

EIS 555

AB019258

Environmental impact statement : extraction of white silica sand, ACI Operations Pty Ltd, Freehold Land, Portion 265, Tanilba, N.S.W.

NSW DEPT PRIMARY INDUSTRIES
AB019258

ACI INDUSTRIAL MINERALS DIVISION
N.S.W. GLASS AND CERAMIC SILICA SAND USERS ASSOCIATION LIMITED

ENVIRONMENTAL IMPACT STATEMENT

EXTRACTION OF WHITE SILICA SAND
ACI OPERATIONS PTY LTD
FREEHOLD LAND
PORTION 265, TANILBA, N.S.W.

Prepared by:

OUTLINE PLANNING CONSULTANTS PTY LTD
TOWN PLANNERS

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September 1989

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ACI INDUSTRIAL MINERALS DIVISION
N.S.W. GLASS AND CERAMIC SILICA
SAND USERS ASSOCIATION LIMITED

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NSW DEPARTMENT OF
MINERALS AND ENERGY
17 JAN 1990
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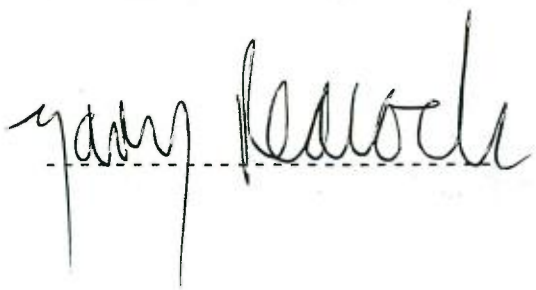
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ENVIRONMENTAL IMPACT STATEMENT
EXTRACTION OF WHITE SILICA SAND
PORTION 265, TANILBA, N.S.W.

CERTIFICATE

This is to certify that this Environmental Impact Statement has been prepared in accordance with Clauses 57 and 58 of the Environmental Planning and Assessment Regulation, 1980.



GARY PEACOCK
B.T.P. (U.N.S.W.)
Member Australian Association of Consulting Planners.
Member Local Govt. Planners Association.

Director
OUTLINE PLANNING CONSULTANTS PTY LTD

AUGUST 1989

0. Summary and Overview

0.1 TERMS OF REFERENCE

This Environmental Impact Statement (E.I.S.) has been prepared by Outline Planning Consultants Pty. Ltd. on behalf of ACI Industrial Minerals Division, the operator and administrator of the N.S.W. Glass and Ceramic Silica Sand Users Association Ltd ("The Glass Sand Association").

The E.I.S. applies to the proposed extraction of high grade white silica glass sand from dune deposits within Portion 265, on Tilligerry Peninsula, in the Shire of Port Stephens, for a period of approximately $1^1/_2$ years.

0.2 NEED FOR THE PROPOSAL

Current supplies of white silica sand are being won from the Glass Sand Association's last remaining active, approved extraction area from Crown lands (P.O. 86/25) some 800 metres north-east of Portion 265.

At the time of writing, the reserves at P.O. 86/25 have a life of approximately 3 months. Hence there is an urgent need to gain further approvals to extract white silica sand from an alternative site in the locality.

ACI's existing sand treatment works for the locality is situated on Portion 265, in its north-east corner. The existing plant is treating sand presently being extracted from P.O. 86/25.

The extraction of sand from the relatively small white silica sand deposits on Portion 265 is seen as a stop-gap reserve pending the availability of the medium-long term deposits of white silica sands from the Tanilba Northern Dune.

0.3 GENERAL DESCRIPTION OF SITE AND PROPOSAL

The land the subject of this proposal comprises Portion 265, Parish of Sutton, having an area of 29.34 hectares. The land is situated some 2 kilometres to the south-west of the village of Tanilba Bay and is connected to the main road in the locality (Lemon Tree Passage Road) by way of a sealed road reserve. Portion 265 is freehold land owned by ACI Operations Pty. Ltd.

The proposal involves the extraction of high grade white silica sand from selected dunes on parts of Portion 265, affecting an area of approximately 4.7 hectares, or 16% of the total site area. It is proposed to extract a total of approximately 150,000 tonnes of white silica sand from Portion 265 over a period of approximately $1^1/_2$ years.

The sands are to be extracted on a staged basis, with rehabilitation following closely behind. Each mining stage is about 1 hectare. At any given time, no more than 1 ha of ground will be stripped of vegetation (preceding extraction), with no more than 1 ha in the process of being mined, and 1 ha to topsoil respreading and rehabilitation.

All haul routes from the worked deposits will be internal to the site. The sands are proposed to be processed at the existing sand treatment plant on the site where they would be then transported from the site to Sydney and Newcastle glass, ceramic and chemical industries.

0.4 STATUTORY PLANNING

Development for the purpose of silica sand extraction on Portion 265 is a use permissible with the consent of Council and the concurrence of the Director of the Department of Planning.

The site is covered by the provisions of Clause 37 of Port Stephens Local Environmental Plan 1987, as amended. The underlying object of Clause 37 is to protect valuable and rare high grade silica sand deposits on the Tilligerry Peninsula, including those found on Portion 265.

The proposed development is also compatible with Hunter Regional Environmental Plan 1989. The subject site has been specifically identified in the Plans as being underlain by white silica sand deposits of regional significance, and specific planning measures put in place to ensure that extraction may occur.

It is of relevance to note that neither the local or regional plans identify Portion 265 as being of any environmental or conservation significance.

0.5 ENVIRONMENTAL IMPACTS AND JUSTIFICATION OF PROPOSAL

Economic

* Current reserves of white glass sand on the only other P.O. held by the Glass Sand Association is rapidly nearing depletion. At the time of writing, there is only a 3 months supply of sand remaining.

* The proposal will enable the supply of an essential resource to the Sydney and Newcastle glass, ceramic and chemical industries.

* The proposal will make a significant, albeit short-term, contribution towards reducing the known shortage of high grade silica sand in the state.

* The deposits contain a large proportion of the region/state's current short-term sources of high quality silica sand.

* The proposal will be a positive addition to economic activity in the region.

Social

* The proposal will provide continuing employment opportunities for an existing workforce in the sand extraction and glass industries.

* There will be no adverse effects on the amenity of the only nearby residence.

* There will be no adverse impacts on infrastructure, health, community and educational facilities as a result of the proposal going ahead.

Environmental

* The high grade silica sand deposits have been recognised in both local and regional environmental planning instruments as being worthy of protection for future sand extraction.

* The proposal will have no adverse impacts on groundwater.

* The proposed extraction works will be undertaken in such a manner as to minimise disturbance to the land and to watercourses in the locality.

* The proposal calls for the retention of a relatively large area of tall open forest on the site - a potential koala habitat - with land clearing for extraction limited to approximately 16% of the total site area. Disturbed lands will be rehabilitated following extraction.

* No wetlands areas are to be cleared or affected (with the exception of a very small area for a temporary causeway).

* The proposal will be sufficiently screened from Lemon Tree Passage Road and a neighbouring residence.

* Sand extraction is located well above existing flood levels.

* Traffic and access impacts are reduced in the case of traffic flows along Lemon Tree Passage Road east of the site, and maintained for that part of the road west of the site. All haul roads for unprocessed sand are located within the site. Only vehicles carrying processed sand leave the site.

* Acoustical impacts have been shown to be within acceptable limits.

* Extraction will be limited to a period of approximately $1\frac{1}{2}$ years, with full rehabilitation and revegetation occurring both during and after extraction.

* Air pollution impacts have been found to be minimal.

* The proposal will not adversely impact on land use either on the site or surrounding lands.

* Energy usage is likely to be reduced compared with existing operations on P.O. 86/25.

* The proposal does not affect the agricultural suitability of the land.

* There should be little problem with the continued conservation of Koalas within the area. With large parts of the tall eucalypt forest retained on Portion 265, and all of the Swamp Forest retained, Koalas should be able to contine to live and breed in the area and on the site. In addition, the known resting tree of the White-bellied Sea-eagle is to be retained.

* The proposed development provides for the maintenance of extraction activities for a company with a proven track record and history of involvement in environmentally appropriate sand extraction and successful rehabilitation works.

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1. INTRODUCTION

1. Introduction

1.1 TERMS OF REFERENCE

This Environmental Impact Statement (E.I.S.) has been prepared by Outline Planning Consultants on behalf of ACI Industrial Minerals Division and the N.S.W. Glass and Ceramic Silica Sand Users Association Ltd. ("The Glass Sand Association"). The report draws on an earlier draft E.I.S. prepared by ACI Industrial Minerals, dated November 1988.

This E.I.S. applies to the proposed extraction of white glass sand from deposits within Portion 265, near Tanilba, N.S.W., for a period of approximately $1^1/_2$ years.

1.2 INDUSTRY OVERVIEW

Australian Consolidated Industries (ACI) through its subsidiary Australian Glass Manufacturers Co., has been manufacturing glass products from its Waterloo plant in Sydney for over 80 years. The Waterloo plant employs in excess of 650 people and manufactures a wide range of glass products including amber, green and white glass bottles, and Crown-Corning ware. The New South Wales plant relies on all of its glass sands from its two sand extraction sites near Tanilba in the Port Stephens shire. Only one of these sites supplies white sand, needed for making clear glass products, on a Crown land permissive occupancy some 800 metres to the north of Portion 265. This deposit is rapidly nearing depletion.

ACI Industrial Minerals Division supplies beneficiated high grade white silica sand from Tanilba to the member companies of the Glass Sand Association, namely:

- ACI Operations Pty. Ltd. - supplying Australian Glass Manufacturers Co. and Pilkington (Australia) Limited.
- Smorgon Glass Containers
- ICI Australia Investment Pty. Limited
- Electric Lamp Manufacturers of Australia Pty. Limited
- Crown Corning Ltd.

The total number of people directly employed in industries utilising this high grade silica sand, including the Sydney and Newcastle based glassworks, is approximately 1,750 people.

ACI Industrial Minerals Division is both the operator and administrator of the Glass Sand Association.

Current supplies of white silica sand are being won from the Glass Sand Association's last remaining Permissive Occupancy (P.O. 86/25) near Tanilba at the rate of up to 85,000 tonnes per annum. Reserves of this P.O. are rapidly nearing depletion. There are inadequate reserves remaining to last until the end of 1989.

1.3 OBJECTIVES OF THE PROPOSAL

The objectives of the proposal are to selectively extract high grade white silica sands from deposits on Portion 265, Tanilba, and to utilise the derived sands for industrial (clear) glass production. The high grade silica sands are an essential future resource for the Sydney and Newcastle glass, ceramic and chemical industries.

It is proposed to extract approximately 152,000 tonnes of white silica sand from dunal deposits on Portion 265 over a period of approximately $1^1/_2$ years, with an extraction program characterised by:

(a) disturbance of only a small part of the site for sand extraction (approximately 4.7 ha out of a total site area of 29.34 ha) or 16% of the total site area);

(b) staged extraction involving a maximum disturbed area of only 3 ha at any one time (1 ha cleared, 1 ha worked, 1 ha rehabilitated);

(c) extraction of sand to a limited depth, not exceeding 3.8 metres depth, with no extraction affecting groundwater;

(d) confining sand extraction to those areas well buffered from existing wetlands areas. The proposal involves extraction operating wholly within elevated areas above R.L. 4m A.H.D., with appropriate drainage and sedimentation controls;

(e) retention of significant areas of vegetation on the site, in the interests of maintaining habitat values;

(f) employment of rehabilitation techniques which have been proven to minimise erosion and which encourage the effective rehabilitation and revegetation of worked areas.

The extraction of sand from these relatively small deposits on Portion 265 is seen as a stop gap reserve for the Glass Sand Association members, pending the availability of the medium-long term reserves of white silica sands from the Tanilba Northern Dune.

1.4 NEED FOR THE PROPOSAL

The Glass Sand Association currently extracts approximately 85,000 tonnes per annum of high grade silica sand from its existing operations from Permissive Occupancy (P.O.) No. 86/25, located some 0.8 kilometre to the NE of Portion 265. The current reserves have a life of approximately 3 months, at the time of writing. Hence there is an urgent need to gain further approvals to extract white silica sand from an alternative source in the locality. Portion 265, on which the existing ACI processing plant is situated, has been found to possess adequate reserves of high grade silica sand to meet approximately the next $1^1/_2$ years of demand.

Currently the sand extracted from P.O. 86/25 is processed at the plant site on Portion 265, where it is thence supplied to several Glass Sand Association members for essential industries including:

- container glass (Australian Glass Manufacturers, Waterloo, Sydney);
- table ware glass (Crown Corning, Sydney);
- chemicals (ICI, Sydney);
- sheet glass (Pilkingtons, Alexandria);

The Glass Sand Association, which was formed for the express purpose of bringing together New South Wales major end user glass industries, has built its long term plans on the supply of high grade silica sands from designated sand deposits on the Tilligerry Peninsula. The uniqueness and regional significance of the Tilligerry Peninsula white glass sand deposits has been given due recognition in the recently gazetted Hunter Regional Environmental Plan 1989. The intent of Clause 37 of Port Stephens L.E.P. 1987 is to specifically set aside the Tilligerry Peninsula sand dunes for the purpose of sand extraction.

The need for the extraction of white glass sand from Portion 265 include:

(a) the Glass Sand Association will be assured of a continuous, readily available supply of glass sands for industry needs;

(b) the high grade silica sands are an essential future resource for the Sydney and Newcastle glass, ceramic and chemical industries;

(c) there are no other feasible alternative sources of white glass sand currently available in New South Wales. The only other presently available alternative source of this sand type is to be found interstate, however, it is not economic to freight sand from such a distance to supply the Sydney and Newcastle glass industries;

(d) employment in the glass industry is assured. The total number of people directly employed in the industries utilising this high grade silica sand, including Sydney and Newcastle based glass industries, is approximately 1,750 people.

1.5 E.I.S. REQUIREMENTS

Development within the area proposed for sand extraction is subject to the provisions of Part IV of the Environmental Planning and Assessment (E.P.A.) Act, 1979, and an E.I.S. is required with respect to development on the subject site.

The proposed development comprises an "extractive industry", as defined, and is a designated development requiring the preparation of an E.I.S. by virtue of s.77(3)(d) of the Environmental Planning and Assessment Act. This is a provision of Part IV of the Act.

Clause 34 of E.P.A. Act Regulation

Under Part IV of the Act the proposed development is 'designated development'. Under Clause 34 of the E.P.A. Act Regulation the following matters must be included in any E.I.S.:

(a) a full description of the proposed development;

(b) a statement of the objectives of the proposed development;

(c) a full description of the existing environment likely to be affected by the proposed development, if carried out;

(d) identification and analysis of the likely environment interactions between the proposed development and the environment;

(e) analysis of the likely environmental impacts or consequences of carrying out the proposed development (including implications for use and conversion of energy);

(f) justification of the proposed development in terms of environmental, economic and social considerations;

(g) measures to be taken in conjunction with the proposed 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 development and the reasons for choosing the latter; and

(i) consequences of not carrying out the proposed development.

Director's Specifications: Clause 35 of Regulation

The Director of the Department of Planning was consulted regarding the preparation of the E.I.S. for the proposed sand extraction operations. The Director advised by letter dated 19th November 1987 that a number of matters should be addressed in the E.I.S.

Those matters to be specifically addressed in this letter of advice are as follows:

- Examine impact on wetland vegetation, groundwater and adjacent Tilligerry Creek system.
- Possible impact on S.E.P.P. 14 Wetland No. 810, Tilligerry Creek, Port Stephens.

- Results of consultation with Hunter District Water Board due to proximity to Tomago Sand Beds Water Supply.

Discussions have been held with relevant government agencies on these issues, and they include the Department of Planning (wetlands), Soil Conservation Service (drainage, siltation, impacts on wetlands) and the Hunter District Water Board (see APPENDIX 1).

1.6 SCOPE AND CONTENT OF THE E.I.S.

The E.I.S. has been prepared by Outline Planning Consultants, acting as consultant to ACI Industrial Minerals Division, with technical assistance provided by the following specialists:

Nerina du Preez	-	Biological investigations, flora assessment, rehabilitation.
Mt. King Ecological Surveys	-	Zoological studies, habitat assessment.
Robert Fitzell Acoustics	-	Acoustics.
Denise Donlon,	-	Aboriginal archaeology.

The reports of the above specialist consultants are contained in the Appendices to the report.

The following describes the structure of the E.I.S.

0. Executive Summary provides a summary of the findings and conclusions of the E.I.S., including an assessment of the environmental impact of the proposal.

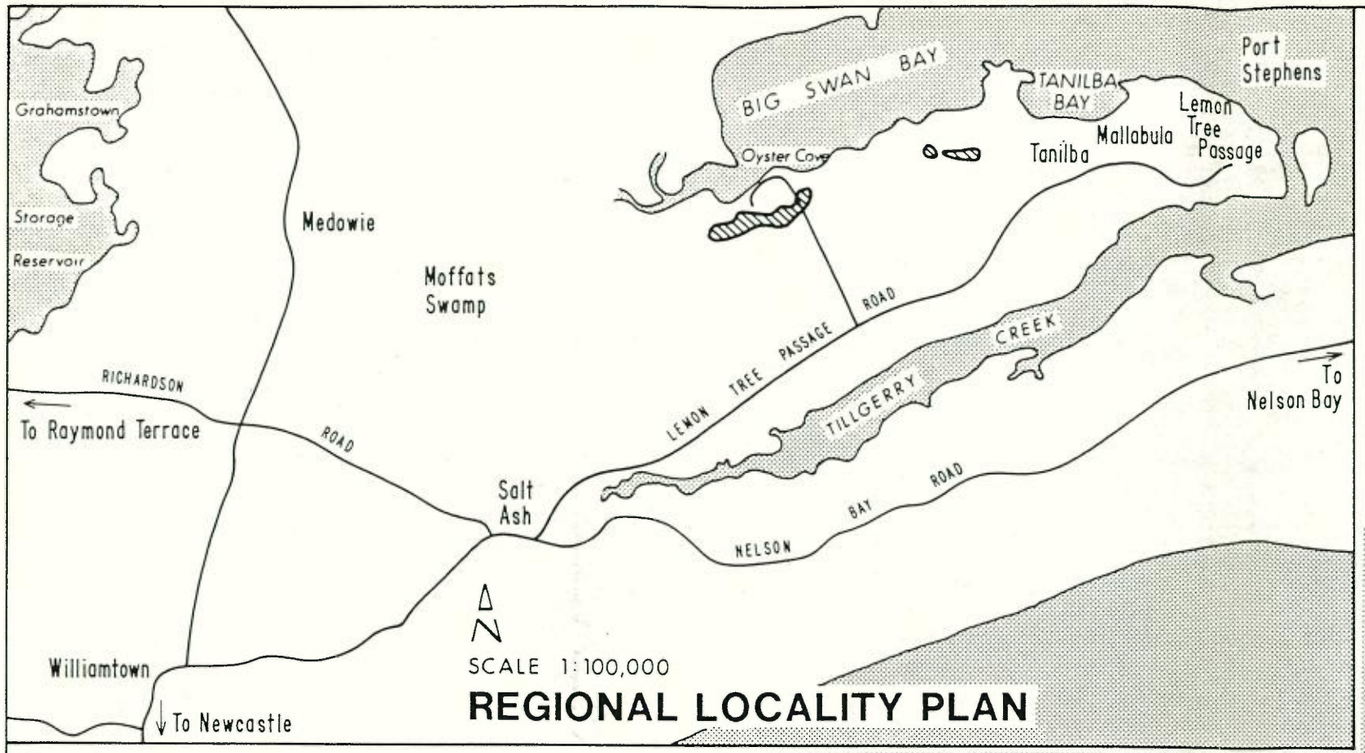
Section 1 - Introduction, contains the terms of reference to the E.I.S. report, an industry overview, the objectives of the proposal, the need for the proposal, statutory requirements for the preparation of an E.I.S., and the scope and content of the E.I.S.

Section 2 - Existing Environment, describes both the natural and man-made environment of the site and surrounding lands.

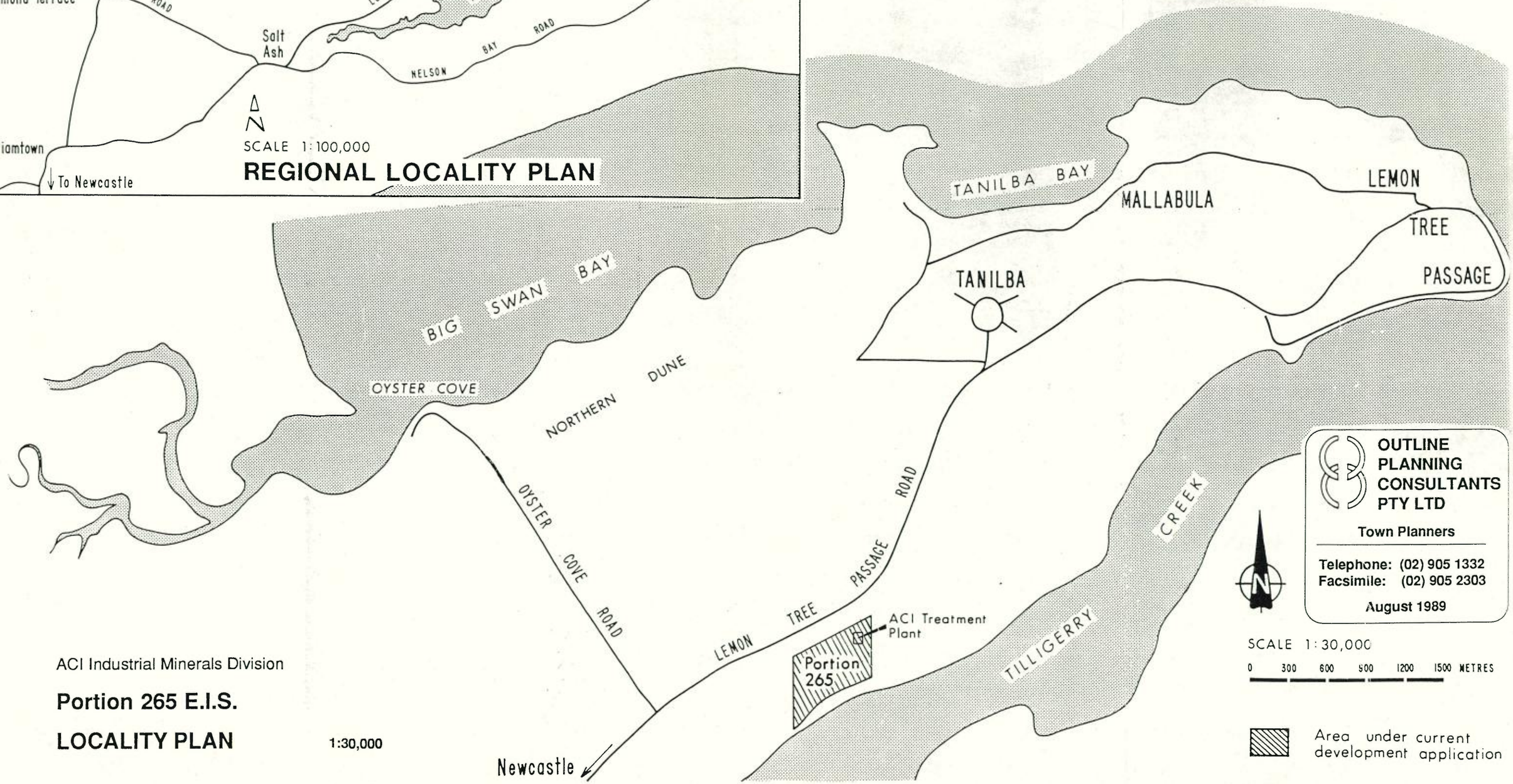
Section 3 - Description of the Proposal, provides a detailed description of the proposed development.

Section 4 - Proposed Environmental Safeguards and Impact Assessment, discusses the potential impacts associated with the proposed development on the site and surrounding lands, and the environmental safeguards employed to ensure that the proposed development has an acceptably low impact on the environment.

Section 5 - Justification of the Proposal, discusses the reasons why extraction of high grade white silica sand should occur on the site.



REGIONAL LOCALITY PLAN



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August 1989

ACI Industrial Minerals Division

Portion 265 E.I.S.

LOCALITY PLAN 1:30,000

2. EXISTING ENVIRONMENT

2. Existing Environment

2.1 REGIONAL SETTING

The area subject to the sand extraction proposal comprises lands owned by ACI Operations Ltd. on the Tilligerry Peninsula, in the Shire of Port Stephens in the Hunter Region of New South Wales. The land is more accurately known as Portion 265 and has an area of 29.34 hectares. The townships of Tanilba Bay and Lemon Tree Passage lie some 2.0 kilometres to 3.0 kilometres respectively to the north-east of the site.

The site is accessible to Newcastle, and thence to Sydney markets via Lemon Tree Passage Road and Nelson Bay Road. The centre of Newcastle (population 132,000) lies some 25 kilometres to the south-west.

The Hunter Region is a major industrial and mining area, possessing significant coal, non-coal and extractive resources including heavy mineral sands, construction sands and glass-making sands. The region is recognised as containing glass-making sands of regional and state significance, all of these deposits located in the Tilligerry Creek - Tanilba area. The subject site forms a part of one of these significant deposits.

> " The Tilligerry Creek - Tanilba area of Port Stephens Shire contains unusually pure dune deposits of clear glass-making sand. Industries in Newcastle and Sydney have taken steps to secure the long-term availability of this area and to avoid sterilisation by incompatible surface uses, until the deposit is worked. "
> (Department of Planning (1989) "Hunter Regional Environmental Plan 1989: Background Report")

2.2 SITE DESCRIPTION

The land the subject of this proposal comprises Portion 265, Parish of Sutton, having an area of 29.34 hectares (72 acres approximately) of which approximately 4.7 hectares, only, are underlain with winnable glass sand deposits. The land is connected to Lemon Tree Passage Road by a road reserve 20.115 metres wide, abutting the NE corner of the site (see APPENDIX 2).

The land is trapezoidal in shape with an irregular southern boundary. The northern boundary is 673.9m, the eastern boundary 471.44m and the western boundary 562.4m.

Portion 265 is owned freehold by ACI Operations Pty. Ltd., is bounded to the north east by undeveloped freehold land owned by Smorgon Glass Containers, to the south west by freehold land owned by Newcastle Glass Works and partially worked for silica sand, to the north by Crown land Water Reserve No. 72152 under the control of the Hunter District Water Board, and to the south by Crown land forming the northern embankment of Tilligerry Creek. The freehold land to the west has a solitary residence on it. This is the nearest and only residence in the immediate neighbourhood of Portion 265. There are no other residences within 1.5 kms of Portion 265.

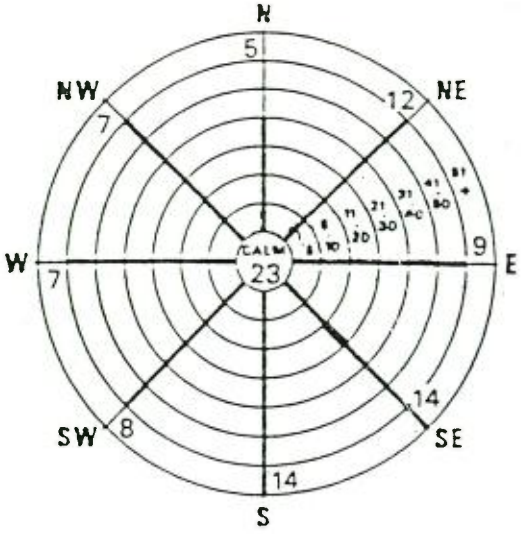
2.3 CLIMATE

In summary the average rainfall of the locality is 1,325mm per annum, with highest rainfall during the winter months. Available records from the nearby R.A.A.F. base at Williamtown indicates an average yearly pan evaporating rate of 1,770mm. Winds are on-shore during the summer, with westerly winds prevailing in winter. Southerly winds are common throughout the year (see APPENDIX 3).

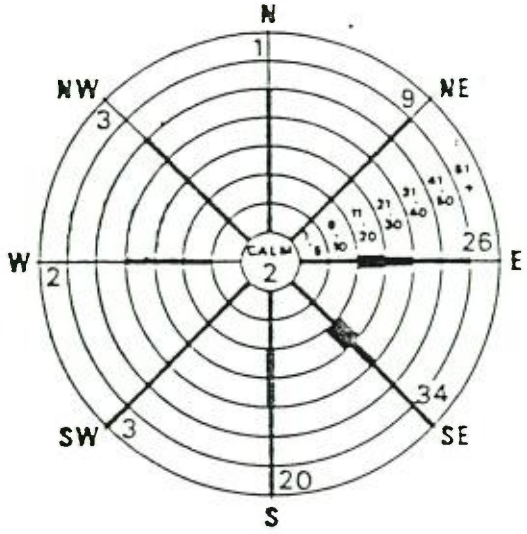
The dominant factor controlling the climate of the Tanilba Bay/Tilligerry Peninsula is its proximity to the coast and the subsequent influence of sea breezes and seasonal variations, although Portion 265 is relatively low lying and well vegetated with tall open forest, with operations within the property being well sheltered from prevailing winds.

In the afternoon in summer some 80% of the winds are from the south east quadrant with dominant wind speeds being the 11-20km/hr and 21-30 km/hr groups. A significant secondary factor is the north east sea breeze.

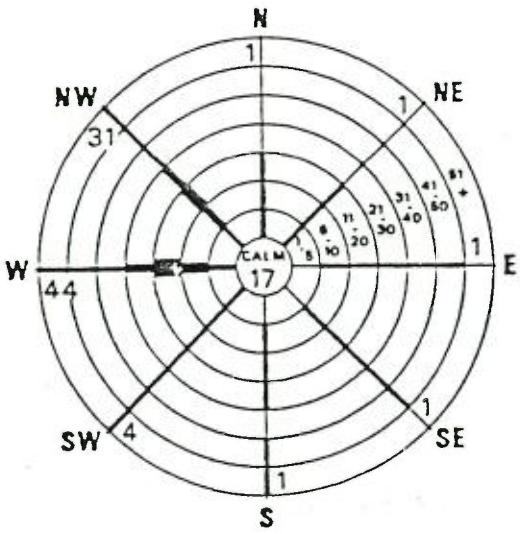
In winter, however, the situation is somewhat reversed. In the morning 75% of the wind is from the west and north west with a dominant wind speed group of 11-20 km/hr. In the afternoon some 51% of the wind is still from the west and north west but there is also south west and south blowing winds (27% of the time).



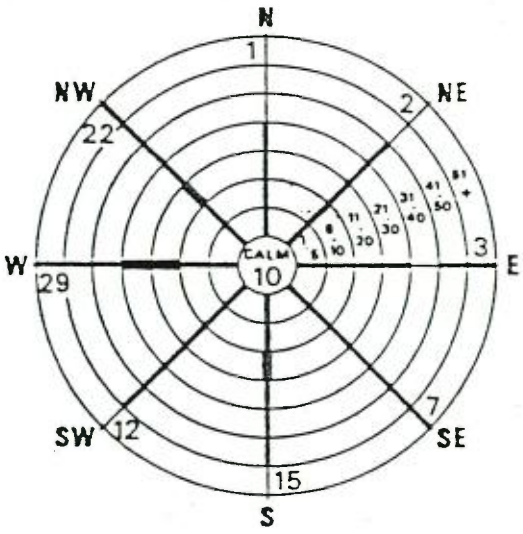
0900 February



1500 February



0900 July



1500 July

Percent frequency, wind speed group by wind direction

Speed Categories km/hr

0 - 5

6 - 10

11 - 15

16 - 20

21 - 25

over 25

Wind rose data for Williamtown for February and July, 0900 and 1500

2.4 GEOMORPHOLOGY

The Tilligerry Peninsula is a generally low-lying coastal area, characterised by extensive sand and estuarine deposits with a number of isolated rocky hills. The hills are of volcanic and sedimentary rock, and are located at Tanilba Bay and Mallabula/Lemon Tree Passage. Stretching along the length of the peninsula are sands comprising former beach ridges. In more elevated areas, these ridges give rise to the Tanilba Northern Dune, to the north of Lemon Tree Passage Road, and to sand dunes running parallel to and to the south of Lemon Tree Passage Road. Portion 265 forms a part of the latter sand dune system.

In the lower lying areas at the base of the southern dune system, running along the margins of Tilligerry Creek, are estuarine deposits, including sands and muds.

2.5 SOILS

The distribution of soil types on Portion 265 is controlled primarily by lithology and slope position. A detailed drilling program was undertaken on the site to determine the nature of sand deposits and soil types.

In lower-lying swampy areas are poorly draining and/or waterlogged soils with a watertable either above or only marginally below the ground surface.

The more elevated dune deposits on Portion 265 are well drained sandy podzols characterised by distinctive upper and lower soil horizons. They are described as follows.

Range of Thickness/Depth	Log Description
Om - 0.7 m	Grey organically contaminated sandy topsoil.
O.7m - 4.2 m	Fine grained clean white silica sand.
Greater than 4.2 m	Soft yellow, dark brown, black Waterloo Rock or water table. (limit of drilling and testing)

Plan 6 is a drillhole plan, showing the depth of grey organic sand overburden, the depth of white silica sand and the depth to Waterloo Rock (WR) or to the watertable (WT). Winnable white glass sand to a maximum depth of 3.8 metres has been identified in the elevated dune in the central-western portion of the subject property. A smaller deposit of in excess of 1.0 metre depth was identified in the central-northern part of the site. Sand deposits with white sand to a depth greater than 1.0 metre are considered to be significant deposits.

The analysis finds acceptable levels of other impurities with a sand well suited for white glass purposes.

2.6 TOPOGRAPHY AND SLOPES

The topography of Portion 265 is generally flat to undulating, with steeper areas encountered on the more elevated sections of the main dune. Away from the main dune, slopes generally range from 0 - 5% slope. In these areas elevations range from R.L. 4m A.H.D or more, in the northern and central-western part of Portion 265, to lower-lying areas (including drainage lines and wetlands) in the more southerly parts of the site, nearer to Tilligerry Creek. The wetlands area to the southern end of the site is generally flat.

On the main dune elevations as high as R.L. 18m A.H.D. are achieved, with the dune separated from elevated areas in the north-eastern sector of Portion 265 by a narrow watercourse. The main dune links with lower lying sandy dunes to the west of Portion 265. Slopes on the main dune range from more than 20% on parts of southerly slopes of the most elevated part of the dune, to 1 - 5% at the base of the dune and between dune "peaks".

2.7 HYDROLOGY

2.7.1 Surface Hydrology

Portion 265 forms the northerly edge of the drainage catchment of Tilligerry Creek, which then flows into Port Stephens. Tilligerry Creek is a small estuarine watercourse which separates the Tomaree and Tilligerry Peninsulas.

As noted in other studies, due to the permeable nature of the underlying sands and moderate topography, very few well defined watercourses drain the area. Immediately north of Portion 265, to the south of Lemon Tree Passage Road, is a low-lying swampy area which drains to Tilligerry Creek by a narrow watercourse which transects the elevated sand dunes and merges with the wetlands forest on the southern part of the site. Waters then drain from this wetland across a relatively broad front into the margins of Tilligerry Creek. All wetlands on the site are believed to be above the level of tidal influence (R.L. 1.9m).

There are no other permanent watercourses on the site.

In regard to flooding, the 1 in 100 year flood plain extends to the margins of Tilligerry Creek. During the peak floods of 1955 a flood path is believed to have been formed between Fullerton Cove and Port Stephens, via Tilligerry Creek. In general, flooding impacts are confined to relatively short periods of time, with localised ponding in lower-lying areas (e.g. wetlands). It is understood that a 1 in 100 year flood level for the locality would be in the vicinity of 2.0 metres A.H.D., allowing for a 1.0 metre storm surge.

Areas subject to this level of flood are generally located to the southern parts of the site away from more elevated dunes and sand ridges. Some short-term overflow would be anticipated from the swamp located to the north of Portion 265, however, drainage flows would be confined to the existing narrow watercourse.

2.7.2 Groundwater

Large areas of the Tilligerry Peninsula (Tomago Sandbeds) are defined water catchments under the Clean Waters Act 1970. Most parts of this catchment is managed and controlled by the Hunter District Water Board. The groundwater reserves in this area provide the potable water requirements of the general locality. Water is extracted from the underground water reserves by way of a series of bores. Portion 265 is in close proximity to the Board's groundwater extraction bores which pump water to the Lemon Tree Passage treatment plant.

The Hunter District Water Board has advised that in respect of the proposed development they require the following conditions to apply:

(a) Groundwater extraction is not permitted.

(b) Under no circumstances should the water from Tilligerry Creek be allowed to enter the above land (see APPENDIX 1).

Based in the extensive drilling program undertaken on Portion 265 and the winnable sand deposits identified, the groundwater table on the site would be well below the level proposed for sand extraction. As extraction is confined to elevated areas, no impacts on water flows to or from Tilligerry Creek are likely. As such, the proposal would satisfy the Boards stated requirements.

Existing water needs for the processing plant on Portion 265 are provided from two bores on the northern margins of the site. The bores have the relevant approvals and have produced a generally good quality of water with little discolouration. These bores are well removed from other privately owned bores in the locality (discussed further in Section 2.12).

2.8 FLORA AND FAUNA

A comprehensive assessment of the flora and fauna communities on the site and in the immediate locality was undertaken by Nerina du Preez, biologist, and Martin Denny, zoologist of Mt. King Ecological Surveys. Their reports are contained in full in Appendices 4 and 5.

2.8.1 Flora

From a regional perspective, the Tilligerry Peninsula and the subject site supports vegetation communities common to coastal areas on the N.S.W. coast. Vegetation communities include:

(a) Forest/Open Forest

This general community type is found on hills and dunes and varies depending on soil type. In summary they are:

* Where soil cover is thin, the dominant tree is Spotted Gum (Eucalyptus maculata), interspersed with Bastard Mahogany (E. umbra), Brown Stringybark (E. capitellata), and near the waterfront, Forest Red Gum (E. tereticornis). These areas are generally disturbed due to fires.
* Further south, where mantling sands occur, the dominant tree species are Smooth-barked Apple (angophora costata), Blackbutt (E. piluraris) and Red Bloodwood (E. gummifera).

(b) Woodlands

Open forests give way to woodland in less elevated dune situations. The tree species are characterised by Scribbly Gum (Eucalyptus haemostoma), commonly in association with Red Bloodwood. In some areas Red Bloodwood and Sydney Peppermint (E. pipereta) form the tree cover.

(c) Scrublands and Heath

Scrublands occur on lower lying dunes, and these grade into heath or wet heath areas. The scrublands are dominated by Wallum Banksia, Ball Hone Myrtle and Paperbark Tea Tree (Leptospermum attenuatum). Sedges and rushes are also commonly found. On wet heaths the characteristic species are Banksias, Paperbarks, Hakeas and Tea Trees, with Rushes. This community is widespread across the centre of the Tilligerry Peninsula.

(d) Swamplands

The wet heaths merge into swamplands where the water table is either at or above ground level. The "shrubby" swamps typically contain Bottlebrush species (notably Callistemon citrinus), Hakeas, Paperbarks, Banksias and Rushes. At the other end of the scale, swamplands dominated by closed forest contain tall Broad-leaf Paperbarks (Melaleuca quinquinervia), with Sedge understorey, or forests of Swamp Mahogany (E. robusta) over dense sedge and shrub understorey.

(e) Estuarine Wetlands

These consist of forest, low forest and sedgeland characterised by Grey Mangrove (Avicenna marina) and Swamp Oak (Casuarina glauca) over and interspersed with sedgeland and saltmarsh. These wetlands skirt the peninsula, including the shores of Tilligerry Creek.

Landscape and Vegetation

The vegetation and land cover on the subject site comprises the following:

(a) Tall open forest: 12.2 ha approximately (some ground disturbance near processing plant).

(b) Swamp forest: 12.74 ha approximately.

(c) Cleared land: 3.2 ha approximately.

(d) Sedge Swamp: 1.2 ha approximately.

Portion 265 is relatively flat and low lying except for the saddle dune south west of the processing plant area, rising to a maximum height of 18 metres above area level, and a low dune east of the plant area, 8 metres high.

The vegetation of the area is predominantly open forest with a woody shrub understorey. The tree cover is well developed, dominated by Smooth-barked Apple (Angophora costata), Blackbutt (Eucalyptus pilularis) and Red Bloodwood (E. gummifera). There are swamplands on the north and south edges and a creek running across the property joining them. The swamp to the north is characterised by Broadleaf Paperbark (Melaleuca quinquenervia) and Crimson Bottlebrush (Callistemon citrinus), whereas that to the south is characterized by Swamp Messmate (E. robusta) and sedges.

There are indications that regular burning occurred in the past, and the most recent fire, in November, 1986, covered the entire site.

The cleared land on the site, including processing plant, offices, sand stockpiles, settling ponds, water wells, roads and nursery covers approximately 3.2 ha, or 11% of the area of the property. All of these uses are situated on the flat areas in Tall Open Forest.

A small part of the Swamp Forest on Portion 265 (approximately 0.5 ha, or 1.7% of the total site area) forms a part of S.E.P.P. 14 Wetland No. 810, Tilligerry Creek, Port Stephens. State Environmental Planning Policy (S.E.P.P. 14) was gazetted by the State Government as a means by which development could be controlled within designated wetlands areas of the State. The proposed development does not impinge in this designated wetland, nor on wetlands adjoining it. The main dune is situated some 150 metres away from S.E.P.P. Wetland No. 810. Measures to ensure that impacts on wetlands are effectively controlled are discussed in Section 3.10 and 4.2.2 of the report.



PHOTOGRAPH - View from 4m contour (approx.) on main dune, looking towards the site of the proposed causeway crossing of sedge swamp and watercourse, with existing sand stock-piles in background.



PHOTOGRAPH - View of Swamp Forest from the southern side of main dune (Mining Stage 1) looking south east towards Tilligerry Creek (distant background). Blackbutt and Smooth-barked Apple are in the foreground, Red Bloodwood and Swamp Mahogany in middleground. Sedges and mangroves bordering Tilligerry Creek in background.



PHOTOGRAPH - View of Tall Open Forest fringing the narrow Sedge Swamp, looking north towards Lemon Tree Passage Road. The sedge in the foreground is Red-fruit Saw-edge.



PHOTOGRAPH - View of the main peak of the main dune looking to the southwest. Tall trees are Smooth-barked Apple and Black-butt, with small middle storey of Saw Banksi.



PHOTOGRAPH - View of the main dune from the southern side of the ridge line within the proposed Mining Stage V, in the south-west corner of the site. Vegetation in this area is Tall Open Forest represented by Smooth-barked Apple (white trunk), Blackbutt (dark trunk) and ground cover of Bracken.

Significant Species

Several of the species listed as endangered plant species in the Tanilba and Swan Bay area were found within Portion 265. Two of these, Pinnate Boronia (Boronia pinnate) and Bundled Guinea-flower (Hibbertia fasciculata) occur in habitats which will not be affected by extraction or affected by activities associated with the proposal. Other species include the Orchidaccae (all orchids are Protected plants) and Xanthorrhoeaceae. Two orchids were found in the survey, the Insect Orchid, (Acianthus fornicatus), and Large Duck Orchid (Caleana major). The former is abundant in most forested areas on the Tilligerry Peninsula, and has regenerated in ACI's rehabilitated mining areas. The latter plant species is known to be moderately common in the locality. Both species occur on parts of Portion 265 which will not be disturbed by the proposal, as well as being situated within parts of the proposed extraction area. Given its widespread distribution on the site, the impact of the proposal on these species is therefore considered to be not significant.

The Grass Tree species likely to be affected by the proposal are Forest Grass Tree (Xanthorrhoea media) and Austral Grass Tree (X. australis). Both species are common and widespread regionally and on the site and are found in the Tall Open Forest. Based on ACI's experience in nearby rehabilitated areas, Grass Trees can be successfully rehabilitated using appropriate methods.

2.8.2 Fauna

A reconnaissance for the survey of Portion 265 was carried out by Mount King Ecological Surveys in August 1989.

Despite a very short survey period, a relatively wide variety of fauna was located. Nine species of mammal (5 native), 24 species of birds, 3 reptile species and 2 species of amphibian were recorded in the two area surveyed. Native mammals found during the survey included the Swamp Wallaby, Bandicoots, Dusky Antechinus, common Brushtail Possum and the Koala. All species of native mammals are commonly distributed along the coast of New South Wales, and the Koala has been reported from many areas on the Tilligerry Peninsula. Two Koalas were sighted within Portion 265 - one within a Swamp Mahogany in the Swamp Forest, on the northern edge of the Portion; the other, a mother and young, was observed resting in a Smooth Barked Apple in the dune area. There was ample evidence of a high usage of Portion 265 by Koalas - from characteristic scratchings on trees and scats lying at the base of trees.

Of the 24 species of birds located during the short survey, most are commonly found within areas of bushland along the New South Wales coast, and are typical of assemblages of avifauna found in areas of bushland near human habitation. Two Raptors were observed; the Grey Goshawk was seen flying over the rehabilitation areas to the north of Portion 265, whilst there was a breeding pair of White-bellied Sea-eagles associated with a nest in a large tree at the eastern end of the main dune on Portion 265.

The eagles were tending their nest continuously and ACI staff reported hearing the calls of young eagles. Although none were seen during the fauna survey, White-bellied Seas-eagles breed between May and October and it is likely that the nest contained young.

Of the herpetofauna observed or reported within Portion 265, three were found in a variety of terrestrial habitats, that is, the Redbellied Black Snake, Brown Snake and Common Tree Snake, whilst the two species of frog found were located within aquatic habitats. All these species are commonly distributed along the New South Wales coast.

Status

The population status of nearly all species either known or expected within Portion 265 can be classified as high, that is, abundant, common or moderately common. The Peregrin Falcon and Australian Hobby are considered uncommon within New South Wales and, as members of the Family Falconidae, are listed on the Convention into Trade of Endangered Species. However, neither are regarded as in danger of extinction within Australia.

Both the Koala and the White-bellied Sea-eagle are listed on Schedule 12 (endangered fauna) of the New South Wales National Parks and Wildlife Act (1974) as Fauna of Special Concern.

The White-bellied Sea-eagle (haliaeetus leucogaster) has an Australian status of Fairly Common and breeds in Australia. The White-bellied Sea-eagle lives and breeds along the Australian coast and has colonised most large man made reservoirs. Nests are in trees or on rocks and the breeding areas are traditional, though several nest sites may be used in each area. The Sea-eagle is sedentary but it disperses widely.

The Koala is classed Common, with limited distribution. The Koala is limited to areas where there are acceptable food trees, predominantly eucalypts, but also non eucalypt trees such as Melaleuca. Although in high numbers in some parts of its range, continued clearing of large tracts of forest and the consequent restriction of populations to small patches of discontinuous and possibly sum-optimal habitat leave the long-term future of this species in some doubt. From the results of a State-wide survey, carried out by the National Parks and Wildlife Service, the Port Stephens region is one of the few areas supporting high numbers of Koalas in New South Wales.

Use of Portion 265 by Koalas

There is strong evidence that Koalas use Portion 265 for feeding etc. Sightings of Koalas (one breeding) were recorded near the processing plant and on the sand dune. There are tracks and dung of this marsupial throughout the Portion and Koalas have been reported in the yard of the adjoining landowner. According to Clulow (n.d.) "a major continuous population of Koalas in Port Stephens occurs throughout the Tomago Catchment Area, Medowie, Salt-Ash and along Tilligerry Peninsula." Clulow places Portion 265 within a southern corridor for Koalas along Tilligerry Peninsula.

One aspect of the distribution of Koalas in and near Portion 265 is that they do not appear to be severely affected by human development. Koalas wander through and feed within the area of the sand treatment plant and are seen within the yards and houses of people with large dogs etc. This is a common phenomenon for Koalas along the N.S.W. coast and there are significant populations of this animal in the urban areas of Port Macquarie and Sydney. In the Port Macquarie region, an important cause of death is collision with vehicles as Koalas cross busy roads. The east-west corridors established along Tilligerry Peninsula do not require the crossing of major roads by Koalas and as long as there is sufficient tree cover within each of the two corridors then Koalas should be able to move freely along the Peninsula.

Wildlife Corridors within Tilligerry Peninsula and the Influence of Portion 265

Clulow has pointed out that there are two major east-west corridors for Koalas along Tilligerry Peninsula. These corridors follow the northern and southern margins of Tilligerry Peninsula i.e. beside Big Swan Bay and Tilligerry Creek, and join onto patches of forest at Mallabula and Lemon Tree Passage. Both corridors comprise stands of tall open forest, woodland, heath and swamp forest. Only the northern corridor is crossed by a relatively major road (Oyster Cove Road).

There has been some breaking up of these corridors, but there still remains sufficient food trees for Koalas to exist in viable numbers. An important aspect of both corridors is the nearly continuous strip of Swamp Forest along their margins. It has been found at Lake Cattai, near Port Macquarie, that Koalas may prefer this type of vegetation community. At present, there are no plans for destruction of the swamp forest and all efforts should be made to ensure it's conservation. A mosaic of patches of eucalypt forest and woodland, cleared areas and swamp forest would still provide an important refuge and corridor for Koalas along Tilligerry Peninsula.

Rehabilitated Areas and Fauna

Previous areas of sand extracted by ACI have undergone extensive rehabilitation and details of the techniques used are provided in separate reports. A short faunal survey of some of the older rehabilitated plots was undertaken. Fewer bird species (10) and mammal species (2) were located within the plots than that recorded within Portion 265. However, less time was spent in this area so comparisons are difficult, particularly considering the limited survey times at both sites.

The major impression gained from the survey of the rehabilitation sites was that the area had a great potential for supporting native fauna, but still required further time for rehabilitation. It is highly unlikely that a mined area can be returned in a decade to a "natural" state which has evolved over thousands of years. There are over 60 references to studies of recolonisation of mined lands in Australia (see Landline No. 11) and all point out that native fauna will return to previously mined lands, and that the speed and extent of return is partly influenced by the degree of careful rehabilitation of the land.

The rehabilitated lands on ACI property are already providing excellent food sources for nectar-feeding birds and are beginning to develop litter formation which is essential for colonisation by small mammals and reptiles. As the trees and shrubs continue to mature, there will be an accumulation of litter and of cover for the smaller animals. The method used e.g. use of local native plant species, is possibly the best method available and should be encouraged.

2.9 VISUAL ASSESSMENT

The general visual character of the site is established by its topographic characteristics and pattern of vegetation cover.

The subject site forms a part of a much larger landscape characterised by a continuous, or near-continuous, forest cover running along the southern side of Lemon Tree Passage Road. This vegetation is broken in places due to land clearing for housing, agriculture and sand extraction. The forests are generally tall woodlands with shrub understorey, adjoining scrub lands and swamp forest.

Views into the subject site from Lemon Tree Passage Road is limited, given the screening effect of existing dense, tall stands of vegetation running along the southern side of the road. Even the trees on the more elevated parts of the site are not generally visible, making the subject site less sensitive to visual change or land clearing.

With only a minimal visual prominence and uniformity of tree coverage, the subject site is considered to possess a generally low-medium visual quality ranking.

The subject site has not been identified as being of any visual significance in the Hunter Regional Environmental Plan or in the National Trust's Tomaree Peninsula Landscape Study.

2.10 BUSHFIRE HAZARD

The present policy of the Department of Planning with regard to bushfires is set out in Circular No. 74, "Planning in Fire Prone Areas" issued in October 1984. The Circular provides advice in ranking land for Low, Medium and High fire hazards and makes recommendations regarding planning measures for land within each category.

Based on the methodology used in the above Circular the subject site would fall into a High fire hazard rating category.

2.11 ABORIGINAL ARCHAEOLOGY

The Tilligerry Peninsula and surrounding sub-region was traditionally occupied by the Worimi tribe. They spoke the "Kutthung" language, in common with other nearby tribes in the Hunter.

To date, no comprehensive, systematic studies have been undertaken of potential Aboriginal archaeological sites in the Tilligerry Peninsula. Based on other studies in the area the most likely evidence of past Aboriginal occupation of the locality would take the form of:

(a) Shell middens, located mainly on sand dunes near the coast and near a water supply.

(b) Middens and other relics on dunes on the southern side of Tilligerry Peninsula, near Tilligerry Creek.

(c) "Dinner-time" camp-types of middens with few or no stone artifacts.

(d) Longer-stay camp sites, with stone artifacts.

(e) It is noted that the chances of finding scarred or carved trees in the locality are poor.

An archaeological study was carried out on Portion 265 in June 1988 (see APPENDIX 6). Three Aboriginal shell middens and an isolated find were located on the site. They are as follows:

(a) Site 1: A shell midden located on the spur at the north eastern end of the main dune.

(b) Site 2: Shell midden located on a saddle between two dunes, on the western boundary of the site.

(c) Site 4: Clusters of shells scattered over a large area, with some stone artifacts.

Site 3 was found to be located outside of the subject site.

The survey found that the above sites are archaeologically significant and should be protected, in particular given the absence of significant sites on the Tanilba Northern Dune and the disturbed sites found elsewhere on Tilligerry Peninsula. Of the four sites, 1 and 4 were considered the most significant. Recommendations for protection of these sites is discussed later in this report (See Section 4.7).

2.12 EXISTING LAND USE: SITE AND SURROUNDS

2.12.1 The Site

ACI's existing sand treatment works for the locality is located on the subject site, near its NE corner. The existing plant is treating sand presently being extracted from Permissive Occupancy (P.O.) 86/25, located some 800 metres to the north-east.

Existing Land Use

ACI purchased Portion 265 in the late seventies for two main reasons:-

(i) to have a site close to the then current Permissive Occupancy at the time, P.0. 77/13, on which the necessary silica sand treatment plant could be built.

(ii) to secure a small tonnage of potential white glass sand for use as a backstop in the event of an emergency in raw sand supplies.

The silica sand treatment plant was constructed soon after purchase of the land and the site has been used exclusively for the receiving, treatment, stockpiling and despatch of raw, product and by-product sands ever since.

An office and workshop were constructed on site as ancillary facilities and recently a specialised shed was installed for the protective storage of the top grade glass sand produced for Crown Corning Ltd. Two water wells were constructed on the site at the time the plant was built, to provide a continuous supply of potable water for the processing plant.

Most of this infrastructure occurs within the north east quadrant of the property. A small nursery for propagating native plants from seeds was constructed at the end of the track leading to the western water well. The nursery and the water well are the only developments not located within the north east quadrant of the property. None of the sand dunes on the property have been used for any purpose. There are a number of tracks over the main dune in the south west quadrant. These tracks are now barely visible in the field. Recent entry onto the main dune for geological sampling and botanical survey, using a 4WD vehicle, followed the ridges for easiest and safest access but could not pick up with any certainty the tracks depicted on these plans which were traced from old aerial photography.

The reason for purchasing Portion 265 for emergency sand supplies has now become significant in view of the dwindling reserves on The Glass Sand Association's remaining Permissive Occupancies which in total are only sufficient to last a little more than another 3 months (at the time of writing).

Access to the Deposits

Access to the white silica sand deposits on Portion 265 will be through the main entrance to the treatment plant off Lemon Tree Passage Road and via the existing access road within the property which have been constructed for the movement of bulk sands to and from the treatment plant and stockpiles.

The internal road adjacent to the plant will be extended and a causeway constructed across the creek to provide access to the main dune in the south west quadrant of the property.

The Mining and Rehabilitation Plan, shows the location or the road extension and the causeway across the creek.

Stockpiles for sand are situated in a number of locations in and around the processing plant site, in the main located near the sand storage sheds. The stockpiles are served by "cyclones" on towers. The heights and capacities of each cyclone tower are as follows:

(a) Glass grade sand: Two stockpile towers approximately 11 metres in height. Maximum capacity 2,500 tonnes each.

(b) Crown Corning sand: Stockpile tower approximately 8 metres in height. Maximum capacity 500 tonnes.

(c) Ceramic grade sand: Stockpile tower approximately 10 metres in height. Maximum capacity 1,000 tonnes.

(d) Sand by-products: Stockpile tower 6 metres in height. Maximum capacity 200 tonnes.

Currently the existing operations provide for stockpiling of processed and reserve supplies of sand are as follows:

(a) Glass grade sand: 4,000 tonnes

(b) Crown Corning sand: 1,000 tonnes

(c) Ceramic grade sand: 1,000 tonnes

(d) Sand by-products: 2 - 5,000 tonnes

(e) Unprocessed sand: 1,000 tonnes (as emergency reserves)

The existing processing plant comprises administrative buildings, weighbridge, sheds, machinery storage, stockpiles, roads, workshops, processing plant and bores. Specifically, the main features may be summarised as follows:

(a) Main office building, located adjacent to the main entry road into the compound in the north-east corner of Portion 265, with a total floor area of approximately 51m^2 and of variable height 2.75 - 3.0m. This building houses:

* administrative office
* general office
* amenities and washing area
* quality control laboratory

(b) Amenities block, located near the processing plant, with a floor area of 25.5m^2 and of approximate height 3 metres.

(c) Weighbridge, located to the north of the main office building, level with the natural ground level. The weighbridge is of steel plate construction and has dimensions of approximately 19m x 3m. It is used for weighing of all haul vehicles transporting sand. A small weighbridge office, of floor area approximately 2m^2, lies adjacent to the weighbridge.

(d) Processing plant. The processing plant houses equipment necessary to obtain the various grades of product sands from extracted material. The building is on two levels and has a total floor area of 85.5m^2 and dimensions of 9m x 9.5m. The base of the plant contains bins and pumps. The floor level is 3.9 metres above the ground and contains banks of spirals (for refining the sand and removing impurities) and wet high intensity magnetic separator. The roof is located 5.2m above the floor level. An open annex, level with the first floor, contains screens and has dimensions of 4m x 9m. The processing plant has a maximum height of 9.1m above the natural ground level.

(e) **Work sheds.** A work shed, containing storage and work area for machinery, is located south of the main office building. The building has a floor area of 53m^2 and is 3.0 - 3.5 metres high. A nearby shed, of 12m^2 floor area, houses equipment used by the contractor.

(f) **Crown Corning sand storage shed.** This shed, measuring 16m x 24m in size, is an enclosed building which contains all processed Crown Corning quality sand.

(g) **The Glass grade sand storage shed** is a covered area with open sides with overall dimensions of 12m x 25m and with a capacity of 750 tonnes.

(h) **Fuel tanks.** There are two fuel tanks located on the site, one with a capacity of 2,300 litres for the exclusive use of ACI and the other with a capacity of 4,500 litres for the use of the contractor.

Production Rates

The following table indicates the monthly and yearly rates of production of processed glass sand and by-product sand from the processing plant on Portion 265 since 1982. The figures show a total production for the seven year period 1982 to 1988 of 0.42 million tonnes of processed glass sand and 0.03 million tonnes of by-product sand.

Table 2.1: Production Rates - Processed glass sand from Portion 265 1982 -1988 (tonnes)

Year	Processed glass sand (tonnes)	By-product sand (tonnes)	Total sands (tonnes)
1982	46,910	880	47,790
1983	50,881	7,046	57,927
1984	48,037	4,843	52,880
1985	61,449	3,795	65,244
1986	63,827	2,792	66,619
1987	81,702	3,905	85,607
1988	72,454	8,180	80,634
1989 (to July)	47,980	3,804	51,784
TOTAL	473,240	35,245	508,485 Tonnes

Source: ACI Industrial Minerals Division.
A. Echt N.S.W. Manager.

Groundwater Usage Levels

Currently ACI draws water for the processing plant from two water wells, located at the northern end of the site. Licences have been granted by the Water Resources Commission to draw groundwater from these two wells at a rate not exceeding 640 megalitres per well. Present water usage is approximately 100 megalitres per well per annum, equivalent to only 15% of the maximum allowable usage level.

Similarly, the licence provisions require a maximum rate of water usage of 22.7 litres/second per well. Existing usage rates are 14.7 litres/second and 15.3 litres/second, well within the licence provisions.

