

EIS 1048 Vol 2

AB020263

Development application : proposed sand extraction and
agricultural land rehabilitation at Lot 3 DP 567166, Old Northern
Road, Maroota, Shire of Hornsby

NSW DEPT PRIMARY INDUSTRIES



AB020263



**COLLIN C. DONGES & ASSOCIATES
PTY LIMITED**

DEVELOPMENT APPLICATION
PROPOSED EXTENSION OF SAND EXTRACTION
AND
AGRICULTURAL LAND REHABILITATION
AT
LOT 3, D.P. 567166 OLD NORTHERN ROAD
MAROOTA
SHIRE OF HORNSBY
VOLUME 2

Prepared by: Collin C Dongés & Associates Pty Limited

November, 1994

B718/3

FIGURES

LIST OF FIGURES

FIGURE 1	-	Regional Location
FIGURE 2	-	Site Location at Maroota
FIGURE 3	-	Property Boundaries and Location of Development
FIGURE 4	-	Cadastral Information
FIGURE 5	-	Reproduction of Part of Aerial Photograph
FIGURE 6	-	Zoning
FIGURE 7	-	Map from Sydney Regional Environmental Plan No. 9(2)
FIGURE 8	-	Topography
FIGURE 9	-	Hydrological Section of North Maroota
FIGURE 10	-	Boundary Set-backs and R.E.P. limits
FIGURE 11	-	Extraction Areas and Stages
FIGURE 12A	-	Mobile Wash Plant
FIGURE 12B	-	Mobile Wash Plant
FIGURE 13	-	Transportation Alternatives
FIGURE 14.0	-	Existing Site Management
FIGURE 14.1	-	Basic Stage Area Determinants
FIGURE 14.2	-	Preliminary Works
FIGURE 14.3	-	Early Stage 1 Works
FIGURE 14.4	-	Final Phase of Stage 1
FIGURE 14.5	-	Early Stage 2 Works
FIGURE 14.6	-	Final Phase of Stage 2
FIGURE 15	-	Water Management Plan
FIGURE 16	-	Schematic Cross Sections
FIGURE 17	-	Soil Profiles

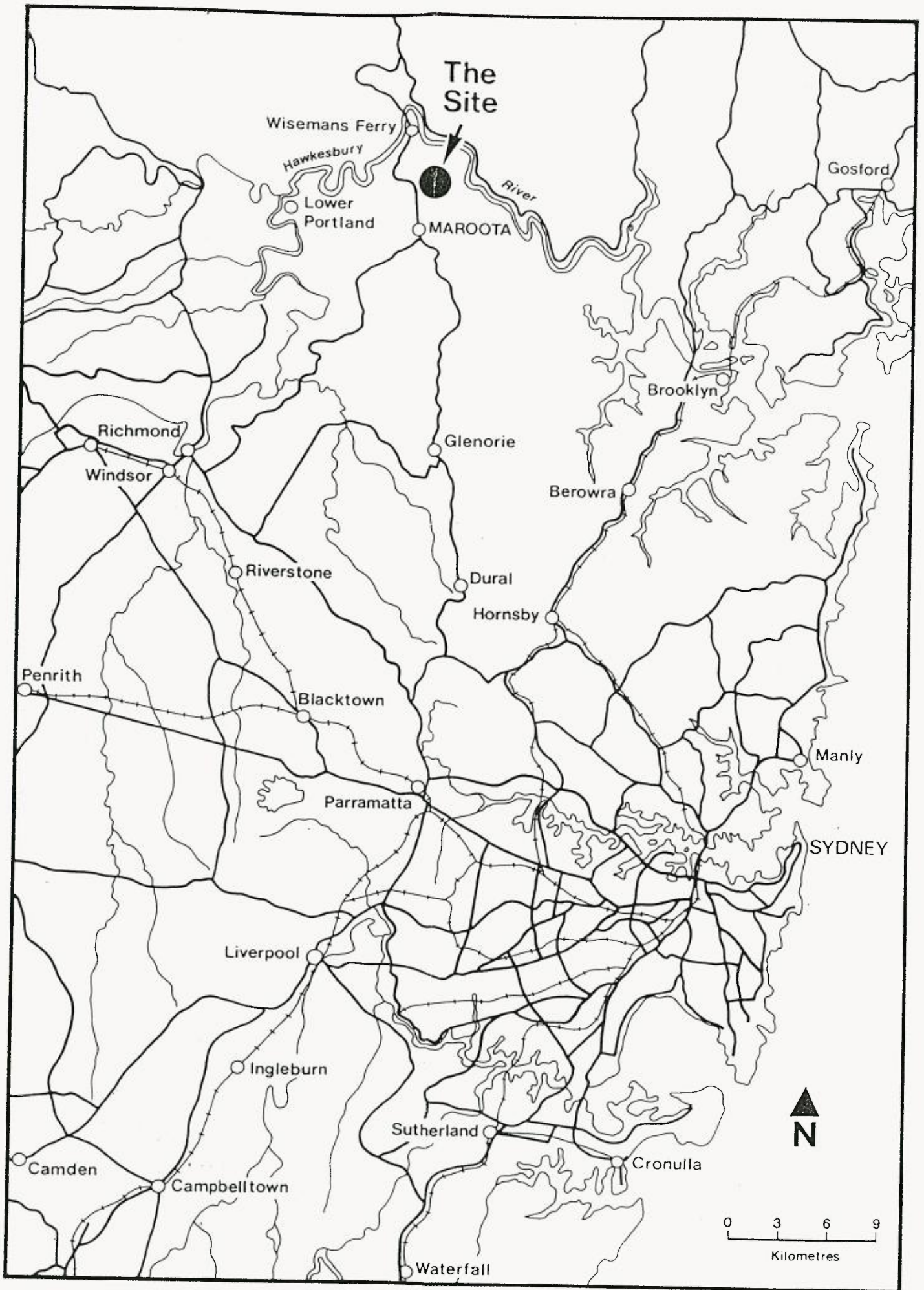


Figure 1: REGIONAL LOCATION

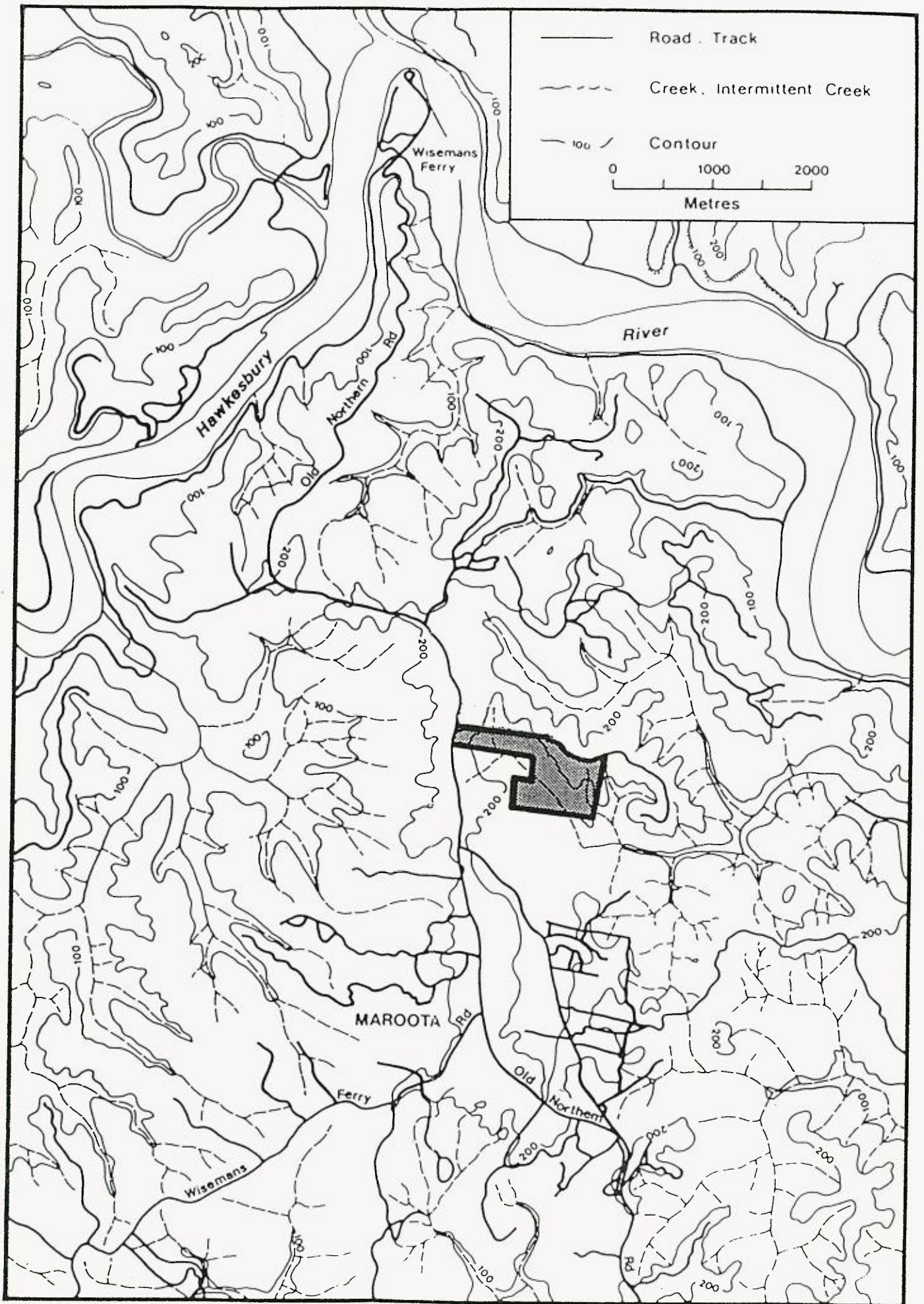


Figure 2: SITE LOCATION AT MAROOTA

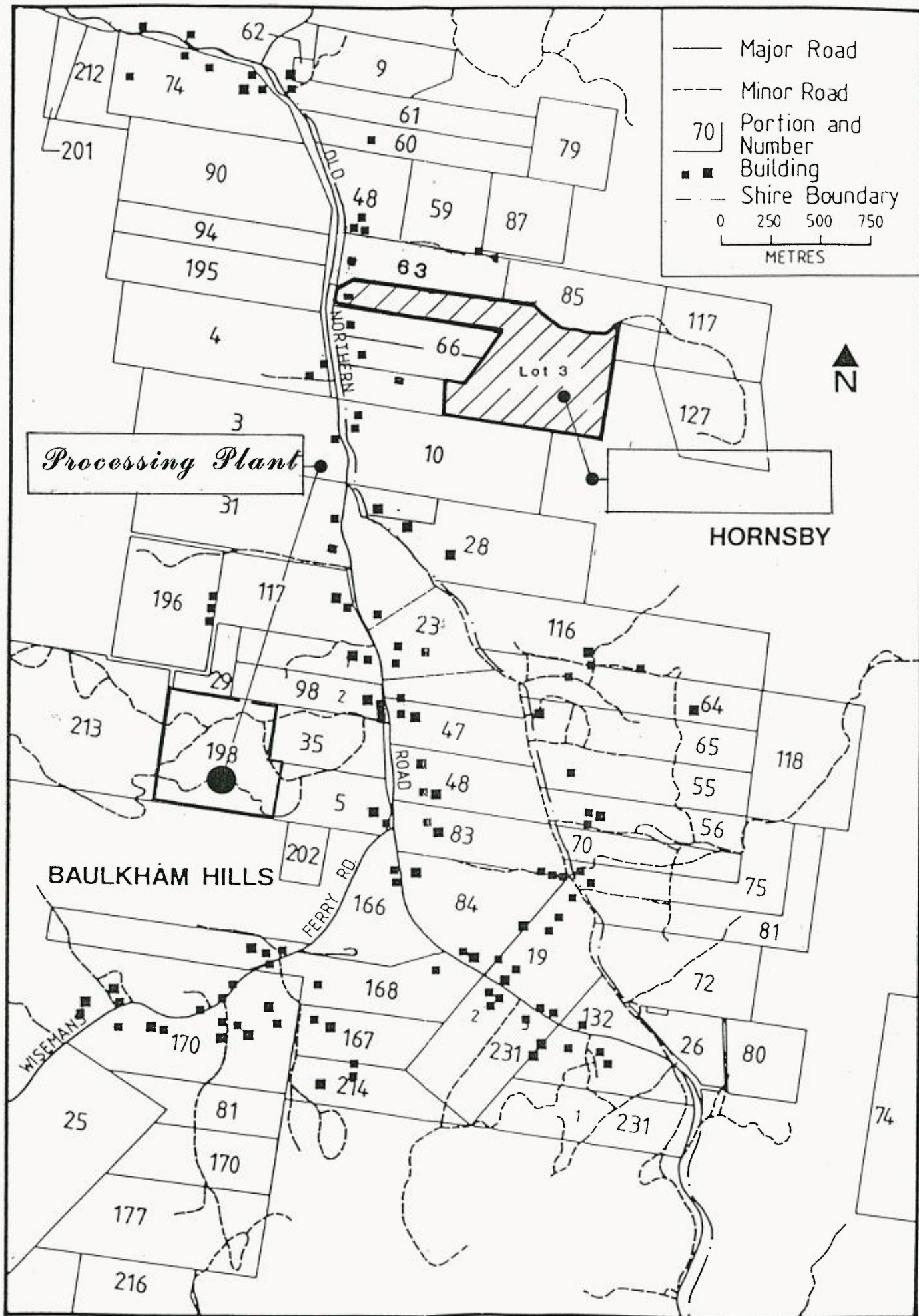
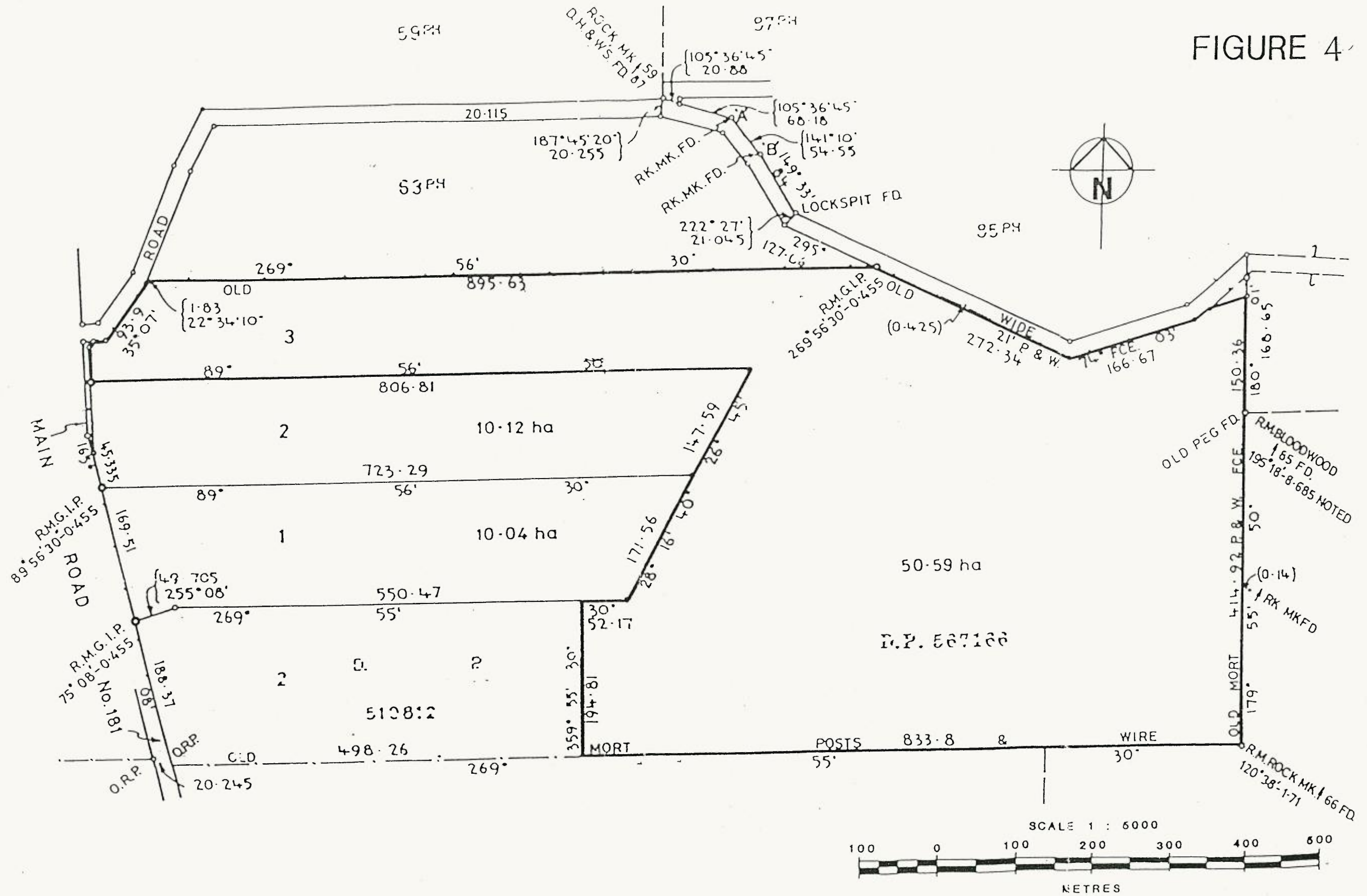


Figure 3 PROPERTY BOUNDARIES AND LOCATION OF DEVELOPMENT

FIGURE 4



Cadastral
Information

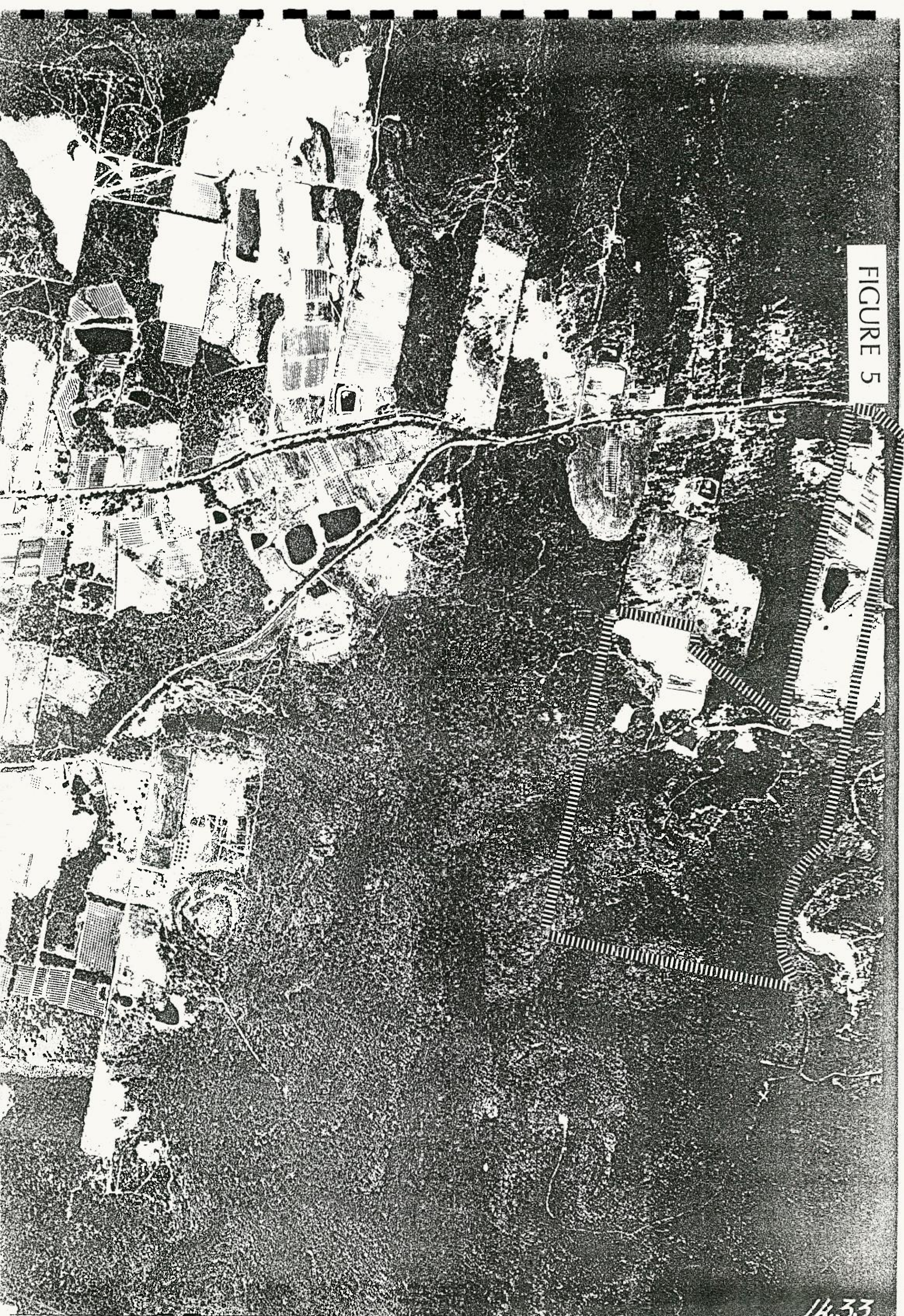
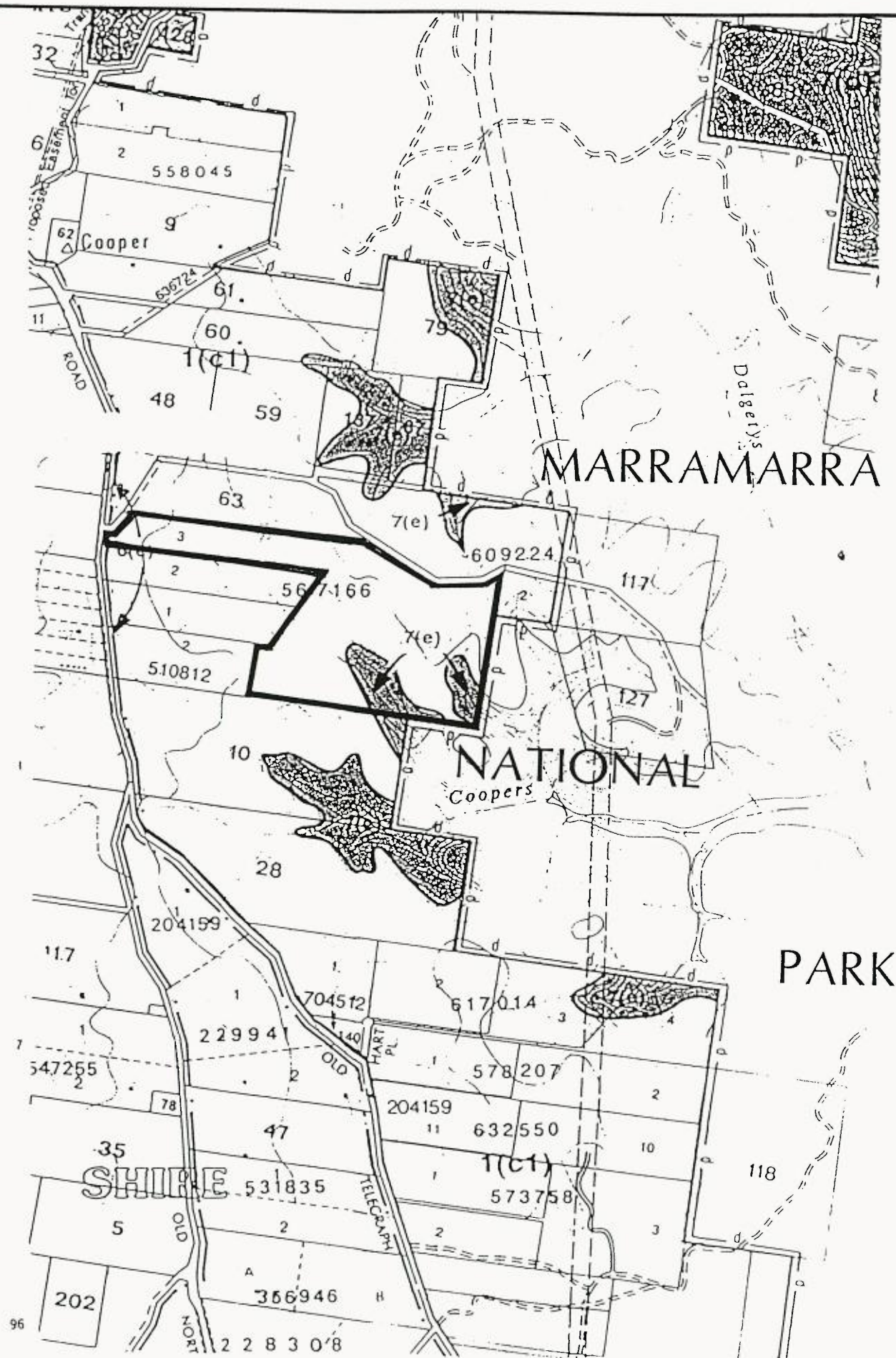


FIGURE 5



ZONING

FIGURE 6

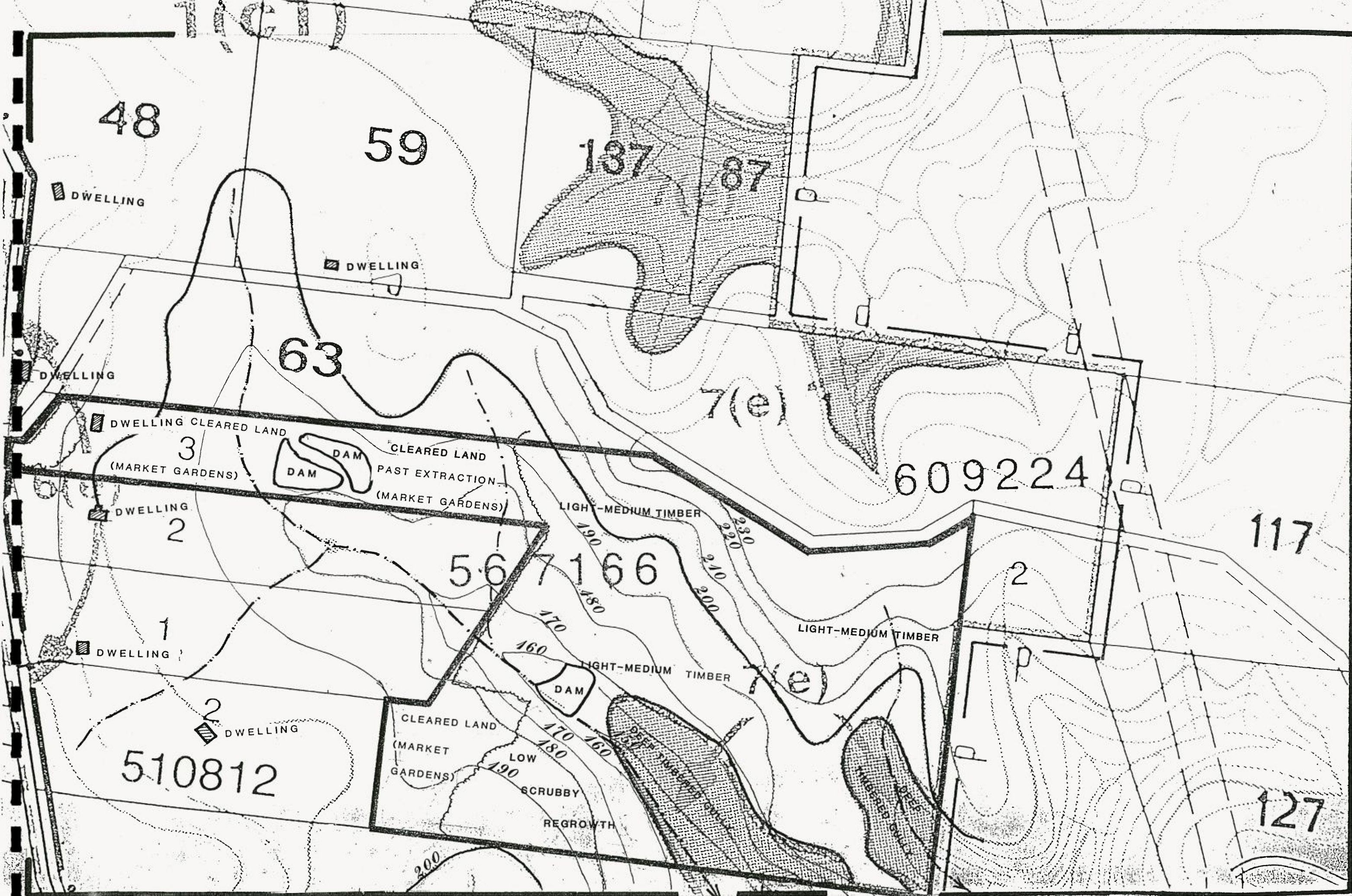
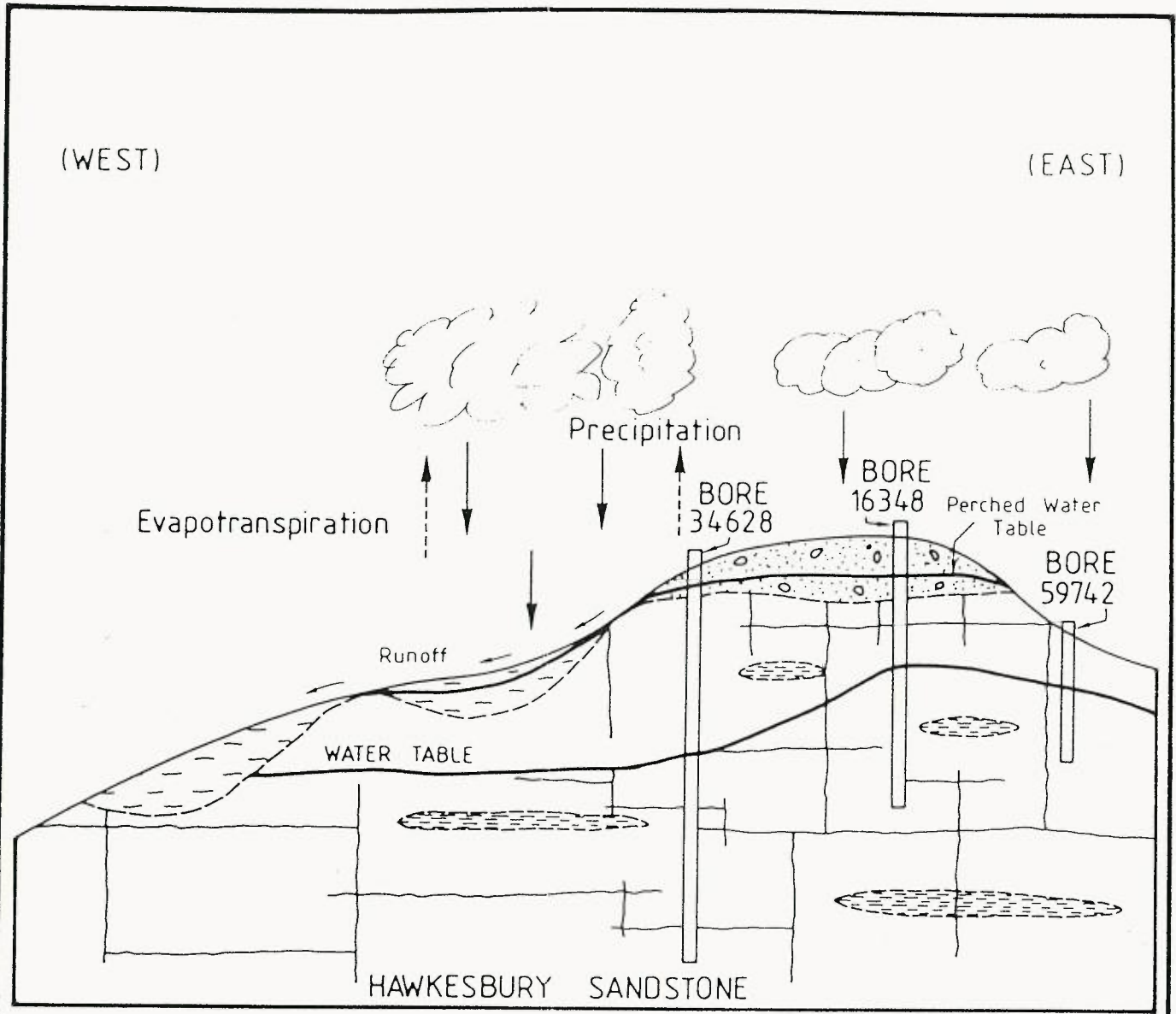


FIG 8 TOPOGRAPHY

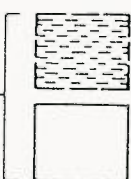


NOT TO SCALE

LEGEND

Eluvial Sand 

Maroota Sand 

Hawkesbury Sandstone 

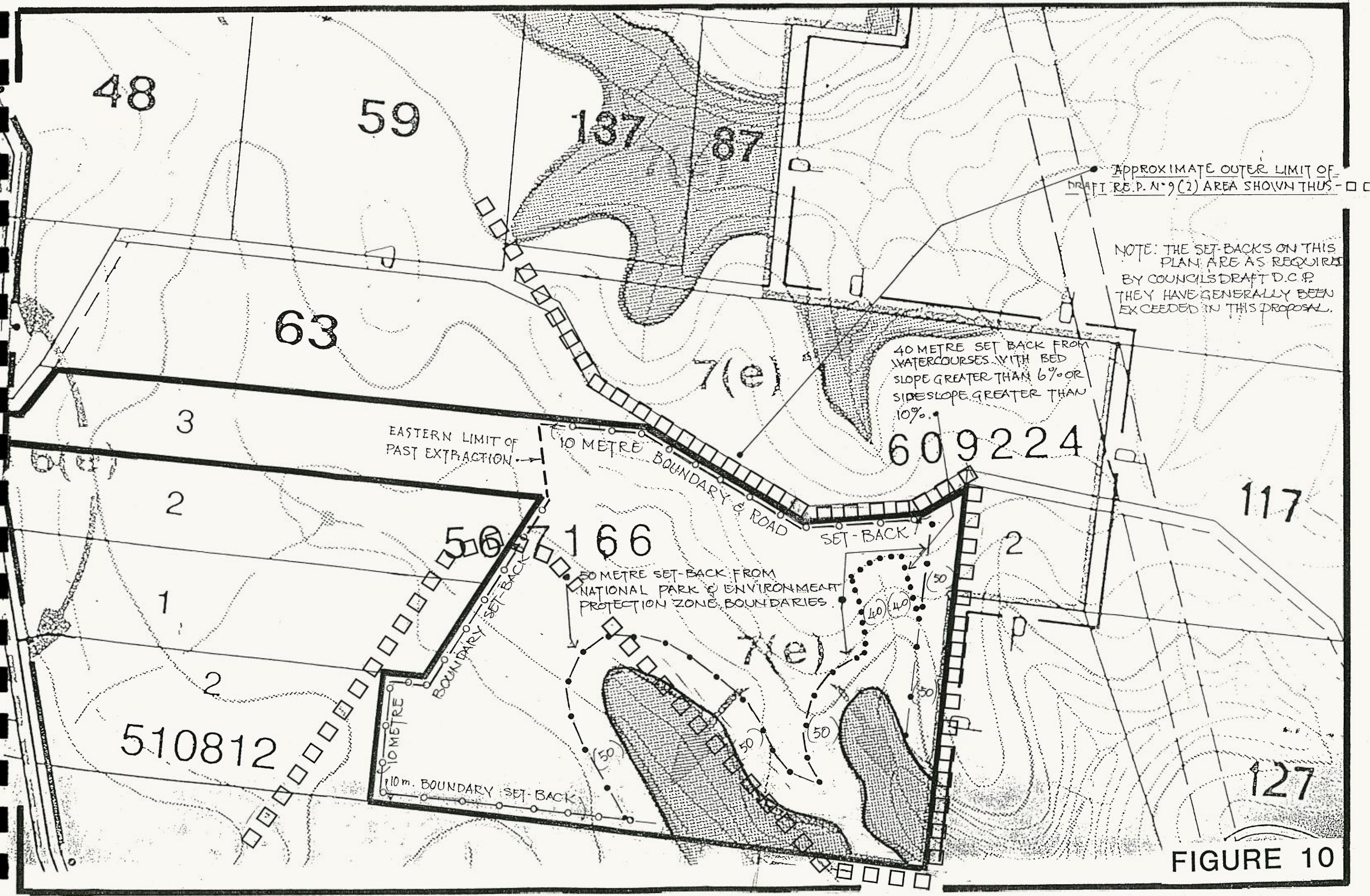
Sand, gravel, silt and clay

Shale lense

Sandstone

Joints and groundwater flow paths through rock

Figure 9 HYDROLOGICAL SECTION AT NORTH MAROOTA



APPROXIMATE OUTER LIMIT OF DRAFT R.E.P. N°9(2) AREA SHOWN THUS - □ □

NOTE: THE SET-BACKS ON THIS PLAN ARE AS REQUIRED BY COUNCILS DRAFT D.C.P. THEY HAVE GENERALLY BEEN EXCEEDED IN THIS PROPOSAL.

40 METRE SET BACK FROM WATERCOURSES WITH BED SLOPE GREATER THAN 6% OR SIDESLOPE GREATER THAN 10%.

EASTERN LIMIT OF PAST EXTRACTION

10 METRE BOUNDARY & ROAD

SET-BACK

BOUNDARY SET-BACK

50 METRE SET-BACK FROM NATIONAL PARK & ENVIRONMENT PROTECTION ZONE BOUNDARIES.

10 METRE

10m. BOUNDARY SET-BACK

FIGURE 10

BOUNDARY SETBACKS AND DRAFT R.E.P. LIMITS

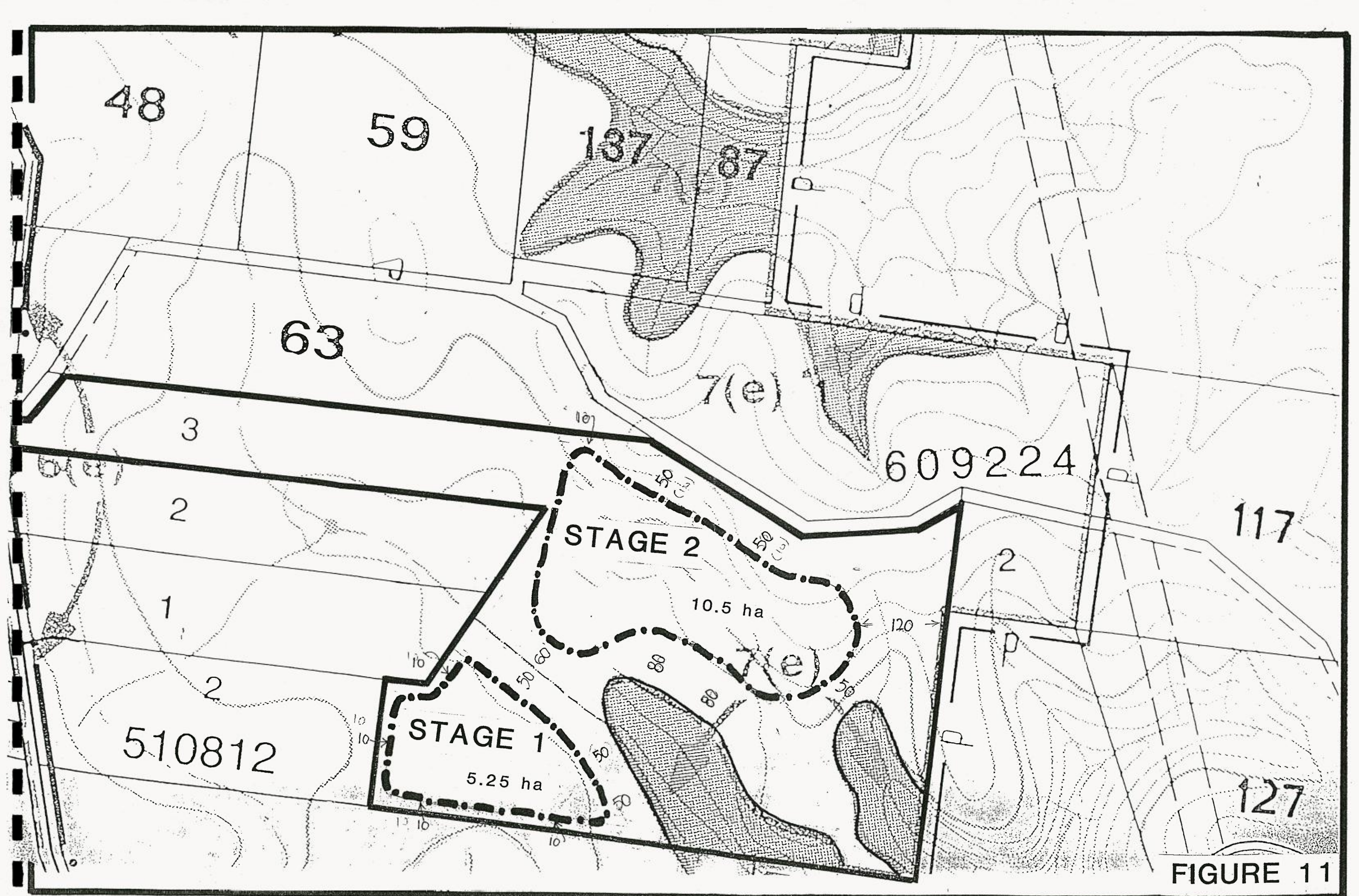
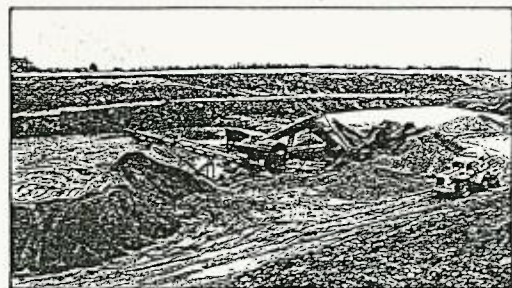
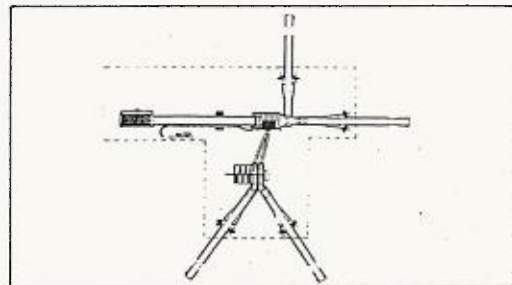
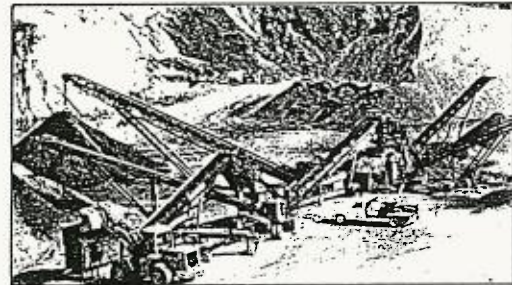
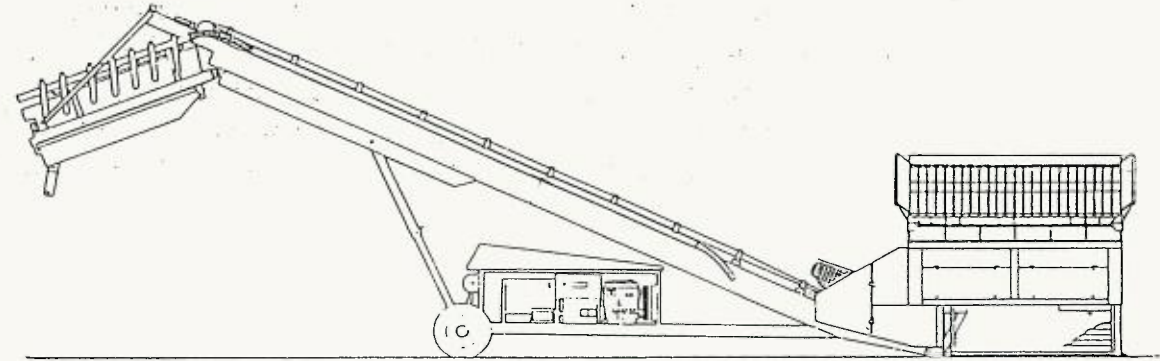


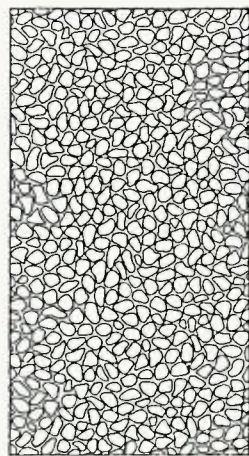
FIGURE 11

THE COMMANDER 10 x 5 RINSING UNIT

SPECIFICATIONS



Towing/Working Length	18.3 m (60 ft)
Width	2.42 m (7 ft 11 ins)
Towing Height	4.0 m (13 ft 1 ins)
Working Height	6.2 m (20 ft 4 ins)
Grid Area	1.8 m (6 ft) x 3.6 m (12 ft)
Hopper Capacity (including grid)	7.6 cu m (10 cu yds)
Approx Weight	14,000 kg (30,800 lbs)
Engine Size	48 KW (65 HP)
Conveyor Belt Width	915 mm (3 ft)
Main Conveyor Belt Speed (loaded)	110 m/min (365 ft/min)
Hydraulic System Capacity	336 litres (74 gals)
Diesel Tank Capacity	180 litres (40 gals)
Tyre Size	1000 x 20 (4 off)
Tyre Pressure	7 Bar (100 PSI)
Water Required	3600 - 4100 l/min (800-900 GPM)



Distributed and serviced by

All specification subject to change without prior notice

**POWERSCREEN INTERNATIONAL
DISTRIBUTION LTD.**
Coalisland Road, Dungannon
N. Ireland BT71 4DR
Tel: (08687) 40701
Telex: 74136 Pscres G
Fax: (08687) 47231



THE COMMANDER 10 x 5 RINSING UNIT

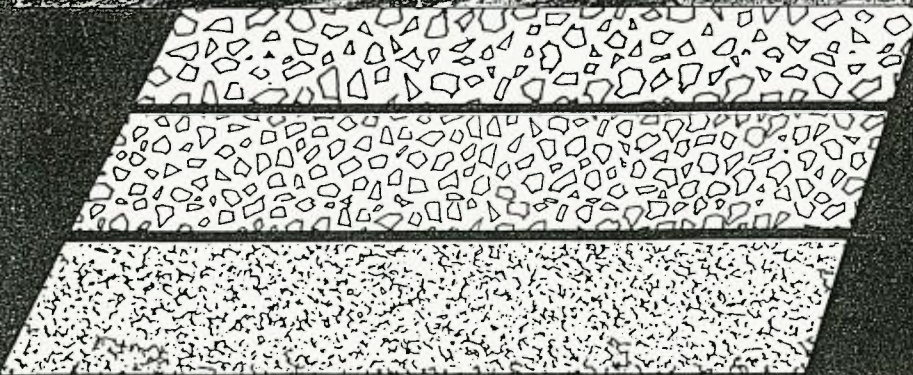


FIGURE 12a

THE COMMANDER

10 x 5 RINSING UNIT

The Powerscreen Commander 10 x 5 Rinsing Unit is a mobile screening and rinsing plant and complements the existing range of Powerscreen equipment.

Although the Commander fits into the present Powerscreen product range, it is a 'new' machine in its own right, having a distinctive new shape. Some of the new features include a diesel/hydraulic power unit, which can be removed as a complete unit, self-adjusting belt cleaners, quick fit tow-bar for on site movement, provision for fitting timber guarding around the two sides and at the back of the feeder section. The machine consists of a variable speed belt feeder, a main conveyor and a two-deck screen unit. It delivers high standards of performance and efficiency yielding high tonnages under the most arduous conditions to meet today's demands in screening efficiency and output.

PERFORMANCE The COMMANDER uses a fuel efficient 65 HP diesel engine. It is powered and designed to drive one or two M70 stock-piling conveyors and a 'Trident 2' Dewaterer. The use of a dual filtration system on the efficient hydraulics line keeps maintenance to a minimum whilst increasing profitability.

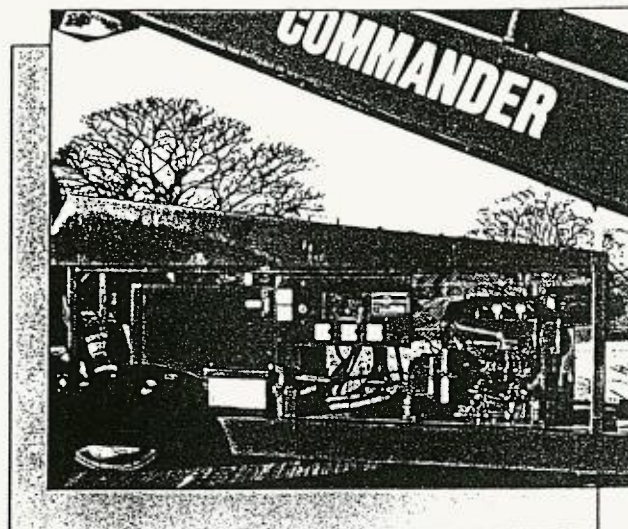
PORTABILITY The hydraulically adjusting frame allows the machine to be lowered for road transport. The use of standard fifth wheel coupling enables the machine to be moved from site to site with ease. A tow bar is provided for on-site movement.

PROFITABILITY The COMMANDER RINSER is fitted with a 1.5 m x 3.0 m four bearing screen unit. It is capable of handling *200 tonnes (220 American tons) per hour giving one or two grades of washed sand and two grades of washed aggregate.

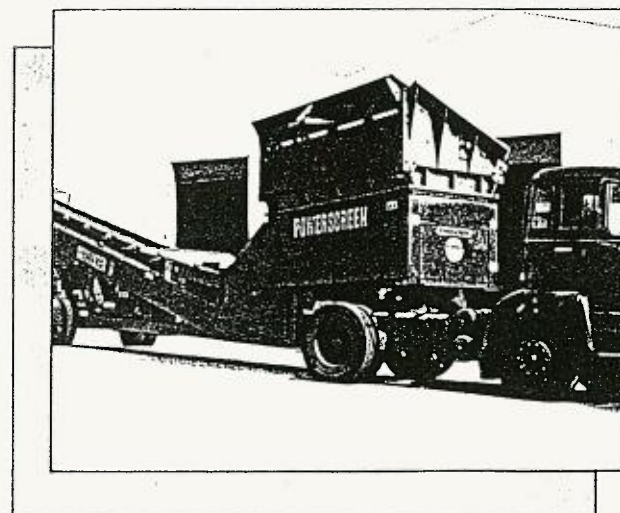
* (This figure is dependent on raw material content).

POWERSCREEN - The leading name in providing solutions to screening and materials-handling problems. It comes complete - requiring no basic add-ons at extra cost. A wide range of chutes, mesh screens and speedharps are available to meet specific production requirements. All equipment is installed ready for use by authorised POWERSCREEN personnel.

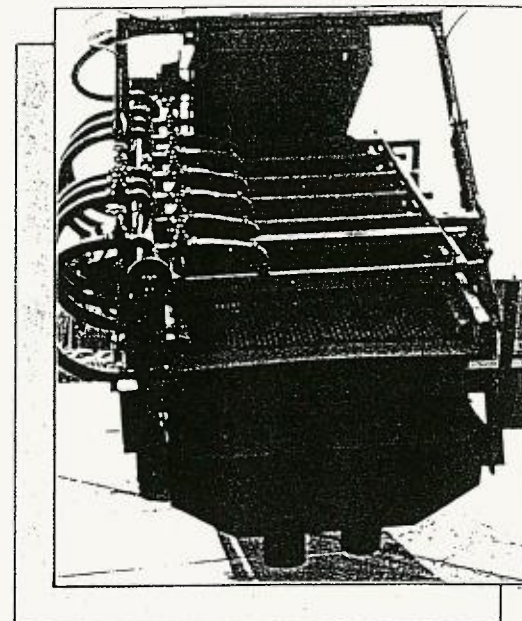
Performance



Portability



Profitability



TIPPING REJECT GRID
The tipping reject grid is constructed of heavy gauge steel to withstand rugged use and includes extension plates for easy loading. Remote controlled hydraulic tipping grid is available as an option.

CONVEYOR FRAME
The conveyor frame is constructed of heavy duty steelwork which is shot cleaned, primed and painted with industrial paint. Sealed for life conveyor rollers are used to carry the 36 ins (915 mm) wide conveyor belt. A new feature introduced on the COMMANDER is the self-adjusting belt cleaners.

WASHBOX
A washbox complete with spray pipe fitted with 7 off high output spray nozzles is fitted in front of the main conveyor head drum to feed moistened raw material evenly onto the screen unit top deck.

BELT FEED HOPPER
The Belt Feed Hopper with its capacity of 7.6 cu m including the grid section and 3.6 m loading width accommodates the largest loader. The 915 mm belt with almost vertical hopper sides and unrestricted outlet eliminates bridging of wet and sticky materials. The variable hydraulic drive allows fingertip control of the feed rate.

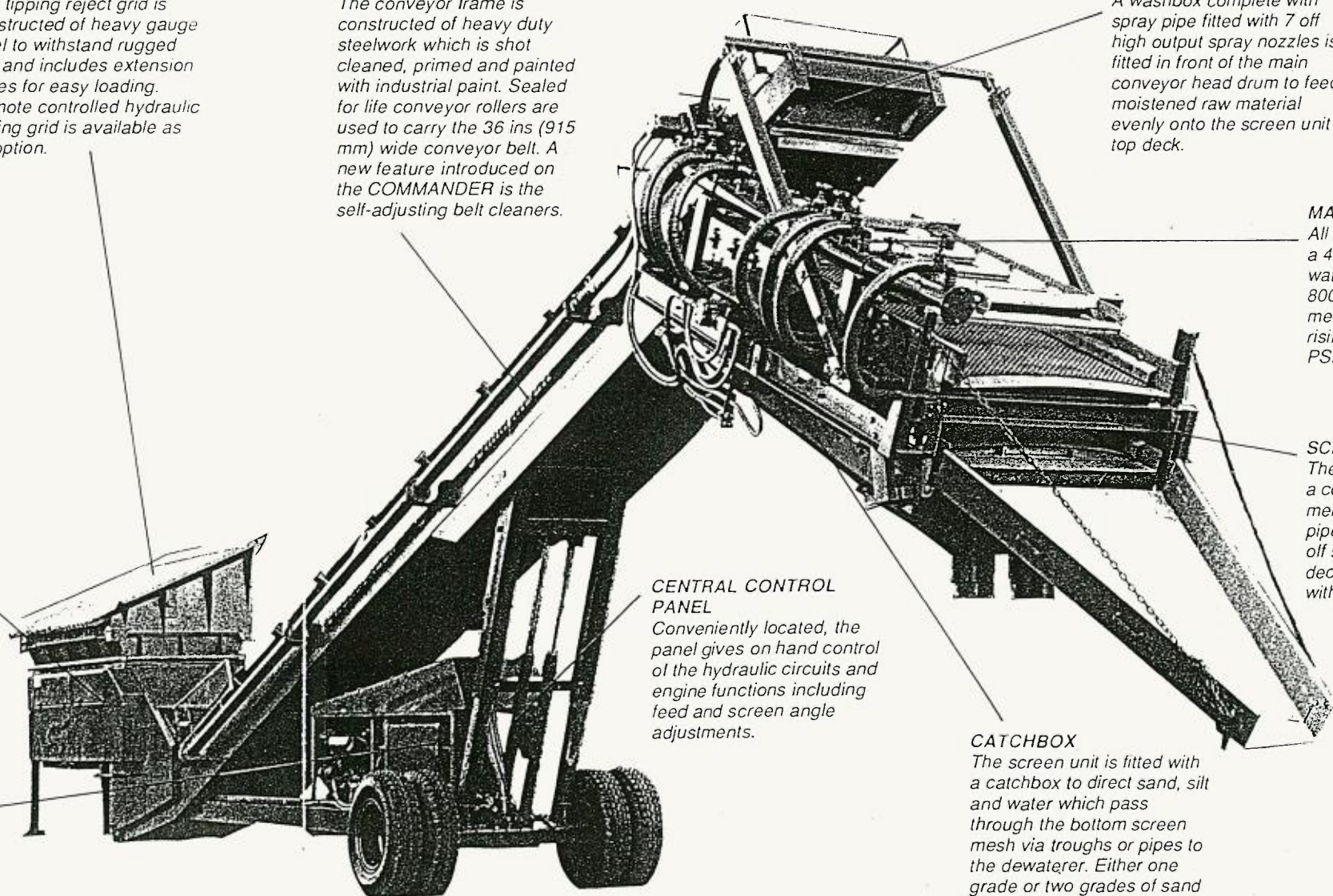
MAIN SUPPLY PIPE
All spray pipes are fed from a 4 ins main supply pipe and water flow requirements are 800 gals/min. at the recommended minimum of 20 PSI rising to 900 gals/min. at 25 PSI and so on.

SCREENBOX
The screen unit is fitted with a complete rinsing attachment consisting of 7 off spray pipes on the top deck and 7 off spray pipes on the bottom deck, each pipe being fitted with 25 spray nozzles.

HYDRAULICS
The 336 litre (74 gallon) capacity hydraulic system incorporates suction and return line filtration for maximum oil filtration for maximum component life. Each control valve is fitted with a pre-set relief valve to protect the complete system.

CENTRAL CONTROL PANEL
Conveniently located, the panel gives on hand control of the hydraulic circuits and engine functions including feed and screen angle adjustments.

CATCHBOX
The screen unit is fitted with a catchbox to direct sand, silt and water which pass through the bottom screen mesh via troughs or pipes to the dewaterer. Either one grade or two grades of sand can be produced.



