand searching, observation, tracks and droppings. Local wildlife and botanical experts were consulted before and after the surveys.

VEGETATION

The site is covered in improved pasture, with Canary Grass Phalaris aquatica and Clovers Trifolium spp., and has a wide variety of introduced weeds (especially thistles). There is a minor representation of native Spear Grasses Stipa spp. and Wallaby Grasses Danthonia spp. There is some native Tussock Grass Poa labillardieri on the low-lying flats adjoining Butmaroo Creek. The creek, which runs along the northeast border of the site, is fairly eroded at this point, with somewhat unstable banks. Associated with the creek are a few species of rushes and sedges, as well as introduced weed species.

The soil in the southwest portion of the site appears to be moister than the rest of the site, and this is reflected in the denser growth of Phalaris, the sedge Carex pumila and a rush Juncus sp.

The southern part of the site, nearest the existing mined area, is the most disturbed, particularly around the gravel flood-retention banks. This area contains the widest variety of introduced and native weeds, dominated by:

Scotch Thistle	Onopordum acanthium*
Saffron Thistle	Carthamus lanatus*
Bathurst Burr	Xanthium spinosum*
Hoary Mustard	Hirschfeldia incana*
Peppercress	Lepidium hyssopifolium
Wireweed	Polygonum aviculare*
Paterson's Curse	Echium lycopsis*

(* denotes introduced species)

Scotch Thistle occurs over most of the site, as does Sorrel Rumex acetosella. The above weeds (and others) occur in patches over most of the site.

Few annual grasses, apart from Barley Grass Hordeum leporinum were identified, probably due to late stage of the season and the moderately heavy grazing. The dominant perennial grass on the site is Phalaris, others present are:

Tall Spear Grass	Stipa bigeniculata
Slender Spear Grass	Stipa falcata
Needle Grass	Stipa neesiana*
Tussock Grass	Poa labillardieri
Lobed Wallaby Grass	Danthonia auriculata
Wallaby Grass	Danthonia (2 other spp.)

The banks of Butmaroo Creek are steep, eroded and collapsing in many places, with the creek bed being some 3-4 metres below the surrounding land. The creek bed contains deposits of coarse sand, and the water plants have been trampled and grazed. River Club-rush Scirpus validus, American Club-rush Scirpus americanus and possibly Bulrush Typha sp. are growing in and near the water. Water Milfoil Myriophyllum sp. is growing in some less disturbed pools. There are also many weeds on the creek banks and sand bars, especially Common Thorn Apple Datura stramonium, Pink Knotweed Polygonum lapathifolium and Bathurst Burr Xanthium spinosum.

FAUNA

Mammals

No signs of native mammals were seen on the site. The area is too heavily grazed and disturbed and has too few refuge areas to offer suitable habitat to most of the smaller species. The nearest native forest is several kilometres to the east, so the grassland is not likely to be used by the Grey Kangaroo. The creek is too small and disturbed to be suitable for Platypus or Water Rats.

Somewhat surprisingly, given the sandy soils on the site, no signs of rabbits were observed. Tracks and a scat considered to be that of a European Fox Vulpes vulpes were seen in the creek bed.

The sandy bars and moist soil in the creek bed were examined for mammal tracks, but the only other tracks belonged to sheep and cattle.

Birds

Fifteen species of birds were observed on the site:

Little Pied Cormorant	Phalacrocorax melanoleucos
White-faced Heron	Ardea novaehollandiae
Straw-necked Ibis	Threskiornis spinicollis
Australian Shelduck	Tadorna tadornoides
Pacific Black Duck	Anas superciliosa
Australian Kestrel	Falco cenchroides
Brown Falcon	Falco berigora
Masked Lapwing	Vanellus miles
Skylark	Alauda arvensis*
Richard's Pipit	Anthus novaeseelandiae
Willie Wagtail	Rhipidura leucophrys
Common Starling	Sturnus vulgaris*
Magpie Lark	Grallina cyanoleuca
Australian Magpie	Gymnorhina tibicen
Little Raven	Corvus mellori

(* denotes introduced species)

All the waterbirds were in or near Butmaroo Creek. Numerous droppings, shed feathers and footprints in the sand indicate that many such birds use the creek for roosting and feeding.

The site provides feeding habitat for these and probably a number of other birds, but there is little roosting or nesting habitat on the site. Only the Pipits, the Skylarks and the Lapwings would breed here, and their nesting success would depend partly on the stocking rate during the breeding season.

Yellow-billed Spoonbills, Egrets and Sacred Ibis were seen flying overhead, moving to and from Lake George.