On-Site Employment

Currently, five full-time staff are employed at the processing plant site on Portion 265. They are as follows:

(a) one quality control technician;

(b) two full-time plant operators;

(c) one position alternating between plant operation and rehabilitation work on extraction sites;

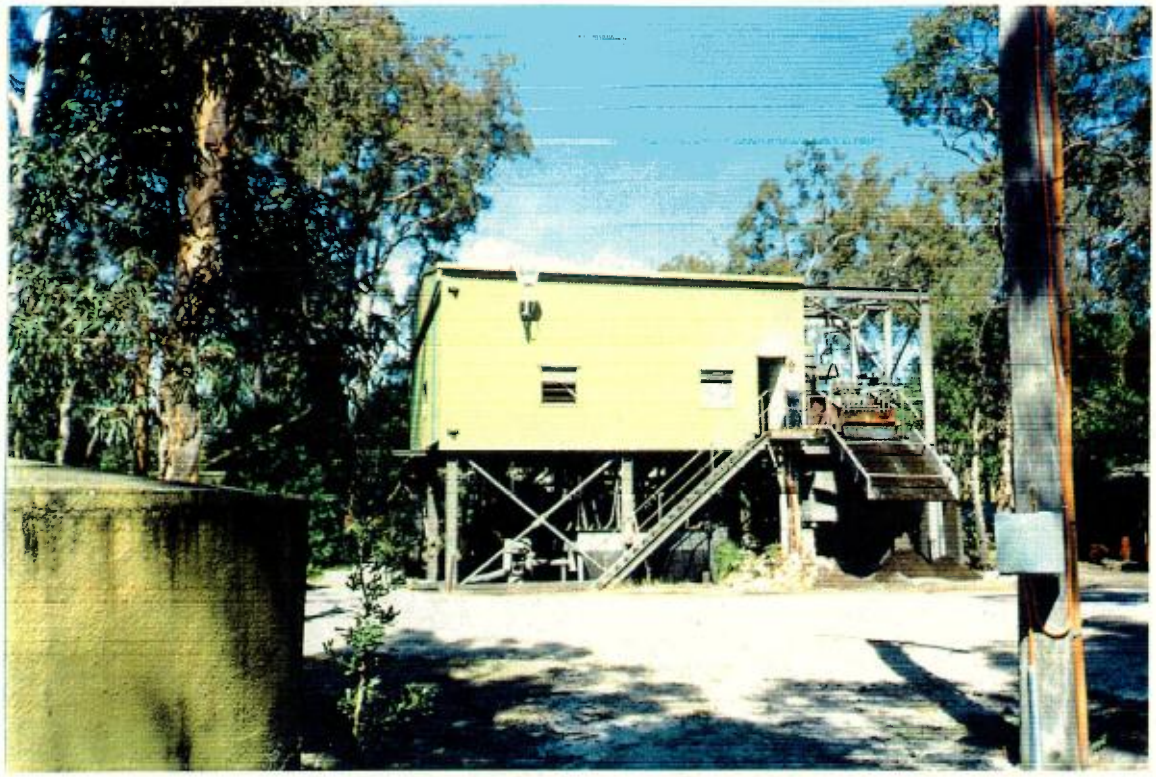
(d) one plant superintendent.

In addition to the above, there are several sub-contractors operating trucks and extraction equipment from the site and from the existing worked sand extraction site, located 800 metres away. This workforce supplies sand to reliant glass making industries in Sydney and Newcastle with a combined workforce of approximately 1,750 people.

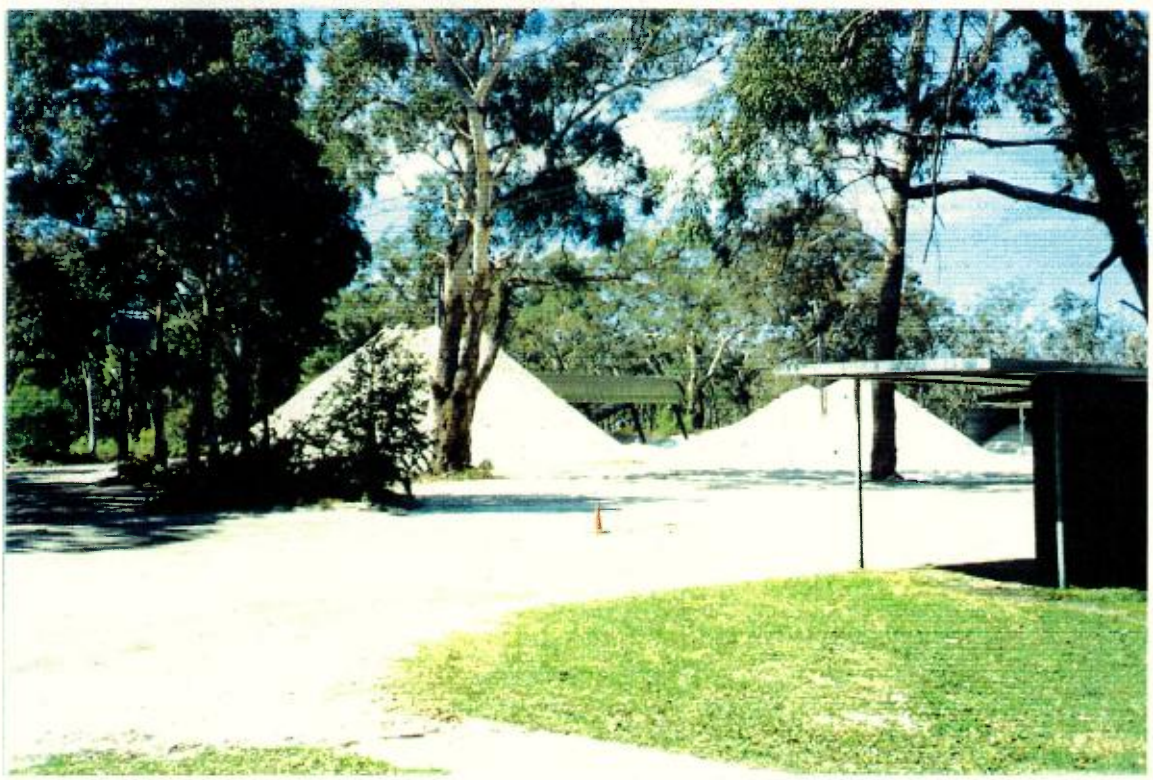
Hours of Operation

Hours of operation of the processing plant site, including the entry and departure of haul vehicles, is restricted to between 5.30am to 1.30pm (up to 5.30pm) Monday to Friday.

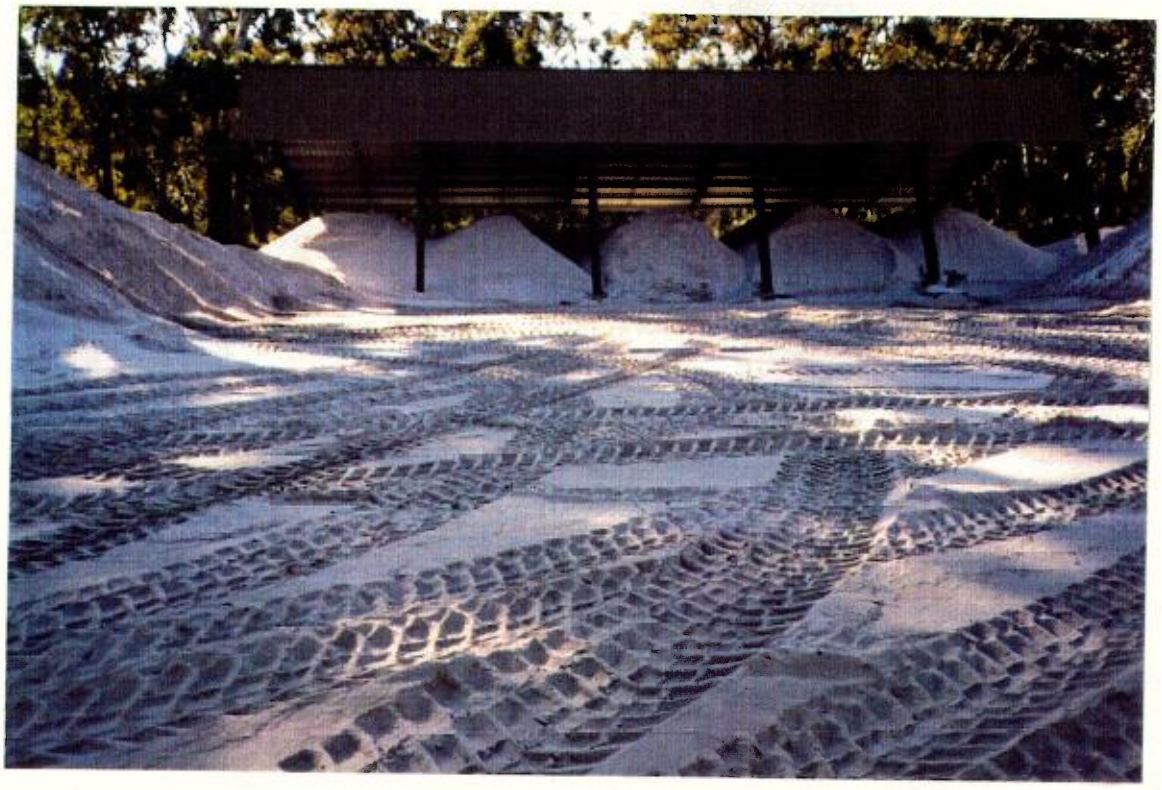
The hours of operation of the extraction site on P.O. 86/25 are 6.00am to 4.00pm, Monday to Friday.



PHOTOGRAPH - ACI Industrial Minerals Division sand treatment plant on Portion 265, Tanilba. Treatment plant contains screens, gravity spirals and WHIMS (wet high intensity magnetic separator).

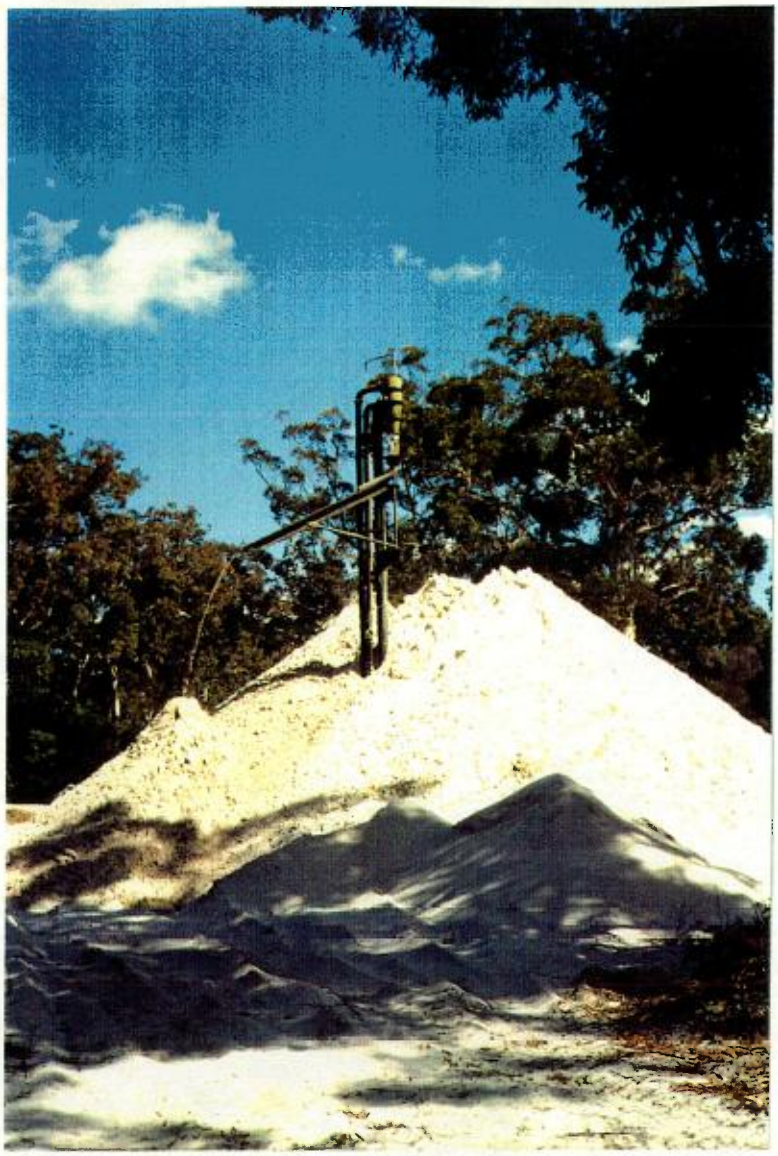


PHOTOGRAPH - View of product stockpiles and undercover storage for Crown Corning grade sands. Weighbridge and weigh-bridge office in foreground.



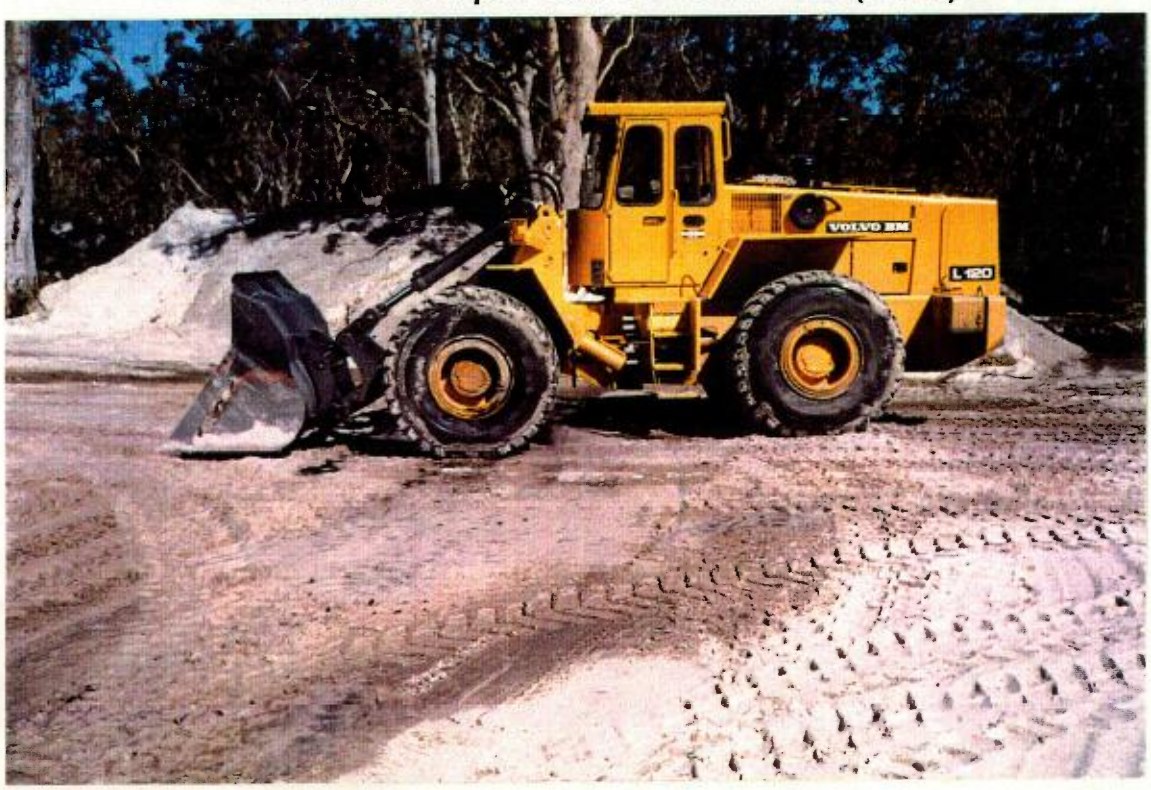
PHOTOGRAPHS - Views of Glass Grade sand storage shed (top) and Crown Corning sand storage shed (lower) located in the north-east corner of Portion 265 near the existing sand treatment plant.





PHOTOGRAPHS - Existing sand stockpile served by "cyclones" on a tower (top).

- Front-end loader used to transport processed sand at the treatment plant site on Portion 265 (lower).





PHOTOGRAPHS - Bore water is presently being pumped from two bores on the site (No. 1 water well, top), where it is then pumped to an aeration pond (lower).



ACI Industrial Minerals Division

Portion 265 E.I.S.

VEGETATION: TILLIGERRY PENINSULA

1:25,000

MAJOR VEGETATION TYPES ON TILLIGERRY PENINSULA

Compiled from aerial photographs (1986), topographic maps and field reconnaissance.

- Forest and Forest Swamp
- Woodland
- Scrubland and Heath
- Swamp
- Estuarine Wetland

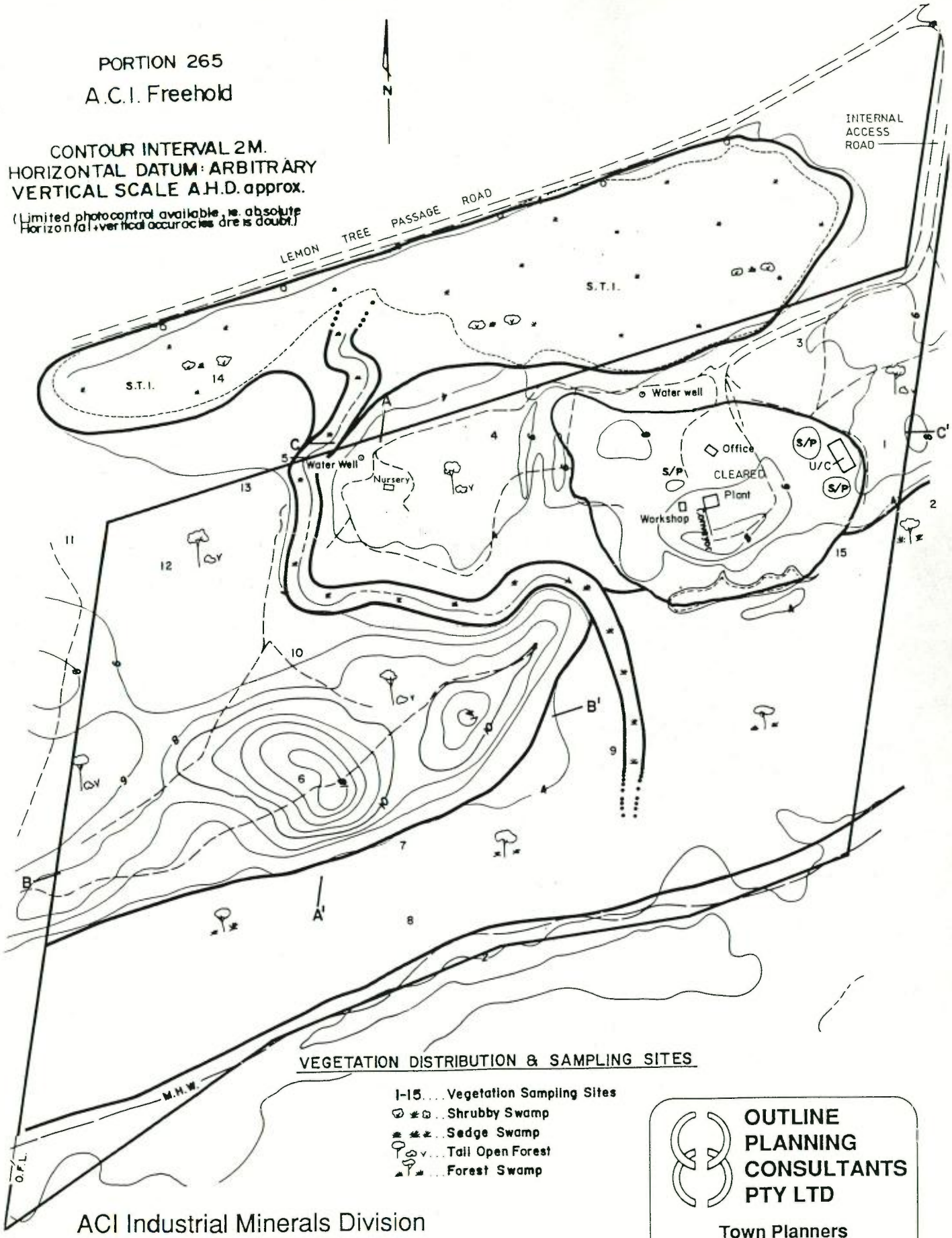
SCALE 1 : 25 000

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VEGETATION DISTRIBUTION & SAMPLING SITES

1-15....Vegetation Sampling Sites
...Shrubby Swamp
...Sedge Swamp
...Tall Open Forest
...Forest Swamp

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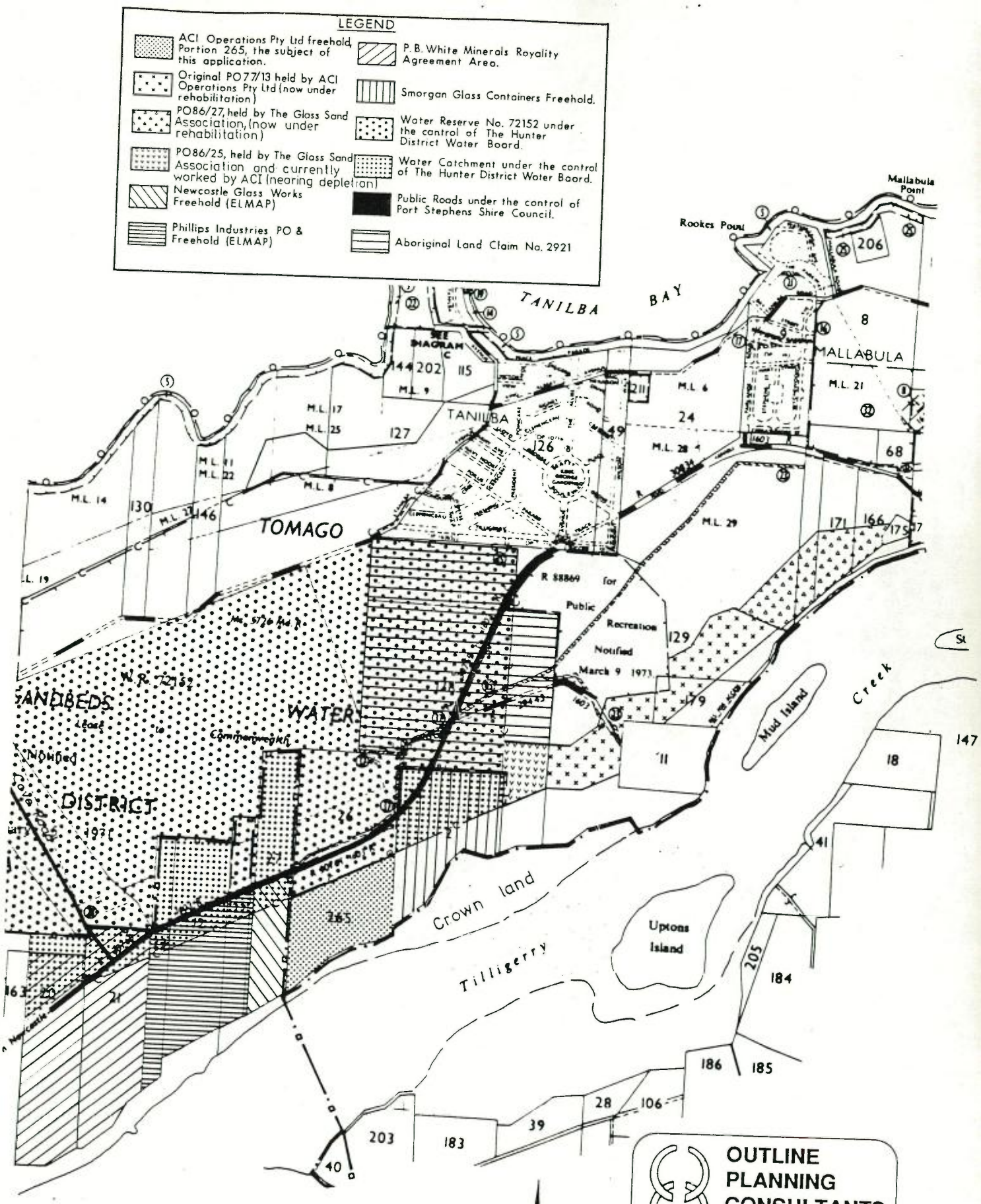
Portion 265 E.I.S.

SITE VEGETATION

1:4,000

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Portion 265 E.I.S.

LAND OWNERSHIP

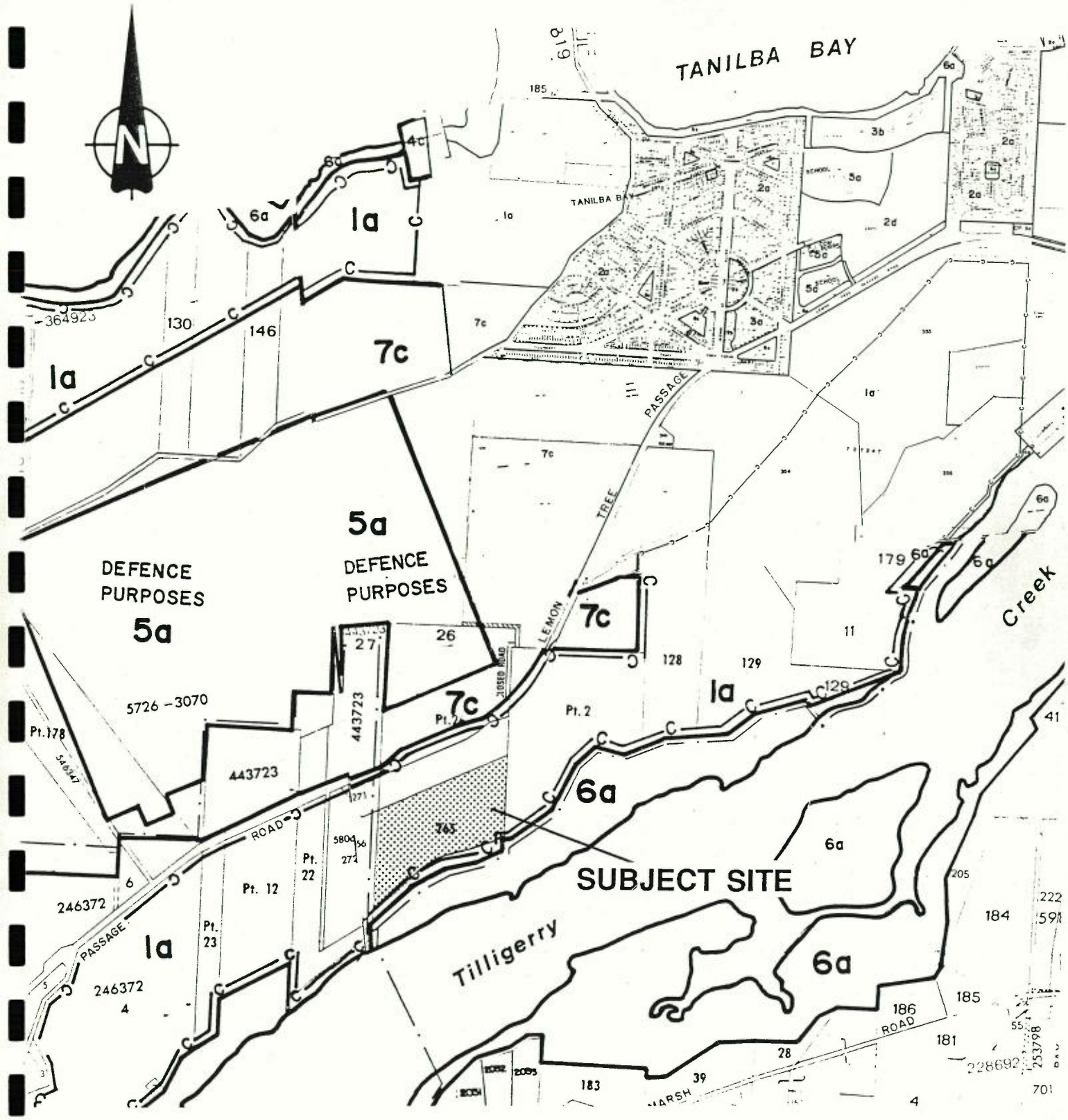
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CONTROLLED DEVELOPMENT AREA —— C —— C —
(Refer to Cl. 37)

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Portion 265 E.I.S.

EXISTING ZONINGS: PORT STEPHENS L.E.P. 1987

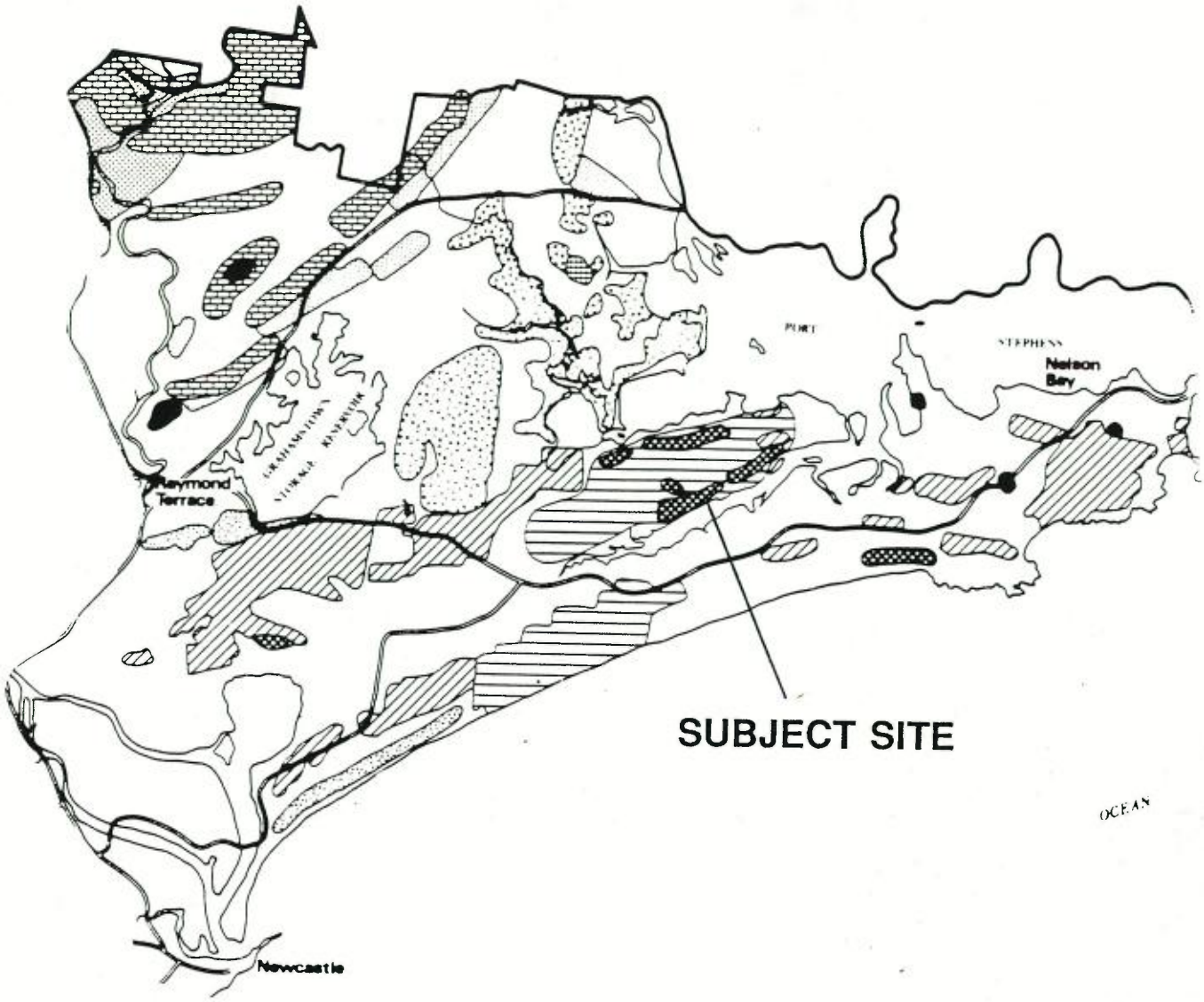
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CATEGORY* COMMODITY

1 2

- Heavy mineral sand
- Industrial sand (glass, foundry)
- Construction sand
- River sand and gravel
- Hard rock aggregate
- Clay / shale
- Dimension stone
- Zeolites
- Road base

*1 Resources proven or indicated
2 Resources inferred or favourable geological setting

HUNTER REGIONAL ENVIRONMENTAL PLAN 1989

LOWER HUNTER EXTRACTIVE MATERIALS AND NON-COAL MINERAL RESOURCES

km 2 0 2 4 6 km

Map 4a

ACI Industrial Minerals Division

Portion 265 E.I.S.

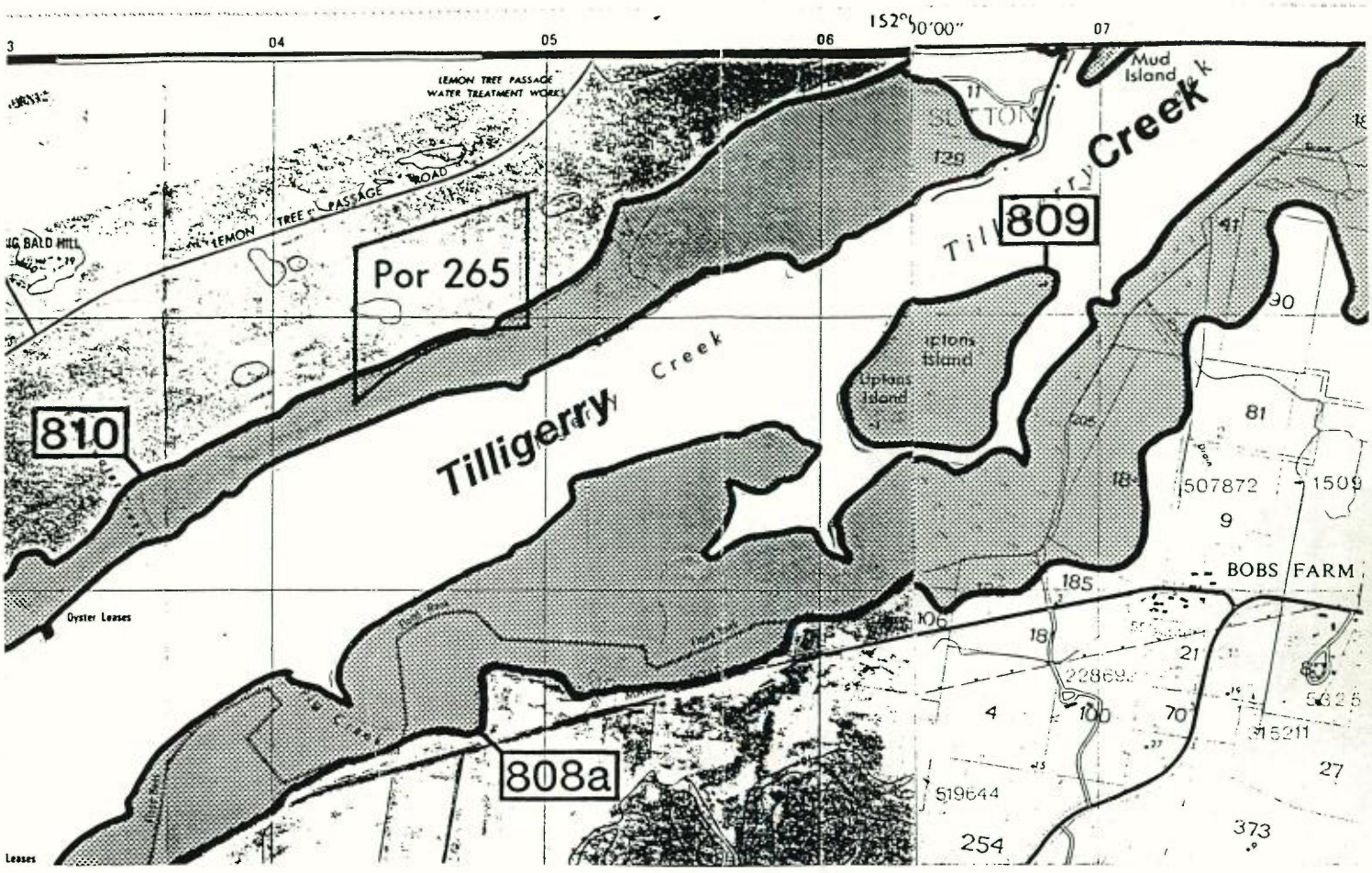
HUNTER REGIONAL PLAN

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SCALE 1:25000

0 500 1000 1500

metres

TOPOGRAPHIC MAP: Morna Point 9332-III-N
Department of Environment and Planning Map No.49

ACI Industrial Minerals Division

Portion 265 E.I.S.

S.E.P.P. 14 WETLANDS

1:25,000

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3. DESCRIPTION OF PROPOSAL

3. Description of Proposal

3.1 GENERAL DESCRIPTION AND SETTING

The proposal involves the extraction of high grade white silica sand deposits from selected dunes on a part of Portion 265, affecting an area of 4.7 hectares, or 16% of the total site area. The sands are proposed to be processed at the existing plant on Portion 265 where they are then transported from the site to supply the Sydney and Newcastle glass, ceramic and chemical industries.

It is proposed to extract approximately 150,000 tonnes of white silica sand from the deposits on Portion 265 over a period of $1^{1}/_{2}$ years.

3.2 THE SAND RESOURCE

3.2.1 Reserves

Approximately 6.6 ha of the property contains mineable white silica sand, i.e. sand no thinner than 1 metre, above a level 1 metre above water table or above Waterloo Rock. Excluding Aboriginal archaeological sites and areas subject to severe noise constraints the area or mineable sand is reduced to approximately 4.7 ha, or 16% of the property.

A hand auger drilling program was completed on a 5Om x 100m grid aligned within the property boundaries, and recorded depths of grey organic sand overburden, depths of white silica sand and basement details, (water table or Waterloo Rock). Approximately 10 Kg samples were taken every 2 metres (or convenient cut). Average thickness of overburden/topsoil intersected was 0.3 metres. Average thickness of white silica sand intersected, (to water table or Waterloo Rock), was 1.2 metres.

Total site reserves of raw (in situ), mineable (no thinner than 1 metre), recoverable (after 10% mining and handling losses), white silica sand are as follows, (conversion factor = 1.5 tonnes/cubic metre):-

Main dune SW quadrant	=	161,000 tonnes
Small dune NE quadrant	=	12,000 tonnes
Thin dune ridge, top centre	=	6,000 tonnes
TOTAL RESERVES	=	179,000 tonnes

Note: Total site reserves.

Excluding the three (3) Aboriginal archaeological sites (shell middens) on the property and areas subject to major noise constraints, available reserves are reduced to 141,000 tonnes

Main dune SW quadrant	=	138,000 tonnes
Small dune NE quadrant	=	12,000 tonnes
Thin dune ridge, top centre	=	2,000 tonnes
TOTAL RESERVES	=	152,000 tonnes

At the current usage of approximately 85,000 raw tonnes/annum, the life span of this resource is approximately $1^{1}/_{2}$ years.

3.2.2 Sand Grades

To meet glass grade specification the white silica sands of the Tilligerry Peninsula must have the 18# BSS (0.83 mm) oversize fraction removed by screening, the -l5O# BSS (0.105 mm) fines fraction removed by washing, and the heavy mineral fraction removed by gravity spiral and Wet High Intensity Magnetic Separation (WHIMS).

In the laboratory this beneficiation process is simulated by washing, screening and bromoform heavy mineral separation.

Physically the laboratory beneficiated product sands are well within specification, with minimal levels of impurities such as iron oxides.

Mesh Size (BSS)		Mesh Size (mm)		Weighed Av. % Retained	ACI Glass Specification
+25		+0.59		Trace	2% max.
-25	+30	-0.59	+0.50	Trace	) 10% max.
-30	+36	-0.50	+0.415	Trace	)
-36	+60	-0.415	+0.25	24.7	
-60	+100	-0.25	+0.145	74.5	
-100	+150	-0.145	+0/105	1.8	
-150		-0.105		0.2	1% max.

2.12.2 Surrounding Lands

Portion 265 is surrounded by essentially undeveloped freehold and Crown lands. The nearest solitary residence, located to the west of the site, is 305 metres from the centre of the highest peak on the main dune and is located approximately 105 metres from the western boundary of Portion 265. Lands adjoining to the east and west are owned by glass companies (Smorgons and Newcastle Glass respectively). The latter site is partially worked for sand extraction purposes, with the former currently uncleared bushland. To the north are scrublands and swamps, with wetlands to the south of the site.

2.13 ACOUSTIC ENVIRONMENT

The acoustic environment is that typical of a rural area adjacent to a major rural road. The main existing background noise sources are general rural activities and passing traffic.

The nearest residence is situated 105 metres west of the western boundary of Portion 265. There are no other residences within 1. 5 kms of Portion 265 .

Whilst a number of industrial activities occur in the immediate area, in most instances the noise impact from these activities is low. The major environmental noise source is road traffic on Lemon Tree Passage Road which has been observed as relatively constant throughout the day .

Proposed sand extraction on Portion 265 will require approximately $1^1/_2$ years operations. The potentially affected dwelling will therefore be the existing dwelling alone. Background noise level surveys have therefore been conducted with specific regard to the residential site situated immediately west of Portion 265.

A noise impact assessment was conducted for Portion 265 in August 88 by noise consultants Robert Fitzell Acoustics Pty. Ltd (see APPENDIX 7 and 8).

Background sound levels close to the western boundary of Portion 265 were measured at two locations - adjacent to the existing dwelling, (approx. 100 metres from Lemon Tree Passage Road), and at a point on the same property but approximately 400 metres from Lemon Tree Passage Road.

The background noise level adjacent to the dwelling was found to range between 37 and 41dB(A), with maxima due to passing traffic ranging between 55 dB(A) and 75dB(A) . Earlier assessments conducted 400 metres from the road coincided with what appeared to be a morning peak traffic flow between 6 a.m. and 8 a.m. at which time background noise levels were observed to range between 43 and 47 dB(A) at which time background noise levels adjacent to the dwelling would have been at least as high. Owing to greater distance from the road, passing traffic peaks were lower than those close to the dwelling, ranging between 52 and 57dB(A).

Based on these readings it is proposed that a suitable background noise level used for assessment of noise impact at the dwelling site is 43dB(A).

2.14 TRANSPORT ROUTES AND ACCESSIBILITY

2.14.1 Transport Network

Lemon Tree Passage

Current access to Portion 265 and the existing processing plant is by Lemon Tree Passage Road and thence by a road reserve 20.115 metres wide. The latter road connects with Lemon Tree Passage Road 220 metres to the north of the NE corner of Portion 265.

Lemon Tree Passage Road is an arterial road linking the settlements of Tanilba Bay, Mallabula and Lemon Tree Passage to centres to the west, and elsewhere in the Port Stephens Shire. The road is a two lane divided carriageway with a 100 km/hr speed limit applying.

Lemon Tree Passage Road has a sealed carriageway width of generally 6.0 metres in a formation between 8.0 and 9.0 metres wide, widening to 8 metres or more adjacent to the entry point to Portion 265 (passing lanes either side of the road) and 8 metres within the near vicinity of the intersection of Lemon Tree Passage Road and Oyster Cove Road. The surface condition of Lemon Tree Passage Road within 3 kilometres either side of the access point to Portion 265 shows frequent examples of damage to the pavement edge, with many potholes in evidence. This is with the exception of that part of Lemon Tree Passage Road near the Oyster Cove Road intersection which is in a good condition. Much of the present condition of Lemon Tree Passage Road can be attributed to existing levels of usage by heavy vehicles.

Presently ACI Industrial Minerals and the Glass Sand Association contribute to a road maintenance levy used by Port Stephens Council for the purpose of maintaining Lemon Tree Passage Road. It is not known if a similar levy applies to other sand extraction sites in the near vicinity of Portion 265.

Internal Access Road

The first point of contact with the traffic stream is at the intersection of the internal access road with Lemon Tree Passage Road. Lemon Tree Passage Road has been widened to allow for a sealed passing bay for vehicles entering and leaving the site; widening opposite the access road being necessary because of the need to allow for heavy vehicles to turn into and exit the site without affecting the efficiency or safety of traffic flows on Lemon Tree Passage Road. We are advised by Council that this intersection is operating satisfactorily for existing traffic volumes.

The sight distance from this intersection point to the east and west is good, and coupled with the existence of passing bays here, is considered that there is a low accident potential for this point.

Internally, the access road to Portion 265 is bitumen sealed to a carriageway width of 6.0 metres in a formation 7.0 to 8.0 metres wide, including gravel shoulders. The road is in a good condition, with the exception of the intersection with Lemon Tree Passage where potholing and surface deterioration is evident. For about the first 250 metres of the internal access route a 6.0 metre sealed surface applies; within Portion 265 the sealed carriageway width varies from 4.0 metres north of the office in a 5.0 metre formation to 6.0 metres in the loop road going around the plant site itself. The condition of the surface is good.

All sections of the internal access road are bitumen sealed; no part of the road is unsealed. This measure reduces the incidence of dust generated by haul vehicles, and encourages a more orderly safe and efficient movement of vehicles generally on the internal roadway. The traffic speeds on the roadway are low.

2.14.2 Traffic Flows

No recent traffic counts have been undertaken on Lemon Tree Passage Road. To obtain more up to date data on traffic flows, a count was undertaken of traffic flows on Lemon Tree Passage Road at the intersection of this road with Oyster Cove Road. The survey recorded hourly movements in each direction for the following vehicle types between the hours of 6am to 6pm on 25th July 1989:

* motorbikes
* cars
* light trucks and commercials
* heavy trucks (4 wheeled)
* heavy trucks (more than 4 wheels)

The full results of the traffic survey is contained in table 2.2. Key results are summarised in the following.

Flow Type/Period/Features	**Traffic Flow on Lemon Tree Passage Road**
Surveyed traffic flow	3,389 vehicles
Average hourly flow 6.00am to 4.00pm	269 vehicles
Peak hour flows	332 vehicles (7am - 8am) 373 vehicles (4pm - 5pm) 325 vehicles (5pm - 6pm)
% Heavy vehicles	292 vehicles (8.6% of traffic)

During the same survey period, sand truck movements between Portion 265 and ACI's existing sand extraction operations on P.O. 86/25, east of the site, and sand truck movements from Portion 265 travelling to the west of the site, were recorded.

In a survey on the same day, 34 truck movements were registered at the processing plant site attributable to vehicles coming to and from P.O. 86/25 (these vehicular movements would not have been registered at the traffic survey point on Lemon Tree Passage Road west of the site).

In the case of trucks carrying processed sand from Portion 265 a total of 24 truck movements were recorded (i.e. 12 trucks entering the site, 12 trucks leaving). These movements occurred between the hours of 6am and 1pm, with no truck movements thereafter.

Based on the above, it is concluded that heavy truck movements on Lemon Tree Passage Road (west of the site) associated with ACI's operations, account for 24 out of a total of 292 heavy truck movements, or 8% of the total.

Table 2.2: Traffic Flows Lemon Tree Passage 25th July 1989 - By Vehicle Type

Vehicular Type	TIME												....
	6am to 7	7am to 8	8am to 9	9am to 10	10am to 11	11am to 12	12noon to 1	1pm to 2	2pm to 3	3pm to 4	4pm to 5	5pm to 6	Total
1. Motorbikes													
(a) E bound	1	1	2	0	0	0	1	1	1	0	3	4	14
(b) W bound	6	2	0	0	0	0	0	0	1	4	0	0	13
Sub Total													27
2. Cars													
(a) E bound	4	44	70	64	79	87	96	91	130	165	221	246	1,297
(b) W bound	181	222	158	133	105	102	79	97	94	68	88	47	1,374
Sub Total													2,671
3. Light trucks & commercials													
(a) E bound	6	10	5	16	10	18	15	24	24	24	32	10	194
(b) W bound	26	16	14	22	18	9	12	20	19	17	18	14	205
Sub Total													399
4. Heavy trucks (4 wheeled)													
(a) E bound	2	11	14	11	13	8	5	6	9	5	5	3	92
(b) W bound	6	12	13	8	6	8	3	4	12	7	2	1	82
Sub Total													174
5. Heavy trucks (more than 4 wheels)													
(a) E bound	6	7	4	6	5	10	1	8	4	2	1	0	54
(b) W bound	9	7	7	6	5	9	6	6	4	2	3	0	64
Sub Total													118
TOTAL	247	332	287	266	241	257	218	257	298	294	373	325	3,389

Source: Outline Planning Consultants, ACI Industrial Minerals.
Location: Lemon Tree Passage Road at intersection with Oyster Cove Road.

Based on the survey results, it is concluded that Lemon Tree Passage Road functions as a rural arterial road with low traffic volumes. Heavy vehicles constitute approximately one out of every twelve (8.6%) vehicles using this road. The level of usage of Lemon Tree Passage Road, west of the site, by heavy vehicles is not expected to increase as a result of the proposed development. East of the site usage by heavy vehicles associated with sand extraction from ACI operations will be eliminated.

2.15 LAND USE PLANNING

2.15.1 Existing Settlements

The Tilligerry Peninsula is a rural area with most of its population located within the centres of Tanilba Bay, Lemon Tree Passage and Mallabula, with existing permanent population in the order of 6,000 persons or more in total. All of these centres are established tourist areas, in the main for caravaning and holiday homes.

There is presently a number of undeveloped, zoned urban areas at the above centres yet to be utilised for housing, with some of these undeveloped urban lands known to be prime koala habitats.

2.15.2 Environmental Planning Instruments

State & Regional

The property is affected by a number of State and Regional planning instruments. None of these planning instruments place any additional restriction on the property except the following:

State Environmental Planning Policy No. 11 ("SEPP 11") requires that referral of development applications to the Traffic Authority of New South Wales where the proposed development is likely to cause increased traffic, as set out in Schedules 1 and 2 to the Policy (copy of which are attached). The proposed development falls within Schedule 1 paragraph (m) "extractive industries".

Hunter Regional Environmental Plan 1989

The Hunter Regional Environmental Plan (R.E.P.) 1989 is dated 8th December 1988 and was placed in Government Gazette No. 32 dated 17th March 1989.

The objectives of Part 6 of the plan - Natural Resources, Division 1 - Mineral resources and extractive materials - encourages extractive industries to be undertaken subject to a consideration of certain matters.

Clause 101 of the plan provides for a number of matters to be accounted for when a consent authority considers any extractive industry proposal including:

- consideration of conservation value of land and applying post-extractive land use conditions;
- consultation with relevant Departments. In this regard, these bodies comprise the Department of Planning, Department of Minerals and Energy, Department of Agriculture and Fisheries, Department of Lands, the Soil Conservation Service and the Forestry Commission. Advice from Council is that all of these Departments etc. have been consulted in respect of the current E.I.S.
- progressive rehabilitation measures;
- groundwater/surface water effects;
- transport routes.
- regard for any relevant Total Catchment Management strategies.

The provisions of Clause 7 of Hunter R.E.P. 1989 is also particularly relevant. The clause provides that in the case of a development requiring development consent:

> " then the consent authority, the Director ..., should, in carrying out its or his or her function under the Act or under the instrument concerned, and for the purposes of advancing the aims and objectives of this plan ... consider the content of the background report and the objectives, policies and principles contained in this plan and relevant to the matter. "
>
> (excerpt from Clause 7 of Hunter R.E.P. 1989)

" The Tilligerry Creek - Tanilba area of Port Stephens Shire contains unusually pure dune deposits of clear glass making sand. Industries in Newcastle and Sydney have taken steps to secure the long-range availability of this area, and to avoid sterilisation by incompatible surface uses, until the deposit is worked. "

(page 59 of background report)

The above aims will need to be taken into account by Council when considering the E.I.S. for the proposed extraction of sand from the Northern Dune. The above statement reinforces and gives importance to the need for glass sand extraction to occur on the land the subject of the E.I.S.

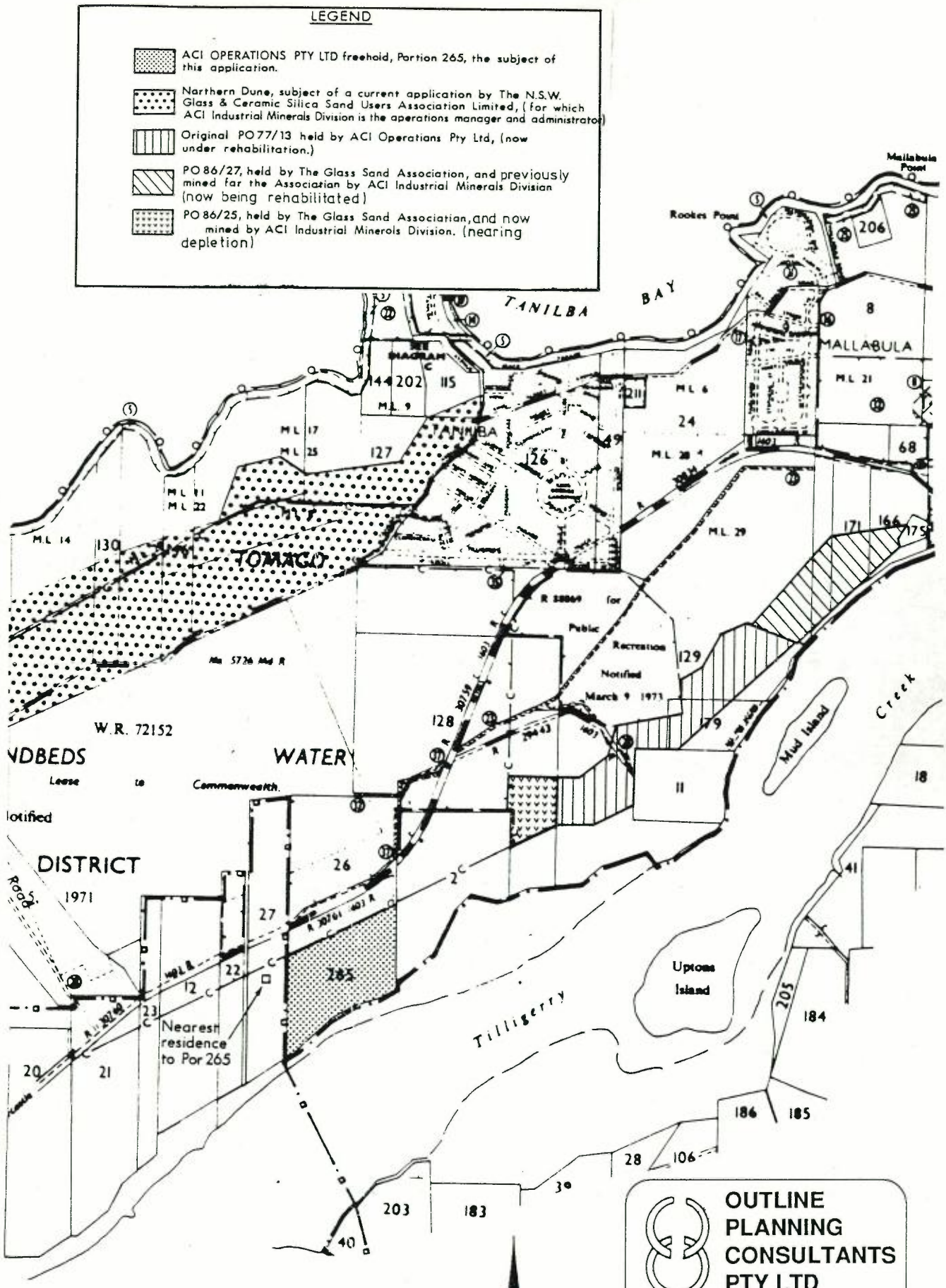
It is noteworthy that Map 4A of the Hunter R.E.P. 1989 clearly identifies the Tanilba Northern dune as a regionally significant source of industrial glass sand (see R.E.P. plan).

Local Planning

Under the provisions of Port Stephens Local Environmental Plan (L.E.P.) 1987 the subject land is zoned No. 1(a) Rural "A" Zone. Accordingly, the whole of the Development Site is subject to Part IV of the Environmental Planning and Assessment Act.

The subject site is affected by the provisions of Clause 37 of Port Stephens L.E.P. 1987. The underlying object of Clause 37 is to protect valuable and rare high grade silica sand deposits in the Tilligerry Peninsula.

Development for the purpose of silica sand extraction is a permissible use, subject to the consent of Council, after consultation with the Director-General of the Department of Mines and Energy, and with the concurrence of the Director of the Department of Planning.

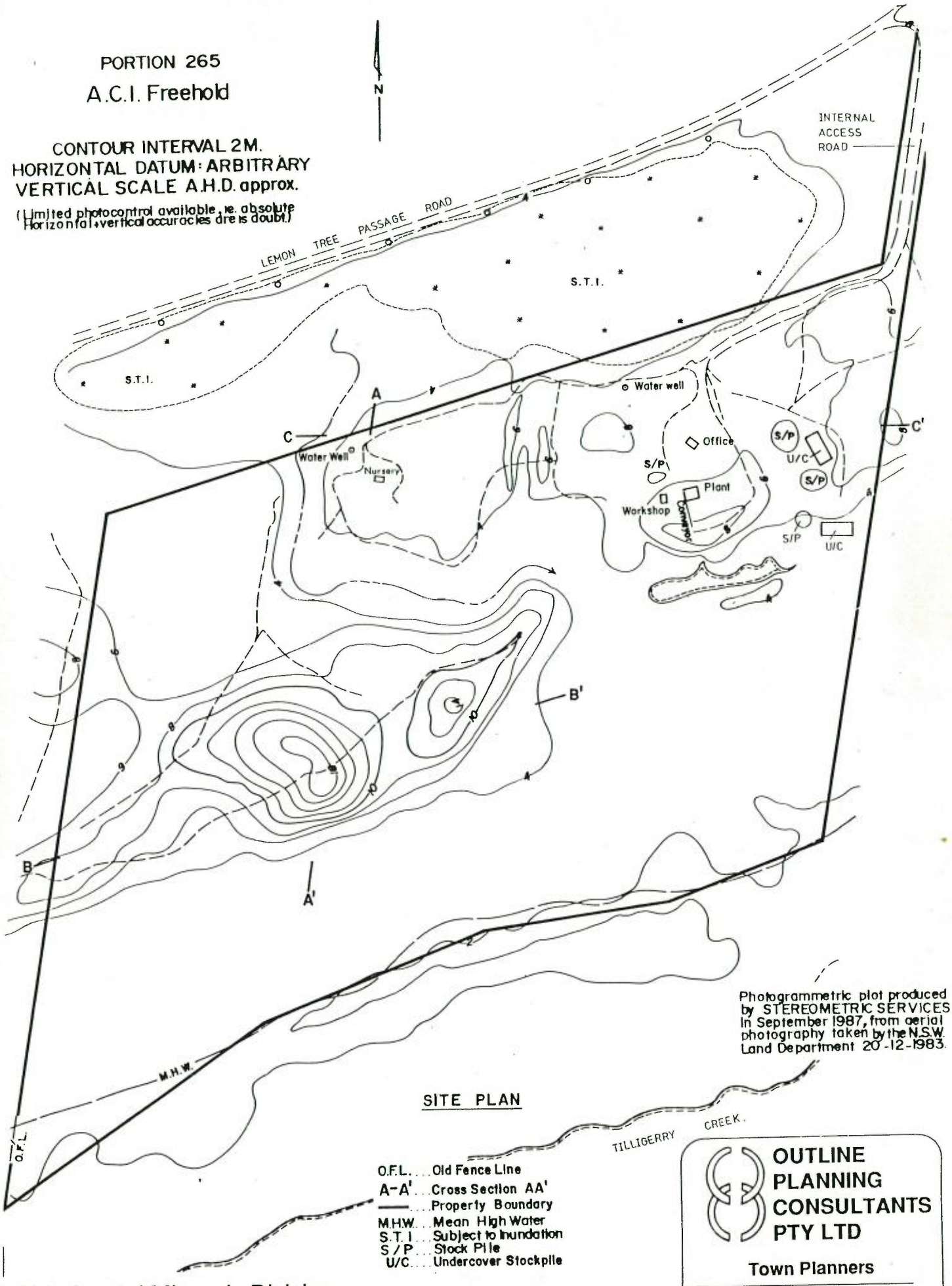


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Photogrammetric plot produced by STEREOMETRIC SERVICES in September 1987, from aerial photography taken by the N.S.W. Land Department 20-12-1983.