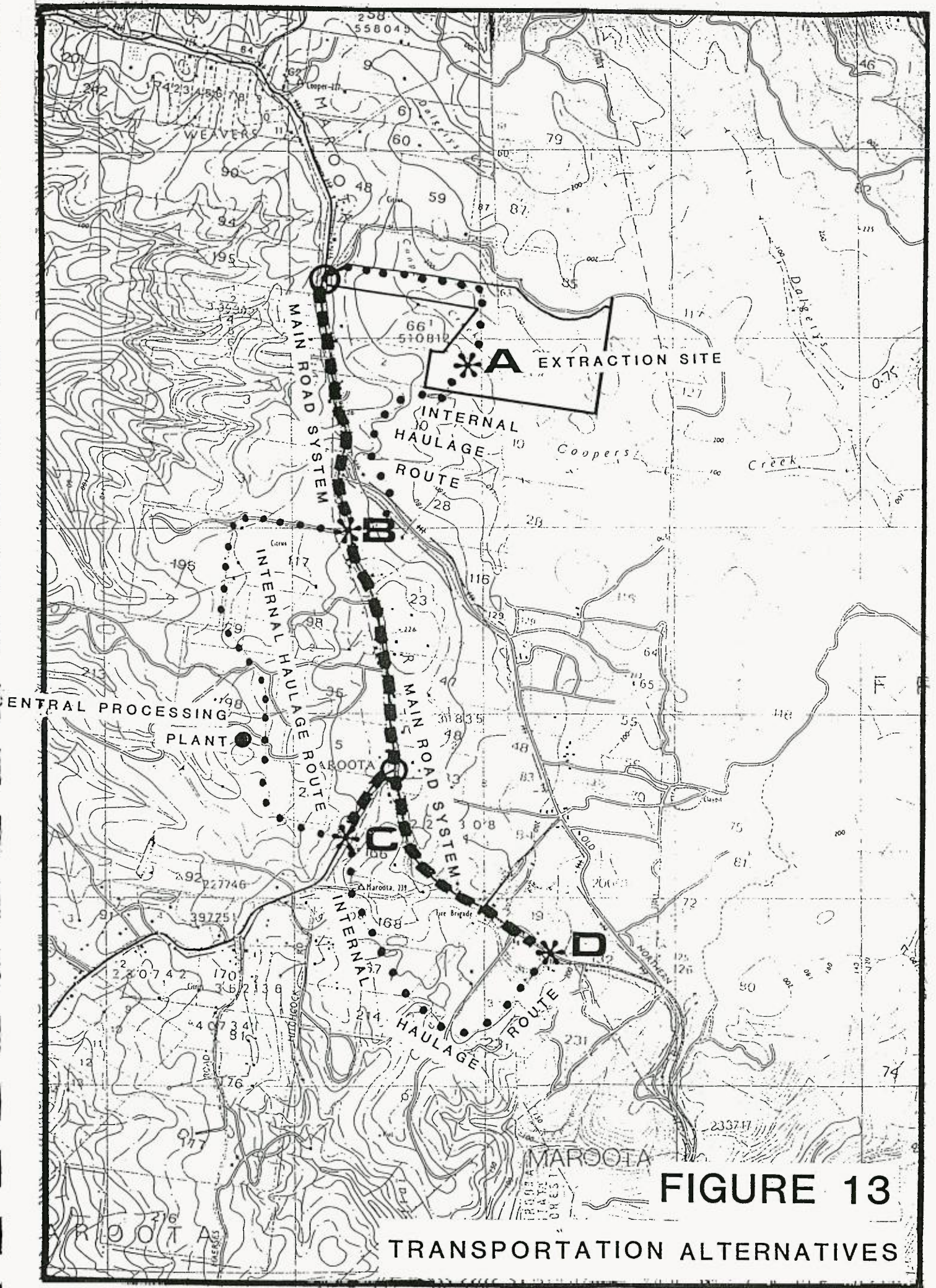
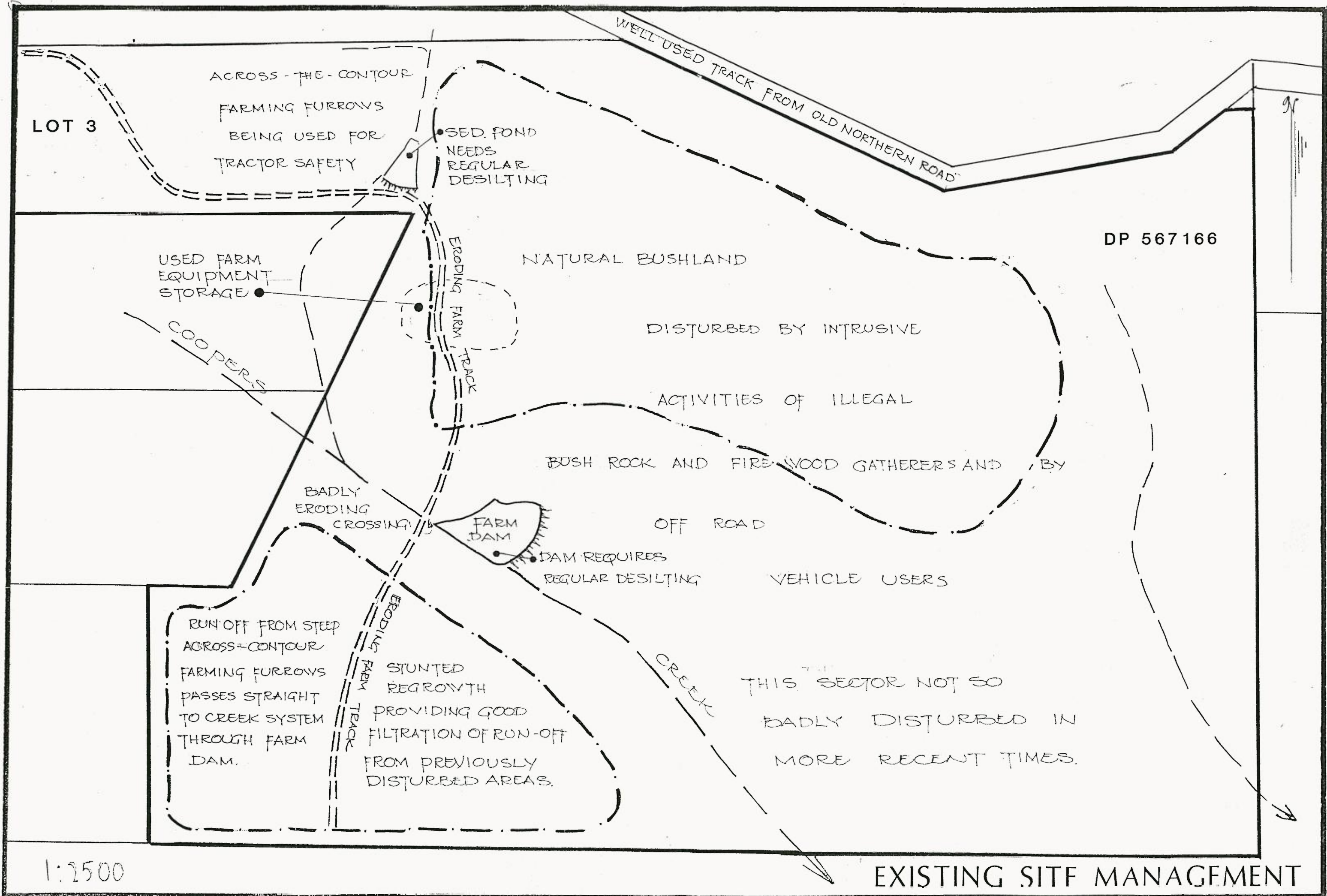


FIGURE 13

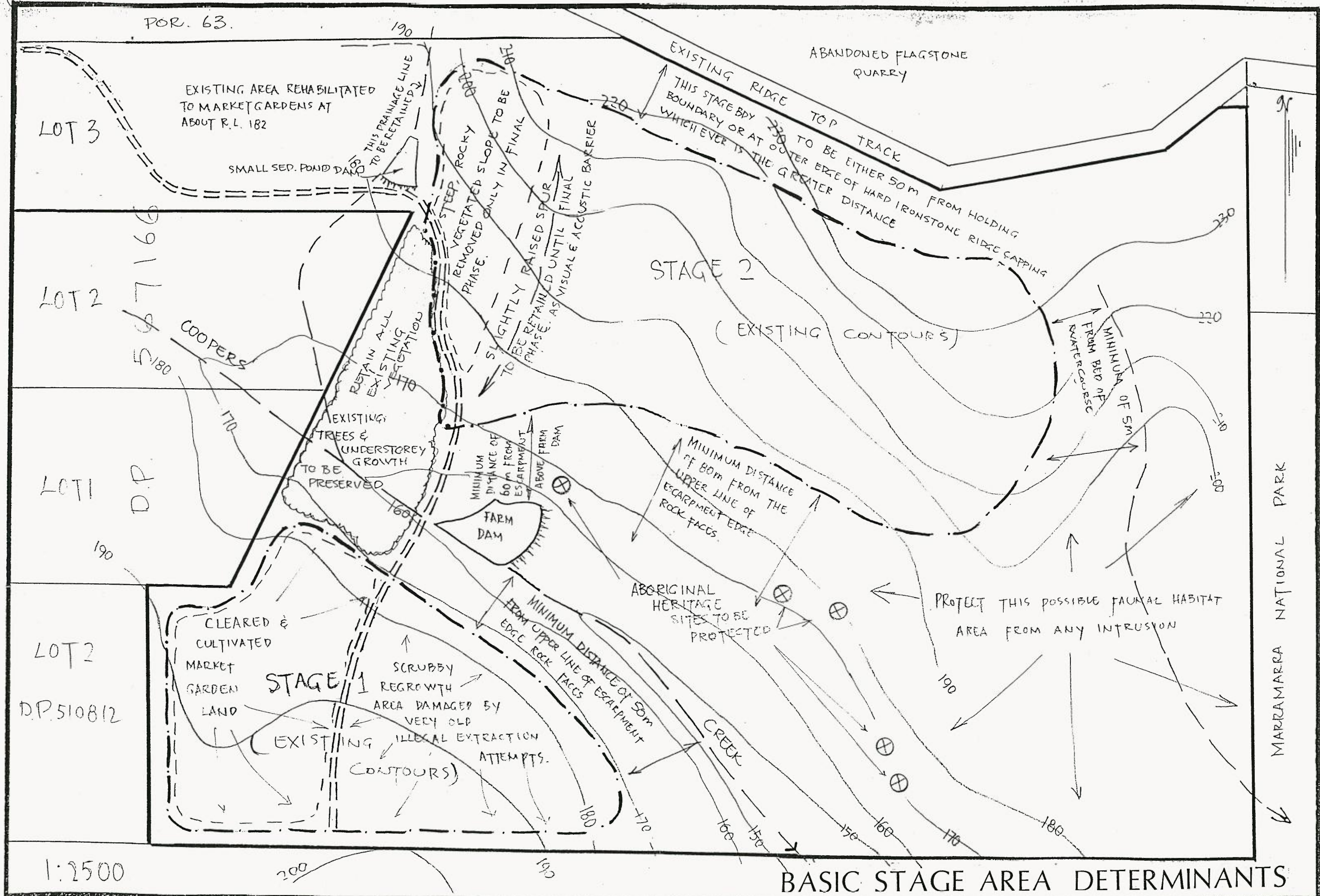
TRANSPORTATION ALTERNATIVES



1:2500

EXISTING SITE MANAGEMENT

FIGURE 14.0

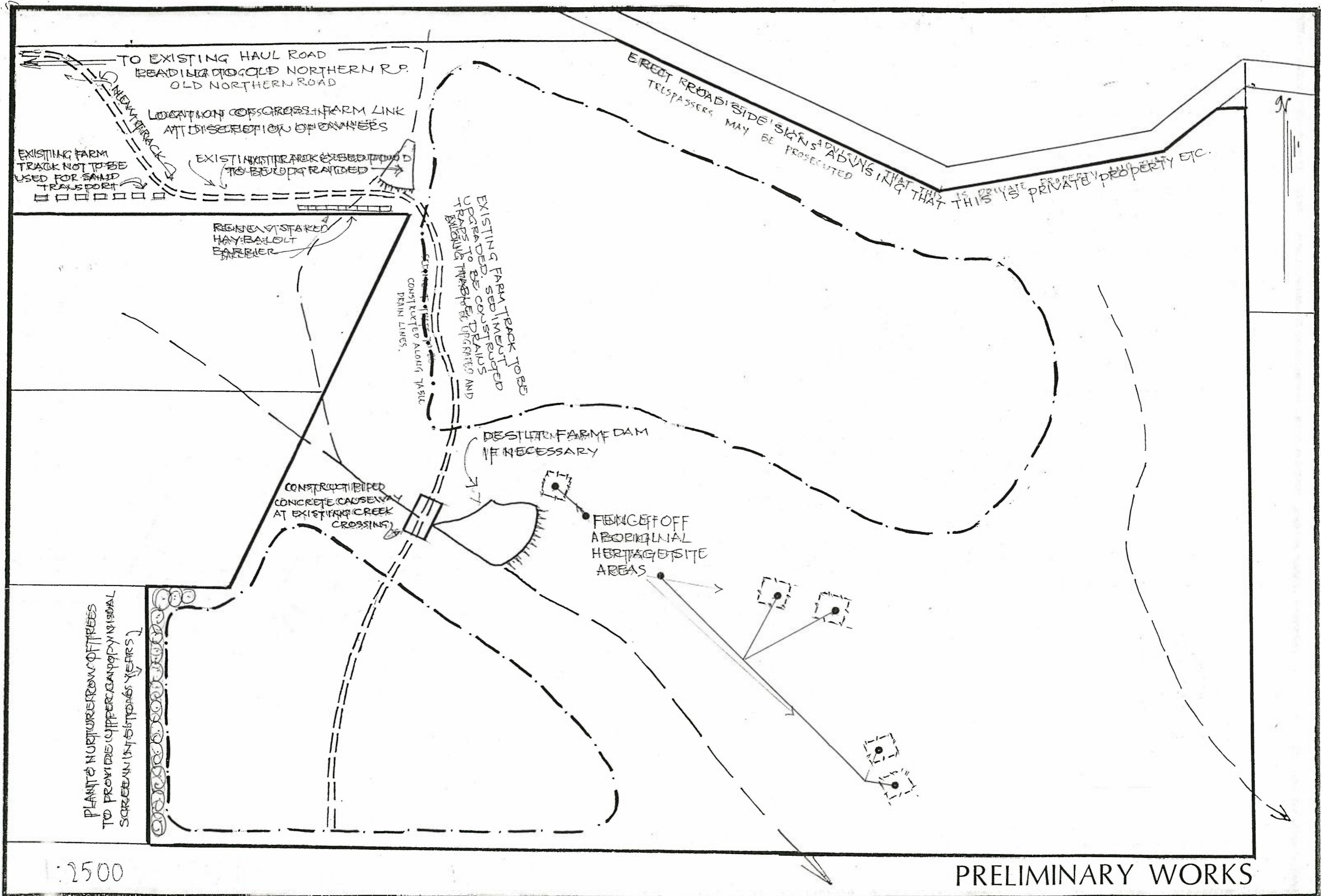


MARRAMBARA NATIONAL PARK

1:2500

BASIC STAGE AREA DETERMINANTS

FIGURE 14.1



1:2500

PRELIMINARY WORKS

FIGURE 14.2

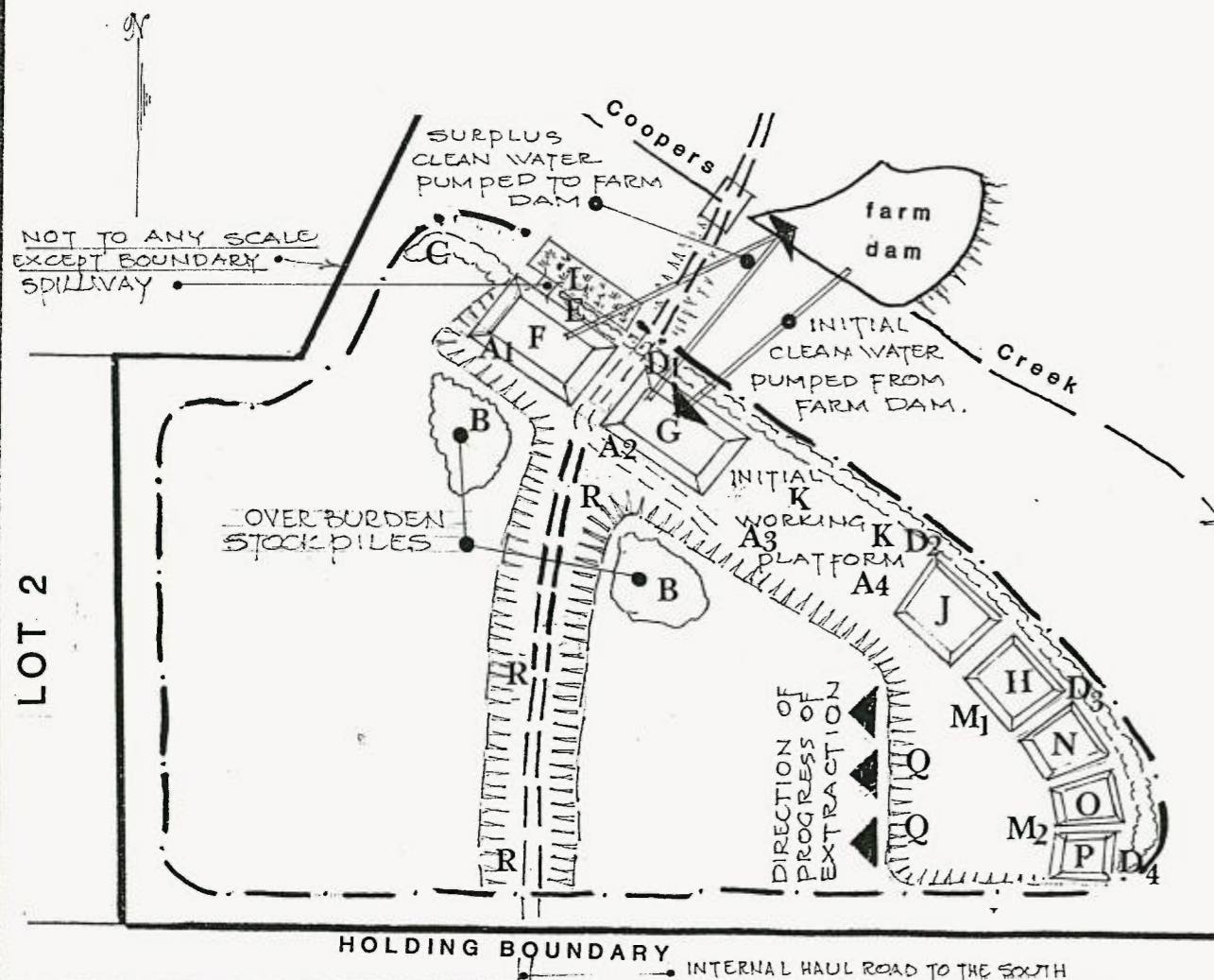
WORKS SEQUENCES

WATER PONDAGE CAPACITIES

(FROM TECHNICAL DETAIL IN BODY OF STATEMENT)

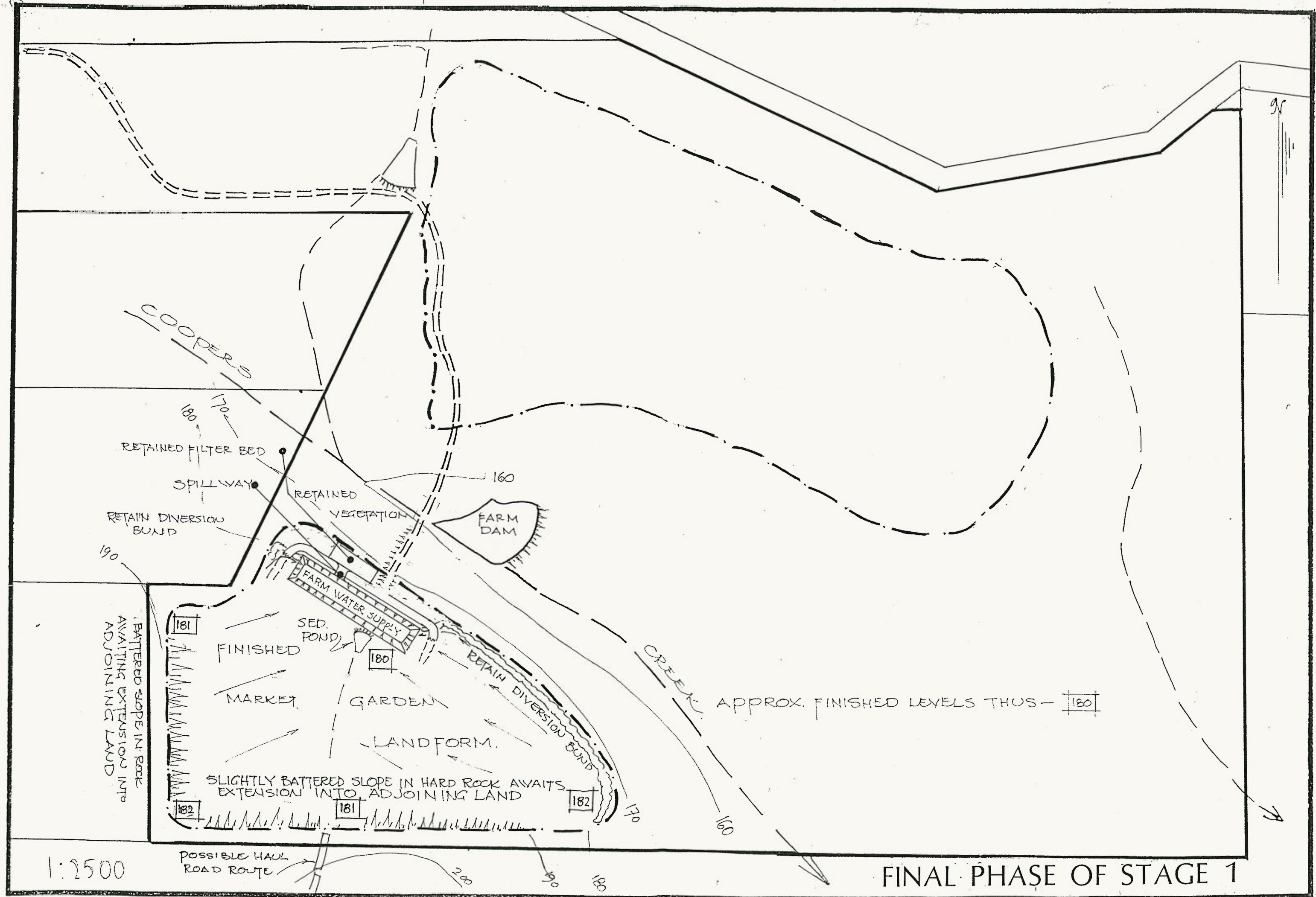
- IDLE CAPACITY OF DAM 'F' - 9200 m³.
- IDLE CAPACITY ABOVE PROCESSING SUPPLY REQUIREMENTS IN DAM 'G' - 1000 m³.
- SEDIMENTATION PONDS COLLECTING SURFACE RUN-OFF PRIOR TO DISCHARGE TO STORAGE DAM 'G' - A TOTAL OF 3500 m³ APPROPRIATELY DISTRIBUTED BETWEEN ALL COLLECTOR PONDS.
- ALL SEDIMENT TRAPPING MECHANISMS TO BE EMPTIED WHEN IDLE CAPACITY FALLS BELOW 50%.
- DAM 'G' TO BE DESILTED SHOULD COMBINATION OF SEDIMENTS AND NEED TO RETAIN IDLE CAPACITY EVER THREATEN CLEAN WATER SUPPLY VOLUME.
- EMPTY DAM 'F' BY PUMPING OUT CLEAN, SETTLED WATERS WHENEVER IT ACCUMULATES.
- NO SURFACE RUN-OFF TO PASS INTO DAMS 'F' & 'G' WITHOUT FIRST HAVING PASSED THROUGH A SEDIMENT TRAPPING MECHANISM.

1. CREATE SHALLOW DRAINAGE DEPRESSION A₁-A₂-A₃-A₄
2. USE TOPSOIL TO PUSH-UP PERIPHERAL BUNDS C, D₁-D₂ & E. STORE SURPLUS TOPSOIL
3. PLACE OVERBURDEN STOCKPILES AT B AS ACOUSTIC SCREENING.
4. EXTEND ACCESS TRACK ACROSS CREEK TO RISE AND FALL OVER BUNDWALL E-D₁
5. WIN INITIAL RESOURCE MATERIAL SUPPLY BY DEEPENING SUMPS AT F & G.
6. CLEAR AREA AROUND J & H USING TOPSOIL FOR BUND D₂-D₃. STORE SURPLUS TOPSOIL
7. SINK SHALLOW, 2 METRE DEEP TAILINGS PONDS AT J & H
8. CONTINUE TO DEEPEN SUMPS F & G PROCESSING AT WORKING PLATFORM K
9. USE CLEAN WATER FROM FARM DAM FOR INITIAL WASHING. PASS DIRTY WASH WATER THROUGH TAILINGS DAMS J & H TO FLOW INTO SUMP Q. TO BE IN TURN REUSED AS CLEAN WASH WATER.
10. ENLARGE AND DEEPEN SUMP F. THIS WILL BE KEPT EMPTY AT ALL TIMES TO ACT AN OVERFLOW COLLECTOR IN TIMES OF EITHER PEAK STORM EVENTS OR ACCIDENTAL DISCHARGES FROM OTHER ON-SITE SOURCES. OVERFLOW FROM G ALSO PASSES INTO F. HOWEVER, PONDAGE G TO BE NORMALLY KEPT LOW BY PUMPING TO FARM DAM.
11. OVERFLOW FROM PONDAGE F TO PASS OVER SPILLWAY ONTO GEOTEXTILE OR RIP-RAP APRON PRIOR TO FLOWING THROUGH DENSE VEGETATION BED OF CONTROLLED KIKUYU AT L. ALL DISCHARGE FROM THIS BED TO PASS THROUGH RETAINED CREEK SIDE VEGETATION BEFORE ENTERING FARM DAM BEFORE FLOWING INTO COOPERS CREEK.
12. ALL ON-SITE SURFACE FLOWS TO PASS THROUGH SEDIMENTATION STRUCTURES (OF 5 CUBIC METRE PER DISTURBED HECTARE CAPACITY) BEFORE ENTERING FRESH WATER SUPPLY STORAGE G.
13. ALL WATER IN SUMP F TO BE PUMPED BACK TO FARM DAM AS CLEAN WATER ONCE ANY SEDIMENTS HAVE FULLY SETTLED.
14. WHEN SUMPS AT G & F HAVE BEEN EXCAVATED TO THE REQUIRED SIZE THE WORKS AREA WILL BE RELOCATED SO AS TO CREATE A SHALLOW DEPRESSION ON THE PREVIOUSLY CLEARED AND STRIPPED AREA M₁-M₂
15. TOPSOIL FROM M₁-M₂ WILL BE USED TO CREATE THE PERIPHERAL BUND D₃-D₄ AND OVERBURDEN AND SURPLUS MATERIAL WILL BE STORED ABOVE THE NEXT WORKING FACE Q-Q AWAITING FINAL REPLACEMENT ON TAILINGS PONDS J & H WHEN FULL.
16. TAILINGS PONDS N, O & P WILL BE SUNK IN THE FLOOR OF THE NEW DEPRESSION M₁-M₂. THESE WILL BE USED TO SETTLE TAILINGS FROM MATERIAL WON FROM NEW WORKS AREA Q-Q.
17. THE WORKING PLATFORM Q-Q WILL THEN BE MOVED PROGRESSIVELY WESTWARD WITH ALL FUTURE WORK BEING CARRIED-OUT IN THE LEE OF A HIGH NORTH-SOUTH WORKING FACE. FLOOR LEVEL AT ABOUT R.L. 180.
18. THE TRENCH FOR THE HAUL ROAD R-R WILL BE CUT, IF NOT ALREADY CUT, WHEN REQUIRED. OVERBURDEN & TOPSOIL TO BE TEMPORARILY MOUNDED ON WEST SIDE OF THE CUTTING.
19. AS THE WORKING FACE MOVES PROGRESSIVELY WESTWARD SUCCESSIVE NEW SERIES OF TAILINGS PONDS WILL BE SUNK ADJOINING N-O-P (AT FIRST) BUT ALSO MOVING CONTINUOUSLY WESTWARD ON THE EAST SIDE OF THE ADVANCING WORKING PLATFORM BELOW THE MOVING EXTRACTION FRONT. OVERBURDEN FROM STOCKPILES B AND THE TRENCH R-R WILL BE USED TO TOP-UP THE FILLED TAILINGS PONDS N-O-P. THESE WILL BE COVERED WITH STORED TOPSOIL. AS STOCKPILED OVERBURDEN IS DEPLETED THE TAILINGS DAM SINKING, FILLING, DRYING AND CAPPING-OFF SEQUENCE WILL BE PROGRAMMED SO THAT COMPLETED PONDS WILL BE SURFACE-REHABILITATED DIRECTLY (WITHOUT DOUBLE HANDLING) FROM AREAS TO BE CLEARED AND STRIPPED FOR EXTRACTION ABOVE THE WESTERLY ADVANCING WORKING FACE.



EARLY STAGE 1 WORKS

FIGURE 14.3



1:2500

FINAL PHASE OF STAGE 1

FIGURE 14.4

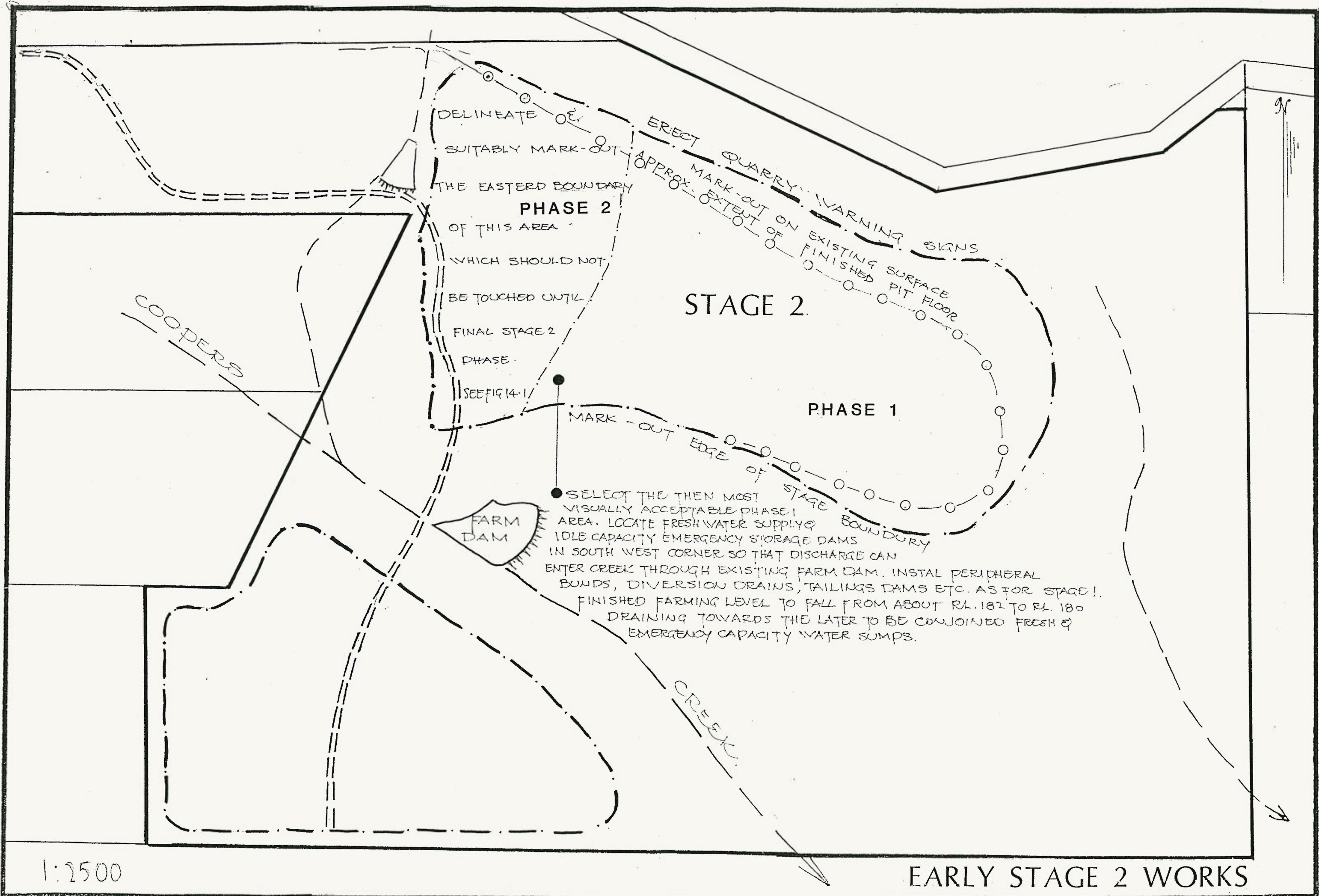
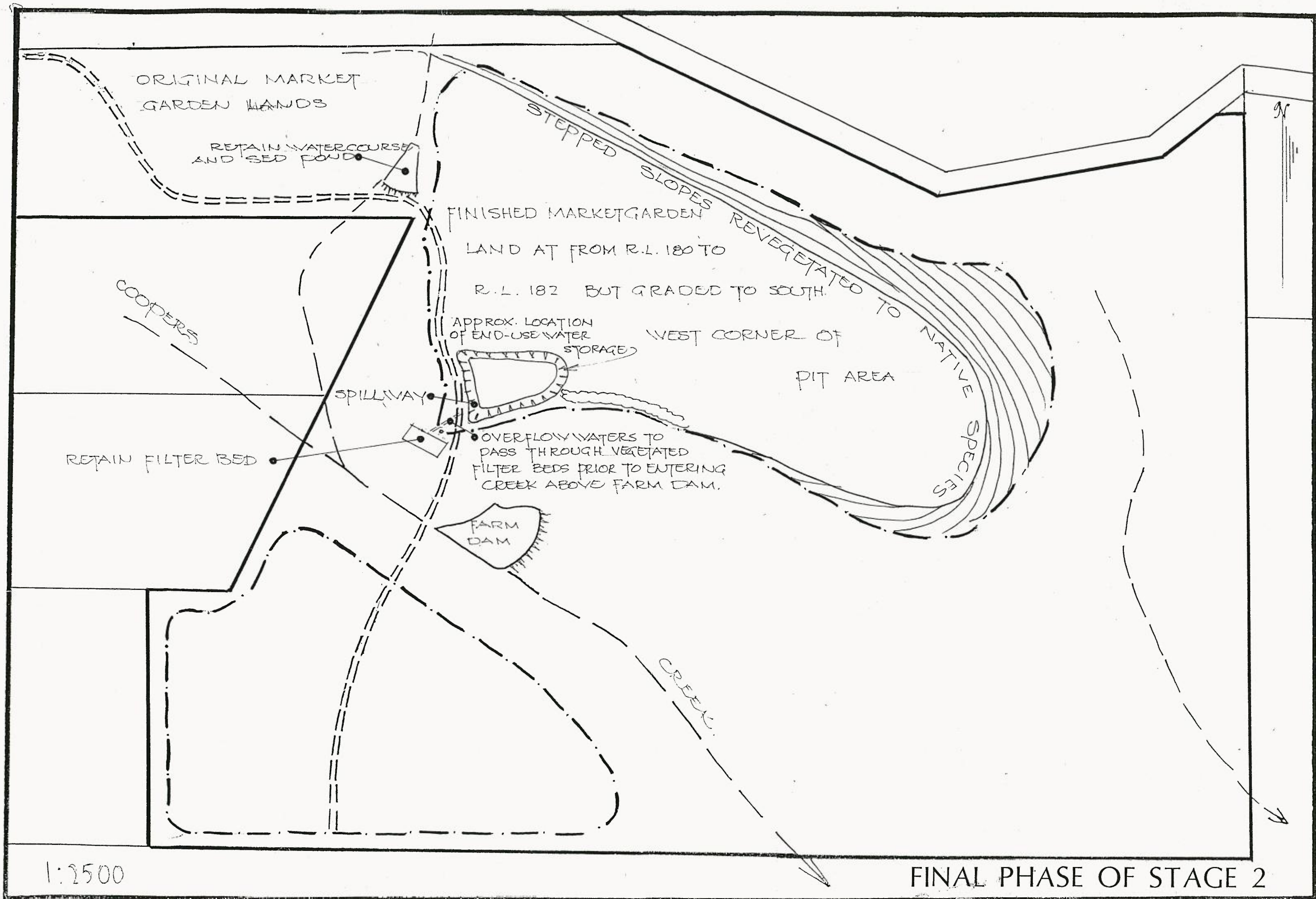
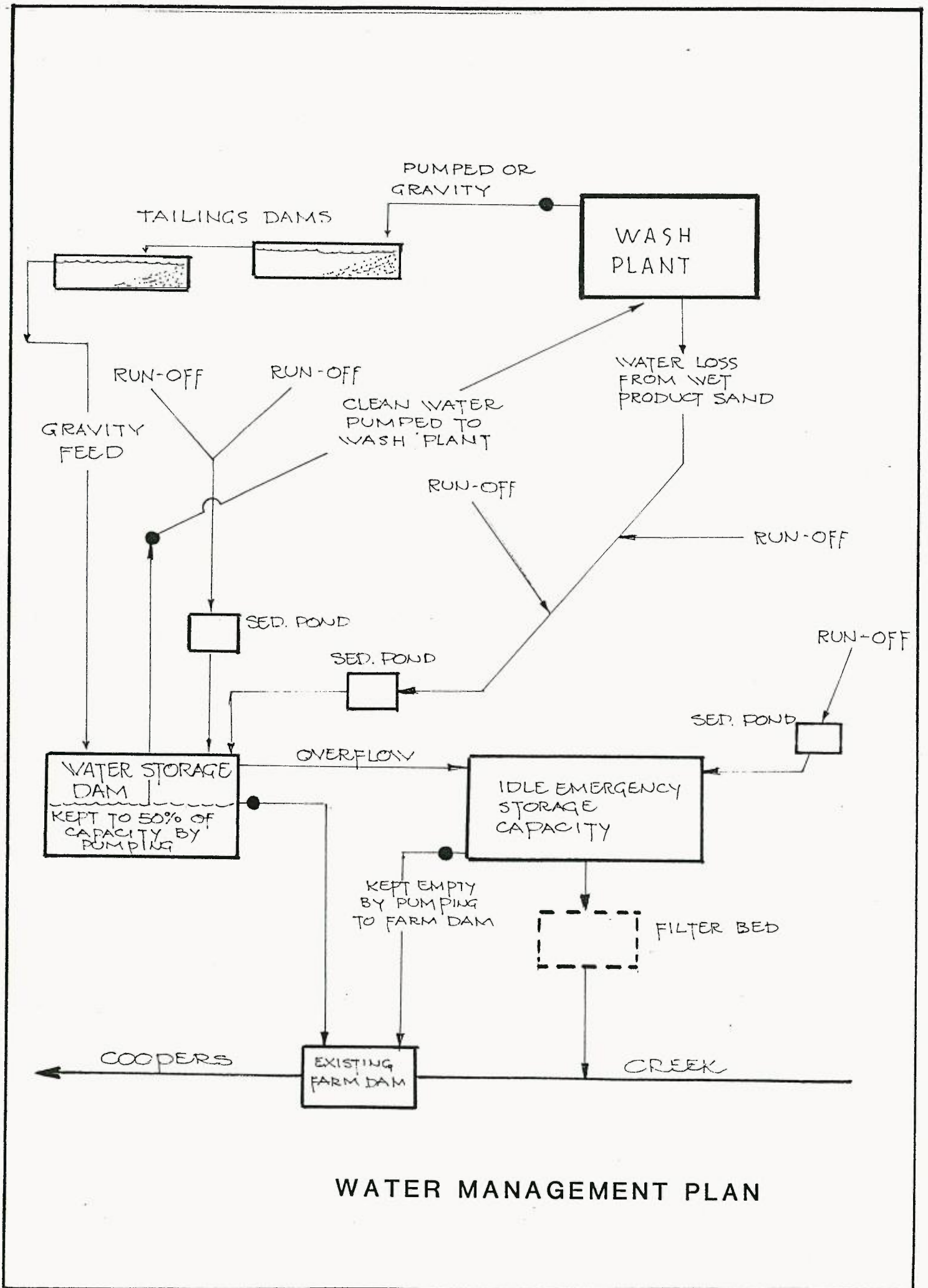


FIGURE 14.5

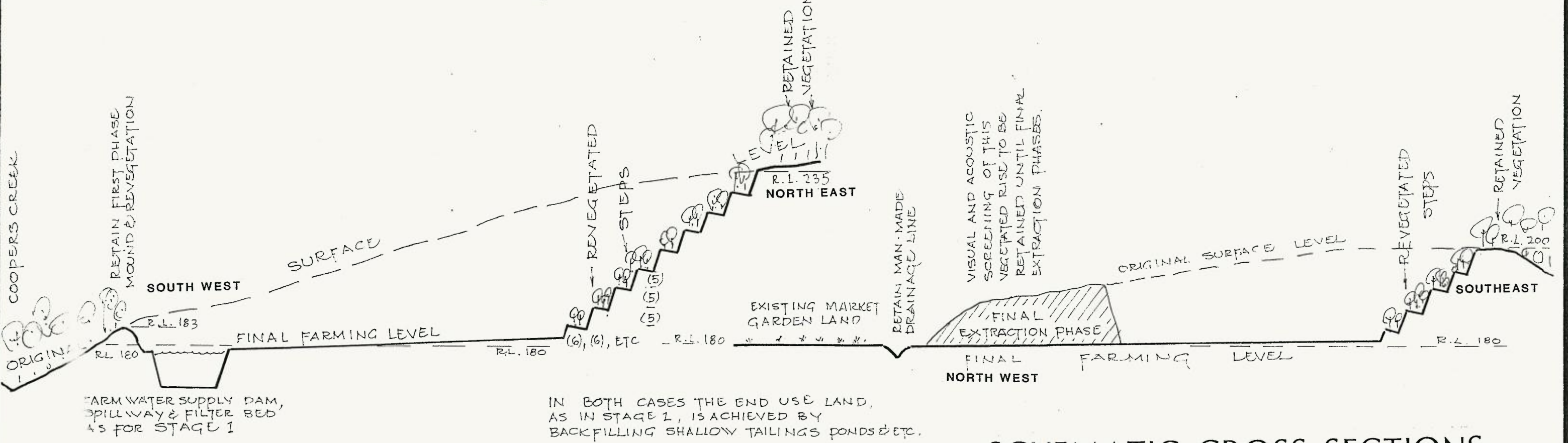
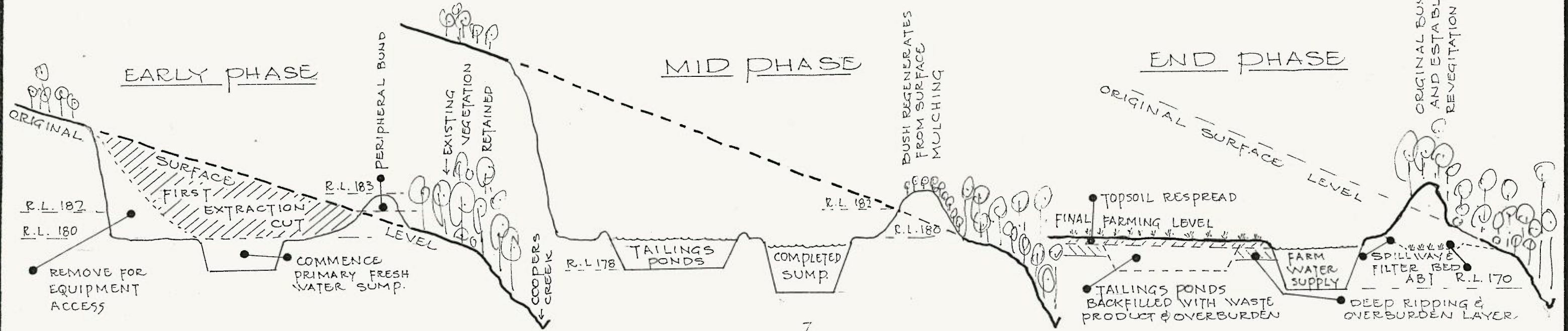




WATER MANAGEMENT PLAN

FIGURE 15

STAGE 1



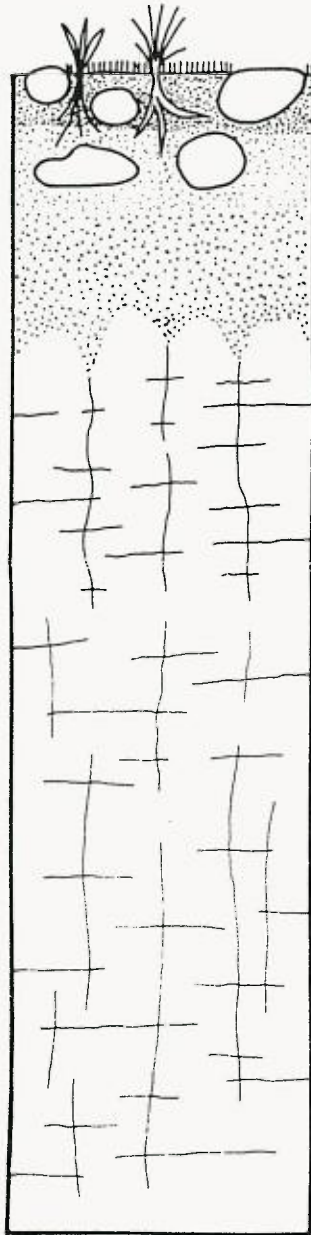
STAGE 2

SCHEMATIC CROSS SECTIONS

(Not to any scale)

FIGURE 16

TYPICAL NATURAL SOIL PROFILE ON SITE

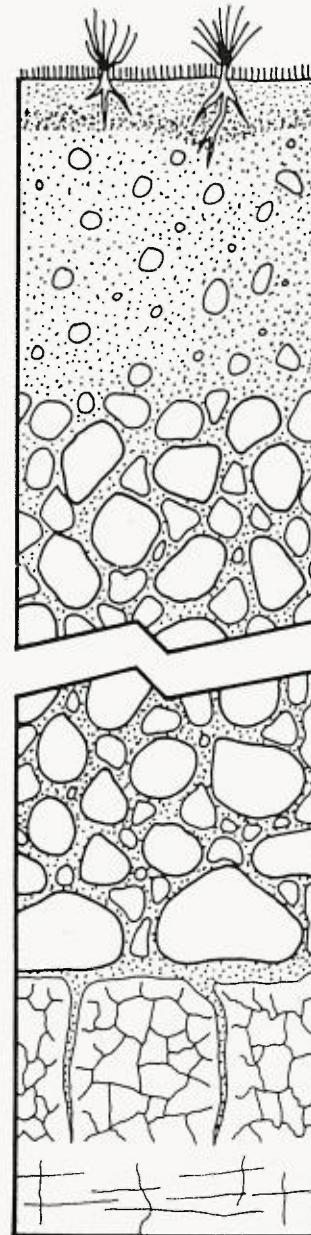


0 - 300 mm. 'A HORIZON'
SANDY DISCONTINUOUS
TOPSOIL, NUMEROUS
STONES, WEAK STRUCTURE.

'B HORIZON'
VARIABLE DEPTH UP TO 1 m.
STRONGLY WEATHERED,
IRON STAINED CLAYEY
SANDSTONE. WATER TABLE
OFTEN PERCHED ON OR
IN THIS UNIT.

1.3 m. - WEATHERED HAWKESBURY
SANDSTONE
(Eluvial Sand).

TYPICAL REHABILITATED SOIL PROFILE



0 - 100 mm. REPLACED ORIGINAL TOPSOIL,
EVENLY SPREAD, FERTILISED
AND MULCHED.

100 mm. - 500 mm.
SANDY OVERBURDEN AND FINE
MINING REJECTS COMPACTED
AND CONTOUR RIPPED

500 mm. - COARSE MINING REJECTS
(bouldes) TO PROVIDE
FREE - DRAINING SUBSOIL.

RIPPED HAWKESBURY
SANDSTONE.

UNDISTURBED HAWKESBURY
SANDSTONE.

Figure 17 : SOIL PROFILES

APPENDICES

LIST OF APPENDICES

- APPENDIX A - Consultations with Authorities
- APPENDIX B - Drilling Report
- APPENDIX C - Hydrogeological Study
- APPENDIX D - Acoustic Study
- APPENDIX E - Vegetation Study and Fauna Impact Statement
- APPENDIX F - Archaeological Study
- APPENDIX G - Trail Maintenance Guidelines
- APPENDIX H - Submission to Director of Department of Planning re
Modification of Plan of Management
- APPENDIX I - Department of water Resources. Need for
Groundwater Model
- APPENDIX J - Proponent Company's Letter relating to refuelling
techniques
- APPENDIX K - Department of Water Resources Letter relating to
depth of extraction.

APPENDIX "A" - Consultations with Authorities



Department of Planning

Mr C Dongés
Collin C Dongés & Associates Pty Ltd
PO Box 244
DURAL NSW 2158

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

Telephone : (02) 391 2000 Ext: 2071

Fax No. : (02) 391 2111

Contact : J Croft

Our Reference : S90/03458/001

Your Reference :

Dear Sir,

**Re: Proposed extractive industry, Lot 3, D.P. 567166 Part Portion 66
Parish of Frederick, Hornsby Shire**

Thank you for your letter of 25 January, 1994 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 Hornsby 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:

- . a brief description of current operations indicating the relationship of the existing operation with the proposed extractive operations. A review of the environmental performance of the existing extraction operations should also be included;
- . the areas where extraction is to occur and the staging of extraction activities;
- . the quantities and destinations of extracted material;
- . a description of extraction methods;
- . extent of vegetation removal, significance of this vegetation and resulting impacts such as habitat loss, increased soil erodibility and visual impacts;

- . access routes (including local haul road) and traffic impacts, such as the type and frequency of traffic. Any road construction or upgrading should be identified;
- . impacts of noise and dust (from both the operation's procedures and haulage) and mitigation measures;
- . the location and size of any overburden stockpile;
- . water requirements, use and disposal. Potential impacts on groundwater and the water quality of the Hawkesbury-Nepean catchment and measures to mitigate impact;
- . potential for increased runoff. Runoff control measures to be described;
- . erosion/sedimentation control measures;
- . visual impacts and the need for screening;
- . the compatibility of the operation with the surrounding landuses particularly in regard to nearby residences, Marramarra National Park and its users and agricultural uses. The relationship of the proposed operation to existing extraction operations in the area should be considered;
- . rehabilitation plans for areas where extraction is completed;
- . consideration of:- SREP No. 9 (including the plan of management for the Maroota area) and the draft amendment;
- . results of consultation with:-
 - the Environment Protection Authority;
 - Department of Conservation and Land Management;
 - National Parks and Wildlife Service
 - NSW Agriculture
 - Department of Mineral Resources
 - Water Board
 - Roads and Traffic Authority
 - Baulkham Hills Council

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 the Hornsby 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 11/3/94

B Adams
 Manager
 Assessments and Major Hazards Branch
 As Delegate for the Director

DEPARTMENT OF PLANNING
ATTACHMENT NO. 1

STATUTORY REQUIREMENTS FOR ENVIRONMENTAL IMPACT STATEMENTS

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

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

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

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

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

DEPARTMENT OF PLANNING
ATTACHMENT NO 2

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

A definition of extractive industry may be found in paragraph (n) to Schedule 3 of the Environmental Planning and Assessment Regulation, 1980, (as amended). Extractive industries may take the form of dredging operations, quarrying operations, turf farms or various forms of land excavation etc. Processing of extracted material on the same site as the winning of the material may also constitute an extractive industry.

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

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

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

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

1. Description of the proposal.

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

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

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

Particular details that may be relevant include:

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

2. Description of the Environment.

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

3. Analysis of Environmental Impacts.

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

- . The flow of any affected rivers or watercourses.
- . The effect of the extraction on the sediment transport rate of any affected rivers or watercourses.
- . The bed and bank stability of any affected rivers during and after completion of the operations and any need for recurrent maintenance dredging.
- . Any possible siltation, sedimentation or downstream effects of the operation.
- . Any likely cumulative effects of the proposed operation when considered together with other operations in the vicinity.
- . Details of floods and any likely effects of the operation on flood liability of surrounding lands.
- . The possible effects of flooding on the operation.
- . Effects on flora and fauna.
- . The agricultural viability of the landholding.
- . Likely noise/vibration disturbance caused by the operations, including transport operations, on nearby residences.
- . Other impacts of trucking movements, including access over railways and onto highways.
- . Dust nuisance likely to be caused.
- . Effects on water quality of nearby watercourses.
- . Disposal of waste material.
- . Effects on the visual environment.

- . Any likely affectation of sites of Aboriginal archaeological or European heritage value if located in the vicinity of operations.
- . Impact of the operations on navigation aspects for all types of shipping (commercial, recreational, etc).

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

4. Contact with relevant Government Authorities.

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

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

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

THE COUNCIL OF HORNSBY

296 Pacific Highway, Hornsby
Postal Address: Box No. 37, P.O. Hornsby 2077
DX 9655 HORNSBY Fax: 847 6999

PERSONAL PAYMENTS AND ENQUIRIES
8.30 A.M. to 4.30 P.M.
MONDAYS TO FRIDAYS

PLEASE ADDRESS ALL COMMUNICATIONS
TO THE GENERAL MANAGER

TELEPHONE: 847 6666
8.30 A.M. to 4.30 P.M.
MONDAYS TO FRIDAYS

Collin C Donges & Associates Pty Limited
PO Box 244
DURAL NSW 2158

ATTENTION: MR C DONGES

Dear Sir

**PROPOSED EXTRACTIVE INDUSTRY, LOT 3, D.P. 567166, MAROOTA, PART PORTION
66, PARISH OF FREDERICK**

I refer to your letter of 25 January, 1994 seeking consultation with Council with respect to details to be addressed in the preparation of an Environmental Impact Statement for the above development. I regret for the delay in replying.

Council requires the following matters be addressed in the Environmental Impact Statement:

- details of existing operation;
- relationship of existing operation with proposed extractive operations;
- area of extraction and staging of extraction activities;
- details of extraction methods;
- the quantities of material already extracted and to be extracted;
- vegetation study - extent of vegetation removal, habitat loss, rare or endangered species;
- fauna study - rare and endangered fauna (F.I.A.);
- noise impact assessment and mitigation measures;
- visual impact and mitigation measures;
- details of erosion and sedimentation control measures/runoff control measures (progressive rehabilitation plan);
- details involving the rehabilitation of the site where extraction has taken place;
- impact of dust and mitigation measures
- access and transport routes and traffic impacts
- type and frequency of traffic (traffic assessment report)
- address proposed depth of extraction and likely impacts on groundwater
- water management plan detailing water requirements, collection, use and disposal
- expected life of the operation
- archeological study

Please note Council's Development Branch fax. number is 847 6996.
(REDMOND-H:WWW21.APR)

THE COUNCIL OF HORNSBY

296 Pacific Highway, Hornsby
Postal Address: Box No. 37, P.O. Hornsby 2077
DX 9655 HORNSBY Fax: 847 6999

PERSONAL PAYMENTS AND ENQUIRIES
8.30 A.M. to 4.30 P.M.
MONDAYS TO FRIDAYS

PLEASE ADDRESS ALL COMMUNICATIONS
TO THE GENERAL MANAGER

TELEPHONE: 847 6666
8.30 A.M. to 4.30 P.M.
MONDAYS TO FRIDAYS

Collin C Donges & Associates Pty Limited

Page 2

- hours of operation, number of employees
- compatibility of the operation with the adjoining and surrounding land uses
- consideration of S.R.E.P. No. 9 and the draft amendment and the plan of management for Maroota area
- relationship of proposal with internal haul road system/transport
- justification for the proposal in terms of market demand and environmental, economic and social considerations
- consideration of proposed end land uses
- details of rate of daily extraction and maximum number of truck movements per day (quantities and destinations of extractive material)
- equipment and machinery to be used
- cumulative effect of the proposal when considered together with other operations in the area
- heads of consideration under S.R.E.P. No. 20 - Hawkesbury and Nepean River
- heads of consideration under S.E.P.P. No. 19 - Bushland in Urban Areas
- draft D.C.P. No. 20

In addition to the above you should consult with the following authorities to ascertain their comments/requirements:

- Roads and Traffic Authority
- Water Board
- National Parks and Wildlife Service
- Environmental Protection Authority
- Department of Conservation and Land Management
- Department of Mineral Resources
- N.S.W. Agriculture
- Department of Water Resources
- Hawkesbury Nepean Catchment Management Trust

In preparing the E.I.S. the matters identified by the Director of the Department of Planning by letter 11 March, 1994 are to be addressed together with guidelines and requirements outlined

THE COUNCIL OF HORNSBY

296 Pacific Highway, Hornsby
Postal Address: Box No. 37, P.O. Hornsby 2077
DX 9655 HORNSBY Fax: 847 6999

PERSONAL PAYMENTS AND ENQUIRIES
8.30 A.M. to 4.30 P.M.
MONDAYS TO FRIDAYS

PLEASE ADDRESS ALL COMMUNICATIONS
TO THE GENERAL MANAGER

TELEPHONE: 847 6666
8.30 A.M. to 4.30 P.M.
MONDAYS TO FRIDAYS

Collin C Donges & Associates Pty Limited

Page 3

in the Department of Planning Attachment No. 1 and No. 2 (advice on the preparation of an E.I.S. for an Extractive Industry).