Reptiles

Two species of skinks were observed on the site. These were the Common Bluetongue Tiliqua scincoides and the Three-toed Skink Hemiergis decresiensis, which were found under some of the very few pieces of wood present. These adaptable species are common in woodland, grassland and pastures in this region. Tiger Snakes are known to be common nearer the lake, but are probably not often found on this site due to the lack of shelter such as logs or rabbit warrens (R. Longmore, pers. comm.). The uncommon Little Whip Snake has been recorded in the Bungendore district, but is unlikely to occur on this site as it is usually found under rocks on well-drained hillsides (Jenkins and Bartell 1980). Other rare and unusual reptile species of the region would also be unlikely to occur here, due to the lack of trees, fallen timber, rocks and stands of native grasses.

Amphibians

Two species of frogs were heard calling during the survey, in the wetter southwest corner of the site and along the creek. They were the Spotted Grass Frog Limnodynastes tasmaniensis and probably the Common Eastern Froglet Crinia signifera, both common species of most wetland types in the region. More species may have been present, but the cool weather would have ended the calling season for most. The wetter parts of the pasture probably provides breeding habitat when temporarily inundated in wet times, and the creek offers some breeding habitat and shelter. Trampling by stock of the emergent vegetation, the instability of the banks and the lack of rocks and shrubs probably limits the number of species and individuals that can use the creek.

IMPACT OF THE PROPOSED MINING LEASE EXTENSION

The flora and fauna which would be destroyed or displaced from the site by mining activities would not be of high conservation value.

Observation of the existing adjacent mining lease gives a good idea of the effect that mining would have on the site. Large turbid settling ponds, frequently moved soil and the constant operation of heavy machinery provides little habitat for flora and fauna, however Grey Teal, a White-faced Heron and Yellow-billed Spoonbills were seen apparently sheltering at the edges of some of the quieter ponds, and a party of Superb Fairy-Wrens were seen in the tall weeds on one of the gravel banks. The same two species of frogs as noted above were heard calling from damp areas near the settling ponds. There has been some planting of trees and shrubs on the western perimeter of the existing site, with some establishment of pines, eucalypts and acacias.

RECOMMENDATIONS

The exclusion zone within 100 metres of the creek should be protected before any extension of mining activities. Particular care should be taken to prevent the runoff of turbid waters from the site into the creek and the lake, or any water movement that would increase the erosion of the creek banks. Dogs should be controlled on the site to minimise disturbance of the waterbirds using the creek.

The existing mining lease area could be restored in a way that would enhance its value as wetland habitat, which should readily be used by some of the species currently using the nearby Lake George area. The banks of the settling ponds could be constructed to a shallower grade, and growth of fringing water vegetation such as Bulrushes could be encouraged. It may be possible to breach the walls separating the existing settling ponds in several places to form islands - these make safe areas for waterbirds to roost, and perhaps breed. Windbreaks of eucalypts, acacias and casuarinas could be planted on the west and northwest borders of the site, to provide some shelter from the prevailing winds in the colder months. There could be some problems with establishing trees in this area due to wind and frost - young trees would probably need protection for the first year or two.