SITE PLAN

O.F.L. . . . Old Fence Line
A-A' . . . Cross Section AA'
——— . . . Property Boundary
M.H.W. . . . Mean High Water
S.T.I. . . . Subject to Inundation
S/P . . . Stock Pile
U/C . . . Undercover Stockpile

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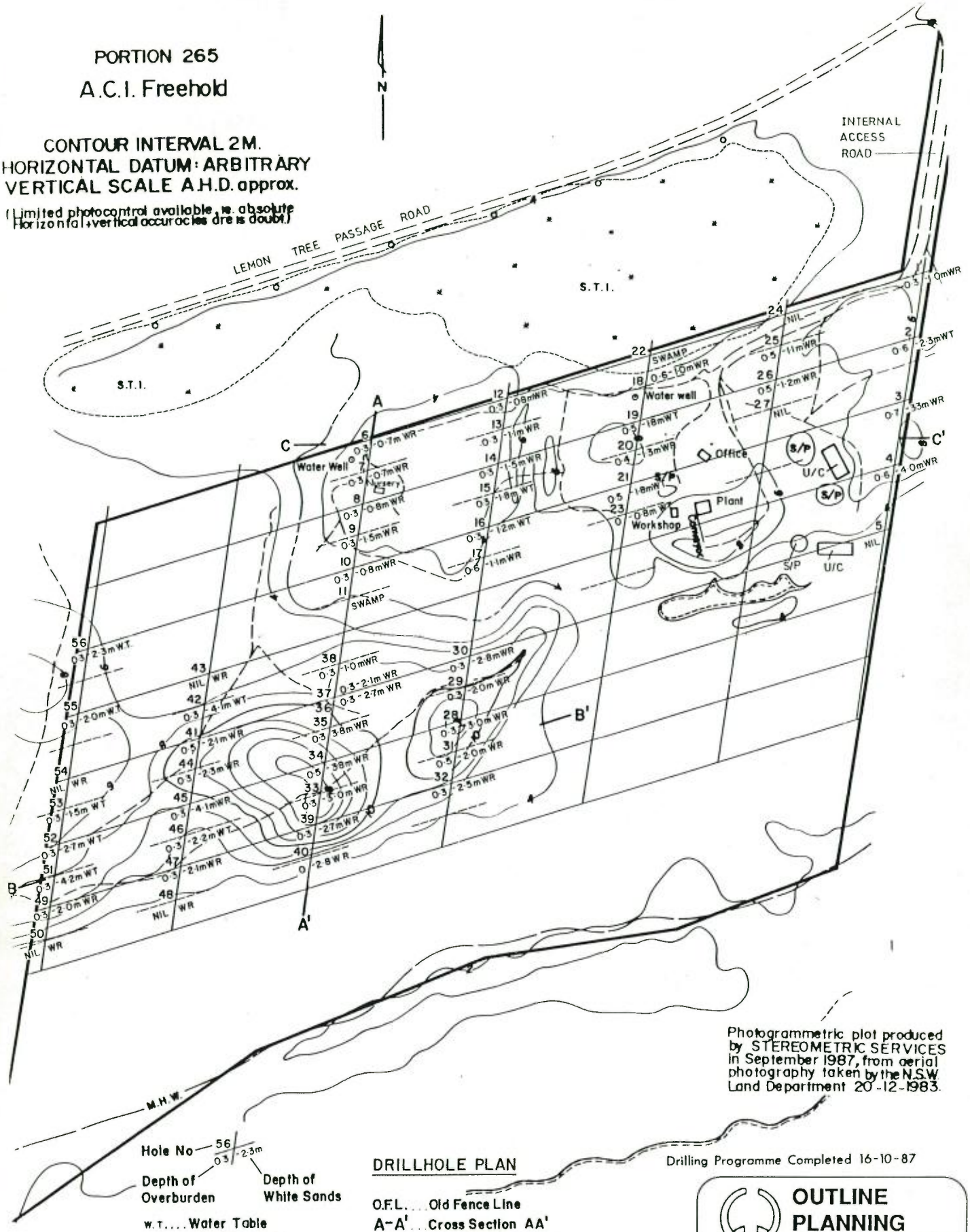
August 1989

ACI Industrial Minerals Division

Portion 265 E.I.S.

SITE PLAN

1:4,000



Photogrammetric plot produced by STEREOMETRIC SERVICES in September 1987, from aerial photography taken by the N.S.W. Land Department 20-12-1983.

Hole No 56 / 0.3 - 2.3m

Depth of Overburden — Depth of White Sands

W.T. .... Water Table
W.R. .... Waterloo Rock

Grid Size: Parallelogram Approx. 100m × 50m

DRILLHOLE PLAN

O.F.L. .... Old Fence Line
A-A' .... Cross Section AA'
——— .... Property Boundary
M.H.W. .... Mean High Water
S.T.I. .... Subject to Inundation
S/P .... Stock Pile
U/C .... Undercover Stockpile

Drilling Programme Completed 16-10-87

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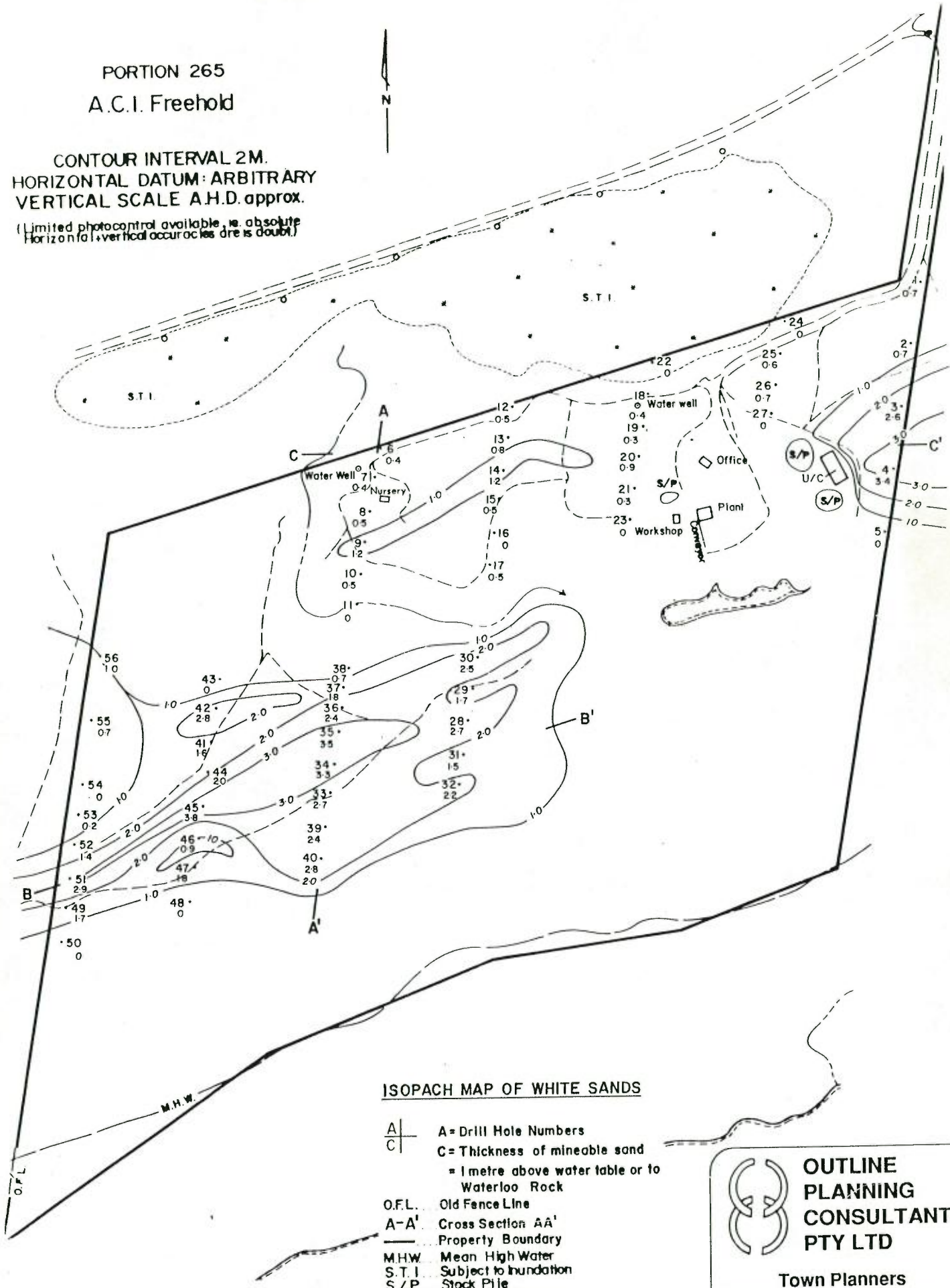
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Portion 265 E.I.S.

DRILLHOLE PLAN

1:4,000



ISOPACH MAP OF WHITE SANDS

A/C — A = Drill Hole Numbers; C = Thickness of mineable sand = 1 metre above water table or to Waterloo Rock

O.F.L. Old Fence Line

A-A' Cross Section AA'

——— Property Boundary

M.H.W. Mean High Water

S.T.I. Subject to Inundation

S/P Stock Pile

U/C Undercover Stockpile

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ISOPACH MAP OF WHITE SANDS

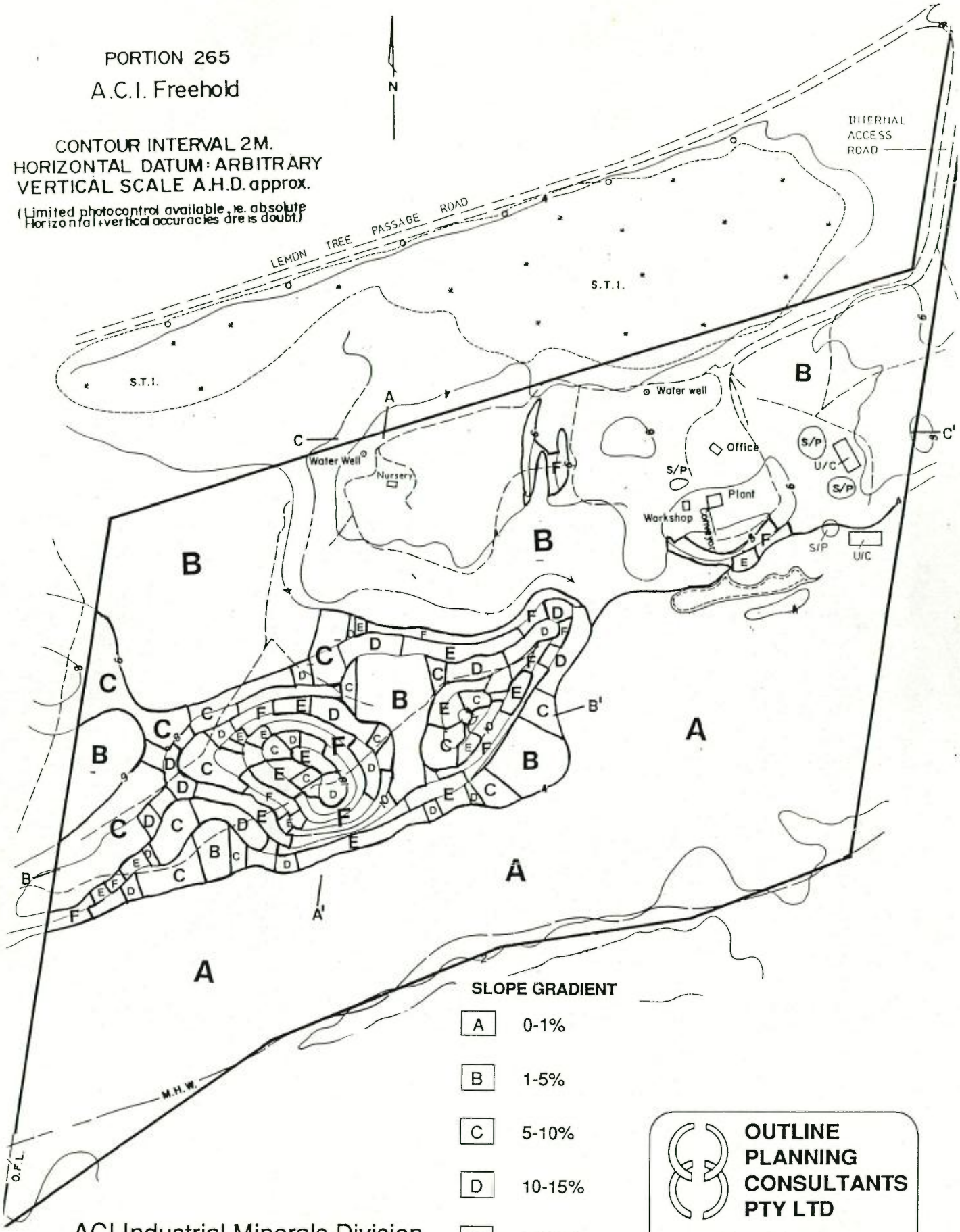
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PORTION 265

A.C.I. Freehold

CONTOUR INTERVAL 2M.
HORIZONTAL DATUM: ARBITRARY
VERTICAL SCALE A.H.D. approx.

(Limited photocontrol available, ie. absolute Horizontal+vertical accuracies are is doubt.)



SLOPE GRADIENT

A	0-1%
B	1-5%
C	5-10%
D	10-15%
E	15-20%
F	20% +

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Portion 265 E.I.S.

SLOPE ANALYSIS

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3.3 PROPOSED EXTRACTION PLAN

The white silica sand resource on Portion 265 will be mined by dry mining methods.

A bulldozer will selectively strip and stockpile the grey organic sandy topsoil, (at an estimated rate of 7 days/hectare), for immediate respreading over finished areas, (at an estimated rate of 4 days/hectare), and a front-end loader will develop a dry mine face as it selectively wins and tips sand directly into a nominal 25 tonne truck (net weight - 40 tonnes total gross weight) at the mine face.

The accompanying diagram illustrates the mining equipment to be used, and the mining method. Where the thickness of sand drops below 2 metres, the bulldozer will be used to push up raw white sand into a stockpile from which the front-end loader will load trucks.

Mining will not win sand thinner than 1 metre above Waterloo Rock basement or above a level which is 1 metre above the water table prevailing at the time of mining. Nor will mining extend lower than R.L. 4m AHD. The accompanying diagrams illustrate the mining depth limits depending on whether Waterloo Rock is absent or present, above, at or below the water table.

Aboriginal archaeological sites will be left intact. Mining will leave the recommended buffer zones around each site.

The mining operation will adopt the noise control treatment and mining plan recommendations as presented in the noise impact assessment report, (Working Paper No. 4).

Access to the main dune in the south west quadrant will be through the plant areas and across the drainage channel, via a causeway to be built.

Mining will strip topsoil from Mining Stage I and stockpile it for later use on completed mining stages and for immediate use on development scars - such as on the channel embankments around the causeway - and a front-end loader will develop a dry mining face within Mining Stage I, in a westerly direction, on both sides of the dune's ridge line. On depletion of reserves in Mining Stage 1, mining will proceed further in a westerly direction into Mining Stage II. The topsoil will be stripped from Mining Stage II and immediately respread onto the finished slopes of Mining Stage I. Mining will then develop a westerly advancing face within the mining stages on the main dune.

Each Mining Stage is approximately one (1)hectare. At any given time, no more than 1 ha of ground will be stripped ahead of the face, no more than 1 ha will be in the process of being mined, and no more than 1 ha will be under the topsoil respreading phase.

In this way a progressive mining and rehabilitation program can be established.

Topsoil for each Mining Stage will come from land stripped ahead, with topsoil for the last stage coming from topsoil carried forward during the mining of first stage mining areas. As mining progresses, the stockpile of surplus topsoil will be progressively replaced with fresher topsoil.

Unsold by-product sands from the processing plant will be returned to the pit floor where they will be evenly spread before topsoil from the next Mining Stage is transferred as a final cover. It is proposed that a maximum of 5 truck movements per hour within the site would be required, similar to existing levels of truck movement from P.O. 86/25 to the site.

There will be periods during the mining program when equipment will be either turned off or in use elsewhere, such as around the treatment plant area, and well away from the mine site. The Final Profile Plan depicts the final surface contours on completion of the proposed development. The last stages will essentially be levelled to the height of the surrounding land near the stockpile areas and plant, but the early stages on the main dune, will just be lowered a few metres and retain a similar topographic shape to the original dune.

3.4 EXTRACTION AND PRODUCTION RATES

It is proposed to extract the resource at an average rate of approximately 80,000 - 90,000 tonnes per annum over a nominal operation life of just over $1^1/_2$ years.

The design requirement for production will be at a rate of 80,000 - 90,000 tones per annum over a period of just over $1^1/_2$ years. On the basis of past operations the expected average rate of output of the plant per month is of the order of 6,670 tonnes per month, or approximately 300 tonnes per day.

3.5 PLANT DESCRIPTION

The following items of plant will be used to carry out the extractive operation. The descriptions are based on existing equipment currently used.

D.B. 14 Bulldozer - used to strip and stockpile the topsoil layer.

Caterpillar 966 Front End Loader - a rubber tyred, four wheel drive loader fitted with a 3.5m^3 bucket. The vehicle will be used for:

* loading haul vehicles with raw sand;
* loading oversized material for return to resource area;
* extraction of mine face.

Haulage Vehicles - haul trucks of 40 tonnes (total) gross weight will be employed to carry raw sand to the processing plant and processed sand away from the site to end users. Trucks used will typically be tri-axle semi-trailers which will be loaded by a front-end loader. Trucks will travel via Lemon Tree Passage Road. Contractors will be used for haulage operations.

Other Equipment - Typical earthmoving and allied equipment to be used from time to time at the extraction site and along the proposed haul routes will be:

* Caterpillar 930 front end loader, fitted with a 2.3m^3 bucket.
* Caterpillar D6 bulldozer.
* Caterpillar 12 Grader.

Existing plant on Portion 265 have been described in Section 2.11.1.

3.6 SAND EXTRACTION PROPOSAL: HOURS OF OPERATION AND EMPLOYMENT

The sand extraction and delivery operations will occur between the hours of 6am to 4pm, Monday to Friday. Operation of the site quarry will on average employ up to three persons including one plant operator, one loader/truck operator, and one site manager/rehabilitation manager.

3.7 ENERGY USAGE

The source of energy required to operate this mine, that is, to operate the earth moving equipment and heavy road transport, is diesel fuel.

It is expected that mobile equipment on the site, including existing plant, would consume approximately 100,000 litres of diesel fuel per annum. This consumption of diesel fuel equates with a primary energy use of 4.4×10^{12} joules.

3.8 WATER MANAGEMENT

ACI Industrial Minerals already has in place a water management system at its existing processing plant which collects process water for recycling back to the process plant. No increase in water usage is envisaged with the proposal going ahead. A relatively small amount of the process water will be drawn for the purpose of dust suppression watering of the short haul routes proposed on the main dune, particularly when dry windy conditions prevail.

Air pollution, in particular, from dust generation, is expected to be minimal from this proposed development since the area to be mined is well within the property, sheltered on all sides by Tall Open Forest or Forest Swamps, and is not subject to significant wind exposure.

Minimal dust generation will be experienced during the stripping stages (of vegetation and overburden topsoil), but these stages of mining development will be intermittent and short lived and restricted to 1 ha blocks at any one time.

Due to the inherent granular nature of silica sand particles and the relatively close proximity of the water table, significant dust generation is not envisaged. Mined raw sand will be transported internally by truck only a short distance to the on-site treatment plant.

Dust generation from product sands in stockpiles is not a problem due to the sheltered location of the treatment plant and storage areas, and dust generation from product sands transported by road to Sydney is eliminated by covering the load to protect the high grade sands from contamination and moisture absorption.

Silica sand on Portion 265 will be won by dry mining methods. Mining will not extend closer than 1 metre to the water table.

No additional water than that which is already being drawn from the two approved wells on Portion 265, for the plant process, will be drawn from the site of the proposed mining development.

Mining will not extend closer to the watercourses and wetlands on Portion 265 than R.L. 4 metre A.H.D contour.

All operational areas, raw sand stockpiles, topsoil stockpiles and windrows of cleared trees will be placed above this contour line.

The only structure which will interact with the watercourse on site is the proposed causeway. The aim is to provide the simplest possible crossing of the watercourse for truck access to the main part of the resource, with minimal disturbance to the vegetation in and on the banks of the watercourse and to the water quality and flow.

Rehabilitation is aimed at rapid re-establishment of native trees.

Water pollution is not considered to be a problem with this

3.9 ACCESS AND HAUL ROUTES

Additional haul routes to be created on Portion 265 will be constructed to a gravel standard. They are proposed to be located on either side of the main dune system, linked to the processing plant via a small culverted causeway. All haul routes have been designed to follow existing contours, with minimal steep grades employed. The haul routes are located to minimise the risk of sediment entering drainage lines and are, with the exception of the causeway, well above flood levels. All roads are far enough from streams and wetlands to provide an effective vegetative buffer to contain any sediment flowing from disturbed areas. In accordance with Soil Conservation Service guidelines, all haul routes will be provided with crossfall drainage at intervals of 30 metres, to reduce runoff along the road to a minimum. Fill battens are proposed to not exceed 2:1 and coupled with the provision of brush matting and revegetation of all disturbed slopes should provide a reasonable control against erosion or sedimentation.

The internal road passing between the workshop and the stockpile to the southwest of the office, will be extended towards the watercourse and a causeway will be constructed across the watercourse from the north eastern side to the sand height contour on the southwest embankment of the creek, at the edge of the main dune.

The accompanying diagram illustrates the proposed causeway design. The roadway will be as narrow as possible within safety limitations to minimise loss of creek vegetation, and yet broad enough to avoid sand spillage into the creek. A width of 4 metres is proposed. The causeway will contain three (3), one (1) metre diameter concrete drainage pipes which, on advice from ACI Industrial Minerals Division, will adequately allow for the maximum expected water flow in the creek. Field inspections to date have not as yet observed a water flow in the creek system through Portion 265. The pipes will rest on the creek floor and will be kept in place and covered with amber sand fill. A 250 mm thick layer of rock fill will be laid down on top of the sand fill as a final road base.

Internal roads within the dunes will be restricted to essential operating roads only, and will be located above the 4m A.H.D. contour level.

There is an alternate route from the extraction area to the processing plant through freehold properties to the south west owned and/or operated by other glass sand miners, (P.B. White Minerals Pty. Ltd. and Electric Lamp Manufacturers (Australia) Pty. Ltd., (incorporating Philips Industries Holdings & Newcastle Glass Works)), but the route is at least 4 kms longer and would involve the transportation of raw sand out onto Lemon Tree Passage Road, the construction of an appropriate intersection with Lemon Tree Passage Road, upgrading of the existing bush track, (approx. 1500 metres in length), to accommodate 40 tonnes trucks (gross), and the permission of the freehold landowners. Also, development of the resource from the south western end would not be as easy, as well designed, or desirable in view of the high level contours at the point of entry across the boundary into Portion 265.

The development of the silica sand resource on Portion 265 is to provide continuity of supply of raw sand to ACI Industrial Minerals Division's sand treatment plant on site for supply of treated sand to The Glass Sand Association Members. Thus the traffic situation prevailing at the present time, in terms of numbers and size of trucks, will be largely unaltered. A significant change, however, will be that for the period of development of this deposit, there will be no trucks carrying raw sand on any section of the Lemon Tree Passage Road, and no raw sand trucks using the plant entrance - Lemon Tree Passage Road intersection, since with a causeway built across the drainage channel on Portion 265, raw sand will be delivered to the treatment plant internally. Internal roads will be minimal and will be maintained with a compacted layer of rock fill. Mining equipment will consist of a front end loader and a bulldozer. Hours of operation will be daylight between 6am and 5.30pm.

Product sands will continue to be transported from the site via the treatment plant entrance/exit gate and road, off Lemon Tree Passage Road.

An average of twelve 40 tonne truck loads of processed sand leave the treatment plant daily on route to Sydney via Stockton and Newcastle.

3.10 LAND MANAGEMENT AND REHABILITATION

Prior to stripping the topsoil, the bulldozer will strip vegetation from within a Mining Stage, stockpiling large organic debris into windrows for later respreading during rehabilitation. Topsoil will then be stripped and immediately spread over the previously completed Mining Stage, except in the case of the initial Mining Stage from which the topsoil will be temporarily stockpiled for use on developmental scars and for later use on various Mining Stages.

As the protection of the watercourses and wetlands on the property is of prime importance in minimising the impact of the proposed mining development on the natural environment on Portion 265, mining will only strip vegetation and topsoil above the 4m A.H.D. contour. All operational activities and areas, raw sand stockpiles, topsoil stockpiles and windrows of cleared trees will be placed above this contour line.

In summary, the measures to be employed during the sand extraction and rehabilitation phases are:

(a) Topsoil is stripped and stockpiled for later spreading.

(b) Organic waste from material extracted is incorporated into the rehabilitation of disturbed land as brush matting. Fine organics, which contain seed of trees and shrubs, are used as top dressing to enhance seed generation.

(c) The deposit is worked from east to west, considered appropriate as the site can be prone to the influence of westerly winds. By carrying out extraction in this manner existing vegetation stands will act as an effective barrier to the effects of these winds.

(d) A windrow will be established at the base of disturbed/mined areas above R.L. 4m A.H.D. Advice from the Soil Conservation Service is this measure will act as an effective sediment and drainage control, in particular if used in conjunction with the following measures:

* provision for regular drainage along haul routes;

* provision for brush matting of disturbed slopes, once extraction is complete (this will ensure little soil erosion or sedimentation occurs);

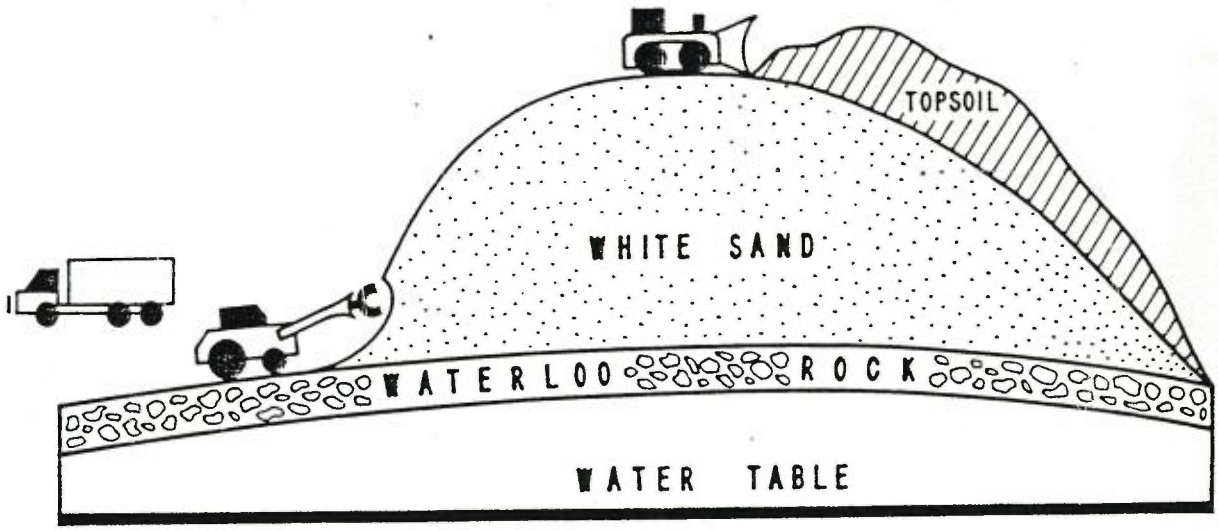
* provision for small breaks in the windrows for drainage purposes with a major sediment trap below each major break (the latter preferably on main drainage lines). It is noteworthy that as the area to be disturbed is very small, and with only a small part of a catchment affected, there will be only minor surface flows generated;

* access tracks to follow contours of the land. In steeper grades, speed bumps will be required in order to divert flows;

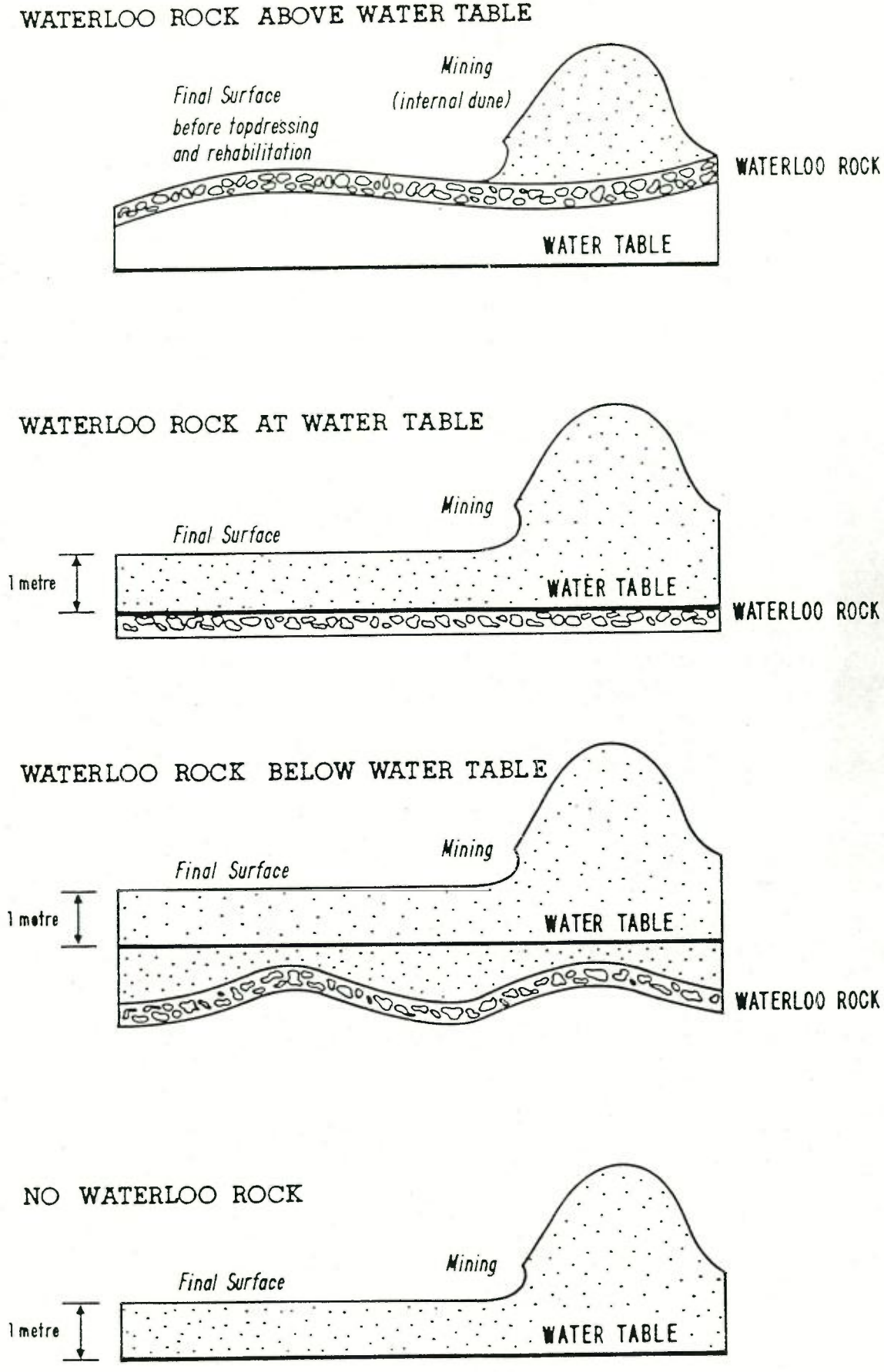
* provision for a silt fence, constructed of geo-textile fabric, to be located on the downstream side of the causeway. This will enable the periodic removal of any sand or other materials washed or blown from the causeway. This will ensure that no sedimentation or siltation of nearby wetlands

(e) extraction areas to be kept well above flood levels and are separated by a vegetative buffer on lands well upslope of any adjoining wetlands;

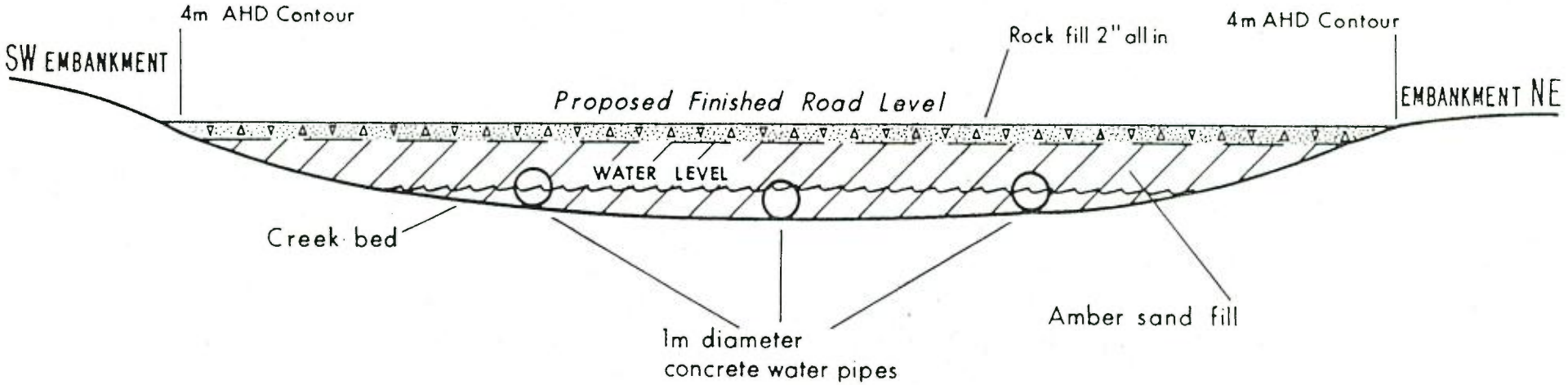
(f) minimisation of areas disturbed at any one time (1 ha extraction area, 1 ha stripped and cleared, 1 ha undergoing rehabilitation).



Sketch diagram of mining equipment and mining method



Sketch diagram showing the mining depth limits in various Waterloo Rock/Water Table configurations

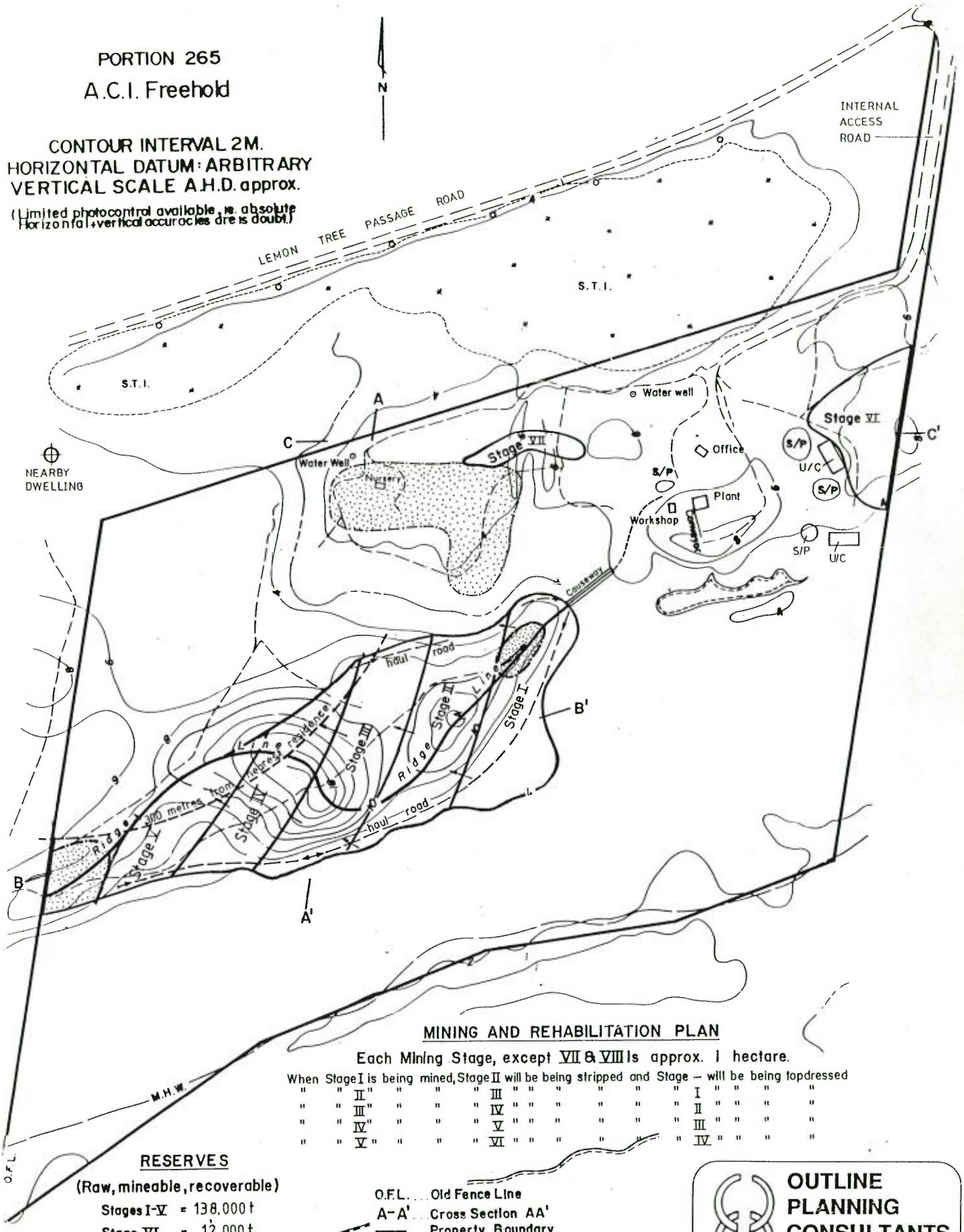


Roadway 4m width

Scale 1:200

Portion 265
CAUSEWAY DESIGN

Figure



MINING AND REHABILITATION PLAN

Each Mining Stage, except VII & VIII is approx. 1 hectare.

When Stage I is being mined, Stage II will be being stripped and Stage – will be being topdressed

" " II " " " III " " " " " " I " " " "
" " III " " " IV " " " " " " II " " " "
" " IV " " " V " " " " " " III " " " "
" " V " " " VI " " " " " " IV " " " "

RESERVES

(Raw, mineable, recoverable)

Stages I-V	= 138,000 t
Stage VI	= 12,000 t
Stage VII	= 2,000 t
TOTAL RESERVES	= 152 000 Tonnes

O.F.L. . . . Old Fence Line
A-A' . . . Cross Section AA'
——— . . . Property Boundary
M.H.W. . . Mean High Water
S.T.I. . . . Subject to Inundation
S/P . . . Stock Pile
U/C . . . Undercover Stockpile
. . . Aboriginal Archaeological Site

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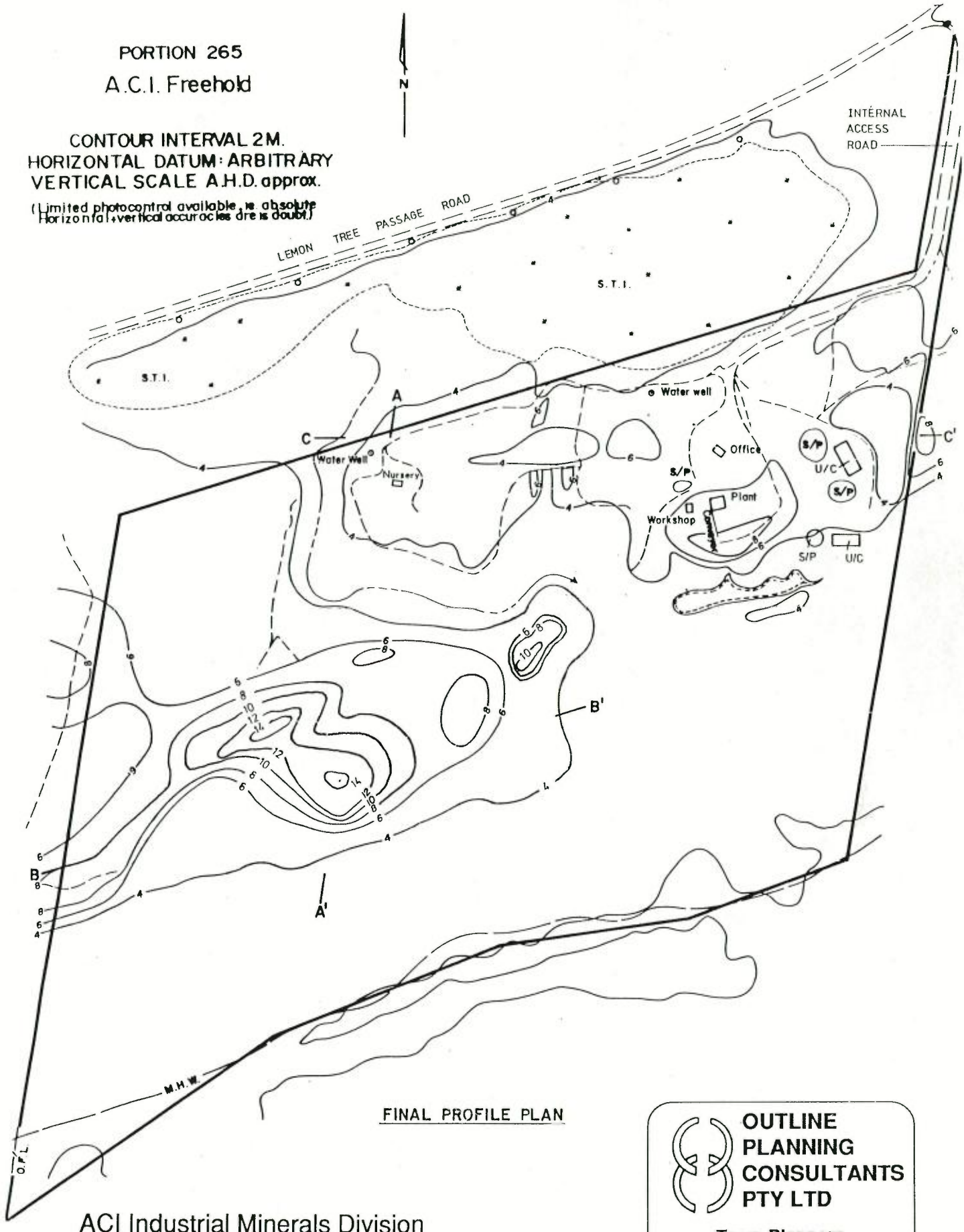
Portion 265 E.I.S.

MINING AND REHABILITATION PLAN

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FINAL PROFILE PLAN

ACI Industrial Minerals Division

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FINAL PROFILE PLAN

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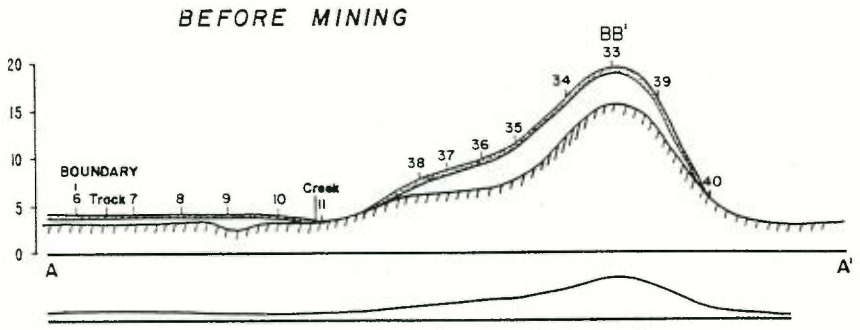
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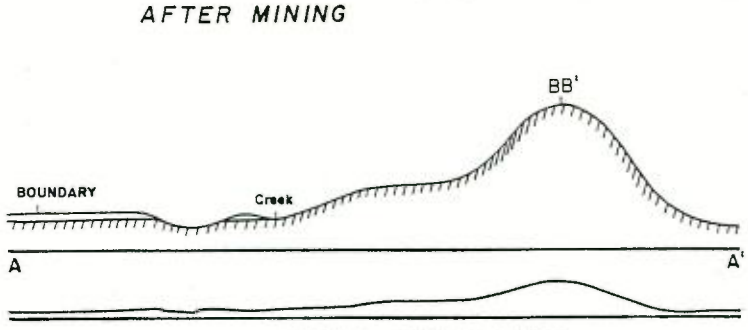
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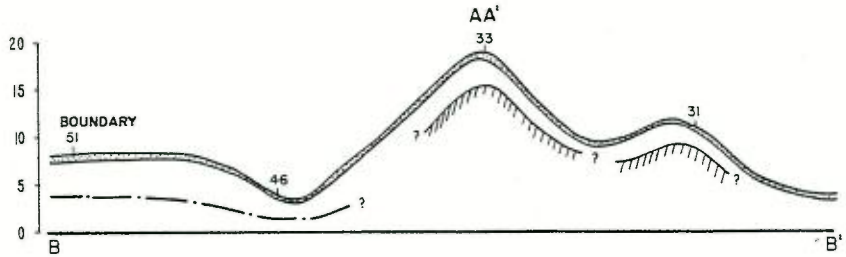
CROSS SECTIONS: EXISTING AND FINAL LAND PROFILES

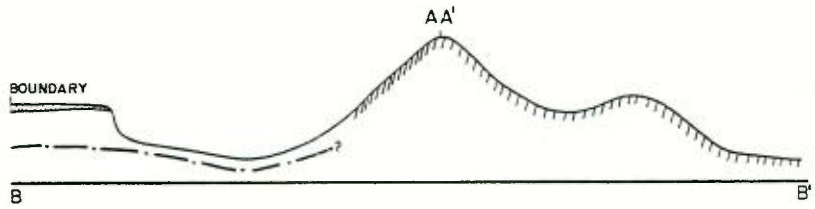
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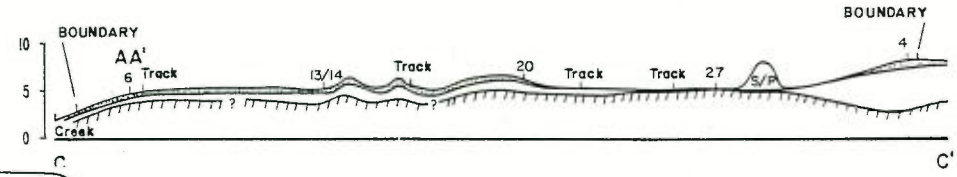
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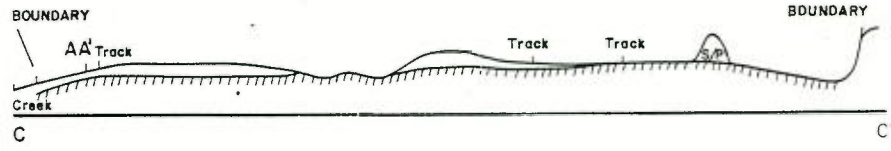












Grey organic sand (overburden) ....

White sand .....

Waterloo Rock contact .....

Water Table .....

Hole No 10 10

PORTION 265
A.C.I. Freehold.

CROSS SECTIONS
A-A', B-B', C-C'

Vertical Exaggeration ×5
Plan 14

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4. PROPOSED ENVIRONMENTAL SAFEGUARDS AND IMPACT STATEMENT

4. Proposed Environmental Safeguards and Impact Assessment

4.1 EFFECTS ON SITE TOPOGRAPHY

The post extraction morphology and longitudinal profile after extraction is represented in the accompanying diagrams.

The proposed extraction will result in a lowering of the level of the dune deposits to be extracted by up to 3.8 metres. The final surface will present a similar profile form to the existing surface, with an elevated dune system being retained after extraction.

The site topography of the land in and around the existing processing plant will not be affected. Existing cleared areas, buildings and structures will be retained without any further changes to the immediate surrounds.

The comparatively small scale of operations proposed on Portion 265, with 4.7 hectares of the site subject to any modification to site topography and with extraction limited in overall depth, are not expected to result in any significant affect on site topography. Existing elevated areas will be modified and retained, with slopes of the final surface being gentler than existing slopes.

4.2 HYDROLOGY

4.2.1 Surface Hydrology

As discussed in Section 2.6.1, the proposed extraction areas are situated on land well above the estimated 1 in 100 year flood level. Some flooding would be anticipated at the proposed causeway, linking the processing site to the extraction area on the main dune, however flood velocities and impacts would be minor, with impacts restricted to short-term periods only. Thus there is a possibility that flood events would interrupt extraction operations, however, it would be for a limited duration.

No fuels or oils would be stored or buildings constructed on flood prone lands on Portion 265.

The implications of flood events for the proposed development will therefore be minor.

The only structure which will impact on the watercourse on-site is the proposed causeway. The proposed causeway design is described in Section 3.9.

Construction of the causeway will temporarily disturb the water in the watercourse but the insertion of pipes large enough to adequately allow for the maximum expected water flow in the creek, will rectify this.

The causeway construction is a single, small, localised development which will only effect the immediate embankments of the creek where it crosses and the disturbance caused to vegetation and the ground surface will be immediately repaired to avoid subsequent erosion.

4.2.2 Groundwater, Wetlands Impacts

There will be no impact on the underground or exposed water on Portion 265 except for the temporary disturbance of the water in the drainage channel by the construction of the proposed causeway. The techniques, limitations and controls of the proposed mining development are designed to avoid adverse impacts on groundwater or wetlands areas.

There will be no significant impacts on S.E.P.P. 14 Wetland No. 810, Tilligerry Creek, Port Stephens since the proposed mining and rehabilitation program will ensure that all extraction, roads and other forms of on-site disturbance are conducted well above water table, watercourse and wetland water levels, so that the risks of soil erosion or sedimentation into lower areas of the site are minimised.

In the context of groundwater, drainage and wetlands impacts the proposal seeks to carry out a range of measures considered appropriate to the site and the proposal, and sufficiently comprehensive in scope to avoid significant adverse impacts. These measures include:

(a) Extraction of the white silica by dry mining methods.

(b) Mining will not extend closer to the watertable than to 1 metre above it.

(c) Mining will be restricted to a level above the 4m A.H.D. contour, so that all ground disturbance will be well clear of the boundaries of the watercourses and wetlands.

A windrow is to be established at the base of disturbed areas above R.L. 4m A.H.D. and with measures outlined in Section 3.10 will act as an effective sediment and drainage control.

(d) Provision for adequate drainage and sediment traps. There will be provision for regular drainage along haul routes. Small drains will be provided along the windrows, with sediment traps. A silt fence, constructed of geo-textile fabric, is to be located on the downstream side of the causeway, enabling sand or other wastes to be trapped, without impacting on wetlands downstream of this point.

(e) The rehabilitation procedures proposed will ensure rapid stabilisation and revegetation of the mined areas and thus avoid the chance of erosion which may otherwise deposit sand and soil in the adjacent wetlands. Particular care will be taken on the dune slopes near the creek.

(f) The total area to be mined on Portion 265 is only approximately 4.7 hectares and clearing an area of this size, (in total), is not expected to affect the water table, particularly since rehabilitation procedures are aimed at rapid re-establishment of the native trees.

(g) Extraction will occur at a level well above the groundwater level, in compliance with Hunter District Water Board requirements.

(h) No additional water than is already being drawn from the two approved wells on Portion 265, for the plant process, will be drawn from the site of the proposed mining development. Thus there will be no impact on the underground fresh water-salt water barrier between Portion 265 and Tilligerry Creek.

(i) Under no circumstances is the water from Tilligerry Creek to be allowed to enter Portion 265, in compliance with Hunter District Water Board requirements. No additional drains are proposed, nor are the wetlands to be affected.

The mining limitations listed above in (a) to (h) inclusive will also assist in preventing any inflow of underground or surface salt water from Tilligerry Creek.

4.3 IMPACTS ON FLORA AND FAUNA

4.3.1 Flora

The proposed sand extraction operations will only affect some 4.7 hectares of the site, or 16% of the total site area, with extraction completed within approximately $1^1/_2$ years. By the end of this period the entire area would be subject to a comprehensive rehabilitation program to enable the disturbed area to be revegetated with native vegetation. Based on the results of ACI's rehabilitation program on Crown lands previously worked nearby, a rehabilitated forest with trees of up to 12 metres in height can be achieved within 9 years of extraction being completed.

As the greatest impact the mining development has on the natural environment of the site is on the vegetation, the main emphasis is establishing mining and post mining safeguards which will be directed towards the progressive rehabilitation of the site. The aim of the rehabilitation programme on Portion 265, after sand mining, will be to re-establish the natural vegetation of the site. The post-mining landscape would thus be in harmony with the surrounding natural areas and the mined and rehabilitated Crown land to the east.

The safeguards which will be adopted will aim to prevent sand and soil erosion, and disturbance to the wetlands vegetation and the adjacent Tilligerry Creek system, and will ensure the return of natural vegetation and native fauna to the site.

The rehabilitation measures which will assist in the achievement of these aims are as follows:

(a) The restriction of stripping, (vegetation and topsoil), and mining activities to a level above the 4m A.H.D. contour, i.e. above the limit of the wetland vegetation.

(b) The restriction of all operational activities and areas, raw sand stockpiles, topsoil stockpiles and windrows of cleared trees to above the 4m A.H.D. contour, the only exception to this being the causeway which will cross the creek at 4m A.H.D and will have its supporting structure resting on the creek bed.

(c) The restriction of mining to small (max. 1 hectare) blocks so that topsoil can be transferred directly to the previously mined block, so as to realise the full regrowth potential of the seeds contained in the topsoil.

(d) The implementation of the following progressive rehabilitation programme to return native species to mined and disturbed areas (such as the creek embankments either side of the causeway), in the quickest possible time:-

Replacing the Topsoil

The topsoil, containing most of the organic matter, nutrients, micro-organisms, plant roots and propagules, (rhizomes, seeds, bulbs, etc.), will be transferred directly from the stripped areas to adjacent mined out areas. Areas containing Waterloo Rock hardpan as a basement after mining, should be ripped prior to topsoil return.

Brush Matting

Brush matting consists of plant material cut ahead of the mine face and spread in a thick layer over re-topsoiled areas. The plants are selectively cut ahead of the mine face, when in seed. The brush matting is thus a form of direct seeding as well as a protective mulch. This mulch retains ground moisture, reduces wind on the soil surface, and shelters seedlings arising from the seed it contains and from the soil. The brush matting is applied to disturbed areas once extraction is complete at any stage of the extraction program.

Direct Seeding

This involves harvesting mature seed when available, removing it from pods, cones, etc., pretreating it where necessary, and sowing it directly in re-topsoiled areas under the most suitable weather conditions.

Preserving Mature Specimens

Retaining a few scattered mature trees within the mine area. This method has been employed with some success on areas previously worked by ACI at Tanilba. The preserved trees react to the mining disturbance around them by flowering and releasing large quantities of seed. Large numbers of seedlings are produced around the tree.

Propagation

Growing native species in tubes, under nursery conditions, for planting out when established. A slow release fertiliser pellet planted with each tree assists early growth and establishment. Broad scale fertilisation, however, is strongly discouraged. ACI has its own nursery on the site, close to Mining Stage VIII, for this purpose.

Transplanting

Transplanting of mature plants or seedlings from ahead of the face or surrounding bush.

Transplanting of mature Grass-trees (Xanthorrhoea species) will be attempted. These should be burned immediately after being moved to stimulate new growth.

Organic Screenings

Organic material screened from the sand at the plant contains seeds of several species, especially Legumes (Peas and Wattles) and it is a valuable organic mulch. It will be spread over rehabilitation areas, especially exposed or eroding spots, to act as a form of direct seeding and to return some of the plant nutrients.

Monitoring

The rehabilitated areas will be inspected annually by a botanist to assess progress and detect problem areas. The rehabilitated areas will be regularly monitored by an on-site rehabilitation officer.

Existing wetlands areas on Portion 265 will remain untouched, with extraction and rehabilitation measures proposed to ensure that the integrity of these areas will not be adversely affected (see also Section 2.7.1, 3.10 and 4.2.2).

In respect of the Tall Open Forest community, vegetation stands on the main elevated dune and a small area near the processing plant will be affected - approximately 4.7 hectares in all. Approximately 7.5 hectares of existing Tall Open Forest will be unaffected by the proposed development, representing nearly 62% of the existing Tall Open Forest on the site. This estimate does not account for existing stands along either side of the internal access road located north of Portion 265. As such, the proposal will affect:

* approximately 4.7 hectares of the total site area of 29.34 ha, equivalent to 16% of the site area;

* no wetlands areas (with the exception of a very small area affected by the proposed causeway linking the main dune to the processing plant);

* approximately 38% of the existing Tall Open Forest on the site and no part of the wetlands.

The Tall Open Forest proposed to be retained during the extraction phase of the proposal links up with Tall Open Forest on privately owned lands to the east and west of Portion 265. The Tall Open Forest vegetation community is widespread regionally, occurring throughout the Tilligerry Peninsula and on other sand deposits on the New South Wales coast.

The sand extraction is expected to be completed in a little over $1^1/_2$ years, during which time the area will be progressively rehabilitated. The rehabilitation techniques are aimed at rapid re-establishment of the natural vegetation, which will minimise the possibility of erosion and disturbance to adjoining wetlands and forest communities. Rehabilitation BY ACI of the same vegetation type in the Crown land nearby has successfully restored the original tree, shrub and ground cover species. Tree heights of 7 to 15 metres are attained in 7 to 10 years.

Endangered species found on the site, that is two orchids and two Grass Tree Species, are widespread over Portion 265 within the Tall Open Forest. The proposed extraction will affect only a part of these vegetation communities. The other vegetation types on the site, all of which are wetland communities, will not be disturbed by the proposal except in the case of the causeway crossing the creek.

These vegetation impacts are considered acceptable, in particular given the rehabilitation measures proposed to revegetate disturbed areas back to a native Tall Open Forest. Existing rehabilitation of areas previously worked by ACI nearby to the site have shown that successful revegetation is achievable (see also Section 3.10).

4.3.2 Fauna

Mining will take place in small stages, with a gradual loss of habitat as each mining block is cleared.

With the implementation of the proposed rehabilitation program for Portion 265, the natural vegetation will be progressively re-established in the area. This would mean that in time the animal species could also become re-established.

In the meantime the similar vegetation types adjacent to mined areas are likely to act as reserves for the species temporarily leaving Portion 265 and also act as a source of recolonizing animals.

Recolonization by most animals is dependent on re-establishment of the natural vegetation. The rate and extent of recolonization will be determined by the progress and quality of vegetation regeneration. The greater the diversity of regrowth achieved, the greater is the potential for recolonization. This potential will increase as the vegetation matures.

There will a loss of approximately 4.7 hectares of Tall Open Forest - a potential koala habitat - on Portion 265, however, it is proposed to retain an existing 7.5 hectares of Tall Open Forest on the site. Located as this latter forest area is on the north of the site, and connecting with existing tall open forests on adjoining properties to the east and west, it is considered that koala movement corridors will be maintained on the site, at the same time as maintaining adequate habitat areas for koalas.

Overall disturbance is likely to be minor only, as the duration of the extractive operations are in the order of approximately $1^{1}/_{2}$ years. Once extraction is completed, and with subsequent rehabilitation and revegetation of mined areas habitats will be restored in the medium to longer term.

In summary, the area proposed for sand extraction supports a wide range of native fauna that is typical of this part of the Central Coast of N.S.W. In general, the extraction of sand from this area will have no significant effects upon the overall status of any native fauna in the area, with the exception of the White-bellied Sea-eagle. The Sea-eagle nests within a large tree on the sand dune proposed for mining. It is proposed that this tree be left untouched and a small buffer area provided.

The construction of a causeway across the swampland between the sand treatment plant and the dune could result in changes to the vegetation composition of the swamp upstream of the causeway and of the S.E.P.P. 14 swamp nearer to Tilligerry Creek, however, ACI have advised that the design of the causeway is such that it will not affect the hydrological regime of the area, and there is only relatively small area of swampland affected by the construction. Consequently, the impacts from the causeway will not be significant

There should be little problem with the continued conservation of Koalas within Tilligerry Peninsula. Provided patches of tall eucalypt forest are retained within Portion 265 and that the Swamp Forest is not touched, Koalas should be able to continue to live and breed in the area.

4.4 ACOUSTICAL IMPACTS

A noise investigation has been undertaken by Robert Fitzell Acoustics as part of this study and is included in APPENDICES 7 and 8.