The issues raised above are a guide and may not be exhaustive. I trust this information is of assistance to you. Should you require any further information regarding this matter please contact Mr P Bezzina on 847 6724 between 8.30am and 10.00am Monday to Friday.

Yours faithfully


P BEZZINA
Town Planner
Development Division

28 April, 1994

Council ref: PP 018634
Enquiries: Mr P Bezzina (847 6724) (8.30am to 10.00am)

PB:JC

HAWKESBURY-NEPEAN CATCHMENT MANAGEMENT TRUST

68 Mileham Street, Windsor
Postal Address: PO Box 556, Windsor 2756

B718/3/11

Please address all communications
to the Chief Executive Officer

Telephone: (045) 77-4243
Facsimile: (045) 77-4236

Your Ref: BE718/3/11

11 February 1994

Collin Donges
Collin Donges & Associates
PO Box 244
DURAL NSW 2158

Dear Collin,

PROPOSED EIS - EXTRACTIVE INDUSTRY
LOT 3 DP567166 MAROOTA, HORNSBY COUNCIL.

Thank you for your request for the Trust's comments on what the EIS should address for the above proposal. As an overall comment, the Trust will be principally concerned with the impact of the proposal on the catchment and water of Coopers/Dalgetys Creek and the Hawkesbury River. Consequently the EIS should address the impact issues.

The specific issues that the Trust considers the EIS should address are:-

1. A description of the existing development of the site and the nature of the current permits (from the council and government agencies);
2. The consistency of the proposal with the Plan of Management for Extractive Resources at Maroota (1991) and where inconsistent, explain why.
3. Consistency of the proposal with the principles of ecologically sustainable development. (The Trust notes that the Australian Council of Governments are committed to these principles via their signatory of the Intergovernmental Agreement on the Environment and their endorsement of the National Strategy for Ecologically Sustainable Development).
4. The cumulative impact of the proposal upon the Hawkesbury River.

mh1102a

5. A brief description of the current Environmental Management Plan for the site and how this is expected to change, should the proposal be approved. The Trust would expect that such a plan would address:
 - water cycle management (groundwater protection, waste waters, polluted runoff and drainage);
 - on-site materials management including soils management;
 - day to day operating procedures;
 - environmental monitoring;
 - emergency/contingency plans;
 - site rehabilitation details;
 - aftercare and final land use options.
6. Whilst the Trust would expect the Environmental Management Plan would provide specific details of the issues listed in (5.) above, the EIS should nevertheless address these issues.
7. How it is proposed to prevent an adverse impact upon the adjoining Marramarra National Park and the Environment Protection Zones on the subject site.
8. The justification for removing bushland when a substantial amount of bushland has already been cleared in the locality and given that extractive resources are present on these lands.
9. Visual aspects particularly when viewed from the Old Northern Road and from the National Park.

In addition to the above matters, the EIS should also address the provisions of Sydney Regional Environmental Plan No.20 Hawkesbury Nepean River and in particular, the consistency of the proposal with the Plan's aims and objectives and criteria.

If you wish to discuss any matter raised in this letter, please do not hesitate to contact Rosalind Batten or Malcolm Hughes on (045) 77 4243.

Your sincerely



Robert B Crawford
CHAIRMAN
HAWKESBURY-NEPEAN CATCHMENT MANAGEMENT TRUST

mh1102a

DEPARTMENT OF MINERAL RESOURCES

NEW SOUTH WALES GOVERNMENT

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

Collin C. Donges & Associates P/L
PO Box 244
DURAL NSW 2158

Our Ref: L87/0173
Your Ref: B718/3/9

Dear Sir,

PROPOSED EXTRACTIVE INDUSTRY, LOT 3, DP 567166, PART PORTION 66, PARISH OF
FREDERICK - AT MAROOTA, HORNSBY SHIRE

I refer to your letter of 25th January, 1994 seeking this Department's requirements for an environmental impact statement (EIS) to be prepared for the abovementioned proposal.

Sand is not a mineral under the Mining Act, 1992. Therefore, the Department of Mineral Resources has no statutory authority over the extraction of this commodity, apart from its role under the Mines Inspection Act, 1901 (as amended) with respect to safe operation of mines and quarries. Notwithstanding the above, this Department is the principal government authority responsible for assessing the State's resources of construction materials and for advising State and local government on their planning and management.

The resources which are the subject of this proposal are identified in Sydney Regional Environmental Plan No. 9 - (Extractive Industry) as part of the regionally significant Maroota sand deposit.

The operator must observe all relevant requirements of the Mines Inspection Act, 1901 (as amended). Advice on these requirements should be sought from Mr Peter Diamantes, Regional Inspector of Mines - telephone (02) 901 8455.

With regard to the requirements of the Department of Mineral Resources for geological and resource information which should be incorporated in environmental impact statements, the following are considered essential:

1. The amount of material available for extraction and the method or methods used to determine this amount (e.g. drilling, trenching, geophysical methods). Plans and cross-sections summarising this data, at a standard scale, showing location of drillholes etc. and the area proposed for extraction, should be included in the EIS. Relevant supporting documentation such as drill logs should be appended.
2. Characteristics of the material to be produced. For sand extraction proposals, grainsize, grading, clay content and contaminants should be indicated. Details of tests carried out to determine the characteristics of the material should be appended.
3. An assessment of the quality of the material based on the testing, and of the suitability of the material for the anticipated range of applications should be given.

4. Anticipated annual production, staging (if any), and life of the operation. Relationship of this proposal to previous operations in its vicinity.
5. Alternative sources to the proposal and their availability.
6. Justification for the proposal in terms of local and, if appropriate, regional context.

The Department's Statistical Section compiles production data for all mining operations in the State. It would be appreciated if you could contact the Statistical Officer on (02) 901 8436 in order that production from the proposed operation, if approved, can be recorded.

Regarding the area referred to in your letter to the Department of Planning (ref: B718/3/1), it was not included in the draft Sydney Regional Environmental Plan No. 9(2) (*REP 9(2)*) because no data was available on character of the sandstone in that area. Any submission to the Department of Planning seeking inclusion of this area in *REP 9(2)* should include data on the characteristics of the friable sandstone (such as depth and extent of weathering, grainsize, grading, and clay content) and the size of the resource.

If you have any queries on this matter please contact Mr Greg MacRae of the Geological Survey on (02) 901 8369.

Yours faithfully,



I.B.L. Paterson
for Director-General

11-2-94

Rehabilitation

Extractive industries inevitably create significant changes in the landscape. The EIS should describe the anticipated landscape and land use following mining, rehabilitation and revegetation. A likely schedule of progressive rehabilitation to be carried out on the site should also be presented in the EIS.

Should you have any enquiries regarding this matter please contact Shane Barter on 325 5638.

Yours sincerely,



WARREN HICKS
Regional Manager - Outer Sydney
for Director-General

EPA



Environment
Protection
Authority
New South Wales

Mr C. Donges
P.O. Box 244
DURAL NSW 2158

PO Box 1135 Chatswood NSW 2057
Tel .02. 795 5000 Fax .02. 325 5678

Our Reference: File No. 300029 B1 : Mr Shane Barter

Your Reference: B718/3/5

10.MAR1994

Dear Mr Donges,

Proposed Extractive Industry
Lot 3 DP 567166 Part Portion 66 - Parish of Frederick, Maroota

I refer to your letter dated 25 January 1994 regarding the above proposed extraction activity at Maroota.

The Environmental Impact Statement (EIS) to be prepared for this development should address, but not be limited to, the following matter.

Air Quality

Consideration should be given to the generation of dust during both the winning of material and the movement of vehicles associated with the extraction activity. The EIS should provide a description of measures proposed to control the generation of dust which may impact sensitive adjacent land uses.

Water Pollution

The potential for pollution of waters by sediment laden process water and stormwater should be described in the EIS. Detailed information must be provided with respect to proposed measures to control or divert stormwater flows, including the design storm events and methods of construction of all erosion and sediment control structures.

Noise

The EIS should include a Noise Impact Statement (NIS) which provides a detailed description and assessment of the impact of the proposed development upon noise levels in the vicinity of the sand extraction area(s). Noise intensity from the site may be reduced by careful choice and maintenance of equipment and the siting and screening of plant. The proposed times of sand extraction and heavy vehicle operation in the area of the proposed sand extraction should be clearly identified.



Collin C. Dongés & Associates Pty Limited
PO Box 244
DURAL NSW 2158

Telex: 121188
Facsimile: (02) 895 7281
Telephone: (02) 895 6211
Ext: 7441
Contact Name: John Ross
Our Reference: 1845489
Your Ref: B718/3/3
[AKW4432#]
15.2.94

Attention: Mr Collin Dongés

Collin
Dear Sir,

Re: EIS - Extraction - Lot 3, DP567166, Part Por 66, Ph Frederick, Maroota.

Thank you for your letter of 25 January 1994 requesting further information/comment to assist in the preparation of the above EIS.

Enclosed for your information and retention are the following Departmental documents:

- a) "Amendments to the NSW Rivers and Foreshores Improvement Act";
- b) "The 7-Step Method of controlling Bank Erosion and Sediment Build-up";
- c) "The Importance of the Riparian Zone in Water Resource Management - A Literature Review";
- d) "NSW State Rivers and Estuaries Policy";
- e) "Minimum Standards for Works in Rivers and Lakes"; and
- f) "General Requirements for Environmental Impact Statements". (This is essentially a checklist of water resources matters to be addressed in the assessment of environmental impacts).

The Department would appreciate being sent a draft copy of the subject document for review. It would be worth noting that if multiple copies of the draft document can be made available (even on a loan basis) this helps significantly to expedite the review process.

I trust the above and enclosed information will prove useful.

Yours sincerely,

John A. Ross

John A. Ross
for J.F. Clarke, Regional Director
Sydney-South Coast

Encl.

Our Reference:

201.5395
Mr Moon
831 0965

KM:amc

B718/3/7

Roads and Traffic
Authority
Sydney Region



Collin C. Dongés & Associates
PO Box 244
DURAL NSW 2158

14 FEB 1994

83 Rushcombe Road
Blacktown
New South Wales 2148
Telephone (02) 831 0911
Facsimile (02) 831 0926
PO Box 558
Blacktown NSW 2148
DX 8120

Proposed Extracting Industry Lot 3 DP 567166.
Part Portion 66 Parish of Frederick at Maroota.

Dear Sir,

I refer to your letter of 25 January 1994 and confirm that the Authority would generally like to see an Environmental Impact Statement give consideration to:

- i. Traffic demands and how that demand is to be accommodated on the existing Regional road network. Information on traffic movements per week, including tonnage, would assist in assessing the impact, if any, of the development on the major road network, and what steps in terms of traffic management measures are required;
- ii Where traffic generation is high and involving heavy vehicles, consideration could be given to the issue of road maintenance. Following a number of Appeals, including Collin C. Donges - v - Baulkham Hills Shire Council (unreported 4 May 1989) the Authority is pursuing the indexed levy rate of three cents per payload tonne kilometre applied to major heavy truck movements where appropriate; and
- iii Where intersection layout in the vicinity of the site is poor, what improvements are required in terms of traffic and safety to accommodate turning movements, street signs, parking restrictions, street lighting, pavement condition, etc and the cumulative effect of the proposal with other development in the area.

I trust the above information assists.

Yours faithfully

C Ford
C Ford
Network & Road Safety Manager
Sydney Region

A handwritten signature in dark ink, appearing to be 'C Ford', written over the typed name.

DRINK DRIVE
You'll be sorry



WATER BOARD

SYDNEY – ILLAWARRA – BLUE MOUNTAINS

3/12

Postal Address:
PO Box 756
CHATSWOOD NSW 2057

Eric Lindberg
Tel : 9520540

4 March 1994

COLLIN C. DONGES & ASSOCIATES PTY. LIMITED
939 Old Northern Road
PO Box 244
DURAL NSW 2158

Dear Sir

Re : Proposed extractive industry. Lot 3 DP 567166. Part Portion 66 Parish of
Fredrick – at Maroota, Hornsby Shire.

Thank you for bringing the above mentioned application to our attention.

The Water Board does not currently service the Maroota area and the proposal will
therefore have no impact on the Boards services.

All water quality issues should be refered to the Environment Protection Agency
(EPA).

Yours faithfully,


for SYSTEMS PLANNING MANAGER

24 February 1994

Messrs Collin C Dongés and Associates Pty Ltd
PO Box 244
DURAL NSW 2158

Dear Sir

**PROPOSED EXTRACTIVE INDUSTRY, LOT 3 DP 567166 PART PORTION
66 PARISH OF FREDERICK - MAROOTA, HORNSBY SHIRE**

In addition to our previous letter of 4 February 1994 a search of the above property has revealed that no Prospect Electricity assets will be affected.

Yours faithfully



P Roche
Engineering Officer
NETWORK PLANNING BRANCH

In reply quote: 91/04692 PR:TJ Your contact: Paul Roche Ext: 2768

10 Smith Street Parramatta NSW 2150 ☎ 131 003 Fax: 02 635 2511
Postal Addresses: PO Box 389 Parramatta NSW 2124 or DX 28443 Parramatta

4 February 1994

Messrs Collin C Dongés and Associates Pty Ltd
PO Box 244
DURAL NSW 2158

Dear Sir

**PROPOSED EXTRACTIVE INDUSTRY, LOT 3 DP 567166 PART PORTION
66 PARISH OF FREDERICK - MAROOKA, HORNSBY SHIRE**

Your letter of 25 January 1994 (ref B718/3/6) regarding the above matter is being processed and a reply will be given in due course.

Yours faithfully



P Roche
Engineering Officer
NETWORK PLANNING BRANCH

In reply quote: 91/04692 PR:TJ Your contact: Paul Roche Ext: 2768

10 Smith Street Parramatta NSW 2150 ☎ 131 003 Fax: 02 635 2511
Postal Addresses: PO Box 389 Parramatta NSW 2124 or DX 28443 Parramatta

APPENDIX "B" - Drilling Report

REPORT

TO : P.F. FORMATION PTY LTD
RE: SAND MINING INVESTIGATION
AT: LOT 3 DP 567166
MAROOTA

REGIONAL GTS PTY. LTD.
Geotechnical & Testing Services
Consulting Engineers

REGIONAL GTS PTY. LTD.
88 Magowar Road, GIRRAWEE N.S.W. 2145
Telephone: (02) 8961555, (02) 636 7377
Facsimile: (02) 631 8716

REGIONAL GTS PTY. LTD. (INC. IN N.S.W.) A.C.N. 001 671 307

Geotechnical & Testing Services

Consulting Engineers

(NATA Registration No. 541)

PO Box 15, Pendle Hill 2145

88 MAGOWAR ROAD

GIRRAWEE NSW 2145

Telephone: (02) 636 7377

Facsimile: (02) 631 8716

Principals

G.D. KEIGHRAN B.E.

P. WEIR Laboratory Manager

Date: 30th June, 1994

Your Ref:

Our Ref: 94150/GK/1

REPORT

TO : P.F. FORMATION PTY LTD
RE : SAND MINING DRILLING
AT : LOT 3 DP 567166
MAROOTA

SUMMARY

At the request of Mr J. Graham of P. F. Formation Pty Ltd, Regional GTS Pty. Ltd. have carried out a series of boreholes at selected locations to identify the potential sand deposits with in Lot 3 DP 567166 at Maroota.

The locations of the boreholes were selected by P.F. Formation Pty Ltd and drilling of the boreholes was carried out by Engineering Exploration Pty Ltd under the supervision of a member of of engineering staff.

This report details the method of investigation and presents the results of the drilling in terms of engineering borehole logs. The approximate Reduced Level (RL) of each borehole has been determined using survey techniques which are related to a known RL of 190 m AHD from a plan provided by Colin Donges & Associates Pty Ltd.

Yours faithfully,

REGIONAL GTS PTY. LTD.

per:



G.D. KEIGHRAN
Principal Engineer

TABLE OF CONTENTS

1. INTRODUCTION
2. FIELD INVESTIGATION
3. SITE GEOLOGY AND SUBSURFACE CONDITIONS
4. GENERAL

DRAWINGS

94150/1A SITE PLAN AND BOREHOLE LOCATIONS

APPENDICES

- A. ENGINEERING LOGS
- B. METHOD OF SOIL CLASSIFICATION
- C. ENGINEERING CLASSIFICATION OF SEDIMENTARY ROCKS IN THE SYDNEY AREA
- D. IMPORTANT INFORMATION ABOUT THIS SITE INVESTIGATION REPORT

REGIONAL GTS PTY LTD

1. INTRODUCTION

At the request of Mr J. Graham of P. F. Formation Pty Ltd, Regional GTS Pty. Ltd. have carried out a series of boreholes at selected locations to identify the potential sand deposits with in Lot 3 DP 567166 at Maroota.

The locations of the boreholes were selected by P.F. Formation Pty Ltd and drilling of the boreholes was carried out by Engineering Exploration Pty Ltd under the supervision of a member of of engineering staff.

This report details the method of investigation and presents the results of the drilling in terms of engineering borehole logs. The approximate Reduced Level (RL) of each borehole has been determined using survey techniques which are related to a known RL of 190 m AHD from a plan provided by Colin Donges & Associates Pty Ltd.

2. FIELD INVESTIGATION

The fieldwork was carried out in several stages using drilling rigs supplied by Engineering Exploration Pty Ltd :-

On 18th May, 1994 using a Gemco 210B drilling rig with spiral flight augers

The first attempt at drilling using the sprial flight augers and Tungsten Carbide (TC)-Bit refusal on weathered sandstone being obtained at in boreholes as detailed below in table No. 1

Table No. 1 Drilling Details 18th May 1994

<u>Borehole</u>	<u>Depth to TC-bit Refusal</u>
BH 1	5.0 m
BH 2	1.5 m
BH 3	2.0 m

On 31st May 1994 and 1st June 1994 using a Edson 2000 drilling rig with HQIVRC gear.

The change in drilling rig was bought about by the lack of penetration of the sprial flight augers into the weathered sandstone bedrock. The rig was upgraded to an Edson 2000 with HQ Induced Vacuum Reverse Circulation gear which achieved the depths required by P.F. Formation Pty Ltd.

On the 31st May, two (2) boreholes (BH 1 and BH 2) were completed and the third (BH 3) borehole was partially completed. The third (BH 3) and fourth BH 4) boreholes were completed on the 1st June 1994. The maximum depths to which the HQIVRC drilling obtained in each borehole is detailed in Table No. 2 below:-

Table No. 2 Drilling Details 31st May and 1st June 1994

<u>Borehole</u>	<u>Maximum Depth</u>	<u>Surface RL</u>	<u>Depth to Water Table</u>
BH 1	12.0 m	182.5 m	Not Encountered
BH 2	13.5 m	184 m	12.0 m
BH 3	21.0 m	190 m	11.0 m
BH 4	12.5 m	199.5 m	Not Encountered

The detailed Engineering Logs of the soil / rock profile are provided in Appendix A with the method of soil classification adopted is presented in Appendix B and an Engineering Classification of Sedimentary Rocks in the Sydney Area being provided in Appendix C.

3. SITE GEOLOGY AND SUBSURFACE CONDITIONS

The site is shown on the Sydney 1:250,000 Geological Sheet as being underlain by Hawkesbury Sandstone masked by the Tertiary Alluvium consisting mainly sand and silty sand soils.

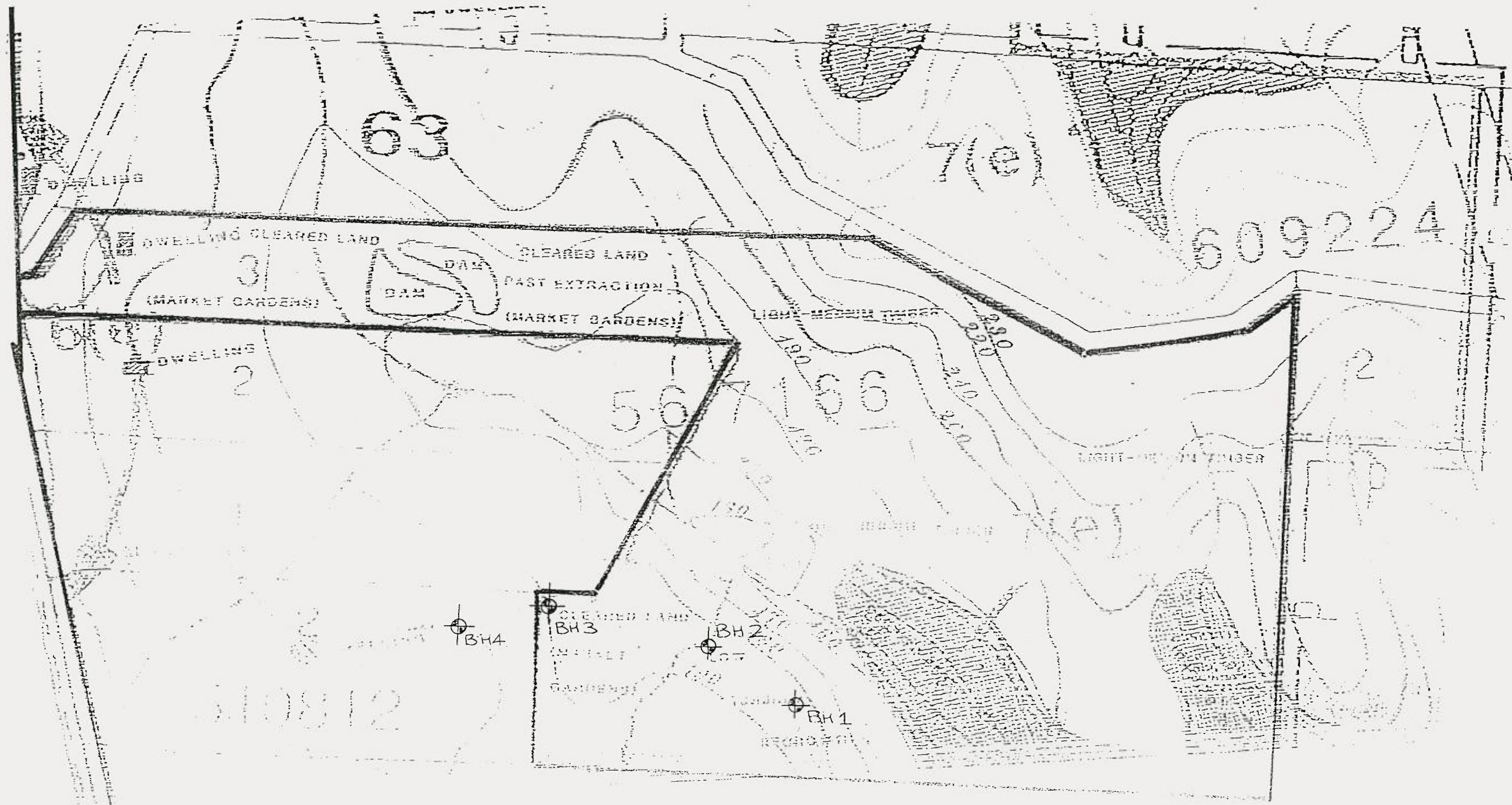
The soil and rock profiles encountered during the investigation confirm the presence of the Hawkesbury Sandstone bedrock reasonably close to the surface. The initial drilling work using spiral flight augers indicated that TC bit refusal was encountered at depths varying from 1.5 to 5.0 metres.

The HQIVRC drilling rig obtained much greater depths than the spiral flight augers ranging from 12.0 to 21 metres below the surface.

The subsurface conditions are fully detailed for each borehole in the Engineering Log provided in Appendix A.

4. GENERAL

The boreholes provided have been carried out for the preliminary investigation of the subject lot with selection of the location of the boreholes made by the client. Prior to beginning excavation of the property, we would recommend that further more detailed and closer spaced subsurface investigation is carried out.



REGIONAL GTS PTY LTD 88 Magowar Road GIRRAWEEEN, 2145 Ph: (02) 896 1555 Fax: (02) 631 8716	Drawn		Scale Plan Long V Section H Cross V Section H	P. F. FORMATION PTY LTD SAND MINING INVESTIGATION LOT 3 DP 567166 MARCOOTA	BOREHOLE LOCATIONS	Drawing No. 94150/1A
	Checked					
	Approved					
Sheet of						

REGIONAL GTS Pty. Ltd.

A.C.N. 001 671 307

BOREHOLE - ENGINEERING LOG

Ph: (02) 896 1555

Ph: (02) 636 7377

Fax: (02) 631 8716

BH 1

Sheet 1 of 3

Client: P.F. FORMATION PTY. LTD.						Appendix: A								
Project: SAND MINING INVESTIGATION - LOT 3 DP567 166 MAROOTA						Your Reference:								
Bore Location: REFER TO SITE PLAN DRAWING No. 94150/1A						Our Reference: 94150 /GK								
Date Drilled: 31st May 1994						File Name: 94150BH1.xls								
Hole Commenced						Supervised by: A.R.								
Hole Completed						Checked by: G.K.								
Slope Deg:			Surface RL: 182.5 m			Drill Model: Edson 2000			Hole Diameter: 100 mm					
Bearing Deg:			Datum: RL 190 AHD at Property Boundary B											
Drilling Information				Sampling Data				Profile Description						
method	support	water	R.L.	Depth metres S.L.	type	sample loss	blows per 300 mm	graphic log	Material Description	Strength	Moisture	hand penetrometer kPa	structure and additional observations	
										Fb VS S F St MD VSt D VD	Dry Moist Wet	100 200 300 400 500		
			182.0	0.5					TOPSOIL: sandy loam yellow orange					
			181.5	1.0					RESIDUAL: Sand, fine to medium grained yellow orange					
			181.0	1.5					RESIDUAL: Sand, fine to medium grained yellow orange					
			180.5	2.0					SANDSTONE: fine grained, weak white and purple					
			180.0	2.5										
			179.5	3.0										
			179.0	3.5					SANDSTONE: Medium Grained, weak Off white with ironstaining					
			178.5	4.0										
			178.0	4.5					SANDSTONE: medium grained, weak purple and white					
			177.5	5.0										
key method			water			Sampling Data			Strength Descriptions			Support		
V	Auger with V-Bit		Date of Water Level			UD 50 Undisturbed Sample 50 mm diameter			Cohesive Non Cohesive			C Casing		
TC	Auger with TC- Bit		Static Water			O Disturbed Sample			VS very soft Fb friable			M Mud		
R	Roller / Tricon		Water Inflow			SPT Standard Penetration Test			S soft VL very loose					
W	Washbore		Partial Water			Nc Cone Penetrometer			F firm L loose					
M	Mud Drilling		Drilling water loss						St stiff MD medium dense					
A	Air Reverse Circulation							VSt very stiff D dense						
									H hard VD very dense					

Client: P.F. FORMATION PTY. LTD.				Appendix: A									
Project: SAND MINING INVESTIGATION - LOT 3 DP567166 MAROOTA				Your Reference:									
Bore Location: REFER TO SITE PLAN DRAWING No. 94150/1A				Our Reference: 94150 /GK									
Date Drilled: 31st May 1994				File Name: 94150BH1.xls									
Hole Commenced				Supervised by: A.R.									
Hole Completed				Checked by: G.K.									
Slope Deg:		Surface RL:		Drill Model: Edson 2000									
Bearing Deg:		Datum: RL 190 A.H.D. at Property Boundary		Hole Diameter: 100 mm									
Drilling Information			Sampling Data			Profile Description:							
method	support	water	R.L.	Depth metres S.L.	type	sample loss	blows per 300 mm	graphic log	Material Description	Strength	Moisture	hand penetrometer kPa	structure and additional observations
										Fb VL J MD D VS VSI VSH H VS S F	Dry Moist Wet Sat	100 200 300 400 500	
C R V I Q I			177.0	5.1					SANDSTONE : Medium grained, medium strong, white & trace purple				
			176.5	5.5					SANDSTONE : very fine grained, medium strong, white & trace purple some grey				
			176.0	6.0					SANDSTONE : very fine grained, medium strong, purple and off white				
			175.5	6.5					SANDSTONE : fine grained, weak Off white				
			175.0	7.0					SANDSTONE : medium grained, weak yellow and white some ironstaining				
		174.5	7.5										
		174.0	8.0										
		173.5	8.5										
		173.0	8.9										
		172.5	9.0										
			9.5										
			10.0										
key method			water			Sampling Data			Strength Descriptions			Support	
V	Auger with V-Bit		Date of Water Level			UD 50 Undisturbed Sample 50 mm diameter			Cohesive Non Cohesive			C Casing	
TC	Auger with TC- Bit		Static Water						VS very soft Fb friable			M Mud	
R	Roller / Tricon		Water Inflow			D Disturbed Sample			S soft VL very loose				
W	Washbore		Partial Water			SPT Standard Penetration Test			F firm L loose				
M	Mud Drilling		Drilling water loss			Nc Cone Penetrometer			St stiff MO medium dense				
A	Air Reverse Circulation								VSI very stiff O dense				
									H hard VD very dense				

REGIONAL GTS Pty. Ltd.

A.C.N. 001 671 307

BOREHOLE - ENGINEERING LOG

Ph: (02) 896 1555

Ph: (02) 636 7377

Fax: (02) 631 8716

BH 1

Sheet 3 of 3

Client: P.F. FORMATION PTY. LTD.				Appendix: A									
Project: SAND MINING INVESTIGATION - LOT 3 DP567166 MAROOTA				Your Reference:									
Bore Location: REFER TO SITE PLAN DRAWING No. 94150/1A				Our Reference: 94150 /GK									
Date Drilled: 31st May 1994				File Name: 94150BH1.xls									
Hole Commenced				Supervised by: A.R.									
Hole Completed				Checked by: G.K.									
Slope Deg:		Surface RL:		Drill Model: Edson 2000									
Bearing Deg:		Datum: RL 190 A.H.D. at Property Boundary		Hole Diameter: 100 mm									
Drilling Information			Sampling Data			Profile Description:							
method	support	water	R.L.	Depth metres S.L.	type	sample loss	blows per 300 mm	graphic log	Material Description	Strength	Moisture	hand penetrometer kPa	structure and additional observations
			10.1										
			172.0	10.5					SANDSTONE : Medium grained, medium strong, purple & some white with grey				
			171.5	11.0									
			171.0	11.5					SANDSTONE : medium grained, medium strong, off white, yellow				
			170.5	12.0									
				12.5									
				13.0									
				13.5									
				14.0									
				14.5									
				15.0									
key method			water			Sampling Data			Strength Descriptions			Support	
V	Auger with V-Bit		Date of Water Level			UD 50 Undisturbed Sample 50 mm diameter			Cohesive Non Cohesive			C Casing	
TC	Auger with TC- Bit		Static Water						VS very soft Fb friable			M Mud	
R	Roller / Tricon		Water Inflow			D Disturbed Sample			S soft VL very loose				
W	Washbore		Partial Water			SPT Standard Penetration Test			F firm L loose				
M	Mud Drilling		Drilling water loss			Nc Cone Penetrometer			St stiff MD medium dense				
A	Air Reverse Circulation								VSt very stiff D dense				
									H hard VD very dense				

REGIONAL GTS Pty. Ltd.

A.C.N. 001 671 307

BOREHOLE - ENGINEERING LOG

Ph: (02) 896 1555

Ph: (02) 636 7377

Fax: (02) 631 8716

BH 2

Sheet 1 of 3


Client: P.F. FORMATION PTY. LTD.				Appendix: A									
Project: SAND MINING INVESTIGATION - LOT 3 DP567166 MAROOTA				Your Reference:									
Bore Location: REFER TO SITE PLAN DRAWING No. 94150/1A				Our Reference: 94150 /GK									
Date Drilled: 31st May 1994				File Name: 94150BH2.xls									
Hole Commenced				Supervised by: A.R.									
Hole Completed				Checked by: G.K.									
Slope Deg:		Surface RL: 184 m		Drill Model: Edson 2000									
Bearing Deg:		Datum: RL 190 AHD at Property Boundary B		Hole Diameter: 100 mm									
Drilling Information-			Sampling Data			Profile Description:							
method	support	water	R.L.	Depth metres S.L.	type	sample loss	blows per 300 mm	graphic log	Material Description	Strength	Moisture	hand penetrometer kPa	structure and additional observations
			183.5	0.5					RESIDUAL: Sand, fine to medium grained yellow orange				
			183.0	1.0					RESIDUAL: Sand, fine to medium grained yellow orange				
			182.5	1.5					SANDSTONE: fine grained, weak off white and trace purple				
			182.0	2.0									
			181.5	2.5									
			181.0	3.0									
			180.5	3.5					SANDSTONE: medium to course grained weak, off white, ironstaining				
			180.0	4.0									
			179.5	4.5									
			179.0	5.0									
key method			water			Sampling Data			Strength Descriptions			Support	
V	Auger with V-Bit		Date of Water Level			UD 50 Undisturbed Sample 50 mm diameter			Cohesive			C Casing	
TC	Auger with TC- Bit		Static Water			D Disturbed Sample			Non Cohesive			M Mud	
R	Roller / Tricon		Water Inflow			SPT Standard Penetration Test			VS very soft				
W	Washbore		Partial Water			Nc Cone Penetrometer			S soft				
M	Mud Drilling		Drilling water loss						F firm				
A	Air Reverse Circulation								St stiff				
									VSt very stiff				
									H hard				
									VD very dense				

Client: P.F. FORMATION PTY. LTD.	Appendix: A
Project: SAND MINING INVESTIGATION - LOT 3 DP567166 MAROOTA	Your Reference:
Bore Location: REFER TO SITE PLAN DRAWING No. 94150/1A	Our Reference: 94150 /GK
Date Drilled: 31st May 1994	File Name: 94150BH2.xls

Hole Commenced	Supervised by: A.R.
Hole Completed	Checked by: G.K.

Slope Deg:	Surface RL:	Drill Model: Edson 2000
Bearing Deg:	Datum: RL 190 A.H.D. at Property Boundary	Hole Diameter: 100 mm

Drilling Information				Sampling Data			Profile Description:																	
method	support	water	R.L.	Depth metres S.L.	type	sample loss	blows per 300 mm	graphic log	Material Description		Strength		Moisture		hand penetrometer kPa	structure and additional observations								
									Fb	VL	L	MD	D	VD	Dry		Moist	100	200	300	400	500		
C R M - D I				5.1					SANDSTONE : fine grained, medium strong, white & trace purple															
			178.5	5.5																				
			178.0	6.0																				
			177.5	6.5																				
			177.0	7.0																				
			176.5	7.5							SANDSTONE : very fine grained, medium strong, off white													
			176.0	8.0																				
			175.5	8.5																				
			175.0	9.0							SANDSTONE : fine grained, medium strong, white & trace purple ironstained													
			174.5	9.5																				
			174.0	10.0																				

key method V Auger with V-Bit TC Auger with TC- Bit R Roller / Tricon W Washbore M Mud Drilling A Air Reverse Circulation	water  Date of Water Level Static Water Water Inflow Partial Water Drilling water loss	Sampling Data UD 50 Undisturbed Sample 50 mm diameter D Disturbed Sample SPT Standard Penetration Test Nc Cone Penetrometer	Strength Descriptions Cohesive Non Cohesive VS very soft Fb friable S soft VL very loose F firm L loose St stiff MD medium dense VST very stiff O dense H hard VD very dense	Support C Casing M Mud
--	---	--	--	-------------------------------------

Client: P.F. FORMATION PTY. LTD.						Appendix: A													
Project: SAND MINING INVESTIGATION - LOT 3 DP567166 MAROOTA						Your Reference:													
Bore Location: REFER TO SITE PLAN DRAWING No. 94150/1A						Our Reference: 94150 /GK													
Date Drilled: 31st May 1994						File Name: 94150BH2.xls													
Hole Commenced						Supervised by: A.R.													
Hole Completed						Checked by: G.K.													
Slope Deg:			Surface RL: 184 m			Drill Model: Edson 2000													
Bearing Deg:			Datum: RL 190 A.H.D. at Property Boundary			Hole Diameter: 100 mm													
Drilling Information				Sampling Data				Profile Description:											
method	support	water	R.L.	Depth metres S.L.	type	sample loss	blows per 300 mm	graphic log	Material Description	Strength	Moisture	hand penetrometer kPa	structure and additional observations						
				10.1															
			173.5	10.5					SANDSTONE : fine grained, weak yellow and off white some ironstaining										
			173.0	11.0															
			172.5	11.5					SANDSTONE : fine grained, weak grey with some organics ironstaining										
	V		172.0	12.0															
			171.5	12.5					SANDSTONE : fine to medium grained, weak off white with yellow bands										
			171.0	13.0															
			170.5	13.5					SANDSTONE : fine to medium grained, weak yellow and orange										
			170.0	14.0															
				14.5															
				15.0															
key method				water				Sampling Data				Strength Descriptions				Support			
V	Auger with V-Bit			31 5 94				UD 50 Undisturbed Sample 50 mm diameter				Cohesive Non Cohesive				C Casing			
TC	Auger with TC- Bit			Date of Water Level				SPT Standard Penetration Test				VS very soft Fb friable				M Mud			
R	Roller / Tricon			Static Water				D Disturbed Sample				S soft VL very loose							
W	Washbore			Water Inflow				SPT				F firm L loose							
M	Mud Drilling			Partial Water				Nc Cone Penetrometer				St stiff MD medium dense							
A	Air Reverse Circulation			Drilling water loss								VSt very stiff D dense							
												H hard VD very dense							

Client: P.F. FORMATION PTY. LTD.						Appendix: A							
Project: SAND MINING INVESTIGATION - LOT 3 DP567166 MAROOTA						Your Reference:							
Bore Location: REFER TO SITE PLAN DRAWING No. 94150/1A						Our Reference: 94150 /GK							
Date Drilled: 31st May and 1st June 1994						File Name: 94150BH3.xls							
Hole Commenced						Supervised by: A.R.							
Hole Completed						Checked by: G.K.							
Slope Deg:			Surface RL: 190 m			Drill Model: Edson 2000			Hole Diameter: 100 mm				
Bearing Deg:			Datum: RL 190 AHD at Property Boundary B										
Drilling Information -				Sampling Data				Profile Description:					
method	support	water	R.L.	Depth metres S.L.	type	sample loss	blows per 300 mm	graphic log	Material Description	Strength	Moisture	hand penetrometer kPa	structure and additional observations
										F _p VL MD VST VD	Dry Moist Wet Sat	100 200 300 400 500	
CORROSION			189.5	0.5					SANDSTONE: Fine grained, weak off white				
			189.0	1.0					SANDSTONE: fine grained, weak white and grey				
			188.5	1.5									
			188.0	2.0									
			187.5	2.5									
			187.0	3.0									
		186.5	3.5						SANDSTONE fine to medium grained, weak grey and white				
		186.0	4.0										Water Seepage
		185.5	4.5										
		185.0	5.0										
key method				water		Sampling Data				Strength Descriptions			Support
V	Auger with V-Bit					UD 50	Undisturbed Sample 50 mm diameter		Cohesive	Non Cohesive			C Casing
TC	Auger with TC- Bit					D	Disturbed Sample		S soft	VL very loose			M Mud
R	Roller / Tricon					SPT	Standard Penetration Test		F firm	L loose			
W	Washbore					Nc	Cone Penetrometer		St stiff	MD medium dense			
M	Mud Drilling								VST very stiff	D dense			
A	Air Reverse Circulation								H hard	VD very dense			

REGIONAL GTS Pty. Ltd.

Ph: (02) 896 1555

BH 3

A.C.N. 001 671 307

Ph: (02) 636 7377

BOREHOLE - ENGINEERING LOG

Fax: (02) 631 8716

Sheet 2 of 5

Client: P.F. FORMATION PTY. LTD.						Appendix: A								
Project: SAND MINING INVESTIGATION - LOT 3 DP567166 MAROOTA						Your Reference:								
Bore Location: REFER TO SITE PLAN DRAWING No. 94150/1A						Our Reference: 94150 /GK								
Date Drilled: 31st May and 1st June 1994						File Name: 94150BH3.xls								
Hole Commenced						Supervised by: A.R.								
Hole Completed						Checked by: G.K.								
Slope Deg: Surface RL: 190 m						Drill Model: Edson 2000								
Bearing Deg: Datum: RL 190 A.H.D. at Property Boundary						Hole Diameter: 100 mm								
Drilling Information			Sampling Data			Profile Description:								
method	support	water	R.L.	Depth metres S.L.	type	sample loss	blows per 300 mm	graphic log	Material Description	Strength	Moisture	hand penetrometer kPa	structure and additional observations	
										Fb VL L MD St D VD	Dry Moist Wet Sat	100 200 300 400 500		
			184.5	5.5					SANDSTONE : medium grained, weak grey white with yellow bands					
			184.0	6.0										
			183.5	6.5										
			183.0	7.0										
			182.5	7.5					SANDSTONE : medium grained, weak off white with yellow bands					
			182.0	8.0										
			181.5	8.5					SANDSTONE : medium grained, weak off white with yellow bands					
			181.0	9.0										
			180.5	9.5					SANDSTONE : medium grained, weak off white with yellow bands ironstaining					
			180.0	10.0										
key method			water			Sampling Data			Strength Descriptions			Support		
V	Auger with V-Bit		Date of Water Level			UD50 Undisturbed Sample 50 mm diameter			Cohesive Non Cohesive			C	Casing	
TC	Auger with TC- Bit		Static Water			D Disturbed Sample			VS very soft Fb friable			M	Mud	
R	Roller / Tricon		Water Inflow			SPT Standard Penetration Test			S soft VL very loose					
W	Washbore		Partial Water			Nc Cone Penetrometer			F firm L loose					
M	Mud Drilling		Drilling water loss						St stiff MD medium dense					
A	Air Reverse Circulation							VSt very stiff D dense						
								H hard VD very dense						

REGIONAL GTS Pty. Ltd.

A.C.N. 001 671 307

BOREHOLE - ENGINEERING LOG

Ph: (02) 896 1555

Ph: (02) 636 7377

Fax: (02) 631 8716

BH 3

Sheet 3 of 5

Client: P.F. FORMATION PTY. LTD.				Appendix: A									
Project: SAND MINING INVESTIGATION - LOT 3 DP567166 MAROOTA				Your Reference:									
Bore Location: REFER TO SITE PLAN DRAWING No. 94150/1A				Our Reference: 94150 /GK									
Date Drilled: 31st May and 1st June 1994				File Name: 94150BH3.xls									
Hole Commenced				Supervised by: A.R.									
Hole Completed				Checked by: G.K.									
Slope Deg:		Surface RL: 190 m		Drill Model: Edson 2000									
Bearing Deg:		Datum: RL 190 A.H.D. at Property Boundary		Hole Diameter: 100 mm									
Drilling Information		Sampling Data		Profile Description:									
method	support	water	R.L.	Depth metres S.L.	type	sample loss	blows per 300 mm	graphic log	Material Description	Strength	Moisture	hand penetrometer kPa	structure and additional observations
										Fb VL L MD D VST H VS S F St VST H Dry Moist Wet Sat 100 200 300 400 500			
				10.1					SANDSTONE : medium grained, weak some clay seams off white some ironstaining				
				179.5	10.5								
				179.0	11.0								Water Table at 11.0 m
				178.5	11.5				SANDSTONE : medium grained, weak off white with yellow bands ironstaining				
				178.0	12.0								
				177.5	12.5				SANDSTONE : medium grained, weak yellow and orange				
				177.0	13.0								
				176.5	13.5				SANDSTONE : medium grained, weak off white with yellow bands				
				176.0	14.0								
				175.5	14.5								
				175.0	15.0								
key method		water		Sampling Data		Strength Descriptions		Support					
V	Auger with V-Bit			31	5	94	UD 50 Undisturbed Sample 50 mm diameter	Cohesive VS very soft S soft F firm St stiff VST very stiff H hard	Non Cohesive Fb friable VL very loose L loose MO medium dense D dense VD very dense	C Casing M Mud			
TC	Auger with TC- Bit						D Disturbed Sample						
R	Roller / Tricon						SPT Standard Penetration Test						
W	Washbore						Nc Cone Penetrometer						
M	Mud Drilling												
A	Air Reverse Circulation												

REGIONAL GTS Pty. Ltd.

A.C.N. 001 671 307

BOREHOLE - ENGINEERING LOG

Ph: (02) 896 1555

Ph: (02) 636 7377

Fax: (02) 631 8716

BH 3

Sheet 4 of 5

Client: P.F. FORMATION PTY. LTD.						Appendix: A							
Project: SAND MINING INVESTIGATION - LOT 3 DP567166 MAROOTA						Your Reference:							
Bore Location: REFER TO SITE PLAN DRAWING No. 94150/1A						Our Reference: 94150 /GK							
Date Drilled: 31st May and 1st June 1994						File Name: 94150BH3.xls							
Hole Commenced						Supervised by: A.R.							
Hole Completed						Checked by: G.K.							
Slope Deg:			Surface RL: 190 m			Drill Model: Edson 2000							
Bearing Deg:			Datum: RL 190 A.H.D. at Property Boundary			Hole Diameter: 100 mm							
Drilling Information				Sampling Data				Profile Description:					
method	support	water	R.L.	Depth metres S.L.	type	sample loss	blows per 300 mm	graphic log	Material Description	Strength	Moisture	hand penetrometer kPa	structure and additional observations
										Fb VL MD VSt D VD VS S F St VSt H Dry Moist Wet Sat	100 200 300 400 500		
			174.5	15.5					SANDSTONE : fine grained, weak yellow and off white some ironstaining				
			174.0	16.0					SANDSTONE : medium grained, weak yellow and grey				
			173.5	16.5					SANDSTONE : medium grained, medium strong yellow and grey				
			173.0	17.0					SANDSTONE : medium grained, medium strong yellow and grey				
			172.5	17.5					SANDSTONE : medium grained, medium strong yellow and grey				
			172.0	18.0					SANDSTONE : medium grained, medium strong yellow and grey				
			171.5	18.5					SANDSTONE : medium grained, medium strong yellow and grey				
			171.0	19.0					SANDSTONE : medium grained, medium strong yellow and grey				
			170.5	19.5					SANDSTONE : fine to medium grained, medium strong grey				
			170.0	20.0					SANDSTONE : fine to medium grained, medium strong grey				
key method				water		Sampling Data				Strength Descriptions			Support
V	Auger with V-Bit			31 5 94		UD 50 Undisturbed Sample 50 mm diameter				Cohesive Non Cohesive			C Casing
TC	Auger with TC- Bit			Date of Water Level						VS very soft Fb friable			M Mud
R	Roller / Tricon			Static Water						S soft VL very loose			
W	Washbore			Water Inflow						F firm L loose			
M	Mud Drilling			Partial Water		D Disturbed Sample				St stiff MD medium dense			
A	Air Reverse Circulation			Drilling water loss		SPT Standard Penetration Test				VSt very stiff O dense			
						Nc Cone Penetrometer				H hard VD very dense			

REGIONAL GTS Pty. Ltd.

A.C.N. 001 671 307

BOREHOLE - ENGINEERING LOG

Ph: (02) 896 1555

Ph: (02) 636 7377

Fax: (02) 631 8716

BH 3

Sheet 5 of 5

Client: P.F. FORMATION PTY. LTD.						Appendix: A																	
Project: SAND MINING INVESTIGATION - LOT 3 DP567166 MAROOTA						Your Reference:																	
Bore Location: REFER TO SITE PLAN DRAWING No. 94150/1A						Our Reference: 94150 /GK																	
Date Drilled: 31st May and 1st June 1994						File Name: 94150BH3.xls																	
Hole Commenced						Supervised by: A.R.																	
Hole Completed						Checked by: G.K.																	
Slope Deg:			Surface RL: 190 m			Drill Model: Edson 2000																	
Bearing Deg:			Datum: RL 190 A.H.D. at Property Boundary			Hole Diameter: 100 mm																	
Drilling Information				Sampling Data				Profile Description:															
method	support	water	R.L.	Depth metres S.L.	type	sample loss	blows per 300 mm	graphic log	Material Description	Strength	Moisture	hand penetrometer kPa	structure and additional observations										
										Fb VL MD VS D VD	Dry Moist Wet Sat	100 200 300 400 500											
H O R V O			169.5	20.5					SANDSTONE : medium grained, medium strong grey														
			169.0	21.0																			
			168.5	21.5																			
			168.0	22.0																			
			167.5	22.5																			
			167.0	23.0																			
			166.5	23.5																			
			166.0	24.0																			
			165.5	24.5																			
			165.0	25.0																			
key method				water				Sampling Data				Strength Descriptions				Support							
V	Auger with V-Bit							UD 50 Undisturbed Sample 50 mm diameter D Disturbed Sample SPT Standard Penetration Test Nc Cone Penetrometer				Cohesive Non Cohesive				C Casing M Mud							
TC	Auger with TC- Bit											VS very soft								Fb friable			
R	Roller / Tricon											S soft								VL very loose			
W	Washbore											F firm								L loose			
M	Mud Drilling											St stiff								MD medium dense			
A	Air Reverse Circulation			VSst very stiff				D dense															
								H hard				VD very dense											

REGIONAL GTS Pty. Ltd.

A.C.N. 001 671 307

BOREHOLE - ENGINEERING LOG

Ph: (02) 896 1555

Ph: (02) 636 7377

Fax: (02) 631 8716

BH 4

Sheet 1 of 3


Client: P.F. FORMATION PTY. LTD.				Appendix: A										
Project: SAND MINING INVESTIGATION - LOT 3 DP567166 MAROOTA				Your Reference:										
Bore Location: REFER TO SITE PLAN DRAWING No. 94150/1A				Our Reference: 94150 /GK										
Date Drilled: 1st June 1994				File Name: 94150BH4.xls										
Hole Commenced				Supervised by: A.R.										
Hole Completed				Checked by: G.K.										
Slope Deg:		Surface RL: 199.5 m		Drill Model: Edson 2000										
Bearing Deg:		Datum: RL 190 AHD at Property Boundary B		Hole Diameter: 100 mm										
Drilling Information			Sampling Data			Profile Description:								
method	support	water	R.L.	Depth metres S.L.	type	sample loss	blows per 300 mm	graphic log	Material Description	Strength	Moisture	hand penetrometer kPa	structure and additional observations	
H O L E C O M P L E T E D			199.0	0.5					TOPSOIL: silt with organics yellow grey					
			198.5	1.0					RESIDUAL: Sand, medium grained yellow					
			198.0	1.5					SANDSTONE: Medium Grained, weak Off white with yellow					
			197.5	2.0										
			197.0	2.5										
			196.5	3.0										
			196.0	3.5										
			195.5	4.0						SANDSTONE: Medium Grained, weak Off white with ironstaining				
			195.0	4.5										
			194.5	5.0										
key method			water			Sampling Data			Strength Descriptions			Support		
V	Auger with V-Bit					UD 50 Undisturbed Sample 50 mm diameter			Cohesive VS very soft Fb friable S soft VL very loose F firm L loose St stiff MD medium dense VSt very stiff D dense H hard VD very dense			C Casing M Mud		
TC	Auger with TC- Bit													Date of Water Level
R	Roller / Tricon		Static Water			Date of Water Level								
W	Washbore		Water Inflow			Date of Water Level								
M	Mud Drilling		Partial Water			Date of Water Level								
A	Air Reverse Circulation		Drilling water loss			Date of Water Level								

Client: P.F. FORMATION PTY. LTD.	Appendix: A
Project: SAND MINING INVESTIGATION - LOT 3 DP567166 MAROOTA	Your Reference:
Bore Location: REFER TO SITE PLAN DRAWING No. 94150/1A	Our Reference: 94150 /GK
Date Drilled: 1st June 1994	File Name: 94150BH4.xls

Hole Commenced	Supervised by: A.R.
Hole Completed	Checked by: G.K.

Slope Deg:	Surface RL: 199.5 m	Drill Model: Edson 2000
Bearing Deg:	Datum: RL 190 A.H.D. at Property Boundary	Hole Diameter: 100 mm

Drilling Information				Sampling Data			Profile Description:												
method	support	water	R.L.	Depth metres S.L.	type	sample loss	blows per 300 mm	graphic log	Material Description	Strength	Moisture	hand penetrometer kPa	structure and additional observations						
										Fb VL L MD D VD	Dry Moist Wet Sat	100 200 300 400 500							
			194.0	5.1					SANDSTONE : Medium grained, weak off white & trace purple (iron)										
			193.5	5.5					SANDSTONE : medium to course grained weak, off white & trace orange										
			193.0	6.0					SANDSTONE : medium to course grained weak, clay seams off white										
			192.5	6.5					SANDSTONE : medium grained, weak some clay pockets Off white with yellow tinge										
			192.0	7.0					SANDSTONE : medium grained, weak Off white with yellow tinge										
			191.5	7.5					SANDSTONE : medium grained, weak Off white with yellow tinge										
			191.0	8.0					SANDSTONE : medium grained, weak Off white with yellow tinge										
			190.5	8.5					SANDSTONE : medium grained, weak Off white with yellow tinge										
			190.0	9.0					SANDSTONE : medium grained, weak Off white with yellow tinge										
			189.5	9.5					SANDSTONE : medium grained, weak Off white with yellow tinge										
				10.0															

key method	water	Sampling Data	Strength Descriptions	Support
V Auger with V-Bit TC Auger with TC- Bit R Roller / Tricon W Washbore M Mud Drilling A Air Reverse Circulation	 Date of Water Level Static Water Water Inflow Partial Water Drilling water loss	UD 50 Undisturbed Sample 50 mm diameter D Disturbed Sample SPT Standard Penetration Test Nc Cone Penetrometer	Cohesive VS very soft S soft F firm St stiff VSt very stiff H hard Non Cohesive Fb friable VL very loose L loose MD medium dense D dense VD very dense	C Casing M Mud

REGIONAL GTS Pty. Ltd.

A.C.N. 001 671 307

BOREHOLE - ENGINEERING LOG

Ph: (02) 896 1555

Ph: (02) 636 7377

Fax: (02) 631 8716

BH 4

Sheet 3 of 3

Client: P.F. FORMATION PTY. LTD.				Appendix: A									
Project: SAND MINING INVESTIGATION - LOT 3 DP567166 MAROOTA				Your Reference:									
Bore Location: REFER TO SITE PLAN DRAWING No. 94150/1A				Our Reference: 94150 /GK									
Date Drilled: 1st June 1994				File Name: 94150BH4.xls									
Hole Commenced				Supervised by: A.R.									
Hole Completed				Checked by: G.K.									
Slope Deg:		Surface RL: 199.5 m		Drill Model: Edson 2000									
Bearing Deg:		Datum: RL 190 A.H.D. at Property Boundary		Hole Diameter: 100 mm									
Drilling Information			Sampling Data			Profile Description:							
method	support	water	R.L.	Depth metres S.L.	type	sample loss	blows per 300 mm	graphic log	Material Description	Strength	Moisture	hand penetrometer kPa	structure and additional observations
			189.0	10.1					SANDSTONE: medium to coarse grained off white with yellow bands				
			188.5	10.5					SANDSTONE: medium grained, medium strong, purple & some white with grey				
			188.0	11.0					SANDSTONE: medium grained, weak off white, some organics				
			187.5	11.5									
			187.0	12.0									
				12.5									
				13.0									
				13.5									
				14.0									
				14.5									
				15.0									
key method			water			Sampling Data			Strength Descriptions			Support	
V	Auger with V-Bit		Date of Water Level			UD 50 Undisturbed Sample 50 mm diameter			Cohesive Non Cohesive			C Casing	
TC	Auger with TC- Bit		Static Water						VS very soft Fb friable			M Mud	
R	Roller / Tricon		Water Inflow			D Disturbed Sample			S soft VL very loose				
W	Washbore		Partial Water			SPT Standard Penetration Test			F firm L loose				
M	Mud Drilling		Drilling water loss			Nc Cone Penetrometer			St stiff MD medium dense				
A	Air Reverse Circulation								VSt very stiff D dense				
									H hard VD very dense				

The method of soil classification adopted is based on that presented in AS1726. Unless specific detailed testing has been undertaken, the soil descriptions in this report are based on visual assessment and are hence subjective interpretations

1. PRIMARY CLASSIFICATION (based on the predominant particle size within the soil mass)

A. COARSE GRAINED SOILS. ie. more than half the soil has particles larger than 0.075mm.

GRAVELS : more than half the coarse fraction is larger than 2.36mm. Gravels are further subdivided into fine (2.36 to 6mm), medium (6 to 20mm) and coarse (20 to 63mm). Particles larger than 63mm minimum dimension are called **COBBLES** and larger than 200mm are called **BOULDERS**.

SANDS : more than half of the coarse fraction is smaller than 2.36mm. Sands are further subdivided into fine (0.075 to 0.2mm), medium (0.2mm to 0.6mm) and coarse (0.6 to 2.36mm).

B. FINE GRAINED SOILS. ie. more than half the soil has particles smaller than 0.075mm.

SILTS : particles range from 0.075mm to 0.002mm particles can be felt but not seen.

CLAYS : particles smaller than 0.002mm, which can be neither felt nor seen.

2. SECONDARY CLASSIFICATION

A. **COARSE GRAINED SOILS** are described as either Well Graded (having good representation of all particles sizes), Poorly Graded (one or more intermediate sizes poorly represented or absent) or Uniform (particles all of one size). In addition gravels and sands may have a proportion of their composition comprising clays and/or silts. When this occurs, the "trace" denotes less than 5 per cent of the total soil, "with clay/silt" denotes 5 to 12 percent of the total soil and the use of the prefix "silty" or "clayey" (as applicable) denotes greater than 12 per cent of the soil mass.

B. **FINE GRAINED SOILS**: The plasticity of fine grained soils is denoted and defined as follows:-

low plasticity	liquid limit less than 35 percent
intermediate or medium plasticity	liquid limit from 35 to 50 percent
high plasticity	liquid limit greater than 50 percent

In addition, clays and silts may have proportion of sands or gravels in their composition. "Trace" denotes less than 15 percent coarse fraction and "with sand / gravel" denotes 15 to 30 percent coarse fraction. When the coarse fraction exceeds 30 percent, "sandy" or "gravelly" are used as a prefix.