A. M. Rowell

Alison Rowell

14 May 1992

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APPENDIX H

APPENDIX H

REHABILITATION PLAN

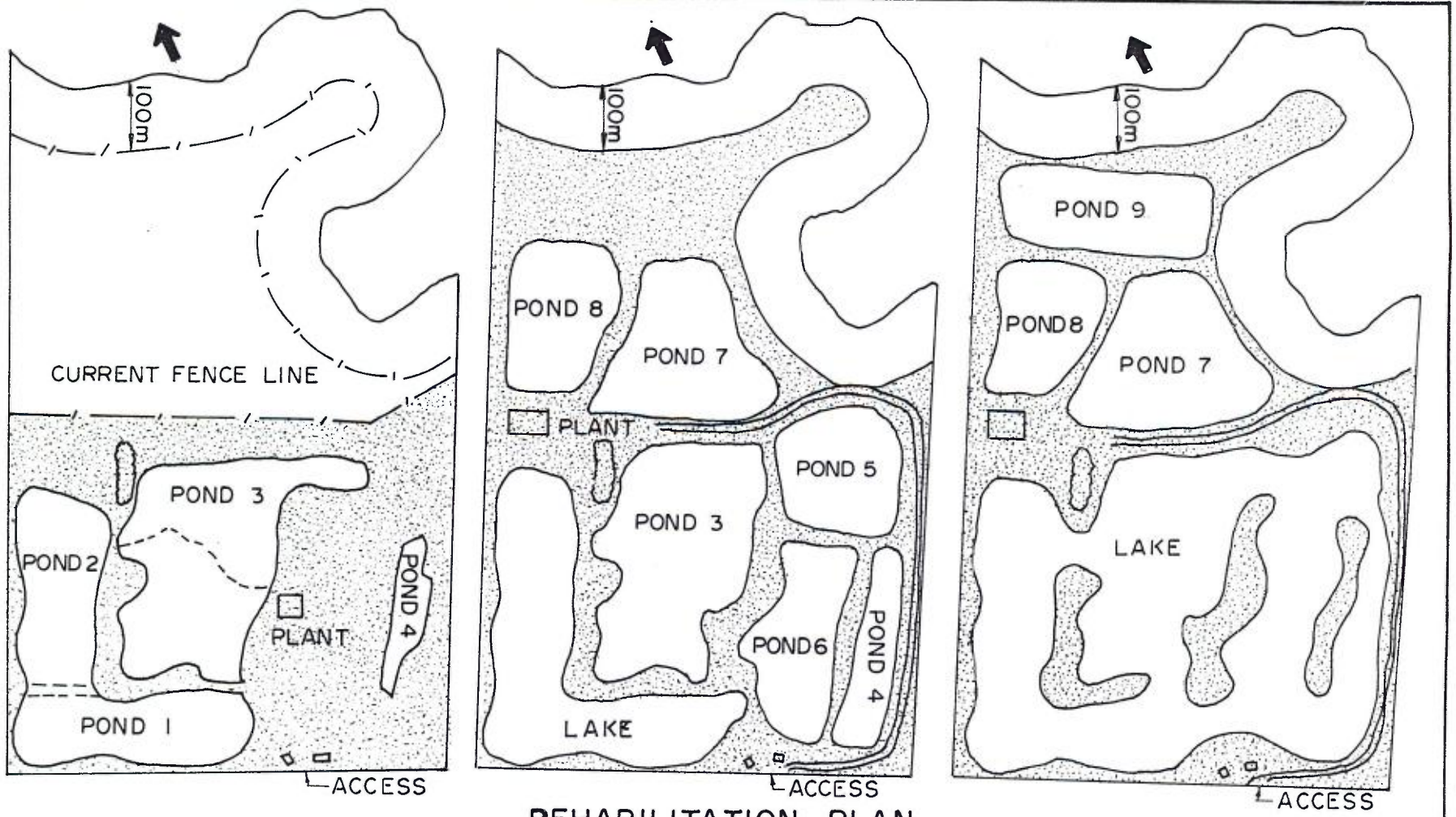
REHABILITATION

Rehabilitation will carried out to stabilise the final banks to prevent erosion from surface runoff, to produce an attractive wildlife environment and to soften the visual impact of the workings when viewed from the Lake George Escarpment to the south west. This will be achieved by:

* flattening the banks of the final lake to a slope not steeper than 1(V) : 4(H);
* rounding sharp corners and removing long lengths of straight edges to produce a more visually attractive appearance;
* tree, shrub, macrophyte and grass plantings as shown on Plate 5 in the EIS; tree and shrub plantings will be grouped to improve the appearance.

Since the site is wholly self-contained, erosion protection while ponds are being used for production is not critical, but some grass plantings will be carried out as at present (Plate 6 in EIS) when banks will be exposed for significant periods of time. Permanent rehabilitiation works will not be carried out until the pond is no longer required for production and thus the works will be progressive, commencing in about 1 to 2 years and proceeding at intervals during the remaining life of the deposit. Following completion of the works the site will comprise a lake with a number of islands to act as wildlife habitats and refuges from predators. It is envisaged that in the long term when the site reverts to being part of the adjoining agricultural lands the lake may also be used for farm water storage.

A proposed rehabilitation plan is presented in Figure H1, with final rehabilitation being carried out in a number of stages. The plan envisages the current workings being substantially completed before new areas closer to Butmaroo Creek are commenced. As the ponds are developed, "bridges" are left in place both to isolate ponds for production purposes and to provide access for rehabilitation works. Following the rehabilitation works the "bridge" will be removed to create the island.



REHABILITATION PLAN

STAGE 1
(1 - 2 years)

- Extend Pond 3, Pond 2
- Rehabilitate S, W banks of Ponds 1 and 2 and island area between Ponds 1/2 and 3
- Fence 100m buffer zone to Creek after archaeological studies

STAGE 2
(2 - 6 years)

- Excavate for Ponds 5, 4 and 6
- Commence rehabilitation on E levee alongside access road and near entrance; relocate washing and screening plant towards end of this stage of operations
- Excavate for Ponds 7 and 8

STAGE 3
(6 - 20 years)

- Rehabilitate and form new islands around old Ponds 4 and 6 and along N, E banks of lake;
- Excavate for Ponds 8 and 9
- Extend lake into N area as use of ponds is complete, forming islands in similar manner to SW area in Stages 1 and 2.

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ENVIRONMENTAL IMPACT STATEMENT
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PART PORTION 9,
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drawing no: FIGURE H1