4.4.1 Noise Level Design Goals

A noise level design goal of 48 dB(A) for the nearby residence to the west of Portion 265 has been adopted for the purposes of impact assessment. This level is considered appropriate given that it is unlikely that further residential development will take place in the area. This level becomes the upper limit for noise emanating from the proposed extractive operations and which can be considered to be acceptable on the basis that the machinery is acoustically treated and the predicted attenuation levels are achieved.

4.4.2 Noise Safeguards

It is proposed that all equipment be acoustically treated and that the hours of operation are adhered to. In respect to areas within 300 metres of the nearby residence located to the north west of the main dune it is proposed that no extraction occurs on that part of the main dune facing the residence (i.e. northern side of dune) on those slopes unable to achieve a minimum cut face of 2.5 metres with extraction occurring on that part of the main dune facing away from the residence (shielded by the dune). Subject to the following controls, extraction of these areas can occur:

(a) Implement an extractive program capable of achieving a minimum height of cut face of 2.5 metres (areas within 300 metres of residence).

(b) Implement extraction limits as noted in the Mining Plan.

(c) Where possible, coordinate operation of the bulldozer to occurs during periods of maximum frequency of westerly winds i.e. for winter months.

(d) Provision for suitable silencing equipment (bulldozer and front-end loader).

The premises will be scheduled under the Noise Control Act, administered by the State Pollution Control Commission (S.P.C.C.). It is a requirement that any proponent to obtain approval in writing from the S.P.C.C. prior to any clearing or extraction being carried out on the site. Conditions attached to any approval granted to the proponent (ACI) by the S.P.C.C. will require that an L90 level of 48 dB(A) not be exceeded at any nearby residential premises.

4.4.3 Predicted Noise Levels and Impacts

Noise levels for steady extraction and movement of vehicles and machinery associated with the proposal have been calculated as varying between 35 to 48 dB(A) for most of the operating life of the proposal.

Higher levels, potentially in excess of 55 dB(A), which would have occurred had there been extraction on the northern side of the dune within 300 metres of the adjacent dwelling, have been avoided by restricting extraction from such areas.

At distances larger than 300m, the combined effects of distance and ground attenuation, together with potentially significant shielding, ensure satisfactory levels at or below preferred criteria.

Mining operations are predicted to be audible, but at an acceptable level of noise impact.

Typical noise levels at the adjacent dwelling with extractive operations occurring at 300 metres and 600 metres distance are provided in Table 4.1 and 4.2.

Based on the above calculations and the recommended acoustic safeguards to be employed on-site, it is concluded that there will be minimal potential for adverse noise impacts to be registered by occupants of the adjoining residence. It is noteworthy that there is only one residence within 1 kilometre of the site, further enhancing the desirability of the proposal on grounds of acoustical impacts. The overall potential for adverse impacts is considered to be acceptable.

4.5 AIR QUALITY IMPACTS

The impact of the proposed mining development on air quality on Portion 265 will be minimal since silica sand being mined in inherently granular in nature, (sand sizing peaks in the 60# - 100# BSS [0.22-0.145mm] size range), and will generally be moist, due to the relative proximity of the water table. The mine site is also well sheltered on all sides from prevailing winds by Tall Open Forest and Swamp Forests.

The potential for dust generation will be minimised, however, by operating a single small face and keeping exposed areas to a minimum. At any one time, no more than 1 hectare will be stripped ahead of the face, (and this maximum area is only required in areas where the sand is thin (around 1 metre) and bulldozer strip mining and stockpiling of raw sand is required as opposed to the front end loader mining of a small working face, and no more than 1 hectare will be in the process of being top dressed ready for rehabilitation.

Additionally, watering of unsealed haul routes will be undertaken during prolonged hot windy conditions if vehicular traffic generates unacceptable dust lift-off. The sheltered nature of the deposits within a forested area should minimise the potential for dust nuisance to occur.

Table 4.1: Noise Levels at Nearest Residence (dBA) With Plant Operating at 300 metres

SOURCE	Sound Power Level	Attenuations					Resultant	Control	Resultant
	(dB(A) re 1 pW)	dispersion	air	ground	barrier	total	Lp	Treatment	Lp
Dozer under load	117	58	2	8	0	68	49	5	44
rolling down hill	111	58	2	7	0	67	44	5	39
under load, over hill	117	58	2	8	13	81	36	5	31
FE loader idling	100	58	2	6	0	66	34	5	29
under load	116	58	2	4	0	64	52	5	47
Haul Truck	110	58	1	3	0	62	48	–	48
Sand tip into empty truck	109	58	1	2	0	61	48	–	48

Maximum Plant Noise Level = 53 dB(A)

Typical Plant Noise, L_{10} = 49 dB(A)

Maximum Treated Plant Noise Level = 49 dB(A)

Typical Treated Plant Noise, L_{10} = 45 dB(A)

Criterion = 48 dB(A)

Table 4.2: Noise Levels at Nearest Residence (dBA) With Plant Operating at 600 metres

SOURCE	Sound Power Level	Attenuations					Resultant	Control	Resultant
	(dB(A) re 1 pW)	dispersion	air	ground	barrier	total	Lp	Treatment	Lp
Dozer under load	117	64	5	8	0	77	40	5	35
rolling down hill	111	64	4	7	0	75	36	5	31
under load, over hill	117	64	5	8	13	90	27	5	22
FE loader idling	100	64	4	5	0	73	27	5	22
under load	116	64	3	3	0	70	46	5	41
Haul Truck	110	64	2	2	0	68	42	–	42
Sand tip into empty truck	109	64	2	1	0	67	42	–	38

Maximum Plant Noise Level = 46 dB(A)

Typical Plant Noise, L_{10} = 41 dB(A)

Maximum Treated Plant Noise Level = 42 dB(A)

Typical Treated Plant Noise, L_{10} = 36 dB(A)

Criterion = 48 dB(A)

Dust generation from product sands in stockpiles is not a problem due to the sheltered location of the treatment plant and storage areas, and dust generation from product sands transported by road to Sydney is eliminated by covering the load to protect the high grade sands from contamination and moisture absorption.

4.5.1 Internal Access Routes

The proposed new internal access haul routes will be constructed to a 4 metre width with a gravel surface. The causeway is to be designed to a 4 metre width (see Section 3.9 for description). The upkeep of these roads is borne by ACI Industrial Minerals and the Glass Sand Association.

The proposed new haul routes will have a total length of only 700 metres, considered to be not long. In addition, these roads will be constructed to enable continuous year-round trafficability, with adequate drainage measures in place (see Section 3.9 and 3.10 for further description).

The new haul route will link up with the already sealed section of internal roadway which links the existing processing plant to Lemon Tree Passage Road.

An additional benefit of the proposal will be that no haul vehicle carrying raw (unprocessed) sand need travel along Lemon Tree Passage Road - the proposed development entails this sand material to be hauled internally within the site to the existing processing plant.

In view of the above, there will be minimal potential for a dust nuisance to be caused either on-site or at the neighbouring residence to the west of the site.

4.6 TRAFFIC AND ACCESS IMPACTS

4.6.1 Traffic Impacts

As outlined in Section 2.14.2, nearby heavy vehicle movements on Lemon Tree Passage Road during weekdays account for some 9% of total vehicle movements. Heavy vehicle movements associated with ACI's operations account for less than 1% of total vehicle movements, and only 8% of heavy vehicle movements.

The proposal will result in no additional truck movements on Lemon Tree Passage Road, given that extractive operations will be merely transferred from P.O. 86/25, 800 metres north of Portion 265, to the site.

In terms of traffic movements on Lemon Tree Passage Road, the proposed mining development will have a positive impact on the environment in that it will eliminate raw sand transport in trucks from a deposit external to the site of the treatment plant. With a causeway built across the drainage channel within Portion 265, raw sand will be transported internally from the mine face to the plant.

The internal cartage of raw sands will not impact adversely on the environment since the deposits are very close to the plant and the internal road system will be very short. The hours of operation, which are daylight 6am to 5.30pm (maximum - usually 4pm) are similar to that of the treatment plant and the mining development will be virtually an extension of the ongoing activities on-site.

The shipment arrangements for processed sand will not vary from the present practice and the impact that the transportation of processed sand has on the trucking routes to Sydney, will not change.

The internal access roads to the resource and the causeway across the drainage channel will not exceed 4m in width, so minimising the area of vegetation destroyed in their paths.

Vegetation disturbed on the embankments of the channel during construction of the causeway will be immediately rehabilitated and on cessation of mining all roads will be ripped, covered with topsoil and rehabilitated.

The causeway will be constructed as narrow as possible within safety limits to minimise loss of creek vegetation, and yet broad enough to avoid sand spillage into the creek. A width of 4 metres is proposed.

The causeway will contain three (3), one (1) metre diameter concrete drainage pipes which will adequately allow for the maximum expected water flow in the creek.

The proposed design will minimise damage to the creek and avoid any alterations to water flow in the creek and in the swamps at both ends of the creek.

Internal roads within the dunes will be restricted to essential operating roads only, and will be located above the 4m A.H.D. contour level.

In conclusion, the proposed development will result in beneficial impacts in terms of no additional truck flows created for trucks leaving the site with processed sand, and an actual elimination of haul vehicles using Lemon Tree Passage Road carrying unprocessed sand.

4.7 ABORIGINAL ARCHAEOLOGY

Three sites have been identified on Portion 265 as being worthy of preservation. The proposal seeks to implement measures aimed at preserving these features of the Aboriginal heritage. These measures are as follows:

(a) All three (3) sites (Sites 1, 2 and 4) on Portion 265 will be left undisturbed. No action will be taken with respect to Site 3, outside Portion 265.

(b) Fences will be erected around each site to be preserved, as detailed in the archaeological report, prior to mining developing the mining stage containing the site.

(c) The fences will be removed on completion of mining and rehabilitation works.

(d) All on-site employees and contractors will be advised of the necessity to preserve all sites and to abide by the procedures adopted to achieve this.

(e) If further sites or relics are unearthed during stripping operations, ACI will immediately inform the Regional Archaeologist of the N.S.W. National Parks and Wildlife Service.

With these measures in place the impact of the proposal on identified items of the Aboriginal heritage will not be felt.

4.8 VISUAL IMPACT ASSESSMENT

The existing treatment plant on Portion 265 can barely be seen from Lemon Tree Passage Road - the nearest public spectator point to Portion 265. The nearest stockpile is approximately 250 metres from this point.

The main dune sand extraction operations on Portion 265 is 280 metres from Lemon Tree Passage Road at its closest point.

The development will not be seen at all during mining on the southern dune ridge and may only just be seen, with difficulty, when extraction occurs on the small sand deposit located nearest the northern boundary of Portion 265. In the case of the latter deposit, the period of extraction would be limited to a number of months only, and as such are not likely to cause any significant visual impacts.

Return of topsoil to a finished area will cover the remnant white sands with a grey coloured organic sand cover, which well be more difficult to see through the stands of trees between the mine site and the main road or the western boundary than the white sands below, which more efficiently reflect light.

In general, the potential visual impacts of the proposal from the nearby residence and from Lemon Tree Passage Road will be mitigated, if not eliminated, by viewing distance and intervening existing vegetation. Overall visual impacts are minimal. Mining operations will be generally not visible from the above locations.

4.9 IMPACT ON AGRICULTURE

An assessment of the agricultural suitability of the subject land was undertaken by Outline Planning Consultants. The site is assessed as comprising Class 4 - 5 land. Land here is suited only for rough grazing or is not suited for agriculture (particularly applicable to wetlands areas). Agricultural production potential is very low to zero. The land has severe or absolute constraints to production imposed by environmental factors prevailing on the site.

Given the above it is considered that the impact of the proposal on the agricultural worth of the subject land is negligible.

4.10 LAND USE IMPACTS

The proposed mining development will have a short term impact on the existing land use in that the vegetation will be temporarily disturbed, making small areas temporarily unsuitable for habitation by local fauna until rehabilitation re-establishes the vegetation. The impact of extractive operations on the site will be for a limited duration only, in the order of $1^1/_2$ years.

ACI has not used the sites of the proposed extraction for any purpose since purchase and has plans for rehabilitating it after mining. The proposal does not adversely impact on the existing sand processing plant on Portion 265.

The fact that the land surface in the vicinity of the sand dunes to be mined will be lowered by a maximum of 3.8 metres (and generally only 1 to 2 metres) will not impact on any future plans ACI may have for the site and is not expected to have any effect on property values.

The proposed development is considered to not adversely impact on neighbouring:

(a) residence to the west of the site, or rural land uses associated with it (including usage of any groundwater);

(b) the wetlands vegetation stands located to the south of Portion 265, including S.E.P.P. No. 810, Tilligerry Creek;

(c) Tomago Sand Beds Water Supply, under the control of the Hunter District Water Board;

(d) groundwater reserves in the vicinity of the site;

(e) designated sand extraction areas to the east and west of Portion 265.

The effects of the proposal on land use will not be significant.

4.11 SOCIO-ECONOMIC IMPACTS

4.11.1 Local Employment

The proposed mining development of the white silica sand resource on freehold Portion 265 at Tanilba will maintain the level of local employment for plant personnel, road transport and earthmoving contractors.

Currently the existing leases and processing plant are operated by 5 personnel, full time, on-site, comprising the Plant Superintendent, Leading Hand Plant Operator, Quality Control Technician, Plant Operator and Plant Operator/Rehabilitation Officer, all of whom live locally.

In addition to these personnel, contractors are hired full time to strip overburden and load and cart raw sand to the treatment plant. These contractors are drawn from the local area and any employment multiplier effects stimulated by the proposed development will also be experienced in the local area and sub-region.

4.11.2 Glass Industry Employment

The glass industries of Sydney and Newcastle are dependent on a readily available supply of high quality white silica sands. The total number of people directly employed in these industries is approximately 1,750 people. There would be the potential for significant adverse impacts on these employment levels should the presently available source of this white silica sand cease.

4.11.3 Income Generation

Given the nature of the proposed operation there will be significant expenditure, locally and in glass industry plants in Sydney and Newcastle, on direct employment and capital equipment. The income generated by the proposal would embrace wages and salary bills for direct, indirect and induced employment, together with the multiplier effects from income expenditure.

4.11.4 A Needed Supply of Sand to the Glass Industry

The high grade white silica sands to be extracted from Portion 265 are an essential resource for Sydney and Newcastle glass, ceramic and chemical industries. The reliance by these industries on the Tilligerry Peninsula white silica sands is due to:

(a) The Tilligerry/Tanilba deposits are the closest available reserves of high-grade silica sand to the Sydney metropolitan area.

(b) The white glass sand attains high chemical purity and homogeneity after beneficiation, which is vital in glass and sodium silicate manufacture.

(c) The natural physical granulametry of the white sand is ideally suited to industry requirements.

The Tilligerry/Tanilba white silica sand deposits are of regional, if not state significance. they are the only remaining white silica sand deposits in the region, and are the only economic deposits presently existing in the state. The only other alternative supply of sand of this type is to be found interstate, however, this would not be economic to freight such a long distance to Sydney and Newcastle markets.

4.11.5 Extraction from Portion 265 as a Stop-gap Measure to Maintain Glass Supply in Short-term

The Glass Sand Association currently extracts approximately 85,000 tonnes per annum of high grade silica sand from its existing operations from Permissive Occupancy (P.O.) No. 86/25, located some 0.8 kilometre to the NE of Portion 265. At the time of writing, the current reserves have a life of approximately 3 months.

As a result, there is a most urgent need to gain further approvals to extract white silica sand from an alternative source in the locality. Portion 265, on which the existing ACI processing plant is situated, has been found to possess adequate reserves of high grade silica sand to meet only the next $1^1/_2$ years of demand.

The proposed development will bridge the gap between the mining of reserves on P.O. 86/25 (rapidly nearing depletion, with a 3 months supply remaining) and on the Northern Dune, and will provide continuity of essential raw material supplies to the Glass Sand Association member industries and continuity of employment for local personnel, including local service industries.

4.12 ENERGY CONSIDERATIONS

The energy requirements for the proposed extractive operations will comprise diesel fuel for mobile plant and electrical power for the existing plant (the latter not the subject of the proposed development).

The favourable physical characteristics of the sand resource on the site, the relatively small scale of operations proposed, coupled with the short haulage distances from the extraction sites to the processing plant, will result in an operation which is fuel efficient. The haulage distance for vehicles carrying unprocessed sand will be reduced, with haulage distances for vehicles carrying processed products maintained at current levels.

All mining equipment will be operated at the existing levels of operation.

No additional mining equipment will be used in the mining development of the deposits on Portion 265 than is currently used.

Any replacement mining equipment will be similar capacity and fuel consumption as equipment currently being used.

Overall, the proposal will result in a net reduction in energy usage compared with existing operations.

4.13 COMPATIBILITY WITH PLANNING CONTROLS, POLICIES AND GUIDELINES

The proposed development is considered compatible with the provisions of all applicable planning instruments, policies and guidelines.

4.13.1 Existing and Proposed Local Planning Instruments

Existing local planning controls are discussed in Section 2.15.2 of the E.I.S.

The subject site falls within the government area of Port Stephens Shire. The relevant local environmental planning instrument is Port Stephens Local Environmental Plan 1987. Clause 37 of this plan is particularly relevant. The underlying purpose of this Clause is to protect valuable and rare high grade silica sand deposits in the Tilligerry Peninsula, including sand deposits on Portion 265. The former defective wording of Clause 37 has been recently rectified and an amended Clause 37 gazetted.

In terms of the amended Clause 37 the proposed development is compatible with the relevant provisions in that:

(a) Portion 265 falls within that land indicated on the zoning map as edged orange, that is, the land to which Clause 37 relates. [Clause 37 (1)].

(b) The proposal complies with the object of Clause 37, that is, to ensure that the extraction of any silica sand from the deposits is not jeopardised. The proposal seeks to utilise the silica sand deposits, as this clause intends. [Clause 37(2)].

(c) The proposal is a permissible use. [Clause 37 (3)].

(d) The development proposed will not adversely affect the extraction of silica that is readily available from any other such land. [Clause 37 (6)(a)].

(e) An environmental impact statement has been prepared. [Clause 37 (6)(b)].

(f) The proposal will result in decreased vehicular traffic levels on Lemon Tree Passage Road, with no likely increase in the demand for public amenities and public services in the locality. [Clause 37 (7)(a)].

(g) No significant adverse environmental effects are likely to arise as a result of the development proceeding. Adequate safeguards are proposed to ensure that the environment of the locality is protected. These are discussed in detail in Sections 2, 3 and 4 of the report. [Clause 37 (7)(b)].

(h) Satisfactory rehabilitation measures have been proposed, capable of enforcement through the imposition of development consent conditions. [Clause 37 (7)(c)].

It is also noteworthy that the subject land does not fall within any environmental protection or similar zone.

Based on the above assessment, the proposal is compatible with local planning controls.

4.13.2 State Environmental Planning Policy No. 11 - Traffic Generating Developments

Under the provisions of the above state planning policy referral of the subject application to the Roads and Traffic Authority may be required. The assessment in Sections 2.14, 3.9 and 4.6 of the E.I.S. shows that the proposal will lead to a net reduction in heavy vehicle traffic flows on Lemon Tree Passage Road east of the site, with heavy vehicle traffic flows west of the site maintained.

The proposal is shown to have no significant adverse traffic impacts and is compatible with S.E.P.P. 11.

4.13.3 Hunter Regional Environmental Plan 1989

The Hunter Regional Environmental Plan 1989 was gazetted on 17th March 1989.

The proposal complies with the general objectives of Part 6 of the plan - Natural Resources, Division 1 - Mineral Resources and Extractive Materials - which encourages extractive industries under appropriate conditions.

The proposal is compatible with the following provisions of Clause 101 of the plan.

(a) The proposal considers the conservation value of the land and seeks to apply appropriate post-extractive land conditions.

(b) Relevant authorities have been consulted.

(c) Progressive and comprehensive rehabilitation measures have been proposed.

(d Groundwater/surface water effects have been found to be minor only.

(e) Transport routes have been considered in the context of the proposal. Impacts have been assessed as being an improvement on the existing situation.

(f) On-site catchment management strategies are proposed.

The regional/state significance of the Tilligerry Peninsula as a source of unusually pure white silica sand is recognised in the plan. The subject site forms a part of this designated area.

Clause 7 of Hunter R.E.P. 1989 provides that in the case of a development requiring development consent (such as the proposal):

" then the consent authority, the Director ..., should, in carrying out its or his or her function under the Act or under the instrument concerned, and for the purposes of advancing the aims and objectives of this plan ... consider the content of the background report and the objectives, policies and principles in this plan and relevant to the matter. "
(excerpt from Clause 7 of Hunter R.E.P. 1989)

The Background Report to Hunter R.E.P. 1989 states that in this regard:

> " Tilligerry Creek - Tanilba area of Port Stephens Shire contains unusually pure dune deposits of clear glass making sand. Industries in Newcastle and Sydney have taken steps to secure the long-range availability of this area, and to avoid sterilisation by incompatible surface uses, until the deposit is worked. "
> (page 59 of background report)

The above aims will need to be taken into account by Council when considering the E.I.S. for the proposed extraction of sand from the Northern Dune. The above statement reinforces and gives importance to the need for glass sand extraction to occur on the land the subject of the E.I.S.

Based on the above assessment, the proposed development is compatible with the Hunter Regional Environmental Plan 1989. The subject site has been specifically identified as being underlain by white silica sand of regional importance. It is of relevance to note that the plan does not identify the land as being of any environmental or conservation significance.

5. JUSTIFICATION OF THE PROPOSAL

5. Justification of the Proposal

5.1 CONTINUITY OF SUPPLY TO ESSENTIAL INDUSTRIES

The members of the Glass Sand Association collectively produce all of the glass containers, tableware, sheet glass, light bulbs and tubes manufactured in New South Wales. ICI uses high grade silica sand for the production of sodium silicate.

Glass furnaces run continuously 24 hours a day, 7 days a week and a continuous supply of glass making raw materials is critical to the viability of the glass manufacturing process.

The total number of people directly employed in the industries utilising this high grade silica sand, including the Sydney, and Newcastle based Glass Works, ICI's sodium silicate production operation at Botany, including subcontractors, is approximately 1,750.

Hence, the Glass Sand Association is not only a significant employer in New South Wales but, in view of its supply responsibilities, services and supports essential industries.

As the operator and administrator for and raw material supplier to the Glass Sand Association, it is ACI Industrial Minerals Division's responsibility to locate, evaluate, acquire and maintain a continuous source of high grade silica sand suitable for the Glass Sand Association member industries.

With the reserves on P.O. 86/25 near depletion, and at the time of writing with reserves sufficient to last only 3 months, with the Northern Dune development application in the process of being amended, ACI must turn to its own source of high grade white silica sand, on its own freehold property, as a stop-gap reserve.

The land is freehold (not Crown land) and will be retained by the owner, ACI Operations Pty Ltd, long after the proposed mining development is completed.

The deposit is only very small, occupying a total of approx. 4.7 ha, and is well hidden within Portion 265, which is 29.34 ha in size.

In short, the impact of the proposed mining development on the environment is expected to be minimal.

5.2 FEASIBLE ALTERNATIVES TO THE PROPOSAL

High grade, (i.e. very low iron = $\%Fe_2O_3$), white silica sand deposits are scarce within a 200 kms radius of Sydney. The Background Report to the Hunter Regional Environmental Plan highlights the comparative rarity of the white glass sands of the Tilligerry Peninsula.

The above findings are reflected in a recent study by the then Department of Mineral Resources of alternative sand resources in the Sydney-Newcastle area.

> " At present there are no secured resources and little potential for the securing of leached coastal dune deposits (such as those at Tanilba Bay) suitable for colourless glass manufacture close to the Sydney market. "
>
> (Dept. Mineral Resources (1986) "Construction and Industrial Sand Resources of the Newnes Plateau" SR Perover, N.S.W. Geological Survey Report GS 1986/214, p. 102).

Extensive exploration by ACI over 20 years has defined all significant, potential sources of white glass grade sand within 200 kms of Sydney. The high grade white silica sand dune deposits of the Tilligerry Peninsula represent the only significant deposits of this grade of sand close to Sydney.

The only deposits of high grade white silica sand remaining on Tilligerry Peninsula, (with the exception of the small deposits held by PB White Minerals Pty Ltd, Electric Lamp Manufacturers (Australia) Pty Ltd and Smorgon Glass Containers - all in a line either side of ACI's Portion 265 property - are the reserves in P.O. 86/25 held by the Glass Sand Association (approx. 3 months total supply), freehold Portion 265 held by ACI Operations Pty Ltd (this application - $1^1/_2$ years supply) and the Northern Dune P.O. 86/65, being applied for by the Glass Sand Association (30 years reserves).

With the reserves on P.O. 86/25 nearing depletion, and at the time of writing with reserves to last only 3 months, and the Northern Dune application in the process of being amended, there is no feasible stop-gap alternative to call upon.

Scattered white silica sand deposits occur north of Port Stephens, but these are lower in grade than the Tanilba sands and product recovery rates would be lower and treatment costs higher. These sands would also incur a significant freight penalty.

The sandstones of the Newnes Plateau, west of Sydney, are marginally closer than the dune deposits of Tanilba but are of much lower grade and require intensive treatment to meet glass grade specification. A new, more sophisticated plant would have to be designed and constructed at Newnes Plateau to treat these sandstones, and treatment costs would be significantly higher than at Tanilba - for a lower grade product. Development work on these sands to date have not been able to produce sands suitable for clear glass making purposes. Even if these deposits were comparable in quality and cost, (which they are not), there would be insufficient time for either one of them to be applied for and developed as a stop-gap alternative to the Portion 265 deposit at Tanilba.

5.3 CONSEQUENCES OF NOT PROCEEDING WITH THE PROPOSAL

If the proposed mining development of the white silica sand deposit on Portion 265, Tanilba, were not approved, and the reserves on P.O. 86/25 depleted before the Glass Sand Association were granted development approval and a permissive occupancy over the Northern Dune, ACI would have no choice but to purchase similar grade glass sands from interstate - from North Stradbroke Island, in Queensland or from Lang Lang in Victoria. These supplies would by-pass the Tanilba treatment plant and be despatched directly to the end user industries.

Additionally, Crown Corning requires a glass sand with a maximum iron level of 0.010%. The Tilligerry Peninsula white glass sands are the only recognised local source of sand meeting this requirement.

Hence the ACI Tanilba mining and treatment operations would shut down and all on-site personnel would be stood down until a development approval and a permissive occupancy were granted over the Northern Dune. The increased cost of this imported silica sand would be passed on to the user industries who in turn would pass it on to consumers by way of increased product prices or, alternatively, reschedule glass production interstate and wind down operations in New South Wales.

Justification for approval of the proposed mining development on Portion 265 is therefore considered to exist and approval will release for emergency use a small, $1^1/_2$ year stop-gap resource which will serve the Glass Sand Association member industries until long term reserves are secured on the Tanilba Northern Dune.

5.4 SITE PLANNING ALTERNATIVES

Known economic deposits of white silica sand are to be found within a limited part of Portion 265. These deposits are those which can be extracted within acceptable environmental parameters.

It could be physically possible to mine sand deposits on that part of the northern face of the main dune within 300 metres of a nearby residence, however, unacceptable background noise levels would result.

Destruction of the three existing Aboriginal sites, in order to obtain increased sand resources, is physically possible, however, this would be at the cost of the loss of significant sites of heritage value.

Increased utilisation of the sand deposits on the main dune, carrying out sand extraction to the edge of the wetland area to the south and east may be physically possible, but in doing so unacceptable adverse impacts on the wetlands may result (e.g. excessive sedimentation, siltation).

In general, the site planning alternatives to the proposal are not considered warranted.

5.5 JUSTIFICATION FOR THE PROPOSAL

The justification for the proposal is based on the following economic, social and environmental considerations. Further reasons are provided in Section 1.2, 1.3, 1.4, 2.1, 3.2, 4 and 5 of the report.

5.5.1 Economic

* Current reserves of white glass sand on the only other P.O. held by the Glass Sand Association is rapidly nearing depletion. At the time of writing, there is only a 3 months supply of sand remaining.

* The proposal will enable the supply of an essential resource to the Sydney and Newcastle glass, ceramic and chemical industries.

* The proposal will make a significant, albeit short-term, contribution towards reducing the known shortage of high grade silica sand in the state.

* The deposits contain a large proportion of the region/state's current short-term sources of high quality silica sand.

* The proposal will be a positive addition to economic activity in the region.

5.5.2 Social

* The proposal will provide continuing employment opportunities for an existing workforce in the sand extraction and glass industries.

* There will be no adverse effects on the amenity of the only nearby residence.

* There will be no adverse impacts on infrastructure, health, community and educational facilities as a result of the proposal going ahead.

5.5.3 Environmental

* The high grade silica sand deposits have been recognised in both local and regional environmental planning instruments as being worthy of protection for future sand extraction.

* The proposal will have no adverse impacts on groundwater.

* The proposed extraction works will be undertaken in such a manner as to minimise disturbance to the land and to watercourses in the locality.

* The proposal calls for the retention of a relatively large area of Tall Open Forest on the site - a potential koala habitat - with land clearing for extraction limited to approximately 16% of the total site area. Disturbed lands will be rehabilitated following extraction.

* No wetlands areas are to be cleared or affected (with the exception of a very small area for a temporary causeway).

* The proposal will be sufficiently screened from Lemon Tree Passage Road and a neighbouring residence.

* Sand extraction is located well above existing flood levels.

* Traffic and access impacts are reduced in the case of traffic flows along Lemon Tree Passage Road east of the site, and maintained for that part of the road west of the site. All haul roads for unprocessed sand are located within the site. Only vehicles carrying processed sand leave the site.

* Acoustical impacts have been shown to be within acceptable limits.

* Extraction will be limited to a period of approximately $1^1/_2$ years, with full rehabilitation and revegetation occurring both during and after extraction.

* Air pollution impacts have been found to be minimal.

* The proposal will not adversely impact on land use either on the site or surrounding lands.

* Energy usage is likely to be reduced compared with existing operations on P.O. 86/25.

* The proposal does not affect the agricultural suitability of the land.

* There should be little problem with the continued conservation of Koalas within the area. With the large parts of Tall Open Forest retained on Portion 265, and all of the Swamp Forest retained, Koalas should be able to continue to live and breed in the area and on the site. In addition, the known nesting tree of the White-bellied Sea-eagle is to be retained.

* The proposed development provides for the maintenance of extraction activities for a company with a proven track record and history of involvement in environmentally appropriate sand extraction and successful rehabilitation works.

APPENDICES

APPENDIX 1: ADVICE FROM GOVERNMENT AUTHORITIES

New South Wales Government

Department of Environment and Planning

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

Telephone: (02) 266 7111 Ext. 7235
Telex: DEP NSW 176826
Fax No.: 266 7599

Contact: V Thomson

Our reference: EHU 87/2782

Your reference:

Exploration Manager
Industrial Minerals Division
ACI Resources Limited
PO Box 1
WATERLOO NSW 2017 10

Dear Sir

RE: PROPOSED SILICA SAND EXTRACTION
PORTION 265, PARISH SUTTON, TANILBA

Thank you for your letter of 8 October 1987 indicating that you are consulting with the Director with regard to the preparation of an environmental impact statement (EIS) for the above development.

2. As development consent is required for the proposal and it is a designated development within the meaning of Schedule 3 of the Environmental Planning and Assessment Regulation, 1980, as amended, an EIS must accompany the development application to the Port Stephens 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 (see Attachment No.1).

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

. Examine impact on wetland vegetation, groundwater and adjacent Tilligerry Creek system.

. Possible impact on SEPP 14 Wetland No 810, Tilligerry Creek, Port Stephens.

. Results of consultation with Hunter District Water Board due to proximity to Tomago Sand Beds Water Supply.

4. 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.

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

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

Yours faithfully

B Adams 19/11/87

B. Adams
Manager
Environmental Assessments Branch

DEPARTMENT OF ENVIRONMENT AND PLANNING
ATTACHMENT No.1

STATUTORY REQUIREMENTS FOR ENVIRONMENTAL IMPACT STATEMENTS.

In accordance with Part 1V 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 Environment and 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 ENVIRONMENT AND 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 winning 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 Environment and Planning to properly understand the environmental consequences of the proposed development.

2/...

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.

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.
- Methods of extraction / plans of operations.
- Details of any blasting and/or crushing.
- Effects of vibrations.
- Type of machinery and equipment to be used.
- Expected life of the operation.
- Number of persons to be employed.
- 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.
- 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.

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 State Pollution Control Commission in regard to air, water and noise impacts and relevant pollution control legislation requirements;
- The Soil Conservation Service regarding appropriate erosion control and rehabilitation procedures;
- The Department of Agriculture if prime agricultural land may be affected by the proposal; and
- 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.

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

Port Stephens Shire Council

59 Port Stephens St. Raymond Terrace Tel (049) 83 1333

Telephone Enquiries:
Planning Dept
File No:
P9/2/3/855

Mr G R Pollington
Exploration Manager
Industrial Minerals Division
ACI Resources Ltd
PO Box 1
WATERLOO 2017

Dear Sir

Re: **Proposed Extractive Industry - White Silica Sand Mining - Portion 265, Tanilba Bay**

I refer to your correspondence dated 8 October, 1987 received by Council (via Fax) on 5 February, 1988 and apologise for the delay in replying. You are advised that the following specific issues of concern should be included for consideration when preparing the Environmental Impact Statement associated with the above development:-

1) Access

- Provision of legal access to the site.

- Anticipated traffic movements and appropriate intersection construction.

2) Drainage

- The effect of the sand extraction on existing drainage channels including Tilligerry Creek and its ecology and wetland.

- The effect on underground water and the associated catchment areas.

3) Rehabilitation

Techniques to be employed.

As per Council's previous verbal advice, due to the existence of the more comprehensive Northern Dune Environmental Impact Statement, the required Environmental Impact Statement for Portion 265 may be submitted in a more condensed form. It

11 May, 1988

WATER WONDERLAND PORT STEPHENS SHIRE

All correspondence to be addressed to the General Manager P.O. Box 42 Raymond Terrace 2324. (DX 7879 Newcastle)
Facsimile (049) 87 3642

Port Stephens Shire Council

59 Port Stephens St. Raymond Terrace Tel (049) 83 1333

this regard, the Environmental Impact Statement should cover all issues for consideration without cross-reference to the previous Environnmental Impact Statement to avoid the need to exhibit both documents.

Should you have need of further information in relation to your proposal, please contact Mr Keith Blackmore of Council's Town Planning Department.

Yours faithfully

J W Walsh
GENERAL MANAGER/SHIRE CLERK

KB/DW

All correspondence to be addressed to the General Manager P.O. Box 42 Raymond Terrace 2324. (DX 7879 Newcastle)
Facsimile (049) 87 3612

HUNTER DISTRICT WATER BOARD

P.O. Box 5171B, Newcastle West N.S.W. 2302. Australia
Telephone (049) 267267 Telex Watsup 28714 DX 7858

Reference: VIS:BB VIS3/38
Enquiries: Vis
Extension: 350

11 May 1988

G R Pollington
Exploration Manager
Industrial Minerals Division
ACI Resources Ltd
PO Box 1
WATERLOO NSW 2017

Dear Mr Pollington

Re: Proposed Silica Sand Mining on ACI Resources Ltd Freehold Block, Portion 265, Tanilba

I refer to your letter of 4 May 1988.

Portion 265 is in close proximity to Tilligerry Creek and also to Board's groundwater extraction bores pumping water to Lemon Tree Passage treatment plant. Consequently, we require two additional conditions in relation to the sand mining at the above site. These are:

i Groundwater extraction is not permitted in the above site.

ii Under no circumstances should the water from Tilligerry Creek be allowed to enter into the above land.

The above conditions are essential to prevent any possible salt water intrusion from Tilligerry Creek.

Yours faithfully

M DAY
Water Investigation
& Planning Engineer

New South Wales Government

State Pollution Control Commission

New South Wales
Government Offices
117 Bull Street
Newcastle West 2302
P.O. Box [redacted] 488G
Newcastle West 2302 2300
Our reference: 270550C2 CH:SS
Your reference:

Telephone: (049) 26 9711
Telex: AA 28110

The Exploration Manager
ACI Resources Limited
PO Box 1
WATERLOO NSW 2017

15 JUN 1988

Dear Sir

Proposed Silica Sand Mining on ACI Resources Limited Freehold Block, Portion 265, Tanilba

We refer to your letter of 5 May 1988 seeking our advice on issues to be addressed in an Environmental Impact Statement for the above project. As you are aware our statutory responsibilities are imposed by the Clean Air, Clean Waters and Noise Control Acts and we are concerned to ensure the requirements of these Acts are complied with.

The premises will be scheduled under the Noise Control Act and this Act requires that you obtain approval in writing from the Commission prior to any extraction being carried out on the site. In this context, when preparing the EIS, you should assess the existing noise climate with respect to any residences likely to be affected by the development, estimate the possible noise impact and propose measures to control any excessive noise emissions.

While no statutory approval is required by the Clean Air and Clean Waters Act, the potential for air and water pollution from the operation should be addressed. In particular the possibility of pollution of underground waters and the waters of the adjacent Tilligerry Creek should be considered and control measures proposed should this be necessary.

It appears that the most likely cause of air pollution from the proposal would be wind-blown dust from areas cleared ahead of the extraction and finished areas awaiting rehabilitation. Control of dust from these sources should be addressed in the EIS.

We trust that this information is adequate for your purpose but should you have further queries please do not hesitate to contact us again.

Yours faithfully



B M Gibbs
Regional Co-ordinator
Newcastle
for Secretary

New South Wales Government

National Parks and Wildlife Service

CENTRAL REGION

Lee Nash House
7 Charles Street
Parramatta

P.O. Box 95
Parramatta 2150

Our reference: BC/TC CR/1272

Your reference:

Telephone: 689-5008

G.R. Pollinton
A.C.I.
Box 1
P.O. Waterloo
SYDNEY. 2017

Dear Mr Pollington,

PROPOSED MINING DEVELOPMENT
PORTION 265, TANILBA

Reference is made to the EIS in preparation for the above mentioned proposal and the likely impact of mining on archaeological resources.

You do not indicate in your letter whether ACI have had an archaeological assessment made of the proposed extraction area (I assume not). The Service does not have records of any Aboriginal sites on the land, however as no survey has been undertaken the absence of Aboriginal sites is not conclusive. Large numbers of Aboriginal sites (particularly shell middens) are recorded to the east and north of the proposed extraction site. This, together with the proximity of the land to Tilligerry Creek and Big Swan Bay, suggests that middens <u>are</u> likely to occur on Portion 265.

An archaeological survey is therefore required. It should be undertaken by a qualified consultant who should be briefed to:

- locate and record Aboriginal sites in the development area;
- assess the likely impact of extraction on the sites;
- advise ACI (as per para. 3 of your letter) of control measures to ensure the sites are not affected;
- or alternatively if ACI decide to apply to the Director of the National Parks and Wildlife Service for Consent to Destroy an Aboriginal site, assess the significance of the site in

relation to the proposal;

- liaise with the Local Aboriginal community in relation to the survey and future management of the sites.

If you have any enquiries about this advice please contact me.

Yours faithfully,

B Conyers

Bronwyn Conyers
for Director

17th May, 1988

New South Wales Government

National Parks and Wildlife Service

CENTRAL REGION

Lee Nash House
7 Charles Street
Parramatta

P.O. Box 95
Parramatta 2150

Our reference: CR/1272 BC:JF

Your reference:

Telephone 689 5008

Mr G Pollington
ACI
P O Box 1
WATERLOO 2017

Dear Mr Pollington,

ABORIGINAL ARCHAEOLOGICAL SURVEY, ACI FREEHOLD, PORTION 265, TANILBA, NSW

The abovementioned report has been assessed by an archaeologist from the Service and is considered to be satisfactory.

A total of four sites were found, three of these within the boundaries of the extraction area. The consultant has recommended that the sites be retained undisturbed and to ensure this, interim fencing of the sites has been proposed. The Service concurs with the recommendations of the report and provided fencing is carried out under archaeological supervision prior to commencement of work, the Service has no objection, on the grounds of Aboriginal sites, to the proposal.

Yours faithfully,

B Conyers.

B. CONYERS
for **Director**

WORIMI LOCAL ABORIGINAL LAND COUNCIL

SHOP 9,
KOOINDAH SHOPPING CENTRE,
TANILBA BAY 2301

Telephone: (049) 82-3405

18th July, 1988

Mr G.R. Pollington,
Exploration Manager,
ACI Industrial Minerals Division,
P.O. Box 1,
WATERLOO N.S.W. 2017

Dear Sir,

RE : Aboriginal Archaeological Survey, ACI
Freehold Portion 265, Tanilba Bay, N.S.W.

Please find attached the report relating to the above mentioned Aboriginal Archaeological Survey. The report also contains certain conditions that the Worimi Local Aboriginal Land Council feels should be adhered to regarding the extraction of sand from portion 265.

Yours sincerely,

Jeff Bradford,
Chairman & Co-Ordinator

REPORT AND EXPRESSION OF INTEREST OF

WORIMI LOCAL ABORIGINAL LAND COUNCIL

PERTAINING TO

ABORIGINAL ARCHAEOLOGICAL SURVEY ACI

FREEHOLD PORTION 265 TANILBA BAY

REPORT PREPARED BY

MR JEFF BRADFORD

CHAIRMAN & CO-ORDINATOR

WORIMI LOCAL ABORIGINAL LAND COUNCIL

SHOP 9 KOOINDAH SHOPPING CENTRE

TANILBA BAY N.S.W. 2301

INTRODUCTION

On 20th June, 1988 I Jeffrey Bradford, Chairman and Co-Ordinator of the Worimi Local Aboriginal Land Council accompanied Ms Denise Donlon and Laura Jane Smith, Archaeologists in an Aboriginal archaeological survey commissioned by ACI Resources Limited and conducted on freehold portion 265, Tanilba Bay N.S.W.

During the above mentioned survey several sites were identified, these being shell middens. The sites which total 4 in number are considered to be of high significance by the Worimi Local Aboriginal Land Council and therefore, inkeeping with the Councils policy pertaining to Aboriginal sites should, under no circumstances be destroyed, disturbed, removed or otherwise tampered with, without the express written consent of the Worimi Local Aboriginal Land Council.

DISCUSSION ON SITE SURVEY REPORT

On Tuesday 5th July, 1988 the Archaeological Survey prepared by Ms Denise Donlon was tabled during a duly constituted meeting of the Council. The report was studied in depth by the meeting, and resulting in the unanimous decision being taken, that being, that ACI Resources be informed that the Worimi Local Aboriginal Land Council requests that ACI Resources consent in writing to adhering to the following conditions prior to the commencement of any work relating to the extraction of sand from the portion of land 265. Such condition as listed being inkeeping with the National Parks and Wildlife Services Act, 1974.

The conditions to which agreement is sought are :

1. That all four (4) sites as mentioned in the survey be retained undisturbed.

2. That fences be erected around sites 1, 2 and 4 in such a manner to give the buffer zone recommended by the survey report.

3. The fences should be removed once mining is completed.

4. That ACI ensure that all employees and contractors working on portion 265 are made aware of the provisions of the National Parks and Wildlife Services Act, 1974 under which it is an offence to disturb or destroy Aboriginal relics.

Further to the conditions listed above the Worimi Local Aboriginal Land Council requests that ACI give consideration to making provision for the employment of an Aboriginal sites curator to monitor the work on a regular basis. The Council considers this request not to be unreasonable, on the following grounds.

1. Visability of the survey area is poor.

2. It is likely that sites were missed by the survey team.

3. Very little survey work has been undertaken in Port Stephens in the past, with developers having a free reign, resulting in the destruction of many Aboriginal sites. The Council is of the opinion that responsiblity for the protection and retention of sites not identified by the archaeological survey, but in all likelyhood are present in the proposed mining area, lies solely with those who wish to profit from the mining or development of lands known to or suspected of containing Aboriginal sites.

New South Wales Government

Soil Conservation Service

PO Box 488G
NEWCASTLE 2300
Telephone: (049) 269882

The Exploration Manager
Industrial Minerals Division
ACI Resources Limited
PO Box 1
WATERLOO NSW 2017

Contact: Mr J Hunt
Our reference: L392
Your reference:
10th May, 1988.

Dear Sir,

Proposed Silica Sand Mining on
ACI Resources Limited Freehold Block,
Portion 265, Tanilba.

I refer to your letter of the 5th May, 1988, seeking Service comment on the above proposal. The tendered documents have been reviewed and the following comments are presented for your information.

Attached please find a copy of the Service's "Guidelines and Requirements for Environmental Impact Statements/Studies for Urban and Associated Developments", which provides a checklist of pertinant soil conservation matters that should be addressed by a proposal such as yours.

Areas of particular interest with your specific proposal include the following:

- the potential exposure of the site to strong winds which may adversely affect rehabilitation measures;
- the potential for the use of temporary cover crops as part of the rehabilitation program;
- land stripping and topsoil stockpiling procedures;
- erosion control of product stockpiles;
- establishment and maintenance of a vigorous stabilizing vegetative cover.

I thank you for this opportunity to comment on your proposal, and would be pleased to discuss further any of these aspects as your planning of this proposal proceeds.

Yours faithfully,

.....

J.S. Hunt
for J.A. Butcher
Regional Director
EASTERN REGION.

APPENDIX 2: SITE DESCRIPTION

STATE OF NEW SOUTH WALES

CROWN GRANT

TORRENS TITLE

No. 48685

Register

Vol. 13739 Fol. 205
Registered 20-11-1978

Registrar General

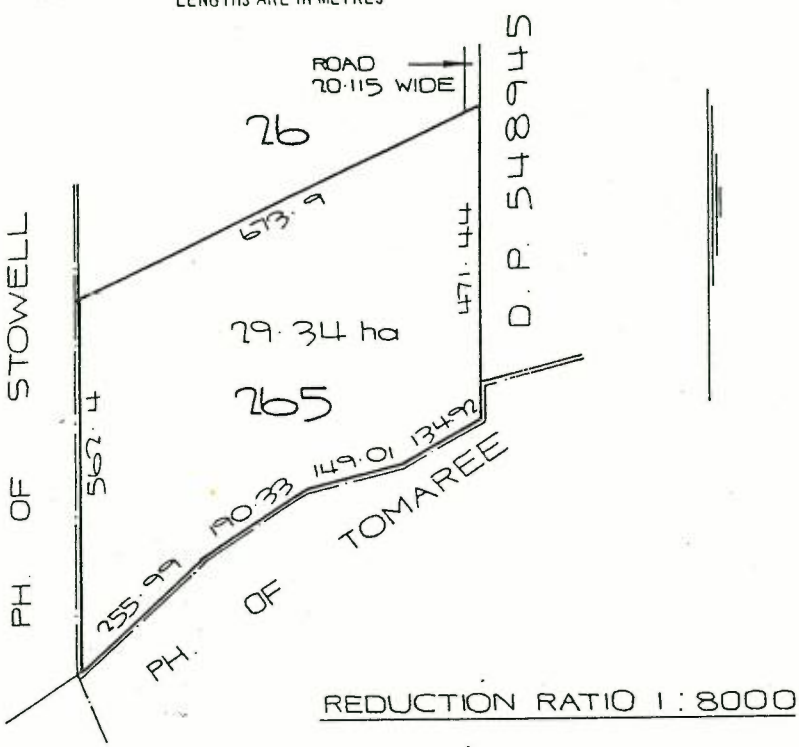
We, Elizabeth the Second, by the Grace of God Queen of Australia and Her other Realms and Territories, Head of the Commonwealth, do hereby grant to the person described in the First Schedule an Estate in Fee Simple in the land within described, subject nevertheless to such reservations, conditions and other provisions as are shown in the Second Schedule. In testimony whereof We have caused this Our Grant to be sealed with the seal of Our said State

Witness Our Governor of Our State of New South Wales and its Oependencies in the Commonwealth of Australia, at Sydney in Our said State, this fourteenth day of November in the twenty seventh year of Our Reign and in the year of Our Lord one thousand nine hundred and seventy eight.

Governor

PLAN SHOWING LOCATION OF LAND

LENGTHS ARE IN METRES



REDUCTION RATIO 1 : 8000

LAND REFERRED TO

Portion 265 in the Shire of Port Stephens Parish of Sutton and County of Gloucester.

FIRST SCHEDULE

~~RALPH FRANCIS SUTERS of 26 Damour Avenue East~~ Lindfield.

SECOND SCHEDULE

1. The reservation and exception unto Us Our Heirs and Successors of:-
   (a) all minerals which the said land contains with full power and authority for Us Our Heirs and Successors and such person or persons as shall from time to time be authorised by Us or Them to enter upon the said land and to search for mine dig and remove the said minerals;
   (b) all such parts and so much of the said land as may hereafter be required for public ways in over and through the same to be set out by Our Governor for the time being of Our said State or some person by him authorised in that respect with full power for Us Our Heirs and Successors and for Our Governor as aforesaid by such person or persons as shall be by Us Them or him authorised in that behalf to make and conduct all such public ways; and
   (c) the right of full and free ingress egress and regress into out of and upon the said land for the several purposes aforesaid or any of them.

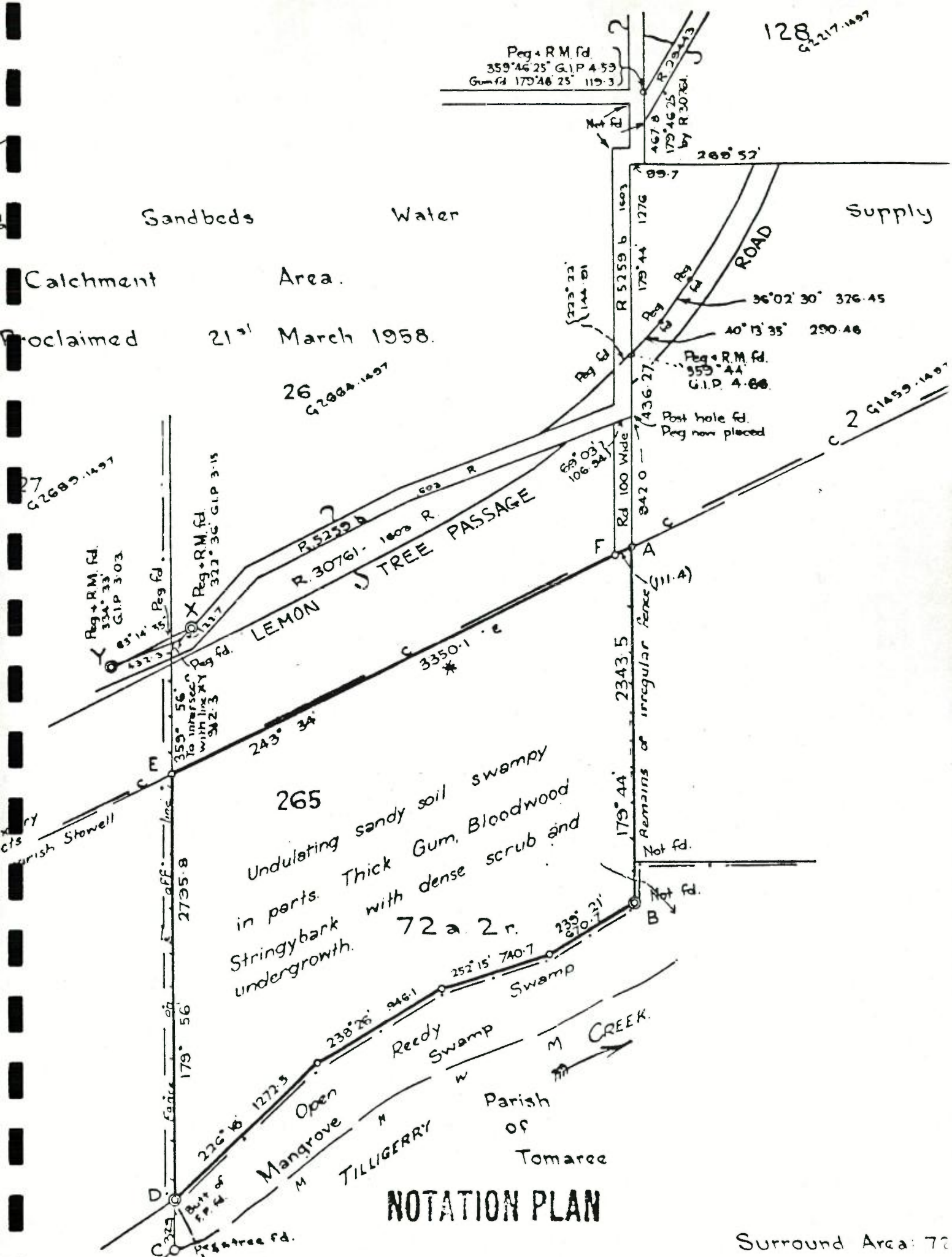
~~2. Restrictions on dealings see section~~

(Page 1) Vol. 13739 Fol. 205

PERSONS ARE CAUTIONED AGAINST ALTERING OR ADDING TO THIS CERTIFICATE OR ANY NOTIFICATION HEREON

WARNING: THIS DOCUMENT MUST NOT BE REMOVED FROM THE REGISTRAR GENERAL'S OFFICE

30th October, 1987 5



NOTATION PLAN

Surround Area: 72

5 TO AN INCH. All measurements shown in links

Requirements Notified 30th August 1946.