3. CONDITION OF SOIL : the condition of the soil may be described in the following terms:-

Moisture condition : is described by the appearance and feel of the soil using one of the following terms:

'Dry' - looks and feels dry; cohesive soils usually hard, powdery or friable, granular soils run freely through the hands.

'Moist' - soil feels cool, darker in colour, granular soils tend to cohere, cohesive soils usually weakened by remoulding

'Wet' - as for moist but free water form on hands when handling.

Consistency of cohesive soils

<u>TERM</u>	<u>UNDRAINED SHEAR STRENGTH</u>	<u>GENERAL GUIDE TO CONSISTENCY</u>
Very soft	less than 12 kPa	Exudes between the fingers when squeezed in hand
Soft	12 to 25 kPa	Can be moulded by light finger pressure
Firm	25 to 50 kPa	Can be moulded by strong finger pressure
Stiff	50 to 100 kPa	Cannot be moulded by fingers and indented by thumb
Very Stiff	100 to 200 kPa	Can be indented by thumb nail
Hard	greater than 200 kPa	Can be indented with difficulty by thumb nail

Relative Density of cohesionless soils: The consistency of an essentially cohesionless soil is described in terms of the density index, as defined in AS 1289.A1 which requires some form of test on an undisturbed or in situ sample. Normally a penetration test (SPT, Scala or Dutch Cone) is used in conjunction with published correlation tables.

<u>TERM</u>	<u>DENSITY INDEX</u>	<u>FIELD GUIDE TO CONSISTENCY</u>
Very loose	less than 15%	Ravels
Loose	15 to 35%	Shovels easily
Moderately Dense	36 to 65%	Shovelling difficult
Dense	66 to 85%	Pick required
Very dense	greater than 85%	Picking difficult

4. STRUCTURE OF SOIL : the following aspects of structure may be noted:-

a) **Zoning** : A soil may consist of separate zones of different properties. A 'Layer' is a continuous zone across an exposure. A 'Lens' is a discontinuous layer of different material, with lenticular shape. A 'Pocket' is an irregular inclusion of different material. The boundaries of the zones are described as 'sharp regular', 'sharp irregular' or 'gradual'.

b) **Defects**: Such as fissures or surfaces along which the soil breaks easily, root holes etc.

c) **Cementing** : Coarse grained soils or defects within soils may be cemented together by various agencies. If the cementing agent allows the particle aggregation to be easily fractured by hand when the soil is saturated it is described as 'weakly cemented'. If the cementing agent prevents fracturing by hand of the particle aggregations when saturated, the soil has assumed rock properties which are described according to the system adopted for classification of rocks.

5. ORIGIN

An attempt is made, where possible, to assess origin (fill, alluvial, residual, colluvial etc.) since this assists in the judgement of probable engineering behaviour. This assessment is generally restricted to field logging activities. An interpretation of landform is a useful guide to the origin of transported soils (eg. talus, slide debris, slope wash, alluvial, lacustrine, estuarine, aeolian and littoral deposits) while local geology and remnant fabric will assist identification of residual soils.

This classification system provides a standardized terminology for the engineering description of the sandstone and shale in the Sydney Area, but the terms and definitions may be used elsewhere when applicable.

Under this system rocks are classified by rock type, degree of weathering, strength, stratification spacing, and degree of fracturing. These terms do not cover the full range of engineering properties. Descriptions of rock may also need to refer to other properties (e.g. durability, abrasiveness, etc.) where these are relevant.

ROCK TYPE DEFINITIONS

Rock Type	Definition
Conglomerate	More than 50% of the rock consists of gravel sized (greater than 2mm) fragments.
Sandstone	More than 50% of the rock consists of sand sized (.06 to 2mm) grains.
Siltstone	More than 50% of the rock consists of silt-sized (less than .06mm) granular particles and the rock is not laminated.
Claystone	More than 50% of the rock consists of clay or siltitic material and the rock is not laminated.
Shale	More than 50% of the rock consists of silt or clay sized particles and the rock is laminated.

Rocks possessing characteristics of two groups are described by their predominant particle size with reference also to the minor constituents, e.g. clayey sandstone, sandy shale.

DEGREE OF WEATHERING

Term	Symbol	Definition
Extremely Weathered	EW	Rock substance affected by weathering to the extent that the rock exhibits soil properties - i.e. it can be remoulded and can be classified according to the Unified Classification System but the texture of the original is still evident.
Highly Weathered	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of weathered substance and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
Moderately Weathered	MW	Rock substance affected by weathering to the extent that staining extends throughout the whole of the rock weathered substance and the original colour of the fresh rock is no longer recognisable.
Slightly Weathered	SW	Rock substance affected by weathering to the extent that partial staining or discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock substance is recognisable.
Fresh	Fr	Rock substance unaffected by weathering.

DEGREE OF FRACTURING

The classification applies to diamond drill cores and refers to the spacing of all types of natural fractures along which the core is discontinuous. These include bedding plane partings, joints and other rock defects, but exclude known artificial fractures such as drilling breaks.

Term	Description
Fragmented	The core is comprised primarily of fragments of length less than 20mm, and mostly of width less than the core diameter.
Highly fractured	Core lengths are generally less than 20mm - 40mm with occasional fragments.
Fractured	Core lengths are mainly 30mm - 100mm with occasional shorter and longer sections.
Slightly fractured	Core lengths are generally 300mm - 1000mm with occasional longer sections and occasional sections 100mm - 300mm.
Unbroken	The core does not contain any fracture.

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (I_{s50}) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Society of Rock Mechanics (1972).

Term	I _{s50} MPa	Stratification spacing
Extremely weak	0.03	Thinly laminated
Very weak		
Weak	0.1	Laminated
Medium strong	0.3	Very thinly bedded
		Thinly bedded
Strong	1	Medium bedded
		Thickly bedded
Very strong	3	Very thickly bedded
Extremely strong	10	

Term	Separation of Stratification Planes
Thinly laminated	<5mm
Laminated	6mm to 20mm
Very thinly bedded	20mm to 60mm
Thinly bedded	60mm to 0.2m
Medium bedded	0.2m to 0.6m
Thickly bedded	0.6m to 2m
Very thickly bedded	2m

IMPORTANT INFORMATION ABOUT THIS SITE INVESTIGATION REPORT

APPENDIX D

Geotechnical engineering is based extensively on judgement and opinion. It is far less exact than other design disciplines. Geotechnical engineering reports are prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor or even some other consulting civil engineer. Unless indicated otherwise, this report was prepared expressly for the client involved and expressly for purposes indicated by the client or his representative. Use by any other persons for any purpose, or by the client for a different purpose, may result in problems. No individual other than the client should apply this report for its intended purpose without seeking additional geotechnical advice. No person should apply this report for any purpose other than that originally contemplated without first conferring with this firm.

1. This Geotechnical Report is based on project-specific factors

This geotechnical engineering report is based on a subsurface investigation which was designed for project-specification factors, including the nature of the structure, its size and configuration, the location of the structure on the site and its orientation, the location of access roads and parking areas. Unless further geotechnical advice is obtained this geotechnical engineering report should not be used:

- * when the nature of the proposed structure is changed
- * when the size or configuration of the proposed structure is modified
- * for application to an adjacent site

Geotechnical engineers cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their report's development have changed.

2. The Limitations of Site Investigation

In making an assessment of a site from a limited number of boreholes or test pits there is the possibility that variations may occur between test locations. Site exploration identifies specific subsurface conditions only at those points where samples are taken. The risk that variations will not be detected can be reduced by increasing the frequency of test locations, however this often does not result in any cost savings for the project. Unless otherwise specified in this report, the investigation programme undertaken is a professional estimate of the scope of investigation required to provide a general profile of the subsurface conditions. The data derived from the site investigation programme and subsequent laboratory testing are extrapolated across the site to form a geological model and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to proposed development. Despite thorough investigation the actual conditions at the site may differ from those inferred to exist, since no subsurface exploration programme, no matter how comprehensive, can reveal all subsurface details and anomalies.

The borehole logs should not be regarded as definitive statements of subsurface conditions at a particular location. They are in fact the subjective interpretation of trained personnel and are limited by the method of investigation. For example, inspection of an excavation or test pit allows greater area of the subsurface profile to be inspected than borehole investigation however, such methods are limited by depth and site disturbance restrictions. In borehole investigation, the actual interface between materials may be more gradual or abrupt than a report indicates.

3. Subsurface conditions are time dependent

Subsurface conditions may be modified by changing natural forces or man-made influences. Because a geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time.

Construction operations at or adjacent to the site and natural events such as floods, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

4. Avoid misinterpretation

A geotechnical engineer should be retained to work with other appropriate design professionals to explain relevant geotechnical findings and to review the adequacy of their plans and specifications relative to geotechnical issues.

5. Boring logs should not be separated from the engineering report

Final boring logs are developed by geotechnical engineers based upon their interpretation of field logs and laboratory evaluation of field samples. Only final boring logs customarily are included in geotechnical engineering reports. These logs should not under any circumstances be redrawn for inclusion in architectural or other design drawings. To minimise the likelihood of boring log misinterpretation, contractors should be given ready access to the complete geotechnical engineering report prepared or authorized for their use. Providing the best available information to contractors helps prevent costly construction problems. For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical Information in Construction Contracts" published by The Institution of Engineers Australia, National Headquarters, Canberra, 1987.

6. Geotechnical Involvement During Construction

During construction, excavation is frequently undertaken which exposes the actual subsurface conditions. For this reason geotechnical consultants should be retained through the construction stage, to identify variations if they are exposed and to conduct additional tests which may be required and to deal quickly with geotechnical problem as if they arise.

APPENDIX "C" - Hydrogeological Study



EXTRACTIVE INDUSTRIES

MAROOKA

GROUNDWATER STUDIES

LOT 3, PORTION 66



PREPARED FOR :
P.F.FORMATION PTY LIMITED

SEPTEMBER 1994
Project No. 3613
Document No. 3613R002-A.WP5

Woodward-Clyde



14 September 1994
Project No. 3613

P.F.Formation Pty Limited
24 Smith Street
EMU PLAINS NSW 2750

Attention: Mr John Graham

Dear John,

Re: P.F.Formation, Extractive Industries
Groundwater Studies, Lot 3, Portion 66, DP 567166

We enclose three copies of our report on the hydrogeological effects of the proposed quarry on the surrounding environment.

We have concluded that only minimal effects are likely to be created by the above excavations, due to a combination of low aquifer permeability, shallow penetration of the water table and general geomorphology of the area.

We thank you for the opportunity to work on this project. Should you have any queries, please, do not hesitate to contact the undersigned.

Yours sincerely



Fabio Carosone
Senior Hydrogeologist



Frank J Mohen
Manager, New South Wales

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1.0 INTRODUCTION	1-1
2.0 AREA GEOLOGY	2-1
3.0 HYDROGEOLOGY	3-1
4.0 HYDROGEOLOGICAL IMPACT	4-1
4.1 HYDROGEOLOGICAL EFFECTS FROM LOT 3	4-1
5.0 CONCLUSIONS	5-1

LIST OF TABLES

TABLE 1	STRATIGRAPHIC SEQUENCE	2-1
TABLE 2	SUMMARY OF DWR BORE RECORDS	3-3
TABLE 3	DISTANCE-DRAWDOWN EFFECTS - LOT 3	4-2

LIST OF FIGURES

FIGURE 1	LOCALITY AND GEOLOGY
FIGURE 2	HYDROGEOLOGICAL SECTION

P.F. Formation has been excavating and producing various grade sands from a number of leases in the Maroota area. In order to plan for future requirements, the company is applying to extend sand quarrying to Lot 3, Portion 66, DP 567166 (Lot 3). The site is located along the Old Northern Road, Maroota (Figure 1).

Lot 3 development is proposed in two stages. Stage 1, located in the southern part of Lot 3 and of an estimated duration of six years, and Stage 2, located in the northern part of Lot 3, to follow completion of Stage 1.

Collin Dongés and Associates Pty Limited (Dongés), the planning consultant to P.F. Formation, has asked AGC Woodward-Clyde Pty Limited (Woodward-Clyde) to prepare a report on behalf of P.F. Formation on the hydrogeological impacts that the proposed extensions to quarrying may have on the surrounding groundwater resources and its users. Woodward-Clyde has been associated in the past in the preparation of similar reports on previous quarrying leases in the same area.

This report presents the results of a site visit, of a search of Department of Water Resources records and of computer modelling of the effects of the proposed excavations.

The Maroota area is known for the production of sand, which represents a valuable resource to the building industry. The sand is obtained from two main sources, the Maroota Sand and the weathered profiles of the Hawkesbury Sandstone. The occurrence of the Maroota Sand has, in the past, been systematically mapped by the Department of Minerals and Energy of New South Wales (Etheridge, 1980) and its distribution over the area is well documented. Figure 1, adapted from Etheridge, shows the occurrence of the Maroota Sand in relation to the area under study.

All quarrying in these areas will occur outside the known boundaries of the Maroota Sand and wholly in the Hawkesbury Sandstone.

The general stratigraphy of the area is as shown in the table below:

TABLE 1 - STRATIGRAPHIC SEQUENCE

AGE	UNIT	LITHOLOGY
Quaternary	Soils	Variable
Tertiary	Unnamed	Basalt
	Maroota Sand	Sand, gravel, clayey sand and clay
Triassic	Ashfield Shale	Shale and laminite
	Hawkesbury Sandstone	Quartzose sandstone with shale lenses

A general description of the main stratigraphic units, extracted from previous Woodward-Clyde reports (1984, 1987) is presented below.

The Maroota Sand comprises a sequence of interbedded gravels, clayey gravels, gravelly sands, pebbly sands and clay which range from unconsolidated to partly consolidated. It unconformably overlies the Hawkesbury Sandstone. No further description is given since this formation is not present in the area under investigation.

The Hawkesbury Sandstone is a quartz sandstone, generally massive, with well developed cross-bedding and intercalations of shale and siltstone beds. Bulk grain size is generally in the range of fine to medium sand, but sorting is generally poor with some silt and pebble grains. The weathered profile, the target of the quarrying operations, can be over 15 m deep and is represented by a soft and friable rock, ranging in colour from white to red-brown. Where this weathered zone is consistently above water table, it is leached to give rise to loose, white sandy soil, referred to as eluvial sand (Etheridge, 1980).

The southern part of Lot 3 (proposed Stage 1 development) consists of shallow soil overlying weathered Hawkesbury Sandstone. The northern part of Lot 3 (Stage 2 of the proposed development) consists mainly of a high ridge of partially weathered Hawkesbury Sandstone.

The formations present in the area have dissimilar hydrogeological characteristics, which often result in the establishment of perched water tables in the Maroota Sand and in the Hawkesbury Sandstone and, within the latter, between the eluvial and weathered profiles and the fresher sandstone. A diagrammatic representation of the overall groundwater regime is presented in Figure 2.

Only the Hawkesbury Sandstone will be discussed in detail, as the Maroota Sand is absent from the area under study.

The Hawkesbury Sandstone is generally an impermeable rock, due to the degree of grain cementation and to the development of secondary minerals in the inter-pore spaces. Although the rock has negligible primary permeability, fracturing and jointing, where interconnected, provide secondary permeability and storage.

Where a deep weathering profile is developed in the sandstone, the resulting eluvial sand develops some permeability and can form a perched aquifer over the fresh sandstone. Dams and large diameter wells constructed into this material can provide a source of farm water supplies, but generally the permeability is too low to yield significant supplies to small diameter boreholes.

A review of the bore records held by the Department of Water Resources is summarised in Table 2 and the bores locations are plotted in Figure 1.

The records show that different water tables are intersected during drilling into the Hawkesbury Sandstone, due to the different degrees of fracturing and of confining layers within the rockmass. However, because most bores in the Hawkesbury Sandstone are completed open hole, an equilibrium water table is eventually established with time, often coinciding with the deeper water table intersection, due to drainage of the upper levels.

The hydrogeological regime of the Hawkesbury Sandstone is then that of a generally semiconfined aquifer open to direct rainfall recharge whose permeability and storage depend largely on the amount of jointing and fracturing and on the degree of their interconneccion.

Estimates of transmissivity (i.e., permeability times aquifer thickness) for the Hawkesbury Sandstone, calculated from the available bore records by Woodward-Clyde (AGC, 1984), range from 0.06 to 2.03 m²/day. Storativity is estimated to be in the order of 0.001, due to the secondary permeability characteristics of the aquifer.

Water quality in the Hawkesbury Sandstone is variable and, in the area around Maroota, is commonly suitable for general domestic purposes, even if often only marginally potable.

TABLE 2 - SUMMARY OF DWR BORE RECORDS

Bore No.	EstSurface R.L.	Total Depth	Static Water Level SWL	Estimated SWL Elevation	Yield	Total Dissolved Solids	Lithology
	m A.H.D.*	m b.g.	m b.g.	m A.H.D.	L/sec	mg/L	
15051	230	85.3	30.4	200	0.44	fresh	sandstone?
16348	215	73.1	30.4	185	0.13	NA	M. Sand over H.Sandstone ?
33197	127	76.2	40.2	87	0.08	NA	clay, sandstone
34628	212	5.4	5.4	207	0.23	NA	sandstone
		91.4	41.1	171	0.13	NA	sandstone
35725	198	155.4	NA	NA	NA	NA	abandoned
37737	137	124.6	54.8	82	0.96	2000	H.Sandstone?
37738	150	94.4	39	111	2.53	NA	H.Sandstone?
38147	200	18.8	17	183	NA	NA	sandstone,soft
		38.7	29.5	161.3	NA	NA	sandstone,soft
		84.1	37.1	162.9	NA	NA	sandstone,soft
		121.9	64.9	135.1	0.687	NA	sandstone,soft
48741	223	30.0	23.2	200	0.08	NA	sandy
53898	183	31.0	6.0	177	0.5	56	H.Sandstone?
55962	185	22.0	2.0	183	0.43	fresh	H.Sandstone?
57460	141	76	24.8	116	NA	NA	sand
58504	145	15.2	3.6	141	0.38	fresh	5 km south
59118	208	6.0	5.0	203	0.5	NA	H.Sandstone?
59742	208	23.2	7.6	200	1.52	NA	H.Sandstone?
60147	185	46	16.8	168.2	NA	150	sandstone
60051	215	172.2	34.2	181	1.4	fresh	sandstone
63775	198	160.1	NA	NA	0.6	fresh	5 km south east
71883	219	120.0	48	171	0.3	70	sandstone

* Elevation estimated from 1:25000 topographic map contours
NA : Not Available

HYDROGEOLOGICAL IMPACT

The effects of sandstone quarrying over the surrounding groundwater has been simulated with the use of the computer program FINIT 3. The program calculates the inflows into mine pits. The assumptions and hydrogeological parameters adopted for Lot 3, Stage 1, were:

- Average water table elevation = 180 m
- Hawkesbury Sandstone permeability = 0.01 m/day to 0.1 m/day
- Hawkesbury Sandstone storativity = 0.001
- Excavation depths into the water table = 10 m to 15 m
- The aquifer is isotropic and homogeneous
- The quarrying operation at Stage 1 of Lot 3 reach maximum extent in 6 years
- The flows into the pits occur under a steady state constant head from the four sides of the pit.
- The effects of the excavations have been calculated for the fully developed depth and area at the end of six years.

The model does not allow for the topographic variations surrounding the proposed sites and for the water table controlling features represented by the deeply incised gullies and creeks, such as Coopers Creek which crosses Lot 3 at an RL around 160 m, a depth below the anticipated depth of the collection sump (approximately 170 m at present). These features when occurring below the average water table in the area represent a drain from the latter and a barrier to the extension of the effects from the excavations towards surrounding bores. In these circumstances, the results of the modelling are overestimating the real hydrogeological impacts of the proposed quarries.

Stage 2 on Lot 3 has not been modelled as this is expected to occur not before six years.

4.1 HYDROGEOLOGICAL EFFECTS FROM LOT 3

The closest bores to Stage 1 of Lot 3 are the same bores as above, i.e.:

- no. 55962, approximately 700 m south of the nearest side of the excavation, with a water table elevation of around 183 m.

- no. 38147, approximately 800 m southwest from the nearest corner of the excavation, with a water table elevation of around 181 m
- no. 60051, approximately 880 m southwest from the nearest corner of the excavation, with a water table elevation between 135 and 170 m.

Within the range of permeability values used, the minimum and maximum interference drawdowns at the above bores have been estimated as shown in the table below:

TABLE 3 - DISTANCE-DRAWDOWN EFFECTS - LOT 3

	Bore 55962	Bore 38147	Bore 60051
Distance	radius = 700 m	radius = 800 m	radius = 880 m
Minimum drawdown	0.14 m	0.01 m	0
Maximum drawdown	0.53 m	0.36 m	0.35 m

The same comments given above with regards to the assumptions used in the model and to rainfall recharge are equally applicable for Lot 3. The presence of Coopers Creek at the northern boundary of Stage 1, at an elevation lower than the excavation sump, precludes any impacts on the bores to the north of the site. Bore 35725 is reported as abandoned.

The maximum flow into the fully developed pit for a water table drawdown of 1 m has been estimated at 2.4 m³/day. Higher rates could be expected for a fully dewatered pit excavated 15 m below the water table.

Rainfall recharge to the aquifer and directly to the excavation has not been evaluated because the exact pattern of drainage and catchment sizes is not known at this stage. However, the nett effect of rainfall recharge would be to reduce the impact on the drawdown caused by the excavations.

CONCLUSIONS

P.F. Formation proposes the excavation of pits into the weathered profile of the Hawkesbury Sandstone in Lot 3 for the purpose of sand production. These pits are planned to be carried below water table, with sumps to collect drainage and to allow settlement of fines during the close circuit cycle of water usage at the sites.

The potential impacts of these excavations on the existing water table conditions and on local groundwater users has been evaluated with the assistance of a computer program, FINIT 3, used to calculate inflows into mine pits.

It is concluded that the impact on nearby bores at the end of six years of quarrying is negligible and, possibly, not discernible from other seasonal effects. Quarrying will occur mainly on high ground defined by deeply incised gullies and creeks, which act as controls on the water table of the area and limit the impact of the excavations.

REFERENCES

Australian Groundwater Consultants Pty Limited *"Hydrogeological Impact of Sand Extraction at Portion 196, Maroota, NSW"* J.N.1023, January 1984






Australian Groundwater Consultants Pty Limited *"Hydrogeological Impact of Sand Extraction on Portions 63 and 66(Part), Maroota, NSW"* J.N.3038, October 1987

Etheridge, L.T. *"Geological Investigation and Resource Assessment of the Maroota Tertiary Alluvial Deposit"* Geol. Survey NSW Report GS1980/201

Koch, D. *"Mine Hydrology, FINIT 3 Model"* Koch and Associates, 1984

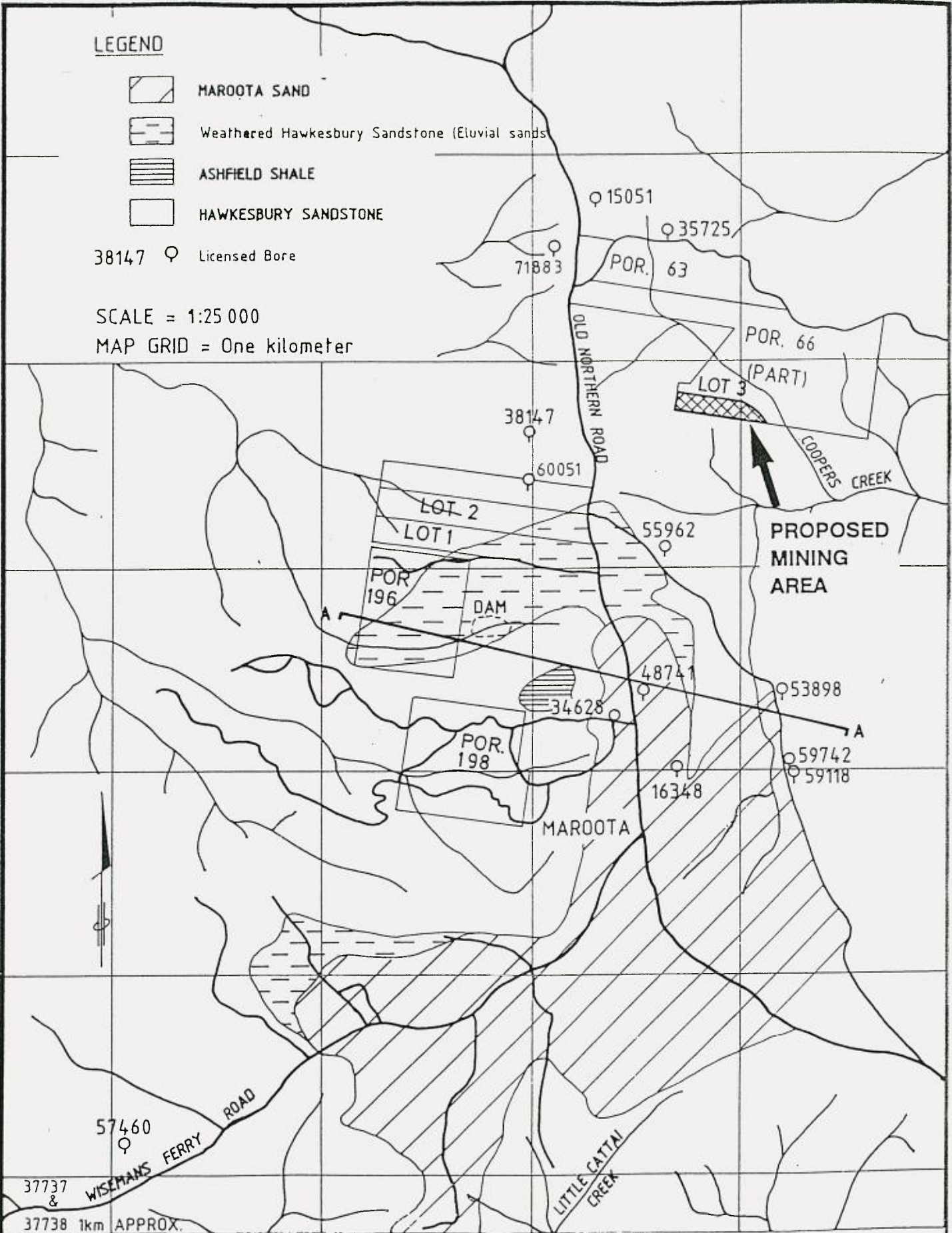
FIGURES

LEGEND

-  MAROOTA SAND
-  Weathered Hawkesbury Sandstone (Eluvial sands)
-  ASHFIELD SHALE
-  HAWKESBURY SANDSTONE
- 38147  Licensed Bore

SCALE = 1:25 000


MAP GRID = One kilometer



DESIGNED	FC
DRAWN	HC
APPROVED	
DATE	SEPT '94

Woodward - Clyde
 Engineering & sciences applied to the earth & its environment

AGC Woodward-Clyde Pty Ltd
 Level 6, 486-494 Pacific Highway
 St Leonards, NSW, Australia 2065
 Tel (02) 436 4666 Fax (02) 436 4110

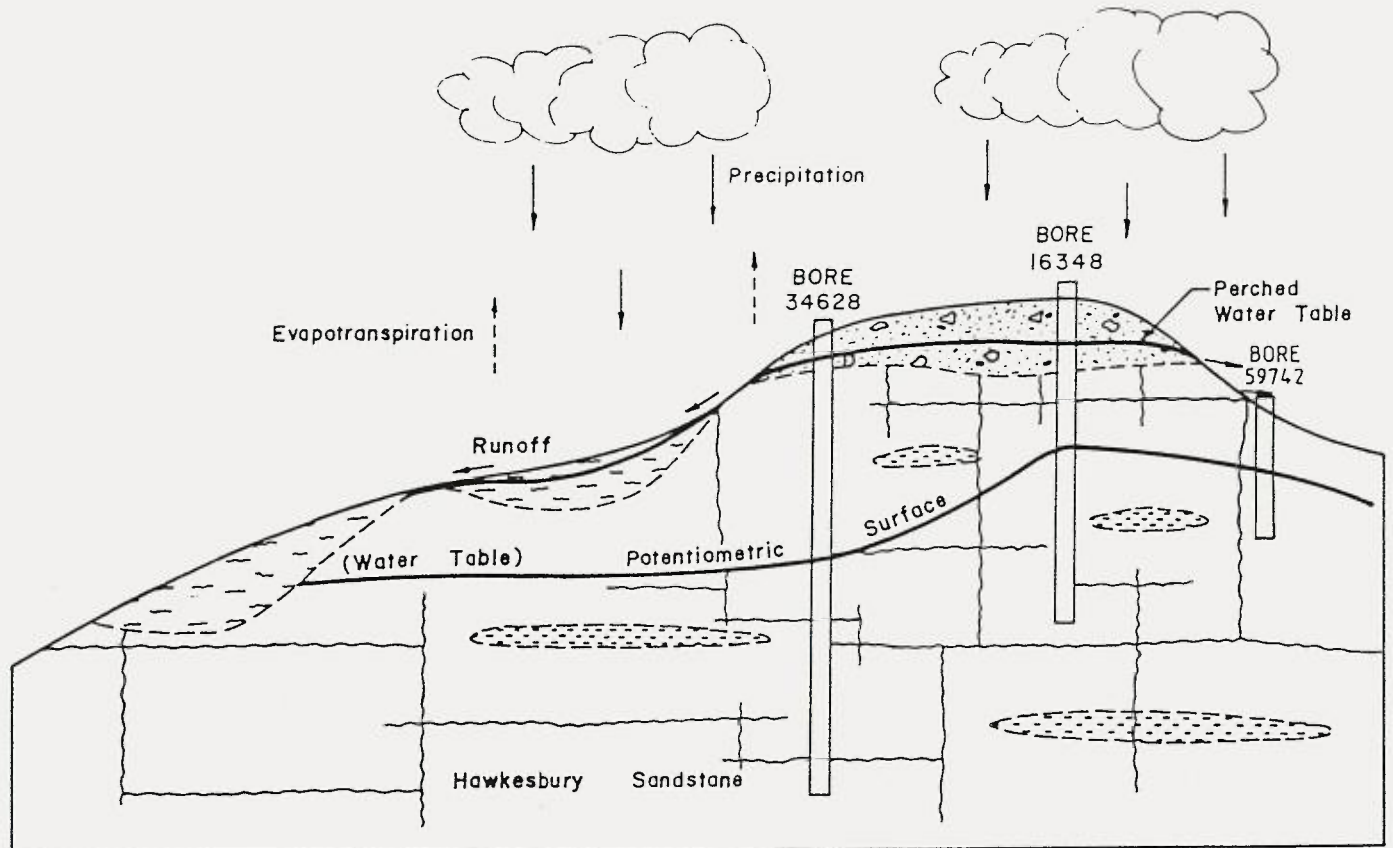
REVISION	
SCALE	As shown
DRAWING	3613G.003
FIGURE	1

COLLIN C DONGES & ASSOCIATES PTY LTD
 SAND MINING, MAROOTA

TITLE
LOCALITY AND GEOLOGY

A (West)

(East) A'



Not to scale

LEGEND

- Eluvial Sand
- Maroota Sand Sand, gravel, silt and clay.
- Hawkesbury Sandstone { Shale lens
- } Sandstone
- Joints and groundwater flow paths through rock

DESIGNED	FC	Woodward - Clyde <small>Engineering & science applied to the earth & its environment</small> AGC Woodward-Clyde Pty Ltd Level 6, 486-494 Pacific Highway St Leonards, NSW, Australia 2065 Tel (02) 436 4666 Fax (02) 436 4110	REVISION		COLLIN C DONGES & ASSOCIATES PTY LTD SAND MINING, MAROOTA
DRAWN	HC		SCALE	Not to scale	TITLE HYDROLOGICAL SECTION
APPROVED			DRAWING	3613G.002	
DATE	SEPT '94		FIGURE	2	

APPENDIX "D" - Acoustic Study

NOISE IMPACT ASSESSMENT REPORT OF A
PROPOSED SAND EXTRACTION AND PROCESSING
OPERATION AT LOT 3 DP5671666 ,
OFF OLD NORTHERN ROAD, MARROOTA

P F FORMATION

Prepared for Colin C Donges & Associates
for inclusion in EIS

Prepared by R T Benbow
DICK BENBOW & ASSOCIATES PTY LIMITED

Report No. EE 1960 CC/PF
November, 1994

Dick Benbow & Associates Pty Limited
ACN: 002 554 761
Unit 4, 5-9 Hunter Street
Parramatta NSW 2150
Tel: (02) 635-5099
Fax: (02) 689-1385

EXECUTIVE SUMMARY

This report provides a noise impact assessment for an operation which involves the extraction, processing and transport of sand from Lot 3 DP5671666 to a central processing plant on Portion 198, off Old Northern Road, Maroota.

The extraction areas will be an extension of two existing sand extraction sites which have involved the mining of sand and the rehabilitation of this land into market gardens. A review of the current sand extraction areas immediately north of this site show that the land, once extracted, has been rehabilitated into productive agricultural land - market gardens.

The writer was involved with the original noise impact assessment report for the current sand extraction operations. There were a minimal number of residences which would be genuinely affected by noise emissions due to the use of extraction cells which initially limited the volume of material extracted in any one area.

The proposed extraction operations would extend the existing operations to the south. To assess any adverse acoustic impacts, continuous noise data logging has been conducted over a period of several days to establish acceptable operational noise levels at nearest residences..

The haulage of the sand presents two possibilities.

- ✦ Part processing of the sand at the extraction site and haulage direct to market as well as haulage using highway delivery trucks to a central processing plant for more detailed processing, ie washing and blending.

This option, therefore, requires the use of 16-20 tonne trucks to haul the sand along Old Northern Road and then to take one of three routes:

- delivery into the Sydney metropolitan area using Old Northern Road;
- delivery along Old Northern Road and Wiseman's Ferry Road;
- delivery to the central processing area using Old Northern Road and then an internal haul road that currently exists in Portions 117, 196 and 198.

This option requires 75 loaded vehicles per day.

- ◆ The second option makes use of 40 tonne dump trucks to haul the sand using a haul road that does not run along public roadways but would cross Old Northern Road at one point. A lesser number of vehicles would be required - 40 Euclid dumpers compared to 75 trucks. The Euclids are more suited to this task. The delivery of finished product would then use the two existing delivery routes as currently used, ie Old Northern Road and Wiseman's Ferry Road.

The advantages and disadvantages of these two options are discussed in this report. The report provides an assessment of noise impact based on the procedures established by the EPA.

R T Benbow
Principal Consultant

CONTENTS

PAGE

1.0 INTRODUCTION..... 1

2.0 ACOUSTIC CRITERIA..... 2

 2.1 EPA Assessment Criteria..... 2

3.0 COMMUNITY NOISE LEVELS..... 4

4.0 DESCRIPTION OF SITE AND PROCESSES..... 8

 4.1 Times of Operation 10

 4.2 Truck Routes 10

 4.3 Traffic Noise Levels..... 11

 4.4 Equipment Noise Levels..... 11

5.0 PREDICTED NOISE LEVELS 13

 5.1 Predicted Levels of Noise..... 14

6.0 STATEMENT OF IMPACT..... 18

1.0 INTRODUCTION

The operation of a site for sand extraction requires a noise impact assessment that determines the potential for noise annoyance to nearest residences by applying acoustic criteria of the Environment Protection Authority (EPA).

A sand extraction site is a scheduled premises under the Noise Control Act if the site area exceeds 20,000 square metres. Following development approval a pollution control application to the EPA is required. This report has, therefore, been prepared to the standards required by the EPA. The noise impact assessment is conducted by establishing the background noise levels at the nearest residences not involved with the sand extraction operations. The noise level from the sand extraction operations are permitted to exceed the background levels by up to 5 dB(A) and if exceedance of this allowance is predicted, then additional noise control measures are required. Annoyance is prevented by limiting the exceedance to 5 dB(A) above background.

The report discusses the relevant EPA acoustic criteria in the following section of the report.

2.0 ACOUSTIC CRITERIA

The noise emissions from the proposed site will be required to satisfy specific EPA acoustic criteria. The site is a scheduled premises under the Noise Control Act.

2.1 EPA Assessment Criteria

The Environment Protection Authority noise criteria applied to the site's operations are:

- 2.1.1 Maintain a maximum noise level within 5 dB(A) of the measured background level. The background level is obtained by measuring the existing noise level without the site operating, eg. prior to start up of the plant or during maintenance days.

If the measured background is 40 dB(A) the maximum permitted noise level is 45 dB(A). If the noise from the site has annoying characteristics, then a 5 dB(A) penalty is applied reducing the maximum permitted level to the background.

- 2.1.2 A range of noise levels is applied based on the predominant land use within the vicinity of the site.

Two sets of noise levels are used, one for daytime, 7.00 am - 10.00 pm and the other for night-time 10.00 pm - 7.00 am.

Table - Land Use Acceptable Noise Levels

Predominant Land Use	Noise Levels	
	Daytime	Night-Time
Residential areas	40-50 dB(A)	35-40 dB(A)
Residential areas on a busy road or near an industrial area. This area also includes church, hospital and school.	50-55 dB(A)	40-45 dB(A)
Passive recreational area	40-50 dB(A)	40-50 dB(A)

The range of acceptable noise levels are:

Daytime	40 - 50 dB(A)
Night-time	35 - 40 dB(A)

The objective for the operation of the site should be in line with maintaining residential noise levels within an acceptable daytime level of 45 dB(A) and night-time of 35 dB(A).

The measured background levels and the above criteria will be used to determine appropriate design objectives for the project.

- Traffic Noise Criteria

L_{A10} 18 hour (6.00 am - midnight) planning level 60 dB(A)

L_{aeq} 24 hour planning level 55 dB(A)

The L_{aeq} planning level of 55 dB(A) would be applied to determining the acoustic impact of using the Old Northern Road compared to an "across country" route.

The acoustic impact of dump trucks should also be assessed for their influence on the $L_{A90} + 5$ dB(A) criterion.

3.0 COMMUNITY NOISE LEVELS

Community noise levels have been measured at several community areas within the vicinity of the site.

The noise levels were measured during the day. A statistical noise level analyser was used to conduct the measurements. The instruments used were ARL data loggers set to record the noise levels for 15 minute periods. The instrument set was calibrated prior to monitoring. A wind sock was placed over the microphone.

Weather conditions during the measurement periods were satisfactory.

The results of the measurement are presented in the following sets of tables. The noise descriptors of most relevance are the L_{A90} and L_{A10} levels. These measurement descriptors are briefly explained below.

- L_{A90}

The L_{A90} is the level of noise exceeded for 90% of the sample time and represents the average of the minimum level of noise experienced during the measurement period.

- L_{A10}

The L_{A10} is the level of noise exceeded for 10% of the sample time and represents the average of the maximum level of noise experienced during the measurement period.

Similarly the L_{A1} is the average of the peaks of noise that are experienced.

The L_{Aeq} is the equivalent continuous level of noise and is a single number that is equivalent to the amount of noise energy that exists. The L_{Aeq} is determined by integrating the level of noise with respect to time.

TABLE 1 : COMMUNITY NOISE LEVELS dB(A)
Date of Measurement : 7 October - 12 October, 1994

Location	Date	Time	Minimum L_{A90}	Repeated Minimum L_{A90}	Average L_{A90}	L_{Aeq}
A	Friday 7.10.94	6.00am - 7.00am	36	37	37	44.8
		7.00am - 8.00pm	36.5	40	45	51.8
	Saturday 8.10.94	6.00am - 7.00am	35.5	35.5	37	48.5
		7.00am - 4.00pm	34.5	36	44	50.2
	Monday 10.10.94	6.00am - 7.00am	33	35	34.5	46.8
		7.00am - 6.00pm	33.5	33.5	36	44.8
	Tuesday 11.10.94	6.00am - 7.00am			35.5	48.5
		7.00am - 6.00pm	33.5	33	38.6	46.9
	Wednesday 12.10.94	6.00am - 7.00am	30.5	31	31.4	43.8
		7.00am - 6.00pm	30.5	30.5	34.4	44.3

The background noise levels were measured at the following four locations over a period of several days through the use of noise data loggers. These locations are shown on Diagram 1. Other residences are more distant and do not need to have background noise readings taken. These residences are adjacent to the Old Northern Road and would be more affected by traffic generated noise when compared to the residences that were measured.

The results of the data loggers are also presented in a set of graphs. These graphs are presented for the noise descriptors L_{A90} , L_{A10} , L_{A1} and L_{Aeq} . The graphs show the occasions when the minimum repeated values of L_{A90} occur.

The results have also been tabulated to present the minimum and average L_{A90} levels during the 6.00 am - 6.00 pm Monday-Friday and 7.00 am - 4.00 pm Saturday for Location A. For the other locations only the minimum repeated L_{A90} level from the whole measurement period is presented as this value is used to set the design objective for that location - refer to Table 2.

The minimum repeated L_{A90} levels are used to determine the acoustic design objectives for the proposed extraction and processing operations. The measurement locations and the acoustic design objectives are explained below.

proposed extraction
operation distance to

- 1.00am

to the proposed site
to Old Northern
eas. The land form
on the eastern side
n 30 metres of this
te would be required
assessment will need
st residence. As the
laced on an adjacent
would be equivalent

- 1.00am

- 6.00pm

Location C

Off Old Telegraph Road, furthestmost residence south of the proposed extraction area. This residence is remote from the proposed site. Separation distance to across country haul route - 600 m.

Acoustic design objective	37.5 dB(A)	6.00am - 7.00am
---------------------------	------------	-----------------

Location D4

Off Old Northern Road, Simpson residence, nearest residence to the proposed site – Lot 2, DP510812. The residence is located at a reduced RL to Old Northern Road and will have direct line of sight over the extraction areas. The land form provides shielding visually to the extraction faces which will be on the eastern side of the slope. The across country haul route would pass within 230 metres of this residence and the "below ground" construction of the haul route would be required to protect the resident's acoustic amenity. The noise impact assessment will need to concentrate on the control of noise emissions at this nearest residence. As the entrance to the property was locked, a noise data logger was placed on an adjacent property in line with the 'Simpson' residence at a location which would be equivalent in terms of ambient noise levels.

Acoustic design objective	36.5 dB(A)	6.00am - 7.00am
	37.0 dB(A)	7.00am - 6.00pm

4.0 DESCRIPTION OF SITE AND PROCESSES

The site, Lot 3 DP 567166, is located to the east of Old Northern Road and immediately south of an existing sand extraction operation at the Travarto/Camillari properties. The site is gently undulating and would be extracted in two areas as shown on the diagrams in the EIS and produced as Diagrams 2 and 3 in this report.

The site has access to Old Northern Road using a corridor of land bordering Lot 2 (south) and Portion 63 (north) – refer to Diagram 2 which also shows the two extraction areas – first stage and later extraction stages. Diagram 3 shows the topography of the site and the location of the nearest residence – location D. This residence, at an approximate RL of 200 is visually and acoustically shielded by the landform being flat for approximately 200 m and then sloping gradually to the east to RL 150. Extraction would take place across the RL 180-RL 190/195 contours. The extraction faces would involve forming north-south working faces which would be to a depth of 12 m and then extending to 20 m in depth. The extraction equipment would, therefore, be operating initially behind a natural landform and as extraction proceeds behind increasingly deep working faces such that the operation would not be visible until it reached the final stage at the eastern end of the Stage 1 extraction area.

The overburden would initially be removed by a bulldozer ripping and pushing the overburden which would be stored for rehabilitation (topsoil for market gardening). This initial operation would be audible at the nearest residence (location D) for a period of 2-4 weeks.

Extraction would be carried out using a CAT 966F front end loader (FEL). This machine would remove the sand and place it either onto a stockpile or directly into a haul truck. Initially haul trucks would be of 16-20 tonne capacity product delivery trucks, (ie registered). In the longer term, the intention is to reduce the number of truck movements in this area of Old Northern Road by using Euclid 40 tonne dumpers travelling along an across country haul route.

There may be the use of a sand processing plant at this site for primary screening and blending. The bulk of the sand is expected to be transported to a central processing plant located on Portion 198 – west of Old Northern Road at the administration and maintenance facilities already established. The processing plant would be placed at a lower RL such that at least 5 m height of acoustic shielding is achieved in the direction of Location D - using earth berm and depth of extraction to achieve the 5 m height of shielding.

A second stage of extraction would take place on the northern half of the site extending from RL 160 up to RL 220/240. The details on the proposed method of extraction have as yet not been finalised and it is expected that the cell technique would continue to be exploited to provide maximum acoustic shielding. Extraction of sand from this second area is not expected for several years. Depth of extraction would be expected to exceed 12 metres and, therefore, substantial acoustic shielding would be provided by the working faces.

As the nearest residence is elevated to the majority of this second extraction area, a berm would need to be established on the western side of the extraction area and extraction commence in a cell running south-north adjacent to the cell wall. Alternately extraction could commence on the northern side of the extraction area and progress towards the west. There is a significant topographical feature between this part of the extraction area and the nearest residence. From our previous experience using the cell technique, significant noise reduction is achieved such that residents are not annoyed. During the initial stage of forming the berm and making the first depths of cut, the equipment is on the surface unshielded. During this initial 2-4 week period it is recommended that public consultation with the affected resident takes place.

Gradual rehabilitation of the land will take place and market gardening commence. The agricultural equipment, including diesel powered water pumps, is independently operated and is not a part of the noise generated by the sand extraction. Agricultural pursuits are not a scheduled premises under the Noise Control Act.

4.1 Times of Operation

The following times of operation are considered necessary for the financial viability of the sand extraction industry:

	<u>Monday-Friday</u>	<u>Saturday</u>
• Removal of sand	6.00am-6.00pm	7.00am-4.00pm
• Processing of sand	6.00am-6.00pm	7.00am-4.00pm
• Transport of sand:		
– public roadway	6.00am-6.00pm	7.00am-4.00pm
– across country haul route	6.00am-8.00pm	7.00am-4.00pm
• Product deliveries:		
– current trucks	7.00am-6.00pm	7.00am-1.00pm
– acoustically treated trucks, to be based on a separate noise impact assessment	6.00am-10.00pm	7.00am-4.00pm

4.2 Truck Routes

The delivery of finished product would take place using the transport routes currently in use, ie Old Northern Road and Wiseman's Ferry Road. Current hours of operation would continue, in the future acoustically treated trucks would be investigated so that an increase in transport hours could be evaluated.

4.3 Traffic Noise Levels

As Old Northern Road is subjected to light traffic flow, the L_{aeq} traffic noise criterion is considered to be of most relevance.

The existing levels of L_{aeq} are presented in the following table. The current EPA planning criterion level is 55 dB(A).

Location		Time Period 6.00am - 7.00am		7.00am - 6.00pm	7.00am - 4.00pm
		Mon - Fri	Sat		
A	Average	46	48.5	47	50.2
	Range	43.8 - 48.5	-	44.3 - 51.8	-
B	Average	44.5	43.6	46	45.3
	Range	43.6 - 45.6	-	42.2 - 50.4	-
C	Average	41.7	45.4	44.4	48.8
	Range	40 - 43.5	-	39.8 - 51.4	-
D	Average	43	44.1	47.2	52.9
	Range	40.3 - 44.6	-	43.4 - 54	-

4.4 Equipment Noise Levels

Equipment noise levels have been obtained by measuring the level of noise generated during typical production conditions at the adjacent sand mining operations.

There would be four phases to the sand extraction:

1. Ripping of overburden and forming a noise control berm.
Equipment type – CAT D10 bulldozer or equivalent.
2. Extracting sand.
Equipment type – CAT 966F FEL or equivalent.
3. Haul truck – either a registered 16-20 tonne rigid axle truck or a 40 tonne Euclid dumper. These trucks would use one of two routes.
 - ⇒ Registered trucks travel along an internal haul route from the extraction area and along the narrow western extension of this lot to Old Northern Road, thence to the intersection of an internal haul route with Wiseman's Ferry Road and into the area where the processing plant would be located.
 - ⇒ Euclid haul trucks would not use the public roadway system and would travel south along a haul road built with berms on either side to shield the movements of the trucks from view, reduce noise emissions and reduce the exposure of the road surface to wind. The haul route would continue to follow an across country route crossing Old Telegraph Road and Old Northern Road. The use of the Euclid dumpers reduces the use of public roadways during daytime and reduces the number of truck movements. Clearly there are environmental advantages especially as a fire trail has already been roughly constructed which would serve as a starting point for the construction of the across country haul route.
4. Processing plants – a basic processing plant to enable dry screening of sand would be used at times at the extraction area. Although a central processing plant with washing facilities would be used, a smaller screening plant has provided considerable advantages to the sand mining operations on the adjacent lot.

Equipment noise levels are listed below:

CAT D10 bulldozer – CAT D10	80-86 dB(A) at 7 m
Front end loader – CAT 966F	80-85 dB(A) at 7 m
Registered delivery truck	80-83 dB(A) at 7 m
Euclid dumper – 40 tonne travelling loaded	76 dB(A) at 26 m
Dry screening plant	86 dB(A) at 7 m

* Distance used due to restricted access at measurement site.

The maximum levels of noise are used in the calculations.

5.0 PREDICTED NOISE LEVELS

The operational noise levels have been predicted for the various stages of operation at each of the two extraction areas and also for the use of the two haul routes.

The predicted noise levels have been calculated on the following basis:

- Use of our version of CONCAWE computer model which has been calibrated for a number of quarry sites.
- 6 dB(A) attenuation for each doubling of distance and with excess attenuation at higher frequencies over distances greater than 100 m due to atmospheric absorption.
- Acoustic shielding provided by the following factors:
 - * Earth berm along the western boundary of the stage 1 extraction area, berm height variable between 2-3 m.
 - * Extraction from behind a 5 m high face which would extend to a depth of 12 metres.
 - * Initial use of extraction cells to maintain effective acoustic shielding until the depth of the extraction provides sufficient shielding over the surface area of the sand deposit being extracted.
 - * Earth berm adjacent to the haul route of 2-3 m height.
- Propagation of noise emissions over soft ground cover.
- Meteorological conditions consisting of:
 - * wind towards residence of 3 m/sec;
 - * high relative humidity and moderate air temperature;
 - * stability class D;

providing neutral to slightly adverse conditions.

- Sequence of operations include the use of the bulldozer only and during extraction the FEL, haul truck and processing plant.
- Separation distances (metres) based on CMA maps:

<u>LOCATION</u>	<u>STAGE 1 AREA</u>	<u>FINAL STAGES</u>	<u>ACROSS COUNTRY HAUL ROUTE</u>
A	650 - 900	950 - 1350	100
B	550 - 800	900 - 1300	380
C	1050 - 1250	1250 - 1450	600
D	260 - 600	500 - 950	230

5.1 Predicted Levels of Noise

The following levels of noise have been predicted from operations at the extraction area. Haulage generated noise levels are discussed separately.

Location A Stage 1 Area

Initial removal of overburden and forming berm.

Time period 2-4 weeks.

EPA allows excess of 20 dB(A) over the background during this initial 4 week construction period.

Extraction of sand using FEL:

- ⇒ upper level of sand deposit; 41 dB(A)
- ⇒ behind 5 m face; 32 dB(A)
- ⇒ as face depth increases past 8 m. < 30 dB(A)

Processing plant located behind berm and depth of extraction providing combined height of acoustic shielding of 5 m.

31 dB(A)

Final Area

Removal of overburden.

Extraction of sand using FEL:

- ⇒ upper level; 36 dB(A)
- ⇒ behind 5 m face; 28 dB(A)
- ⇒ at base of sand deposit behind 2-3 m high berm 30 dB(A)

Processing plant located behind 5 m high acoustic shielding.

31 dB(A)

Combined noise levels	-	Stage 1 area	34.5 dB(A)
	-	Final area	33.5 dB(A)
Acoustic design objective			35.5 dB(A)

Comment: Complies.

Location B Stage 1 Area

Initial removal of overburden and forming berms – time period 2-4 weeks.

Extraction of sand using FEL:

- ⇒ upper level of sand deposit; 42 dB(A)
- ⇒ behind 5 m face; 31 dB(A)
- ⇒ as face depth increases past 8 m. < 30 dB(A)

Processing plant located behind 5 m high acoustic shielding. 33 dB(A)

Final Area

Removal of overburden.

Extraction of sand using FEL:

- ⇒ upper level of sand deposit; 36 dB(A)
- ⇒ behind 5 m face; 28 dB(A)
- ⇒ at base of sand deposit behind 5 m high acoustic shielding. 30 dB(A)

Combined noise levels - Stage 1 area 35.1 dB(A)

- Final area 33.5 dB(A)

Acoustic design objective 36 dB(A)

Comment: complies.

Location C Stage 1 Area

Initial removal of overburden and forming berms – time period 2-4 weeks.

Extraction of sand using FEL:

- ⇒ upper level of sand deposit; 37 dB(A)
- ⇒ behind 5 m face; < 30 dB(A)
- ⇒ as face depth increases past 8 m. < 30 dB(A)

Processing plant located behind 5 m high acoustic shielding < 30 dB(A)

Final Area

Removal of overburden.

Extraction of sand using FEL:

- ⇒ upper level of sand deposit; 36 dB(A)
- ⇒ behind 5 m face; < 30 dB(A)
- ⇒ at base of sand deposit behind 5 m high acoustic shielding. < 30 dB(A)

Combined noise levels - Stage 1 area 33 dB(A)

- Final area 33 dB(A)

Acoustic design objective 37.5 dB(A)

Comment: complies with criteria.

Location D Stage 1 Area

Initial removal of overburden and forming berms – time period 2-4 weeks.

Extraction of sand using FEL:

- ⇒ upper level of sand deposit; 51 dB(A)
- ⇒ behind 5 m face; 32 dB(A)
- ⇒ as face depth increases past 8 m. < 30 dB(A)

Processing plant located behind 5 m high acoustic shielding 35 dB(A)

Final Area

Removal of overburden.

Extraction of sand using FEL:

- ⇒ upper level of sand deposit; 44 dB(A)
- ⇒ behind 5 m face; 33 dB(A)
- ⇒ at base of sand deposit behind 5 m acoustic shielding < 30 dB(A)

Combined noise level	-	Stage 1 area	35 dB(A)
	-	Final area	33 dB(A)
Acoustic design objective			36.5 dB(A)

Comment: complies with acoustic criteria except at initial period of forming berm and commencing extraction.

The noise impact assessment has not been extended to further residences as compliance has been achieved at those evaluated which are similar to all other residential areas. Residences on the Travarto and Camillari properties are associated with sand mining. There are further residences to the north of these properties along Old Northern Road and others on the western side of this road. These residences are either more distant or also have additional acoustic shielding and, therefore, would have noise levels lower than those predicted.

Haulage Route

There are two haulage routes proposed:

— Initially registered 16-20 tonne trucks would use Old Northern Road during daytime hours. The passage of these trucks is controlled by the RTA and need to satisfy EPA traffic noise criteria of an L_{A10} 18 hours of 60 dB(A) and an L_{Aeq} 24 hours of 55 dB(A). As the number of truck movements would be 75 laden and the same number unladen (ie. 150) over a 12 hour period, the average of 12.5 vehicle movements per hour or on average one every 5 minutes would not exceed the traffic noise criteria.

— Long term there are benefits if an across country haul route is used. This route would enable 40 tonne dump trucks to be used and, therefore, the total number of truck movements would be reduced to 76 or on average 1 every 9.5 minutes. As these trucks would be off the public road system, many residents would consider this to be an advantage.

The haul route could be constructed at a reduced RL level so that berms are formed in the direction towards nearest residences. Typical maximum noise levels expected at the nearest residences have been estimated based on the use of Euclid dump trucks.

Location	A	34 dB(A) using 5 m depth cut and berm for acoustic shielding
	B	< 30 dB(A) using 3 m depth cut and berm for acoustic shielding
	C	< 30 dB(A) using 3 m depth cut and berm for acoustic shielding
	D	< 30 dB(A) using 4 m depth cut and berm for acoustic shielding

Further detailed evaluation of the use of the haul route may prove warranted, the use of an across country route is considered to have numerous environmental benefits and should be investigated in more detail with a detailed acoustical assessment desirable.

6.0 STATEMENT OF IMPACT

The sand mining industry in this area has been able to operate by using specific measures to reduce noise nuisance and enable rehabilitation of land back to viable market gardens.

The proposed extraction of two deposits of sand would also be able to satisfy acceptable acoustic criteria. Long term community noise monitoring has taken place and the results used to determine acoustic design objectives to protect the amenity of nearest residents.

The assessment that has been undertaken has found that the use of earth berms and extraction taking place from behind working faces would provide sufficient noise control. The mobile equipment in use generates low noise levels and is free of tonal or other annoying characteristics. Frequently other agricultural equipment and diesel powered irrigation pumps are audible such that the sand extraction operations are not of a sufficiently different noise character to be intrusive.

Further noise control measures are not considered warranted.

R T Benbow
Principal Consultant

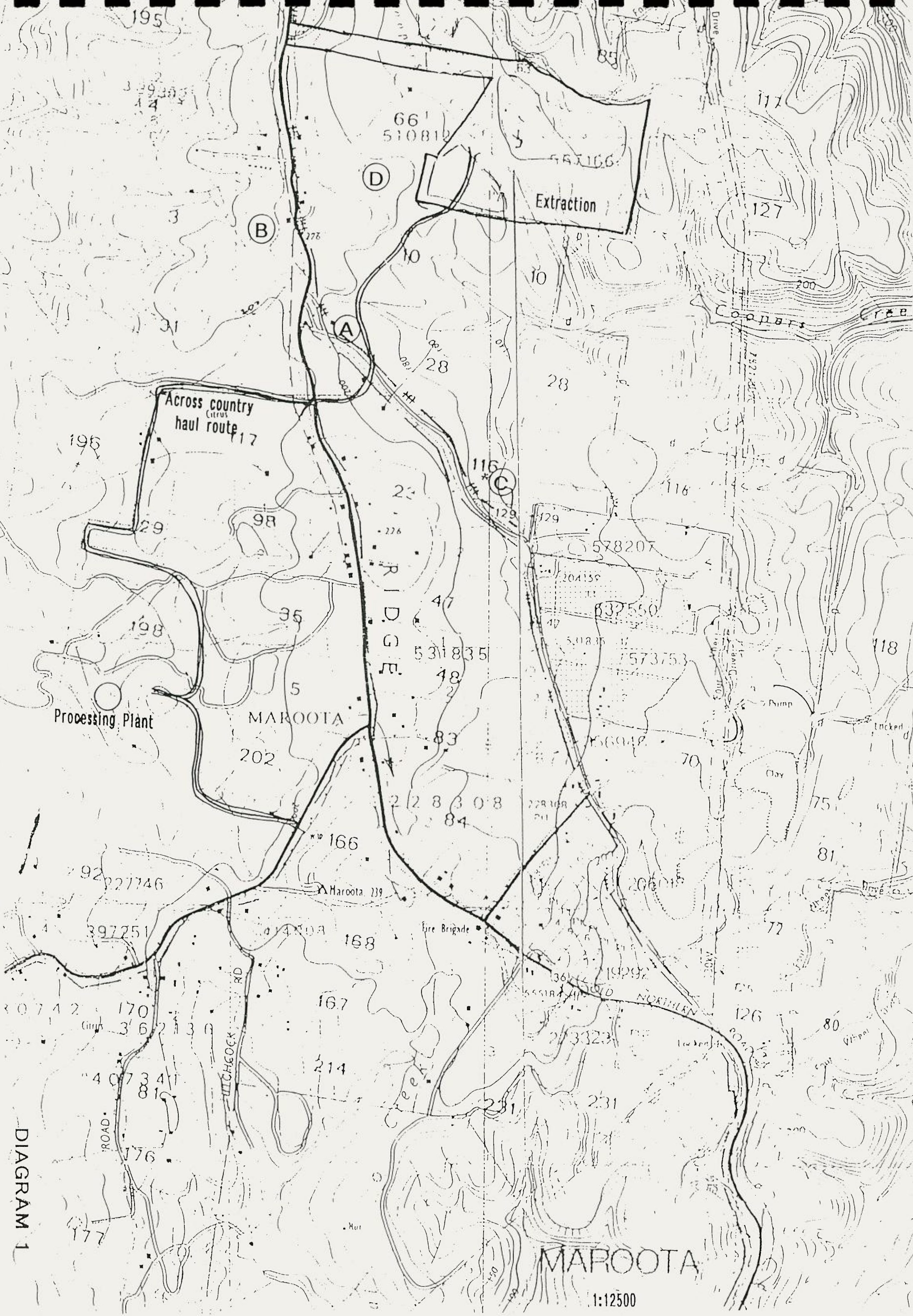
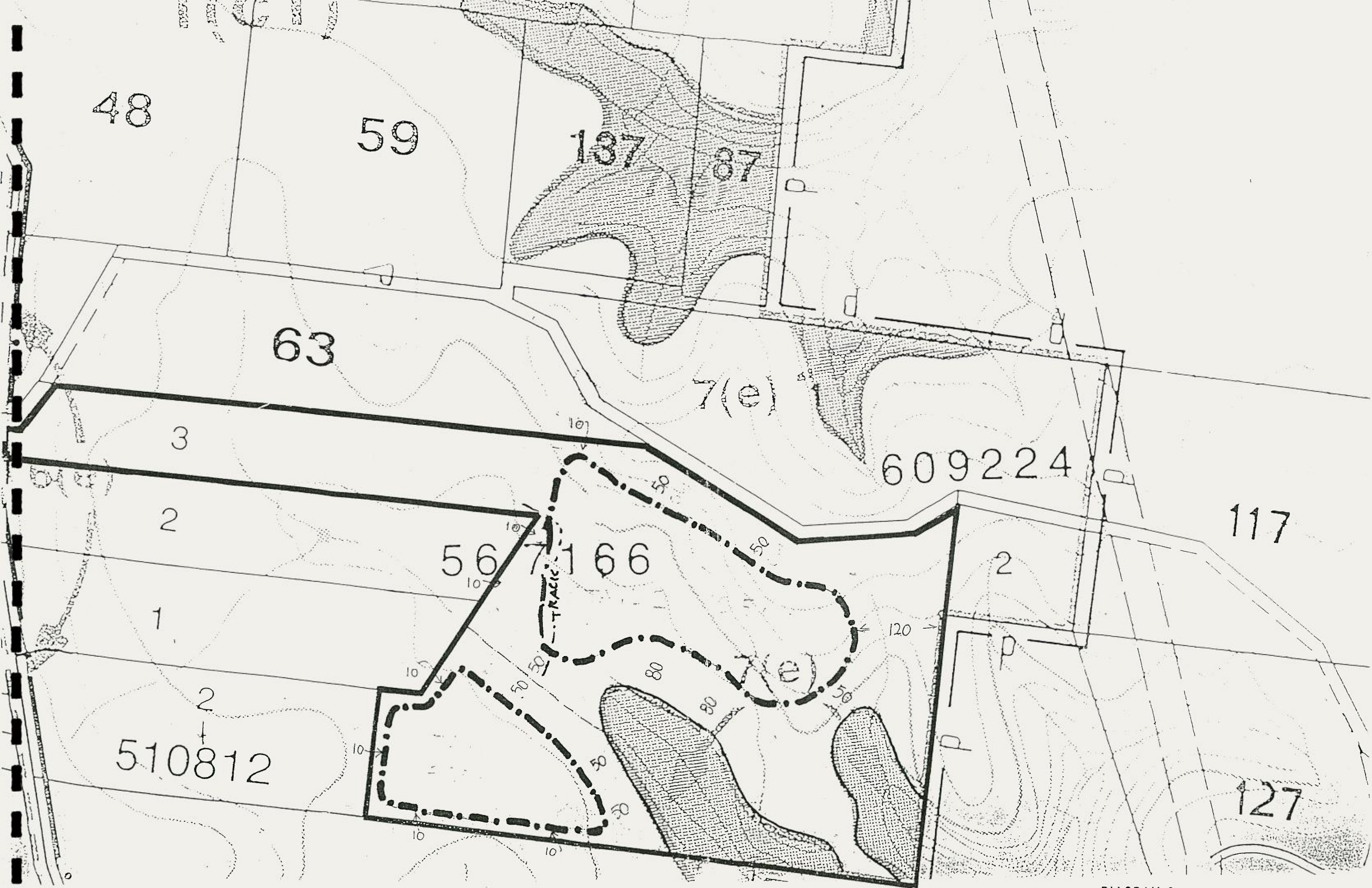
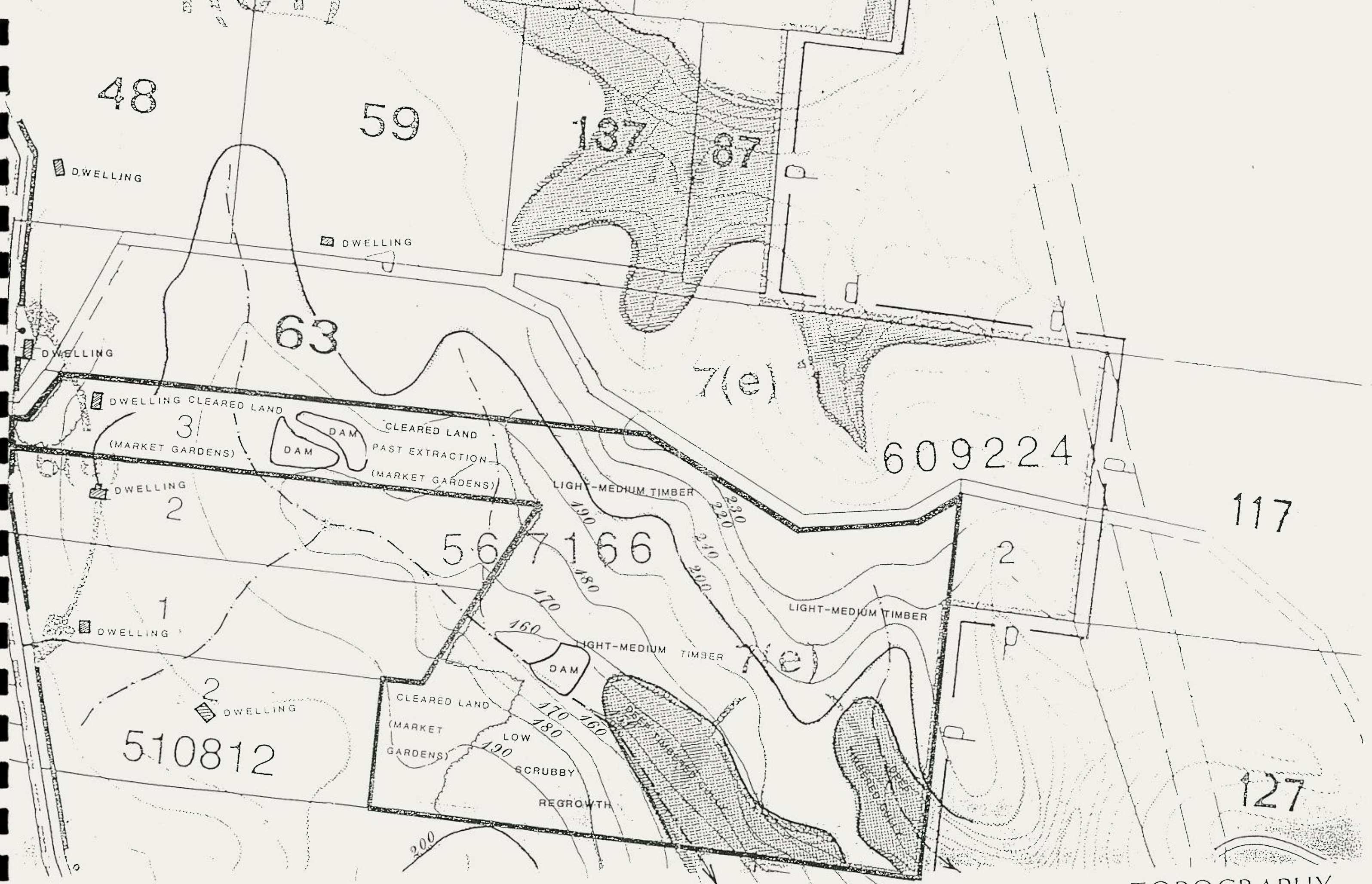


DIAGRAM 1



1:500

DIAGRAM 2
SITE LAYOUT

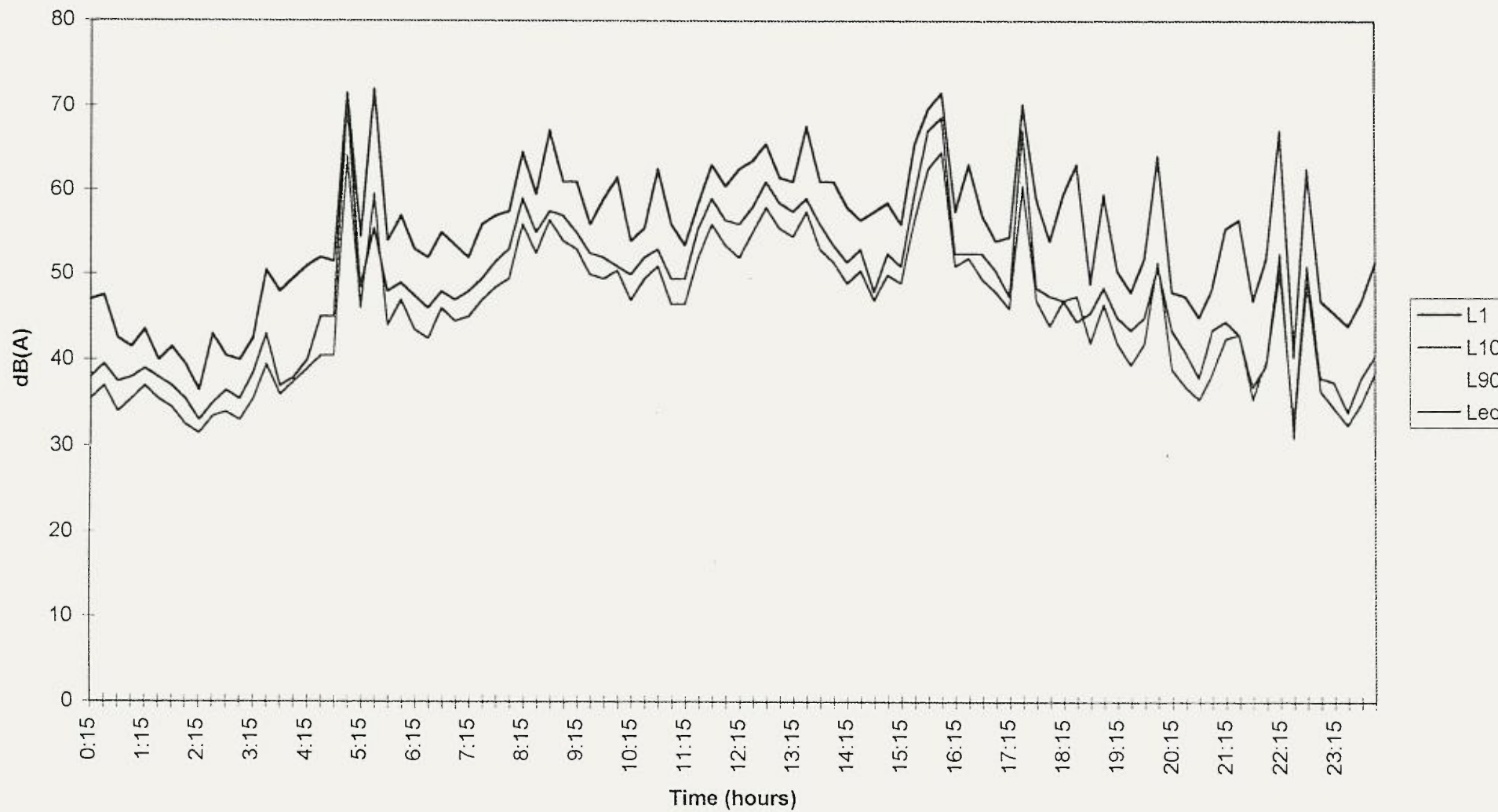


TOPOGRAPHY
DIAGRAM 3

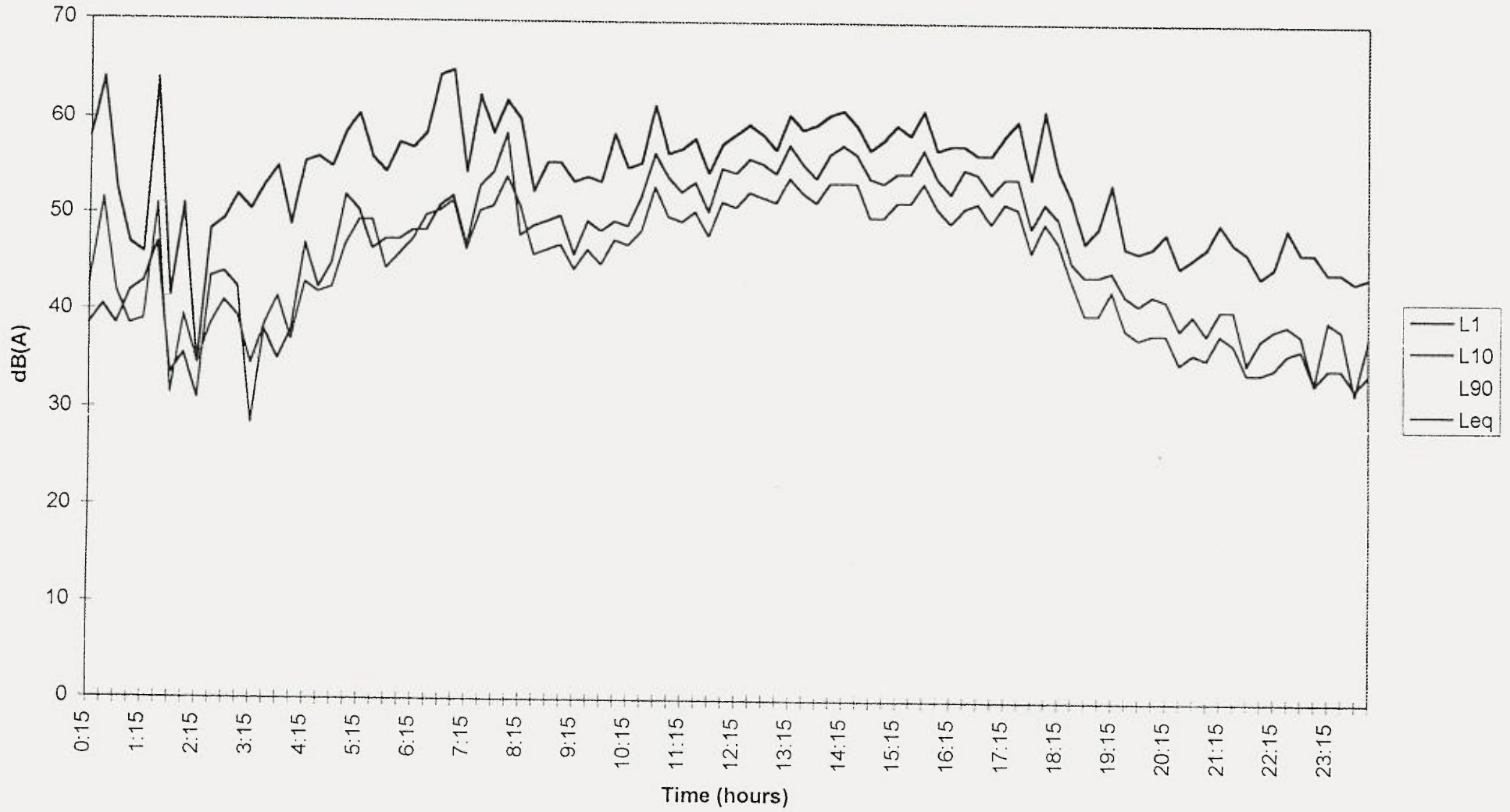
1:500

ATTACHMENTS

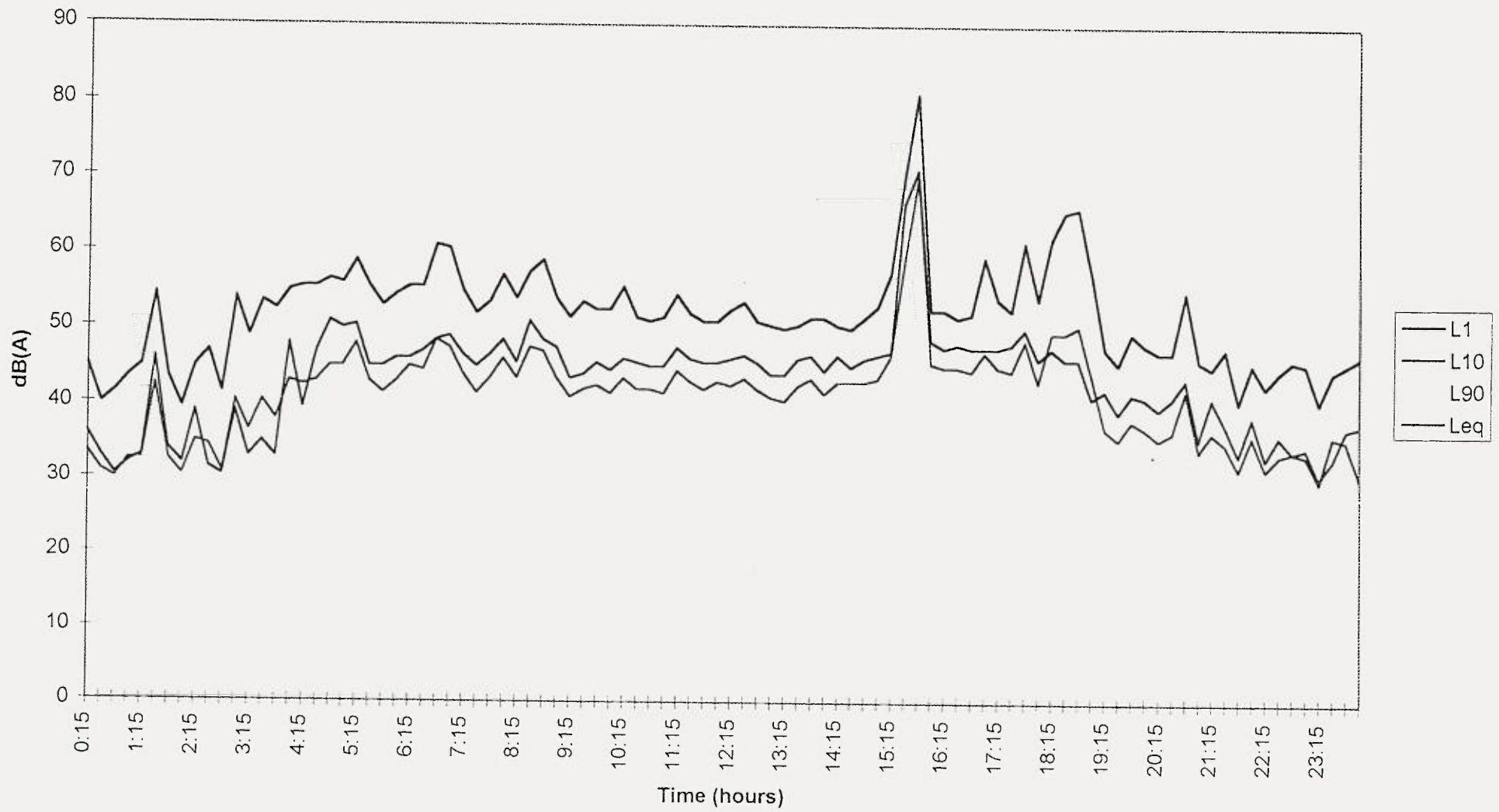
Location A - Background Noise Levels (7/10/94)



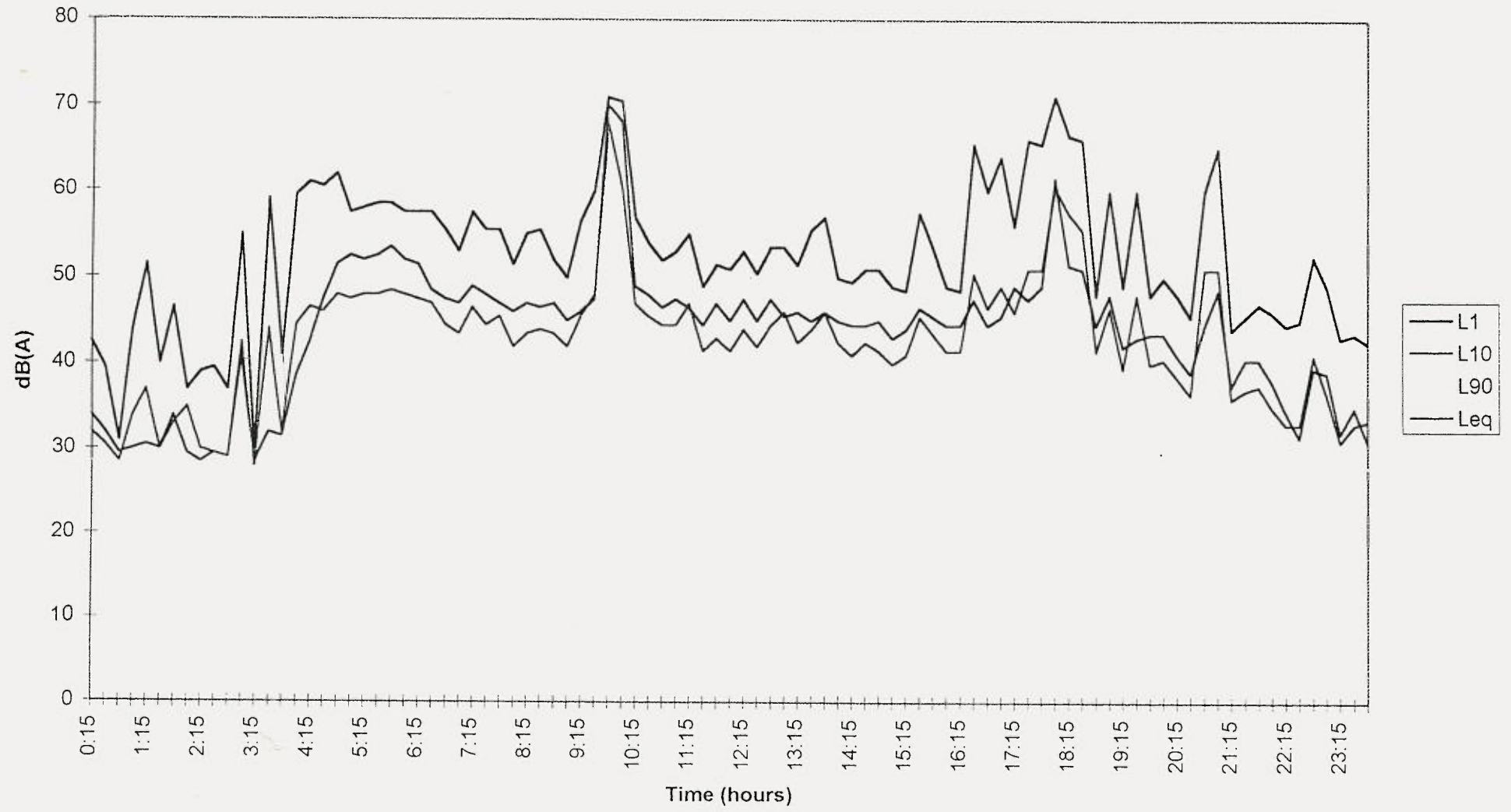
Location A - Background Noise Levels (8/10/94)



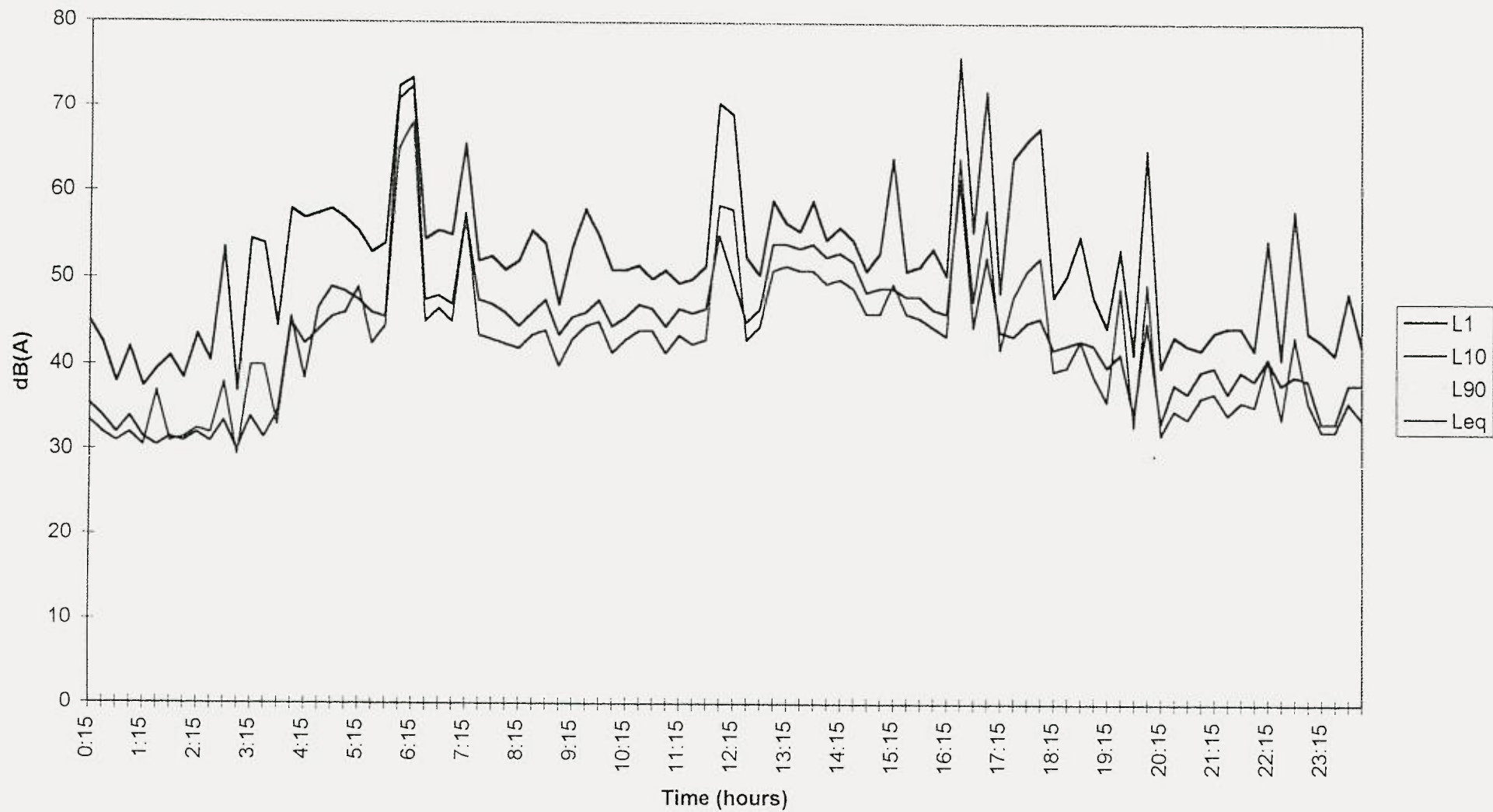
Location A - Background Noise Levels (9/10/94)



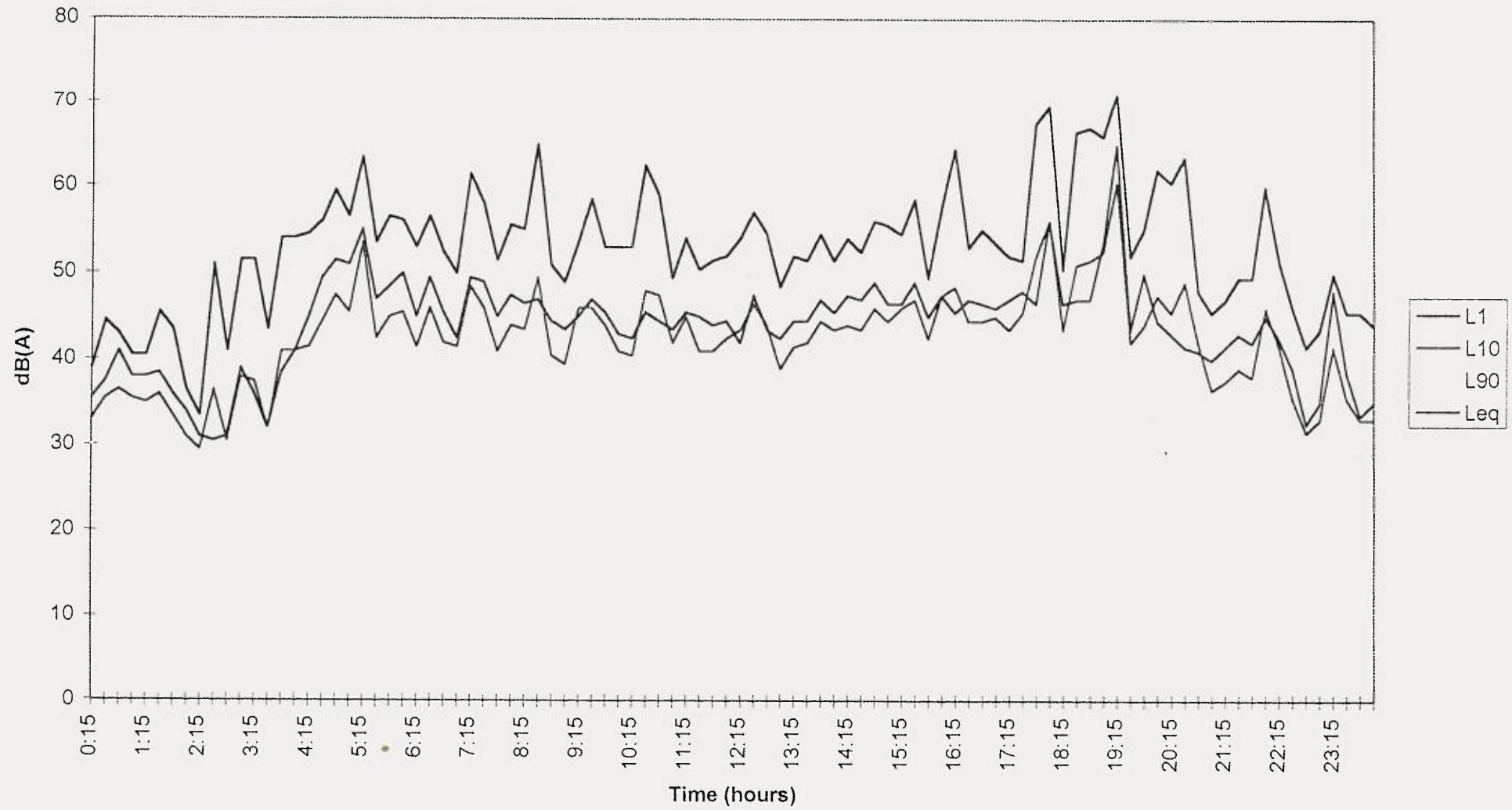
Location A - Background Noise Levels (10/10/94)



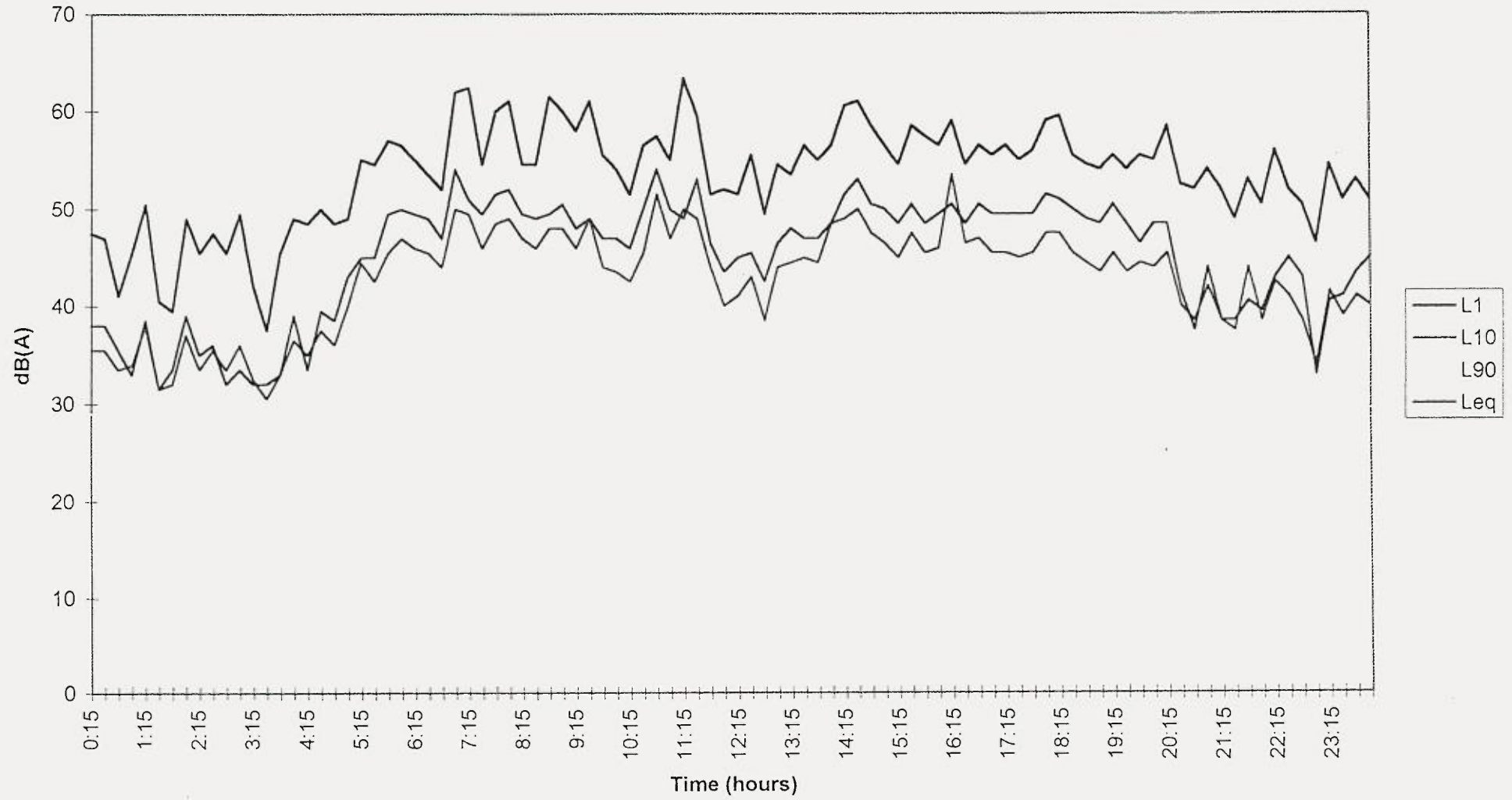
Location A - Background Noise Levels (11/10/94)



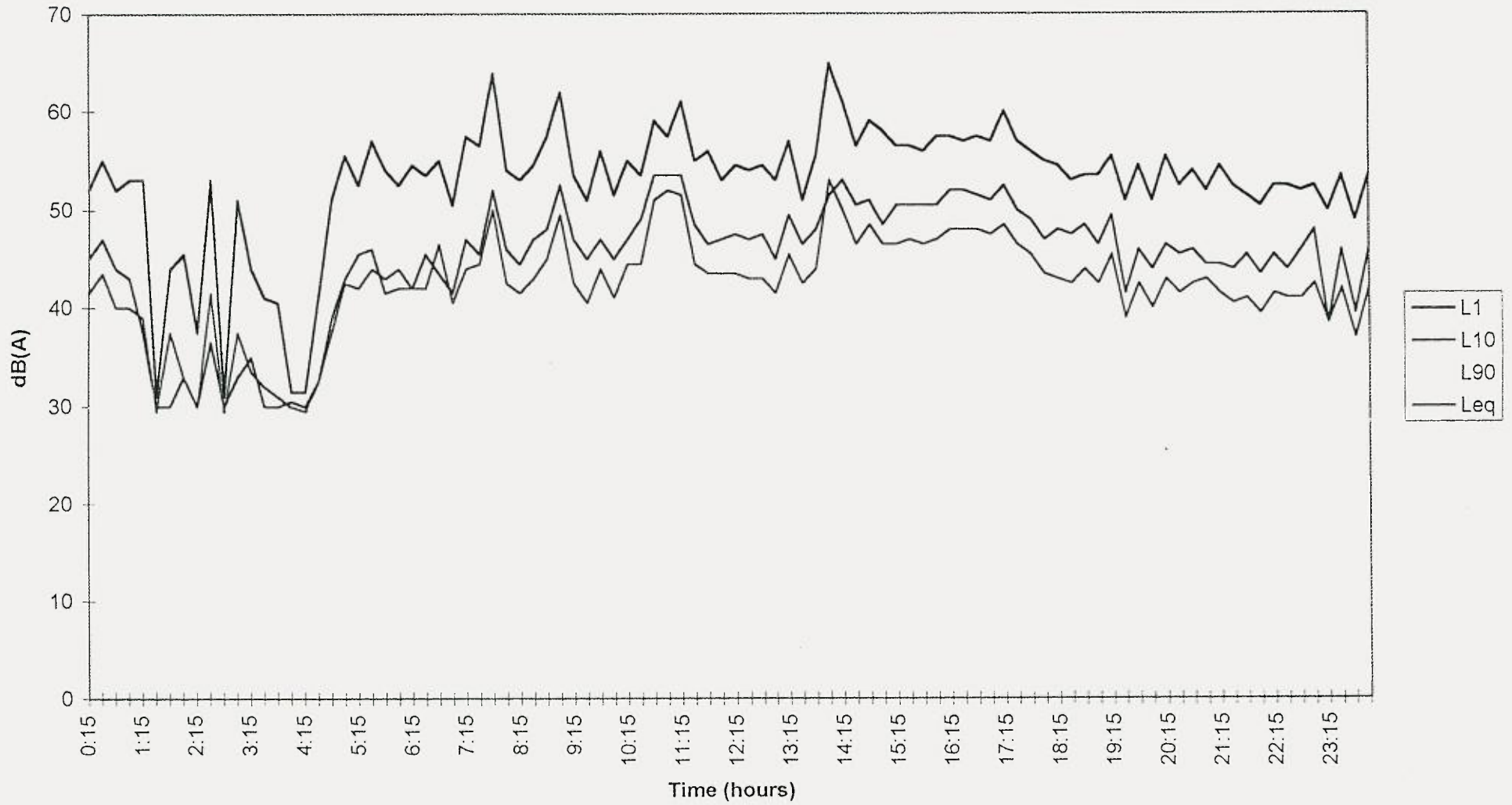
Location A - Background Noise Levels (12/10/94)



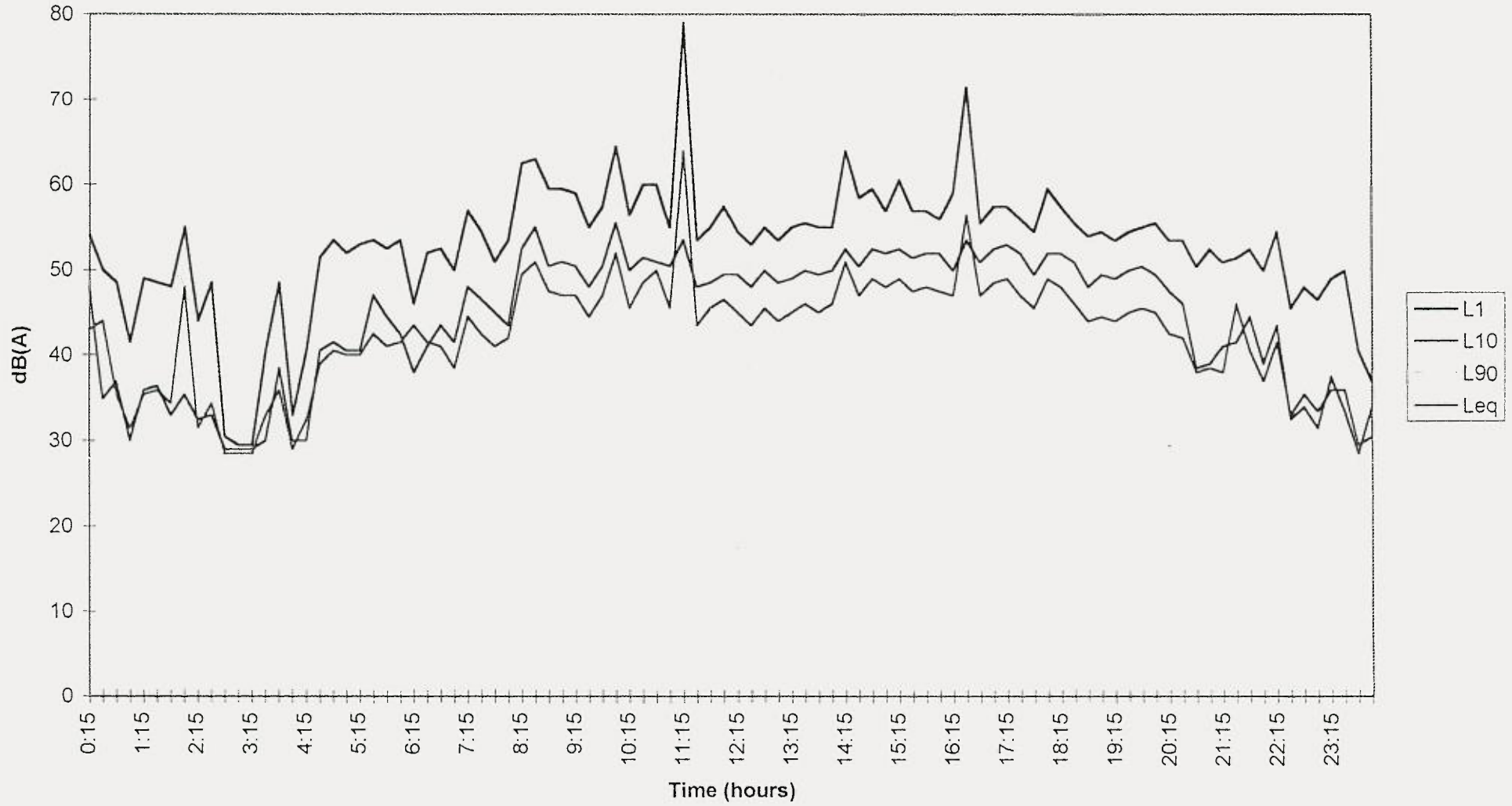
Location B - Background Noise Levels (14/10/94)



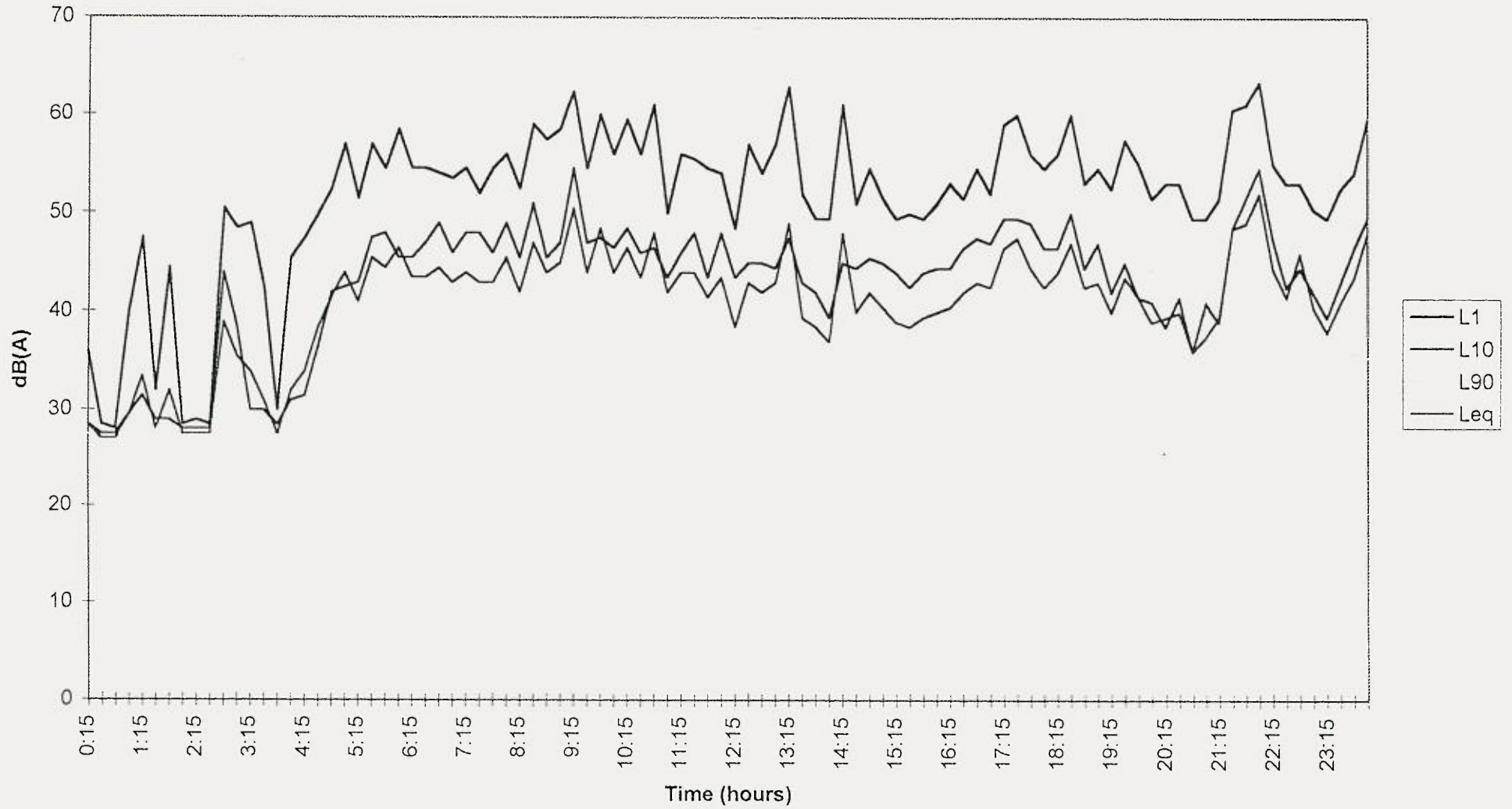
Location B - Background Noise Levels (15/10/94)



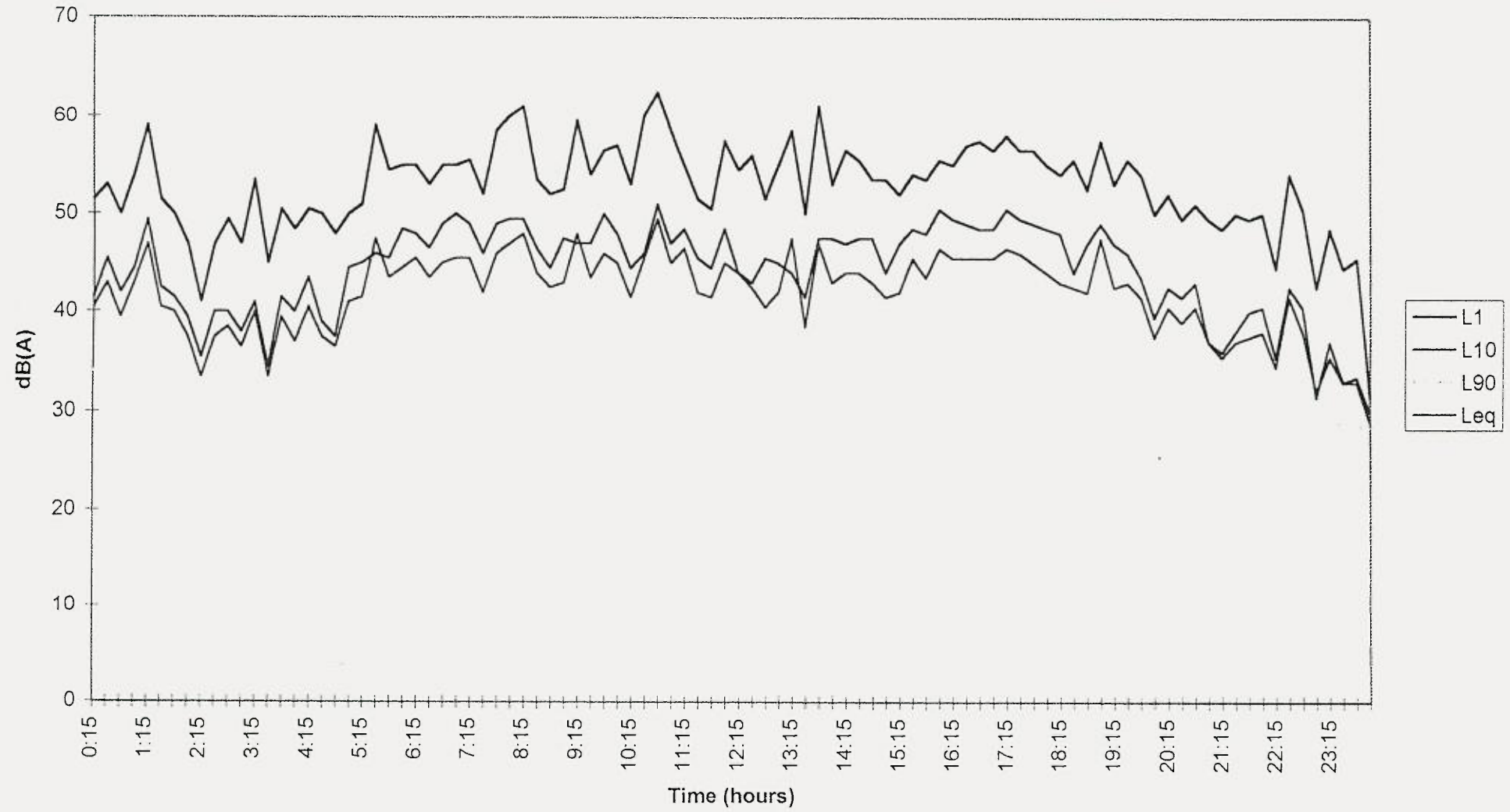
Location B - Background Noise Levels (16/10/94)



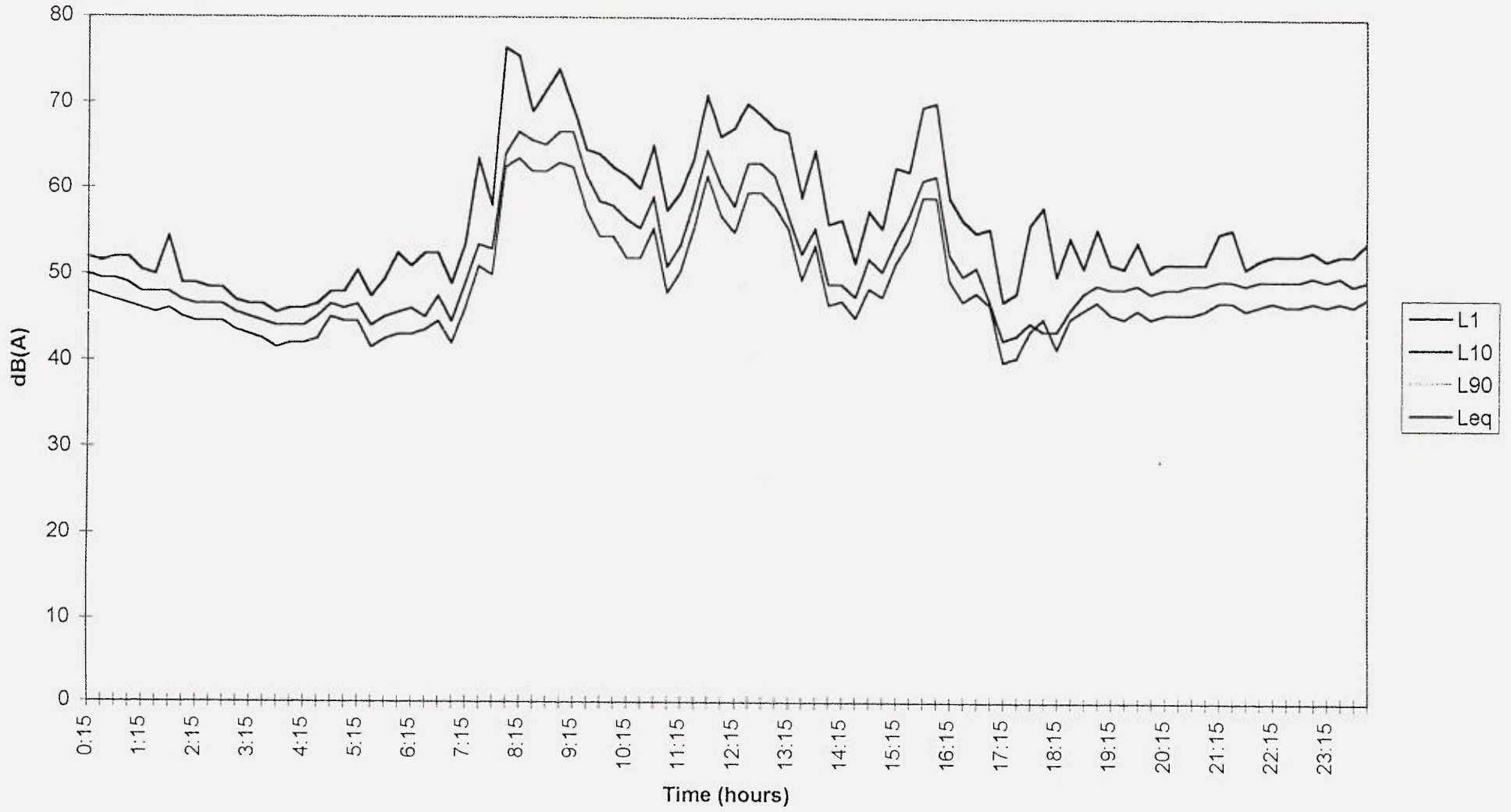
Location B - Background Noise Levels (17/10/94)