REFERENCE

CORNER	BEARING	FRO
A	106° 27'	Gu

APPENDIX 3: METEOROLOGICAL DATA

BUREAU OF METEOROLOGY - SURFACE WIND ANALYSIS

PERCENTAGE OCCURRENCE OF SPEED VERSUS DIRECTION BASED ON 41 YEARS OF RECORDS

FIRST YEAR : 1942 LAST YEAR : 1986 NUMBER OF MISSING OBSERVATIONS (AS PERCENTAGE OF MAXIMUM POSSIBLE) : 14.18 %

STATION : 061078 WILLIAMTOWN AMO 32 48 S, 151 50 E 9.0 M ELEV

JANUARY 0900 HOURS LST

CALM	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	A L
17								
DIRN								
N	2	3	2	*	*	*		7
NE	2	3	6	1	*			12
E	1	3	5	1	*	*		10
SE	1	3	7	3	*	*		15
S	1	3	6	5	1	1		17
SW	1	1	3	1	*	*		6
W	1	2	2	1	*	*		7
NW	2	3	3	1	*	*	*	8
ALL	10	22	34	13	2	1	*	

NO. OF OBS.1178

FEBRUARY 0900 HOURS LST

CALM	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	A L
25								
DIRN								
N	2	2	1	*				5
NE	1	4	5	1	*	*		11
E	1	2	4	1	*	*		9
SE	1	2	6	3	*	*	*	13
S	1	3	6	4	1	1	*	16
SW	1	2	3	1	*	*		8
W	2	3	2	*	*	*		7
NW	2	3	2	*	*	*		8
ALL	11	21	29	11	2	1	*	

NO. OF OBS.1074

MARCH 0900 HOURS LST

CALM	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	A L
27								
DIRN								
N	2	2	2	*				6
NE	2	2	3	*	*			7
E	1	2	3	1	*			7
SE	1	1	4	2	*	*	*	9
S	1	2	5	3	1	*	*	12
SW	1	1	3	1	*	*		7
W	3	4	4	2	*	*		12
NW	4	5	4	1		*		13
ALL	14	20	27	11	1	1	*	

NO. OF OBS.1209

APRIL 0900 HOURS LST

CALM	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	A L
25								
DIRN								
N	1	1	1	*				4
NE	1	1	1	*	*			3
E	*	1	1	*	*			3
SE	*	1	1	1	*	*		4
S	*	1	2	2	*	*		5
SW	1	2	4	1	*	*		8
W	3	6	9	4	2	1	*	26
NW	6	7	8	3	1	*	*	23
ALL	11	21	27	11	3	1	*	

NO. OF OBS.1170

JANUARY 1500 HOURS LST

CALM	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	A L
1								
DIRN								
N	*	*	1	*				1
NE	*	1	5	5	1	*		12
E	*	2	12	12	2	*		28
SE	*	2	16	12	2	*	*	32
S	*	1	6	6	3	1	*	17
SW		*	*	1	*			1
W		*	1	1	*	*		2
NW	*	*	1	1	*	*		4
ALL	2	7	42	39	8	2	*	

NO. OF OBS.1147

FEBRUARY 1500 HOURS LST

CALM	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	A L
2								
DIRN								
N	*	1	1	*	*			2
NE	*	1	4	3	1	*		8
E	*	2	12	8	2	*		26
SE	1	4	17	9	1	*	*	33
S	*	1	8	8	2	1	*	22
SW	*	*	1	1	*	*	*	2
W			1	1	1	*	*	2
NW	*	1	1	1	*	*		3
ALL	3	11	46	31	7	2	*	

NO. OF OBS.1043

MARCH 1500 HOURS LST

CALM	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	A L
4								
DIRN								
N	*	1	1	*				2
NE	*	1	4	2	*			8
E	1	3	13	8	1			26
SE	*	4	19	7	1	*	*	32
S	*	1	6	6	3	*	*	17
SW	*	*	1	1	*	*		3
W	*	*	1	1	*	*		4
NW	*	1	1	1	*	*		5
ALL	3	12	47	28	5	1	*	

NO. OF OBS.1179

APRIL 1500 HOURS LST

CALM	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	A L
6								
DIRN								
N	1	1	1	*				3
NE	*	2	3	1				7
E	1	2	8	2	*	*		13
SE	1	6	15	4	*	*		26
S	*	1	9	6	1	1		18
SW	1	*	2	1	*	*		4
W	*	2	3	3	2	1	*	12
NW	1	2	3	3	2	1	*	11
ALL	5	16	46	20	6	2	*	

NO. OF OBS.1169

* OCCURRED BUT LESS THAN 0.5 PERCENT

PRODUCED BY M.I.S.S. 29/ 7/86

FRAME 605

APPENDIX 4 : SURFACE WIND ANALYSIS
JANUARY - APRIL
WILLIAMTOWN, NSW

BUREAU OF METEOROLOGY - SURFACE WIND ANALYSIS

PERCENTAGE OCCURRENCE OF SPEED VERSUS DIRECTION BASED ON 41 YEARS OF RECORDS

FIRST YEAR : 1942 LAST YEAR : 1986 NUMBER OF MISSING OBSERVATIONS (AS PERCENTAGE OF MAXIMUM POSSIBLE) : 14.18 %

STATION : 061078 WILLIAMTOWN AMO 32 48 S, 151 50 E 9.0 M ELEV

MAY 0900 HOURS LST

DIRN	CALM	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	A L
N		*	*	*		*			1
NE		*	*	*	*				1
E		*	*	1	*	*			2
SE		*	*	1	1	*		*	2
S		*	*	*	1	*	*	*	2
SW		*	1	3	1	*	*		5
W		3	8	13	7	3	2	*	37
NW		5	9	12	3	2	1	*	31
ALL		9	19	33	13	6	2	1	

NO. OF OBS.1209

JUNE 0900 HOURS LST

DIRN	CALM	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 TO 60	61 & UP	A L
N		*	*	*		*				1
NE		*	*							*
E		*	*	*	*					1
SE		*	*	1	1	*	*	*	*	3
S			*	1	1	*	*	*	*	2
SW		*	1	3	1	*	*			6
W		2	10	16	8	3	2	1		41
NW		4	10	10	4	2	1	*		32
ALL		7	22	31	16	6	3	2		

NO. OF OBS.1139

JULY 0900 HOURS LST

DIRN	CALM	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 TO 60	61 & UP	A L
N		*	1	*						1
NE		*	*	*						1
E			*	*	*	*	*			1
SE			*	*	*	*	*	*	*	1
S		*	*	*	*	*	*	*	*	1
SW		*	1	2	1	*	*	*		4
W		1	7	18	10	3	2	1		44
NW		3	8	12	6	2	2	*		32
ALL		5	17	33	18	6	4	1		

NO. OF OBS.1177

AUGUST 0900 HOURS LST

DIRN	CALM	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	A L
N		1	1	1	*		*		2
NE		1	*	1	*				2
E		*	*	*	*	*			1
SE		*	*	1	1	*	*	*	2
S			*	1	*	*	*	*	2
SW		*	*	2	1	*	*		4
W		3	7	12	10	5	2	1	40
NW		2	9	10	5	3	1	*	31
ALL		7	18	27	18	8	4	1	

NO. OF OBS.1209

MAY 1500 HOURS LST

DIRN	CALM	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	A L
N	12	*	1	*	*				2
NE		1	1	2	*				4
E		1	2	3	1	*			6
SE		2	5	6	1	*			16
S		1	3	9	4	1	*	*	18
SW		1	1	4	2	1	*	*	9
W		1	3	7	5	3	3	1	22
NW		1	2	4	3	2	2	*	14
ALL		7	17	36	16	7	6	1	

NO. OF OBS.1209

JUNE 1500 HOURS LST

DIRN	CALM	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 TO 60	61 & UP	A L
N	12	1	1	*	*					1
NE		1	1	*		*				2
E		1	1	1	*	*	*			3
SE		2	3	3	2	*	*			10
S		1	3	8	3	1	*	*		17
SW		1	2	6	3	1	*	*		13
W		1	4	8	6	3	2	2		26
NW		1	2	4	4	2	1	1		15
ALL		8	16	31	18	8	4	3		

NO. OF OBS.1140

JULY 1500 HOURS LST

DIRN	CALM	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 TO 60	61 & UP	A L
N	11	*	1	*	*					1
NE		*	1	1	*	*				2
E		*	1	1	*		*	*		3
SE		*	2	3	1	*	*	*		6
S		1	2	8	3	1	*			15
SW		*	1	4	3	1	*			11
W		1	4	9	7	4	3	1		28
NW		2	3	6	6	2	2	1		22
ALL		6	13	33	20	9	5	2		

NO. OF OBS.1176

AUGUST 1500 HOURS LST

DIRN	CALM	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 TO 60	61 & UP	A L
N	6	*	1	1	*	*	*			3
NE		1	1	1	1	*				4
E		1	2	3	1	*				6
SE		1	5	8	1	*	*	*		15
S		1	2	8	5	1	*	*		17
SW		*	1	2	2	1	*	*		6
W		1	2	5	6	4	3	2		23
NW		1	3	5	5	3	2	1		20
ALL		5	16	36	21	10	6	3		

NO. OF OBS.1208

* OCCURRED BUT LESS THAN 0.5 PERCENT

PRODUCED BY M.I.S.S. 29/ 7/86

FRAME M05

APPENDIX 4 : SURFACE WIND ANALYSIS
MAY - AUGUST
WILLIAMTOWN, NSW

BUREAU OF METEOROLOGY - SURFACE WIND ANALYSIS

PERCENTAGE OCCURRENCE OF SPEED VERSUS DIRECTION BASED ON 41 YEARS OF RECORDS

FIRST YEAR : 1942 LAST YEAR : 1986 NUMBER OF MISSING OBSERVATIONS (AS PERCENTAGE OF MAXIMUM POSSIBLE) : 14.14 /

STATION : 061078 WILLIAMTOWN AMO 32 48 S, 151 50 E 9.0 M ELEV

SEPTEMBER 0900 HOURS LST

DIRN	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
CALM	18							
N	2	1	1	*			*	4
NE	1	1	2	*				4
E	*	*	1	*	*			2
SE	*	1	1	*	1			2
S	1	1	2	1	*	*		5
SW	1	1	3	2	1	*		8
W	2	7	10	7	3	2	*	31
NW	3	8	8	4	2	1	*	25
ALL	9	20	28	15	7	3	1	

NO. OF OBS.1189

OCTOBER 0900 HOURS LST

DIRN	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
CALM	18							
N	2	2	2	*				6
NE	1	3	4	1	*		*	8
E	*	1	2	1	*		*	4
SE	*	2	3	1	*	*	*	6
S	1	2	5	3	1	*	*	13
SW	1	2	5	2	1	*		10
W	1	3	6	4	3	1	*	19
NW	3	5	5	2	1	1	*	17
ALL	8	20	31	14	6	3	*	

NO. OF OBS.1237

NOVEMBER 0900 HOURS LST

DIRN	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
CALM	12							
N	2	3	1	*				7
NE	1	2	4	1	*			8
E	1	1	4	1	*			7
SE	1	2	5	2	*		*	9
S	1	3	6	3	1	1		15
SW	1	2	3	2	1	*		9
W	1	3	6	4	1	1	*	17
NW	2	5	5	3	1	1	*	16
ALL	8	22	34	16	5	2	1	

NO. OF OBS.1200

DECEMBER 0900 HOURS LST

DIRN	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
CALM	17							
N	2	2	2	*				6
NE	1	4	6	1	*			12
E	1	2	4	1				8
SE	1	3	5	2	*			12
S	1	3	6	4	2	1		16
SW	1	2	3	1	*	*		7
W	1	2	4	2	*	*	*	10
NW	2	4	4	1	*	*	*	12
ALL	10	21	34	13	3	1	*	

NO. OF OBS.1208

SEPTEMBER 1500 HOURS LST

DIRN	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
CALM	4							
N	*	1	1	*	*			2
NE	*	1	3	2	*	*		6
E	*	2	7	3	*		*	13
SE	1	4	16	4	1	*	*	23
S	*	1	6	6	2	1	*	16
SW	*	*	1	1	1	1	*	4
W	*	1	6	4	3	3	1	16
NW	*	2	4	4	3	2	1	16
ALL	2	11	61	26	10	6	2	

NO. OF OBS.1188

OCTOBER 1500 HOURS LST

DIRN	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
CALM	2							
N	1	1	1	*	*			3
NE	*	1	4	3	1			9
E	*	2	10	6	1			20
SE	*	2	15	6	1	*		25
S	*	1	6	7	3	1	*	17
SW		*	1	1	1	*	*	3
W		1	2	3	2	2	1	10
NW	*	1	3	3	2	1	1	11
ALL	2	9	42	30	10	4	2	

NO. OF OBS.1207

NOVEMBER 1500 HOURS LST

DIRN	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
CALM	2							
N	*	*	1	*	*	*		2
NE	*	1	4	4	1			11
E	*	2	10	10	2	*		25
SE	*	2	14	10	1	*	*	27
S	*	1	4	5	3	1	*	15
SW	*	*	1	*	*	*	*	2
W	*	*	1	2	2	1	1	8
NW	*	1	2	2	2	1	1	8
ALL	1	7	38	36	11	4	2	

NO. OF OBS.1169

DECEMBER 1500 HOURS LST

DIRN	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
CALM	1							
N	*	1	1	*	*	*		2
NE	*	1	3	5	2	*	*	11
E	*	2	11	13	2	*		28
SE	*	2	13	12	1	*		30
S	*	*	2	6	3	1	*	14
SW		*	*	1	*	*		2
W		*	1	1	1	1	*	5
NW	*	1	2	3	1	1	*	7
ALL	1	7	36	41	10	4	1	

NO. OF OBS.1178

* OCCURRED BUT LESS THAN 0.5 PERCENT

PRODUCED BY M.I.S.S. 29/ 7/86

FRAME 105

APPENDIX 4 : SURFACE WIND ANALYSIS
SEPTEMBER - DECEMBER
WILLIAMTOWN, NSW

Station Name WILLIAMTOWN AMO NEW SOUTH WALES

Number 061078 Latitude 32 Deg 48 Min S Longitude 151 Deg 50 Min E Elevation 9.0 M

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
9 am Mean Temperatures (C) and Mean Relative Humidity (%)													
Dry Bulb	23.0	22.7	21.5	18.1	15.8	11.4	10.1	11.9	15.2	18.6	20.8	22.3	17.5
Wet Bulb	19.6	19.7	18.7	15.7	11.9	9.9	8.3	9.5	12.1	14.9	16.8	18.4	14.6
Dew Point	18	18	17	14	10	8	6	7	9	12	14	16	12
Humidity	71	72	75	76	79	81	77	71	67	65	65	67	72
3 pm Mean Temperatures (C) and Mean Relative Humidity (%)													
Dry Bulb	26.0	25.9	24.8	22.7	19.2	16.8	16.3	17.4	19.5	21.7	23.7	25.5	21.6
Wet Bulb	20.6	20.7	19.8	17.4	14.6	12.8	11.4	12.2	14.0	16.1	18.0	19.5	16.4
Dew Point	17	18	17	14	11	9	6	7	9	12	14	16	13
Humidity	59	60	61	56	58	60	51	50	51	53	54	54	56
Daily Maximum Temperature (C)													
Mean	27.5	27.3	26.2	23.7	20.1	17.6	16.9	18.4	20.7	23.3	25.5	27.1	22.9
86 Percentile	32.8	31.7	30.2	27.0	23.2	19.8	19.3	21.4	25.2	28.5	31.2	32.8	
14 Percentile	23.1	23.3	22.7	20.6	17.4	15.3	14.6	15.6	16.7	18.6	20.5	22.2	
Daily Minimum Temperature (C)													
Mean	18.0	17.9	16.3	13.1	9.6	7.8	6.0	6.8	9.0	12.1	14.4	16.5	12.3
86 Percentile	20.6	20.5	19.2	16.5	12.8	10.9	9.1	10.1	12.6	15.6	17.6	19.1	
14 Percentile	15.1	15.2	13.3	9.7	6.4	4.3	2.7	3.8	5.4	8.8	10.8	13.2	
Rainfall (mm)													
Mean	116	110	125	90	109	126	66	88	59	78	71	86	1124
Median	90	100	108	61	94	103	47	72	49	60	57	63	1102
Raindays (No)													
Mean	12	12	13	11	11	13	9	11	10	13	11	11	137

APPENDIX 5 : TEMPERATURE, HUMIDITY AND RAINFALL DATA WILLIAMTOWN, NSW

FRAME 003

APPENDIX 4: VEGETATION AND REHABILITATION REPORT

A VEGETATION AND REHABILITATION REPORT PREPARED FOR AN EIS ON EXTRACTION OF WHITE SILICA SAND FROM ACI's FREEHOLD PORTION 265 TANILBA

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1.0 THE VEGETATION OF TILLIGERRY PENINSULA - A REGIONAL OVERVIEW

1:1 THE MAJOR VEGETATION COMMUNITIES

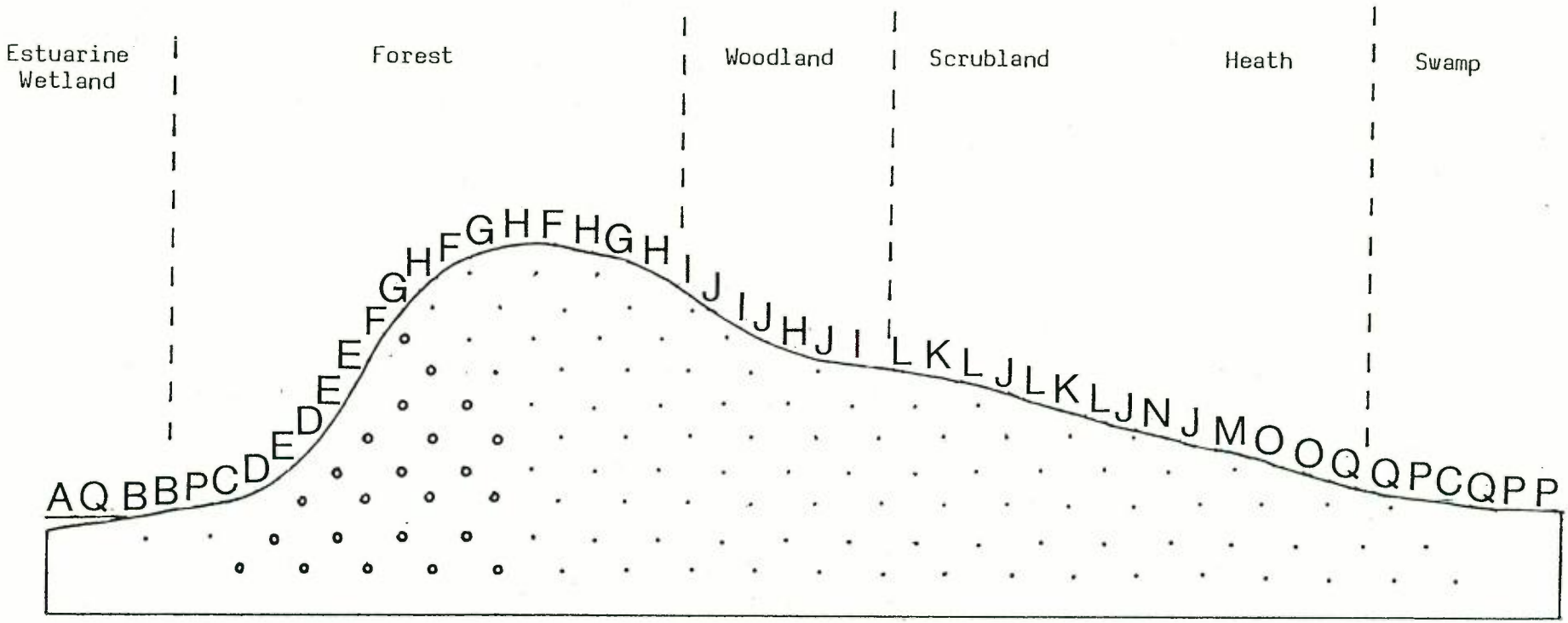
The Tilligerry Peninsula supports a range of vegetation types form tall forest, woodland, scrubland/heath to fresh and saltwater swamps and mangroves. The vegetation types are typical of those found on quaternary sand deposits along the NSW coast. There have been three Environmental Impact Statements i.e. Croft & Associates (1982), Pollington (1989) and Sinclair Knight & Partners (1987), which contain vegetation studies covering parts of the Tilligerry Peninsula and adjoining areas. These studies, aerial photographs and field reconnaissance were used to produce a map of the major vegetation types (refer Plan 1). The vegetation of Portion 265 was surveyed in greater detail, as described in Section 2.0.

Figure 1 shows the trend of distribution of the major plant communities in relation to elevation.

These vegetation types are briefly described as follows:-

1:1:1 Forest/Open Forest

There are distinct forest types which grade into each other as the soils change. This gradation can be seen on volcanic hills with varying depths of mantling sands between Mallabula and Lemon Tree Passage. When the soil cover is thin over volcanic rock, e.g. near Mallabula Point, the dominant tree is Spotted Gum (Eucalyptus maculata), interspersed with Bastard Mahogany (U. umbra), Brown Stringybark (E. capitellata) and, near the water front, Forest Red Gum ((E. tereticornis). The shrub layer is characterised by Bush Pea (Pultenaea villosa), Long-leaf Hop-bush (Dodonaea triquetra) and Hill Banksia (Banksia spinulosa var collina). The ground layer is typically dominated by Blady Grass (Imperata cylindrica). These areas are relatively disturbed by fire. Further south on this same group of hills where there are mantling sands the dominant tree species are Smooth-barked Apple (Angophora costata), Black butt (Eucalyptus pilularis) and Red Bloodwood (E. gummifera). There is a medium to tall understorey of Saw-toothed Banksia (Banksia serrata). The shrub layer typically includes Appressed Bossiaea (Bossiaea rhombifolia), Small-leaf Parrot-pea (Dillwynia retorta), Long-leaf Hop-bush, Grass Tree species (Xanthorrhoea spp.), Common Aotus (Aotus ericoides) and Bracken (Pteridium esculentum). Species characterizing the ground layer were Blue Paroo Lily (Dianella caerulea), Mat-rushes (Lomandra spp.) and Kangaroo Grass (Themeda australis). This latter forest association is also typical of that found on



LEGEND :

A	Avicennia marina	G	Eucalyptus pilularis	M	Banksia oblongifolia
B	Casuarina glauca	H	Eucalyptus gummifera	N	Melaleuca sieberi
C	Eucalyptus robusta	I	Eucalyptus haemastoma	O	Callistemon spp.
D	Eucalyptus tereticornis	J	Banksia aemula	P	Melaleuca quinquenervia
E	Eucalyptus maculata	K	Melaleuca nodosa	Q	Sedges
F	Angophora costata	L	Leptospermum attenuatum		

Volcanic Rock

Sand

FIGURE 1 : TREND OF DISTRIBUTION OF MAJOR PLANT COMMUNITIES

the sand dune system running down the southern side of the Peninsula (including Portion 265), and also on more elevated parts of the dune system on the northern side of the Peninsula, WSW of Tanilba Bay. This forest generally occurs on more elevated areas but is not restricted to them.

1:1:2 Woodland

Open Forest gives way to woodland in less elevated dune situations. The tree storey is characterized by Scribbly Gum (Eucalyptus haemastoma), commonly in association with Red Bloodwood. In some areas Red Bloodwood and Sydney Peppermint (E. piperita) form the tree cover. There is a dense and floristically diverse shrub layer typically dominated by Wallum Banksia (Banksia aemula), Paperbark Tea-tree (Leptospermum attenuatum), Austral Grass Tree (Xanthorrhoea australis) and Small-leaf Parrot Pea. The ground layer is reduced, mainly consisting of Leaf litter and rushes, especially Tassel Rope-rush (Hypolaena fastigiata),

1:1:3 Scrublands and Heath

Scrublands occur on lower lying dunes, usually with less than 2 metres of white sand above the water table or waterloo rock, and these grade into heath and wet heath where the water table is close to the surface. The scrublands are dominated by Wallum Banksia, Ball Honey Myrtle (Melaleuca nodosa) and Paperbark Tea-tree. Many of the shrubs common in woodlands also occur here, such as Austral Grass Tree, Pink Beard Heath (Leucopogon ericoides), Waxflower (Eriostemen australasius), Rosy Baeckea (Baeckea ramosissima) and Wedding Bush (Ricinocarpos pinifolius). There is often a dense field layer of sedges and rushes including (Restio fimbriatus,) curly sedge (Caustis recurvata) and Tassel Rope-rush. On wet heaths the vegetation is lower and the characteristic species are Fern-leaf Banksia (Banksia oblongifolia), Sieber's Paperbark (Melaleuca sieberi), Dagger Hakea (Hakea teretifolia) and Olive Tea-tree (Leptospermum liversidgei). There is a dense field layer of sedges and rushes, notably Cord-rush (Restio gracilis), Scale-rush (Lepyrodia scariosa) and Slender Twine-rush (Leptocarpus tenax).

Scrublands, heath and wet heath are widespread across the centre of the Peninsula.

1:1:4 Swamplands

The wet heath communities described above merge into

swampland where the water table is at or above the surface. These vary from low shrub and sedge communities with some emergent taller shrubs, through to closed forest over sedges. The "shrubby" swamps typically contain Bottlebrush species (notably Callistemon citrinus), Dagger Hakea, Sieber's Paperbark, Fern-leaf Banksia, Large-leaf Banksia (Banksia robur), Feather Honey Myrtle (Melaleuca quinquenervia) and Swamp Mahogany (Eucalyptus robusta). The shrubby swamps are often hard to distinguish from wet heath in aerial photographs. At the other end of the scale there are swamps dominated by tall Broad-leaf Paperbark with an inundated sedge understorey, or forests of Swamp Mahogany over dense sedge and shrub understorey including Swamp Water Fern (Blechnum indicum), Red-fruit saw sedge (Gahnia sieberana) and Mat Grass (Hemarthria uncinata).

1:1:5 Estuarine Wetlands

These consist of forest, low forest and sedgeland characterized by Grey Mangrove (Avicennia marina) and Swamp Oak (Casuarina glauca) over and interspersed with sedgeland and salt marsh including Juncus species, Salt couch (Paspalum paspalodes), Saltwort (Sarcocornia quinqueflora) and Suaeda australis. These wetlands skirt the Peninsula, occur on islands, and are well developed along the shores of Tilligerry Creek.

1:2 SIGNIFICANCE OF THE MAJOR COMMUNITIES

While none of these plant communities are unique to Tilligerry Peninsula, and in fact are widespread regionally, they do contain a wide variety of floristically diverse habitats, some relatively undisturbed, others variously disturbed by fire, weeds, urban development and mining.

Several endangered species are known to occur on the Peninsula, particularly in the scrubland, heath and swamp vegetation, a large part of which are within Hunter District Water Board Catchment areas. The significant species occurring on Portion 265 are discussed in section 2.4. In summary, most occur in sections that will not be mined, and the others are locally common in nearby areas and/or can be regenerated.

Most of the estuarine wetlands are protected by State Environmental Planning Policy (S.E.P.P. 14). A small part of the swamp forest on Portion 265 (approximately 0.5ha) forms part of S.E.P.P. 14 wetlands No. 810, Tilligerry Creek, Port Stephens. The proposed development does not impinge on this designated wetland, nor on wetlands adjoining it.

The forest and woodlands, including the dune forests and tall swamp communities are considered to be of major significance as Koala habitat and movement corridors. This is discussed more fully in the fauna report. In essence, the forest and woodlands along the northern and southern edges of the Peninsula are proposed as being significant corridors for dispersal of Koalas between colonies near Salt Ash and Medowie and those at Tanilba Bay, Mallabula and Lemon Tree Passage. In this regard, the area proposed for sand extraction in Portion 265 would affect about 1/4 to 1/3 of the width of the southern corridor of suitable vegetation for a distance of about 500 metres in total, and thus should not have a major impact on the corridor.

2:0 THE VEGETATION AND REHABILITATION OF ACI FREEHOLD PORTION 265, TANILBA

2:1 INTRODUCTION

A brief vegetation survey was carried out on ACI Freehold Portion 265, Tanilba in November 1987. The survey was aimed at identifying the major vegetation types and common plant species of the area. This data was then used in outlining a programme for rehabilitation after mining. The area was re-examined in August 1989 and any changes were noted.

ACI have been mining silica sand on Crown land in the Tanilba area since 1979 and are carrying out a very successful rehabilitation programme based on data from a pre-mining vegetation survey (Gullan and Van Rees, 1980). The experience gained there and at ACI's other sand mines is incorporated in the rehabilitation section of this report.

The Freehold land is 0.8 kilometres south west of the Crown land and approximately 3 kilometres south west of Tanilba township and covers 29.34 hectares. The sand processing plant for the current mining operation is situated on the Freehold land.

The area is relatively flat and low lying except for a double dune south west of the plant area and a low dune east of the plant area (see contour map of Vegetation Sampling Sites, Plan 2).

The vegetation of the area is predominantly open forest with a woody shrub understorey. The tree cover is well developed, dominated by Smooth-barked Apple (Angophora costata), Blackbutt (Eucalyptus pilularis) and Red Bloodwood (E. gummifera).. There are swamplands on the north and south edges and a creek running across the property joining them. The swamp to the north is characterized by Broad-leaf Paper Bark (Melaleuca quinquenervia) and Crimson Bottlebrush (Callistemon citrinus), whereas that to the south is characterized by Swamp Messmate (E. robusta) and sedges.

There are indications that regular burning occurred in the past, and the most recent fire, in November, 1986, covered the entire area.

The processing plant, office, sand stockpiles, settling ponds, roads and nursery occupy approximately one tenth of the property. All of these are situated on the flat areas in tall open forest.

2:2 METHODS

The vegetation was sampled at 15 sites across the area. The sampling sites were selected to contain a cross

section of the various topographic situations and any obviously differing plant communities (see map of Vegetation Sampling Sites).

Each sampling site consisted of a quadrat of 100 square metres, as appropriate for forest situations (Bridgewater, 1976; Gullan et. al., 1976). A complete species list was recorded for each sample site, and each species was assigned a quantitative estimate of cover and abundance using a scale similar to that designed by Braun-Blanquet (1932) (see Table 1).

TABLE 1

The Cover/Abundance scale used in data collection and the two-way table:

+	=	occasional,	cover <5%
1	=	common,	cover <5%
2	=	any number,	cover 5-25%
3	=	any number,	cover 25-50%
4	=	any number,	cover 50-75%
5	=	any number,	cover 75-100%

The data was sorted so that sites which share a number of species were placed together, and species which are often found together in the field are placed together. The data is presented in a two-way table which sets out the sampling sites across the top and species down the side. Each vertical column of figures represents a list of the species found in one site and each horizontal row represents all the sites in which one species has been found. (see Table 2).

From studying the data it was possible to identify the major plant communities. The major structurally different vegetation types are shown on the map.

A species list was compiled which includes all species recorded, their common names, family and plant form (Table 3).

2:3 RESULTS

The fire in November, 1986, burnt through the entire area, although less severely in the swamps. This means that the whole area is in the process of regeneration and the estimates of cover and abundance for the plants present do not necessarily represent those of the normal mature vegetation. The species which regenerate most rapidly after fire, such as Bracken, tend to dominate whereas this may not be the case several years after a fire. Many species are present in seedling and young stages which would

eventually outgrow the Bracken, given enough time without fire. It is also likely that some species are yet to re-appear. These effects relate to the understorey and ground cover species only since the upperstorey species (the trees) were not killed by the fire. In most cases the tall crowns were not burnt, although middlestorey crowns, such as the Banksia species, were burnt. They have since regenerated. Bearing these factors in mind it is still possible to describe the major vegetation types.

Field observations and a study of the two-way table reveal a basic similarity in the vegetation type across much of the area, around the plant and on the dunes. These are variations related to aspect and proximity of the water table within this basic vegetation type. As could be expected there are distinct vegetation types in the swamps and the creek. The distribution of the vegetation types are shown on Plan 2 and they are briefly described as follows:-

2:3:1 Tall Open Forest: Smooth-barked Apple - Bracken Association. - occupies 12.2 hectares, or 41.6 % of site.

Smooth-barked Apple (Angophora costata) is the most common tree of the area, extending across all except the wettest areas. This species, and to a lesser extent Blackbutt (Eucalyptus pilularis) and Red Bloodwood (E. gummifera) form a canopy 20 to 25 metres tall with 70 to 80% cover. Bracken (Pteridium esculentum) is distributed throughout this vegetation type and has the highest cover rate of all species. As mentioned above this is due to Bracken's rapid regeneration after fire. Other common species of the understorey are Common Aotus (Aotus ericoides), Appressed Bossiaea (Bossiaea rhombifolia) and Paroo Lily (Dianella caerulea). Raspwort (Gonocarpus teucrioides) and Purple Coral-pea (Hardenbergia violacea) are common ground covers.

There is an open middlestorey of Saw Banksia (Banksia serrata) across much of the area, which is most well developed on the top of the tallest dune (site 6). In lower areas closer to the water table Saw Banksia is replaced by Wallum Banksia (B. aemula), e.g. on sites 11, 12 and 13, and forms 25 to 60% cover.

The Tea-tree species (Leptospermum attenuatum and L. flavescens) formed a dense middlestorey prior to the fire on low lying flat areas (sites 10,11,12 and 13) and are now regenerating.

Ball Honey Myrtle (Melaleuca nodosa) is also regenerating after being the dominant shrub in site 12, which is presumably a wetter area.

Grass Trees (Xanthorrhoea australis) are sparsely scattered through much of the area but are common at

the western edge of the property (site 11).

The vegetation around the plant is relatively disturbed and has lower species diversity than that closer to the nursery, across the creek and on the dunes. Blady Grass (Imperata cylindrica) is common to abundant near the plant, on road edges and other disturbed areas. Sallow Wattle (Acacia longifolia) is also common in one area near the entrance gate (site 3), perhaps also as a result of disturbance.

2:3:2 Sedge Swamp - occupies 1.2 hectares, or 4.1% of site.

The creek running through the property is densely covered with sedges, particularly Tailed Rapier-sedge (Lepidosperma urophorum). Tall Spike-rush (Eleocharis sphacelata) is common in the centre of the creek. The edges of the creek are scattered with Broad-leaf Paper Bark (Melaleuca quinquenervia), Crimson Bottle-brush (Callistemon citrinus), Swamp Mahogany (Eucalyptus robusta), Large-leaf Banksia (Banksia robur), Stiff Rapier-sedge (Lepidosperma neesii) and Swamp Water-Fern (Blechnum indicum).

2:3:3 Shrubby Swamp : Swamp Messmate - Crimson Bottle-brush - Tassel Cord-rush Association. - included in sedge swamp area calculation.

The swamp along the northern boundary of the property has an upper storey of Swamp Mahogany from 3 to 10 metres tall and with cover varying from 10 to 80% (site 14). The understorey is densely covered by Crimson Bottle-brush and Tassel Cord-rush (Restio tetraphyllus). Red-fruit Saw-sedge (Gahnia sieberana) and Bracken are less common. Underneath these shrubs is a dense mat of Wiry Panic (Entolasia stricta) forming 50 to 75% cover.

Tassel Cord-rush also extends into low lying drier areas (eg. sites 10, 11, 12 and 13) but is less common there.

2:3:4 Forest Swamp - occupies 12.74 hectares, or 43.4% of site.

To the south of the property the Tall Open Forest grades into swampy vegetation in lower areas while maintaining 75% tree cover. Swamp Mahogany is mixed with Smooth-barked Apple in sites 2, 7 and 8 but takes over completely in lower areas (sites 9 and 15) where there is water at the ground surface.

Dusky Coral-pea (Kennedia rubicunda), Bracken and Red-fruit Saw-sedge are abundant in the intermediate forest type (sites 2, 7 and 8). Sallow Wattle used to be common here before the fire and is now regenerating. Where Swamp Mahogany dominates, Tassel Cord-rush,

Swamp Water Fern and Red-fruit Saw-sedge form a very dense understorey while mat Grass (Hemarthria uncinata) is tangled through underneath.

Broad-leaf Paper Bark is scattered through the damp areas and is most concentrated along the edge of the creek (site 9).

Immediately south of these swamp areas is the high water mark of Tilligerry Creek which is vegetated with mangroves.

2:3:5 Cleared or Disturbed Areas - occupies 3.2 hectares, or 10.9% of site.

These include the Plant and office site, sand stock piles, nursery and tracks and occur in former Tall Open Forest areas. A few trees remain scattered through the Plant site.

2:4 SIGNIFICANT SPECIES

Several of the species listed by McNair (1989) as endangered plant species on Tanilba and Swan Bay Area were found within Portion 265.

Two of these, i.e. Pinnate Boronia (Boronia pinnata) and Bundled Guinea-flower (Hibbertia fasciculata) occur in habitats which will not be affected by the proposal. The other species are in the Orchidaceae (all orchids are Protected Plants) and Xanthorrhoeaceae, the latter presumably include by McNair as they are considered difficult to regenerate.

Two orchids were found in the survey, ie. an Insect Orchid (Acianthus fornicatus) and Large Duck Orchid (Caleana major). The former is abundant in most forested areas on the Peninsula, and has regenerated in ACI's rehabilitated mine areas. The latter species is known to be moderately common in the locality. Both species occur in Tall Open Forest, and as only a portion of this forest will be cleared for extraction purposes, it is concluded that the impact of the proposal on these species will not be significant.

The Grass Tree species to be affected by the proposal are Forest Grass Tree (Xanthorrhoea media) and Austral Grass Tree (X. australis). Both species are common and widespread in forest, woodland and scrubland on the Tilligerry Peninsula. On Portion 265 they occur in the Tall Open Forest. Based on ACI's experience in the nearby rehabilitated Crown Land, Grass Trees can be successfully replaced by transplanting, using the appropriate method, by direct seeding, or by planting nursery raised plants. Grass Trees are not difficult to propagate but are very slow growing. They are proposed to be re-established on the site as part of the rehabilitation programme.

2:5 REHABILITATION RECOMMENDATIONS

2:5:1 Aims

The aim of rehabilitating after sand mining the ACI Freehold land would be to re-establish the natural vegetation of the site. The post-mining landscape would thus be in harmony with the surrounding natural areas and the mined and rehabilitated Crown Land to the east. A description of these rehabilitated areas is given in Section 3. The following recommendations are based on experience gained in these areas over the past 10 years.

2:5:2 Areas Affected

If mining of silica sand were to proceed, most of the flat areas would not be disturbed as they contain insufficient depth of white sand above the water table or Waterloo Rock basement. A significant portion of the tallest dune would also remain undisturbed.

The vegetation of these wetlands will not be disturbed in the mining process except that it will be necessary to build a causeway across the creek to take the mined sand to the Plant.

With respect to the causeway the following recommendations are made:

- The causeway width should be as narrow as possible within safety limitations to minimise loss of creek vegetation, and yet broad enough to avoid sand spillage into the creek.

- The causeway should contain drainage pipes which allow adequately for the maximum expected water flow in the creek.

- A silt trap should be installed immediately down stream to trap any road run off or spillages.

The precautions would minimise damage to the creek and avoid any alterations to water flow in the creek and in the swamps at both ends of the creek.

The following safeguards are recommended to prevent disturbance to the wetland vegetation and adjacent Tilligerry Creek system:

- The boundary of the areas to be mined should be above the upper limit of the wetland vegetation, i.e., above the 4 metre contour. This boundary should be clearly marked on site prior to commencing clearing. The

windrows of cleared trees should be above this boundary, as should the loading and sand stockpile areas.

- Small breaks should be provided in the windrows for drainage, with a sediment trap below each major break. Above all breaks the land surface should be brush matted.

- The rehabilitation procedures recommended in the next section (4.3) should be carefully followed. This will ensure rapid stabilisation and revegetation of the mined areas and thus avoid the chance of erosion which may otherwise deposit sand and soil in the adjacent wetlands. Particular care should be taken on the dune slopes above the creek.

There are only three areas likely to be suitable for mining - the large double peaked dune to the south west of the plant, the small dune to the east of the Product Sand stockpile shed and a narrow low dune ridge to the west of the plant. The total area to be mined is approximately 4.7 hectares, and clearing an area of this size is not expected to affect the water table, particularly since rehabilitation procedures are aimed at rapid re-establishment of the native trees. The ground water quality will not be affected.

The vegetation on these dunes consists of Tall Open Forest as described in section 2.3.1 above, and the rehabilitation recommendations are aimed at re-establishing this vegetation type. The mined Crown land 1 kilometre to the north east contained very similar vegetation and the experience gained in rehabilitation there forms the basis for the following recommendations.

2:5:3 Basic Principles and Techniques

The points outlined below are described in greater depth in "The Vegetation and Rehabilitation of the Tanilba Northern Dune", du Preez (1986), a report accompanying the Environmental Impact Statement on mining the Tanilba Northern Dune.

(a) REPLACING THE TOPSOIL

Silica sand mining of necessity alters the soil profile in that most of the white sand (A2 horizon of a sandy podzol) is removed, and in this case, exposing a more or less hardened layer of "Waterloo Rock" at the surface. In re-establishing the natural vegetation it is important to select plant communities appropriate

to the altered landscape, while trying to re-create as closely as possible the natural soil conditions. On this site the Tall Open Forest occurs on both shallow and deeper sand over Waterloo Rock and should therefore be suited to the post-mining landscape.

It is recommended that any exposed hardpan areas of Waterloo Rock be ripped prior to any further rehabilitation work to allow penetration of plant roots.

The topsoil, containing most of the organic matter, nutrients, micro-organisms, plant roots and propagules (rhizomes, seeds, bulbs, etc.) should be respread over mined out areas as soon as possible after it is cleared. Stockpiling of topsoil, and the consequent deleterious changes associated with it, should be avoided. It is recommended that the mining allow for direct transfer of topsoil from cleared areas to adjacent mined out areas. During respreading, the topsoil should be left in small furrows along the contour to reduce rain run off.

Topsoil should not be brought from elsewhere as it could introduce foreign species or pathogens unfavourable to the re-establishment of the natural vegetation.

Rapid replacement of topsoil leads to natural regeneration of many species. In section 4.4 below on the re-establishment of species, the letter "a" denotes that that species is known to regenerate from fresh topsoil in ACI's experience. There are however many other species which do not regenerate from topsoil and need to be re-introduced by other means, such as the methods described in "b" to "g" below.

(b) BRUSH MATTING

Brush matting consists of plant material cut ahead of the mine face and spread in a thick layer over re-topsoiled areas. The plants are selectively cut ahead of this mine face, when in seed. The brush matting is thus a form of direct seeding as well as a protective mulch. This mulch retains ground moisture, reduces wind at the soil surface, and shelters seedlings arising from the seed it contains and from the soil.

Brush matting is very effective if correctly applied and is a cost-efficient way of replacing certain species which are required in large numbers. It is especially effective for Leptospermum, Melaleuca and Eucalyptus species.

Brush matting is especially useful in steeper areas or areas prone to erosion.

(c) DIRECT SEEDING

This involves harvesting mature seed when available, removing it from pods, cones, etc., pretreating it where necessary, and sowing it directly in re-topsoiled areas under the most suitable weather conditions. This has proven a simple, effective method of re-establishing many species, notably Eucalyptus, Angophora, Banksia and Xanthorrhoea. It is cheaper and quicker than nursery propagation and therefore preferred where possible.

The seed should be sown in the soil, not broadcast on the surface, using a seeding stick or other method to cover the seed.

(d) PRESERVING MATURE SPECIMENS

Retaining a few scattered mature trees in the mine area has proved an enormously effective method of re-establishing Eucalyptus and Angophora in large numbers. The preserved trees react to the mining disturbance around them by flowering and releasing large quantities of seed. Large numbers of seedlings are produced around the tree. The effectiveness of these preserved trees at ACI's nearby mining areas has been far greater than that of direct seedling and planting.

N.B. A pair of White Breasted Sea Eagles (Haliaetus leucogaster) have a nest in a large Blackbutt (Eucalyptus pilularis) on the small dune nearest the creek. The birds have used this nest for breeding each year for several years and it is strongly recommended that this tree is identified as one of those preserved for seeding.

(e) PROPAGATION

The above techniques may not be suitable for all species or situations and it may be necessary to propagate some species for planting out.

ACI already have an established plant nursery on the site and are familiar with propagation techniques.

Plants should be grown in tubes as these are more efficient to handle and produce a better root system than pots. A slow release fertiliser pellet planted with each tree assists

early growth and establishment. Broad scale fertilisation however is strongly discouraged.

(f) TRANSPLANTING

Transplanting of mature plants or seedlings, from the bush, is sometimes advantageous. Frequently a bushfire or other disturbance causes mature plants to shed seed and numerous seedlings appear below. Some of these could be transplanted into pots or directly into rehabilitated areas.

Transplanting of mature plants is difficult and time consuming but worthwhile in the case of very slow growing plants. It is especially recommended for Xanthorrhoea species (Grass-trees) which are scattered over the site. The transplanted Grass-trees need to be burned immediately after being moved to stimulate new growth.

(g) ORGANIC SCREENINGS

Organic material screened from the sand at the Plant contains seeds of several species, especially Legumes (Peas and Wattles) and it is a valuable organic mulch. It is recommended that the screenings be spread over rehabilitation areas, especially exposed or eroding spots to act as a form of direct seeding and return some of the plant nutrients.

(h) MONITORING

It is recommended that the rehabilitated areas be monitored regularly, say twice a year, to assess progress and detect problem areas. This would enable corrective measures to be taken early, and modification of procedures if necessary.

2:5:4 Notes on Re-establishing the Species

The following notes provide a brief description of the common species in the ares to be mined and recommended rehabilitation techniques.

The methods described above are referred to by the letters used above, i.e.:

a - Regenerates from fresh topsoil
b - Brush Matting
c - Direct Seeding
d - Preserving Mature Specimens
e - Propagation
f - Transplanting
g - Regenerates from Organic Screenings

The methods suggested are listed in order of preference. where the comments are based on experience at ACI's other mine sites the source is indicated by: L - Lang Lang (Vic), N - North Stradbroke Island (Qld) and T - Tanilba (NSW).

Acacia ulicifolia (Juniper Wattle) - rounded prickly shrub, flowering late winter and spring. Regenerates readily from topsoil and organic screenings (T, N), or can be direct seeded after scarifying the seed. Use a, g and c.

Angophora costata (Smooth-barked Apple) - medium to tall tree with smooth grey to salmon-pink bark, and branches often gnarled or curled. Flowers irregularly, collect seed whenever possible (T). Use d, c, b or e.

Aotus ericoides (Common Aotus) - low to medium rounded shrub, pea flowers yellow with red markings, flowering spring. Known to regenerate from fresh topsoil (T, N, L). Use a.

Banksia serrata (Saw Banksia) - tall slender shrub or small tree, flowering January to March. It can regenerate from lignotubers. Responds well to direct seeding (T, N). Use c, b, and e.

Billardiera scandens (Common Apple-berry) - small to medium sized twiner with slender woody stems. Pale yellow bell shaped flowers in spring. Regenerates from topsoil (T). Use a.

Bossiaea rhombifolia (Appressed Bossiaea) - erect shrub to 1 metre high, yellow red pea flowers in spring. Known to regenerate from fresh topsoil and organic screenings. Use a and g.

Dianella caerulea (Paroo Lily) - lily with long flaxlike leaves, bright blue flowers in summer followed by bright blue berries. Known to regenerate from roots in fresh topsoil (T). Can also be propagated from seed (the fruit have to be dried immediately or by division). Use a, e or f.

Eucalyptus gummifera (Red Bloodwood) - tall tree with rough scaly bark throughout and large urn-shaped fruits. Profuse white flowers are born in summer and autumn. Known to regenerate from preserved mature specimens and direct seeding (T), or can be propagated from seed. Use d, c, b, or e.

Eucalyptus pilularis (Blackbutt) - tall straight tree with fine rough bark at base and on lower trunk and smooth creamy-grey bark on upper trunks and branches. Known to regenerate prolifically from preserved mature specimens (T) does well from direct seeding (T, N) and can be propagated from seed (T, N). Use d, c, b, or e.

Glycine clandestina (Twining Glycine) - slender twiner with small bluish-purple pea flowers. Known to regenerate from fresh topsoil (T). Use a.

Gonocarpus teucrioides (Raspwort) - slender erect herb, flowers inconspicuous. Regenerates readily from fresh topsoil (T). Use a.

Hardenbergia violacea (Purple Coral-pea) - medium sized twiner with purple pea flowers in spring. Regenerates readily from fresh topsoil and organic screenings (T). Use a and g.

Hibbertia linearis (Guinea-flower) - small erect shrub with bright yellow "buttercup" flowers in spring. Regenerates from fresh topsoil (T). Use a.

Imperata cylindrica (Blady Grass) - vigorous twiner with dull red pea flowers in spring. Regenerates from fresh topsoil (T) or can be propagated from scarified seed. Use a or e.

Leptospermum attenuatum (Paper-bark Tea-tree) - medium, stiff woody shrub with flaky bark and white flowers at variable times. May regenerate from roots in fresh topsoil as other Leptospermum species do (L, T, N). Use b, c, a and e.

Leucopogon lanceolatus (Lance Beard-heath) - erect bushy shrub with sprays of small white flowers. May regenerate from fresh topsoil as other Leucopogon species do (L, T, N) otherwise could be propagated from cuttings. Use a or e,

Persoonia laevis (Smooth Geebug) - erect medium to large shrub with large rounded leaves and small yellow flowers. Known to regenerate readily from fresh topsoil (T). Use a.

Pomax umbellata (Pomax) - small rounded herb with inconspicuous flowers. Regenerates readily from fresh topsoil (T). Use a.

Pteridium esculentum (Austral Bracken) - fern with erect fairly leathery fronds, growing from underground rhizomes. Regenerates from fresh topsoil (L, T) and can become a prolific invader. Use only a.

Ricinocarpos pinifolius (Wedding Bush) - open shrub to 1 metre with narrow dark green leaves and masses of white starry flowers in spring. Known to regenerate from fresh topsoil (T, N). Use a.

Tetracheca thymifolia (Black-eyed Susan) - small slender shrub with bright pink flowers with black centres. Known to regenerate from fresh topsoil (T, L), or can be grown from cuttings. Use a or e.

Themeda australis (Kangaroo Grass) - tufted fine leaved grass up to 50cm high with bunched flower heads. Known to regenerate from fresh topsoil (T), propogation from seed is difficult as seed has to be stored 6 to 11 months to overcome dormancy. Use a or try f.

Tricoryne elatior (Yellow Rush-lily) - small tufted lily with yellow star-like flowers. Regenerates readily from fresh topsoil (T). Use a.

Xanthorrhoea australis (Austral Grass-tree) - robust Grass-tree often forming a trunk, with flowering spikes from 0.5 to 3.5 metres long, leaves quadrangular in cross-section. Has been successfully direct seeded, propagated from seed and transplanted (T, N). Use c, f and e.

2:6 SUMMARY OF RECOMMENDATIONS FOR REHABILITATION

It is recommended that:-

- Rehabilitation is aimed at re-establishing the vegetation occurring naturally on shallow white sand.
- Wet land communities and low lying areas on shallow sand are left undisturbed.
- The topsoil is respread over mined areas without stockpiling as regeneration of many species depends on it.
- The subsoil is ripped prior to recovering with topsoil if it is hard and impenetrable (e.g. Waterloo Rock) or compacted from mining activities.
- A few scattered mature trees are preserved in the minepath to act as a source of direct seeding.
- Seed is collected in large quantities for extensive use in direct seeding.
- The ACI nursery is maintained for propagation of plants where required.
- Seed-bearing plants are harvested ahead of the mine face for use in brush matting.
- Organic screenings are returned to the mine area and respread over re-topsoiled areas.
- Some mature grass trees are transplanted.
- Rehabilitation is regularly monitored.

3:0 REHABILITATION OF ACI's SAND MINE, TANILBA

3:1 INTRODUCTION

ACI started mining silica sand for glass in the Tanilba area in 1978. The existing mine is on Crown Land (defined as Permissive occupancy Lease Area 77/13 with NE and SW extensions) having a total area of 77 hectares. This area is south of Tanilba township and covers a series of dunes running SW and NE between Lemon Tree Passage Road and Tilligerry Creek. The areas to be mined in Portion 265 form part of a larger dune system running parallel to Lemon Tree Passage Road.

Most of the white sand reserves in the current Lease Area have been mined out, with only a few months reserves remaining in the SW Extension.

Rehabilitation has followed closely behind the mine face so that no more than two hectares are exposed at any time.

Rehabilitation is aimed at re-establishing as closely as possible the natural vegetation of the area, and results are monitored against a pre-mining vegetation survey.

3.2 METHODS

The methods used for rehabilitation here are based on similar techniques used successfully at ACI's other sand mines in Victoria and Queensland. Techniques were refined to suit the requirements of species at this particular site. They are essentially as described in the rehabilitation recommendations (especially section 2.5.3) for Portion 265. This is possible because the vegetation over most of the mined Lease Area was very similar to the Tall Open Forest of Portion 265.

3.3 RESULTS

Each year all the rehabilitation areas are examined and detailed vegetation studies are made on all areas less than 2 to 3 years old. In this way it has been possible to build up a clear understanding of the patterns of regeneration and work required to achieve the desired result.

An example of the type of data recorded, extracted from a report prepared by the author in April 1988, is given in Table 4. This Table gives the height and cover/abundance of species present in rehabilitation zones 34 to 44 which were re-topsoiled between March 1986 and December 1987. Figure 2 shows the location of these zones in P.O. 77/13. These areas had basically the same vegetation cover as the dune areas to be mined

in Portion 265. It can be seen that the species identified as common in the natural vegetation are also common in regenerating areas. These include Common Aotus (Aotus ericoides), Appressed Bossiaea (Bossiaea rhombifolia), Blue Paroo Lily (Dianella caerulea), Raspwort (Gonocarpus teucrioides) and Purple Coral-pea (Hardenbergia violacea), all of which have regenerated from fresh topsoil. The upperstorey species, i.e. Red Bloodwood (Eucalyptus gummifera), Blackbutt (E. pilularis) and Smooth-barked Apple (Angophora costata) are also present in good proportions as a result of direct seeding (by hand and from preserved mature specimens) and planting.

A study of this data over the years has revealed the following pattern of regeneration:

Legumes and a few herb species are the first to appear and dominate. The most common primary colonizers are Sweet Wattle (Acacia suaveolens), Appressed Bossiaea, Common Aotus, Broom Spurge (Amperea xiphoclada) and Raspwort.

In areas where Blady Grass (Imperata cylindrica), Kangaroo Grass (Themeda australis) and/or Blue Paroo Lily were common prior to mining, these species regenerate readily after mining. After three years the Wattles start to die out, Broom Spurge and Raspwort decrease, and other shrubs or grasses/sedges become dominant, in proportions resembling the pre-mining condition. The planted and seeded tree species grow at different rates depending on aspect and seasonal fluctuations, and eventually dominate over the shrub layer after 5 to 7 years.

The older areas, re-topsoiled 7 to 10 years ago now have trees from 7 to 15 metres tall, with projective foliar cover of 50 to 100% In areas re-topsoiled 4 to 5 years ago, trees are from 2 to 5 metres in height, with variable cover.

Erosion has not been a problem due to the rapid germination of native seedlings from fresh topsoil. After unusually heavy rain small washouts sometimes form in newly topsoiled areas. This does not usually occur as shallow furrows are left along the contour during the re-topsoiling process, which catch the run off. Washouts have been repaired successfully by backfilling with organic screenings.

Weeds are a minor problem only and have been controlled with herbicide.

The only other problem of any significance if from wood cutters, 4WD vehicles and trail bikes which occasionally drive over rehabilitated ares. These are deterred by obstacles at entry points, signs and by burning the windrows of logs (in safe conditions only).

Damage of this nature is not expected to occur on Portion 265 as the only access will be through the Plant site which is locked after hours.

4.0: IMPACT ON FLORA

The proposed sand extraction will affect approximately 4.7 hectares, or 16% of the total site area. The affected areas include part of the elongate double peaked dune in the south west quadrant of the property, and two small lower dunes nearer the processing Plant. All are in Tall Open Forest and a further 7.5 hectares of this forest type will remain undisturbed on the site. Thus the proposed sand extraction operations will affect 38.5% of the Tall Open Forest on the site. The remaining 61.5% of this forest is distributed over both flat and higher dune areas, including part of the dune in the south west quadrant.

The Tall Open Forest extends on either side of the internal access road to the north of the property, and to the east and west of the property, occurring along much of the southern edge of the Tilligerry Peninsula. It joins up with the Tall Open Forest between Lemon Tree Passage and Mallabula, and occurs on parts of the northern side of the Peninsula (refer Plan 1). It is widespread regionally, occurring on Tomaree Peninsula and other quaternary sand deposits along the NSW coast.

The sand extraction is expected to be completed in a little over 1.5 years, during which time the area will be progressively rehabilitated so that not more than 2 hectares will be exposed at any time. The rehabilitation techniques (described in section 2.5) are aimed at rapid re-establishment of the natural vegetation, which will minimize the possibility of erosion and disturbance to adjoining wetland and forest. Rehabilitation of the same vegetation type in the Crown Land nearby has successfully restored the original tree, shrub and ground cover species. Tree heights of 7 to 15 metres are attained in 7 to 10 years.

Endangered species, i.e. 2 orchids and 2 grass tree species, occurring in the proposed mine area also occur in the remaining Tall Open Forest on the site and in the region (refer section 2.4). The Grass Trees will be replanted and the Orchids may regenerate from top soil in rehabilitated areas.

The other vegetation types on the site, all of which are wetlands, will not be disturbed by the proposal except for the causeway across the creek, linking the main dune to the processing plant. Provided that this is designed to adequately cope with maximum expected water flow, and a silt trap is installed downstream to catch any runoff or spillage, the adjoining wetlands should not be adversely affected.

In summary, the proposal will affect 38.5% of the existing Tall Open Forest on the site, and no wetlands except the very small area affected by the proposed

causeway. Given that the Tall Open Forest is widespread regionally, and that proven rehabilitation techniques will be used to re-establish the natural vegetation, these impacts are considered acceptable, particularly in the long term.

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TABLE 2 : THE TWO-WAY TABLE

SPECIES	SAMPLING SITE 1	3	4	6	10	13	11	12	7	8	2	15	9	14	5
Acianthus sp.											1				
Amperea xiphoclada								+							
Cassytha glabella			+												
Cassytha pubescens							1								
Clematis aristata	+														
Conospermum taxifolium							+								
Dendrophthoe vitellina			+												
Dillwynia retorta			+												
Dodonaea triquetra			+												
Epacris purpurascens							1								
Eriostemon australasius							1								
Exocarpos cupressiformis										+					
Gnaphalium candidissimum	+														
Hibbertia fasciculata	+														
Hypochaeris radicata			1												
Hypolaena fastigiata			1												
Leptomeria acida							1								
Leptospermum juniperinum			+												
Leptospermum liversidgei			+												
Leucopogon ericoides							1								
Lomandra filiformis								+							
Lomandra glauca	+														
Lomandra longifolia			+												
Marsdenia suaveolens										1					
Microtis unifolia				+											
Mitrasacme polymorpha			+												
Olax stricta		+													
Persoonia lanceolata								+							
Platylobium formosum	+														
Poranthera microphylla			1												
Stylidium graminifolium			+												
Xanthorrhoea media							1								
Xanthorrhoea minor						+									
Acacia mearnsii		1	+												
Actinotus helianthi							2	1							
Boronia pinnata								+							
Caleana major			+	+											
Comesperma ericinum			+				+								
Dampiera stricta			+					1							
Gompholobium latifolium			+	+											
Gonocarpus micrantha			+						1						
Lomandra multiflora	+			1											
Macrozamia spiralis	+			+											
Monotoca elliptica		+					1								
Pandorea pandorana		+		+											
Patersonia glabrata							+	+							
Phyllota phylicoides						+	+								
Pimelia linifolia			+				+								
Platysace ericoides	+		+												
Xanthosia pilosa			+			+									
Banksia aemula						3	3	3							
Leucopogon esquamatus				+	+		1	1							
Rubus sp.		1	1	1											
Themeda australis	2		+	2											
Acacia suaveolens	+		+	1		1									
Banksia serrata	+	1	1	3	1										
Glycine clandestina	1	+	+	1											
Pomax umbellata	1	1	+	1											
Acacia ulicifolia	+		+	2		2	1								
Billardiera scandens	1		1	+		+		+							
Bossiaea heterophylla		1				1	1								
Leptospermum attenuatum			1		4	1	3	1							
Leptospermum flavescens	1		+		3			2	1						
Ricinocarpos pinifolius			1	+		+	1	1							
Tetratheca thymifolia			+	1	2		1	1							
Tricoryne elatior	1		+	1			+								
Zieria laevigata			+		1	1	1	1							
Hibbertia linearis	1		1	1		1	1	1							
Imperata cylindrica	2	5	2				+		+	1					
	Tall Open Forest								Forest Swamp					Shrubby Swamp	Creek

cont./-

TABLE 2 : cont./-

SPECIES	SAMPLING SITE														
	1	3	4	6	10	13	11	12	7	8	2	15	9	14	5
Persoonia levis	1	+	+	1		+		+							
Bossiaea rhombifolia	2		1	3	1	1	1	2							
Leucopogon lanceolatus	1	1	+	1			1		+					1	
Xanthorrhoea australis		1	+	+		+	2	+							
Aotus ericoides	1	1	2	1	2	3	2	3							
Gonocarpus teucrioides	1	1	2	1		1		1		2	1				
Hardenbergia violacea	1	+	1	2		1		1	1		1				
Acacia longifolia		3							1	3	2				
Indigophora australis	+	1	1								2				
Eucalyptus pilularis	3			1	1		3	3	3						
Dianella caerulea	4	2	1	2			+		1	1	1				
Eucalyptus gummifera	+		2	3	3	1	+				2	1			
Kennedia rubicunda	1	1	1	+					3	3	3		2		
Angophora costata	2	4	4	2	3	3		4	3	3	2				
Pteridium esculentum	5	2	4	5	4	5	3	3	4	4	3			1	
Restio tetraphyllus					2	1	1	1		1	2	3	4	4	
Culcita dubia	1								+	2					
Gahnia sieberana									4	5	3	5	2	1	1
Blechnum indicum										1	2	4	5	+	1
Eucalyptus robusta									3	4	3	5	4	4	+
Melaleuca quinquenervia									+		+	+	3		1
Hemarthria uncinata									2			3	3		
Callistemon citrinus														4	1
Pultenaea myrtoides											2			1	
Banksia robur															+
Blechnum camfieldii											2				
Drosera binnata															1
Eleocharis sphacelata															3
Entolasia stricta														4	
Goodenia paniculata											1				
Lepidosperma neesii															1
Lepidosperma urophorum															5
Leptocarpus tenax														1	
Melaleuca nodosa								4							
Melaleuca thymifolia															+
Opercularia varia															+
Pultenaea retusa											1				
Schoenus pachylepis															+
Selaginella uliginosa														1	
Villarsia exaltata															+
Viminaria juncea															1
	Tall Open Forest								Forest Swamp					Shrubby Swamp	Creek

TABLE 3 : TOTAL SPECIES LIST FOR ACI FREEHOLD PORTION 265

Fern	.....	F	Parasite	.....	P
Grass	.....	G	Rush	.....	R
Herb	.....	H	Sedge	.....	Se
Iris	.....	I	Shrub	.....	S
Lily	.....	L	Tree	.....	T
Orchid	.....	O	Twiner	.....	Tw

Acacia longifolia	Sallow Wattle	Mimosaceae	S
Acacia mearnsii	Black Wattle	Mimosaceae	T
Acacia suaveolens	Sweet Wattle	Mimosaceae	S
Acacia ulicifolia	Juniper Wattle	Mimosaceae	S
Acianthus fornicatus	Insect Orchid	Orchidaceae	O
Actinotus helianthi	Flannel Flower	Umbelliferae	H
Amperea xiphoclada	Broom Spurge	Euphorbiaceae	S
Angophora costata	Smooth-barked Apple	Myrtaceae	T
Aotus ericoides	Common Aotus	Papilionaceae	S
Banksia aemula	Wallum Banksia	Proteaceae	S
Banksia robur	Large-leaf Banksia	Proteaceae	S
Banksia serrata	Saw Banksia	Proteaceae	S/T
Billardiera scandens	Common Apple-berry	Pittosporaceae	TW
Blechnum camfieldii	Fish-bone Fern	Blechnaceae	F
Blechnum indicum	Swamp Water Fern	Blechnaceae	F
Boronia pinnata	Pinnate Boronia	Rutaceae	S
Bossiaea heterophylla	Variable Bossiaea	Papilionaceae	S
Bossiaea rhombifolia	Appressed Bossiaea	Papilionaceae	S
Caleana major	Large Duck Orchid	Orchidaceae	O
Callistemon citrinus	Crimson Bottle-brush	Myrtaceae	S
Cassytha glabella	Slender Dodder-laurel	Lauraceae	Tw/P
Cassytha pubescens	Downy Dodder-laurel	Lauraceae	Tw/P
Clematis aristata	Australian Clematis	Ranunculaceae	Tw
Comesperma ericinum	Heath Milkwort	Polygalaceae	S
Conospermum taxifolium	Variable Smoke-bush	Proteaceae	S
Culcita dubia	Common Ground-fern	Dennsteadtiaceae	F
Dampiera stricta	Blue Dampiera	Goodeniaceae	S
Dendrophthoe vitellina	Long-flower Mistletoe	Loranthaceae	P
Dianella caerulea	Paroo Lily	Liliaceae	L
Dillwynia retorta	Small-leaf Parrot-pea	Papilionaceae	S
Dodonaea triquetra	Long-leaf Hop-bush	Sapindaceae	S
Drosera binata	Forked Sundew	Droseraceae	H
Eleocharis sphacelata	Tall Spike-rush	Cyperaceae	R
Entolasia stricta	Wiry Panic	Gramineae	G
Epacris purpurascens	Heath	Epacridaceae	S
Eriostemon australasius	Wax-flower	Rutaceae	S
Eucalyptus gummifera	Red Bloodwood	Myrtaceae	T
Eucalyptus pilularis	Blackbutt	Myrtaceae	T
Eucalyptus robusta	Swamp Mahogany	Myrtaceae	T
Exocarpos cupressiformis	Cherry Ballarat	Santalaceae	T

Gahnia sieberana	Red-fruit Saw-sedge	Cyperaceae	Se
Glycine clandestina	Twining Glycine	Papilionaceae	Tw
Gnaphalium candidissimum	White Cudweed	Compositae	H
Gompholobium latifolium	Giant Wedge-pea	Papilionaceae	S
Gonocarpus micrantha	Creeping Raspwort	Haloragaceae	H
Gonocarpus teucriodides	Raspwort	Haloragaceae	H
Goodenia paniculata	Goodenia	Goodeniaceae	H
Hardenbergia violacea	Purple Coral-pea	Papilionaceae	Tw
Hemarthria uncinata	Mat Grass	Gramineae	G
Hibbertia fasciculata	Bundled Guinea-flower	Dilleniaceae	S
Hibbertia linearis	Guinea-flower	Dilleniaceae	S
Hypochaeris radicata	Catsear	Compositae	H
Hypolaena fastigiata	Tassel Rope-rush	Restionaceae	R
Imperata cylindrica	Blady Grass	Gramineae	G
Indigofera australis	Austral Indigo	Papilionaceae	S
Kennedia rubicunda	Dusky Coral-pea	Papilionaceae	Tw
Lepidosperma neesii	Stiff Rapier-sedge	Cyperaceae	Se
Lepidosperma urophorum	Tailed Rapier-sedge	Cyperaceae	Se
Leptocarpus tenax	Slender Twine-rush	Restionaceae	R
Leptomeria acida	Sour Current-bush	Santalaceae	S
Leptospermum attenuatum	Paperbark Tea-tree	Myrtaceae	S
Lepospermum flavescens	Yellow Tea-tree	Myrtaceae	S
Leptospermum juniperinum	Prickly Tea-tree	Myrtaceae	S
Leptospermum liversidgei	Olive Tea-tree	Myrtaceae	S
Leucopogon ericoides	Pink Beard-heath	Epacridaceae	S
Leucopogon esquamatus	Swamp Beard-heath	Epacridaceae	S
Leucopogon lanceolatus	Lance Beard-heath	Epacridaceae	S
Lomandra filiformis	Wattle Mat-rush	Xanthorrhoeaceae	R
Lomandra glauca	Pale Mat-rush	Xanthorrhoeaceae	R
Lomandra multiflora	Many-flower Mat-rush	Xanthorrhoeaceae	R
Macrozamia spiralis	Burrawang	Zamiaceae	S
Marsdenia suaveolens	Scented Milk-vine	Asclepiadaceae	Tw
Melaleuca nodosa	Ball Honey Myrtle	Myrtaceae	S/T
Melaleuca quinquenervia	Broad-leaf Paper Bark	Myrtaceae	T
Melaleuca thymifolia	Feather Honey Myrtle	Mytraceae	S
Microtis unifolia	Common Onion-orchid	Orchidaceae	O
Mitracacme polymorpha	Varied Mitrewort	Loganiaceae	H
Monotoca elliptica	Tree Broom-heath	Epacridaceae	S
Olax stricta	Olax	Olacaceae	S
Opercularia varia	Variable stinkweed	Rubiaceae	H
Pandorea pandorana	Wonga-vine	Bignoniaceae	Tw
Patersonia glabrata	Leafy Purple-flag	Iridaceae	I
Persoonia lanceolata	Geebung	Proteaceae	S
Persoonia levis	Smooth Geebung	Proteaceae	S
Phyllota phylicoides	Heath Phyllota	Papilionaceae	S
Pimelia linifolia	Slender Rice-flower	Thymelaeaceae	S
Platylobium formosum	Handsome Flat-pea	Papilionaceae	S
Playtsace ericoides	Heath Platysace	Umbellifera	S
Pomax umbellata	Pomax	Rubiaceae	H
Poranthera microphylla	Small Poranthera	Euphorbiaceae	H
Pteridium esculentum	Austral Bracken	Dennstaedtiaceae	F
Pultenaea myrtoides	Bush-pea	Papilionaceae	S
Pultanaea retusa	Bush-pea	Papilionaceae	S

Restio tetraphyllus	Tassel Cord-rush	Restionaceae	R
Ricinocarpos pinifolius	Wedding Bush	Euphorbiaceae	S
Rubus sp.	Bramble	Rosaceae	S
Schoenus pacylepis	Bog-rush	Cyperaceae	R
Selaginella uliginosa	Swamp Selaginella	Selaginellaceae	F
Stylidium graminifolium	Grass Trigger-plant	Stylidiaceae	H
Tetratheca thymifolia	Black-eyed Susan	Tremandraceae	S
Themeda autralis	Kangaroo Grass	Gramineae	G
Tricoryne elatior	Yellow Rush-lily	Liciaceae	L
Villarsia exaltata	March-flower	Menyanthaceae	H
Viminaria juncea	Golden Spray	Papilionaceae	S
Xanthorrhoea australis	Austral Grass-tree	Xanthorrhoeaceae	S
Xanthorrhoea media	Forest Grass-tree	Xanthorrhoeaceae	S
Xanthorrhoea minor	Small Grass-tree	Xanthorrhoeaceae	S
Xanthosia pilosa	Woolly Xanthosia	Umbelliferae	S
Zieria laevigata	Angular Zieria	Rutaceae	S

TABLE 4 : REGENERATION IN NEWER* REHABILITATION ZONES OF P.O. 77/13 CURRENTLY BEING MINED

(first figure Cover/Abundance, second figure average height in cm.)