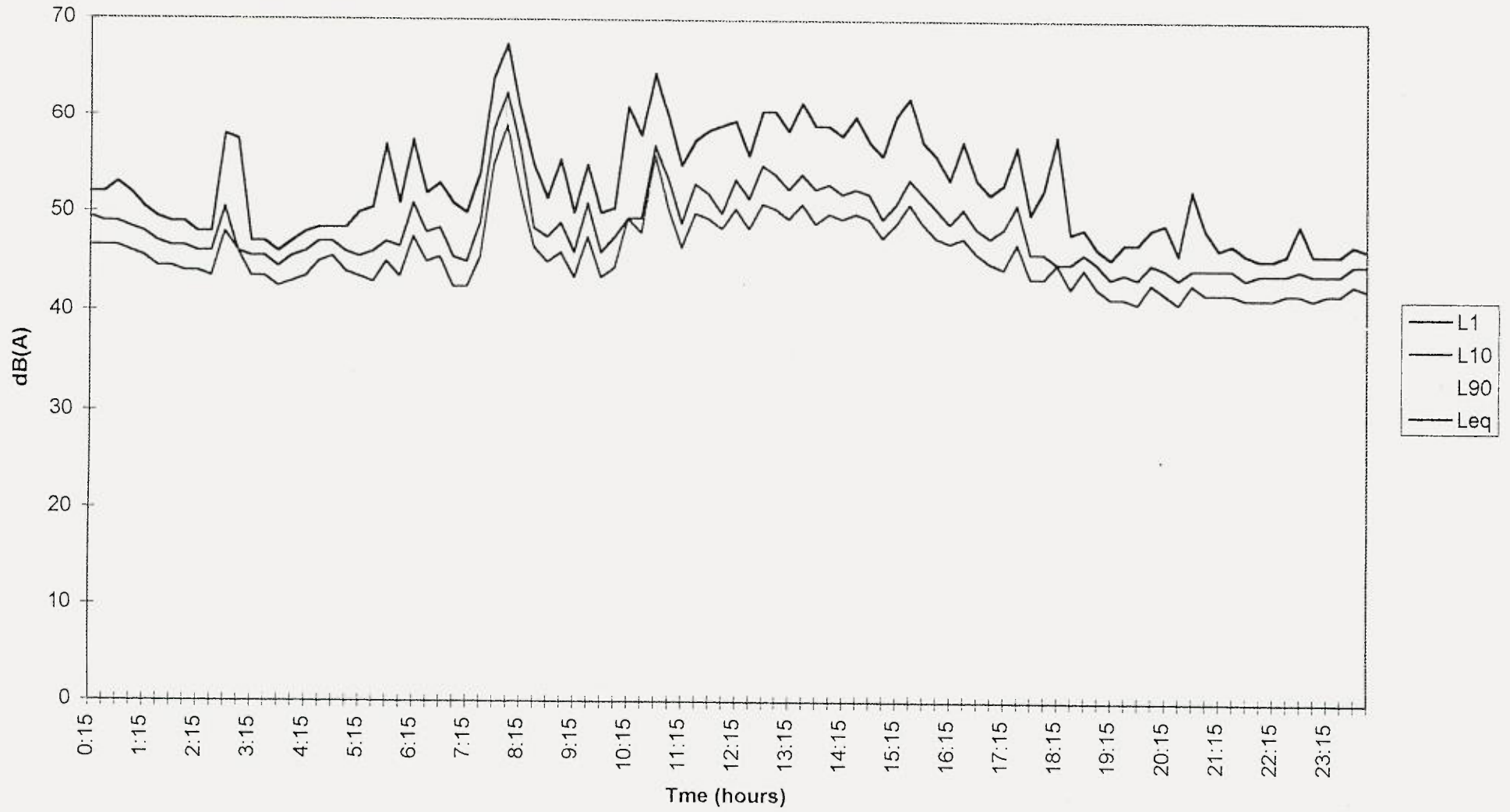
Location B - Background Noise Levels (18/10/94)



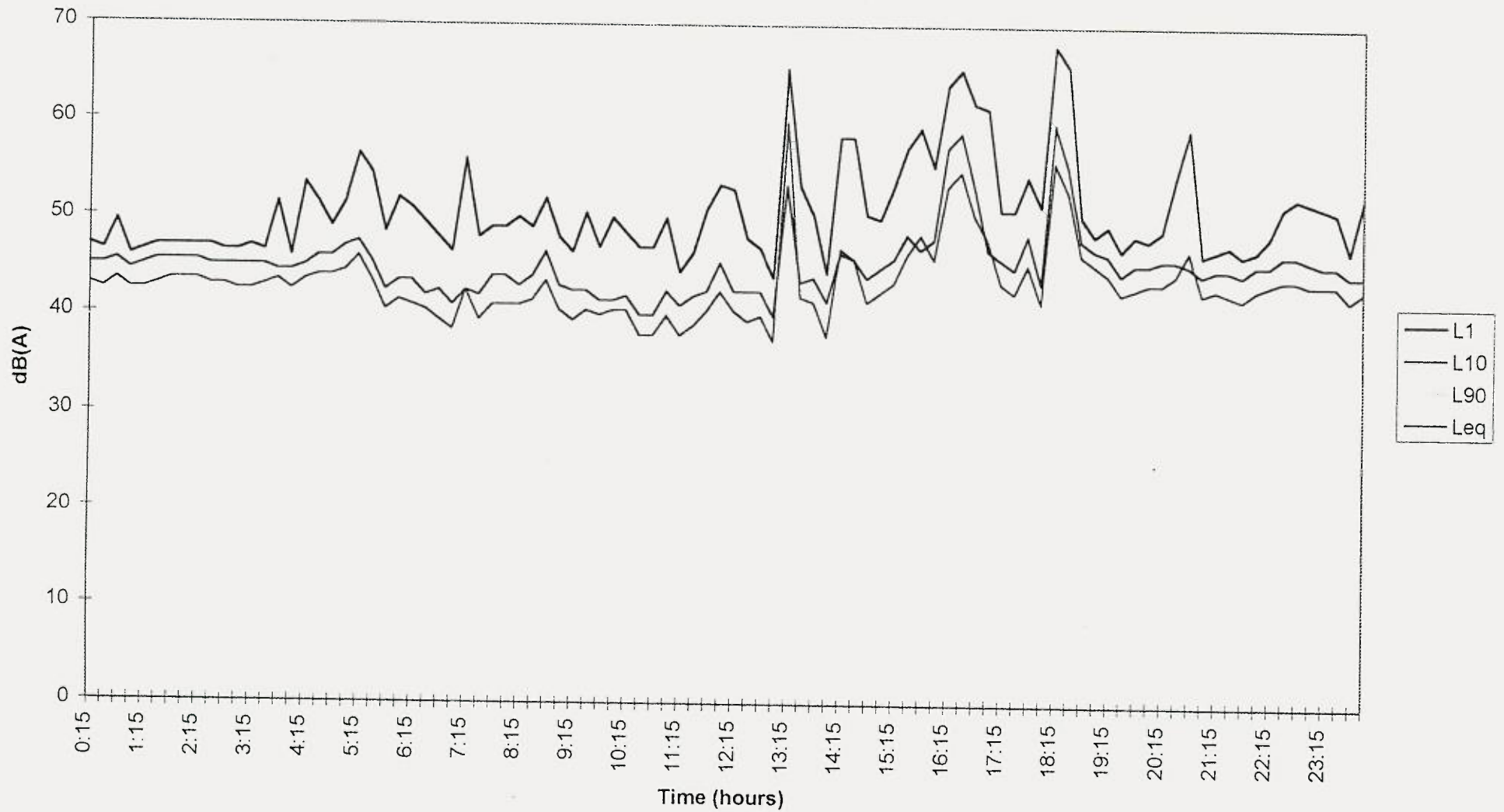
Location C - Background Noise Levels (7/10/94)



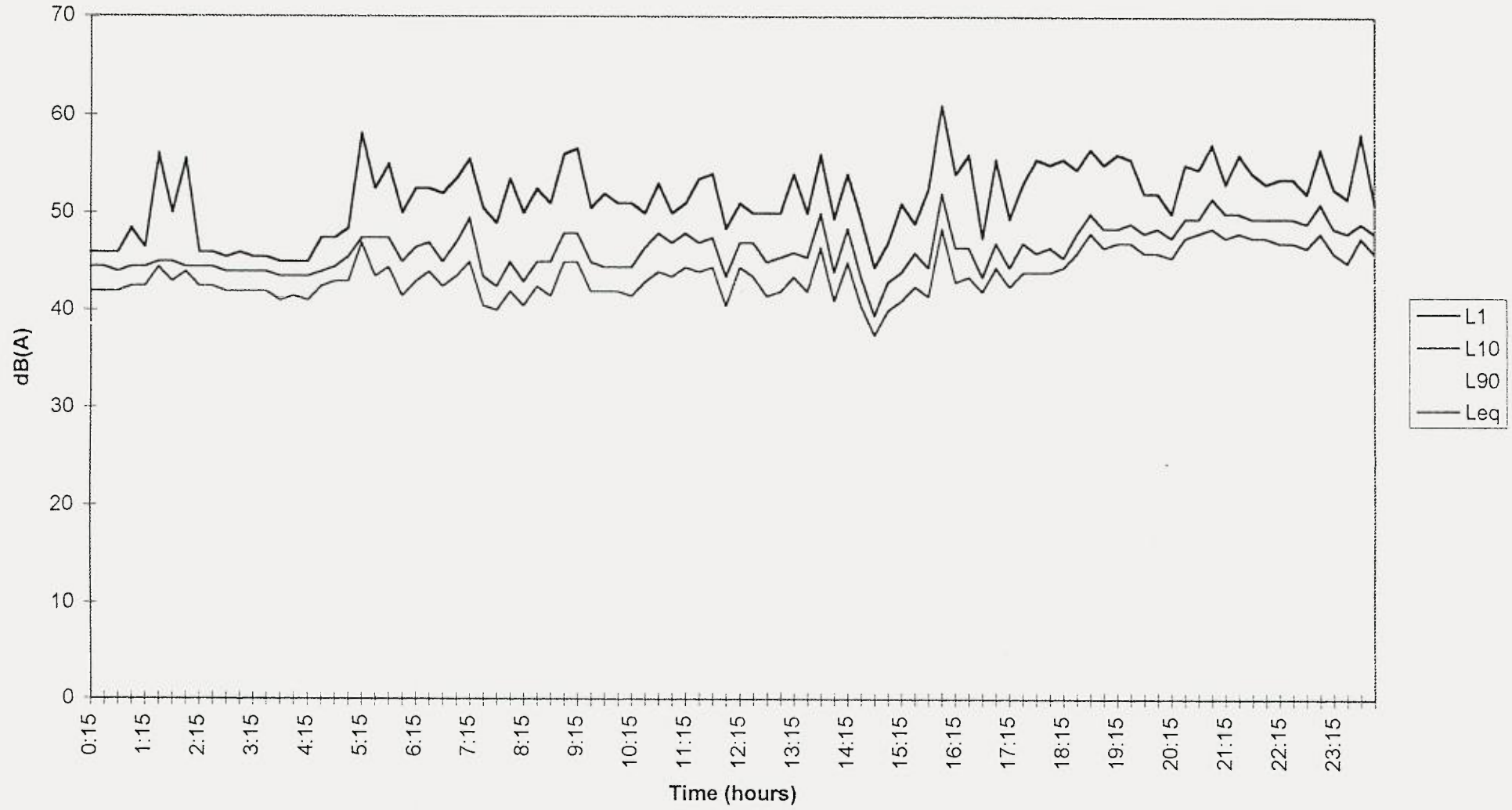
Location C - Background Noise Levels (8/10/94)



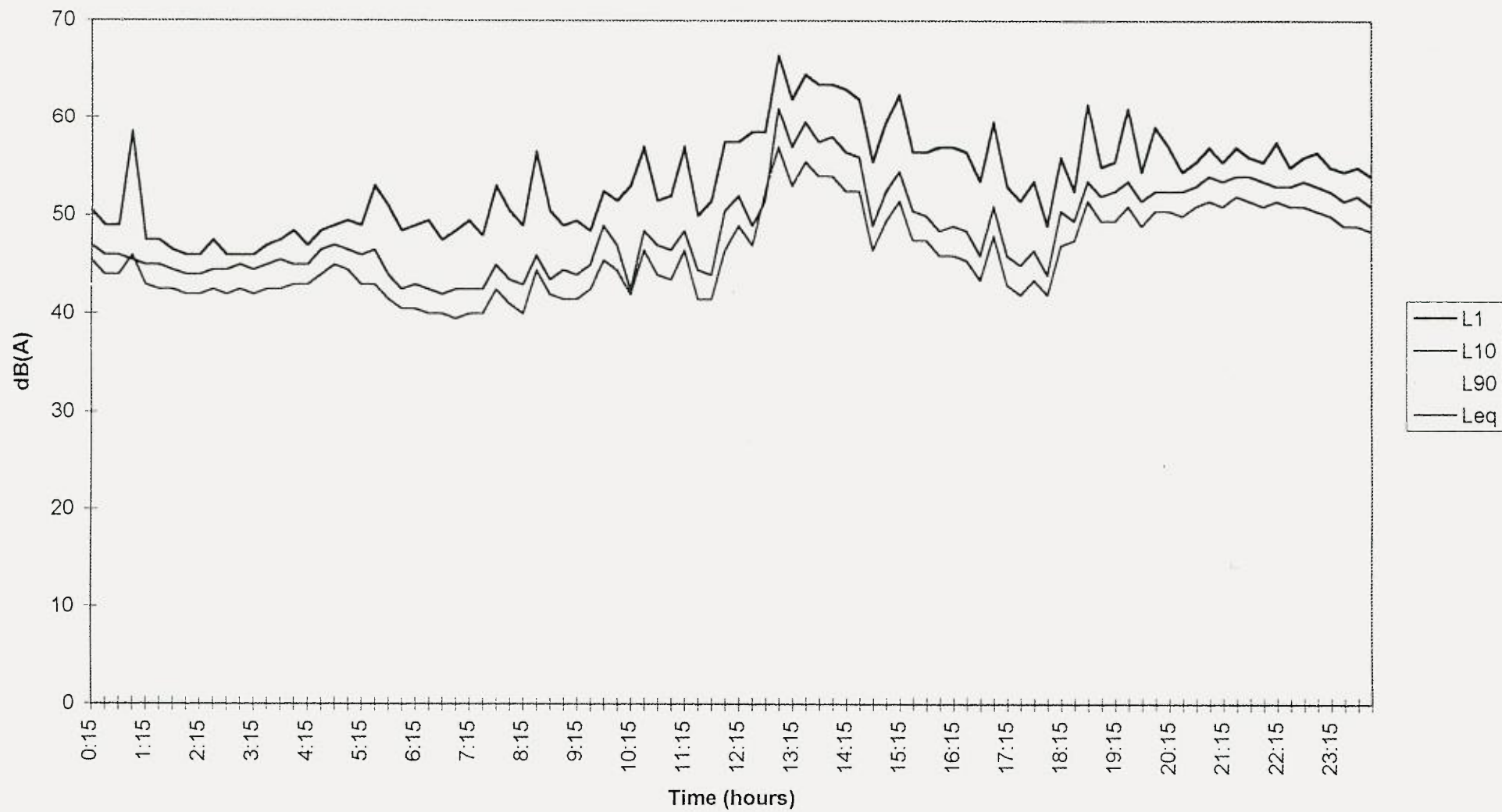
Location C - Background Noise Levels (9/10/94)



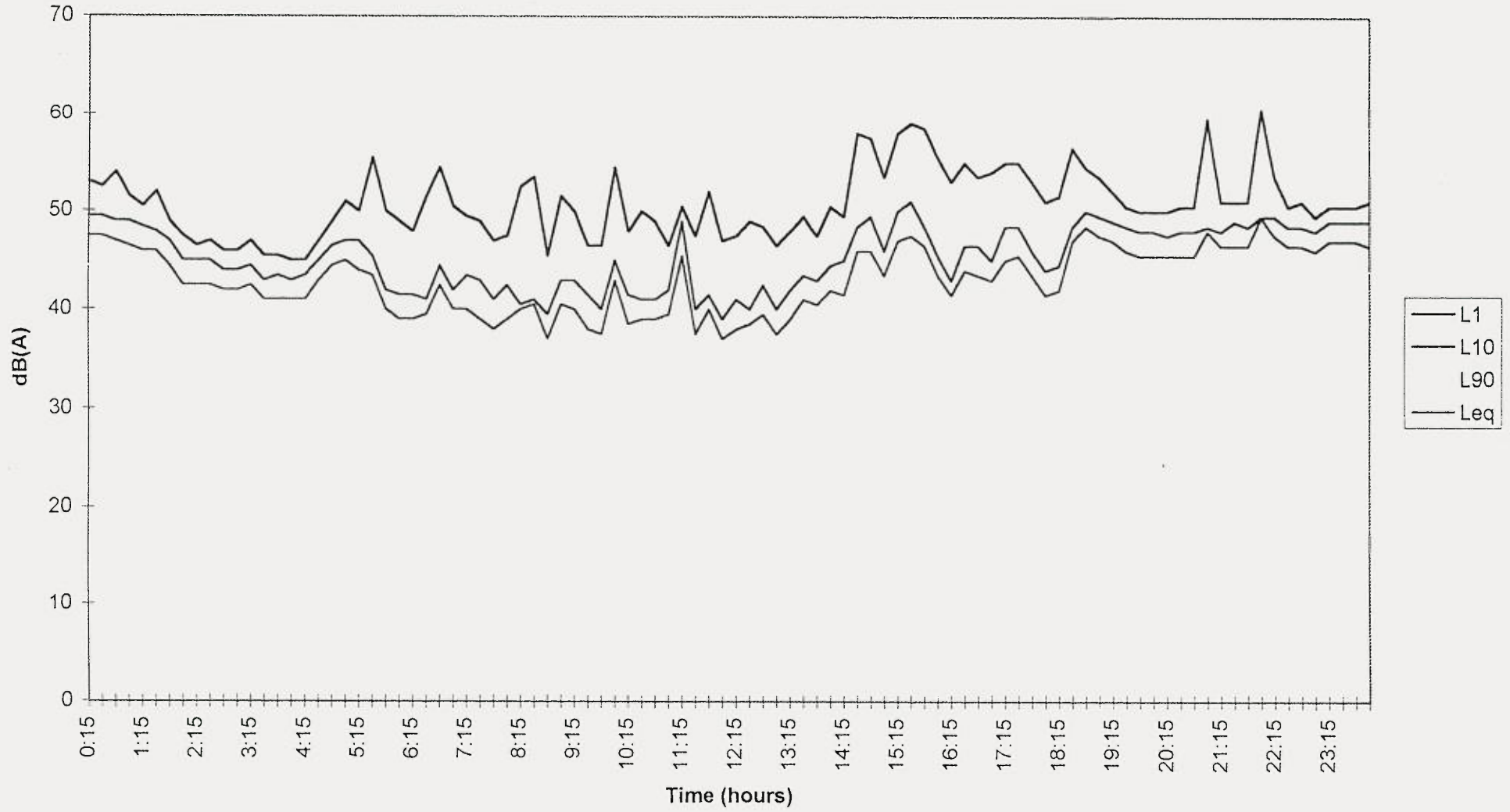
Location C - Background Noise Levels (10/10/94)



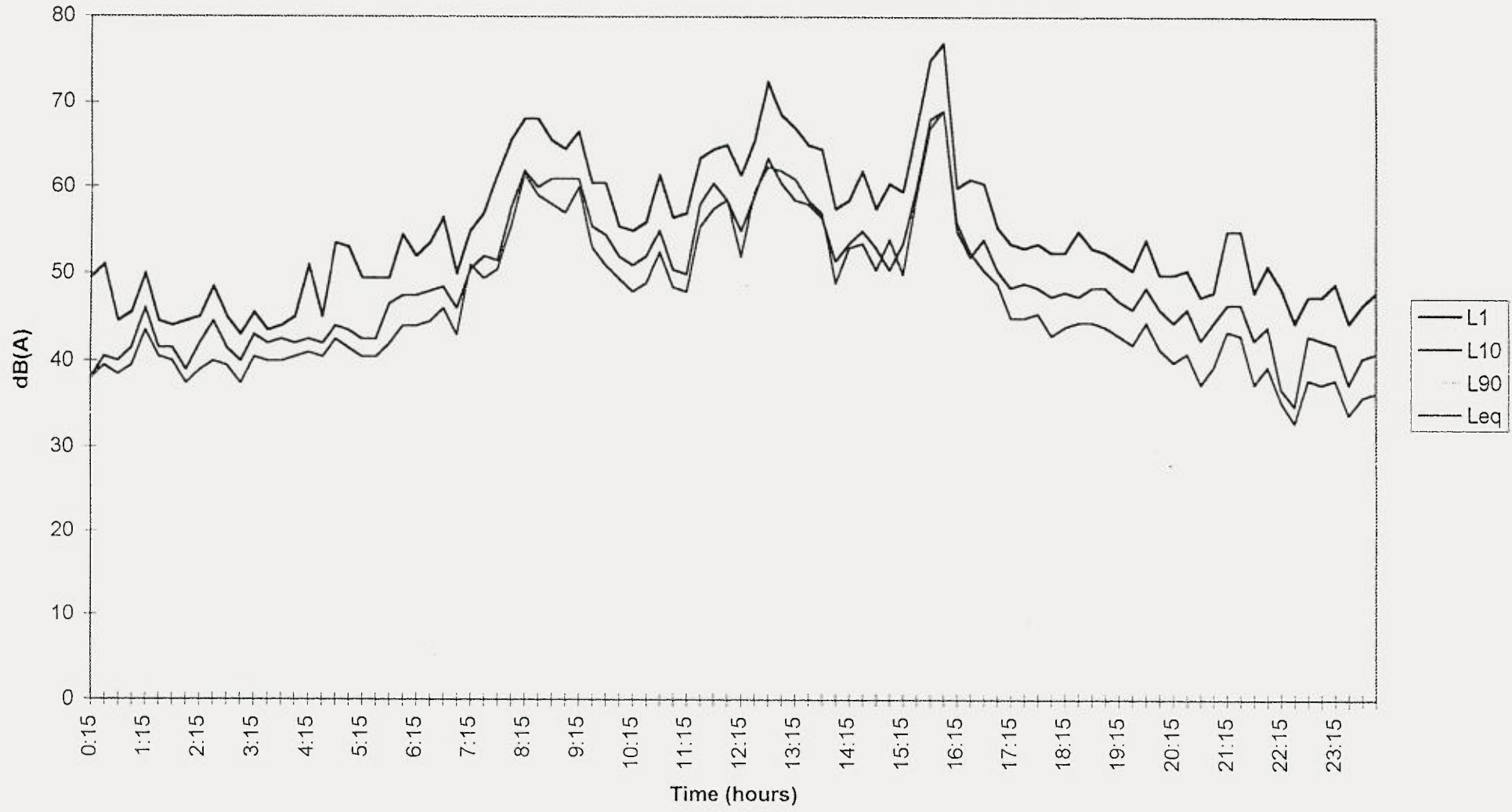
Location C - Background Noise Levels (11/10/94)



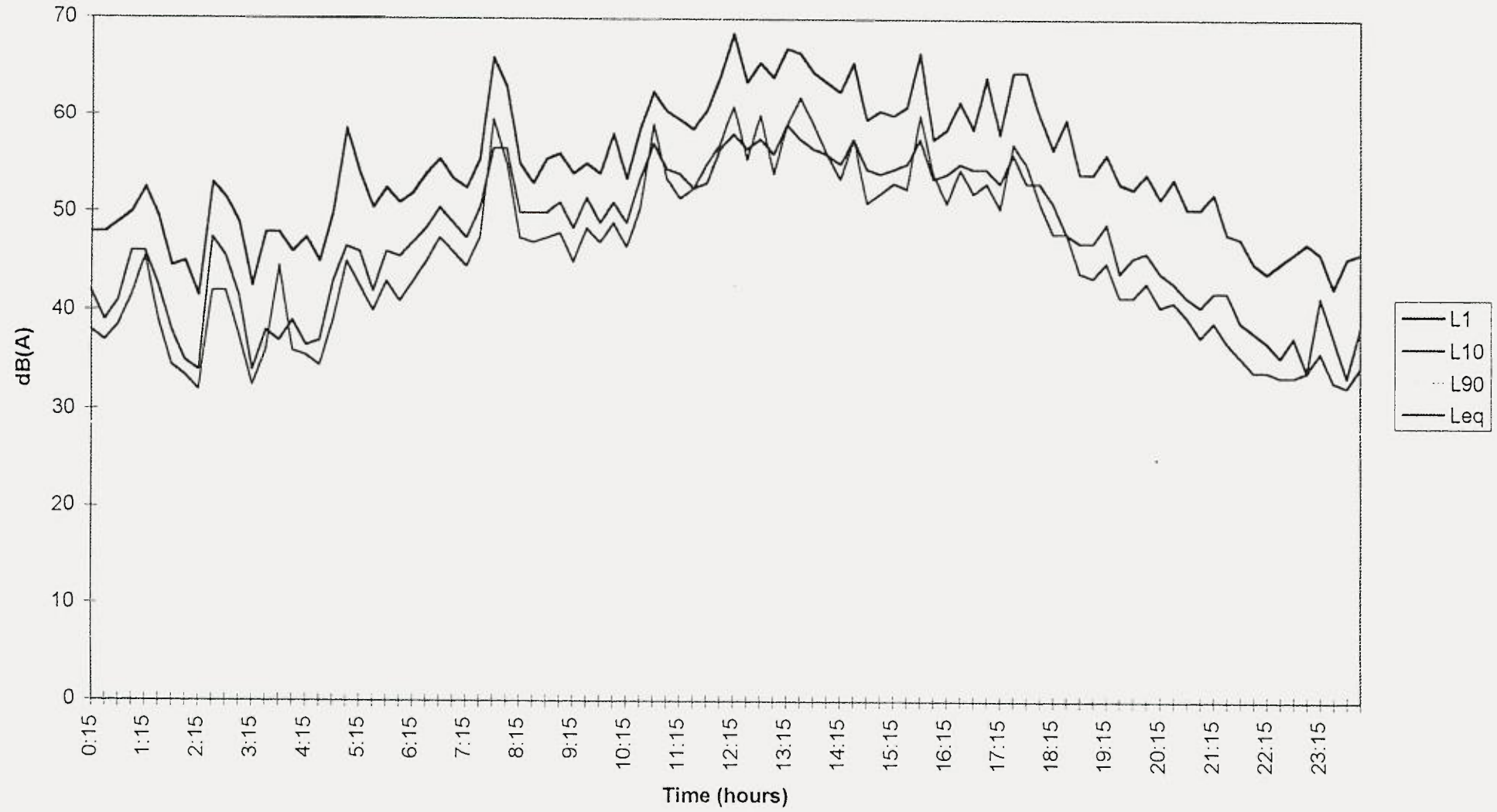
Location C - Background Noise Levels (12/10/94)



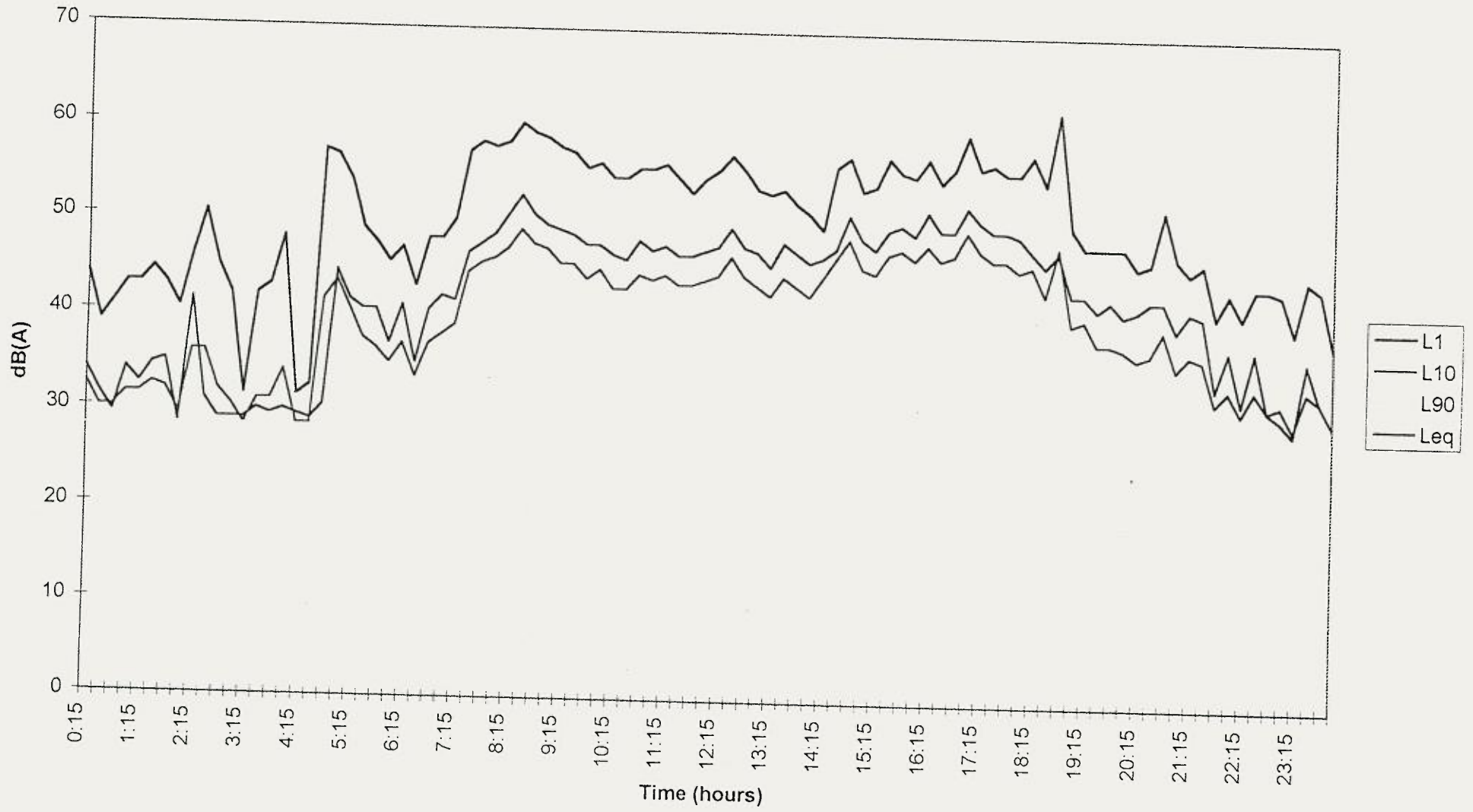
Location D - Background Noise Levels (7/10/94)



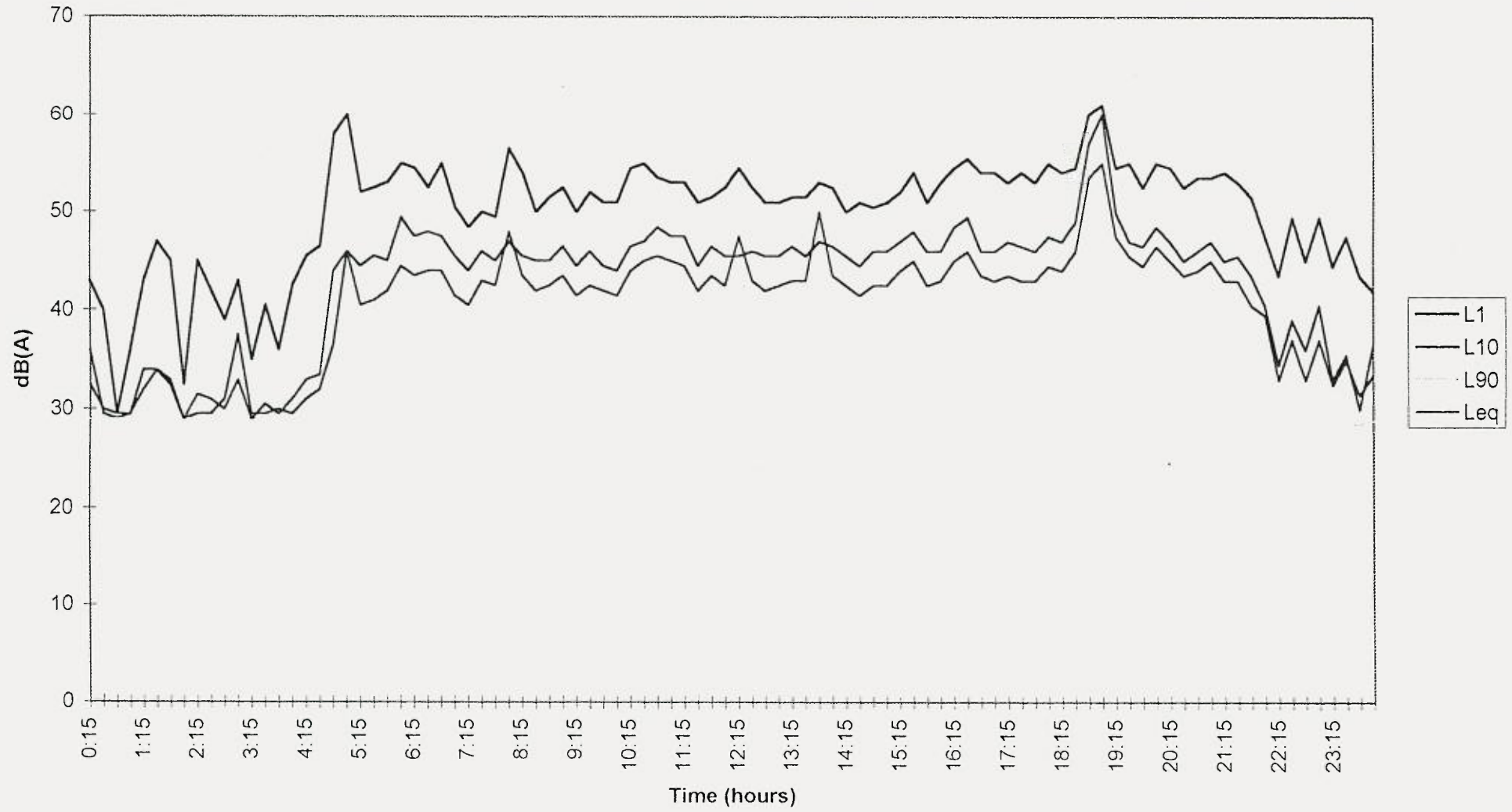
Location D - Background Noise Levels (8/10/94)



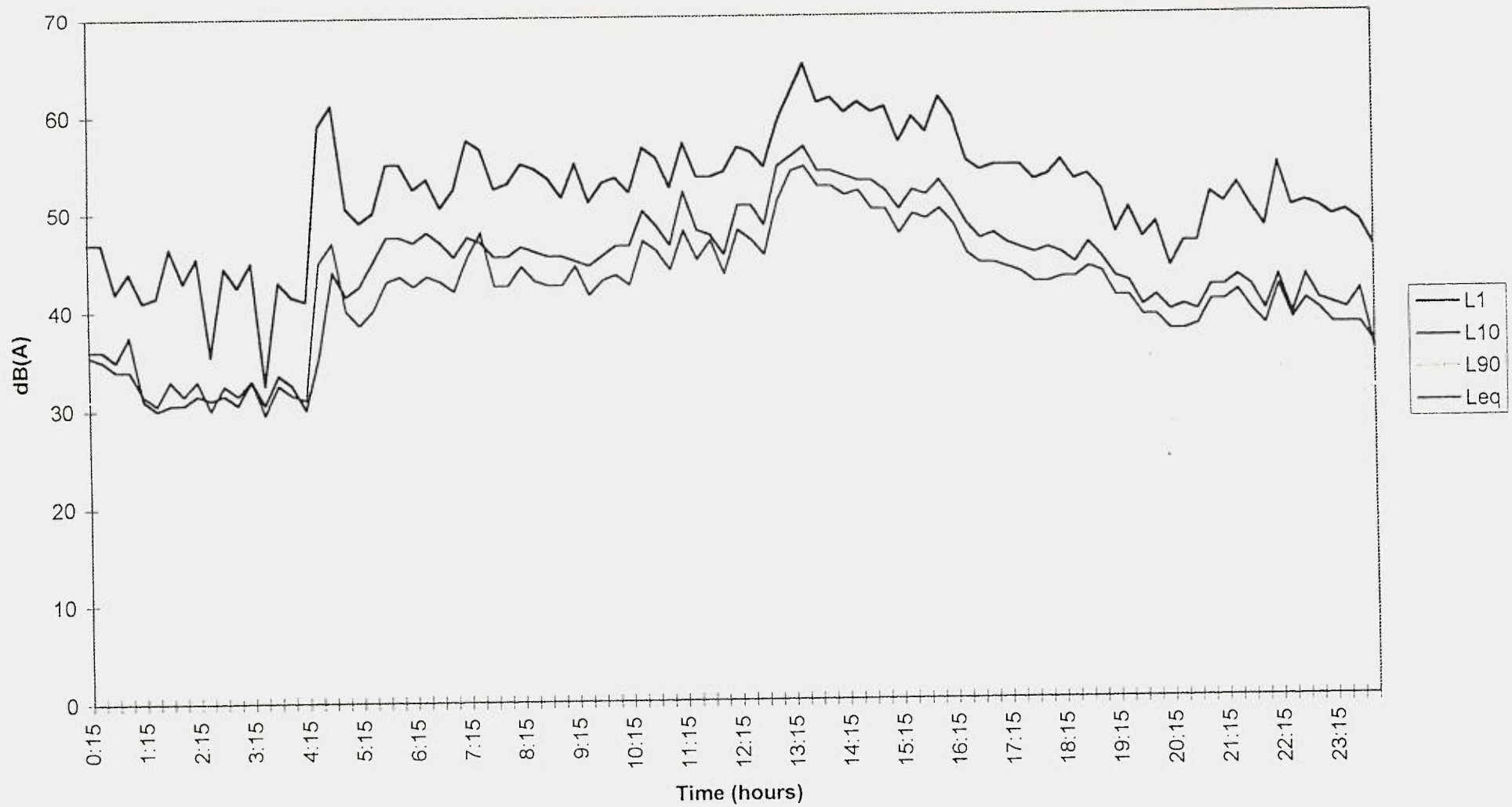
Location D - Background Noise Levels (9/10/94)



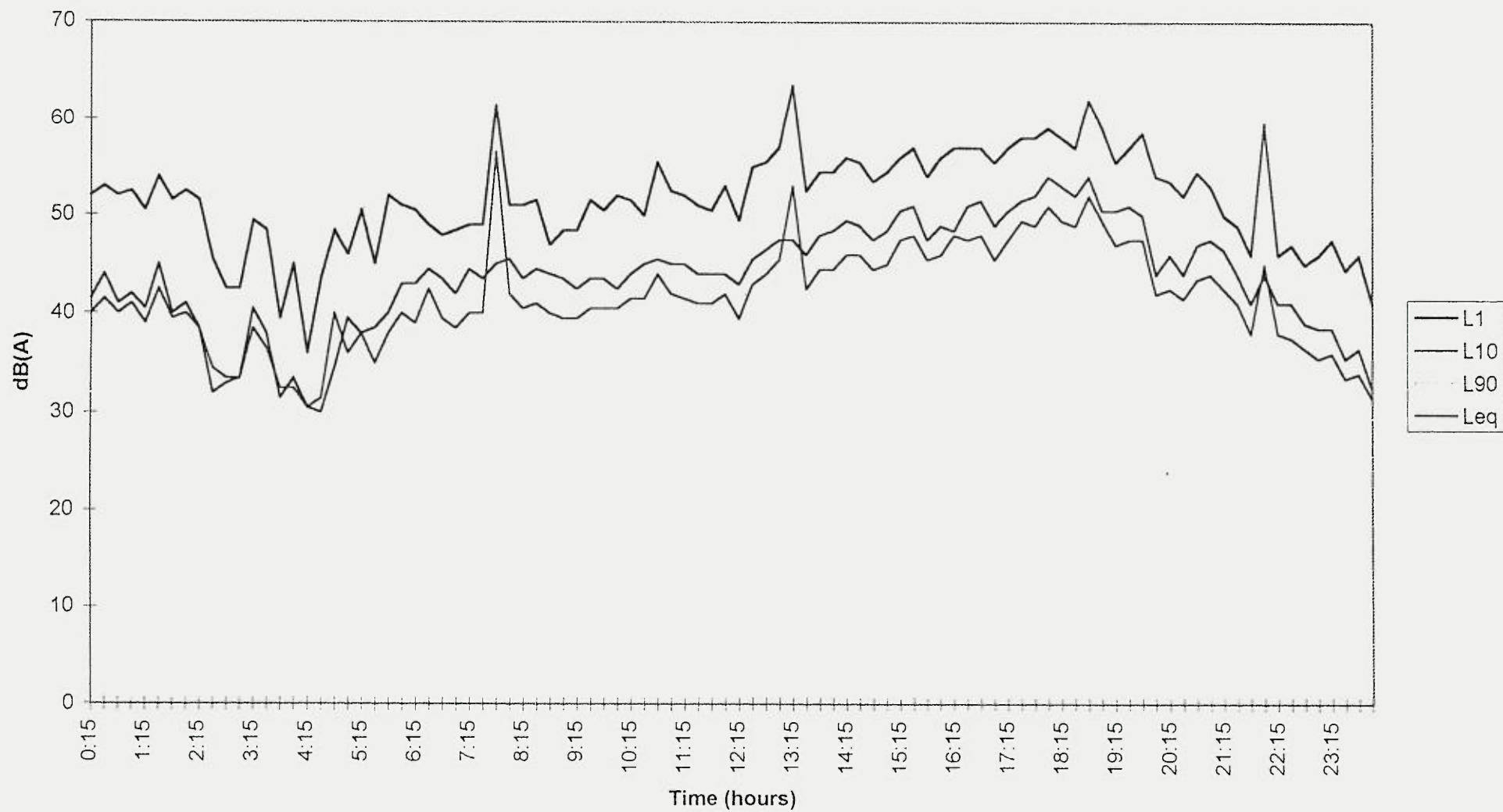
Location D - Background Noise Levels (10/10/94)



Location D - Background Noise Levels (11/10/94)



Location D - Background Noise Levels (12/10/94)



APPENDIX "E"

PART APPENDIX "E" - Vegetation Study

FLORA SURVEY

PROPOSED EXTRACTION SITE
LOT 3 DP 567166
OLD NORTHERN ROAD, MAROOTA, NSW

Paul Burcher
Antcliff Ecological Surveys (AES)
39 Dean Street
West Pennant Hills 2125

Phone and Fax: (02) 484 2722

Table of Contents

1. Introduction and Recommendations	1
2. Description of the Site and Proposed Development	1
3. Methodology	2
4. Vegetation Description	2
4.1 Vegetation Communities	2
4.1.1 Open Forest	2
4.1.2 Woodland	3
4.1.3 Wetland	3
4.1.4 Open Scrub	3
5. Plant Species	4
6. Disturbance	5
6. Interaction Between Proposed Subdivision and Flora	6
References	6
Appendix - Plant Species List	

1. Introduction and Recommendations

During July and August 1994 a flora survey was undertaken for the proposed sand extraction site at Lot 3 DP 567166 ("the site"). The aims of the survey are as follows:

- determine whether significant flora, in terms of vegetation communities or plant species, occurs on the site
- assess the likely effect of the proposed development on flora at local, regional and state-wide scales, and
- suggest appropriate ameliorative strategies.

The main findings of the flora survey are as follows:

- Four vegetation communities occur on the site. These are Open Forest, Woodland, Wetland and Open Scrub. There is also an area in the south-west corner of the site that has been cleared for market gardening.
- A total of 159 plant species were recorded on the site comprising 11 ferns and 148 species of flowering plants, 12 of which were introduced (**Appendix A**).
- One of these species, *Tetratheca glandulosa* is listed as vulnerable on the national database of rare and threatened species (Briggs and Leigh 1988). It is common throughout the woodland of the site. Substantial numbers of the plant will be conserved in those areas of woodland left unmined.
- The development will result in the loss of about 10ha of woodland and 2.5ha of scrub. It is unlikely to significantly affect the status of either vegetation communities or plant species at either regional or state-wide levels.

2. Description of the Site and Proposed Development

The site occurs in the upper catchment of Coopers Creek, east of the Old Northern Road, Maroota. It is surrounded by privately owned bushland to the north and south, Marramarra National Park to the east and market gardens and existing sand mines to the west.

Slope steepness varies from moderate in the proposed extraction areas to steep in the environment protection zones and the ridge-slope in the north of the site. The site is drained by two non-permanent streams which flow into Coopers Creek. There are also a few smaller ephemeral watercourses.

The proposal involves the extraction of sand from two areas on the site. Stage 1 will cover an area of 5.25ha and take place over six years. Stage 2 covers 10.5ha and will take twelve years. The total area earmarked for extraction is 15.75ha. After mining ceases the land will be rehabilitated for agricultural use.

3. Methodology

The vegetation communities on the site were described based on the dominant tree species and the height and cover of the tree layer (following Specht, 1970). The site was surveyed for plant species by thorough walking transects and those not readily identified in the field were collected for identification using standard texts. Checks were made against standard reference texts (Briggs & Leigh, 1988) for any rare and vulnerable species.

The degree of disturbance to native vegetation was noted with particular attention given to introduced plants.

4. Vegetation Communities

The four vegetation communities found on the site are discussed below. Their distribution on the site and environs is illustrated in the fauna Impact Statement which also accompanies the EIS.

4.1 Open Forest

This vegetation community occurs in the two gullies which comprise the environment protection zones. No mining will take place in this community. Extraction will be setback 80m from the southern gully and 50m from the northern gully.

The tree layer is dominated by Sydney Peppermint (*Eucalyptus piperita*) and Smooth-barked Apple (*Angophora costata*) up to 25m with some Turpentine (*Syncarpia glomulifera*) in the lower parts of the southern gully.

Prior to the fires of January, 1994 there would have been a thick small tree/tall shrub layer of Finger Hakea (*Hakea dactyloides*), Saw Banksia (*Banksia serrata*) and Forest Oak (*Allocasuarina torulosa*). This remains in parts of the southern gully but lost in the northern gully.

The groundcover of the southern gully is dominated by ferns such as Umbrella Fern (*Sticherus flabellatus*), Rainbow Fern (*Calochaena dubia*) and Gristle Fern (*Blechnum cartilagineum*) as well as Sword Sedge (*Gahnia aspera*) in wet areas and Grass Tree (*Xanthorrhoea arborea*) on the drier

slopes. In the northern gully Gynea Lily (*Doryanthes excelsa*) and the orchid Lady's Fingers (*Caladenia catenata*) dominate the post-fire forest floor.

4.2 Woodland

This community occurs on the south facing slope. The larger of the two areas earmarked for sand extraction is restricted to this community.

The canopy species are 8-20m tall with foliage cover of 10-25%. A variety of species occur in this layer. In the western section Scribbly Gum (*Eucalyptus haemastoma*) is dominant whereas further east Narrow-leaved Apple (*Angophora bakeri*) becomes more common. Other species present are Sandstone Stringybark (*Eucalyptus oblonga*), Yellow Bloodwood (*Eucalyptus eximia*), Red Bloodwood (*E.gummifera*), Grey Gum (*E.punctata*), Sydney Peppermint and Smooth-barked Apple. Some large Saw Banksia also occur.

The fire has removed much of the shrub layer though there are many regenerating Banksias (*Banksia spinulosa* and *B.oblongifolia*) and Boronias (*B.pinnata* and *B.lidifolia*). The groundcover is also dominated by fire regenerators such as the sedges, *Ptilothrix deusta* and *Cyathochaeta diandra*, Brown's Love Grass (*Eragrostis brownii*) and the sundew, *Drosera peltata*.

Within this community there are areas where drainage appears to be restricted. This has resulted in small hanging swamps developing. Such areas have few eucalypts and are dominated by *Ptilothrix deusta*, Spreading Rope-rush (*Empodisma minus*), sundews (*Drosera sp*) and *Banksia oblongifolia*.

4.3 Wetland

A small wetland occurs around and behind the dam which has been built at the head of the southern gully. The vegetation here is dominated by Cumbungi (*Typha orientalis*) with some aquatic plants in inundated areas and Paspalum (*Paspalum dilatatum*), Whiskey Grass (*Andropogon virginicus*) and Red-stemmed Wattle (*Acacia rubida*) around the edges.

This wetland would serve to lessen the impacts of sediments and nutrients originating from cultivated and disturbed areas on down-stream communities.

4.4 Open Scrub

The smaller area of extraction is proposed for this community. About 2.5ha of this community will be removed for extraction. It occurs on a gentle

slope with many exposed rocks and shallow soil. It is dominated by Dwarf Apple (*Angophora hispida*) and Paperbark Tea-tree (*Leptospermum trinervium*) to 2m. The burnt remains of Conesticks (*Petrophile pulchella*) are also a feature. There is a groundcover of *Ptilothrix deusta*, *Lomandra glauca* and other herbs. As there are a number of Scribbly Gum saplings it may develop into a low woodland if left undisturbed.

5 Plant Species

A total of 159 plant species were identified on the site, including 12 of the more common introduced species. The native species consisted of 11 species of fern and 136 species of flowering plants (**Appendix A**). This high plant diversity is typical of sandstone vegetation communities in the Sydney region.

The following species found on the site are listed in Schedule 13 - Protected Native Plants, of the National Parks and Wildlife Act, 1974:

- Rough Treefern (*Cyathea australis*)
- King Fern (*Todea barbara*)
- Flannel Flower (*Actinotus helianthi*)
- Gynea Lily (*Doryanthes excelsa*)
- Curly Sedge (*Caustis flexuosa*)
- Crinkle Bush (*Lomatia silaifolia*)
- Christmas Bush (*Ceratopetalum gummiferum*)
- Waratah (*Telopea speciosissima*)
- Woody Pear (*Xylomelum pyriforme*)
- Snake Flower (*Cymbidium suave*)
- Rock Orchid (*Dendrobium speciosum*)
- Boronia species (*B.pinnata* & *B.ledifolia*)

These species are protected as they are sought by wildflower collectors for their attractive flowers and/or foliage. They are not presently rare or threatened.

Tetradlea glandulosa

One species listed in the national database of rare and threatened plants (Briggs and Leigh, 1988) occurs on the site. This is a Black-eyed Susan (*Tetradlea glandulosa*) which is common in the woodland on the site.

The threat code for this species is 2VC- which indicates;

- the species has a maximum geographic range of 100km
- the species is at risk of disappearing from the wild over two to five decades if depletion continues, and
- while the species is known to occur in a conservation reserve, its population size is unknown (Briggs and Leigh 1988).

Black-eyed Susan is found from Port Jackson to the southern Central Coast and west to the lower Blue Mountains. Throughout this distribution area it is typically found in sandy soils in heath, scrub or woodland. Dry locations on ridges and north-facing slopes are also favoured. Recorded localities include Mangrove Mountain, Kulnura, Colo Heights, Kurmond, Glenorie, Maroota, Cowan, Berowra, Mt Colah, Hornsby, Oxford Falls, Duffy's Forest and Belrose.

Black-eyed Susan has been recorded in a number of reserves, these being Pennant Hills Park, Berowra Valley Bushland Park, Garigal National Park, Ku-ring-gai Chase National Park, Dharug National Park, Marramarra National Park and Muogamarra Nature Reserve (NPWS Data Base; Fairley, 1989; Smith & Smith 1990). However, there is no data available on abundances in any of these locations.

It is expected this species will be adequately conserved in the zones separating the extraction area from the E.P zones.

6 Disturbance

The most recent disturbance to the site vegetation has been the January, 1994 fires. Although not as severely affected as bushland to the near north, most of the woodland on the site lost its understorey in this fire as did much of the open forest. Regeneration of Dwarf Apple is apparent in the scrub community. The moderate to high temperatures that this fire was likely to have burned at means that germination of many species will have been stimulated and complete regeneration of vegetation structure and species composition would occur over time.

A range of other disturbances have also occurred. Vehicular tracks and partial clearing have occurred in the woodland allowing weed species to establish in some areas. The south-east corner of the site has been cleared for market gardening and the provision of a small dam. This dam has resulted in changed vegetation upstream where large eucalypts have died due to hydrological changes and downstream where overflows have carried weed propagules, especially Crofton Weed (*Ageratina adenophora*), along Coopers Creek and well into Marramarra National Park. The open scrub community has also been disturbed by vehicle tracks and excavation of test pits.

7 Interaction Between the Proposed Development and Flora

The characteristics of the existing site vegetation and the proposed development are such, that the proposed development is unlikely to significantly affect flora at either regional or state-wide levels. These characteristics include:

- The vegetation communities found on the site are well represented in the local area and the Sydney Region. They are reserved in National Park estate and other reserved areas (e.g. Wollemi National Park, Dharug National Park, Marramarra National Park, Muogomarra Nature Reserve and Brisbane Waters National Park).
- Although one nationally listed rare plant species occurs commonly in the extraction area it will be adequately conserved in unmined areas of the site.

The main threat to local flora, especially that of the Coopers Creek gully, is the likely increase in weed invasion. Sedimentation is already evident in the creek and the introduced crofton weed (*Ageratina adenophora*) is common. The agricultural uses planned for the site after cessation of extraction will also contribute to an increase in soil nutrient levels along the watercourses thus further aiding the proliferation of weeds.

To ameliorate these likely impacts a complex of settling ponds and filtration zones will be implaced during and after extraction. The design of these is detailed in the EIS.

References

- Briggs, J.D., and Leigh, J.H., (1988), 'Rare or Threatened Australian Plants', Special publication No.14, ANPWS, Canberra.
- Fairley, A., (1989), 'Native Plants of the Sydney District', Kangaroo Press, Kenthurst.
- Smith, P. and Smith, J. (1990), 'Vegetation and Fauna of Berowra Valley Bushland Park.'
- Specht, R.L., (1970), 'Vegetation of the Australian Environment' G.W.Leeper Ed. 4th edition, CSIRO, Melbourne.

Appendix A Plant Species List, Lot 3 DP 567166, Maroota.

Key

Communities

F – open forest; w – woodland; s – open scrub; D – dam/wetland

* – denotes introduced species

Scientific Name	Common Name	Community
PTERIDOPHYTES – FERNS		
BLECHNACEAE		
<i>Blechnum ambiguum</i>	Water Fern	F
<i>B. cartilagineum</i>	Gristle Fern	F, W
CYATHEACEAE		
<i>Cyathea australis</i>	Rough Treefern	F
DENNSTAEDTIACEAE		
<i>Histiopteris incisa</i>	Batswing Fern	F
<i>Pteridium esculentum</i>	Bracken Fern	F, W, D
DICKSONIACEAE		
<i>Calochaena dubia</i>	Rainbow Fern	F, W
GLEICHENIACEAE		
<i>Gleichenia dicarpa</i>	Coral Fern	F, W
<i>Sticherus flabellatus</i>	Umbrella Fern	F
LINDSAEACEAE		
<i>Lindsaea linearis</i>	Screw Fern	F, W
<i>L. microphyllus</i>	Lacy Wedge Fern	F, W
OSMUNDACEAE		
<i>Todea barbara</i>	King Fern	F
ANGIOSPERMS – FLOWERING PLANTS		
MONOCOTYLEDONS		
AGAYACEAE		
<i>Doryanthes excelsa</i>	Gynea Lily	F
COLCHICACEAE		
<i>Burchardia umbellata</i>	Milkmaids	W
CYPERACEAE		
<i>Caustis flexuosa</i>	Curly Sedge	F, W
<i>Cyathochaeta diandra</i>	–	W
<i>Eleocharis sphacelata</i>	Tall Spike-rush	D
<i>Gahnia clarkei</i>	Saw Sedge	F
<i>G. melanocarpa</i>	Saw Sedge	W
<i>Lepidosperma laterale</i>	Sword Sedge	S, W
<i>Ptilothrix deusta</i>	–	F, W

Scientific Name	Common Name	
<i>Schoenus ericetorum</i>	-	S,W
<i>S. melanostachys</i>	Black Bog-rush	F,W
HYPOXIDACEAE		
<i>Hypoxis hygrometrica</i>	Golden Weather-grass	S,W
IRIDACEAE		
<i>Paterersonia sericea</i>	Silky Purple Flag	S,W
JUNCACEAE		
<i>Juncus sp.</i>	A Rush	D,W,S
HAEMODORACEAE		
<i>Haemodorum corymbosum</i>	Blood Root	S,W
LOMANDRACEAE		
<i>Lomandra glauca</i>	Mat-rush	W
<i>L. glauca</i>	"	W,S
<i>L. gracilis</i>	"	W
<i>L. longifolia</i>	Spiky Mat-rush	S,F,W
<i>L. obliqua</i>	Fishbones	W
ORCHIDACEAE		
<i>Caladenia catenata</i>	Lady's Fingers	W
<i>Cymbidium suave</i>	Snake Flower	F
<i>Dendrobium speciosum</i>	Rock Orchid	F
<i>Glossodia major</i>	Wax-lip Orchid	W
<i>Prasophyllum sp.</i>	Leek Orchid	S,W
<i>Thelymitra ixioides</i>	Spotted Sun Orchid	W
PHORMIACEAE		
<i>Dianella caerulea</i>	Paroo Lily	S,F,W
<i>D. prunina</i>		W
POACEAE		
<i>Andropogon virginicus*</i>	Whiskey Grass	D,S,W
<i>Anisopogon avenaceus</i>	Spear Oat Grass	S,W
<i>Aristida vagans</i>	Three-awn Speargrass	W
<i>Echinopogon caespitosus</i>	Tufted Hedgehog Grass	S,W
<i>Entolasia stricta</i>	Wiry panic	F,W
<i>Eragrostis brownii</i>	Brown's Love Grass	W
<i>Imperata cylindrica</i>	Blady Grass	W,F
<i>Paspalum dilatatum*</i>	Paspalum	D
<i>Themeda australis</i>	Kangaroo Grass	W
RESTIONACEAE		
<i>Empodisma minus</i>	Spreading Rope-rush	F,W
<i>Lepyrodia scariosa</i>	Scale-rush	W,S
SMILACACEAE		
<i>Smilax glycyphylla</i>	Native Sarsparilla	F,W
TYPHACEAE		
<i>Typha orientalis</i>	Cumbungi	D

Scientific Name	Common Name	
XANTHORRHOEACEAE		
<i>Xanthorrhoea arborea</i>	Grass Tree	F
<i>X. media</i>	Grass Tree	W,S
DICOTYLEDONS		
ACANTHACEAE		
<i>Pseuderanthemum variable</i>	-	F
APIACEAE		
<i>Actinotus helianthi</i>	Flannel Flower	W
<i>A. minor</i>	Lesser Flannel Flower	W,S
<i>Platysace linearifolia</i>	Carrot Tops	W
<i>Xanthosia pilosa</i>	-	F
<i>X. tridentata</i>	-	W
APOCYNACEAE		
<i>Parsonsia straminea</i>	Common Silkpod	F
ASTERACEAE		
<i>Ageratine adenophora*</i>	Crofton Weed	F
<i>Cassinia uncata</i>	Bent Cassinia	W
<i>Hypochoeris radicata*</i>	Catsear	D
<i>Senecio vagus</i>	-	F
<i>Sanctus oleraceus*</i>	Common Sowthistle	D
<i>Taraxacum officinale*</i>	Dandelion	W,D
BAUERACEAE		
<i>Bauera rubioides</i>	Dog Rose	W
CASSYTHACEAE		
<i>Cassytha glabella</i>	Devil's Twine	F,W
CASUARINACEAE		
<i>Allocasuarina littoralis</i>	Black She-oak	S,W
<i>A. torulosa</i>	Forest Oak	F
CUNONIACEAE		
<i>Callicoma serratifolia</i>	Black Wattle	F,W
<i>Ceratopetalum apetalum</i>	Coachwood	F
<i>C. gummiferum</i>	Christmas Bush	F,W
DILLENIACEAE		
<i>Hibbertia aspera</i>	Rough Guinea Flower	W
DROSERACEAE		
<i>Drosera pymaea</i>	Pygmy Sundew	W
<i>D. peltata</i>	Common Sundew	F,W
ELAEOCARPACEAE		
<i>Elaeocarpus reticulatis</i>	Blueberry Ash	F
ELATINACEAE		
<i>Elatine gratioides</i>	Waterwort	D

Scientific Name	Common Name	
EPACRIDACEAE		
<i>Epacris pulchella</i>	Heath	S,W
<i>Leucopogon microphyllus</i>	Beard Heath	S,W
<i>Monotoca scoparia</i>	Prickly Broom-heath	F,W
<i>Styphelia tubiflora</i>	Red Five Corners	W
EUPHORBIACEAE		
<i>Micranthemum ericoides</i>	-	W
<i>Phyllanthus hirtellus</i>	Thyme Spurge	F
FABACEAE		
Sub-Family Faboideae		
<i>Bossiaea heterophylla</i>	Variable Bossiaea	W
<i>B. lenticularis</i>	-	F
<i>B. obcordata</i>	Spiny Bossiaea	F
<i>Dillwynia retorta</i>	Eggs and Bacon	W
<i>D. floribunda</i>	Eggs and Bacon	S
<i>Gompholobium latifolium</i>	Broad-leaf Wedge-pea	F
<i>Hardenbergia violacea</i>	False Sarsparilla	S
<i>Mirbelia rubifolia</i>	-	W
<i>Pultenaea flexilis</i>	A Bush pea	F
<i>P. palacea</i>	"	D
<i>Vicia sp*</i>	Vetch	D
Sub-Family Mimosoideae		
<i>Acacia linifolia</i>	Flax-leaved Wattle	S,W
<i>A. longifolia</i>	Sydney Golden Wattle	F
<i>A. myrtifolia</i>	Myrtle-leaved Wattle	W
<i>A. rubida</i>	Red-stemmed Wattle	D
<i>A. suaveolens</i>	Sweet Wattle	W
GOODENIACEAE		
<i>Dampiera stricta</i>	Blue Dampiera	W
<i>Goodenia heterophylla</i>	Variable-leaved Goodenia	W
<i>Scaevola ramosissima</i>	Purple Fan-flower	W
<i>Vellia lyrata</i>	-	W
HALORAGACEAE		
<i>Gonocarpus teucrioides</i>	Raspwort	W
LOBELIACEAE		
<i>Lobelia dentata</i>	-	W
LOGANIACEAE		
<i>Logania albilflora</i>	-	F
<i>Mitrasacme polymorpha</i>	Mitre Wort	W,S
MORACEAE		
<i>Ficus rubiginosa</i>	Port Jackson Fig	W

Scientific Name	Common Name	
MYRTACEAE		
<i>Angophora bakeri</i>	Narrow-leaved Apple	W
<i>A. costata</i>	Smooth-barked Apple	F,W
<i>A. hispida</i>	Dwarf Apple	S,W
<i>Austromyrtus tenuifolia</i>	Narrow-leaf Myrtle	F
<i>Callistemon citrinus</i>	Crimson Bottlebrush	W
<i>Eucalyptus eximia</i>	Yellow Bloodwood	W
<i>E. gummifera</i>	Red Bloodwood	F,W
<i>E. haemastoma</i>	Scribbly Gum	S,W
<i>E. oblonga</i>	Narrow-leaved Stringybark	W
<i>E. piperita</i>	Sydney Peppermint	F,W
<i>E. punctata</i>	Grey Gum	W
<i>Leptospermum arachnoides</i>	Spidery Tea-tree	W
<i>L. parvifolium</i>	Small-leaved Tea-tree	W
<i>L. polygalifolium</i>	Yellow Tea-tree	F,W
<i>L. trinervium</i>	Flakey-bark Tea-tree	S,W
<i>Melaleuca linariifolia</i>	Snow-in-summer	F
<i>Tristaniaopsis collina</i>	Hill Kanuka	F
<i>Syncarpia glomulifera</i>	Turpentine	F
OLACACEAE		
<i>Olax stricta</i>	-	W
POLYGALACEAE		
<i>Comesperma ericinum</i>	Matchheads	W
PHYTOLACCACEAE		
<i>Phytolacca octandra*</i>	Ink Weed	F
PITTOSPORACEAE		
<i>Billardiera scandens</i>	Apple Berry	F
PROTEACEAE		
<i>Banksia ericifolia</i>	Short-leaved Banksia	S
<i>B. oblongifolia</i>	-	W
<i>B. serrata</i>	Saw Banksia	W,F
<i>B. spinulosa</i>	Hairpin Banksia	W,F
<i>Conospermum longifolium</i>	Smoke-bush	W
<i>Grevillea buxifolia</i>	Grey Spider Flower	S,W
<i>G. speciosa</i>	Red Spider Flower	W
<i>Hakea dactyloides</i>	Finger Hakea	W,S,F
<i>Lambertia formosa</i>	Mountain Devil	W
<i>Lomatia myricoides</i>	River Lomatia	F
<i>L. silaifolia</i>	Crinkle bush	F,W
<i>Persoonia levis</i>	Broad-leaved Geebung	F,W
<i>P. linearis</i>	Narrow-leaved Geebung	F
<i>Petrophile pulchella</i>	Cone Stick	S,F
<i>Telopea speciosissima</i>	Waratah	F
<i>Xylomelum pyriforme</i>	Woody Pear	F
RHAMNACEAE		
<i>Cryptandra amara</i>	-	W

S

Scientific Name	Common Name	
RUTACEAE		
<i>Boronia pinnata</i>	Pinnate-leaved Boronia	S,W
<i>B. ledifolia</i>	Sydney Boronia	W
SANTALACEAE		
<i>Exocarpos cupressiformis</i>	Cherry Ballarat	W
SOLANACEAE		
<i>Solanum mauritianum</i> *	Wild Tobacco	D
<i>S. nigrum</i> *	A nightshade	D
TREMADRACEAE		
<i>Tetraloche glandulosa</i>	Black-eyed Susan	W
VERBENACEAE		
<i>Lantana camara</i> *	Lantana	D
<i>Verbena bonariensis</i> *	Purple-top	D

PART APPENDIX "E" - Fauna Impact Statement

FAUNA IMPACT STATEMENT

PROPOSED SAND EXTRACTION SITE
LOT 3 DP 567166, MAROOKA, NSW

Prepared by:
Paul Burcher
Antcliff Ecological Surveys (AES)
39 Dean Street
West Pennant Hills NSW 2125

Phone and Fax: (02) 484 2722

Table of Contents

Summary	1
1. Introduction	3
1.1 Description of the Proposed Activity	3
1.2 Description of the Study area	3
2. Fauna Survey Methodology	4
2.1 Habitat Assessment	4
2.2 Birds	4
2.3 Mammals	5
2.4 Reptiles	5
2.5 Frogs	6
2.6 Species Likely to Occur	6
3. Fauna Habitat	7
3.1 Open Forest	7
3.2 Woodland	7
3.3 Wetland	8
3.4 Open Scrub	8
3.5 Habitat Features and Disturbance	8
4. Fauna of the Study Area	9
4.1 Birds	9
4.2 Mammals	10
4.3 Reptiles	10
4.4 Frogs	11
5 Endangered Fauna	12
5.1 Powerful Owl	12
5.2 Masked Owl	15
5.3 Glossy Black-Cockatoo	16
5.4 Tiger Quoll	17
5.5 Koala	18
5.6 Common Bent-wing Bat	19
5.7 Broad-headed Snake	20
5.8 Red-crowned Toadlet	21
5.8 Giant Burrowing Frog	22
6. Species for which Licence to take is sought	23
References	24
Acknowledgements	26

Figures

Figure 1 Regional Location - between pages 3 and 4

Figure 2 Fauna Habitat and Survey Locations - between pages 7 and 8

Appendices

Appendix A - Fauna Species List

Appendix B - Fauna Likely to Occur

Appendix C - Fauna Status Category Definitions

Appendix D - Bat Survey Report by Ray Williams

Appendix E - Weather Conditions During the Field Survey

Attachments

Curriculum Vitae of personnel involved

Certification

Director-general's Requirements

SUMMARY

This report assesses the impact of a proposed sand extraction activity at Lot 3 DP 567166, Maroota on the environment of endangered fauna. The two areas proposed for extraction will be done in two stages totalling 15.75 hectares in area. The majority of the proposed extraction area is relatively undisturbed bushland. Details of the project are outlined in the Environmental Impact Statement which this report accompanies.

Four habitat types occur on the site. They are:

- open forest dominated by Sydney peppermint (*Eucalyptus piperita*) and smooth-barked apple (*Angophora costata*). No extraction will occur within this habitat type.
- woodland dominated by scribbly gum (*E. haemastoma*) and narrow-leaved apple (*A. bakeri*). Stage 2 of the project which covers 10.5ha is within this habitat type.
- open scrub of dwarf apple (*A. hispidula*) and paperbark tea-tree (*Leptospermum trinervium*). About 2.5ha of this habitat type will be removed in Stage 1.
- wetland area around a dam with Cumbungi (*Typha orientalis*) and other aquatic plants. There will be some disruption to this habitat type due to road construction and drainage works.

Apart from the open forest habitat, all show signs of disturbance with habitat fragmentation being caused by clearing, vehicle tracks and bush rock collection. The open forest, woodland and open scrub habitats are all represented in Marramarra National Park which adjoins the site.

During the field survey, a total of 65 fauna species were detected in the study area, which comprised the site and surrounds. Of the 62 species detected there were 42 species of bird; 13 mammal species (including two introduced species); five reptile species and five frog species. During the field survey the only endangered species detected was the powerful owl (*Ninox strenua*).

After reviewing literature and database records this list was supplemented with a further 40 bird species (including three introduced species); ten mammal species (three introduced); twenty-seven reptiles and five frogs. Of these species likely to occur the following are endangered: glossy black-cockatoo (*Calyptorhynchus funereus*), masked owl (*Tyto novaehollandiae*), tiger quoll (*Dasyurus maculatus*), koala (*Phascolarctos cinereus*), common bent-wing bat (*Miniopterus schreibersii*), broad-headed snake (*Hoplocephalus bungaroides*), red-crowned toadlet (*Pseudophryne australis*) and giant burrowing frog (*Heleioporus australiacus*).

The major impact of the proposed activity will be the direct removal of approximately 13ha of habitat. Although relatively small in scale the proposed development will contribute to the loss of habitat in the area due to other sand mine sites and rural and residential development.

Other impacts will be noise associated with blasting, large machinery and truck movements. As the land will be rehabilitated for agricultural use after extraction there will be greater edge effects placed on fauna in the adjacent National Park. The likely outcome of this is that native and exotic fauna adapted to edge environments will push forest and woodland fauna further into undisturbed areas. The imposition of a large area of cleared land will also inhibit fauna movement between habitat areas to the north and south of the site. Agricultural use of the land after extraction will probably include use of pesticides - another threat to local fauna particularly insectivorous bats.

The powerful owl, the only endangered species known to occur on the site, will lose a small proportion of foraging habitat. However, this effect is magnified by the fact that their suspected breeding area is in close proximity to the site. Noise generated by the extraction activity near the nest site may disrupt breeding and dispersal.

The two species most affected by the activity, should they occur in the extraction areas, are the red-crowned toadlet and giant burrowing frog. There would be direct removal of populations of these species.

The other endangered species that are likely to occur are expected to only use the site on an infrequent basis and therefore the effect of the proposed activity on these species would be a marginal contribution to habitat loss.

As the nature of the activity involves the direct removal of habitat there is minimal scope for mitigation, particularly on the endangered frog species which may be present. The design and configuration of the stage 2 extraction area is such that as little as 6ha will become agricultural land. The balance will either be part of increased valley set-backs or benches revegetated with native species. This should be done using locally sourced plant stock. Nest boxes could be used to increase the rate of arboreal mammal recolonisation of the revegetated area thus decreasing the amount of time required for the powerful owl to recommence foraging in that area. To minimise the impact of stage 1 of the mine site on the pair of powerful owls it is proposed that during extraction bund walls be built up near the site's southern boundary to baffle noise. Haulage roads should also be restricted to existing tracks to reduce habitat destruction.

1 Introduction

This report assesses the impacts of a proposed sand extraction activity on the environment of protected and endangered fauna. The proposed extraction site is located at Lot 3 DP 567166, east of the Old Northern Road, Maroota. Regional location of the site is illustrated on Figure 1.

1.1 Description of the proposed activity

In brief, it is proposed that the site will be mined in two stages. Stage 1 will cover an area of 5.25ha and take six years. Stage 2 will cover 10.5ha and will be mined over a 12 year period. On completion of extraction the land will be prepared for agricultural use. Details of the proposed activity are contained in the Environmental Impact Statement prepared by Collin Donges & Associates.

1.2 Description of the Study Area

For the purposes of this assessment the study area was centred upon the two proposed extraction sites and adjacent habitats (Figure 2). These adjacent habitats included those woodland, open forest and scrub areas contiguous with site vegetation and contained within Marramarra National Park and private property.

The study area is characterised by typical Hornsby Plateau topography. The agricultural lands and plateaux of the ridge-tops and slopes fall away through rocky escarpments and sandy benches to the deep gullies of Coopers Creek and its tributaries. These watercourses are ephemeral and their flow affected by dams and irrigation. Coopers Creek drains into the Hawkesbury River about four kilometres to the east.

Apart from market gardens and existing sand extraction activities to the west and north-west, the study area is generally surrounded by bushland most of which is part of the northern section of Marramarra National Park. This bushland was burnt during the January, 1994 fires. However, from aerial photograph inspection it appears bushland to the north and east around Dalgetys Creek was more severely affected. Regeneration of vegetation was apparent in the study area at the time of survey with thick epicormic growth on trees and resproutings and germination of plants in the shrub and groundcover layers.

Apart from Marramarra National Park other large habitat areas occur in the vicinity. Dharug National Park is a few kilometres to the east; crown land and former State Forest occur to the west and south-west of the Old Northern Road; and further to the north-west beyond the Hawkesbury River is Wollemi National Park.

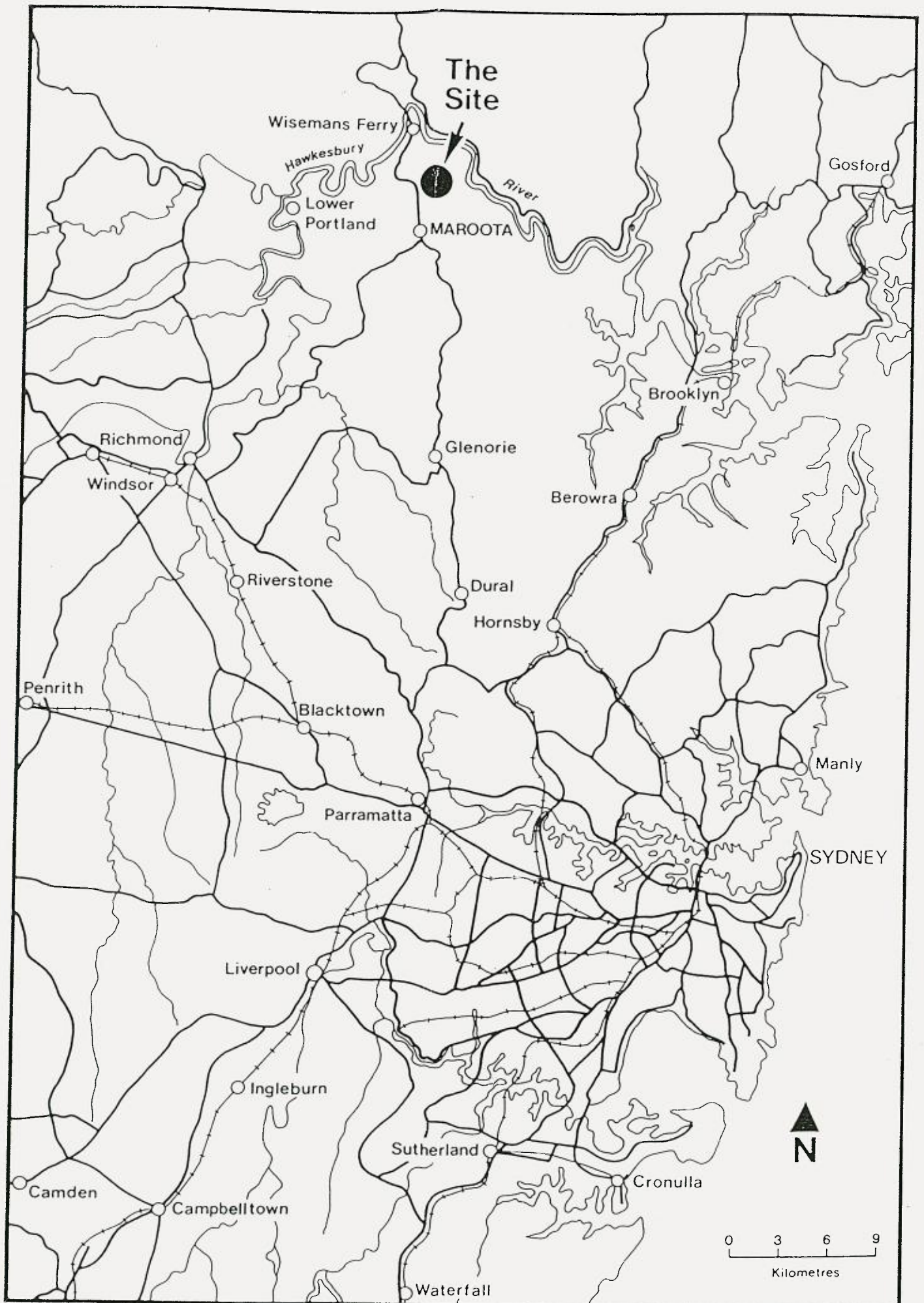


Figure 1: REGIONAL LOCATION

2. Fauna Survey Methodology

Detailed fauna surveys of the study area were carried out between 26/7/94 and 23/10/94. Fauna survey effort was stratified through the study area to sample the different habitats present.

The methods of survey undertaken to detect the various fauna groups are outlined below and in Appendix D for the bat survey. The survey was complemented by listing species that are likely to occur on the site, but were not detected during the survey. The location of fauna census sites for spotlighting transects, small mammal trap lines and bird census points are indicated on Figure 2.

2.1 Habitat Assessment

The fauna habitat of the study area was mapped using 1994 1:25 000 colour aerial photographs (1994 Sydney Bushfire Series, run 23 Nos. 68 & 69) and the Gunderman and Lower Portland 1:25 000 topographic maps. Habitat types and boundaries were verified in the field.

Each fauna habitat was described in terms of dominant plant species and vegetation height and density. The structural names (e.g. Open Forest) given to the habitats follow that of Specht (1970). A search was also undertaken for specific sources of food and shelter, such as flowering trees and tree hollows. The presence, or lack of particular fauna habitat requirements, was noted to enable predictions of species that would be likely to utilise the site. The degree of existing habitat disturbance was noted and major weed species identified.

2.2 Birds

Diurnal Birds

This group was surveyed by ten minute censuses in each habitat type on three consecutive mornings. Incidental sightings, while undertaking other fieldwork, were also recorded.

Nocturnal Birds

Calls of the powerful and masked owls were played on a 50 watt cassette player on a rocky outcrop above the southern gully. This was done at dusk and a period of 20 minutes allowed for responses. This is consistent with methodology recommended by Kavanagh and Peake (1993).

Other nocturnal species were identified by call recognition.

2.3 Mammals

Small and Medium Sized Mammals

Three trap lines were used in the following locations:

- 25 medium Elliot live traps (32 x 9 x 10cm), one large Elliot live trap (46 x 15 x 15cm) and one cage trap in Woodland Habitat.
- 15 medium Elliot live traps, one large Elliot live trap and one cage trap in the Open Forest of the southern gully
- 10 medium Elliot live traps in Open Scrub habitat.

Traps were placed with a 5-6 metre spacing and were baited with a mixture of peanut butter, honey and rolled oats. Cage traps were baited with fish in an effort to trap quolls. The above configurations resulted in a total of 162 trap nights. Trap line locations are shown in Figure 2.

A search was made for indirect evidence of small to medium sized mammal presence, such as bandicoot holes, droppings etc. Owl castings were sent to Barbara Triggs, an expert in mammalian hair identification, for analysis.

Arboreal Mammals

Spotlighting was undertaken for a total of 10 hours over four nights using a 12 volt battery, 50W spotlight and 10 x 50 Gerber binoculars. Locations of spotlight transects are indicated on Figure 2. Trees were also examined during daylight hours for evidence of arboreal mammal use such as scratchings and scats. Particular attention was paid to grey gums (*Eucalyptus punctata*) in an attempt to detect the presence of the koala (*Phascolarctos cinereus*)

Large Mammals

The site and surrounding habitat was traversed in an attempt to detect large mammals by direct observation. A search was also made for indirect evidence of large mammal presence such as droppings, burrows, tracks, diggings and bones. These were identified using the keys and illustrations prepared by Triggs (1984).

Bats

Methodology for surveying bats is described in the report by Ray Williams of Ecotone Ecological Consultants (Appendix D).

2.4 Reptiles

A reptile search was undertaken throughout the site in fine weather for a period of six hours on each of two consecutive days during September. This involved looking under bark, fallen timber and leaf litter and using a torch to search rock crevices. An assessment was made of the suitability of habitat for reptile occupation.

2.5 Frogs

Debris found around moist areas was checked during the day for the presence of frogs and the wetland area and site dam were checked at night by spotlight and by listening for frog calls. Unknown calls were identified using reference tapes (Barker and Grigg 1983).

2.6 Species Likely to Occur

For a species to be listed as "likely to occur", suitable habitat must occur on the site and at least one of the following criteria be satisfied:

- The species has been recorded in the locality or region on the NPWS database or by previous local studies e.g AES, 1994; Smith & Smith, 1990a.
- Birds with a reporting rate of greater than 40% in 'The Atlas of Australian Birds' (Blakers et.al. 1984) for the 1° block which encompasses the study area and for which suitable habitat occurs in the study area
- Mammals, reptiles or frogs which are listed as common to abundant in standard reference texts (e.g. Cogger 1986, Strahan 1983, Swan, 1990) and which include the site within their known distribution.
- Advice from the National Parks and Wildlife Service of NSW (NPWS) that the species is known to occur in the Maroota area.

Species which may use the site were not detected during the survey for the following reasons:

- The species was present during the survey but was not detected due to inactivity or cryptic habits.
- The species uses the site at other times of the year, but was not present during the survey due to being nomadic or migratory.

3. Fauna Habitat

Description of the fauna habitat of the study area is based on vegetation community descriptions in the Environmental Impact Statement for the proposed activity. Specific habitat features are also addressed.

3.1 Open Forest

This vegetation community occurs in the two gullies which comprise the council zoned environment protection areas. The tree layer is dominated by Sydney peppermint (*Eucalyptus piperita*) and smooth-barked apple (*Angophora costata*) up to 25m with some turpentine (*Syncarpia glomulifera*) in the lower parts of the southern gully.

Prior to the fires of January, 1994 there would have been a thick small tree/tall shrub layer of finger hakea (*Hakea dactyloides*), saw banksia (*Banksia serrata*) and forest oak (*Allocasuarina torulosa*). This remains in parts of the southern gully but is lost in the northern gully.

The groundcover of the southern gully is dominated by ferns such as umbrella fern (*Sticherus flabellatus*), rainbow fern (*Calochaena dubia*) and gristle fern (*Blechnum cartilagineum*) as well as sword sedge (*Gahnia aspera*) in wet areas and grass tree (*Xanthorrhoea arborea*) on the drier slopes. In the northern gully Gynea lily (*Doryanthes excelsa*) and the orchid lady's fingers (*Caladenia catenata*) dominate the post-fire forest floor.

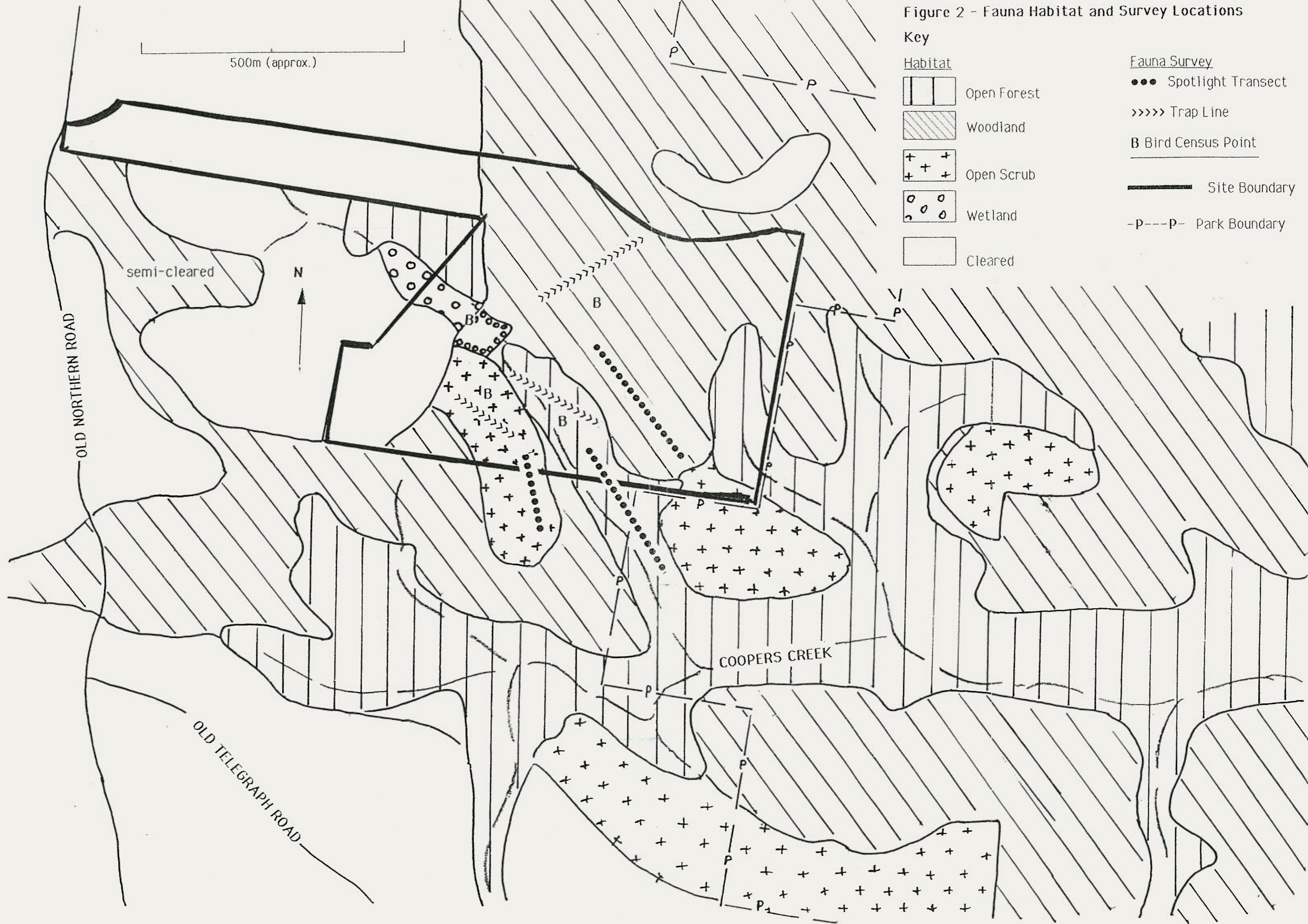
3.2 Woodland

This habitat occurs on the south facing slope. The larger of the two areas earmarked for sand extraction is restricted to this community.

The canopy species are 8-20m tall with foliage cover of 10-25%. A variety of species occur in this layer. In the western section scribbly gum (*Eucalyptus haemastoma*) is dominant whereas further east narrow-leaved apple (*Angophora bakeri*) becomes more common. Other species present are sandstone stringybark (*Eucalyptus oblonga*), yellow bloodwood (*Eucalyptus eximia*), red bloodwood (*E.gummifera*), grey gum (*E.punctata*), Sydney peppermint and smooth-barked apple. Some large saw banksia also occur.

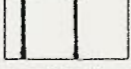
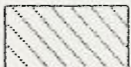
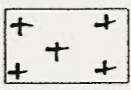
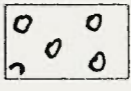
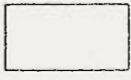
The fire has removed much of the shrub layer though there are many regenerating banksias (*Banksia spinulosa* and *B.oblongifolia*) and boronias (*B.pinnata* and *B.ledifolia*). The groundcover is also dominated by fire regenerators such as the sedges, *Ptilothrix deusta* and *Cyathochaeta diandra*, Brown's love grass (*Eragrostis brownii*) and the sundew, *Drosera peltata*

Figure 2 - Fauna Habitat and Survey Locations







Key

Habitat

-  Open Forest
-  Woodland
-  Open Scrub
-  Wetland
-  Cleared

Fauna Survey

-  Spotlight Transect
-  Trap Line
- B Bird Census Point
-  Site Boundary
-  Park Boundary

3.3 Wetland

A small wetland occurs around and behind the dam which has been built at the head of the southern gully. The vegetation here is dominated by cumbungi (*Typha orientalis*) with some aquatic plants in inundated areas and paspalum (*Paspalum dilatatum*), whiskey grass (*Andropogon virginicus*) and red-stemmed wattle (*Acacia rubida*) around the edges.

3.4 Open Scrub

The smaller area of extraction is proposed for this community. It occurs on a gentle slope and is dominated by dwarf apple (*Angophora hispida*) and paperbark tea-tree (*Leptospermum trinervium*) to 2m with a groundcover of *Cyathochaeta diandra* and other herbs.

3.5 Habitat Features and Disturbance

Specific habitat features that favour the presence of fauna on the site include:

- Tree hollows were present of a size suitable to provide daytime shelters for microchiropteran bats and possums and nesting hollows for birds. These were abundant in both the woodland and the open forest communities.
- Rock outcrops on the site would provide suitable habitat for a variety of reptile species and shelters for small mammal species. Some of these outcrops have been disturbed by bush rock collection.
- The construction of the site dam for agricultural purposes has provided habitat for a variety of frog and bird species that would otherwise not be present.
- The wide variety of flowering plants present would provide an important source of food for birds and mammals.

Disturbances to the site include:

- the recent fires have removed thick leaf litter and vegetation cover making much of the site unsuitable in the short term for a range of small reptile and frog species. It has probably also resulted in a short to medium term reduction in the abundance of bird and mammal species due to loss of nesting and feeding resources.
- noise from the extant extraction site and dam pumps
- bush-rock removal. This is particularly detrimental to reptiles and is an on-going problem in the local area.
- excavation of test pits in the open scrub
- vehicle access tracks through the woodland
- clearing of native vegetation for market gardening

- construction of the dam. Apart from the direct removal of vegetation this has resulted in die-back in open forest upstream of it due to impeded drainage.
- weed invasion, particularly by crofton weed (*Ageratina adenophora*), along Coopers Creek due to past land clearing and sedimentation

4. Fauna of the Study Area

62 fauna species were detected during the survey period. This was comprised of 40 birds, 12 mammals, five reptiles and five frogs. These species are listed in Appendix 2. Those considered likely to occur are listed in Appendix B. Each taxon is discussed below.

4.1 Birds

42 bird species were detected during the site inspection. A further 40 were listed as "likely to occur" on the basis of being known to occur in similar habitats in the region.

26 bird species were detected in the woodland, 20 in the open forest, three in the wetland and dam area, and eight in the open scrub.

The most common species in the woodland and open scrub were yellow-faced honeyeater (*Lichenostomus chrysops*), spotted pardalote (*Pardalotus punctatus*), New Holland honeyeater (*Philydonyris novaehollandiae*) and eastern spinebill (*Acanthorhynchus tenuirostris*). In the open forest of the southern gully, calling Lewin's honeyeaters (*Meliphaga lewini*) were common as were the scratchings of superb lyrebirds (*Menura superba*). Bird species more typical of disturbed or open areas, such as willie wagtail (*Rhipidura leucophrys*), were common around the dam.

One endangered species, powerful owl (*Ninox strenua*), was detected on the site. Another two species listed as rare and vulnerable are likely to occur. These are glossy black cockatoo (*Calyptorhynchus lathamii*) and masked owl (*Tyto novaehollandiae*). These three species are discussed fully in section 5.

A number of species indicated by the Atlas of Australian Birds (Blakers *et al*, 1984) as being uncommon in the region were detected during the survey. These are wedge-tailed eagle (*Aquila audax*), peaceful dove (*Geopelia striata*), common bronzewing (*Phaps chalcoptera*), channel-billed cuckoo (*Scythrops novaehollandiae*), Australian owlet-nightjar (*Aegotheles cristatus*) and double-barred finch (*Poephila bichenovii*). The channel-billed cuckoo is also regarded as uncommon at a state level (Morris *et al*, 1981).

4.2 Mammals

Six native mammal species were detected by trapping or direct observation. These were - brown antechinus (*Antechinus stuartii*), sugar glider (*Petaurus breviceps*), common ringtail possum (*Pseudocheirus peregrinus*), long-nosed bandicoot (*Perameles nasuta*), swamp wallaby (*Wallabia bicolor*), and bush rat (*Rattus fuscipes*).

Trapping only resulted in one brown antechinus being caught in the woodland and one bush rat being caught in the open forest. Two black rats (*R.rattus*) were also caught in the open forest below the dam. The recent fires may have facilitated their movement into this habitat. The sugar glider was heard calling in the woodland and both the swamp wallaby and bandicoot were seen in gullies of the Coopers Creek system.

In addition to this the following insectivorous bat species were detected: Gould's long-eared bat (*Nyctophilus gouldii*), small forest bat (*Vespadelus vulturinus*), Gould's wattled bat (*Chalinolobus gouldi*), freetail bat (*Mormopterus sp* probably *loriaë*). For details on the bat survey see Appendix D.

On the basis of the presence of suitable habitat eight other native species are listed as "likely to occur". These are short-beaked echidna (*Tachyglossus aculeatus*), spotted-tailed quoll (*Dasyurus maculatus*), common bent-wing bat (*Miniopterus schreibersii*), common brushtail possum (*Trichosurus vulpecula*), mountain brushtail possum (*T.caninus*), red-necked wallaby (*Macropus rufogriseus*) and grey-headed flying fox (*Pteropus poliocephalus*). All of these species would be expected to primarily use the open forest and woodland habitats. Of these the spotted-tailed quoll and common bent-wing bat are endangered. They are discussed further in section 5.

Apart from black rat, the introduced fox (*Vulpes vulpes*) was the only other introduced species detected in the study area. Three other introduced species were listed as "likely to occur". These are cat (*Felis catus*), dog (*Canis familiaris*) and house mouse (*Mus domesticus*). The presence of these introduced species is another environmental pressure on local native fauna.

4.3 Reptiles

Five reptile species, common scaly foot (*Pygopus lepidopodus*), eastern water skink (*Eulamprus quoyii*), eastern water dragon (*Physignathus leseurii ssp leseurii*), snake-necked turtle (*Chelodina longicollis*) and red-bellied black snake (*Pseudechis porphyriacus*) were detected in the study area. Both the snake-necked turtle and red-bellied black snake were found

in and around the site dam whereas the dragon and water skink were found in the southern gully. The scaly foot was found in woodland near the Park boundary.

In addition to these species 27 others are listed as "likely to occur" due to the presence of suitable reptile habitat and records for the region. Amongst these are a variety of dragons, geckoes, skinks and snakes. Although many of these species may have suffered in the recent fires recolonisation would occur over time. A more serious threat to local reptile populations is the collection of bush rock, evidence of which occurs on the site.

Amongst those likely to occur is the broad-headed snake (*Hoplocephalus bungaroides*) which has been recorded east of the site in Berowra. There has also been an unconfirmed report of the species at Canoelands (S.King NPWS pers comm.). This species is dealt with in section 5.

4.4 Frogs

Five frog species were detected during the site survey. These were eastern common froglet (*Crinia signifera*), brown-striped marsh frog (*Limnodynastes peronii*), Peron's tree frog (*Litoria peronii*), eastern dwarf tree frog (*Lit. fallax*) and whistling tree frog (*Lit. verreauxi*).

The froglet, the marsh frog and Peron's tree frog were calling from the southern gully. The froglet was also common around the dam as were eastern dwarf tree frog and whistling tree frog. Green tree frog (*Lit. caerulea*), bleating tree frog (*Lit. dentata*) and spotted marsh frog (*Limnodynastes tasmaniensis*) were also listed as likely to occur.

Although not detected during the survey, the endangered red-crowned toadlet (*Pseudophryne australis*) and giant burrowing frog (*Heleioporus australiacus*) were also listed as likely to occur. These species are discussed below.

5. Endangered Fauna

The endangered fauna species detected or likely to occur in the study area are discussed below. In this section "region" refers to the Sydney 1:100000 map sheet and to those areas on the Gosford sheet south of the Hawkesbury River; "local" refers to Hornsby and Baulkham Hills Council areas and nearby localities north of the Hawkesbury River. Records for all species are restricted to those within the last twenty years.

For explanations of status definitions see **Appendix C**.

5.1 Powerful Owl (*Ninox strenua*)

Habitat

The Powerful Owl lives solitary or in pairs and has territories in the order of 800-1000ha (Fleay, 1968; Blakers *et al*, 1984) though where prey is abundant these may be smaller. It is strongly associated with tall open forest and open forest for roosting and breeding though it also occurs in riparian and woodland habitats (Debus & Chafer, 1994).

In the Sydney area it is found in habitat similar to that of the study area i.e. forested gullies with a mesophyll understorey along the creek-line. Often these are near residential areas viz. Pennant Hills Park, North Rocks. Such gullies are critical to the breeding success of the species. It appears as long as these are protected and sufficient prey is available the species will continue to successfully reproduce. The species' ability to survive and breed in close proximity to human habitation has also been noted in Victoria (Quinn, 1993) and Queensland (Pavey, 1993).

Its main prey items are arboreal mammals (possums, gliders, bats) though it will also take birds and ground mammals (Hollands, 1991; Debus & Chafer, 1994). In lowland coastal forests of NSW common ring-tailed possums are the main prey item whereas in highland areas greater gliders (*Petauroides volans*) are the staple diet (Debus & Chafer, 1994). Studying the effects of predation by the powerful owls on a population of greater gliders, Kavanagh (1988) concluded it may take several years for powerful owls to forage in all parts of their range.

Occurrence in the Study Area

On 27 July, 1994 a male Powerful Owl responded to the use of playback tapes near the southern gully. A search was then made over the following weeks of the gullies in the vicinity for the species' roosting and nesting sites. The male of the pair was observed twice in the southern gully east of the site. On both occasions it was perched in a coachwood (*Ceratopetalum apetalum*) holding a ringtail possum in its talons. Later the

female and the male were observed in a gully further south. Frequently used roosting sites were found within the study area. A small sample of castings (regurgitated hair and bones of prey) was sent to Barbara Triggs for identification. Only sugar gliders and ring-tailed possums were detected.

Although its nest tree was not positively identified, it is thought to be a smooth-barked apple (*Angophora costata*) located in the same gully in which the pair were observed together. After fledging was likely to have occurred, the gullies in and around the study area were searched for owls or recent signs of roosting on three occasions. These searches were unsuccessful. Generally pairs do not leave the breeding area until around Christmas but erratic behaviour such as this also occurs (Kavanagh pers comm).

It is likely the subject pair of powerful owls' territory encompasses the whole of the Coopers and Dalgety Creek catchments, including ridge-tops. The recent fires which would have removed a large amount of prey could have forced them to expand this territory in to semi-cleared lands along Old Northern Road or into neighbouring creek systems.

Distribution

State: Coast, tablelands, south-west slopes and north-west plains (Morris et al, 1981). A broad coastal and subcoastal strip at altitudes below 1500m with more records on the coast than inland (Debus & Chafer, 1994)

Region: Beacon Hill, Garigal National Park and Gordon, Newport. (Burton & Morris, 1993a, 1993b, 1994; Debus & Chafer, 1994)

Local: Berowra Valley Bushland Park, Pennant Hills Park, Dural, North Rocks, Marramarra National Park (Burton & Morris , 1993 (a), (b), 1994; Debus & Chafer, 1994); South Maroota (M.Smith pers comm)

Status

State: Listed in Part 2 'Rare and Vulnerable' of Schedule 12. Uncommon (Morris et al, 1981). Probably uncommon (Debus & Chafer, 1994)

Region: Moderately common (Blakers *et al*, 1984)

Threatening Processes

In the study area environs and the local area in general, direct removal of habitat and fragmentation due to urban expansion, clearing of rural-residential properties and mining will continue to lessen the availability of prey. Fortunately, the species' breeding habitat (deep gullies) is generally unsuitable for these developments. Cases of road-kill are also known (J. Wiles pers comm) therefore increased traffic movements in the area may be a minor threat. Bird-watchers may also be disturbing suburban populations (Debus & Chafer, 1994).

NSW populations of the species may have declined by up to 50% since white settlement due to removal of habitat. Remaining habitat is being fragmented by logging, grazing and burning making dispersal by young difficult. Nest robbing by humans is also not uncommon (Debus & Chafer, 1994). These authors also warn that although powerful owls occur in equal frequency in both logged and un-logged forest the long-term effects of forestry on prey availability and breeding success are unknown.

Due to a host of factors including juvenile mortality, strict seasonal breeding and the length of time required for males to reach sexual maturity, it takes many years for a pair of powerful owls to successfully produce offspring to replace themselves (Debus & Chafer, 1994). This makes the species vulnerable to the range of environmental pressures discussed above.

Effects of the Proposed Activity

The proposed activity will result in direct removal of about 12ha of prey item (arboreal mammal) habitat. Within this area sugar glider, and ring-tailed possums were detected and flying-foxes are also expected to occur. Spotlight transects failed to provide enough data for estimates of potential prey population size.

Apart from direct habitat removal there may also be possible disruption to breeding activity. The noise generated by blasting, extraction and haulage within close proximity to the pair's breeding area could cause abandonment of the nest site until the activity ceases or the owls become accustomed to the disturbance.

In the short to medium term, the owls may also be wary of flying over the extraction site and resultant cleared land thus causing decreased foraging efficiency. In the long term the owls are likely to become accustomed to the changed habitat. There have been examples of powerful owls dispersing across large areas of open or lightly wooded country (Debus & Chafer, 1994).

Amelioration

The major expected effect on the owls (noise disrupting breeding) could be ameliorated by building up spoil along the southern boundary of stage 1 to buffer noise

The high walls along the northern and eastern boundaries of the stage 2 extraction area will be stepped down with five metre benches and sloping rises. These will revegetated with native plant species and recolonisation by arboreal mammals will eventually result. Ring-tailed possums, the species' main prey item locally, have potential for rapid recolonisation after disturbance or habitat alteration (Tilley, 1982). Ring-tails shelter in

dreys constructed of leaf material, unlike other possums and gliders which require tree hollows and therefore greater time for rehabilitation of habitat. To expedite recolonisation by sugar gliders nesting boxes could be installed in the rehabilitation area.

The haulage route south of stage 1 should be restricted to already existing tracks and avoid further removal of habitat near the breeding area.

On-going Monitoring

It is suggested that yearly checking of breeding attempt success in winter/spring be done for three years.

5.2 Masked Owl (*Tyto novaehollandiae*)

Habitat

The masked owl inhabits a range of habitats including tall open forest, open forest, and wooded farmlands. Prime habitat has a combination of tall or dense vegetation for roosting and nesting and more open areas for hunting. They commonly use interfaces between wooded and cleared areas and are often detected along roads. Masked owls usually roost in tree hollows but have also been recorded from caves and thick vegetation. Tree hollows are also used for nesting. Prey consists mainly of small and medium-sized mammals. In disturbed areas introduced species such as house mouse (*Mus domesticus*) and black rat (*Rattus rattus*) are important prey items. (Hollands, 1991; Debus & Rose, 1994).

It is seldom detected probably due to lack of recognition of its call and confusion with the more common barn owl, *Tyto alba* (Blakers et al, 1984).

Occurrence in the Study Area

A number of efforts were made to attract masked owls to sites within the study area. Although not detected, the species is likely to occur based on habitat preference and local distribution (see below).

Distribution

State: all regions. Apparently more numerous in east than west (Morris et al, 1981; Debus & Rose, 1994).

Region: Ku-ring-gai Chase N.P., Royal N.P. (Burton & Morris, 1993(b), 1994). North Ryde (Debus & Rose, 1994)

Local: Cliftonville (Tribolet pers comm); Berowra Valley Bushland Park (Kavanagh pers comm); Annangrove (Burton & Morris, 1993 b). Dharug National Park (NPWS database, Debus & Rose, 1994)

Status

State: Listed in Part 2 'Rare and Vulnerable' of Schedule 12. Uncommon (Morris et al, 1981). May be secure on the coast and tablelands but threatened on the slopes, plains and far west; scarce (Debus & Rose, 1994).

Region: Uncommon (Blakers et al, 1984)

Threatening Processes

Blakers *et al* (1984) considered the masked owl's decline was probably related to the decline of native mammals. However, this is contradicted by Debus and Rose (1994) that although this may be the case inland where native mammals have been replaced by unstable populations of introduced rabbits and mice, it did not apply to coastal areas. New South Wales populations may have declined by almost 50% in forested areas and more than 50% in woodland areas. Probable causes are forestry (particularly on the Central and North Coasts where nesting trees have been lost) and clearfelling of forest and woodland for agriculture and coastal development (Debus & Rose, 1994).

Effects of the Proposed Activity

Removal of small proportion (2-3%) of potential habitat.

Amelioration

Those suggested for the powerful owl should also mitigate impacts on the masked owl.

On-going Monitoring

Specific surveys for masked owls could be carried out concurrently with those for powerful owls.

5.3 Glossy Black Cockatoo (*Calyptorhynchus lathamii*)Habitat

Woodlands, open forests and scrubs containing plants of the Casuarinaceae family on which it almost exclusively feeds (Blakers et al, 1984). The species is an autumn-winter breeder generally using a hollow limb or hole in a dead tree standing in a forest clearing (Forshaw, 1962).

Occurrence in the Study Area

Not detected. However, the species is likely to occur on the site due to the presence of *Allocasuarina* species (forest oak and black she-oak) and sightings of the species in the Hawkesbury River area. The fruit of the forest oak and black she-oak form a major part of its diet and so may attract this species to the proposed development site.

Distribution

State: All regions except upper western (Morris *et al*, 1981).

Region: Ku-ring-gai Chase National Park, Narrabeen, Bayview, Garigal National Park (Burton & Morris, 1993 (a) (b), 1994; NPWS database)

Local: Berowra Valley Bushland Park, Annangrove, Galston, Cattai National Park, Dharug National Park, Muogamarra Nature Reserve, Cowan, Gunderman, Lower Portland (Karplus ed., 1993; Burton & Morris, 1993 (a) (b), 1994; pers obs)

Status

State: Listed in Part 2 'Rare and Vulnerable' of Schedule 12. Moderately common (Morris *et al*, 1981).

Region: Moderately common (Blakers *et al*, 1984)

Threatening Processes

Destruction and clearing of (Allo)Casuarina forest (Kennedy 1990).

Effects of the Proposed Activity

Removal of a small amount of potential habitat. The species' habitat and its food resource (various Casuarinaceae [she-oak] species) are plentiful in the local area. However, although the proposed activity will have minimal effect on the species it will contribute to loss of habitat in the local area.

Amelioration

Inclusion of *Allocasuarina littoralis* in re-planting schedule.

On-going Monitoring

None suggested

5.4 Tiger Quoll (*Dasyurus maculatus*)Habitat

Wide range of habitats including swamps and woodlands though it prefers moist forests. It has a wide range of prey including arboreal and terrestrial mammals, macropods, birds and insects (Edgar, 1981; D.Andrew pers comm)

Occurrence in the Study Area

Although not detected during this survey the tiger quoll was listed as likely to occur as it has been sighted sporadically in the Sydney region over the past few years and can cover large distances. Quolls could prey on poultry from nearby properties as well as native fauna in the local bushland.

Distribution

State: Coast and ranges of NSW with concentrations of records in the south-east (Ellis & Etheridge, 1993)

Region: Ku-ring-gai Chase National Park, Ingleside, Mt Colah, Garigal National Park (NPWS database). One trapped in French's Forest was recaptured in Granville (D. Andrew, NPWS pers.comm.)

Local: Marramarra National Park (NPWS database). This year one was trapped at Berowra Waters (R. Williams pers. comm.).

Status

State: Listed as Rare and Vulnerable on Schedule 12. Common to sparse; distribution greatly reduced since European settlement (Edgar in Strahan, 1981).

Region: Indeterminate

Threatening Processes

Processes that threaten the tiger quoll are introduced predators (foxes and cats); clearing of forest for agriculture or forestry; fragmentation of habitat by roads, fences and other barriers; siltation of streams; and shooting, trapping and poisoning (Andrew pers comm; Wilson, 1991).

Effects of the Proposed Activity

Removal of small proportion of potential habitat.

Amelioration

None suggested

On-going Monitoring

None suggested

5.5 Koala (*Phascolarctos cinereus*)Habitat

Forests and woodlands containing suitable eucalypt species.

Occurrence in the Study Area

Although not detected during this survey the koala may sporadically use the study area and environs due to the presence of one of its favoured food trees, grey gum (*Eucalyptus punctata*).

Distribution

State: The Atlas of NSW wildlife (Ellis & Etheridge, 1993) indicates concentrations of records of the species along the coast and tablelands of northern NSW and in the south-east forests.

Region: Ku-ring-gai Chase National Park, Barrenjoey Peninsula (NPWS database) and possibly Garigal National Park.

Local: Muogamarra Nature Reserve. A colony is known to occur around the western banks of Berowra Waters. Probable outliers of this colony have been sighted at Arcadia and Galston Gorge. May also occur in Maroota State Forest.

Status

State: Listed as Rare and Vulnerable on Schedule 12. Common, limited (Martin, 1981).

Region: Rare, declining. The Ku-ring-gai Chase population was severely affected by the January, 1994 fires. The Avalon colony is estimated to be only five individuals.

Threatening Processes

Historical accounts of NSW koala numbers indicate that the species was abundant late last century and early this century (Reed and Lunney 1990). The subsequent decline in numbers has been attributed to a number of environmental pressures including hunting, bushfires, disease and habitat fragmentation. It has been contended that habitat fragmentation is the primary threat to koalas and that the much publicized effect of Chlamydia related diseases on koalas is a result of this primary threat (Hume 1990). Koalas are also severely affected by increased exposure to dogs and cars (Smith & Smith, 1990 b)

Effects of the Proposed Activity

Removal of small proportion of potential habitat.

Amelioration

Inclusion of grey gum in re-planting schedule.

On-going Monitoring: None suggested

5.6 Common Bent-wing Bat (*Miniopterus scheibersi*)

Habitat

A variety of habitats adjoining favourable roost sites, including caves, mines, road culverts and occasionally buildings.

Occurrence in the Study Area

Not detected during this study. However, there is a high likelihood the species occurs in the area.

Distribution

State: Coast and ranges.

Region: Several records from forest to the north, the central coast and associated ranges

Status

State: Listed as "rare and vulnerable" in Schedule 12; common but vulnerable due to availability of roost sites

Region: Unknown

Threatening Processes

Destruction of nursery caves

Effects of the Proposed Activity

The species is not likely to be affected by the proposed development since no cave roost sites will be affected and feeding areas will still be available.

Amelioration

None suggested.

On-going Monitoring

None suggested.

5.7 Broad-headed Snake (*Hoplocephalus bungaroides*)

Habitat

Inhabits sandstone ridges in forested areas where it feeds on lizards and frogs (Swan, 1990; Cogger, 1992).

Occurrence in the Study Area

There is a low to medium likelihood of the broad-headed snake occurring in the study area. Its preferred habitat (outcropping Hawkesbury sandstone) is abundant on the site. However, much of this habitat has been ruined by bush rock collectors.

Distribution

State and Region: Coast and ranges within an area approximately 250 km from Sydney - limits of distribution are Mudgee to the north; Bathurst to the west; and Nowra to the south. Confined to the Sydney sandstone formation (Swan, 1990; Cogger, 1992)

Local: Canoelands (unconfirmed), Cowan and Berowra (S. King NPWS pers comm); Loughtondale area (NPWS database)

Status

State: Listed as "threatened" in Schedule 12; Vulnerable - status assigned in the action plan for Australian reptiles. (Cameron, 1994)

Region: Indeterminate but probably very rare and declining in abundance despite substantial areas of habitat reserved in National Parks. "...rarely been seen in the last few years.....once quite common even in the suburbs of Sydney" (Shine, 1991)

Threatening Processes

Bush rock collection, urban expansion, habitat modification (Griggs et al, Shine, 1990; 1991); illegal collection.

Effects of the Proposed Activity

The proposed activity will remove a number of outcrops which may harbour the species. Foraging habitat will also be removed. Bush rock removal, witnessed during the survey, has already degraded much of its habitat off and on site.

Amelioration

None suggested.

On-going Monitoring

None suggested.

5.8 Red-crowned Toadlet (*Pseudophryne australis*)

Occurrence in the Study Area

A specific search for the endangered red-crowned toadlet was carried out by searching likely locations on the site. The ephemeral watercourses in the woodland and their environs have been made unsuitable for habitation by this species in the short to medium term due to vegetation cover loss and sedimentation. As weather during the field study was cool and dry and therefore not optimum for frog detection, the species may have been present on the site but not detected.

Habitat

Red-crowned toadlets have specific habitat requirements. It is only found on sandstone ridge-slopes with some shale influence resulting in yellow podzolic soils. It breeds in feeder creeks with depressions forming puddles after heavy rain. These puddles must last at least 28 days to allow tadpoles to develop into adults. In the feeder creeks it uses leaf litter and debris for nesting. When not breeding they disperse and inhabit moist microclimates under rocks, logs etc (K. Thumm pers comm, Cogger, 1992).

Distribution

State: Found within a radius of 160km around Sydney where it is restricted to the Sydney sandstone formation (Cogger, 1992)

Region: Ku-ring-gai Chase National Park, Garigal National Park, Belrose, Oxford Falls, Ingleside (NPWS database)

Local: Berowra Valley Bushland Park and environs; Marramarra National Park; Muogomarra Nature Reserve; Kenthurst (NPWS database)

Status

State: Listed in Part 2 'Rare and Vulnerable' of Schedule 12.

Region: Formerly common but now declining.

Threatening Processes

Urban expansion, stormwater run-off. As the species is an ecological specialist it is vulnerable to habitat modification. In a study in western Sydney, Ferraro and Burgin (1993) concluded habitat loss and resultant pollution were the main factors influencing amphibian decline rather than global factors such as climate change and increased ultra-violet radiation.

Effects of the Proposed Activity

Ephemeral creeks in the woodland will be removed by the proposed activity. Prior to the January, 1994 fires these would have been suitable habitat for the breeding and foraging by the species. The fires removed the thick vegetative cover required and sedimentation has also occurred.

Amelioration

The nature of the proposed activity does not allow on-site amelioration for this species

On-going Monitoring:

None suggested

5.9 Giant Burrowing Frog (*Heleioporus australiacus*)

Occurrence in the Study Area

During a nocturnal survey for owls on 7/10/94 a low cooing, consistent with descriptions in literature, was heard from open forest in the southern gully. Subsequent attempts to find the source were unsuccessful. However, suitable habitat for giant burrowing frogs occurs on the site and they have been recorded locally.

Habitat

Open forests, breeding in hollows in sandy stream banks (Cogger, 1992).

Distribution

State: Coast and ranges from central coast of NSW to eastern Victoria (Cogger, 1992)

Region: Many records in Ku-ring-gai Chase National Park; Oxford Falls, Ingleside (NPWS database)

Local: Berowra Valley Bushland Park; Galston; Marramarra National Park; Muogomarra Nature Reserve (NPWS database)

Status

State: Listed in Part 2 'Rare and Vulnerable' of Schedule 12.

Region: Indeterminate. Due to its cryptic nature it may be more common than thought.

Threatening Processes

As the species is an ecological specialist and restricted in distribution it is vulnerable to habitat destruction. Siltation of streams and pollution are other likely threats.

Effects of the Proposed Activity

Prime habitat for the species occurs in the sandy banks around the gullies and this will remain unaffected by the proposed activity. However, there is a possibility that the species inhabits the woodland and open scrub due to the sandy substrate. Therefore, direct removal of about 12ha of habitat would occur.

Amelioration

The nature of the proposed activity does not allow on-site amelioration for this species

On-going Monitoring:

None suggested

6. Species for which Licence to "take" is sought

"Take", as defined by section 5.1 of the National Parks and Wildlife Act, 1974, in relation to endangered fauna includes significant modification of habitat likely to affect its essential behaviour patterns.