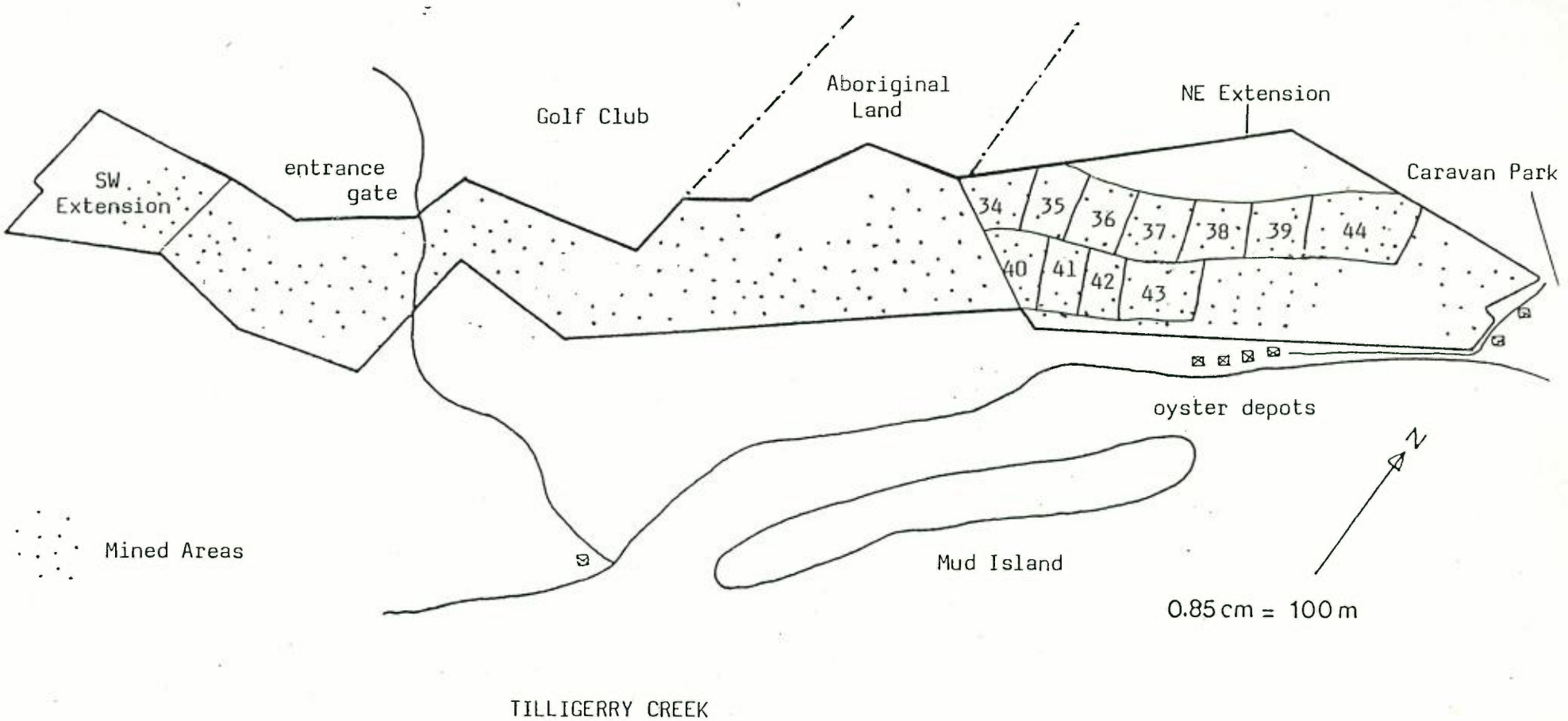
SPECIES \ ZONES	34	35-36	37	38	39	40-41	42	44
Acacia longifolia	-	-	-	-	+,40	-	-	-
Acacia suaveolens	3,130	4,150	3,150	4,160	1,40	3,60	2,80	1,20
Acacia terminalis	-	+,80	+,100	-	-	-	-	-
Acacia ulicifolia	+,100	+,100	1,60	+,60	+,20	1,30	-	+,20
Amperea xiphoclada	3,30	2,30	1,30	-	1,30	2,20	+,20	-
Angophora costata (P,S)	-	3,30	+,30	+,30	+,30	+,20	+,20	-
Aotus ericoides	1,20	2,30	1,30	-	1,30	1,20	+,20	-
Axonopus affinis	-	-	-	-	1,50	-	-	-
Banksia serrata (P,S)	+,20	-	-	-	1,20	+,20	-	-
Billardiera scandens	+,20	-	-	-	+,30	+,20	-	-
Bossiaea ensata	1,30	1,30	-	+,30	-	+,15	-	1,15
Bossiaea heterophylla	-	-	-	-	-	-	-	+,15
Bossiaea rhombifolia	2,30	2,30	1,30	2,100	1,30	1,20	1,20	2,20
Conyza canadensis	-	-	+,100	+,80	-	-	-	-
Dianella caerulea	+,30	2,30	-	1,30	+,30	2,30	-	+,20
Dillwynia retorta	1,40	-	-	-	-	-	-	-
Eucalyptus gummifera (P,S)	1,40	2,40	1,20	1,30	2,30	1,20	+,20	1,10
Eucalyptus pilularis (P,S)	1,40	2,40	1,20	1,30	2,30	1,20	+,20	1,10
Eucalyptus piperita (P,S)	-	1,100	-	-	1,40	+,30	-	-
Gahnia sieberana	-	-	-	-	+,50	-	-	-
Glycine clandestina	-	-	-	-	-	-	+,30	-
Gompholobium latifolium	-	-	-	-	+,30	-	-	1,15
Gonocarpus teucrioides	1,20	+,2-	2,20	1,20	2,30	2,20	-	-
Hardenbergia violacea	1,30	-	-	+,10	1,60	+,5	2,30	+,5
Hibbertia linearis	1,30	1,30	-	1,30	+,30	1,20	-	-
Hypochaeris radicata	-	-	-	-	-	+,20	+,20	-
Imperata cylindrica	-	-	5,40	1,70	+,70	+,20	2,40	-
Leucopogon ericoides	+,20	2,40	-	-	-	-	-	-
Lomandra filiformis	-	1,30	-	1,30	-	+,20	-	-
Lomandra longifolia	1,30	-	-	-	+,30	+,30	-	-
Monotoca elliptica	+,20	-	-	-	-	-	-	-
Pandorea jasminoides	-	-	-	-	-	+,5	-	-
Persoonia levis	+,15	+,15	-	-	+,20	1,20	+,10	-
Persoonia lanceolata	-	+,30	+,30	+,20	+,20	-	-	-
Pimelea linifolia	1,50	1,20	+,40	+,20	+,30	-	-	-
Platysace ericoides	1,20	1,20	1,20	+,20	+,20	+,20	-	-
Pomax umbellata	+,10	-	-	-	-	1,10	-	-
Pteridium esculentum	+,30	+,30	+,30	+,30	+,30	1,20	1,30	+,20
Ricinocarpus pinifolius	1,40	1,50	1,30	-	+,20	1,20	+,30	+,20
Themeda australis	-	+,80	1,80	-	+,80	-	1,80	2,30
Tricoryne elatior	1,20	1,30	1,30	1,30	1,30	+,20	+,20	-
Xanthorrhoea sp. (S)	-	-	-	-	1,20	-	-	-
Xanthosia pilosa	2,20	1,20	-	-	-	1,20	-	-
Zieria laevigata	1.30	-	-	-	-	-	-	-
TOTAL (% Cover, Av. Ht.cm)	80%,80	90%,120	95%,150	90%,160	80%,30	40%,20	50%,20	20%,20

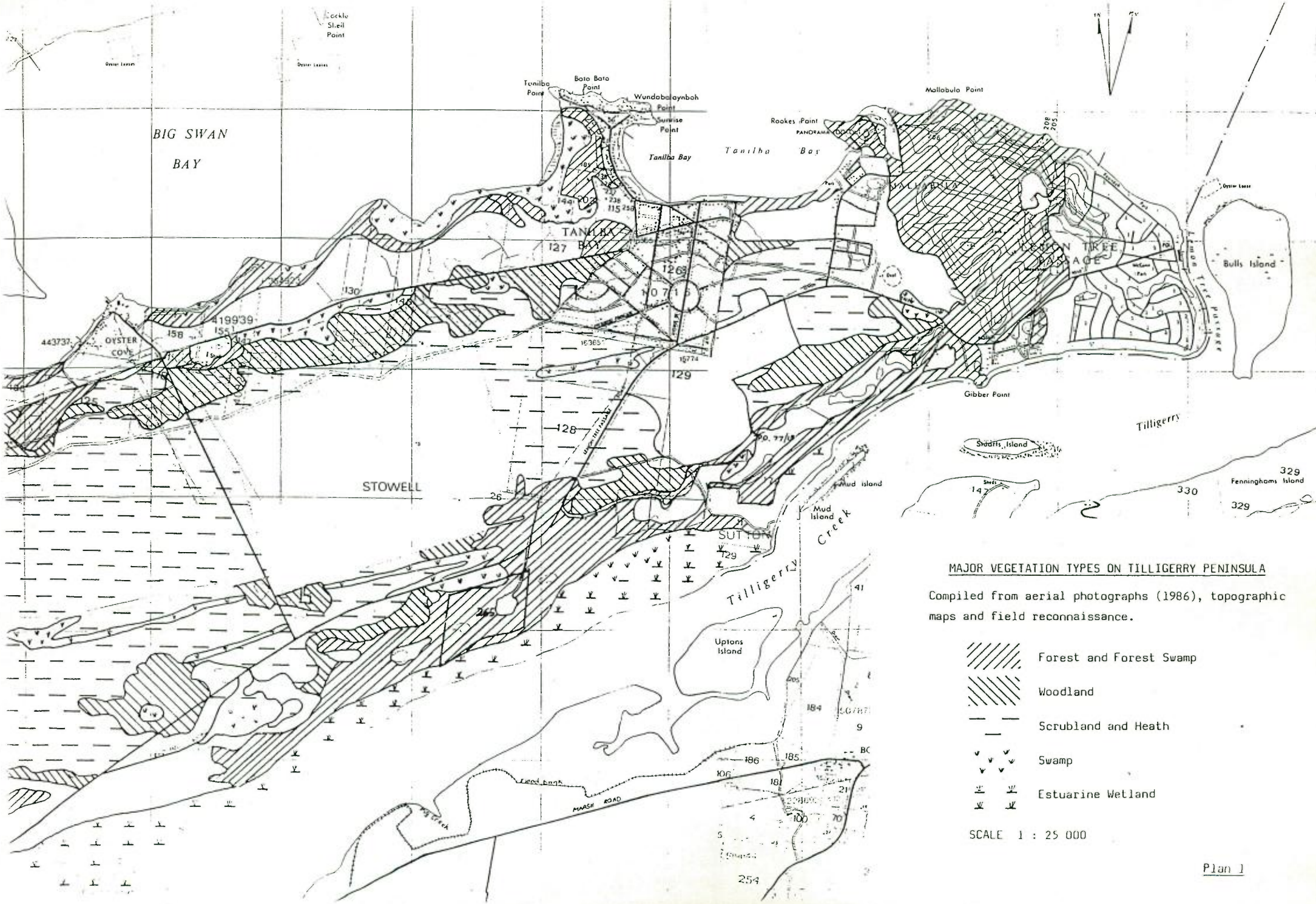
* Date of re-topsoiling : 3/86 6/86 11/86 11/86 3/87 4/87 8/87 12/87
Date of mining 2 or 3 months earlier

Cover/Abundance Scale : + = occasional, cover < 5% 3 = any number, cover 25-50%
1 = common, cover < 5% 4 = any number, cover 50-75%
2 = any number, cover 5-25% 5 = any number, cover 75-100%

Refer to Figure 2 for location of these Rehabilitation Zones within P.O. 77/13

FIGURE 2 : PERMISSIVE OCCUPANCY LEASE 77/13 WITH N.E. AND S.W. EXTENSION AREAS, SHOWING LOCATION OF ZONES 34 TO 44, USED IN TABLE 4





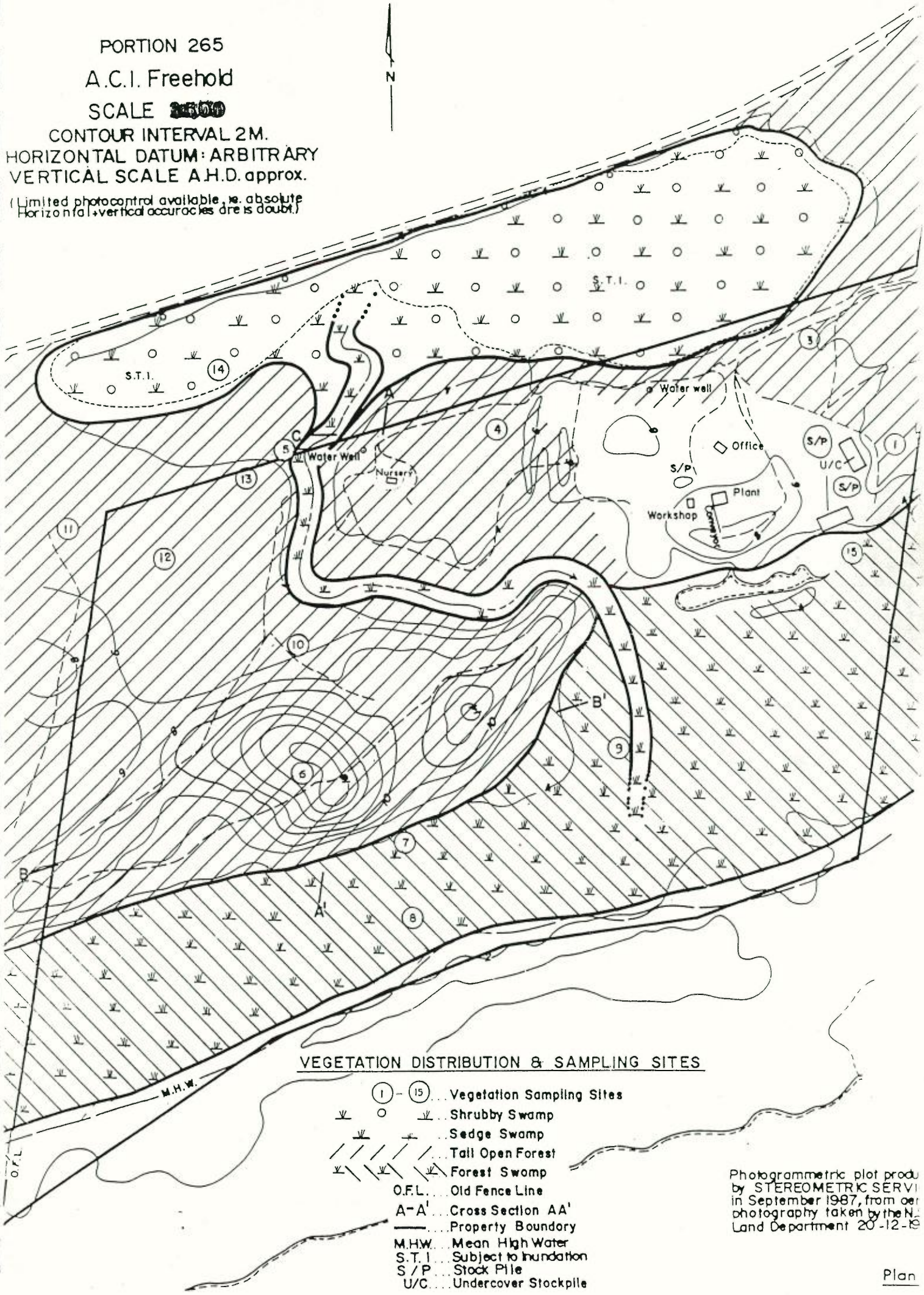
MAJOR VEGETATION TYPES ON TILLIGERRY PENINSULA

Compiled from aerial photographs (1986), topographic maps and field reconnaissance.

- Forest and Forest Swamp
- Woodland
- Scrubland and Heath
- Swamp
- Estuarine Wetland

SCALE 1 : 25 000

Plan 1


PORTION 265
A.C.I. Freehold
SCALE
CONTOUR INTERVAL 2M.
HORIZONTAL DATUM: ARBITRARY
VERTICAL SCALE A.H.D. approx.
(Limited photocontrol available, ie. absolute Horizontal + vertical accuracies are is doubt.)
N
S.T.I.
S.T.I.
Water well
Office
S/P
U/C
S/P
Plant
Workshop
Water Well
Nursery
A
A'
B
B'
C
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
M.H.W.
O.F.L.
VEGETATION DISTRIBUTION & SAMPLING SITES
1 - 15 ... Vegetation Sampling Sites
... Shrubby Swamp
... Sedge Swamp
... Tall Open Forest
... Forest Swamp
O.F.L. ... Old Fence Line
A-A' ... Cross Section AA'
... Property Boundary
M.H.W. ... Mean High Water
S.T.I. ... Subject to Inundation
S/P ... Stock Pile
U/C ... Undercover Stockpile
Photogrammetric plot produ
by STEREOMETRIC SERVI
in September 1987, from aer
photography taken by the N.
Land Department 20-12-8
Plan

APPENDIX 5: FAUNA REPORT

MKES

MOUNT KING ECOLOGICAL SURVEYS

P.O. BOX 161, VAUCLUSE, N.S.W. 2030. TELEPHONE: (02) 337 3101

PRINCIPALS: DR. M. J. S. and E. A. DENNY

R E C O N N A I S A N C E S U R V E Y O F A C I F R E E H O L D P O R T I O N 2 6 5 , T A N I L B A

by

MOUNT KING ECOLOGICAL SURVEYS

August, 1989

RECONNAISANCE FAUNA SURVEY OF ACI FREEHOLD PORTION 265, TANILBA

by

MOUNT KING ECOLOGICAL SURVEYS

1.0 INTRODUCTION

It is proposed by ACI Industrial Minerals Division to extract small deposits of white silica sand on it's own freehold property, Portion 265, at Tanilba. Parts of the Portion are used for a sand treatment plant and offices. Portion 265 is located on Tilligerry Peninsula about 3 km south west of Tanilba. It is proposed to extract sand from about 4.7 ha of the 29.3 ha site. The main area proposed to be mined is a double peaked dune located in the southwest quadrat of the property, whilst there are smaller areas nearer the sand treatment works site.

The vegetation of the area is predominantly open forest with a shrub understorey. The tree cover is well developed and dominated by Smooth-barked Apple [Angophora costata], Blackbutt [Eucalyptus pilularis] and Red Bloodwood [E. gummifera]. There are swamplands on the north and south edges of the Portion and a creek runs across the property joining them. The swamps are characterised by Broad-leaf Paperbark [Melaleuca quinquenervia], Swamp Mahogany [Eucalyptus robusta], Crimson Bottlebrush [Callistemon citrinus] and sedges. There are indications of regular burning of the area in the past, and the most recent fire, in November, 1986, covered the entire area.

2.0 METHODOLOGY

It is the intention of this brief fauna survey to describe the fauna found or likely to occur within Portion 265; to assess the significance of the faunal communities on a regional [Tilligerry Peninsula] basis; to assess the effects of mining and subsequent rehabilitation upon any wildlife corridors; and to comment upon the potential for re-colonisation of rehabilitated areas by native fauna species. In particular, the present status of, and potential impacts from sand extraction, on any populations of Koala [Phascolarctos cinereus] in the area require detailed comments.

The area was surveyed for two days in August, 1989. Terrestrial vertebrates were located within Portion 265 by use of a limited trapping program [25 Elliott trap-nights], spotlighting and general observation. In addition, part of an area previously rehabilitated [Sites 4,5 and 10] was also surveyed for fauna [25 Elliott trap-days]. Trapping sites and spotlighting transects within Portion 265 are given in Figure 1. The surveys were undertaken by Dr Martin Denny, using a National Parks and Wildlife Service General Licence [Collection] No. GLE/E:97. Additional information about the presence of fauna within Portion 265 came from ACI site staff and nearby landowners.

Information about the general distribution of the fauna within Tilligerry Peninsula came from a previous reports by Du Preez [1987] and Mount King Ecological Surveys [1987]. Both reports drew extensively on distribution records for the Port Stephens district obtained from the National Parks and Wildlife Service, Australian Museum and from several published reports e.g. Croft & Associates Pty Ltd, 1982, Planning Workshop, 1976.

3.0 RESULTS

3.1 Fauna Located Within Portion 265 and Rehabilitation Areas

Despite a very short survey period, a relatively wide variety of fauna was located. Nine species of mammal [5 native], 24 species of bird, three reptile species and two species of amphibian were recorded from the two areas surveyed [see Table 1]. Most of these were direct sightings, but some were from indirect evidence e.g. bandicoot diggings, or from reported sightings by ACI staff and landowners.

Three of the native mammals located [Swamp Wallaby, bandicoots, Dusky Antechinus] are usually associated with terrestrial habitats i.e. occupy ground habitats. However, the Dusky Antechinus is known to use trees in searching for food and a large male was observed climbing the base of a Red Bloodwood during the survey. The exact identity of the bandicoot using the area was not determined, but it would be either the Northern Brown Bandicoot and/or the Long-nosed Bandicoot. Both species are common along the central coast of N.S.W. There was plenty of evidence [scats] of the Swamp Wallaby within the dune and plant site area, indicating the presence of an animal relatively common in this part of N.S.W. Although there was no evidence of the smaller macropod, the Red-necked Wallaby, this common species would probably also be found in the area.

Two native mammals were observed within trees in the survey area. The arboreal mammals were the Common Brushtail Possum and the Koala. Both are commonly distributed along the coast of N.S.W., and the Koala has been reported from many areas on the Tilligerry Peninsula. Two Koalas were sighted within Portion 265 - one within a Swamp Mahogany in the swamp forest, on the northern edge of the Portion; the other, a mother and young, was observed resting in a Smooth-barked Apple in the dune area. There was plenty of evidence of a high usage of the Portion by Koalas - from characteristics scratchings on trees and scats lying at the base of trees. Both ACI staff and nearby landowners reported several sightings of Koalas in the area.

Of the 24 species of bird located during the short survey, most are commonly found within areas of bushland along the N.S.W. coast, and are typical of assemblages of avifauna found in areas of bushland near human habitation. Only a few honeyeaters were observed, as there was little blossoming of trees and shrubs during the survey period. Other bird species located were mainly small birds associated with dense bushland and timber e.g. wrens, fantail, pardalote, treecreeper, rosella and thornbills. The larger "opportunistic" feeders such as magpies, currawongs and

ravens were observed throughout the Portion. Avifaunal species associated with wetter types of vegetation included the Eastern Whipbird and the Brown Pigeon.

Two raptors were observed, the Grey Goshawk was seen flying over the rehabilitation areas whilst there were a breeding pair of White-bellied Sea-eagles associated with a nest in a large tree at the eastern end of the dune. The eagles were tending their nest continually and ACI staff reported hearing the calls of young eagles. Although none were seen during my visit, White-bellied Sea-eagles breed between May and October and it is likely that the nest contained young.

Of the herpetofauna observed or reported within Portion 265, three were found in a variety of terrestrial habitat i.e. Red-bellied Black Snake, Brown Snake and Common Tree Snake, whilst the two species of frog were located within aquatic habitats [Common Eastern Toadlet, Eastern Dwarf Tree Frog]. All these species are commonly distributed along the N.S.W. coast.

3.2 Fauna Likely to be Found Within Portion 265

Because of the short survey period, it was impossible to give an account of all native fauna species found within Portion 265. A list of species known or likely to occur within those areas of the Portion likely top be affected is given in Table 2. The list was derived from distributional records and habitat preferences [see Section 2.0]. Because of the wide range of habitats found within Tilligerry Peninsula, there is a high diversity of species known from the region The lists provided by Du Preez [1987] shows that 34 native mammal species, 125 bird species, 34 reptile and 23 frog species could be expected in the study area. However, some of the habitats found in the Portion are not likely to be significantly affected by the development e.g..wetlands, and the associated species can be removed from the species list.

Most of the terrestrial fauna expected within Portion 265 is that commonly found along the N.S.W. coast and is well represented within nearby conservation areas e.g. Myall Lake National Park. Many of the bird species expected are visitors to the area at various times of the year, whilst others utilize the area for roosting and feeding, but are found over a far greater range e.g. raptors. Many of the bats expected in the area would have roosting places far away from Portion 265 e.g. caves [bent-wing bats], and would only utilize the area for feeding. Small mammals such as the New Holland Mouse, Bush Rat and Brown Antechinus would be expected, but it is unlikely that the Eastern Chestnut Mouse would be found in the drier timbered areas. It is mainly found in wet heath, particularly associated with swamps [Fox, 1983].

3.3 Status

The population State and Australian population status of nearly all species either known or expected within Portion 265 can be classed as high i.e. abundant, common or moderately common. The Peregrine Falcon and Australian Hobby are considered uncommon

within N.S.W. and, as members of the Family Falconidae, are listed on CITES [Convention into Trade of Endangered Species]. However, neither are regarded as in danger of extinction within Australia.

Both the Koala and the White-bellied Sea-eagle are listed on Schedule 12 [Endangered Fauna] of the N.S.W. National Parks and Wildlife Act [1974] as Fauna of Special Concern.

The White-bellied Sea-eagle [Haliaeetus leucogaster has an Australian Status of Fairly Common and breeds in Australia. The White-bellied Sea-Eagle lives and breeds [between May and October] along the Australian coast and has colonized most large man-made reservoirs. Nests are in trees or on rocks and the breeding areas are traditional, though several nest sites may be used in each area. The Sea-Eagle is sedentary but it disperses widely. Diet is mainly small birds e.g. penguins, terns, and other animals. This species is listed on The Draft Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and Their Environment [CHAMBA].

The Koala is classed as Common, with limited distribution. The Koala is limited to areas where there are acceptable food trees, predominantly eucalypys, but also non-eucalypt trees such as Melaleuca. Although in high numbers in some parts of its range, continued clearing of large tracts of forest and the consequent restriction of populations to small patches of discontinuous and possibly suboptimal habitat, leave the long-term future of this species in some doubt. From the results of a State-wide survey, Reed et al [in press, 1989] point out that the Port Stephens region is one of a few areas supporting high numbers of Koalas.

4.0 DISCUSSION

4.1 Use of Portion 265 by Koalas

There is strong evidence that Koalas use Portion 265 for feeding etc. Sightings of Koalas [one breeding] were recorded near the processing plant and on the sand dune. There are tracks and dung of this marsupial throughout the Portion and Koalas have been reported in the yard of the adjoining landowner. According to Clulow [n.d.] "a major continuous population of koalas in Port Stephens occurs throughout the Tomago Catchment Area, Medowie, Salt-Ash and along Tilligerry Peninsula." Clulow places Portion 265 within a southern corridor for Koalas along Telligerry Peninsula.

The surprising aspect of the distribution of Koalas in and near Portion 265 is that they do not appear to be severely affected by human development. Koalas wander through and feed within the area of the sand treatment plant and are seen within the yards and houses of people with large dogs etc. This is a common phenomenon for Koalas along the N.S.W. coast and there are significant populations of this animal in the urban areas of Port Macquarie and Sydney. In the Port Macquarie region, an important

cause of death is collision with vehicles as Koalas cross busy roads. The east-west corridors established along Tilligerry Peninsula do not require the crossing of major roads by Koalas and as long as there is sufficient tree cover within each of the two corridors proposed then Koalas should be able to move freely along the Peninsula.

Tree cover does not have to be continuous, as it is obvious that Koalas will cross open areas at night e.g. Portion 265 sand treatment work site. It is with this in mind that it is recommended that limited development of parts of the Peninsula could go ahead, provided belts of native timber are retained and preferred Koala trees are actively replanted.

4.2 Wildlife Corridors Within Tilligerry Peninsula and the Influence of Portion 265

Clulow has pointed out that there are two major east-west corridors for Koalas along Telligerry Peninsula. These corridors follow the northern and southern margins of Tilligerry Peninsula i.e. beside Big Swan Bay and Tilligerry Creek, and join onto patches of forest at Mallabula and Lemon Tree Passage. Both corridors comprise stands of tall open forest, woodland, heath and swamp forest. Only the northern corridor is crossed by a relatively major road [Oyster Cove Road].

There has been some breaking up of these corridors, but there still remains sufficient food trees for Koalas to exist in viable quantities. An important aspect of both corridors is the nearly continuous strip of Swamp Forest along their margins. It has been found at Lake Cattai, near Port Macquarie, that Koalas may prefer this type of vegetation community. At present, there are no plans for destruction of the swamp forest and all efforts should be made to ensure it's conservation. A mosaic of patches of eucalypt forest and woodland, cleared areas and swamp forest would still provide an important refuge and corridor for Koalas along Tilligerry Peninsula

4.3 Rehabilitated Areas and Fauna

Previous areas of sand extracted by ACI have undergone extensive rehabilitation and details of the techniques used are provided in separate reports. A short faunal survey of some of the older rehabilitated plots was undertaken and the results are given in Table 3. Fewer bird species [10] and mammal species [2] were located within the plots than that recorded within Portion 265. However, less time was spent in this area so comparisons are difficult, particularly considered the limited survey times at both sites.

The major impression gained from the survey of the rehabilitation sites was that the area had a great potential for supporting native fauna, but still required further time for rehabilitation. It is highly unlikely that a mined area can be returned in a decade to a "natural" state which has evolved over thousands of years. There are over 60 references to studies of recolonisation of mined lands in Australia [see Landline No.11]

and all point out that native fauna will return to previously mined lands, and that the speed and extent of return is partly influenced by the degree of careful rehabilitation of the land.

The rehabilitated lands on ACI property are already providing excellent food sources for nectar-feeding birds and are beginning to develop litter formation which is essential for colonisation by small mammals and reptiles. As the trees and shrubs continue to mature, there will be an accumulation of litter and of cover for the smaller animals. The method used e.g. use of local native plant species, is possibly the best method available and should be encouraged. It is a shame that no records have been taken of any changes in fauna populations within the rehabilitated areas. Two short fauna surveys each year of the rehabilitated areas would yield important information that would be useful in arguing the case for future mining and rehabilitation.

4.4 General Conclusions

The area proposed for sand extraction supports a wide range of native fauna that is typical of this part of the Central Coast of N.S.W. In general, the extraction of sand from this area will have no significant effects upon the overall status of any native fauna in the area. The Sea-eagle nests within a large tree on the sand dune proposed for mining [see Figure 1]. However, this tree will be retained by ACI as part of the Aboriginal protection area so that the proposal should not adversely affect the status of the White-bellied Sea-eagle. The tree could also form an important seed source for future rehabilitation, as well as being a prominant symbol of the care undertaken by ACI to preserving the environment.

The construction of a causeway across the swampland between the sand treatment plant and the dune could result in changes to the vegetation composition of the swamp upstream of the causeway and of the SEPP 14 swamp nearer to Tilligerry Creek. However, ACI have advised that the design of the causeway is such that it will not affect the hydrological regime of the area, and there is only relatively small area of swampland affected by the construction. Consequently, the impacts from the causeway will not be significant.

There should be little problem with the continued conservation of Koalas within Portion 265. Provided patches of tall eucalypt forest are retained within the Portion [there is no need for indiscriminate removal of trees to provide another space for a shed or machine] and that the Swamp Forest is not touched, Koalas should be able to continue to live and breed in the area.

31-8-89

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TABLE 1 FAUNA LOCATED WITHIN PORTION 265

1. MAMMALS

Scientific Name	Common Name	Status Aust
MARSUPIALIA		
DASYURIDAE		
Antechinus swainsonii	Dusky Antechinus	A
PERMAELIDAE		
Isoodon macrourus	Northern Brown Bandicoot	C
Perameles nasuta	Long-nosed Bandicoot	C
PHASCOLARCTIDAE		
Phascolarctos cinereus	Koala	C
PHALANGERIDAE		
Trichosaurus vulpecula	Common Brushtail Possum	A
MACROPODIDAE		
Wallabia bicolor	Swamp Wallaby	C
EUTHERIA		
MURIDAE		
Mus musculus	House Mouse	A
CANIDAE		
Canis familiaris	Dog	C
EQUIDAE		
Equus caballus	Horse	C

Australian status from Strahan [1983]

A - Abundant
C - Common

2. AVIFAUNA

Common Name	Scientific Name	Status Aust	Status NSW	Habitat
ARDEIDAE				
White-faced Heron	Ardea novaehollandiae	C	A	F,S
ACCIPITRIDAE				
White-bellied Sea-Eagle	Haliaeetus leucogaster	MC	U	F,S
RALLIDAE				
Purple Swamphen	Porphyrio porphyrio	MC	A	F,G
COLUMBIDAE				
Brown Cuckoo-Dove	Macropygia amboinensis	C	C	R
Crested Pigeon	Ocyphaps lophotes	A	A	W,G
PLATYCERCIDAE				
Eastern Rosella	Platycercus eximius	A	A	W,H
CUCULIDAE				
Pallid Cuckoo	Cuculus pallidus	MC	C	W
ALCEDINIDAE				
Laughing Kookaburra	Dacelo novaeguineae	A	A	W,H
CAMPEPHAGIDAE				
Black-faced Cuckoo-Shrike	Coracina novaehollandiae	C	A	W
MUSCICAPIDAE				
Eastern Yellow Robin	Eopsaltria cucullata	C	C	W,R,He
Grey Fantail	Rhipidura fuliginosa	C	A	W
ORTHONYCHIDAE				
Eastern Whipbird	Psophodes olivaceus	C	A	R,W
MALURIDAE				
Superb Fairy-Wren	Malurus cyaneus	MC	A	W,G,He
Variegated Fairy-Wren	Malurus lamberti	MC	C	W,He
ACANTHIZIDAE				
White-browed Scrubwren	Sericornis frontalis	C	A	He,W
Yellow-rumped Thornbill	Acanthiza chrysorrhoa	A	A	W,H
Striated Thornbill	Acanthiza lineata	MC	A	W
CLIMACTERIDAE				
White-throated Treecreeper	Climacteris leucophaea	MC	A	R,W
MELIPHAGIDAE				
Little Wattlebird	Anthochaera chrysoptera	MC	C	W,He,H
Noisy Friarbird	Philemon corniculatus	C	A	W,H
New Holland Honeyeater	Phylidonyris novaehollandiae	C	A	He,W

Common Name	Scientific Name	Status Aust	Status NSW	Habitat
PARDALOTIDAE				
Striated Pardalote	Pardalotus striatus	C	A	W
ZOSTEROPIDAE				
Silvereye	Zosterops lateralis	A	A	W,R,He
CRACTICIDAE				
Australian Magpie	Gymnorhina tibicen	A	A	W,G,H
Pied Currawong	Strepera graculina	C	A	W,G,H
CORVIDAE				
Australian Raven	Corvus coronoides	C	A	W,G,He

1. Scientific and common names from "Recommended English Names for Australian Birds" (RAOU, 1978).

2. Australian status from MacDonald, 1973 and New South Wales status from Morris et al, 1981. Status rankings used are:

A - Abundant
C - Common
MC - Moderately common
U - Uncommon
S - Scarce
R - Rare

3. Habitat preferences grouped into the following categories:

W - Woodland (dry, wet and swamp sclerophyll forest)
R - Rainforest (rainforest)
He - Heath (Heath community)
G - Grassland (areas primarily cleared for grazing or development)
H - Urban development

3. HERPETOFAUNA

Reptiles

Common Tree Snake [Dendrelaphis punctulatus]
Red-bellied Black Snake [Pseudechis porphyriacus]
Eastern Brown Snake [Pseudonaja textilis]

Amphibians

Common Eastern Toadlet [Ranidella signifera]
Eastern Dwarf Tree Frog [Litoria fallax]

TABLE 2 FAUNA LOCATED ON REHABILITATION PLOTS 4,5 & 10

1. MAMMALS

Scientific Name	Common Name	Status Aust
MARSUPIALIA		
PERMAELIDAE		
?Isoodon macrourus	Northern Brown Bandicoot	C
?Perameles nasuta	Long-nosed Bandicoot	C
MACROPODIDAE		
Wallabia bicolor	Swamp Wallaby	C
EUTHERIA		
MURIDAE		
Rattus rattus	Black Rat	A
CANIDAE		
Canis familiaris	Dog	C
EQUIDAE		
Equus caballus	Horse	C

2. AVIFAUNA

Common Name	Scientific Name	Status Aust	Status NSW	Habitat
ACCIPITRIDAE				
Grey Goshawk	Accipiter novaehollandiae	MC	U	W,R
RALLIDAE				
Purple Swamphen	Porphyrio porphyrio	MC	A	F,G
COLUMBIDAE				
Brown Cuckoo-Dove	Macropygia amboinensis	C	C	R
MUSCICAPIDAE				
Grey Fantail	Rhipidura fuliginosa	C	A	W
ORTHONYCHIDAE				
Eastern Whipbird	Psophodes olivaceus	C	A	R,W
MALURIDAE				
Superb Fairy-Wren	Malurus cyaneus	MC	A	W,G,He
MELIPHAGIDAE				
Little Wattlebird	Anthochaera chrysoptera	MC	C	W,He,H
New Holland Honeyeater	Phylidonyris novaehollandiae	C	A	He,W
PARDALOTIDAE				
Striated Pardalote	Pardalotus striatus	C	A	W
CORVIDAE				
Australian Raven	Corvus coronoides	C	A	W,G,He

1. Scientific and common names from "Recommended English Names for Australian Birds" (RAOU, 1978).

2. Australian status from MacDonald, 1973 and New South Wales status from Morris et al, 1981. Status rankings used are:

A - Abundant
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S - Scarce
R - Rare

3. Habitat preferences grouped into the following categories:

W - Woodland (dry, wet and swamp sclerophyll forest)
R - Rainforest (rainforest)
He - Heath (Heath community)
G - Grassland (areas primarily cleared for grazing or development)
H - Urban development

TABLE 3 FAUNA KNOWN AND LIKELY TO OCCUR ON PORTION 265

1. MAMMALS

Scientific Name	Common Name	Status Aust
MONOTREMES		
Tachyglossus aculeatus	Echidna	C
MARSUPIALIA		
DASYURIDAE		
Antechinus stuartii	Brown Antechinus	A
Antechinus swainsonii	Dusky Antechinus	A
Sminthopsis murina	Common Dunnart	C
Planigale maculata	Common Planigale	C
PERMAELIDAE		
Isoodon macrourus	Northern Brown Bandicoot	C
Perameles nasuta	Long-nosed Bandicoot	C
PHASCOLARCTIDAE		
Phascolarctos cinereus	Koala	C
PETAURIDAE		
Pseudcheirus peregrinus	Common Ringtail Possum	C
Petaurus breviceps	Sugar Glider	C
PHALANGERIDAE		
Trichosaurus vulpecula	Common Brushtail Possum	A
BURRAMYIDAE		
Cercatetus nanus	Eastern Pygmy Possum	C
Acrobates pygmaeus	Feathertail Glider	C
MACROPODIDAE		
Wallabia bicolor	Swamp Wallaby	C
Macropus rufogriseus	Red-necked Wallaby	C
EUTHERIA		
MURIDAE		
Rattus rattus	Black Rat	A
Rattus fuscipes	Bush Rat	A
Rattus lutreolus	Swamp Rat	C
Mus musculus	House Mouse	A

Scientific Name	Common Name	Status Aust
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	C
Pseudomys novaehollandiae	New Holland Mouse	C
CANIDAE		
Canis familiaris	Dog	C
FELIDAE		
Felis catus	Feral Cat	A
EQUIDAE		
Equus caballus	Horse	C

Australian Status from Strahan [1983].

2. AVIFAUNA

COMMON NAME	SCIENTIFIC NAME	STATUS Aust	STATUS NSW	HABITAT
ACCIPITRIDAE				
Black-shouldered Kite	Elanus notatus	MC	C	W,G
Whistling Kite	Haliastus sphenurus	C	MC	W,G,He
Brown Goshawk	Accipiter fasciatus	MC	MC	W,He
Collared Sparrowhawk	Accipiter cirrhocephalus	MC	MC	W,G,He
Grey Goshawk	Accipiter novaehollandiae	MC	U	W,R
White-bellied Sea-Eagle	Haliaeetus leucogaster	MC	U	F,S
Little Eagle	Hieraaetus morphnoides	MC	MC	W,He,G
Marsh Harrier	Circus aeruginosus	MC	MC	G,F
FALCONIDAE				
Peregrine Falcon	Falco peregrinus	MC	MC	G,F
Australian Hobby	Falco longipennis	MC	MC	W,He
Brown Falcon	Falco berigora	A	MC	W,He,G
Australian Kestrel	Falco cenchroides	A	C	G,He
PHASIANIDAE				
Stubble Quail	Coturnix novaezelandiae	C	A	G
Brown Quail	Coturnix australis	C	C	G
TURNICIDAE				
Painted Button-Quail	Turnix varia	MC	MC	G,W
RALLIDAE				
Buff-banded Rail	Rallus philippensis	C	MC	G,F
CHARADRIIDAE				
Masked Lapwing	Vanellus miles	A	C	G,F
COLUMBIDAE				
*Feral Pigeon	Columba livia	C	A	H
*Spotted Turtle-Dove	Streptopelia chinensis	C	A	H
Brown Cuckoo-Dove	Macropygia amboinensis	C	C	R
Bar-shouldered Dove	Geopelia humeralis	A	C	W,He
Common Bronzewing	Phaps chalcoptera	C	A	W,He
Brush Bronzewing	Phaps elegans	MC	MC	W,He
Crested Pigeon	Ocyphaps lophotes	A	A	W,G
Wonga Pigeon	Leucosarcia melanoleuca	MC	MC	R,W
CACATUIDAE				
Yellow-tailed Black-Cockatoo	Callyptorhynchus funereus	MC	MC	W
Galah	Cacatua roseicapilla	A	A	W,G,H
Sulphur-crested Cockatoo	Cacatua galerita	C	C	W,G
POLYTELITIDAE				
Australian King-Parrot	Alisterus scapularis	C	C	R,W
LORIIDAE				
Rainbow Lorikeet	Trichoglossus haematodus	C	C	W,R,He

COMMON NAME	SCIENTIFIC NAME	STATUS Aust	STATUS NSW	HABITAT
Scaly-breasted Lorikeet	Trichoglossus chlorolepidotus	C	MC	W
Musk Lorikeet	Glossopsitta concinna	C	MC	W,G
Little Lorikeet	Glossopsitta pusilla	C	C	W,H
PLATYCERCIDAE				
Eastern Rosella	Platycercus eximius	A	A	W,H
Crimson Rosella	Platycercus elegans	C	A	W,H
Red-rumped Parrot	Psephotus haematonotus	C	A	W
CUCULIDAE				
Pallid Cuckoo	Cuculus pallidus	MC	C	W
Brush Cuckoo	Cuculus variolosus	MC	MC	W,R,He
Fan-tailed Cuckoo	Cuculus pyrrhophanus	C	C	W
Horsefield's Bronze Cuckoo	Chrysococcyx basalis	C	C	W,G
Shining Bronze-Cuckoo	Chrysococcyx lucidis	C	C	W
Common Koel	Eudynamis scolopacea	C	MC	W,R
Channel-billed Cuckoo	Scythrops novaehollandiae	MC	U	W
Pheasant Coucal	Centropus phasianinus	C	MC	W,R
STRIGIDAE				
Southern Boobook	Ninox novaeseelandiae	C	C	W,He
TYTONIDAE				
Barn Owl	Tyto alba	C	U	W
Masked Owl	Tyto novaehollandiae	U	U	W
PODARGIDAE				
Tawny Frogmouth	Podargus strigoides	C	A	W
AEGOTHELIDAE				
Australian Owlet Nightjar	Aegotheles cristatus	MC	A	W
APODIDAE				
White-throated Needletail	Hiurndapus caudacutus	C	C	A
ALCEDINIDAE				
Azure Kingfisher	Ceyx azurea	MC	MC	F,S,A
Laughing Kookaburra	Dacelo novaeguineae	A	A	W,H
Sacred Kingfisher	Halcyon sancta	C	A	W,F,S
MEROPIDAE				
Rainbow Bee-eater	Merops ornatus	C	A	G,W
CORACIIDAE				
Dollarbird	Eurystomus orientalis	MC	MC	W
HIRUNDINIDAE				
Welcome Swallow	Hirundo neoxena	C	A	A
Tree Martin	Cecropis nigricans	A	A	A,W

COMMON NAME	SCIENTIFIC NAME	STATUS Aust	STATUS NSW	HABITAT
Fairy Martin	Cecropis ariel	C	A	A
MOTACILLIDAE				
Richard's Pipit	Anthus novaeseelandiae	A	A	G
CAMPEPHAGIDAE				
Black-faced Cuckoo-Shrike	Coracina novaehollandiae	C	A	W
Cicadabird	Coracina tenuirostris	U	MC	W,G
MUSCICAPIDAE				
Rose Robin	Petroica rosea	C	C	W,R
Scarlet Robin	Petroica multicolor	MC	C	W,R
Eastern Yellow Robin	Eopsaltria cucullata	C	C	W,R,He
Jacky Winter	Microeca leucophaea	A	A	W
Crested Shrike-tit	Falcunculus frontatus	MC	C	W
Golden Whistler	Pachycephala pectoralis	C	A	R,W,He
Rufous Whistler	Pachycephala rufiventris	C	A	W
Grey Shrike-thrush	Colluricincla harmonica	C	A	W,He
Leaden Flycatcher	Myiagra rubecula	C	C	W
Satin Flycatcher	Myiagra cyanoleuca	C	MC	W
Restless Flycatcher	Myiagra inquieta	U	A	W
Rufous Fantail	Rhipidura rufifrons	MC	C	R,W
Grey Fantail	Rhipidura fuliginosa	C	A	W
Willie Wagtail	Rhipidura leucophrys	A	A	W,G,He
ORTHONYCHIDAE				
Eastern Whipbird	Psophodes olivaceus	C	A	R,W
MALURIDAE				
Superb Fairy-Wren	Malurus cyaneus	MC	A	W,G,He
Variegated Fairy-Wren	Malurus lamberti	MC	C	W,He
Southern Emu-Wren	Stipiturus malachurus	MC	MC	He,W
ACANTHIZIDAE				
White-browed Scrubwren	Sericornis frontalis	C	A	He,W
Chestnut-rumped Hylacola	Sericornis pyrrhopygius	MC	MC	He,W
Weebill	Smicrornis brevirostris	C	A	W
White-throated Gerygone	Gerygone olivacea	C	A	W
Brown Thornbill	Acanthiza pusilla	C	A	W,R,He
Buff-rumped Thornbill	Acanthiza reguloides	C	A	W
Yellow-rumped Thornbill	Acanthiza chrysorrhoa	A	A	W,H
Yellow Thornbill	Acanthiza nana	C	A	W
Striated Thornbill	Acanthiza lineata	MC	A	W
NEOSITTIDAE				
Varied Sittella	Daphoenositta chrysoptera	C	C	W
CLIMACTERIDAE				
White-throated Treecreeper	Climacteris leucophaea	MC	A	R,W
Red-browed Treecreeper	Climacteris erythrops	MC	C	W

COMMON NAME	SCIENTIFIC NAME	STATUS Aust	STATUS NSW	HABITAT
MELIPHAGIDAE				
Red Wattlebird	Anthochaera carunculata	C	A	W,H
Little Wattlebird	Anthochaera chrysoptera	MC	C	W,He,H
Noisy Friarbird	Philemon corniculatus	C	A	W,H
Noisy Miner	Manorina melocephala	C	A	W,H
Yellow-faced Honeyeater	Lichenostomus chrysops	C	A	W
White-eared Honeyeater	Lichenostomus leucotis	MC	A	W
Fuscous Honeyeater	Lichenostomus fuscus	MC	A	W
Brown-headed Honeyeater	Melithreptus brevirostris	MC	A	W
White-naped Honeyeater	Melithreptus lunatus	C	A	W
New Holland Honeyeater	Phylidonyris novaehollandiae	C	A	He,W
White-cheeked Honeyeater	Phylidonyris nigra	U	A	He,W
Eastern Spinebill	Acanthorhynchus tenuirostris	C	A	He,W
Scarlet Honeyeater	Myzomela sanguinolenta	C	C	W,S
DICAEIDAE				
Mistletoebird	Dicaeum hirundinaceum	MC	A	W,R,He
PARDALOTIDAE				
Spotted Pardalote	Pardalotus punctatus	C	A	W
Striated Pardalote	Pardalotus striatus	C	A	W
ZOSTEROPIDAE				
Silvereye	Zosterops lateralis	A	A	W,R,He
PASSERIDAE				
*House Sparrow	Passer domesticus	A	A	H
PLOCEIDAE				
Red-browed Firetail	Emblema temporalis	C	A	W,He
STURNIDAE				
*Common Starling	Sturnus vulgaris	A	A	G,H
ORIOLIDAE				
Olive-backed Oriole	Oriolus sagittatus	MC	C	W
DICRURIDAE				
Spangled Drongo	Dicrurus hottentottus	C	MC	W,R
GRALLINIDAE				
Australian Magpie-Lark	Grallina cyanoleuca	C	A	G
ARTAMIDAE				
White-breasted Woodswallow	Artamus leucorhynchus	MC	MC	A,W
Dusky Woodswallow	Artamus cyanopterus	C	A	W
CRACTICIDAE				
Grey Butcherbird	Cracticus torquatus	C	A	W,G
Pied Butcherbird	Cracticus nigrogularis	C	A	W,G

COMMON NAME	SCIENTIFIC NAME	STATUS Aust	STATUS NSW	HABITAT
Australian Magpie	Gymnorhina tibicen	A	A	W,G,H
Pied Currawong	Strepera graculina	C	A	W,G,H
CORVIDAE				
Australian Raven	Corvus coronoides	C	A	W,G,He

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U - Uncommon
S - Scarce
R - Rare

3. Habitat preferences grouped into the following categories:

W - Woodland (dry, wet and swamp sclerophyll forest)
R - Rainforest (rainforest)
F - Freshwater communities
S - Saltwater communities
He - Heath (Heath community)
G - Grassland (areas primarily cleared for grazing or development)
H - Urban development
A - Aerial

3. HERPETOFAUNA

COMMON NAME	SCIENTIFIC NAME
Reptiles	
Wood Gecko	Diplodactylus vittatus
Thick-tailed Gecko	Underwoodidaurus milii
Lesueur's Velvet Gecko	Oedura lesueurii
Burtons Snake-lizard	Lialis burtonis
Common Scaly-foot	Pygopus lepidopodus
Bearded Dragon	Amphibolorus barbatus
Jacky Lizard	Amphibolorus muricata
Lace Monitor	Varanus varius
	Carlia burnettii
	Carlia vivax
Fence Skink	Cryptoblepharus virgatus
Striped Skink	Ctenotus robustus
Copper-tailed Skink	Ctenotus taeniolatus
White's Skink	Egernis whitii
Grass Skink	Lampropholis delicata
Garden Skink	Lampropholis quichenoti
Weasel Skink	Lampropholis mustelina
Red-throated Skink	Leiolopisma platynotum
Three-toed Skink	Saiphos equalis
Eastern Water Skink	Sphenomorphus quoyii
Oak Skink	Tiligua casuarinae
Eastern Blue-tongued Skink	Tiligua scincoides
Diamond Python	Morelia spilota
Common Tree Snake	Dendrelaphis punctulatus
Common Death Adder	Acanthophis antarcticus
Eastern Small-eyed Snake	Cryptophis nigrescens
Yellow-faced Whip Snake	Demansia psammophis
Dwarf Crowned Snake	Cacophis krefftii
Black-bellied Swamp Snake	Hemiaspis signata
Eastern Tiger Snake	Notechis scutatus
Eastern Brown Snake	Pseudonaja textilis
Red-bellied Black Snake	Pseudechis porphyriacus
Bandy Bandy	Vermicella annulata
Amphibians	
Giant Burrowing Frog	Heleioporus australiacus
Eastern Banjo Frog	Limnodynastes dumerilii
Ornate Burrowing Frog	Limnodynastes ornatus
Brown-striped Frog	Limnodynastes peronii
Spotted Grass Frog	Limnodynastes tasmaniensis
Common Eastern Froglet	Ranidella signifera
Brown Toadlet	Pseudophryne bibronii

Red-backed Toadlet	Pseudophryne coriacea
Green Tree Frog	Litoria caerulea
Bleating Tree Frog	Litoria dentata
Dwarf Tree Frog	Litoria fallax
Freycinet's Frog	Litoria freycineti
Dainty Green Tree Frog	Litoria gracilenta
Lesueur's Frog	Litoria lesueurii
Rocket Frog	Litoria nasuta
Leaf Green Frog	Litoria phyllochroa
Verreaux's Tree Frog	Litoria verreauxii

PORTION 265

A.C.I. Freehold

SCALE [redacted] 1:4000

CONTOUR INTERVAL 2M.

HORIZONTAL DATUM: ARBITRARY

VERTICAL SCALE A.H.D. approx.

(Limited photocontrol available, ie. absolute Horizontal+vertical accuracies are in doubt)

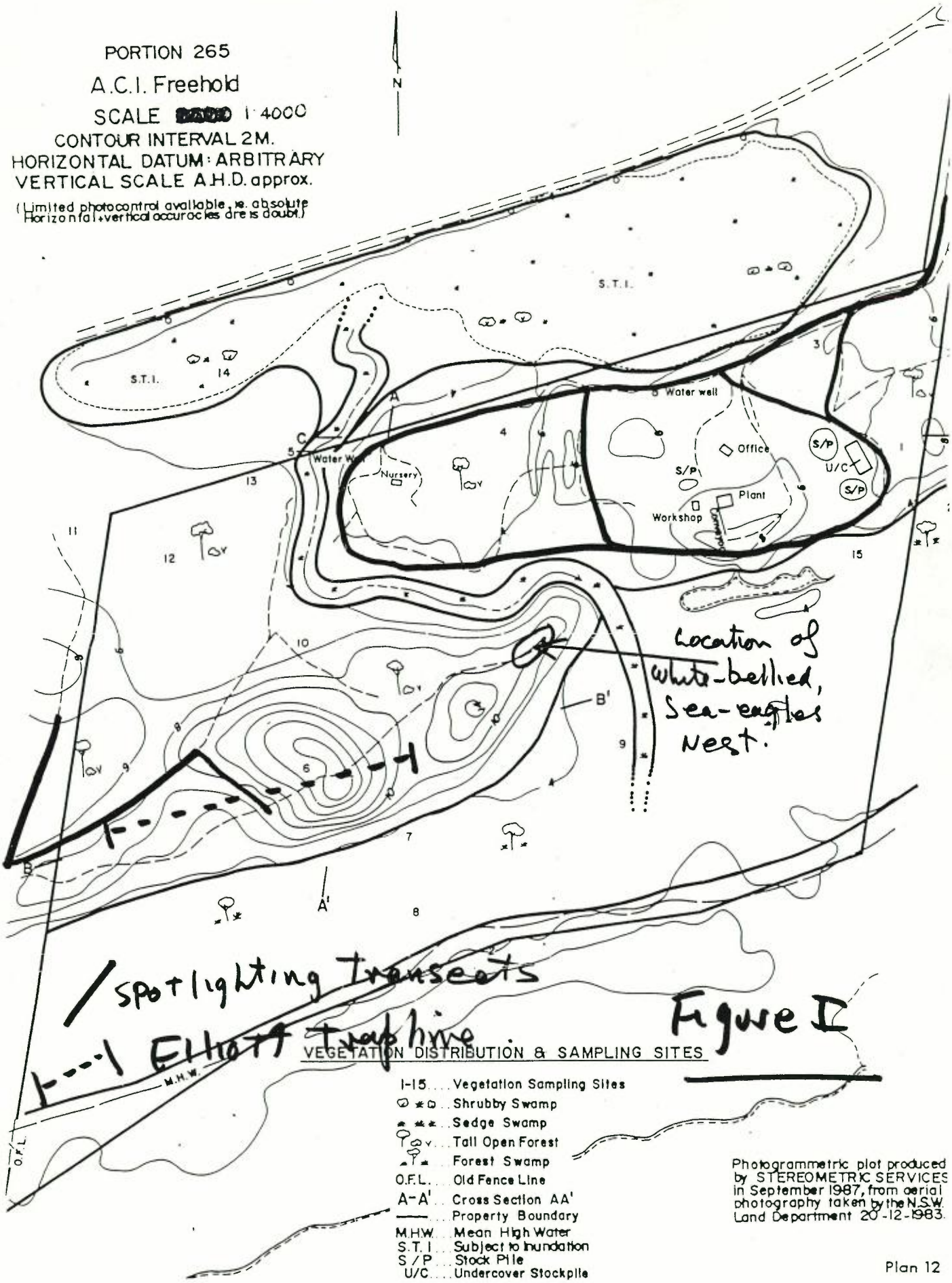


Figure II

VEGETATION DISTRIBUTION & SAMPLING SITES

1-15 . . . Vegetation Sampling Sites
Shrubby Swamp
Sedge Swamp
Tall Open Forest
Forest Swamp
O.F.L. . . . Old Fence Line
A-A' . . . Cross Section AA'
——— . . . Property Boundary
M.H.W. . . . Mean High Water
S.T.I. . . . Subject to Inundation
S/P . . . Stock Pile
U/C . . . Undercover Stockpile

Photogrammetric plot produced by STEREOMETRIC SERVICES in September 1987, from aerial photography taken by the N.S.W. Land Department 20-12-1983.

Plan 12

MKES

MOUNT KING ECOLOGICAL SURVEYS

P.O. BOX 161, VAUCLUSE, N.S.W. 2030. TELEPHONE: (02) 337 3101

PRINCIPALS: DR. M. J. S. and E. A. DENNY

APPENDIX 6: ARCHAEOLOGICAL REPORT

ARCHAEOLOGICAL SURVEY OF PROPOSED SAND-MINING SITE ON TILLIGERRY PENINSULA, NSW.

DENISE DONLON

JUNE 1988

Report prepared for A.C.I. Resources Limited.

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2	ABORIGINAL CONSULTATION	1
3	ENVIRONMENTAL SETTING	2
4	ARCHAEOLOGICAL CONTEXT	3
5	FIELD PROCEDURE	6
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7	DISCUSSION AND SITE ASSESSMENT	9
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8. Isolated find - a single oyster shell 24

1. INTRODUCTION

On June 20, 1988, an archaeological survey was made of a proposed glass sand-mining area on portion 265 off Lemon Tree Passage Road, on Tilligerry Peninsula, at Tanilba, NSW.

The work was commissioned by A.C.I. Resources Limited. A.C.I. planned to remove 1 to 2 metres of white sand from three discrete ridge lines (dunes) within the development area. The proposed development would destroy any relics found on these ridge lines.

1.1 Summary of results and recommendations

Four sites and one isolated find were found during the survey. One of these sites (Site 3) is outside the survey area.

It has been recommended that all three sites (Sites 1,2 and 4) within the survey area be retained undisturbed. Details of the method by which this process is to be carried out are explained in section 8 of this report.

No further action is required of the developer with regard to site 3 and to the isolated find.

2 ABORIGINAL CONSULTATION

The survey area is located within the boundaries of the Worimi Local Aboriginal Land Council. Aboriginal consultation on this survey was done with Mr Jeff Radford representing the Worimi Land Council. This land council has been commissioned to prepare a report on their interest in the survey area following their next meeting on July 5, 1988. This report will be sent to both A.C.I. Resources Ltd. and to the National Parks and Wildlife Service of NSW, Central Region

3 ENVIRONMENTAL SETTING

The survey area is portion 265, off Lemon Tree Passage Road, on the southern side of Tilligerry Peninsula, on the southern side of Port Stevens, NSW. The survey area is 29ha in area and is bounded on the south by Tilligerry Creek. It is proposed that sand-mining will take place on approximately 7ha of the area on back-barrier sand dunes which are Pleistocene in age, dating from the last interglacial or earlier. A small creek runs from from the west of the survey area between the sand dunesand empties into an extensive swamp which extends from Tilligerry Creek for 125 metres to the base of the sand dunes.More than 50% of portion 265 is swamp. (Figs. 1 & 2)

Geological deposits on Tilligerry Creek are mainly Quaternary in age and consist of gravels, sands, silts and clays.
At the end of the peninsula are found volcanics which are Carboniferous in age. Loamy sands are the most common soil type.

Vegetation in the area includes Sydney red gum/Smooth-barked apple (Angophora costata), Blackbutt (Eucalyptus pilularis), paperbark (Melaleuca quinquenervia), Old Man banksia (Banksia serrata) and grey gums (Eucalyptus propinqua). Potential food sources include geebung (Persoonia levis) and the rhizome of braken fern. There is a fairly dense understory of ferns making the ground visibility less than 10% except for those areas where vehicle tracks increase visibility to around 80%.
Extensive mud flats along Tilligerry Creek and probably the swamp itself provide favourable environments for fish and shellfish resources. Common shellfish in this area include the rock oyster (Crassostrea commercialis), the drift or mud oyster (Ostrea angasi), the cockle (Anadara trapezia) and the whelk(Pyrazus ebenius).
There appears to have been little disturbance to the area, with the exception of vehicle tracks and the construction of a small nursery and two water wells.

4 ARCHAEOLOGICAL CONTEXT

The most common archaeological sites located in the Port Stevens area are shell middens. Stone artefact scatters, burials and scarred trees occur less often (National Parks and Wildlife Service [NPWS] Site Register). Most of these shell middens are found on Holocene sand dunes on the coast. Sullivan (1982),after doing a computer analysis of all middens on the north coast of NSW, suggested that such sites could be classified into two types:

i. Short-stay or dinner-time camps. These have a thin layer of shell deposit and few or no stone artefacts. They occur along beaches or headlands.

ii. Longer-stay camps. These camps contained stone artefacts and bone as well as shell. They are more often found in areas on the borders between different environmental zones - eg. the edges of lagoons with access to beaches floodplains.

On Tilligerry Peninsula middens are again the most common site type although they tend to be smaller (i.e. they contain less dense deposits of shell) than those found in the Port Stevens area in general. Cubis (1981) has noted that open beach and headland middens contrast with those of middens at Lemon Tree Passage which he says tend to be unstratified, smaller and less likely to contain stone, bone and charcoal.

No systematic surveys have been carried out on the back-barrier sand dunes in the Tilligerry Peninsula. Four small surveys have been carried out on the peninsula (Dyall 1977; Cubis1981; Brayshaw 1984; Byrne 1987). Nine middens have been found on the Tilligerry Peninsula.

Approximately 4km to the west of the survey area Dyall (1977) found two very small shell middens on a ridge about 1.5km north of Tilligerry Creek. Oneof these sites (NPWS site no. 38-4-110) consisted of 1 rock oyster, 1 drifting oyster and 5 whelks while the other contained 1 cockle and 2 whelks (38-4-112).

Approximately halfway between these middens and the survey area Dyall (NPWS Register) located another four small middens (38-4-71, 38-4-72, 38-4-73, 38-4-74). These middens consist of a few shells of 2 or 3 species of estuarine molluscs and are small and unstratified. Varying quantities of flaked stone and charcoal occur in these sites.

During a survey 2km to the east of the survey area Brayshaw (1984) located a shell midden (38-4-86) in a section exposed by excavation of a barge channel. Four shell species were present - rock oyster, drift oyster, whelks and cockles. The shell matrix is up to 14cm thick and 30 cm deep and is in loamy sand. Further to the east near Gibber POint, Cubis (1981) found a large shell midden (38-5-74). It consisted of a band of cockles and whelks varying in thickness from 3 to 5 cm and lying in black loamy sand which covered the midden to a depth of 5cm. No associated stone artefacts were found. In 1987 Byrne carried out an inspection of a small area of the foreshore of Tilligerry Creek west of Gibber Point. He located no midden or other archaeological material. At the end of Tilligerry Peninsula a shell midden was located at Mallabulla Point (38-5-2) which consisted of drift and rock oysters. The midden has been disturbed by the planting of avocado trees.

The type of middens found on the Tilligerry Peninsula are consistent with the results of Sullivan,s analysis (1982). The same two types seem to be occurring although longer-stay camps are found on the headlands or very close to the creek while the dinner-time camps are found further upstream and away from the creek.

A survey of the Northern Dune,(a dune system running most of the length of the Tilligerry Peninsula) by site curators from the Worimi Local Aboriginal Land Council resulted in no sites of any significance being found (Jeff Radford 1988-pers. comm.)

To the far west of Tilligerry Peninsula, but still on the Tomago sandbeds near the Hunter River, Brayshaw (1981) found a possible scarred tree. Also further to the south at the Williamtown RAAF Base an Aboriginal burial site was discovered by accident (38-4-53).

No excavations have been carried out on the Tilligerry Peninsula.

Conclusions

The following conclusions are made on the basis of the above discussion of previous archaeological work done in the Port Stevens area and particularly on the Tilligerry Peninsula :

1. Shell middens are the most likely type of Aboriginal site to occur.

2. Sites are more likely to occur on the southern side of the Tilligerry Peninsula.

3. Small unstratified shell middens with few or no stone artefacts are the most likely type of site to occur- i.e. 'dinner-time camps'.

4. Areas which border two environmental zones are more likely to have 'longer-stay camps'.

5. The chances of finding scarred or carved trees are poor.

5 FIELD PROCEDURE

The NSW National Parks and Wildlife Service Site Register and associated reports of surveys in the area were consulted prior to the field survey. No Aboriginal sites were known in the survey area. This background information also enabled site prediction in terms of location and site types in the survey area (see section 4).

The Williamtown 1:25 000, aerial photographs and 1:2500 maps of the survey area supplied by A.C.I. Resources were used during the field survey. Mr Len Koncek, A.C.I. Resources' Geologist pointed out the mining stages and access routes to the various parts of the survey area. The survey was performed on foot on June 20 1988 by Denise Donlon and Laurajane Smith. Mr Jeff Radford of the Worimi Local Aboriginal Land Council also took part in the survey. The survey team carried out six transects, 10 to 20 metres apart, across each of the three area to be affected by the proposed development. The ground was investigated for midden material, stone artefacts and exposed burials. Vehicles tracks, where visibility was greater, were closely examined. Mature trees were inspected for signs of Aboriginal scarring or carving.

6 RESULTS

Four Aboriginal shell middens and one isolated find were located during the survey. Three of these sites are within the survey area while one is just outside the western boundary. A stone artefact was associated with one midden- site 4. The positions of each of the sites and the isolated find are marked on Figure 3.

The sites are designated and described as follows:

SITE 1 - Tilligerry Peninsula #1

(0455.7510 Williamtown 1:25 000)

This site is located at the end of an overgrown track on the spur of the north eastern end of the large dune system.

This site would be disturbed by mining stages I and V.

Visibility < 10%

Dimensions: 20 x 10 m

Animal diggings suggest that subsurface deposit of at least 5cm is possible.

Edible species: rock oyster 5%
whelk 15%
cockle 80%

Some of the shells appear to have been burnt. Most of the shells are bleached and some were quite fragile.

Shell density: Maximum shell density = 10/0.2m²
Average shell density = 1/m²

Soil: grey loamy sand.

(Figures 3 and 4. Plates 1,2 and3)

SITE 2 - Tilligerry Peninsula #2 (Figs.3 &5. Plates 4&5)
(0425. 7495 Williamtown 1:25000)

This site is located on a saddle between two dunes on the south western end of the large dune system. It would be disturbed by mining stages IIIA and IIIB.

Visibility: < 10%

Dimensions: 20 x 10m

Edible species: cockle 70%
whelk 30%

Shell density: Maximum density = 5/m²
Average density = 1/2m²

Soil: grey loamy sand.

SITE 3 - Tilligerry Peninsula #3 (Figs.3 & 6)
(0415. 7495 Williamtown 1:25 000)

This site is located partly on a track about 20 m outside the western boundary of the survey area.

Visibility: < 20% off the track.

Dimensions: 10 x 5 m

Shell density: maximum shell density = 5/m²
average shell density = 1/2m²

Edible species cockle 100%

Soil: grey loamy sand

SITE 4 - Tilligerry Peninsula#4 (Figs.3&7. Plates 6&7)
(0440. 7525 Williamtown 1:25 000)

This site is made up of two clusters of shells which overlap and are therefore considered to be one site.
The site would be affected by stage VII of mining.

Cluster 1 This cluster of shells is located close to and south east of the nursery.
Visibility: < 10%
Dimensions: 20 x 100 m
Shell density: maximum shell density = 10/0.2m²
average shell density = 1/m²
Edible species: cockle 100%
Also associated with this midden are a number of geebung trees which produce edible fruit.
Soil: grey loamy sand.

On the edge of this cluster of shells, just by the south western corner of the nursery is a bulldozed spoil heap consisting of shell and a stone artefact.
The average density of shells in this spoil heap = 36/m²
Edible species: cockles 60%
rock oyster 30%
whelk 10%
Artefact: The artefact is a cream chert flake with flakes off the dorsal surface and platform retouch. The distal end is broken off.
Dimensions: 17 x 15 x 2mm (Fig. 8)

Cluster 2 This cluster of shells is located on a track to the east of the nursery.
Dimensions: 50 x 3m
Shell density: average density = 1/5m²
Edible species: cockle 50%
Whelk 50%
Soil: grey loamy sand.
The high density of shells in the spoil heap suggets the deposit is at least 5 cm deep.

ISOLATED FIND (0440. 7505 Williamtown 1:25 000)

One oyster shell was found on the south western side of the largest dune, 10 m from the top. (Fig. 3, Plate 8).

7 DISCUSSION AND SITE ASSESSMENT

Because of the close proximity of Tilligerry Creek and a smaller creek and swamp it was considered prior to the survey that the likelihood of finding Aboriginal sites in the survey area was high. This expectation was supported by the results.

The absence of significant sites on the Northern Dune and the disturbed nature of the larger middens found on Tilligerry Peninsula makes the sites found on this survey archaeologically significant. In addition, there are few areas on the Tilligerry Peninsula where similar middens may be found given the residential and commercial development to the east and the likelihood of flooding to the west.

The middens found on this survey could be considered typical of those on the Tilligerry Penonsula in terms of their shell composition. In terms of size these middens are intermediate in size between the large middens found on the headland and close to the creek and the smaller middens found further away from the creek and headland. This result is not unexpected given the close proximity of the smaller creek and associated swamp. In terms of Sullivan's model for coastal occupation sites the middens found in this survey could be considered large "dinner-time camps'.

These sites are assessed as being of high archaeological significance. This assessment is based on two criteria. These are:

1. Research potential - that is, whether a site contains undisturbed material that has the potential to provide archaeological information.

2 Representativeness - that is, whether a site is rare or common. Rare sites by virtue of their scarcity are considered to be highly significant. More common sites however, may still be considered as highly significant if they are good or representative examples of a common type.

The four sites in this survey area are considered to be archaeologically significant as:

1. Very few sites are known on the Tilligerry Peninsula and due to the degree of disturbance (mining, residential development etc.) across the peninsula it is unlikely that very many sites still remain.

2. The sites are apparently undisturbed and the research potential of each site is high.

3. The sites are valuable as they have both common and uncommon features - i.e. in terms of composition and size.

Of the four sites , 1 and 4 are considered to be the most significant as both sites contain the highest density of shell. Site 4 also contains a stone artefact which is relatively unusua

Site 3 is outside the survey area and so no recommendations concerning this site are made here.

The origin of the isolated find is uncertain. There is no evidence that it arrived in its position as a result of the activities of Aboriginal people.

Due to the low visibility across the survey area it is likeky that the sites could be larger than recorded and that the survey team may have missed a number of sites.

8 RECOMMENDATIONS

The following recommendations were made based on discussion with
- Mr Jeff Radford, representative of the Worimi Local Aboriginal Land Council.
- Discussion with Ms Bromwyn Conyers, senior archaeologist in the Central Region of the National Parks and Wildlife Service.
- the assessment of sites outlined in section 7 of this report.
- provisions of the National Parks and Wildlife Service Act,1974 whereby it is illegal to damage, deface or destroy a relic without permission of the Director.

The recommendations are:

1. That all three sites (Site nos. 1,2 and 4) located within the survey area be retained undisturbed.

2. No further action is required of the developer with regard to site 3 which is outside the survey area or to the isolated find.

3. In order to avoid disturbing site 1, a fence should be erected so as to provide a 10 metre buffer zone around the site.This would place the fence on the 8 metre contour line. The proposed access road to to the large dune would have to be diverted around the site. The midden should not be disturbed as it is confined to the top of the spur.

4. In order to avoid disturbing site 2, a fence should be erected as shown in Figure 3 . This would allow a buffer zone of 20 metres to be left around the site.

5. In order to avoid disturbing site 4 a fence should be erected as shown in Figure 3. This would provide a 20 metre buffer zone around the site.

6. The fences should be removed once mining is completed.

7. To avoid inadvertant damage to the sites, A.C.I. Resources should inform all employees and contractors working on portion 265 that it is an offence under the National Parks and Wildlife Service Act, 1974, to disturb or destroy Aboriginal relics.

8. Due to the low ground visibility it is possible that further sites or relics might be unearthed during the mining of the sand. If this occurs then A.C.I. Resources should inform the Regional Archaeologist of the NSW National Parks and Wildlife Service immediately.

9. One (1) copy of this report be forwarded to

Mr Jeff Radford
Administrator of Worimi Local Aboriginal
Land Council
Shop 9, Koowindah Shopping Arcade
Tanilba Bay NSW 2301

10. Five (5) copies of this report be forwarded to

Ms Bromwyn Conyers
Regional Archaeologist
Central Region Office
NSW National Parks and Wildlife Service
7 Charles Street
Parramatta NSW 2150

9 REFERENCES

Brayshaw, H. 1981 Archaeological survey of proposed site of Tomago Aluminum smelter near Hexham. Unpublished report to Tomago Aluminium Co. Pty Ltd.

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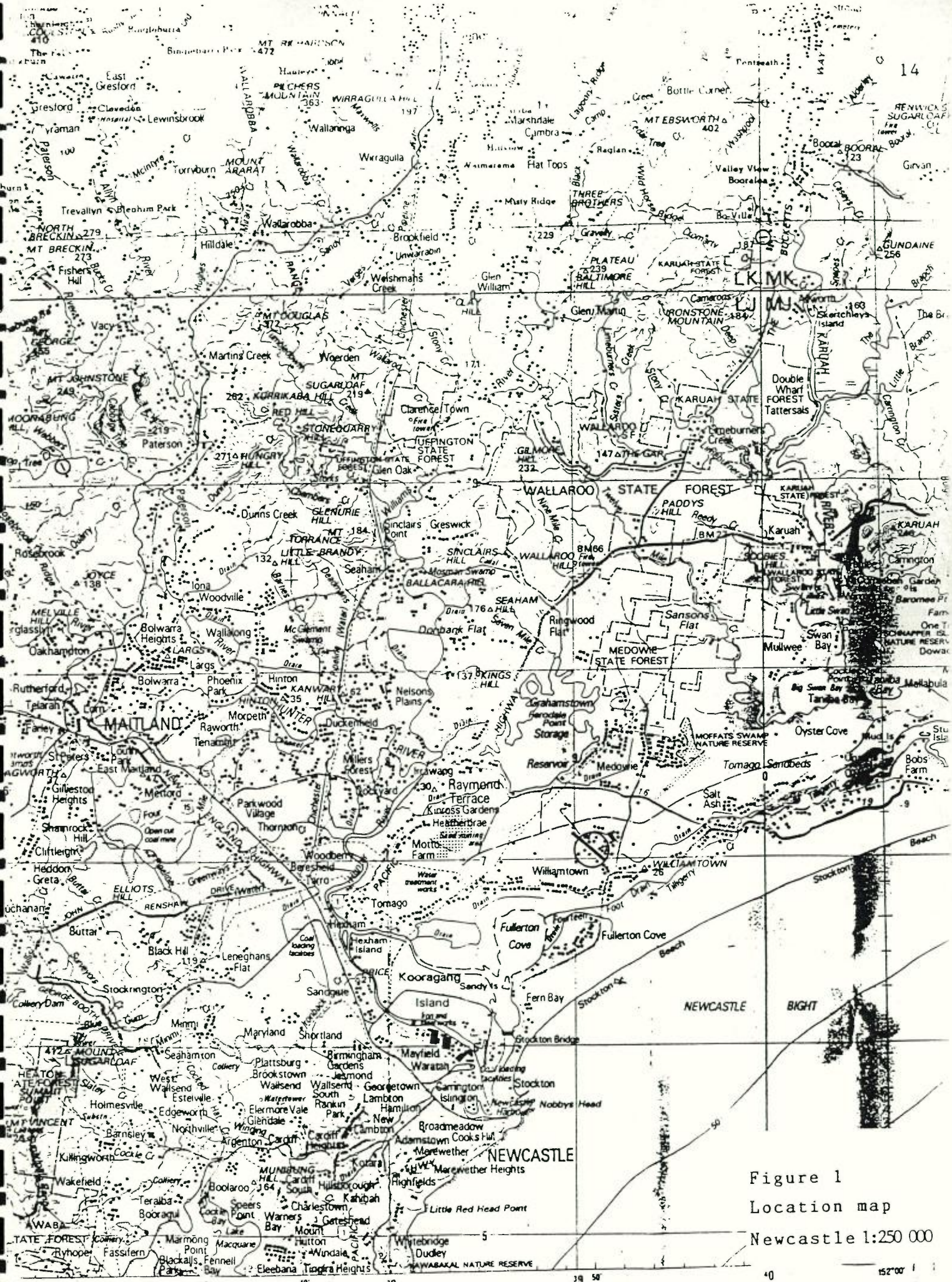
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MAITLAND
NEWCASTLE
NEWCASTLE BIGHT
WALLAROO STATE FOREST
KARUAH STATE FOREST
MEDOWIE STATE FOREST
UFFINGTON STATE FOREST
MOFFATS SWAMP NATURE RESERVE
WAWABAKAL NATURE RESERVE
Stockton Bridge
Fullerton Cove
Tomago Sandbeds
Oyster Cove
Williamtown
Raymond Terrace
Kooragang Island
Hexham Island
Tomago
Maitland
Rutherford
Telarah
Bolwarra
Bolwarra Heights
Oakhampton
Largs
Morpeth
Raworth
East Maitland
Gillieston Heights
Metford
Thornton
Woodberry
Beresfield
Tarro
Hexham
Sandgate
Stockrington
Kotara
Waratah
Mayfield
Shortland
Maryland
Seahampton
Wallsend
Lambton
Georgetown
Islington
Cardiff
Adamstown
Cooks Hill
Broadmeadow
Marewether
Marewether Heights
Highfields
Whitebridge
Dudley
Redhead
Belmont
Toronto
Survey Area
Figure 1
Location map
Newcastle 1:250 000
WORLD GEODETIC SYSTEM

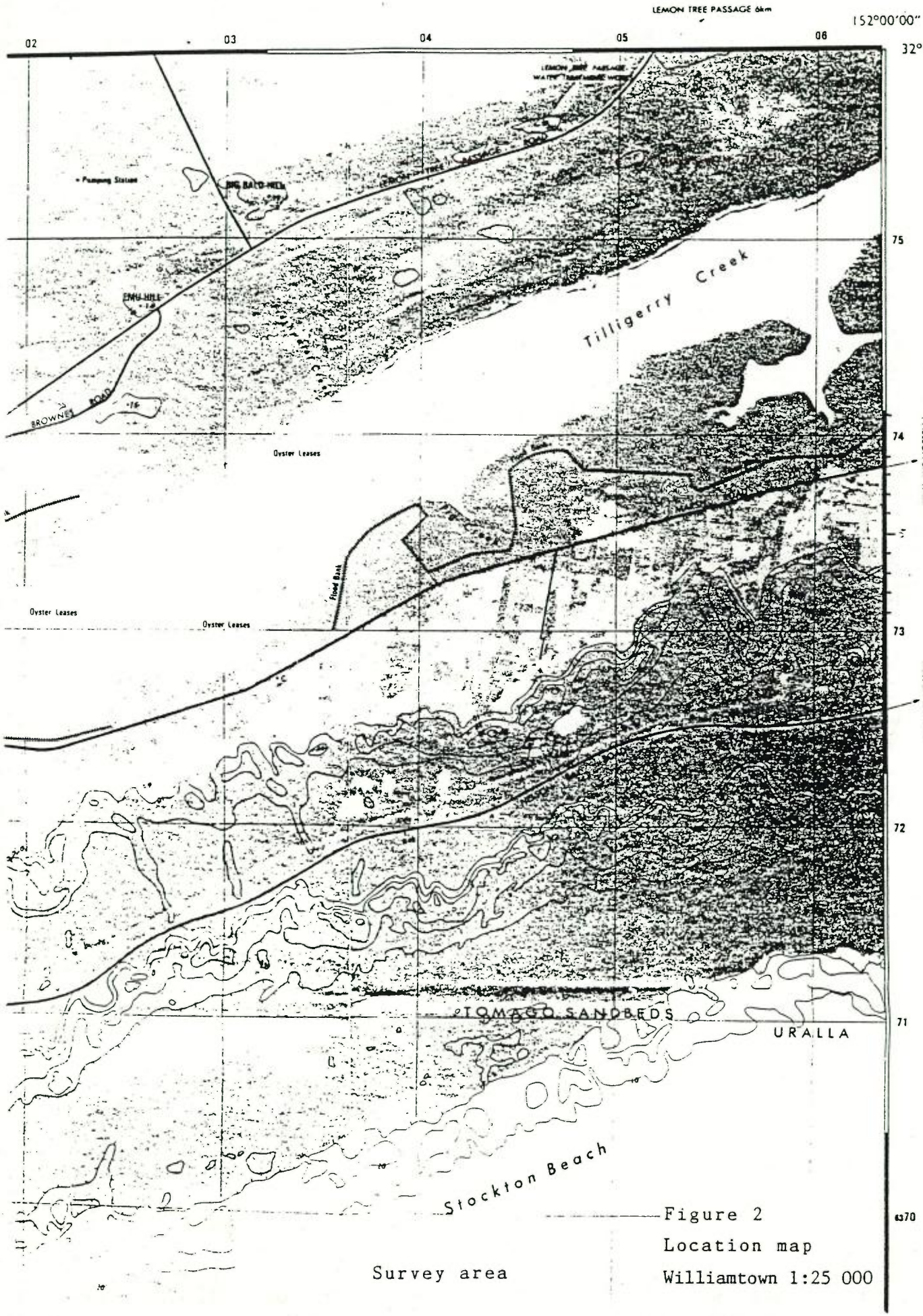
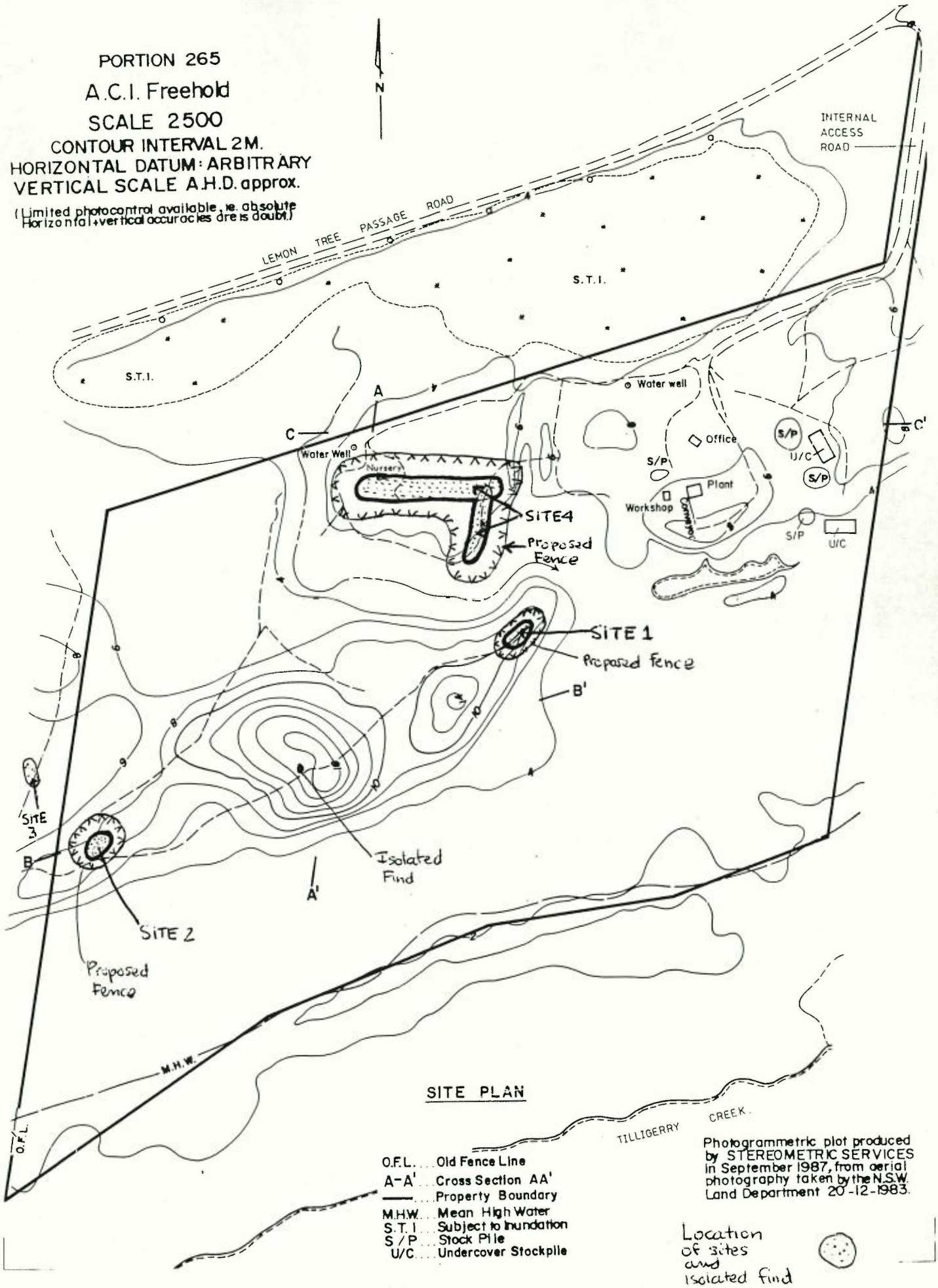


Figure 2
Location map
Williamtown 1:25 000

Survey area


PORTION 265
A.C.I. Freehold
SCALE 2500
CONTOUR INTERVAL 2M.
HORIZONTAL DATUM: ARBITRARY
VERTICAL SCALE A.H.D. approx.
(Limited photocontrol available, ie. absolute Horizontal+vertical accuracies are in doubt.)
N
LEMON TREE PASSAGE ROAD
INTERNAL ACCESS ROAD
S.T.I.
S.T.I.
Water well
Water Well
Nursery
A
C
C'
Office
S/P
U/C
Plant
Workshop
Compressor
SITE4
Proposed Fence
SITE 1
Proposed fence
B'
SITE 3
B
A'
Isolated Find
SITE 2
Proposed Fence
M.H.W.
O.F.L.
TILLIGERRY CREEK
SITE PLAN
O.F.L. . . . Old Fence Line
A-A' . . . Cross Section AA'
——— . . . Property Boundary
M.H.W. . . Mean High Water
S.T.I. . . Subject to Inundation
S/P . . . Stock Pile
U/C . . . Undercover Stockpile
Photogrammetric plot produced by STEREOMETRIC SERVICES in September 1987, from aerial photography taken by the N.S.W. Land Department 20-12-1983.
Location of sites and isolated find
Proposed location of fences

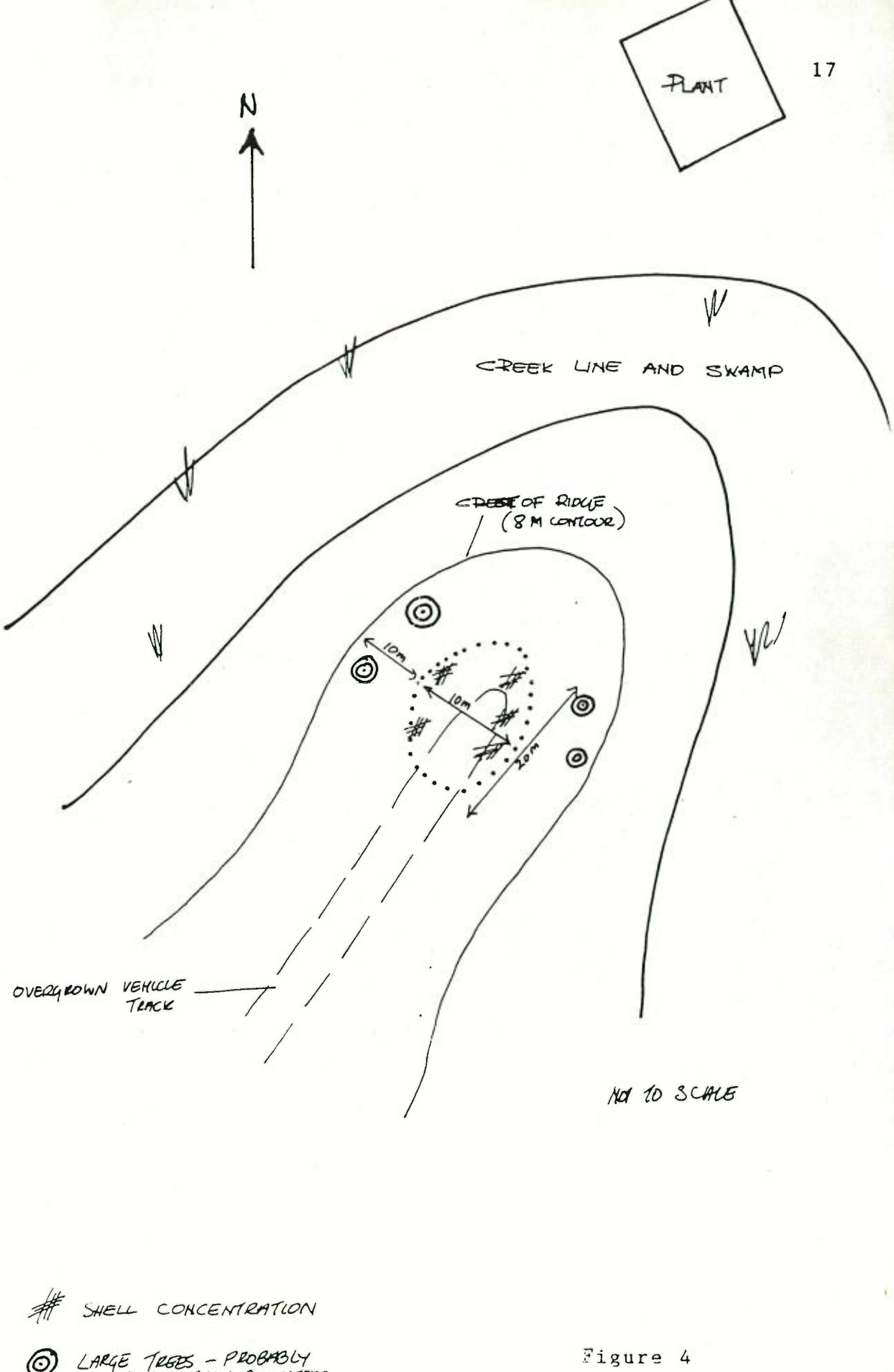


Figure 4
Sketch of site 1

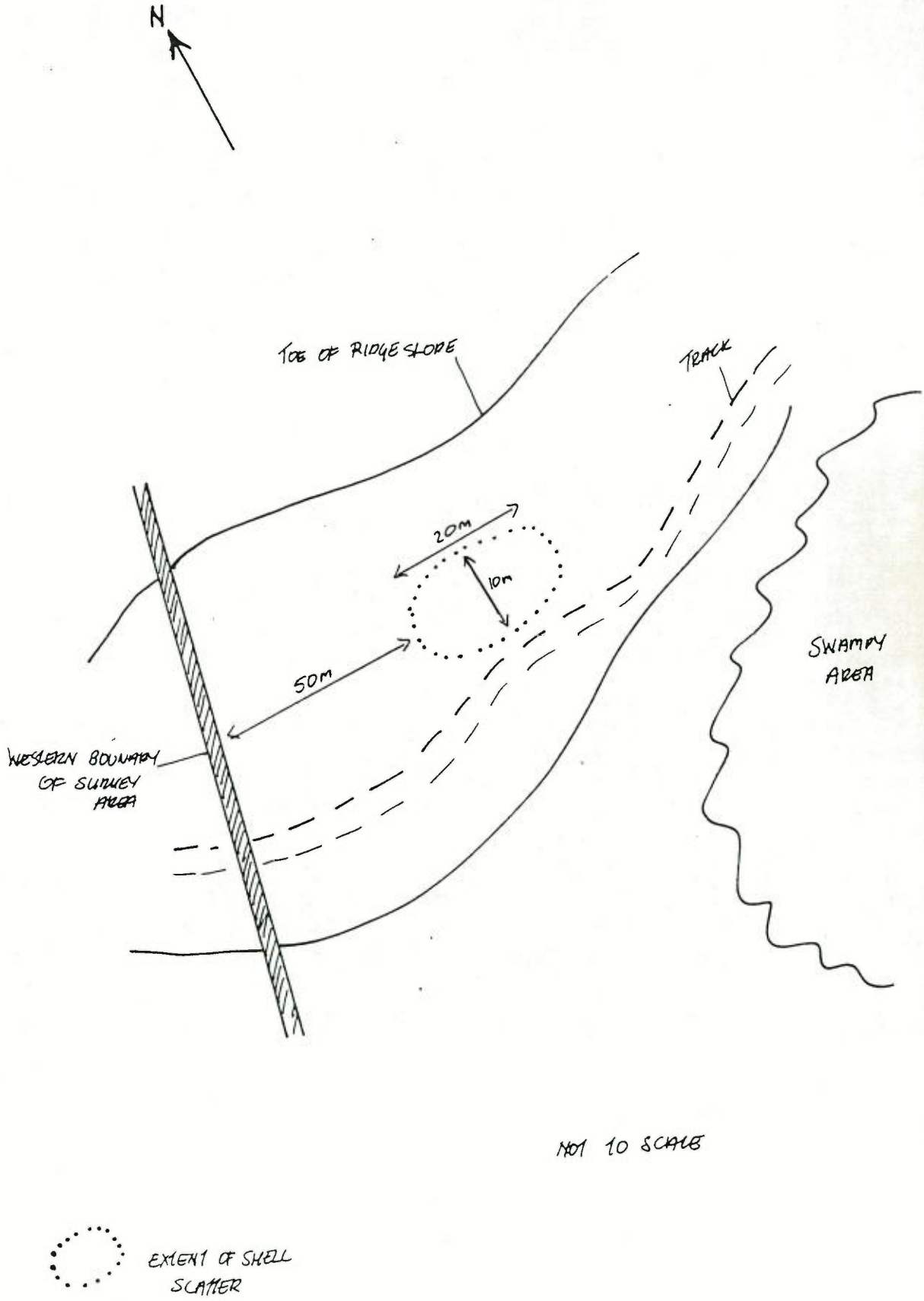


Figure 5
Sketch of site 2

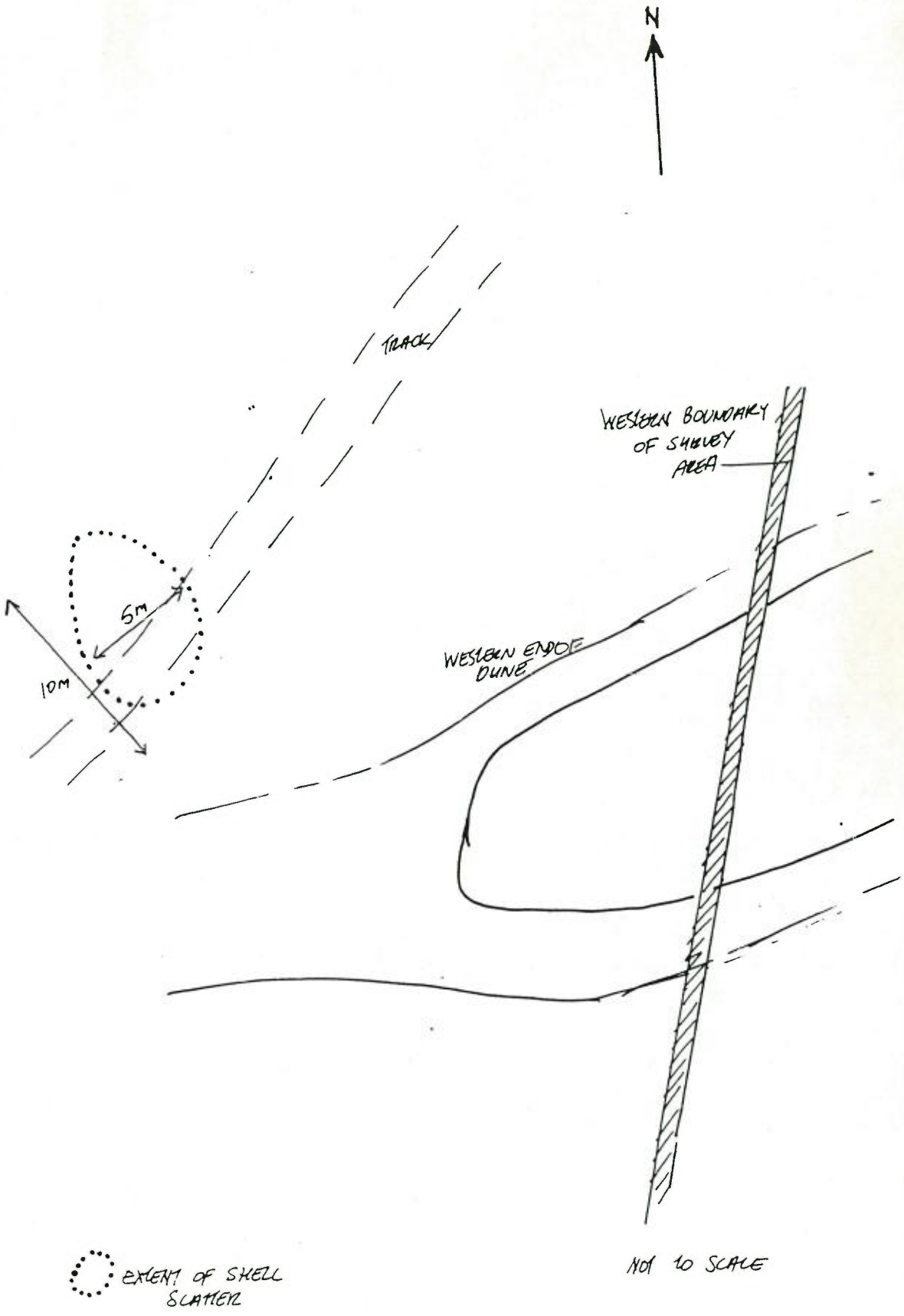


Figure 6
Sketch of site 3

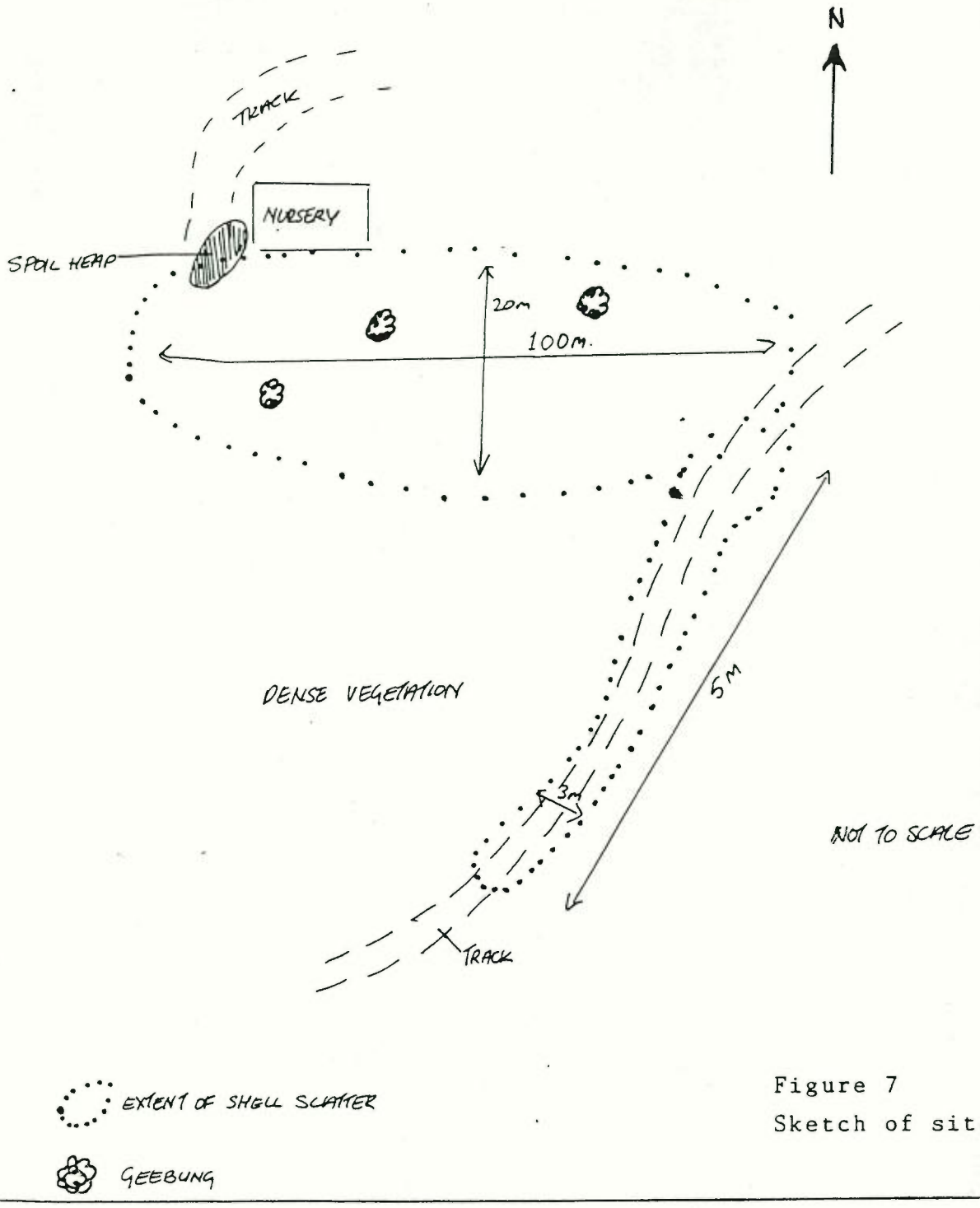


Figure 7
Sketch of site 4

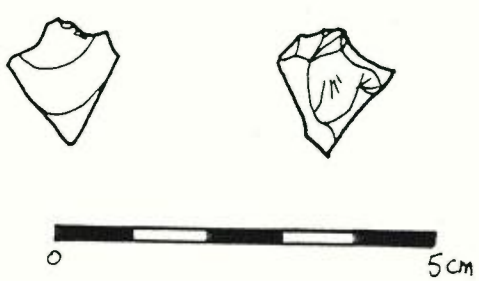


Figure 8
Artefact - site 4



Plate 1: Site 1 - shell concentration

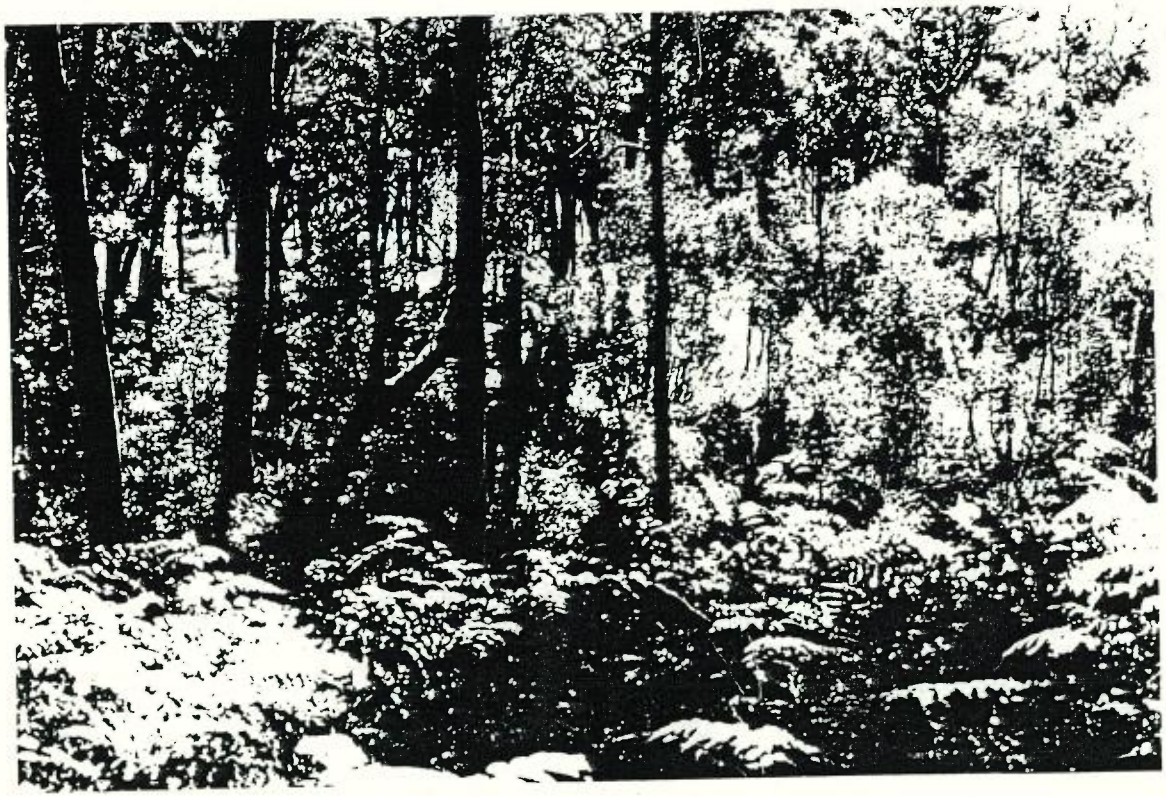


Plate 2: View of creek line and swamp from site 1.
Camera facing north west.

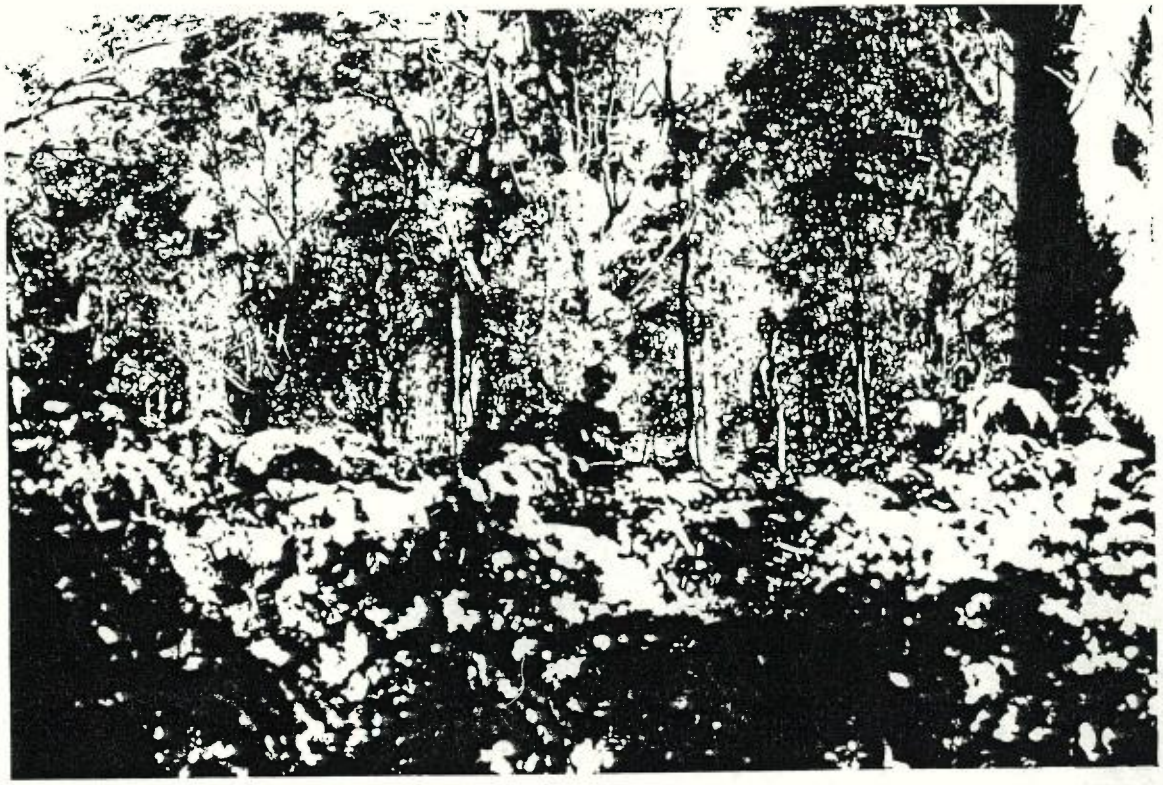


Plate 3: View of ridge/dune top. Camera facing south west. Standing figure marks area of shell concentration of site 1.

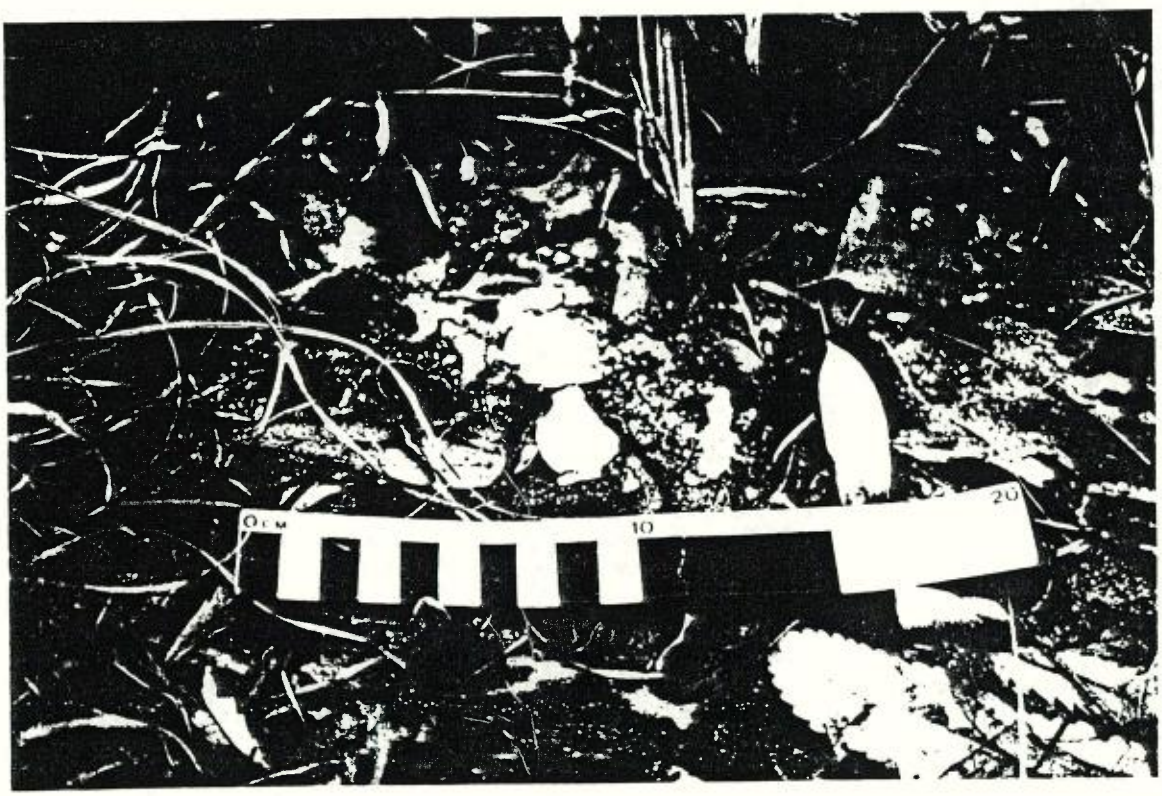


Plate 4: Site 2. Shell concentration found in leaf litter. Camera facing north east.

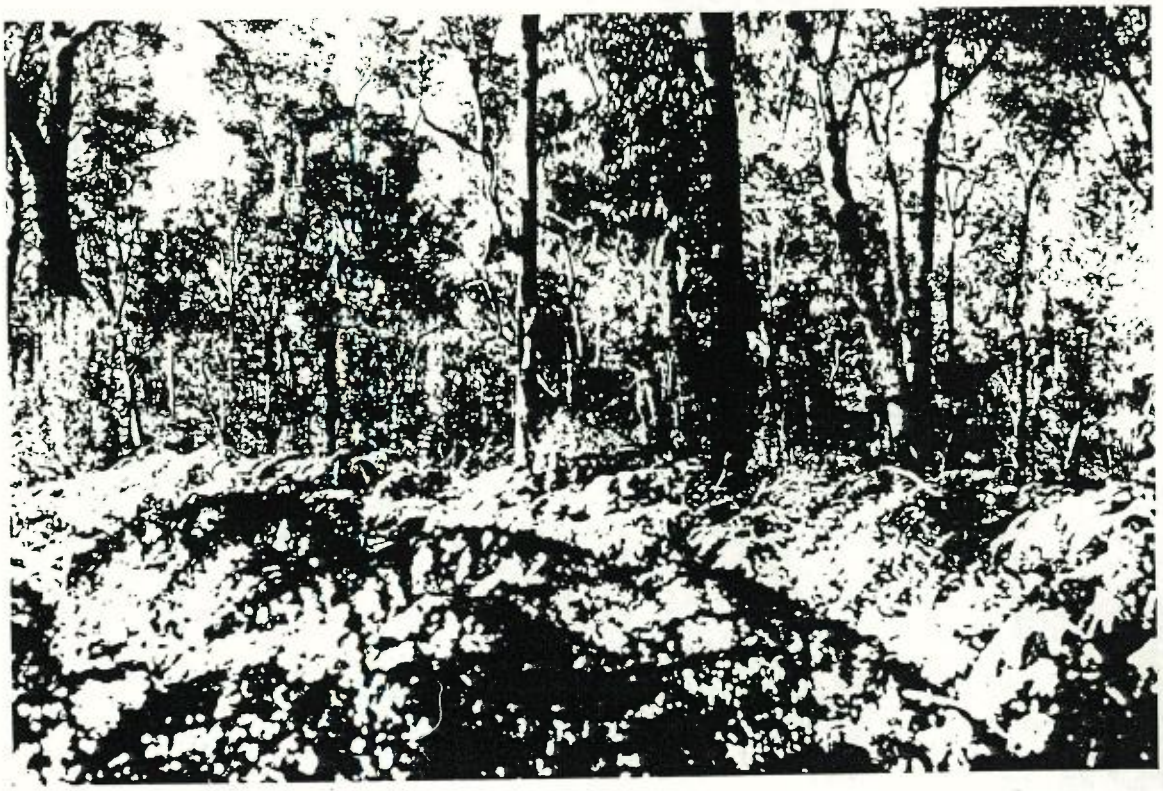


Plate 5: View of site 2. Camera facing north east along ridge line from western end of site.



Plate 6: Site 4. Shell concentration behind nursery (cluster 1) Camera facing south east.



Plate 7: Site 4. View along track where the second cluster of shells was found. Camera facing north.



Plate 8: Isolated find - a single oyster shell

APPENDIX 7: ACOUSTICAL REPORT (1988)

ROBERT FITZELL ACOUSTICS PTY. LTD.

Acoustic Consultants

1/1297 Pacific Highway, Turramurra
PO. Box 449, Turramurra NSW 2074.
Telephone: (02) 488 8188
Facsimile: (02) 488 9865
Directors: Robert Fitzell
Valerie Bray
Associates: Don Craig

PORTION 265, TANILBA - NOISE IMPACT ASSESSMENT

Report No: 081-8-1
Date: August 1988

Report prepared for:

ACI Industrial Minerals Division
813 Dowling Street
WATERLOO NSW 2017

This firm is a Member of AAAC and the work here reported has been performed in accordance with the Terms of Membership

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1. INTRODUCTION

This report provides an analysis of potential noise impact from proposed sand mining of three sand dunes on Portion 265, Tanilba.

The report describes the existing acoustical environment, in both objective and subjective terms, and predicts the changes in, or impact upon, the existing environment which would result from implementation of the proposed scheme.

The proposed development site is a free hold title land owned by ACI. The site area is approximately 29 hectares, approximately 1 hectare of which is devoted to a sand treatment works with associated short term stock pile areas. Portion 265 is therefore already classified as a scheduled premises under the Noise Control Act, 1975 and subsequent approval for the proposed operation will be required from the State Pollution Control Commission prior to commencement of any work.

It is found that noise from the proposed sand mining operation will exceed preferred criteria at various times during the operation. Specific recommendations are made in this assessment report regarding the silencing of mining equipment. Further recommendations are made regarding scheduling and management of the extraction operations.

The fitting of silencing kits to the mining equipment will minimise the incidence of occasional high noise levels experienced at the boundary with the adjacent dwelling.

2. DESCRIPTION OF LOCALITY AND ENVIRONMENT

The locality surrounding Portion 265 is described as rural residential but with established industry to the south east and west of the site. The township of Tanilba Bay is located approximately 3 kilometres north east of Portion 265, areas of oyster leases bordering Tilligerry Creek occur approximately one kilometre to the east of the site, together with a number of small associated workshops and maintenance areas, whilst a similar sand washing and treatment works is situated a little over one kilometre to the west of Portion 265.

Portion 265 is zoned Rural 1(a) which permits extractive industry with development consent from council. The property is already the site of a substantial sand washing and treatment plant.

The nearest residence is situated 105 metres west of the western boundary of Portion 265. There are no other residences within 1.5 kilometres of Portion 265. The adjacent dwelling is located approximately 600 metres from the treatment plant constructed on Portion 265 and approximately 1200 metres from a similar industrial operation to the south west.

Apart from a large area of land situated to the north of Portion 265 and used intermittently by the Air Force as a site for parachute training, the locality surrounding Portion 265 is coastal heath land, undulating slightly and well covered by undergrowth and small trees to a typical height of 8 metres. Larger trees are relatively sparse and a clear site line in most undulating areas is possible for a distance of perhaps 200 metres.

2.1. Amenity

Whilst a number of industrial activities occur in the immediate area, in most instances, the noise impact from these activities is low. The major environmental noise source is road traffic on Lemon Tree Passage Road which has been observed as relatively constant throughout the day.

Proposed sand extraction of Portion 265 will require approximately two years operations. Potentially affected dwellings will therefore be existing dwellings alone. Background noise level surveys have therefore been conducted with specific regard to the residential site situated immediately west of Portion 265.

2.2. Background Sound Levels

Background sound levels close to the western boundary of Portion 265 have been measured at two locations - at a point on the adjacent property approximately 400 metres from Lemon Tree Passage Road (Location 1), and adjacent to the existing dwelling, approximately 100 metres from Lemon Tree Passage Road (Location 2).

Apart from the noise of poultry and dogs on the property and birds, the only noise sources observed during surveys were motor vehicles on Lemon Tree Passage Road. Whilst mining and processing of sand was in progress throughout most of the measurement period, no machinery noise was identifiable at any time adjacent the dwelling area. Front end loader noise was audible for a short period when measuring 400 metres from Lemon Tree Passage Road, emanating from the other industrial site to the west of Portion 265.

The background noise level adjacent to the dwelling was found to range between 37 and 41 dBA, with maxima due to passing traffic ranging between 55 and 75 dBA. Earlier measurements conducted 400 metres from the road coincided with what appeared to be a morning peak traffic flow between 6 and 8 a.m. when background noise levels were observed to range between 43 and 47 dBA at which time background noise levels adjacent to the dwelling would have been at least as high. Owing to greater distance from the road, passing traffic peaks were lower than those close to the dwelling, ranging between 52 and 57 dBA.

Based on these readings it is proposed that a suitable background noise level used for assessment of noise impact at the dwelling site is 43 dBA.

A summary of background noise level measurements is given in Table 1.

No Air Force activities were observed in relation to the parachute training area to the north of Portion 265. Air Force activities will significantly effect the background noise level amenity of the area, although it will be short term and intermittent and will not have influence on the long term background noise levels relevant to environmental impact assessment.

Table 1. Background Noise Levels, Measurement Summary, dBA

Location	Time	L_{90}	L_{10}	L_{01}	L_{eq}	Comment
1	0615-0625	45.5	52.5	56.5	49.9	Dawn, constant traffic on Lemon Tree Passage Road, bird noise, no audible mining noise.
1	0629-0634	43.5	52	56.5	49.8	
1	0740-0750	47	53.5	56	51.1	
2	1040-1050	37	54	63.5	51.2	Rooster crowing, dog barks, constant traffic.
2	1345-1355	41	59.5	73	59.7	Steady traffic on Lemon Tree Passage Road, rooster crowing.

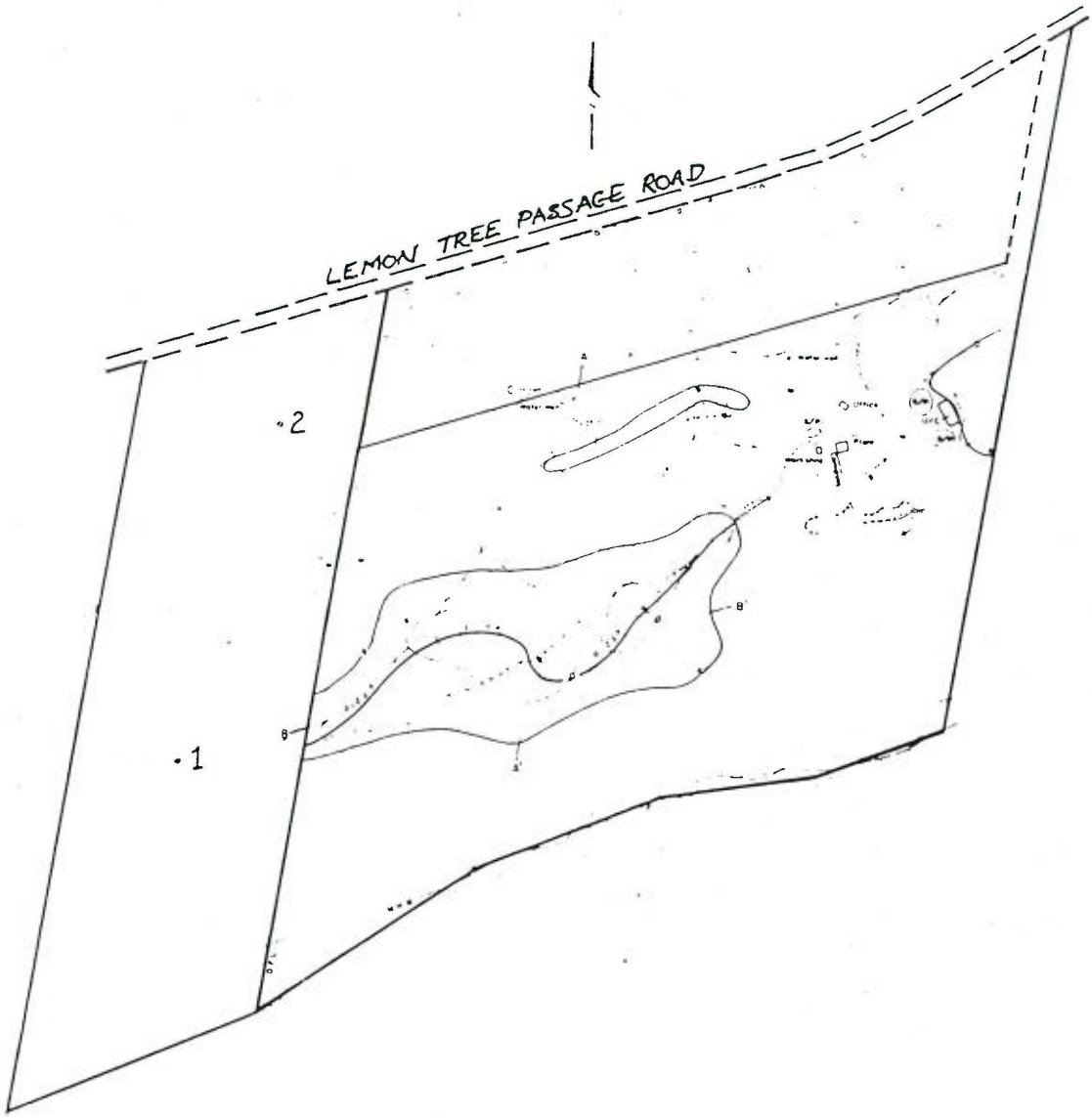


Figure 1: Site Plan and Noise Measurement Locations

3. DESCRIPTION OF OPERATIONS

The development proposal is to extract white silica sand deposits occurring in three areas of Portion 265. The raw materials will be washed and processed through the existing treatment plant on the site, stockpiled and transported by road to ACI glass works operations.

The mining process will involve removal and temporary stock piling of existing top soil, undergrowth and smaller trees, removal of sand by front end loader directly or after stock piling by bulldozer depending on the thickness of sand deposit, transport from the extraction site to the treatment plant by road going haul truck, followed by regrading and replacement of top soil by bulldozer. The bulldozer and front end loader will operate in parallel. The area of vegetation stripping will depend on the depths of sand in each working area. In general terms, stripping of vegetation and top soil for each hectare will involve bulldozer operation for approximately seven days. Subsequent replacement of top soil will require bulldozer operation for approximately 4 days per hectare.

Total reserves are estimated at 166,000 tonnes of sand, to be hauled from the dune to the treatment plant using nominal 20 tonne capacity trucks. The sand delivery truck driver will reach the excavation site, will turn off the truck engine and will then drive the front end loader to load his truck. Allowing typical load times this procedure will permit a maximum of 5 loads per hour for a single front end loader operation, however the present market requirements for processed sand and the present processing rate of the plant restrict the intake of raw sand to a maximum of 3 trucks per hour. Thus there is opportunity to mine continuously for periods, with stockpiling of raw sand, in order to take advantage of the noise control benefits obtained by adopting the mining constraints within the noise sensitive zone as recommended in Section 9. There will be periods during the mining program when equipment will be either turned off or in use elsewhere, such as around the treatment plant area, and well away from the mine site.

The extraction process will be staged in accordance with Figure 5.

Noise will be produced by the following equipment:

a) Bulldozer
b) Front end loader
c) Road going haul truck

All plant and equipment used in the mining, transportation and rehabilitation of the dune area of Portion 265 will be owned by a sub-contractor.

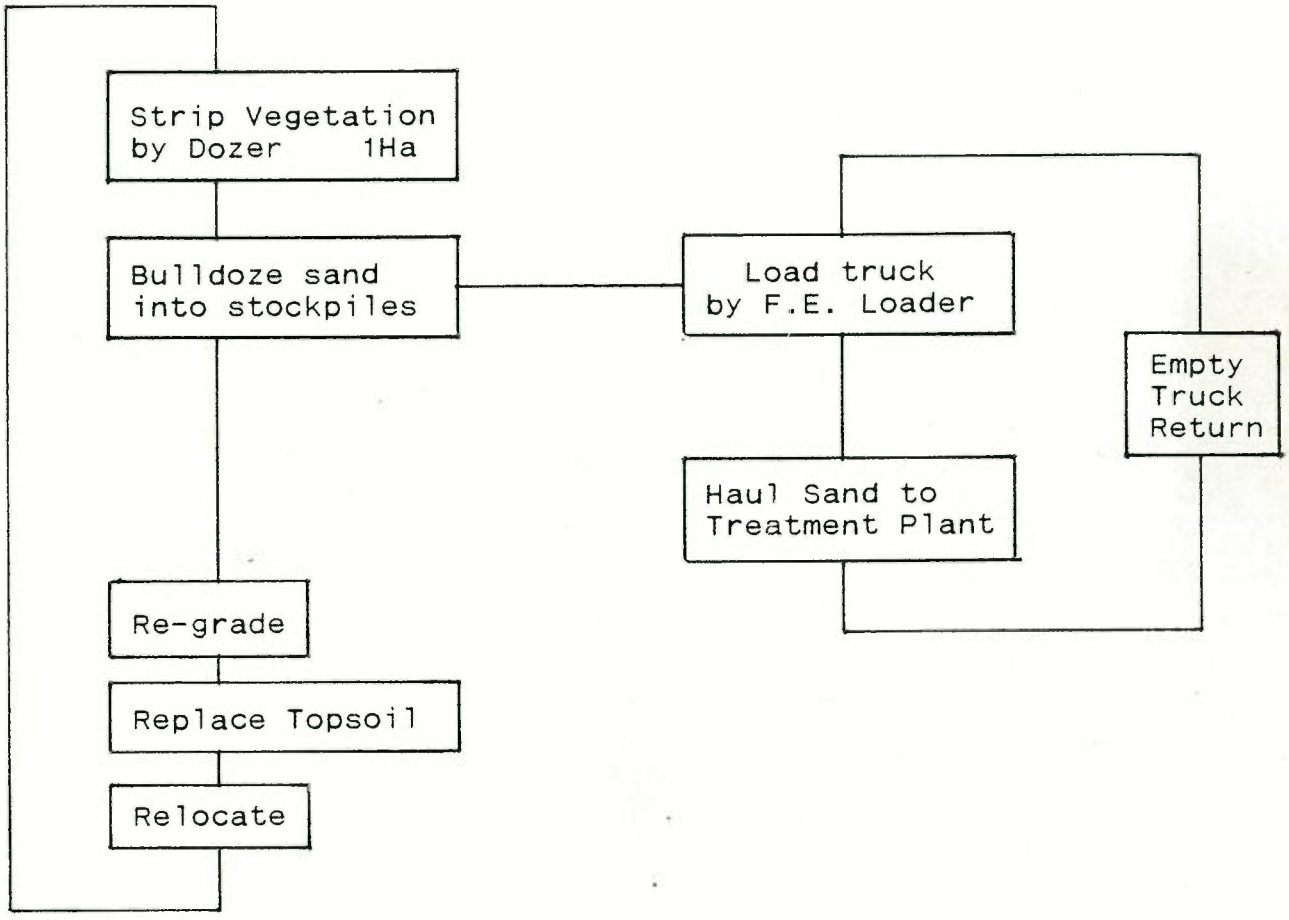


Figure 2: Operation Flow Sheet

4. MINING NOISE SOURCES

4.1. Noise Sources and Levels

The following equipment list and sound power levels have been used for the preparation of this report. The data represent typical values for mining operations and originate from a number of sources, including measurements at a similar mine site, using equipment operated by a sub-contractor for ACI, approximately 3 kilometres north east of Portion 265. The reserves being mined at the present site are close to exhaustion, and the equipment in use at the site could be expected to satisfy mining requirements for Portion 265.

The data given in Table 2 represent maximum sound power emission for mining activities using relatively new and well maintained equipment, but without any noise suppression equipment fitted. The tables of predicted noise level given in Section 7 include both the predicted maximum level and the expected L_{10} for the mining processes assessed for a tyical 15 minute period. The predicted relationship between the maximum and L_{10} noise levels is based on survey results from the existing mine site. The predicted levels will be conservative estimates of L_{10} for hourly or eight hourly periods.

Table 2: Equipment Activities and Noise Levels, Typical Maxima

Source	Sound Power Level, dB re 1pW							
	63	125	250	500	1k	2k	4k	dB(A)
Bulldozer under load, uphill	117	108	104	108	112	113	101	117
rolling down hill	117	108	101	105	106	106	99	111
Front end Loader idling	110	95	94	95	196	95	85	100
load	123	123	113	113	110	107	106	116
Haul truck	119	119	112	106	103	102	95	110
Sand tip into empty truck	121	118	107	103	104	100	94	109

4.2. Hours of Operation

It is proposed that mining be approved to occur during the hours 0600 to 1600, Mondays to Fridays only.

APPENDIX 8: ACOUSTICAL REPORT (1989)

ROBERT FITZELL ACOUSTICS PTY. LTD.

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PROPOSED SILICA SAND MINING

PORTION 265, TANILBA

VARIATION TO MINE PLAN

NOISE IMPACT ASSESSMENT

Report Number: H081-3
Date: August, 1989

Prepared for:

ACI Industrial Minerals Division
813 Dowling Street
Waterloo NSW 2017

This Firm is a member of AAAC and the work here reported has been performed in accordance with the Terms of Membership

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1. INTRODUCTION

This report analyses potential for noise impact from proposed sand mining of a dune on Portion 265, Tanilba.

The report provides a more detailed analysis of noise from mining described previously in Report no. 081-8-1, prepared August 1988. Based on background noise level measurement for the adjacent property, a recommended L_{10} noise level at the dwelling site due to mining during daytime hours of 48 dB(A) has been recommended.

It has been previously identified, in report 081-8-1, that potential for undesirably high noise level from mining exists when extraction is occurring within approximately 300 metres of the nearest dwelling. This affects the portion of dune shown shaded on Figure 1. The purpose of this report is to examine in more detail the impact of noise from and potential to achieve noise control for the western portion of the western limit of mining. This will involve areas indicated as Stage IV and Stage V of the mine plan. Mining of Stage VI is not recommended.



FIGURE 1: PORTION 265 PLAN
NOISE SENSITIVE ZONE SHOWN SHADED

2. REVIEW OF OPERATIONS

The development proposal is to extract white silica sand deposits occurring in three areas of Portion 265. The raw materials will be washed and processed through the existing treatment plant on the site, stockpiled and transported by road to ACI glass works operations.

The mining process will involve removal and temporary stock piling of existing top soil, undergrowth and smaller trees, removal of sand by front end loader directly or after stock piling by bulldozer depending on the thickness of sand deposit, transport from the extraction site to the treatment plant by road going haul truck, followed by regrading and replacement of top soil by bulldozer. At times the bulldozer and front end loader will operate together. The area of vegetation stripping will depend on the depths of sand in each working area. Stripping of vegetation and top soil will be by bulldozer at a rate of approximately seven days per hectare. Subsequent replacement of top soil, also by bulldozer, will occur at a rate of approximately 4 days per hectare.

Total reserves on Portion 265 are estimated at 166,000 tonnes of sand. Haulage from the dune to the treatment plant will be by nominal 20 tonne capacity trucks. The sand delivery truck driver will reach the excavation site, will turn off the truck engine and will then operate the front end loader to load his own truck. Allowing typical load times of 10 to 12 minutes per truck this procedure will permit a maximum of 5 loads per hour for a single front end loader operation. The present market requirements for processed sand and the present processing rate of the plant on Portion 265 restrict the intake of raw sand to a maximum of 3 trucks per hour. Thus there is opportunity to mine continuously for periods with stockpiling of raw sand or to maintain a lesser but steady extraction rate. There will be periods during the mining program when equipment will be either turned off or in use elsewhere, such as around the treatment plant area, and well away from the mine site.

Overall, based on the above, the bulldozer will be working on the site approximately 1/7th of the time involved in the sand extraction process. The large majority of activity will relate to use of the front end loader and truck transportation. Depending on other commitments, it is therefore possible that the dozer may be brought to site for approximately three days work each month, or if remaining on site, could either work approximately one day a week or one hour per day continuously.

3. PREDICTED NOISE LEVELS

It has been previously reported (report 081-8-1) that noise levels at the adjacent dwelling will be dependent on a number of factors. The most significant of these are the source output level and the distance between the source and receiver, however in the case of mining around dunes, there are numerous points at which significant shielding by the intervening dune will occur. Additional attenuation factors are ground absorption and air absorption.

Detailed calculations have been conducted using an iterative calculation routine to include the area of the dune indicated on Figure 1. This area extends inside the 300 metre arc line from the nearest dwelling but includes areas in which natural shielding by the dune will occur, enabling acceptable noise levels. Important conclusions regarrding these areas are noted on Figure 2.

Figures 2, 3, 4 and 5 show scatter plot summarises of the repetitive calculations for both the front end loader and the dozer operating within the area described, using new and well maintained plant but with no special treatments to reduce noise. These results indicate similar trends to the levels reported in report 081-8-1, and show that noise from excavation closer than 300 metres from the dwelling may exceed recommended levels.

Where mining is occurring on the remote side of the E-W ridge of the western dune, considerable screening of noise from the front end loader will occur providing the loader is working from the south east. A practical strategy to limit noise from the loader is, therefore, to impose a mining limit as a boundary line whereby a dune face of 2.5 metres height between the loader and the dwelling is maintained. This depth of sand will ensure that the loader exhaust is shielded, although the bucket may at times be visible. This mining limit is shown on Figure 5.

The dozer will, at times, operate in exposed situations. Together with the higher L_{10} sound power levels of the dozer, this will lead to higher sound levels associated with the dozer. It is estimated from the working rate that L_{10} noise levels at the dwelling from the dozer will exceed 48 dB(A) for approximately 14 days in total. Using the aims implicit in the guidelines of the SPCC regarding higher allowable construction noise, an L_{10} noise level of 53 dB(A), and perhaps higher, should be satisfactory given the short exposure time. These levels are satisfied by the dozer operation, providing stockpiling of topsoil by the dozer is in the areas indicated on Figure 2.

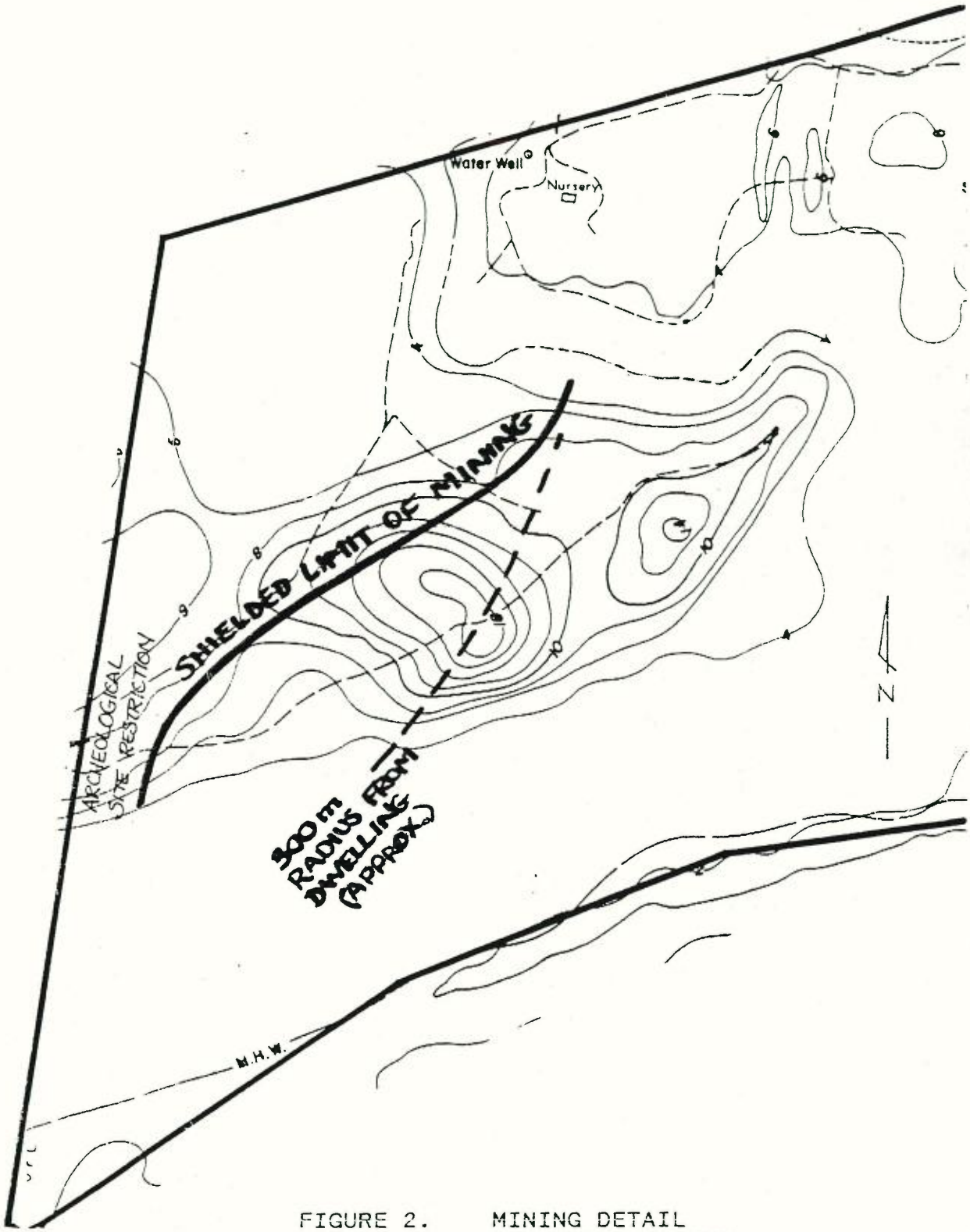


FIGURE 2. MINING DETAIL
WESTERN BOUNDARY

FIGURE 3: FRONT END LOADER NOISE LEVELS ALLOWING FOR CONTINUITY OF SCREENING BY INTERVENING DUNE

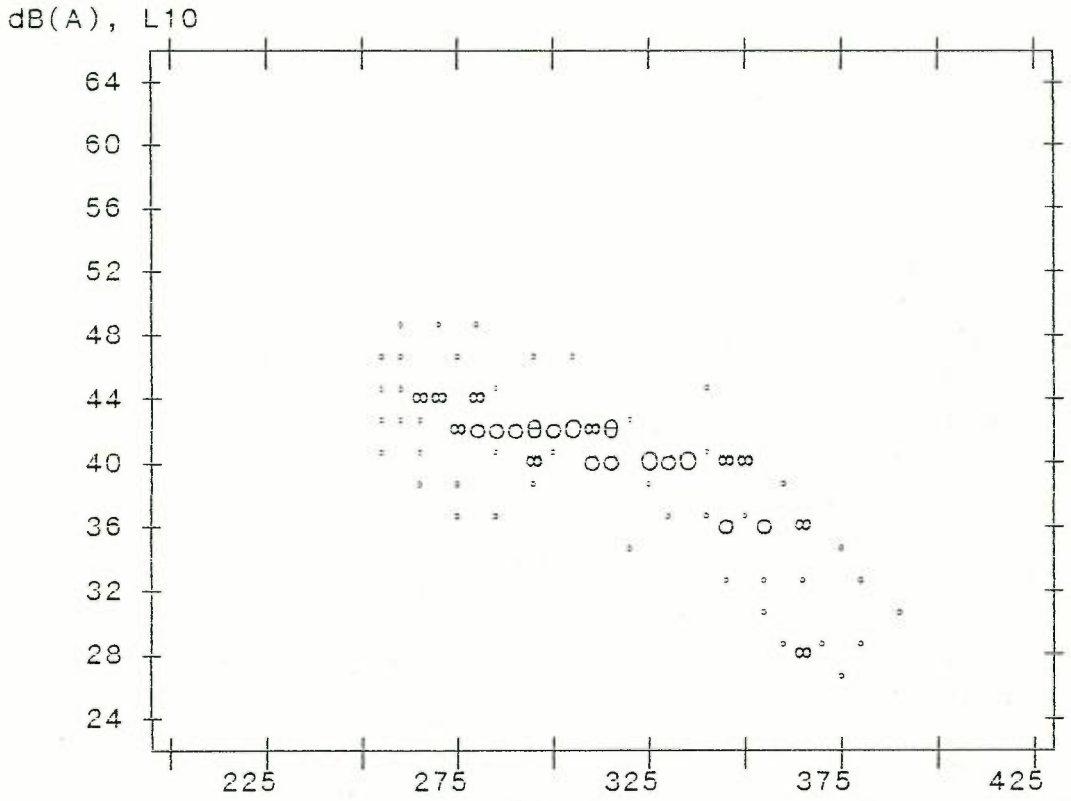


FIGURE 4: NOISE LEVEL OF DOZER AT DWELLING SITE ALLOWING FOR CONTINUITY OF SCREENING BY INTERVENING DUNES AS WILL OCCUR DURING MOST OF THE STRIPPING

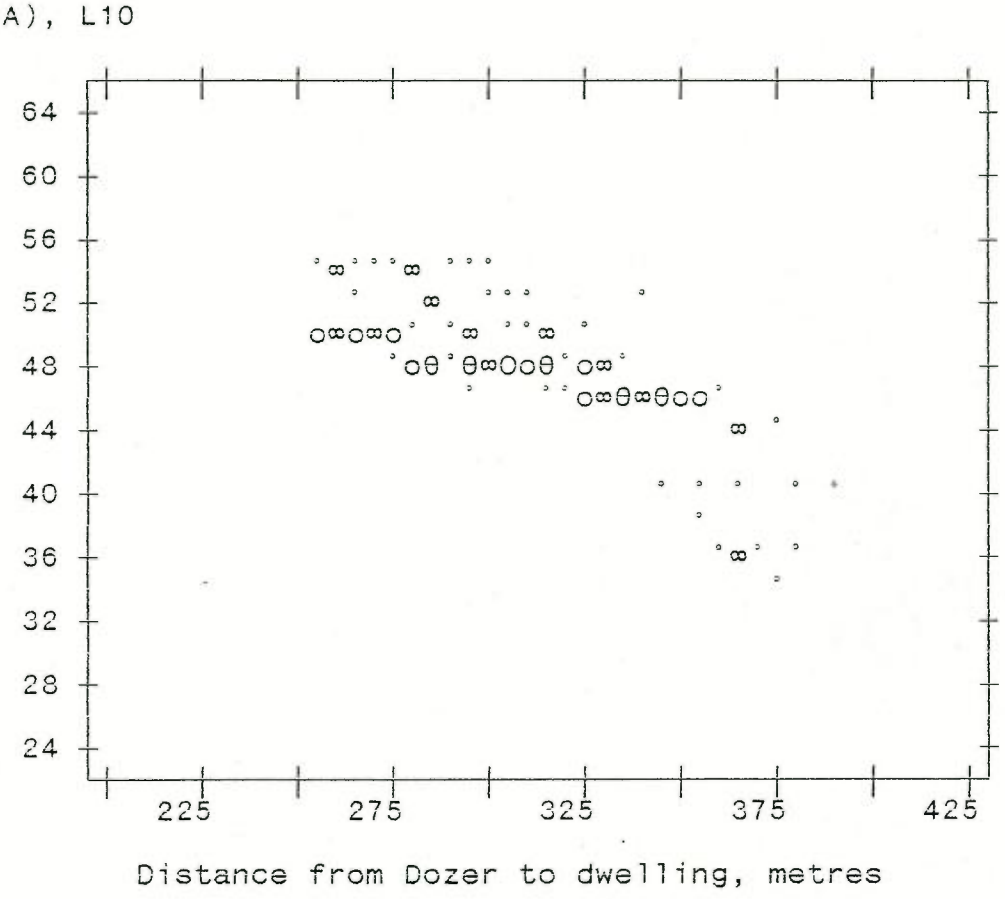
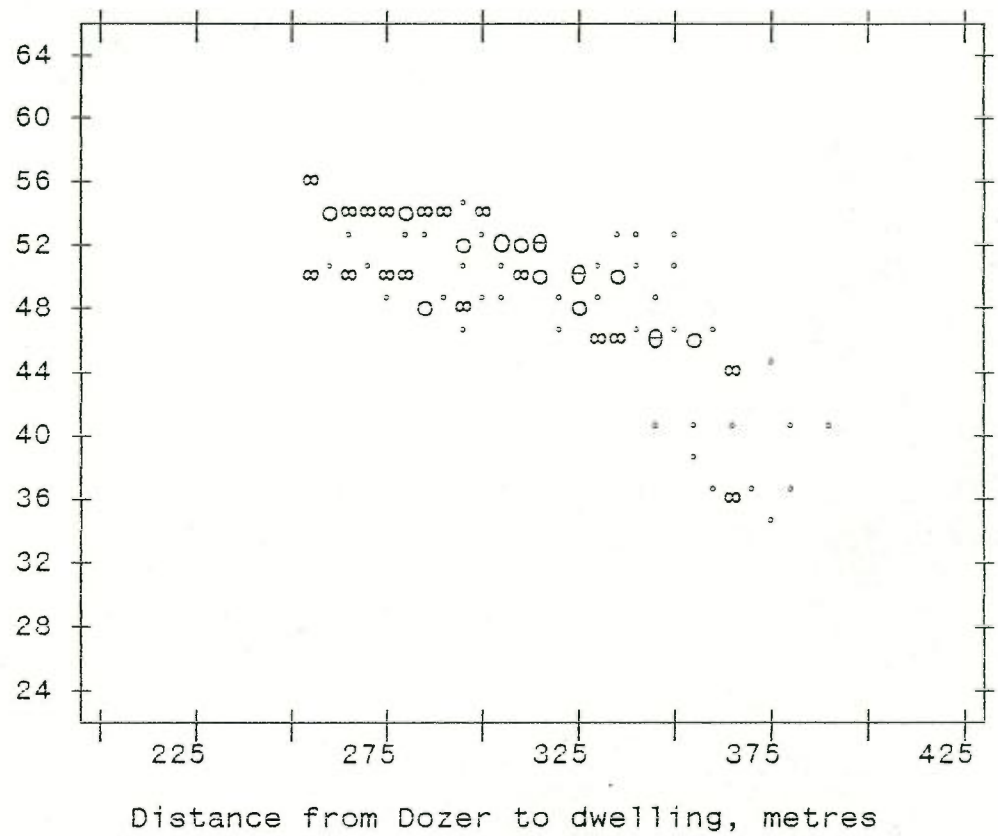


FIGURE 5: NOISE LEVELS FOR DOZER ALLOWING FOR PERIODIC EXPOSURE ABOVE THE DUNE LEVELS AS WILL OCCUR DURING REGRADING



4. NOISE CONTROL

1. Implement a mining limit as noted on Figure 2.

2. Maintain front end loader operations S-E of the dune face to ensure shielding.

3. Where possible, co-ordinate operation of the bulldozer to occur during periods of maximum frequency of westerly winds - i.e. winter months.

4. Require the operator to maintain and service the bulldozer and front end loader silencing equipment. This report is based on operation noise levels of:-

Bulldozer	L_{10} sound level of 85 dB(A) at 15 m Maximum sound level of 87 dB(A) at 15 m
Front End Loader	L_{10} sound level of 80 dB(A) at 15 m Maximum sound level of 85 dB(A) at 15 m

5. Stockpile topsoil in the areas indicated on Figure 2 or at other points providing they are further from the dwelling.

These control guidelines are designed to avoid construction of large earth berms or barriers between the dwelling and the mine site. Using additional barriers may permit the extraction area to extend further toward the dwelling.

4.3. Period of Operation

Mining of sand dunes on Portion 265 is scheduled to take approximately two years.

4.4. Road Traffic Generation

The extraction process and the treatment plant are both situated on Portion 265. Accordingly, no road traffic will be generated by the proposed operation, other than transport of washed sand from the treatment plant to ACI Glassworks. To the extent that road haul trucks carrying raw sand to the treatment works are not required to travel on public roads, the proposed extraction process will result in a reduction in road traffic generation for the extraction period, compared with current operation.

5. NOISE PROPAGATION

Noise propagation from the proposed site will occur, in some cases, over a distance of the order of 1000 metres. Consequently, consideration of attenuations due to numerous factors will be relevant. These are:

* Divergence, a function of distance between the source and the receiver.

* Air absorption, a function of distance, temperature and relative humidity, as well as frequency content of the source noise.

* Barrier screening, a function of height of the source and receiver, and of intervening screens or ground contours.

* Vegetation absorption, a function of density of intervening vegetation.

* Ground Effect, a function of height of source and receiver, and of vegetation occurring on intervening ground.

* Wind attenuation, a function of wind velocity and of distance between source and receiver.

* Thermal effects, a function of thermal stratification in the lower atmosphere levels.

5.1. Divergence Attenuation

Attenuation due to divergence is relatively simple, and will apply to all sources. All of the activities are effective point sources at the distances involved, and attenuation at a rate of 6 dB per doubling of distance may be applied. Typical propagation distances are given in Table 4, together with divergence attenuation values. Compared with other attenuation factors described below divergence (or distance) attenuation may be seen as the major factor affecting resultant noise levels for the distances involved at this site.

Table 3: Distance and attenuation to Adjacent Dwelling

	Distance metres	Divergence attenuation dB
Closest point of mining	150	52
Centre of main mining activity	300	58
Furthest point of mining	600	64

5.2. Air Absorption

Air absorption occurs as a result of energy dissipation within the air molecules and results in attenuation rates which exceed those produced by divergence alone. Air absorption rates vary with frequency, temperature and humidity, all of which will vary from source to source and from day to day. An approximation for air absorption in dB(A) has been found, for a condition of low absorption rate at 10 degrees celsius and 50 percent relative humidity, to be:

$$N\ (air) = 4.66 * (distance/1000)^{0.55}\ dB(A)$$

where distance is measured in metres,
and N (air) is the excess attenuation.

For the distances involved in this study, excess air attenuation varies up to approximately 3 dB(A), although it should be noted that for conditions of higher air absorption the excess air attenuations will be up to 3 dB(A) higher than those predicted by this formula. The values for attenuation due to air absorption tabled in Section 8.0 have been obtained from octave band analyses in preference to the above formula, although the results are very similar.

5.3. Barrier Screening

Significant attenuation due to screening, in the order of 15dB(A), will occur when mining machinery is situated on the remote or eastern side of the larger dunes. The major strategy to be adopted to retain maximum benefit of screening will be to commence mining on the southern and eastern sides of the ridge line so as to maintain screening for the longest possible period. There will be periods, however, particularly when clearing top soil and vegetation prior to extraction, when the bulldozer will be operating in exposed locations at which screening can not be achieved.

5.4. Vegetation Absorption and Ground Effect

Excess attenuation will occur if noise propagation occurs through vegetation or to locations for which the noise propagation path remains within 1-3 degrees of the mean ground profile. The U.S. Department of Transportation adopts a value of 5 dB(A) per 30 metres up to a maximum of 10 dB(A) for excess attenuation due to vegetation, and reported measurements of attenuation rates through open forest in Australia indicate rates of 2-3 dB(A) per 100 metres for surveys over distances up to 300 metres.

Excess attenuation due to ground absorption has been measured at a Coffs Harbour site through ground and vegetation comparable with that occurring at Tanilba. The results of these tests are reported in Figure 5 and the values have been used in this report. Comparison with values given in other accepted literature may be made with reference 2 (CONCAWE, 1981) from which the data of Figure 6 have been obtained. Whilst results are tabled in Section 8 of this report in dB(A), calculations have all used octave band data.

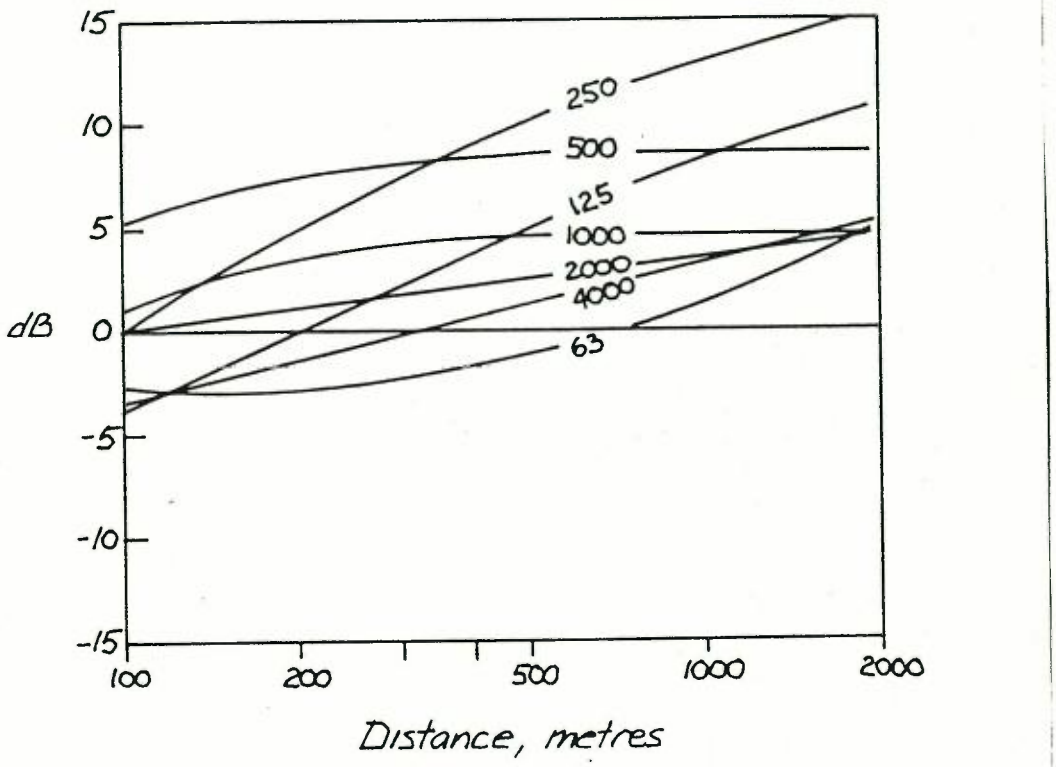


Figure 3: Ground Attenuation Test Measurements

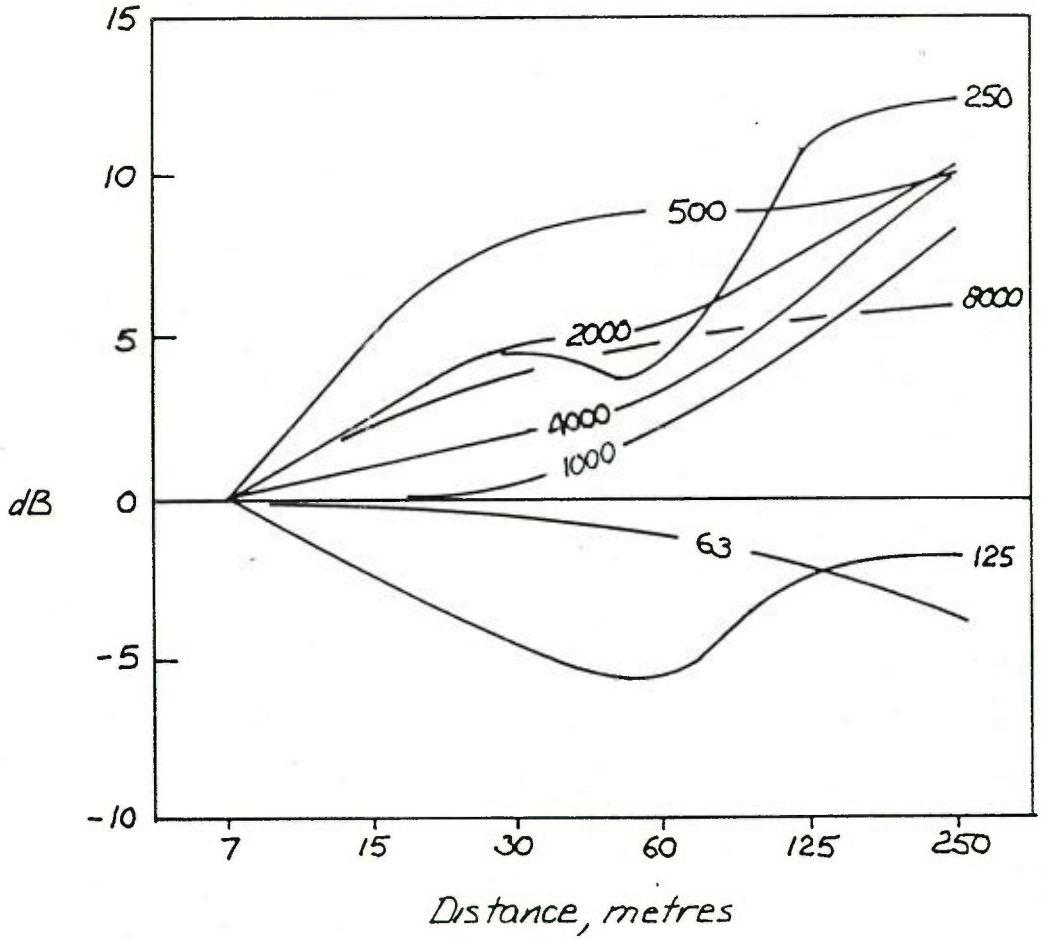


Figure 4: Ground Attenuation Values from Reference 2.

5.5. Meteorological Effects

Excess attenuation effects of wind may be considerable but are obviously transient. Downwind propagation is comparable to a state of temperature inversion where noise from a distant source follows a curved elevated path through the atmosphere and results in higher noise levels at some distance from the source when compared with calm or neutral atmospheric conditions. An important distinction between down-wind and temperature inversion propagations is that wind induces noise in trees and can result in masking of other noises.

Atmospheric thermal effects on noise propagation can be significant. These effects can be particularly strong in valleys over large expanses of water where local temperature inversion states can occur regularly.

Reference 1 provides calculation data from which the effects of downwind noise propagation may be estimated and these have been used to confirm the findings of this report. An alternative, but simpler, approach is to assume that the temperature inversion conditions will eliminate ground and intermediate low barrier effects, but that divergence, air absorption rates and the effect of large barriers close to the source or receiver remain applicable.

Consequently, for longer propagation distances when wind is blowing toward the receiver noise levels may be approximately 8 dB(A) higher than under stable conditions. Similarly, under conditions of unstable atmosphere, such as during thermal updrafts and wind currents on hot days, noise from distant sources will 'waft' with noise level fluctuating approximately 10 dB(A).

Surface wind analyses issued by the Bureau of Meteorology for Williamtown indicate that morning breezes tend to dominate from the north west and western direction in the winter months, and from the east in the summer months. Similar, though less distinct wind patterns, occur in the afternoon. In respect of the dwelling close to the western boundary the maximum benefit due to excess wind attenuation will occur during winter (April to September inclusive).

6. ASSESSMENT CRITERIA

6.1. S.P.C.C. Criteria

The proposed development will be classified as a scheduled premises under the Noise Control Act. Specifically, the scheduled premises classification requires that the site area available to be worked equal or exceed 20,000 m^2, or 2Ha. The total area covered by mineable white sand deposits for portion 265 is approximately 6 Ha. It will therefore be necessary to make future application to the State Pollution Control Commission of NSW for statutory approval to proceed with the proposed extraction works.

The SPCC may be expected to examine the Environmental Impact Statement report and to indicate the need for approval or for a future license, to comment on the adequacy of proposed noise control measures and to comment on the acceptability of the proposed development having regard to their guidelines for approval. Current guidelines are documented in the Environmental Noise Control Manual issued by the S.P.C.C. Whilst extractive industries are not specifically included in the guideline recommendations, the following criteria from the manual would be expected to apply:

a) Road Traffic: Section 157. Maximum A-weighted equivalent noise level of 55 dB(A), measured at 1 metre from residential facades, due to traffic generated by the development.

b) Truck Movement: Section 24.

Substantially reduced	6am - 7am
Normal frequency	7am - 6pm

c) Background Noise Level: As measured.

d) Machinery Noise: The $L_{A,10}$ measured within 1 metre of any residential boundary or other noise sensitive area for at least a 15 minute period shall not exceed the background level by more than 5 dB(A).

Based on measurement reported in Table 1, we propose the following design aims:

Table 4: Recommended Maximum Noise Level at Nearest Dwelling

Period	Maximum $L_{A,10}$
0600 - 1600	48 dB(A)

6.2. Australian Standards

AS1055 gives limited criteria for assessment of the magnitude or seriousness of intrusive noise in residential areas. It is stated in the 1984 edition that where the adjusted maximum A weighted sound level exceeds the A-weighted background sound level, the noise is likely to be annoying, and that differences of 5 dB or less may be of marginal significance with respect to annoyance (Appendix A, AS1055.2-1984).

6.3. Audibility and Other Criteria

It is important to consider audibility of noise. In general terms any noise event which has an A-weighted sound level 5 dB(A) above the existing background may be heard. In many instances a 5dB increase in just one octave band alone may be heard, particularly where the intrusive noise is relatively steady and may be identified over a time period. In general the guidelines issued by the S.P.C.C. allow that noise may be just audible.

Other criteria have been used by various authorities, particularly the concept of equivalent energy noise level where the steady state noise level having equal energy as the time varying noise level is used. These criteria are frequently used where intermittent or occasional noise is concerned. The value of 55dB(A) equivalent energy sound level (L_{eq}) is widely proposed as an acceptable community noise impact level for many sources. These criteria assume that approximately 12 to 17 percent of persons subject to that level will be highly annoyed by the intrusive noise. The proportion of persons moderately affected by the same noise appears to be two to three times this number.

Equivalent energy criteria have been adapted with the intent of giving a better assessment of nuisance in specific situations in the United States Environmental Protection Agency levels document report 550/9-74-004. The method requires corrections to be made to equivalent energy criteria as outlined for the Portion 265 locality below:

Table 5: $L_{A,eq}$ noise level corrections, dB(A)

Year-round operation	0
Quiet rural community	+10
Some prior experience with the intruding noise	+0
Total Penalty	+10

The EPA method suggests an L_{DN} no higher than 45 dB(A), or 48 dB(A) for daytime only operation, is recommended. The daily L_{eq} for the mining operation is predicted at approximately 45 to 50 dB(A) at the nearest dwelling.

7. SAND EXTRACTION NOISE IMPACT ASSESSMENT

An assessment of noise generated by equipment and processes on the site has been completed. The results of these computations are given below, based on source sound levels obtained by measurement at the present extraction site. The results show that noise levels can be expected for short periods, when working close to the western boundary, to exceed preferred criteria. In particular the bulldozer and front end loader have the potential to generate high noise levels.

The tabulated levels given in Tables 6.1, 6.2 and 6.3 show noise levels, both in terms of expected typical maxima (or L_{10}) and potential maximum, exceed desirable criteria when plant is operating within approximately 300 metres of the dwelling site. The mining region with potential for excess noise levels is shown shaded in Figure 5. Higher noise levels will be experienced at the dwelling site whilst work occurs in the zone, due to the combined effects of being both exposed to view and at the same time closer. In order to improve control of noise from this zone it is recommended that topsoil and/or cleared vegetation be stacked on the north western side of the mining boundary. As a margin of safety the analysis of Table 6.1 excludes any allowance for such barriers.

Control kits fitted to the front end loader and bulldozer can achieve approximately 5 dB(A) noise reduction when used in conjunction with a residential grade exhaust muffler. Both of these treatments will be required when mining closer than 300 m from the dwelling.

At distances greater than 300 metres, the combined effects of distance and ground attenuation, together with potentially significant shielding, ensure satisfactory levels at or below preferred criteria.

Table 6.1: NOISE LEVELS AT NEAREST NORTH WESTERN RESIDENCE, dB(A)
WITH PLANT OPERATING AT 150 METRES.

Source	Sound Power Level (dB(A) re 1 pW)	Attenuations dispersion	air	ground	barrier	total	Resultant L_P	Control Treatment	Resultant L_P
Dozer under load	117	52	1	6	0	59	58	5	53
rolling down hill	111	52	1	6	0	59	52	5	47
loaded, over hill	117	52	1	6	13	72	45	5	40
FE Loader idling	100	52	1	5	0	58	42	5	36
under load	116	52	1	4	0	57	59	5	54
Haul Truck	110	52	1	3	0	56	54	-	54
Sand tip into empty truck	109	52	1	2	0	55	54	-	54

Maximum Plant Noise Level = 62 dB(A)
Typical Plant Noise, L_{10} = 57 dB(A)

Maximum Treated Plant Noise Level = 55 dB(A)
Typical Treated Plant Noise, L_{10} = 51 dB(A)

Criterion = 48 dB(A)

Table 6.2: NOISE LEVELS AT NEAREST DWELLING, dB(A)
WITH PLANT OPERATING AT TOP OF NEAREST DUNE, 300 metres

Source	Sound Power Level (dB(A) re 1 pW)	Attenuations dispersion	air	ground	barrier	total	Resultant L_P	Control Treatment	Resultant L_P
Dozer under load	117	58	2	8	0	68	49	5	44
rolling down hill	111	58	2	7	0	67	44	5	39
under load, over hill	117	58	2	8	13	81	36	5	31
FE Loader idling	100	58	2	6	0	66	34	5	29
under load	116	58	2	4	0	64	52	5	47
Haul Truck	110	58	1	3	0	62	48	-	48
Sand tip into empty truck	109	58	1	2	0	61	48	-	48

Maximum Plant Noise Level = 53 dB(A)
Typical Plant Noise, L_{10} = 49 dB(A)

Maximum Treated Plant Noise Level = 49 dB(A)
Typical Treated Plant Noise, L_{10} = 45 dB(A)

Criterion = 48 dB(A)

Table 6.3: NOISE LEVELS AT NEAREST DWELLING, dB(A)
WITH PLANT OPERATING AT FAR EDGES OF DUNE, 600 metres

Source	Sound Power Level (dB(A) re 1 pW)	Attenuations dispersion	air	ground	barrier	total	Resultant L_P	Control Treatment	Resultant L_P
Dozer under load	117	64	5	8	0	77	40	5	35
rolling down hill	111	64	4	7	0	75	36	5	31
under load, over hill	117	64	5	8	13	90	27	5	22
FE Loader idling	100	64	4	5	0	73	27	5	22
under load	116	64	3	3	0	70	46	5	41
Haul Truck	110	64	2	2	0	68	42	-	42
Sand tip into empty truck	109	64	2	1	0	67	42	-	38

Maximum Plant Noise Level = 46 dB(A)
Typical Plant Noise, L_{10} = 41 dB(A)

Maximum Treated Plant Noise Level = 42 dB(A)
Typical Treated Plant Noise, L_{10} = 36 dB(A)

Criterion = 48 dB(A)

Figure 5: Mining area plan showing noise sensitive operation zone

8. CONCLUSIONS

This analysis has examined a development proposal to extract sand from Portion 265, Tanilba and reports on predicted noise impact on the adjacent dwelling that will result from the extraction equipment.

Typical noise levels at the nearest dwelling, due to the proposed mining equipment, are expected to range between 35 and 45 dB(A) for most of the operating life of the mining. Background noise assessment levels for the area have been found to be 43 dB(A) with a recommended maximum L_{10} noise level from mining activities therefore of 48 dB(A).

Higher levels, potentially in excess of 55 dB(A), will occur for short periods whilst work is conducted in the area specified in Figure 5. The predicted noise levels compare favourably with frequently occurring noise from traffic affecting the adjacent dwelling at approximately 50 to 60 dB(A) typical passby noise levels. A short term exposure to higher noise levels in the same order of magnitude as passing traffic is not, therefore, considered a serious environmental impact.

Noise from the proposed operation can be shown to meet recommended criteria, with the exception of an area shown on Figure 5, within which, bulldozer and front end loader may result in higher levels. Noise control treatment is recommended for both of these items, in order to improve noise impact whilst working in this area.

Mining operations are predicted to be audible, but at an acceptable level of noise impact.

9. NOISE CONTROL TREATMENT

Options for noise reduction treatment for equipment within the zone shown in Figure 5 are limited. The most effective attenuation will be engine enclosures and exhaust silencers. Other benefits will result when earth barriers, or similar sight proof solid barriers are positioned between the equipment and the western boundary.

Necessary treatment is listed below:

1. Fit noise suppression kit to the bulldozer, comprising high performance muffler, engine canopy treatment, fan blade modification and radiator intake noise silencer. This treatment shall be designed so as to achieve not less than 5 dB(A) attenuations, in accordance with the values used in part 6 of this report.

2. Fit noise control treatment to the front end loader as per item above.

To assist mitigation of occasional high noise events, the following recommendations should be adopted where practical within the 300 metre noise sensitive zone:

1. Use topsoil or cleared vegetation berms on the north western mining boundary.

2. Retain the maximum existing ground cover and foliage around mining.

3. Sequence the extraction zoning to commence mining at the eastern side of dunes and work to the west.

4. Wherever possible, operate the front end loader from the eastern side of dunes so as to maintain shielding by ground contours, developing a north-western progressing face.

5. Wherever possible, coordinate operation of the bulldozer to occur during periods of maximum frequency of wind from the westerly direction, ie the winter months.

It is proposed that the above treatments will reduce to an acceptable level, the incidence of noise levels above the recommended criteria at the adjacent dwelling generated whilst mining within the 300 metre noise sensitive zone particularly when compared with frequently occurring noise from passing traffic.

10. REFERENCES

1. State Pollution Control Commission, "Environmental Noise Control Manual", as amended 30 August 1986.

2. CONCAWE, "The Propagation of Noise from Petroleum and Petrochemical Complexes to Neighbouring Communities", Report No. 4/81.Den Haag 1981.

3. Australian Standard 1055-1984, Parts 1-3, "Acoustics-Description and Measurement of Environmental Noise".

4. May, Daryl N., Ed., "Handbook of Noise Assessment", Van Nostrand Reinhold Company, 1978.

11. APPENDIX - NOISE MEASUREMENT PROCEDURES

In order to prepare this noise impact assessment a number of noise measurements have been taken, both within and outside the development locality. Australian Standard 1055.1-1984 describes noise measurement procedures appropriate to various situations. Measurements have been taken in accordance with the procedures applicable to the measurement described in AS1055.

The following readings have been taken:

- Typical maxima noise levels in dB(A) associated with various events
- Average minima background noise levels in dB(A)
- Statistical distribution samples of background noise in dB(A)
- Narrow band period average analysis of equipment and plant noise
- Equivalent continuous noise levels in dB(A) for truck noise.

The following instruments have been used:

Precision Sound Level Meters:

Bruel & Kjaer type 2231
Bruel & Kjaer type 2203
Bruel & Kjaer type 2215

Microphones: Bruel & Kjaer types 4165, 4155

Pistonphone Calibrator: Bruel & Kjaer type 4220

Tape Recorder: Uher 4200 Report Monitor

Graphic Level Recorders: Bruel & Kjaer type 2306
Bruel & Kjaer type 2305

Dynamic Signal Analyser: Hewlett Packard type 3561A

In accordance with the Terms of Membership of the A.A.A.C. we submit our instrumentation to the manufacturer for periodic equipment calibration checking, as well as carrying out regular instrument calibration checks in our laboratory and during field measurements.

12. APPENDIX - GLOSSARY OF TERMS

Ambient noise: The existing noise level at a particular location, made up of noise from sources both near and far.

Background Noise: As above, considered for the specific case excluding any noise under assessment.

Decibel, dB: Unit of acoustic measurement. Measurements of power, pressure and intensity may be expressed in dB relative to standard reference levels.

dB(A): Unit of acoustic measurement, electronically weighted to approximate the sensitivity to frequency of human hearing.

dB(A) re 1pW: Sound power level of a source expressed in decibels, weighted to a standard weighting.

L_{90}, L_{10} etc: A statistical measurement giving the sound pressure level which is exceeded for the given percentile of the observation period. i.e. L90 is the level which is exceeded for 90 percent of the period of observation. i.e. L90 is an indication of the lower commonly occurring levels. It is normal to specify a time period over which the assessment or measurement is made.

$L_{A,10}$: A statistical measurement measured in dB(A).

L_{AE} or SEL: Sound Exposure Level expressed in decibels. The integration of the dB(A) time history, normalised to a 1 second time period. This unit permits calculation of equivalent energy sound levels for any arbitrary period.

L_{DN}: Day-night equivalent noise level. The equivalent noise level applicable to a 24 hour period whereby noise occurring between the period 2200-0700 is mathematically penalised by 10 decibels.

L_{eq}: The constant sound level which, when operating over the same time interval, would result in the receiver experiencing the same total acoustic energy.

Sound Power Level: The level of total sound energy radiated per unit time by a source, expressed in decibels, equal to 10 times the logarithm to the base 10 of the sound power of the source relative to a reference power of 1 picowatt. Sound power cannot be measured directly but must be calculated from sound intensity level measurements.

Sound Pressure Level: The level, expressed in decibels, equal to 20 times the logarithm to the base 10 of the ratio of the r.m.s. sound pressure to a reference pressure of 20 micropascal. Sound pressure level is measured using a microphone and a sound level meter, and varies with distance from the source and the environment.

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