From the preceding discussion of the endangered species occurring and likely to occur in the study area, it is concluded that the proponent is required a licence to take for the following species:

- Powerful Owl (*Ninox strenua*)
- Broad-headed Snake (*Hoplocephalus bungaroides*)
- Red-crowned Toadlet (*Pseudophryne australis*)
- Giant Burrowing Frog (*Heleioporus australiacus*)

References

- Antcliff Ecological Surveys, (1994), 'Flora & Fauna Survey, Proposed Extraction Site, Lot 2 DP 595538, Old Northern Road, Maroota.' Report to Collin Donges & Assoc.
- Barker, J., Grigg, G., (1983), *Frog Calls of S.E. Australia* The University of Sydney.
- Blakers, M., Davies, S.J.J.F., Reilly, P.N., (1984), *The Atlas of Australian Birds* Royal Australasian Ornithologists Union, Melbourne University Press.
- Burton, A.C.G. & Morris, A.K.M. (1993a) '1990 New South Wales Bird Report.' *Australian Birds* 26 (4) pp 89-120.
- Burton, A.C.G. & Morris, A.K.M. (1993b) '1991 New South Wales Bird Report.' *Australian Birds* 27 (2) pp 29-76.
- Burton, A.C.G. & Morris, A.K.M. (1994) '1992 New South Wales Bird Report.' *Australian Birds* 27 (4) pp 97-139.
- Cogger, H.G., (1992), *Reptiles and Amphibians of Australia*, Reed Books Pty Ltd, 2 Aquatic Drive, French's Forest.
- Debus S.J.S and Chafer, C.J. (1994) The powerful owl *Ninox strenua* in New South Wales. in *Australian Birds* 28 (supplement). pp 21-39.
- Debus S.J.S and Rose, A.B. (1994) The masked owl *Tyto novaehollandiae* in New South Wales. in *Australian Birds* 28 (supplement). pp 40-59..
- Edgar, R (1991) 'Spotted-tailed Quoll (*Dasyurus maculatus*)' in *Complete Book of Australian Mammals* (ed R. Strahan,), Cornstalk Publishing, North Ryde.
- Ellis, M. & Etheridge, A., (1993) *Atlas of New South Wales Wildlife: monotremes and marsupials* NSW National Parks and Wildlife Service.
- Ferraro, T.J. and Burgin, S., (1993) Amphibian decline: a case study in western Sydney. in *Herpetology in Australia: a diverse discipline*. (eds D. Lunney & D. Ayers) pp 197-204. Transactions of the Royal Zoological Society of New South Wales.
- Forshaw, J. M., (1962) *Australian Parrots* Lansdowne Press, Melbourne.
- Hollands, D., (1991), *Birds of the Night* Reed Books, Balgowlah, NSW.

Hume, I., (1990) 'Biological basis for the vulnerability of koalas to habitat fragmentation.' in *Koala Summit - Managing Koalas in NSW*. Eds - Daniel Lunney, Chris Ann Urquhart and Philip Reed. NSW National Parks and Wildlife Service, Sydney.

Karplus, T. (ed), (1993), NSW Field Ornithologists Club Inc. Newsletter No.135 February, 1993.

Kavanagh, R.P., (1988) 'The impact of predation by the powerful owl, Ninox strenua, on a population of the greater glider, Petauroides volans.' *Australian Journal of Ecology* 13 pp 445-450.

Kavanagh, R.P & Peake, P. (1993) Survey procedures for nocturnal birds: an evaluation in variability of census results due to temporal factors, weather and technique. in *Australian Raptor Studies* (ed P. Olsen). Australasian Raptor Association, RAOU, Moonee Ponds, Victoria.

Kennedy, M., (1990), *A Complete Reference to Australia's Endangered Species* Simon and Schuster Australia, Brookvale, NSW.

Martin, R.W. (1991) 'Koala, Phascolarctos cinereus.' in '*Complete Book of Australian Mammals* (R. Strahan ed), Cornstalk Publishing, North Ryde.

Morris, A.K., McGill, A.R., Holmes, G. (1981), *Handlist of Birds in New South Wales*, NSW Field Ornithologists Club, Sydney.

Pavey, C.R. (1993) The distribution and conservation status of the powerful owl, Ninox strenua, in Queensland. in *Australian Raptor Studies* (ed P. Olsen) pp 144-154. Australasian Raptor Association, RAOU, Moonee Ponds, Victoria.

Quinn, D. (1993) Nesting Powerful Owls. in *Australasian Raptor Association News* 14(4) pp 70-71.

Reed, P., & Lunney, D., (1990), 'Habitat loss: the key problem for the long-term survival of koalas in New South Wales' in *Koala Summit - Managing Koalas in NSW* (Eds - D. Lunney, C. A. Urquhart & P. Reed) pp9-31. NSW National Parks and Wildlife Service, Hurstville.

Shine, R. (1990) The Broad-headed Snake. in *Australian Natural History*. Vol 23 (6) pp 442.. The Australian Museum, Sydney.

Shine, R. (1991), *Australian Snakes: A natural history*. Reed Books, Balgowlah.

Smith, P. and Smith, J. (1990a), *Vegetation and Fauna of Berowra Valley Bushland Park* Report to Hornsby Shire Council.

Smith, P. and Smith, J. (1990b) 'Decline of the urban koala (Phascolarctos cinereus) population in Warringah Shire, Sydney. *Australian Zoologist* 26(3&4) pp 109-129.

Specht, R.L., (1970), Vegetation. in *The Australian Environment* (ed. G.W.Leeper) pp44-67. 4th edition, CSIRO, Melbourne.

Strahan, R., (ed) (1991), *Complete Book of Australian Mammals*, Cornstalk Publishing, North Ryde.

Swan, G., (1990), *A Field Guide to the Snakes and Lizards of New South Wales*, Three Sisters Publications, Winmalee.

Tilley, S., (1982) 'Diet of the powerful owl, Ninox strenua, in Victoria.' *Australian Wildlife Research* 9 pp 157-175.

Triggs, B., (1984), *Mammal Tracks and Signs*, Oxford University Press, Melbourne.

Wilson B.A., (1991), 'Conservation of Forest Fauna in Victoria.' in *Conservation of Australia's Forest Fauna* (D. Lunney ed.). Royal Zoological Society of New South Wales, Mosman, NSW.

ACKNOWLEDGEMENTS

The author wishes to thank the following people for assistance with this project: the Attard family for uninhibited access to their property; Rod Kavanagh for assistance with "owling"; Stephen Debus for an advance copy of Large Forest Owls of NSW; Stephen King of NPWS; Ray Williams for his bat survey; and Collin Donges for patience.

Appendix A Fauna Species List, Lot 3 DP 567166, Maroota.

Key: Habitat: W-woodland; F-forest; S-scrub; D- dam/wetland area

Status: A - Abundant
 C - Common
 M - Moderately common
 U - Uncommon
 E - Endangered - listed on Schedule 12 of the National Parks and Wildlife Act (1974)
 * - introduced

The status for birds is given for the site (S), region (R) (Blakers *et.al.* 1984) and New South Wales (N) (Morris *et.al.* 1981). The status for mammals is given for the site and for Australia (N) (Strahan 1991). No published data is available for reptile and frog status at regional or state levels. For these groups the site status only is given. Status categories are defined in Appendix C.

Scientific Name	Common Name	Habitat	Status		
			S	R	N
BIRDS					
<i>Anas superciliosa</i>	Pacific Black Duck	D	M	C	A
<i>Aquila audax</i>	Wedge-tailed Eagle	overhead	U	U	M
<i>Geopelia striata</i>	Peaceful Dove	W	U	U	A
<i>Leucosarcia melanoleuca</i>	Wonga Pigeon	F	U	M	M
<i>Phaps chalcoptera</i>	Common Bronzewing	W	U	U	A
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	W	U	C	A
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	W	U	C	C
<i>Platycercus elegans</i>	Crimson Rosella	F,W	M	C	A
<i>P.eximius</i>	Eastern Rosella	W	U	C	A
<i>Cuculus pyrrhophanus</i>	Fan-tailed Cuckoo	F	M	C	C
<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo	W	U	U	U
<i>Ninox novaeseelandiae</i>	Southern Boobook	F	M	M	C
<i>N.strepera</i>	Powerful Owl	F	U	M	U(E)
<i>Podargus strigoides</i>	Tawny Frogmouth	W	U	M	A
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	W	M	U	A
<i>Dacelo novaeguineae</i>	Kookaburra	W	U	C	A
<i>Menura superba</i>	Superb Lyrebird	F	M	M	C
<i>Hirundo neoxena</i>	Welcome Swallow	D	M	C	A
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	W,S	C	C	A
<i>Eopsaltria australis</i>	Eastern Yellow Robin	F,W	C	C	A
<i>Pachycephala pectoralis</i>	Golden Whistler	F,W	C	C	A
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	F,W	C	C	A
<i>Rhipidura fuliginosa</i>	Grey Fantail	F,W,S	C	C	A
<i>R.leucophrys</i>	Willie Wagtail	D	M	C	A
<i>Psophodes olivaceus</i>	Eastern Whipbird	F	M	C	A
<i>Malurus cyaneus</i>	Superb Blue Wren	F,W,S	C	C	A
<i>Sericornis frontalis</i>	White-browed Scrub-wren	F	M	C	A
<i>Gerygone olivacea</i>	White-throated Warbler	F	U	M	A
<i>Acanthiza pusilla</i>	Brown Thornbill	F,W	C	C	A
<i>Climacteris leucophaea</i>	White-throated Treecreeper	F,W	C	C	A

Scientific Name	Common Name	Habitat	Status		
			S	R	N
<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	W,S	M	C	A
<i>Meliphaga lewinii</i>	Lewin's Honeyeater	F	C	C	A
<i>Philydonyris novaehollandiae</i>	New Holland Honeyeater	F,W,S	C	C	A
<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill	W,S	M	C	A
<i>Zosterops lateralis</i>	Silvereye	W	U	C	A
<i>Pardalotus punctatus</i>	Spotted Pardalote	F,W	C	C	A
<i>Embema temporalis</i>	Red-browed Firetail	S,W	C	C	A
<i>Poephila bichenovii</i>	Double-barrèd Finch	S,W	M	U	A
<i>Oriolus sagittatus</i>	Olive-backed Oriole	F	M	C	C
<i>Gymnorhina tibicen</i>	Australian Magpie	W	M	C	A
<i>Strepera graculina</i>	Pied Currawong	W	M	C	A
<i>Corvus coronoides</i>	Australian Raven	W	M	C	A
MAMMALS					
<i>Antechinus stuartii</i>	Brown Antechinus	W	U	-	A
<i>Parameles nasuta</i>	Long-nosed Bandicoot	F,W	C	-	C
<i>Petaurus breviceps</i>	Sugar Glider	W	U	-	C
<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum	F,W	U	-	C
<i>Wallabia bicolor</i>	Swamp Wallaby	F,W	C	-	C
<i>Vespadelus vulturnus</i>	Little Forest Bat	F,W,D	C	-	C
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	S,D, W,F	C	-	A
<i>Mormospterus sp</i>	A Freetail Bat	F,S,W	M	-	-
<i>Myctophilus gouldi</i>	Gould's Long-eared Bat	W	M	-	C
<i>Scotorepens orion</i>	Eastern Broad-nosed Bat	D	U	-	C
<i>Rattus fuscipes</i>	Bush Rat	F	U	-	A
<i>R. rattus*</i>	Black Rat	F	M	-	A
<i>Vulpes vulpes *</i>	Fox	W	C	-	A
REPTILES					
<i>Chelodina longicollis</i>	Eastern Snake-necked Turtle	D	U	-	-
<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake	D	U	-	-
<i>Physignathus leueurii</i>	Eastern Water Dragon	F	U	-	-
<i>Pygopus lepidopus</i>	Common Scaly Foot	W	U	-	-
<i>Eulamprus quoyii</i>	Eastern Water Skink	F	U	-	-
FROGS					
<i>Crinia signifera</i>	Eastern Common Froglet	F,D	C	-	-
<i>Limnodynastes peronii</i>	Brown-striped Frog	F,D	M	-	-
<i>Litoria verreauxii</i>	Bleating Tree Frog	D	C	-	-
<i>L. fallax</i>	Eastern Dwarf Tree Frog	D	C	-	-
<i>L. peronii</i>	Peron's Tree Frog	F	C	-	-

Appendix B Fauna Likely to Occur, Lot 3 DP 567166, Maroota.

* – denotes introduced species
E – schedule 12 species

L – species listed as "likely to occur"

Scientific Name	Common Name
BIRDS	
<i>Ardea novaehollandiae</i>	White-faced Heron
<i>Chenonetta jubata</i>	Maned Duck
<i>Elanus notatus</i>	Black-shouldered Kite
<i>Accipiter fasciatus</i>	Brown Goshawk
<i>Streptopelia chinensis</i> *	Spotted Turtledove
<i>Macropygia amboinensis</i>	Brown Pigeon
<i>Callyptorhynchus funereus</i>	Yellow-tailed Cockatoo
<i>C. lathamii</i> (E)	Glossy-black Cockatoo
<i>Alisterus scapularis</i>	King Parrot
<i>Chrysococcyx lucidus</i>	Shining Bronze-cuckoo
<i>Cuculus variolosus</i>	Brush Cuckoo
<i>Eudynamys scolopacea</i>	Koel
<i>Tyto novaehollandiae</i> (E)	Masked Owl
<i>Halcyon sancta</i>	Sacred Kingfisher
<i>Eurystomus orientalis</i>	Dollarbird
<i>Hirundopus caudocutus</i>	White-throated Needletail
<i>Hirundo neoxena</i>	Welcome Swallow
<i>Petroica rosea</i>	Rose Robin
<i>Pachycephala rufiventris</i>	Rufous Whistler
<i>Myiagra rubecula</i>	Leaden Flycatcher
<i>Monarcha melanopsis</i>	Black-faced Monarch
<i>Rhipidura rufifrons</i>	Rufous Fantail
<i>Malurus lamberti</i>	Variiegated Wren
<i>Origma solitaria</i>	Rock Warbler
<i>Gerygone mouki</i>	Brown Warbler
<i>Acanthiza lineata</i>	Striated Thornbill
<i>A.nana</i>	Yellow Thornbill
<i>Manorina melanocephala</i>	Noisy Miner
<i>Anthochaera carunculata</i>	Red Wattlebird
<i>A.chrysoptera</i>	Little Wattlebird
<i>Philemon corniculatus</i>	Noisy Friarbird
<i>Lichenostomus leucotis</i>	White-eared Honeyeater
<i>Melithreptus brevirostris</i>	White-naped Honeyeater
<i>Phylidonyris nigra</i>	White-cheeked Honeyeater
<i>Sturnus vulgaris</i> *	Common Starling
<i>Acridotheres tristis</i> *	Common Mynah
<i>Ptilorhynchus violaceus</i>	Satin Bowerbird
<i>Grallina cyanoleuca</i>	Australian Magpie-lark
<i>Artamus cyanopterus</i>	Dusky Woodswallow
<i>Cracticus torquatus</i>	Grey Butcherbird
MAMMALS	
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna
<i>Dasyurus maculatus</i> (E)	Spotted-tailed Quoll
<i>Trichosurus vulpecula</i>	Common Brushtail Possum
<i>T.caninus</i>	Mountain Brushtail Possum
<i>Macropus rufogriseus</i>	Red-necked Wallaby
<i>Pteropus poliocephalus</i>	Pale-headed Flying Fox
<i>Miniopterus schreibersii</i> (E)	Common Bent-wing Bat

Scientific Name	Common Name
MAMMALS (cont)	
<i>Mus domesticus</i> *	House Mouse
<i>Canis familiaris</i> *	Dog
<i>Felis catus</i> *	Cat
REPTILES	
<i>Varanus varius</i>	Lace Monitor
<i>Amphibolurus muricatus</i>	Jacky Lizard
<i>Pogona barbata</i>	Bearded Dragon
<i>Tympanocryptis diemenensis</i>	Mountain Dragon
<i>Diplodactylus vittatus</i>	Stone Gecko
<i>Oedura lesueurii</i>	Lesueur's Gecko
<i>Phyllurus platurus</i>	Southern Leaf-tailed Gecko
<i>Cryptoblepharus virgatus</i>	Fence Skink
<i>Ctenotus robustus</i>	Striped Skink
<i>C. taeniolatus</i>	Copper-tailed Skink
<i>Egernia whitii</i>	White's Skink
<i>Eulamprus tenuis</i>	Bar-sided Skink
<i>Eulepis platynota</i>	Red-throated Skink
<i>Lampropholis delicata</i>	Garden Skink
<i>L. guichenoti</i>	Grass Skink
<i>Saiphos equalis</i>	Three-toed Skink
<i>Saproscincus mustelina</i>	Weasel Skink
<i>Tiliqua scincoides</i>	Blue-tongued Lizard
<i>Rhamphotyphlops nigrescens</i>	Blind Snake
<i>Morelia spilotes</i>	Diamond Python
<i>Baiga irregularis</i>	Brown Tree Snake
<i>Dendrelaphis punctulata</i>	Green Tree Snake
<i>Acanthophis antarcticus</i>	Death Adder
<i>Cacophis squamulosus</i>	Golden-crowned Snake
<i>Hoplocephalus bungaroides</i> (E)	Broad-headed Snake
<i>Pseudonaja textilis</i>	Eastern Brown Snake
<i>Demansia psammophis</i>	Yellow-faced Whip Snake
<i>Vermicella annulata</i>	Bandy bandy
FROGS	
<i>Heleioporus australiacus</i> (E)	Giant Burrowing Frog
<i>Pseudophryne australis</i> (E)	Red-crowned Toadlet
<i>Limnodynastes tasmanienis</i>	Spotted Marsh Frog
<i>Litoria dentata</i>	Bleating Tree Frog
<i>L. caerulea</i>	Green Tree Frog

Appendix C - Fauna Status Category Definitions

1. Birds

Site Status - based on survey results.

Common - the species or indirect evidence of the species commonly encountered (>10 occasions)

Moderately Common - the species or indirect evidence of the species encountered on 2-10 occasions

Uncommon - the species or indirect evidence of the species only encountered once.

Regional Status - based on Blakers *et al.* (1985) reporting rate for the 1^o block whose north-west corner is 33°S 151°E. The reporting rate is the percentage of record sheets in the Field Atlas on which a given species was recorded.

Common - reporting rate >40%

Moderately Common - reporting rate 11%-40%

Uncommon - reporting rate <11%

NSW Status - based on Morris *et al.* (1981) where the status is given according to an estimate of the maximum NSW population in any given year.

Abundant: > 1 000 000

Common: 100 000 - 1 000 000

Moderately Common: 10 000 - 100 000

Uncommon: 1000 - 10 000

Scarce: 100 - 1000

Rare: <100

2. Mammals

Site Status - based on survey results.

Common - the species or indirect evidence of the species commonly encountered (>10 occasions)

Moderately Common - the species or indirect evidence of the species encountered on 2-10 occasions

Uncommon - the species or indirect evidence of the species only encountered once

Regional Status - information not available for most species.

NSW Status - information not available for most species.

Australian Status - based on Strahan (1983). Status categories not defined.

3. Reptiles and Frogs

Site Status - based on survey results.

Common - the species or indirect evidence of the species commonly encountered (>10 occasions)

Moderately Common -the species or indirect evidence of the species encountered on 2-10 occasions

Uncommon -the species or indirect evidence of the species only encountered once

Regional Status - information not available.

NSW Status - information not available.

Appendix D

BAT SURVEY

SAND EXTRACTION F.I.S.

LOT 3, D.P. 567166, MAROOTA.

Prepared by: Ecotone Ecological Consultants,
10 King St, Mt. Kuring-gai...N.S.W...2080.

11th November, 1994.

BAT SURVEY LOT 3, D. P. 567166, MAROOTA.
SAND EXTRACTION F.I.S

Ecotone Ecological Consultants have been engaged by Antcliff Ecological Surveys to carry out a bat survey at the above property as part of an Fauna Impact Statement. It is proposed to extract sand in two stages and involves the removal of existing vegetation and the underlying sandstone substrate. The resulting levelled areas will then be used for market gardens. The land adjoins Marramarra National Park on the eastern boundary. Approximately 15.75 ha. of the property will be subjected to sand extraction, Stage 1 being 5.25 ha. and Stage 2 the remaining 10.5 ha.

SITE DESCRIPTION

The area is typical of Hawkesbury Sandstone with exposed sandstone ridges and wind blown caves in some of the larger cliffs. Vegetation is Open Woodland on the south facing ridges (Stage 2) and Open Forest in the 2 deep gullies which form an environmental protection zone between the proposed Stages 1 and 2. About half of Stage 1 is covered by Open Scrub with the rest being already cleared for agriculture. The major tree species found on the ridges are the Red Bloodwood (*Eucalyptus gummifera*), Yellow Bloodwood (*E. eximia*), Scribbly Gum (*E. haemostoma*), Sydney Peppermint (*E. piperita*), Grey Gum (*E. punctata*), Sandstone Stringybark (*E. oblonga*), Narrow-leaved Angophora (*Angophora bakeri*) and the Smooth-barked Angophora (*Angophora costata*). In the moister gullies the Sydney Peppermint and Smooth-barked Angophora were most dominant with Turpentine (*Syncarpia glomulifera*) occurring in some areas.

The area was almost totally burnt in the January 1994 bushfires resulting in a sparse shrub and ground cover, although some regenerated ground cover occurs in the gullies along with some of the original vegetation in the southern gully. Although the fire crowned on parts of the ridges it was less intense in the moister gullies.

METHODS

Bat traps (harp traps) were set for three nights during September/October 1994. Two traps were set for one night on the 16th September, both within the the area proposed for stage 2 of the sand extraction. Four traps were set for two nights on the 15th - 16th October, with one trap being set in Stage 1, two in Stage 2 and the fourth near the dam situated between Stages 1 & 2.

Two bat detectors (Anabat, Titley Electronics, Ballina, NSW) were set on each of the three nights. The detectors were set on the ground and timers used so that bat activity could be monitored throughout the night. Ultrasonic calls, produced by the bats as they passed over the detector, were recorded onto a tape recorder and later analysed with the aid of a computer.

Bat records for the district were searched for in the National Parks and Wildlife Service of NSW Wildlife Atlas and also Central Coast and North Metropolitan District records. Personal records and those obtained by Ecotone Ecological Consultants during other surveys in the district and Australian Museum records of endangered bat species were also reviewed.

Scientific and common names used in this report follow those suggested by Richards et. al. 1993.

SURVEY LIMITATIONS

The open nature of the vegetation on the site made trap placement difficult. Best capture results are usually obtained where obvious flyways through dense vegetation occurs. Tracks and roads provide the best locations, especially where a tunnel effect through the vegetation is present. However, such sites were not available during this study.

Weather conditions also play an important role in capture success. Air temperatures, wind velocity, cloud cover and the phase of the moon are considered to affect bat activity and the insect prey availability as well as flight behaviour. Should the insect population be centred around the tree canopy, bats would also be expected to be feeding in this area, thus reducing the effectiveness of the bat traps set only a few metres above the ground. In addition, some species spend most of their active period above the tree canopy so are rarely caught (e.g. Freetail and Sheathtail bats).

The use of Bat Detectors has helped to locate species difficult to trap during surveys, but also provide some problems. Some of the ultrasonic calls produced on the tape recorder can be of short duration or poor quality and also, several call variations, including the sound frequency (in kHz), can occur within a species, thus causing some confusion between different species when assessing the results. Therefore, detector results cannot always be regarded as conclusive.

WEATHER CONDITIONS.

Date	Ta.Min.	Ta. Max.	Wind	Cloud	Moon	Rain
16/9/94	4	24	SW strong	Nil	3/4 waxing	Nil
15/10/94	12	--	Light	Nil	3/4	Nil
16/10/94	12	21	Medium	Nil	3/4	Nil

RESULTS

The results were poor with only one species of bat, Gould's Long-eared Bat being caught in the traps set in the proposed Stage 2.

The detectors showed that a further four species occur in the study area. None of these are listed as Endangered in Schedule 12 of the National Parks and Wildlife Act 1974, although the Freetail Bat recorded may have been the Eastern Freetail Bat (*Mormopterus norfolkensis*), but more than likely it was the Little Freetail Bat (*Mormopterus loriae*).

Trap Results

16/9/94	Trap 2	Gould's Long-eared Bat (<i>Nyctophilus gouldi</i>)	1F
15/10/94	Trap 3	Gould's Long-eared Bat (<i>Nyctophilus gouldi</i>)	2F
16/10/94	Trap 3	Gould's Long-eared Bat (<i>Nyctophilus gouldi</i>)	1F

Detector Results

16/9/94 - Overlooking Gully between Stages 1 & 2

Small Forest Bat (*Vespadalus vulturinus*) - several poor calls
Gould's Wattled Bat (*Chalinolobus gouldii*) - poor calls
Freetail Bat (*Mormopterus* sp. probably *M. loriae*) - poor calls

16/9/94 - Overlooking Dam.

Small Forest Bat (*Vespadalus vulturinus*) - a few calls early.

15/10/94 - Stage 1

Gould's Wattled Bat (*Chalinolobus gouldii*) - 2 passes
Freetail Bat (*Mormopterus* sp. probably *loriae*) - 3 passes?

15/10/94 - Top of Ridge, Stage 2.

Gould's Wattled Bat (*Chalinolobus gouldii*) - 5 passes
Small Forest Bat (*Vespadalus vulturinus*) - 1 pass
Freetail Bat (*Mormopterus* sp. probably *loriae*) - 2 passes

16/10/94 - Overlooking Gully (facing south)

Small Forest Bat (*Vespadalus vulturinus*) - 4 passes
Long-eared Bat (*Nyctophilus* species) - 1 pass?

Bat Survey, Maroota Sand Extraction FIS

16/10/94 - Overlooking Dam - Equipment failure after 10.30 p.m.

Gould's Wattled Bat (*Chalinolobus gouldii*) - 5 + passes
Small Forest Bat (*Vespadalus vulturinus*) - 6 + passes
Eastern Broad-nosed Bat (*Scotorepens orion*) - 2 passes

Endangered Species Recorded from the Region but NOT recorded this study.

Most Likely

Common Bent-wing Bat (*Miniopterus schreibersii*)

Possible

Greater Broad-nosed Bat (*Scoteanax rueppellii*)
Eastern Freetail Bat (*Mormopterus norfolkensis*)
Yellow-bellied Shearwater (*Saccolaimus flaviventris*)

Not Likely

Large-footed Myotis (*Myotis adversus*)
False Pipistrelle (*Falsistrellus tasmaniensis*)
Large-eared Pied Bat (*Chalinolobus dwyeri*)

COMMENTS ON SURVEY RESULTS

The survey showed that at least five species of insectivorous bats occur on the subject land. No species regarded as being endangered were recorded during this survey, although some of these species could occur as they have been recorded within the general area and suitable habitat exists. Weather conditions and loss of vegetation diversity through the bushfires are likely to have affected the overall results, as prey availability, in the form of insects, is regarded to have a major influence on bat activity and population numbers. Of equal importance is the presence of suitable roost sites. Most of the bat species likely to occur on the site are known to roost in tree hollows or behind loose bark. Caves and man-made structures such as buildings, culverts and tunnels are also used by some species.

No previous records of bats were found for the immediate area and records are few for the district. This does not mean that bats are rare in the area but rather that the habitat type is difficult to survey and bat surveys have probably not been conducted in this area. The recent use of bat detectors has helped improve survey results in areas difficult to trap and the results of this survey demonstrates this.

Of the endangered species listed above, the most likely to occur is the Common Bent-wing Bat. This species has been recorded on several occasions on the Central Coast and northern suburbs of Sydney in a variety of habitats (Ecotone, NPWS & Aust. Museum records).

There are very few records of the other species thought to possibly occur. The Greater Broad-nosed Bat and Yellow-bellied Sheathtail Bat have been recorded from Dharug National Park to the north-east of the site (NP&WS records). The Eastern Freetail Bat has not been recorded from the district and only old Australian Museum Records occur from Hunters Hill north of Sydney. The difficulty in separating the calls of this species from the apparently more common Little Freetail Bat may be hiding the true status of this species.

The Large-eared Pied Bat has been recorded from the Watagan State Forests well to the north east of the site (pers. obs.). Although habitat suitable for this cave dwelling species occurs in the Wisemans Ferry region no other records could be found. Although not likely, it would not be impossible for this species to occur on the site. The False Pipistrelle has also been recorded from the Watagan State Forests (pers. obs.) and although recorded from Kuring-gai Chase National Park (NP&WS regional records) appears to prefer large tracts of tall moist forests. The Large-footed Myotis has been recorded from Dharug National Park, Penrith and the Central Coast (NP&WS, Aust. Museum, Ecotone records), but is usually associated with large bodies of water used as feeding areas. Suitable caves, tunnels or culverts are also required for roosting. The large number of farm dams in the region could provide feeding areas and suitable caves may occur along the Hawkesbury River and environs. Despite this the occurrence of this species at the study site is not considered likely.

Other common species of bat that may occur include the Eastern Horseshoe Bat (*Rhinolophus megaphyllus*), Lesser Long-eared Bat (*Nyctophilus geoffroyi*), Chocolate Wattled Bat (*Chalinolobus morio*) and the White-striped Freetail Bat (*Tadarida australis*).

IMPACTS

The loss of roost sites is an obvious impact and, in the case of this proposal, will be a permanent situation on the land to be cleared for sand extraction. However, several of the larger trees within the vegetation to be retained were noted to contain hollows suitable for roost sites so will provide some habitat for bats. Hollows do not need to be large, in fact the use of quite small spouts on the terminal parts of branches has been observed (pers. obs.). Dead trees are also often used and it is recommended that these should not be removed from the environmental protection zones. Unfortunately such trees are often targeted for firewood collection. Some species prefer to roost in caves (e.g. the Eastern Horseshoe Bat, Common Bent-wing Bat and Large-eared Pied Bat) but although some shallow wind blown caves occur on site, none were observed to be suitable as bat roosts.

The loss of natural vegetation coupled with the use of insecticides in the proposed agricultural areas is likely to reduce the food availability for bats and therefore a reduction in bat populations may occur in the local area. The direct effects of the chemicals entering the food chain and poisoning the bats is largely unknown and is dependent on the chemical used. In the U.S.A. organochlorine based chemicals such as D.D.T. have been suspected of causing massive deaths of nursing young in the Mexican Freetail Bat (*Tadarida brasiliensis*), (Hill & Smith, 1984). Fortunately most of these substances are now banned from use.

CONCLUSIONS

Several species of bat are known or expected to occur on the proposed site for sand extraction. Most of these are common widespread species. Of the species listed as Vulnerable and Rare in Schedule 12 of the National Parks & Wildlife Act 1974 and known to occur in the region, only the Common Bent-wing Bat is likely to occur on the actual site. However, given the lack of knowledge on the distribution and habitat preferences and mobility of the other species mentioned in this report, they cannot be excluded as they may pass infrequently through the area in search of food or only occur on a seasonal basis.

Although a local reduction in bat populations in general may result because of the sand extraction and subsequent loss of roost sites, no bat species are expected to disappear from the area as large areas of similar bat habitat occur in the adjacent Marramarra National Park and some good habitat occurs in the proposed habitat protection zone.

We therefore conclude that the proposed sand extraction on the subject land is unlikely to have a detrimental affect on endangered bat species.

ENDANGERED BAT SPECIES ACCOUNTS

- Eastern Freetail Bat (*Mormopterus norfolkensis*)

- Distribution

National - Coastal areas of eastern Australia from about Maryborough, Qld, south to Sydney, N.S.W. (Allison, 1983).

Local - Few confirmed records exist for the region although the species has been recorded from Sydney (Aust. Museum records) life Data Base). Both this species and the more common Little Freetail Bat could occur on the site since a *Mormopterus* species was detected by ultrasonic calls during the present surveys. The two *Mormopterus* species are very difficult to distinguish between by their ultrasonic call alone.

- Status

Unknown. The difficulty in catching this and other related species by conventional survey techniques and the similarity of their ultrasonic calls could be a major reason for the paucity of confirmed records.

- Habitat

Forests along the coast and adjacent ranges.

- Ecology

Very little is known about the ecology of this species other than that small colonies have been found in tree hollows and behind loose bark. As with all Freetail Bats, this species flies swiftly above the vegetation canopy or in clearings on the forest edge (Allison, 1983). Suitable buildings such as churches are also used as roost sites (Aust. Museum records).

- Effects of Proposed Sand Extraction

Unknown, although a major reduction in suitable roost hollows would be detrimental to the species.

- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)

- Distribution

National - Most of the northern half of Australia extending south through the eastern half of NSW and into some coastal areas of Victoria (Richards, 1983c).

Local - Records exist from Wisemans Ferry and Dharug N. P. (NP&WS regional records) and there are Australian Museum records from northern suburbs of Sydney. Further records exist for the central coast (NPWS Regional Records).

- Status

Unknown. Rarely recorded owing to the difficulty in capturing this species. Appears to be widespread over its known range, being more common in the tropics.

Bat Survey, Maroota Sand Extraction FIS

- Habitat

Recorded from a variety of habitats ranging from mallee inland to coastal forests.

- Ecology

Very little is known about this species. It feeds on insects above the vegetation canopy and can be recognised by experienced observers by its size, coloration and distinctive flight. It is regarded as a solitary species, but small colonies (<10) have been found in suitable roosts, usually tree hollows. Apparently exhausted bats have been found hanging on the external walls of buildings. Winter migration north may occur, but this has not been confirmed (Richards, 1983c).

- Effects of Proposed Sand Extraction

Unknown, although a drastic reduction in suitable roost hollows would be detrimental to the species.

- Common Bent-wing Bat (*Miniopterus schreibersii*)

- Distribution

National - The coast and ranges of eastern Australia extending from Cape York to near Adelaide.

Local - Although not recorded during this survey this species is likely to occur in the area. Several records occur from the forests to the north and the Central Coast and associated ranges (NPWS and Australian Museum records, pers. obs.).

- Status

A common species where suitable caves or structures are available for roost sites. The status at Maroota is unknown,

- Habitat

A variety of habitats adjoining favourable roost sites, including caves, mines, road culverts and occasionally buildings.

- Ecology

The limiting factor for this species is the availability of roost sites. Maternity roosts are particularly important. Long migrations between roost sites have been recorded (Dwyer, 1983a). Records of nursery caves are few in number and widespread which leaves this species vulnerable should any of these areas be destroyed. In N.S.W. mating occurs in May-June just prior to hibernation, delayed implantation occurs and development of the young does not commence until late August. Births occur in December and young are independent between February and March and disperse over long distances. They are sexually mature in their second year and may live to over 17 years. Predators include owls, pythons, feral cats and foxes (Dwyer, 1983a).

- Effect of the Proposed Sand Extraction

This species is not likely to be affected by the proposed development since no cave roost sites will be affected, and feeding areas will still be available.

- Greater Broad-nosed Bat (*Scoteanax rueppellii*)

- Distribution

National - The coast and ranges of eastern Australia from northern Queensland to the N.S.W./Victorian border.

Local - This species was not recorded during this survey, but has been recorded from Dharug N.P. and Olney State Forest (NP&WS records, pers. obs)

- Status

This species is regarded as uncommon to sparse given the current lack of knowledge of its distribution (Richards 1983a, Parnaby 1992).

- Habitat

A variety of habitats including rainforests are used as foraging areas. This species usually roosts in tree hollows.

- Ecology

Little is known about this large species of insectivorous bat. It has been recorded to eat other bats when caught with other species in a bat trap (Woodside & Long, 1984 and pers. obs.).

- Effects of the Proposed Sand Extraction

The main threat to this species is the loss of roost sites. The retention of any large hollow trees on the site will help to alleviate any impact on this species should it occur.

Large-eared Pied Bat (*Chalinolobus dwyeri*)

- Distribution

National - Central southern Queensland south along the Great Divide to just south of Sydney N.S.W.

Local - Recorded from Olney State Forest to the north of Maroota (pers. obs.).

- Status - on current records regarded as rare and only scattered throughout the known range. The status at Maroota is unknown.

- Habitat - well timbered drier habitat with gullies (Hall & Richards 1979, Parnaby 1992). Known to roost in caves, mine tunnels and old Fairy Martins nests (Dwyer 1983).

- Ecology - This species was first described in the 1960's. From the limited data available, the Large-eared Pied Bat forms small aggregations in suitable caves or mine tunnels in Spring. Dwyer (1966 & 1983) studied a colony of up to 13 females and a few

males in mine tunnels at Copeton, N.S.W. The colony formed in early Spring and one or two young were born in late November /early December and weaned in January. Females can breed during their first year. The colony dispersed during Autumn and Winter and may hibernate during the coldest months. Mating may take place in early winter as males had enlarged testes and the glands on the muzzles of both sexes were also swollen at this time of the year.

- Effects of Sand Extraction

Although not expected to occur on the site, the main impact on this species would be the destruction of roost sites during excavation work. No suitable caves were noted within the extraction zones during this survey.

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)

- Distribution

- National - Found along the coast and ranges of eastern Australia from southern Queensland to the Victorian/South Australian border. Also found in Tasmania and S.W. Western Australia.

- Local - Records occur from Olney State Forest (pers. obs.) and Kuring-gai Chase National Park (N.P.W.S. records) but no records for the Maroota district.

- Status - Unknown but regarded as uncommon and localised (Parnaby, 1992).

- Habitat - Not fully known but preferred habitat appears to be tall forest on the coast and ranges.

- Ecology - They roost in large trees and occasionally in caves and buildings. Fairly large aggregations (10) have been recorded (Phillips et.al. 1985). It has been suggested that some populations of this species migrates to the coast in winter (Parnaby, 1983), but near Canberra evidence points towards hibernation rather than migration (Phillips et. al. 1985).

- Effect of Sand Extraction

- Although not expected to occur at this site, removal of large roost trees is considered a major threat to the species (Parnaby, 1983).

- Large-footed Myotis (*Myotis adversus*)

- Distribution -

- National - Coast and ranges from northern Western Australia, around the east coast to the south-east of South Australia.

- Local - No records occur for the immediate area but the species has been recently recorded on the Central Coast - including Dharug National Park (N.P.W.S. records and

Ecotone, 1994). Australian Museum records also occur from Penrith and Warragamba Dam.

- Status

Locally common where suitable roost and feeding sites occur, especially in the northern parts of Australia. The true status of this species is unknown in the southern part of the distribution area, although a large colony (100+) has recently been discovered in tunnels at Vales Point Power Station at Lake Macquarie to the south west of Newcastle (N.P.W.S. regional records).

- Habitat

Usually near large bodies of water, including lakes, rivers and large streams. Suitable roost sites are usually nearby. These include caves, tunnels, mines, buildings and under bridges. They have also been found roosting in dense vegetation in the tropics (Richards, 1983).

- Ecology

Breeding colonies of ten to several hundred form in a suitable roost site. Within these colonies small clusters form, consisting of a male and a harem of females. This territory is defended from other males by the dominant male. In N.S.W. breeding occurs in November-December and only a single young is produced. Further north the breeding season is extended and up to three successive births occur (Richards, 1983). At the Vales Point colony young were reported in November, 1993 (N.P.W.S. regional records) however, pregnant females were caught in early February, 1994 at Wyrribalong National Park some 15 kms south of Vales Point. This suggests that two births are occurring in the area. The constant warm humid conditions in the power station tunnels may be influencing the breeding pattern in this area (Ecotone, 1994). When not breeding the males roost alone, still defending their territory. After weaning, the young forms a strong bond with its mother for at least 4 weeks and is probably taught how to catch food by raking the surface of the water with their large feet (Richards, 1983). Aquatic insects form a large part of the diet of this species with small fish also caught in some areas (Robson, 1984).

- Effects of Sand Extraction

This species is not expected to occur at the site but, where it does occur, the destruction of roost sites is regarded as being a major threat to the species.

REFERENCES

- Allison, F. R. (1983). The Eastern Little Mastiff-bat, p. 325 in *The Australian Museum's Complete Book of Australian Mammals*, ed. by R. Strahan. Angus and Robertson: Sydney.
- Dwyer, P. D. (1966). Observations on *Chalinolobus dwyeri* (Chiroptera: Vespertilionidae) in Australian J. Mammal. 47; 716-718.
- Dwyer, P. D. (1983a). Common Bent-wing Bat. pp. 336-337 in *The Australian Museum's Complete Book of Australian Mammals*, ed. R. Strahan. Angus and Robertson; Sydney.
- Dwyer, P. D. (1983b). Large Pied Bat. p. 343 in *The Australian Museum's Complete Book of Australian Mammals*, ed. R. Strahan. Angus and Robertson; Sydney.
- Hall, L. S. and Richards, G. S. (1979). Bats of Eastern Australia. Queensland Museum Booklet No. 12.
- Parnaby, H. A. (1983). Great Pipistrelle p. 356 in *The Australian Museum's Complete Book of Australian Mammals*, ed. R. Strahan. Angus and Robertson; Sydney.
- Parnaby, H. A. (1992). An Interim Guide to Identification of Insectivorous Bats of South-eastern Australia. Technical Report No. 8., Australian Museum, Sydney.
- Richards, G. C. (1983a). Greater Broad-nosed Bat. p. 348 in *The Australian Museum's Complete Book of Australian Mammals*, ed. R. Strahan. Angus and Robertson; Sydney.
- Richards, G. C. (1983b). Large-footed Mouse-eared Bat. p. 346 in *The Australian Museum's Complete Book of Australian Mammals*, ed. R. Strahan. Angus and Robertson; Sydney.
- Richards, G. C. (1983c). Yellow-bellied Sheath-tail Bat. p. 315 in *The Australian Museum's Complete Book of Australian Mammals*, ed. R. Strahan. Angus and Robertson; Sydney.
- Woodside, D. P. & Long, A (1984). Observations on the Feeding Habits of the Greater Broad-nosed Bat, *Nycticeius rueppellii* (Chiroptera: Vespertilionidae). Aust. Mammal. 7: 121-129.

Appendix E Weather Conditions during the Field Survey

Unless otherwise indicated weather statistics are for Richmond (the closest Bureau of Meteorology station)

Key to taxon: M - small mammal trapping; Ba - bats; S- spotlighting;
O - owl survey; B - bird census; F- frogs; R - reptiles

Date	Max temp	Min temp	Rainfall(mm)	Taxon
26/7/94	17	-1	-	S,O
22/8/94	21	2	-	O
24/8/94	19	2	-	O
26/8/94	21	4	-	O
29/8/94	23	4	-	O
2/9/94	24	4	-	O
16/9/94*	24	4	-	M,B,R,Ba
17/9/94	25	1	-	M,B,R,F,S
18/9/94	25	4	-	M,B,R,F,O
7/10/94	25	9	-	O,F,S
15/10/94*	-	12	-	Ba
16/10/94*	21	12	-	Ba
23/10/94	21	8	-	O,F,S

* recorded on site

CURRICULUM VITAE

Paul Burcher

Antcliff Ecological Surveys (AES)
39 Dean Street
West Pennant Hills, NSW 2125.
Phone and Fax: (02) 484 2722

Date of Birth: 16th January, 1962

Qualifications: Awarded Bachelor of Applied Science (Applied Biology) May, 1987. New South Wales Institute of Technology (now U.T.S.)

Fields of Special Competence:

Three years experience in conducting flora and fauna surveys, rainforest plant taxonomy, and habitat management plans.

Current Work:

- Fauna Impact Statement as part of EIS - proposed jet boat operation on the Nepean River
- Flora and fauna assessment, Liverpool City Council drainage study.
- Endangered fauna survey and assessment of wildlife corridor, Local Environment Study, St Georges Basin
- Vegetation and fauna survey. Local Environment Study, Byron Bay.

Examples of Relevant Experience:

- Plan of management for Stapleton Park, Avalon. Client: Pittwater Council
- Habitat and wildlife corridors study. Client: Pittwater Council
- Flora and fauna survey for inclusion in Statement of Environmental Effects, Curl Curl Lagoon, NSW. Client: Patterson Britton & Partners Pty Ltd.
- Flora & fauna survey for inclusion in Local Environment Plan, Millallen Estates, Sussex Inlet, NSW. Client: Nexus Environmental Planning.
- Vegetation survey of the Brooklyn area and recommendations for zoning for inclusion in Local Environment Study. Client: Hornsby Shire Council.
- Fauna survey and assessment of zoning, Springwood, NSW. Client: Blue Mountains City Council.
- Flora & fauna survey for inclusion in Local Environment Plan, proposed urban release area, Mt Gilead, Campbelltown. Client: Nexus Environmental Planning.
- Flora and fauna survey and assessment of effect on the environment of endangered fauna of proposed subdivision, Castlereagh, NSW. Client: Bondellar P/L

- Rare frog survey of Big Tableland area, Queensland. Employer: Queensland National Parks and Wildlife Service.
- Flora and fauna survey and assessment of effect on the environment of endangered fauna of road works, Eternity Corner & Colo River, NSW. Client: RTA
- Fauna survey for inclusion in FIS of proposed subdivision site, Medowie, NSW. Client: Vimtest Pty. Ltd.
- Fauna survey of proposed subdivision site, Valentine, NSW. Client: Stocklands (Constructors) Pty.Ltd.
- Assessment of SEPP 19 requirements, proposed road extension, Glenhaven, NSW. Client: Landcom.
- Fauna survey and assessment of effect on the environment of endangered fauna of proposed Integrated Development Site, Leura. Client: Charles Glanville (Architects) Pty.Ltd.
- Fauna survey and assessment of effect on the environment of endangered fauna of proposed development, Camden, NSW. Client: Hassel Planning Consultants.
- Flora and fauna survey and assessment of effect on the environment of endangered fauna of proposed development, Wallacia, NSW. Client: Rhodes Thompson Associates.
- Flora and fauna survey, For inclusion in EIS, proposed sand mine site, Maroota NSW. Client: Collin Donges & Assoc..
- Flora and fauna survey and assessment of effect on the environment of endangered fauna of proposed development, Faulconbridge, NSW. Client: Freeburn & Freeburn Architects.
- Flora and fauna survey and assessment of effect on the environment of endangered fauna of proposed development, Tinda Creek, NSW. Client: Mushroom Composters Pty Ltd.
- Assessment of effect on the environment of endangered fauna of proposed activity, Cattai, NSW. Nexus Environmental Planning.
- Plant identification and data base collation as part of Wet Tropical Highlands Survey. Employer: Queensland National Parks and Wildlife Service.

Membership of Relevant Organizations

Royal Zoological Society of NSW (Scientific Member)
 NSW Field Ornithologists Club
 Australasian Raptor Association
 Royal Australian Ornithologists Union
 National Parks Association

CURRICULUM VITAE

NAME: C. Ray Williams

YEAR OF BIRTH: 1946

QUALIFICATIONS:

Biological Technicians Certificate, Sydney Technical College

PROFESSIONAL AFFILIATIONS

Royal Zoological Society of N.S.W - Scientific Member

- Chairman, Mammal Section 1983 - 1987

- Vice-Chairman, Mammal Section 1987 - Present

Australian Mammal Society - Member

Australian Bat Society - Member

PROFESSIONAL EXPERIENCE

Ecotone Ecological Consultants

Principal 1987 - Present

Management of Ecological Projects and co-ordination of field surveys and specialist sub-consultants. Major input to fauna studies (see Business Resume for more details on projects undertaken.)

University of New South Wales

Technical Officer in Charge, Zoology Department - Cowan Research Station 1975 - 1992

Responsible for the running of the Field Station and Staff. A wide range of native fauna, particularly mammals, were maintained in captivity for research.

Department of Technical and Further Education

Part-time Teacher of Animal Care 1983 - 1991

Private Fauna Consultant

Fauna Surveys and Ecological Studies for Environmental Impact Statements. 1975 - 1984

- Ecological Studies of the State Highway No.23 Corridor (Shortland to Pacific Highway) for Macdonald Wagner Pty Ltd and Department of Main Roads N.S.W - 1984

- Study of the Biological and Physical Consequences of River Sand Extraction - Lower Colo River Study for Colo River Action Group - 1983

- Vertebrate fauna of the East Wyong Shire prepared for the N.S.W. Planning and Environment Commission - 1980

- Faunal Impact of River Improvement E.I.S for Colo River Stream Clearing for Gutteridge, Haskins and Davey - 1982

- Environmental Impact of Sand and Soil Extraction - Nepean River, Camden for Monier Ltd and Wellings, Smith and Byrnes Pty Ltd - 1981

Studies undertaken in conjunction with Macquarie University -Centre for Environmental and Urban Studies

- Flora and Fauna Studies for the proposed Penrith Lakes Scheme. (Environmental and Urban Studies Report No.65 for Kinhill Planners Pty Ltd - 1981)

- Flora and Fauna Studies for the proposed Penrith Lakes Scheme 2. Regional Environmental Study.

PUBLICATIONS

" The Life Cycle of Antechinus swainsonii in "Carnivorous Marsupials" M Archer, Ed. Royal Zoological Society of N.S.W. - 1982

Grant, T .R., Williams, C. R. and Carrick F. N. (1977) "Maintenance of the Platypus (Ornithorhynchus anatinus) in Captivity under Laboratory Conditions." Aust.zool. 25 (2), pp. 117-124

Ellis, M. V. Williams, C. R. and Wilson, P.(1989) "Extension to the known range of Gould's Long-eared bat (Nyctophilus gouldi) Tomes, 1858 (Chiroptera: Vespertilionidae) in New South Wales, Aust. Zool. 25: pp.79-82

Williams, C. R. (1983) "May School Holiday Excursion to Central Western New South Wales.Koolewong 12 (2) :pp 10-15

Major Contributor "Care and Handling of Native Fauna" Royal Zoological Society of N.S.W.

ADDITIONAL REPORTS/STUDIES

Organiser of Field Surveys for Royal Zoological Society of N.S.W. for over 14 years. Although these are usually voluntary weekend or school holiday surveys, valuable work has been achieved in State Forests. Range extentions for four mammal species have resulted from this survey work to date. Typical examples follow:

National Parks and Wildlife Service of N.S.W.

- Mammal Surveys of sandridge vegetation, Sturt National Park - 1976

- Mammal Surveys of mallee and other vegetation types, Yathong Nature Reserve, Cobar N.S.W - 1983

- Ecological Studies of the effects of Wildfire on small mammal populations in Kuringai Chase National Park - 1983 to Present

Forestry Commission of N.S.W

- Ecological Studies of the effects on small mammal populations of clearing natural moist forest and of subsequent eucalypt plantation management practices, in the Olney State Forest, near Wyong N.S.W - 1977 to 1992. This included an extensive bat survey carried out over several years.

WILDLIFE PHOTOGRAPHER

Contributor of a number of photographs to The National Photographic Index of Australian Wildlife, Urban Wildlife and various other books and magazines.

CERTIFICATION

This is to certify that this Fauna Impact Statement has been prepared in accordance with the requirements of Section 92D(1) of the National Parks and Wildlife Act, 1974 and the requirements of the Director-general of the National Parks and Wildlife Service.

Paul Burcher B.App.Sc
Principal Antcliff Ecological Surveys

Paul Burcher
.....



NSW
NATIONAL
PARKS AND
WILDLIFE
SERVICE

Mr Paul Burcher
Antcliff Ecological Surveys
39 Dean St
WEST PENNANT HILLS NSW 2125

Our reference: A13080
Your reference: pb:PB:M3

**DIRECTOR-GENERAL'S REQUIREMENTS FOR PROPOSED
SAND MINE SITE AT LOT 3, DP 567166, MAROOTA.**

Dear Mr Burcher,

Thank you for your letter, dated 23 August 1994 received by the Service 24 August 1994 requesting my requirements for a Fauna Impact Statement for the above cited development.

The Fauna Impact Statement (FIS) must meet all of the requirements of Section 92D(1) of the National Parks and Wildlife Act, 1974. Pursuant to Section 92D(3), and in addition to the basic requirements set out in Section 92D(1), (which are repeated below in bold lettering), I require the following:

"92D(1) A Fauna Impact Statement must:

- (a) **be in writing; and**
- (b) **be signed by the person who prepared it; and**
- (c) **include to the fullest extent reasonably practicable, the following;**
 - "(i) a full description of the fauna to be affected by the actions and the habitat used by the fauna;"**

Head Office
43 Bridge Street
Hurstville NSW
Australia
PO Box 1967
Hurstville 2220
Fax: (02) 585 6555
Tel: (02) 585 6444

In addition to this requirement:

a fauna survey is required to be conducted in the area proposed for the development and surrounding areas likely to contribute to fauna habitat (study area). Sampling methodology should include but is not limited to the Glossy Black Cockatoo (*Calyptorhynchus lathami*), Masked Owl (*Tyto novaehollandiae*), Koala (*Phascolarctos cinereus*), Tiger Quoll (*Dasyurus maculatus*), Red-crowned Toadlet (*Pseudophryne australis*) and Broad-headed Snake (*Hoplocephalus bungaroides*).

Previous fauna studies may be incorporated as part of this work.

a full description of the methodology used in the fauna survey (eg. dates of survey, weather conditions, number of traps, configuration of traps etc). Identification of reptiles, frogs and bats should be confirmed by a recognised authority (eg. Australian Museum) for species of taxonomic uncertainty.

"(ii) an assessment of the regional and statewide distribution of the species and the habitat to be affected by the actions and any environmental pressures on them;"

In addition to this requirement, further assessment should include:

a description of the local distribution and abundance of endangered fauna known or likely to occur in the study area, and any environmental pressures on them and their habitat.

a description of the habitats and potential habitats of endangered fauna in the study area, describing habitat distribution within the study area and local distribution of these habitats. Habitat critical to essential behavioural patterns of the endangered species should be identified.

an assessment of dispersal or movement areas or routes of endangered fauna species known or likely to occur in the study area and any existing or future barriers to interbreeding opportunities between populations of endangered fauna within the local area.

"(iii) a description of the actions and how they will modify the environment and affect the essential behavioural patterns of the fauna in the short and long term where long term encompasses the time required to regenerate essential habitat components;"

In addition to this requirement:

- . a description of the location, nature and extent of habitat degradation which may result from the proposed development, and the likely effect on endangered fauna known or likely to occur in the study area.
- . a description of the possible effects of the development on any local populations of endangered fauna known or likely to occur in the study area.

"(iv) details of the measures to be taken to ameliorate the impacts;"

In addition to this requirement, detailed information should be provided on:

- . any habitat restoration proposed for the study area, including the expected time taken to restore habitat, any proposals or opportunities to improve habitat and the likely impact on fauna, particularly during the time the habitat is being restored.
- . any measures proposed to reduce possible effects of the activity on endangered fauna known or likely to occur in the study area.
- . any proposed on-going monitoring of the effectiveness of those ameliorative measures.
- . reference should be made to any alternative proposals and proposed habitat retention areas that would reduce the extent of any habitat degradation.
- . An assessment of the endangered fauna species (including a list of those species) which will or are likely to be taken or killed by the proposed development, as ameliorated. In undertaking this assessment consideration should be given to the meaning of "take" as defined by section 5 (1) of the National Parks and Wildlife Act, 1974. If the Fauna Impact Statement is to accompany a licence application for a General (Section 120) licence to take or kill endangered fauna, then the Fauna Impact Statement must clearly list those species for which licence coverage is sought.

"(v) details of the qualifications and experience in biological science and fauna management of the person preparing the statement and of any other person who has conducted research or investigations relied upon."

In addition to this requirement:

- . all information cited, where statements or conclusions are made, must be provided or fully referenced.

The Fauna Impact Statement which satisfies the above requirements must be forwarded in writing to the National Parks and Wildlife Service. Should you require any further information please contact the Manager, Threatened Species Unit on (02) 585 6540.

Yours sincerely,



for ROBYN KRUK
Director-General.

19/9/94

APPENDIX "F" - Archaeological Study

SURVEY FOR ABORIGINAL ARCHAEOLOGICAL

SITES ON LOT 3, DP567166,

MARROOTA, NSW

by

Tessa Corkill

July 1994

Report to Collin C. Dongés & Associates Pty Ltd
for PF Formation

TESSA CORKILL, BA Hons, MAACAI
Archaeological Consultant
"Archaeics"
72 Cairnes Road
GLENORIE
NSW 2157

Telephone: (02) 652-1470

CONTENTS

	Page
1 INTRODUCTION	1
1.1 Summary of Results	
2 ABORIGINAL CONSULTATION	1
3 SOURCES OF INFORMATION	2
4 ENVIRONMENTAL CONTEXT	2
4.1 Climate	
4.2 Description & Topography	
4.3 Geology & Soils	
4.4 Vegetation & Fauna	
5 ARCHAEOLOGICAL CONTEXT	5
6 THE SURVEY	9
6.1 Survey Procedure	
6.2 Survey Results	
6.3 Discussion & Assessment	
7 RECOMMENDATIONS	18
REFERENCES	19
APPENDIX I Plans for Archaeological Sites CC1-4	
PHOTOGRAPHS	

FIGURES

Behind Page

1	Regional Location: 1:300 000	1
2	Location of Survey Area: Lower Portland & Gunderman 1:25,000 Topographic	1
3	Location of proposed Development and Environmental Protection Zones 1:5000 (base map supplied by client)	1
4	Topography, Landscape and location of Archaeological Site CC1 1:5000 (base map supplied by client)	1
5	Location of Archaeological Sites Lower Portland & Gunderman 1:25,000 Topographic	9

PHOTOGRAPHS

- 1 Survey area from SW corner, looking NE. Northern boundary is along wooded ridgetop (photo 2).
- 2 Survey area from NE corner, looking SW to Market Garden (photo 1). Note evidence of bushfire.
- 3 Grinding Groove Site CC1, Group 1. Looking SE. 20cm measure.
- 4 Grinding Groove Site CC1, Group 2. Looking SE. 60cm of measure exposed.
- 5 Scattered pebbles on southern hillside, indicating residual presence of Tertiary "Maroota Sand", a raw material source for Aboriginal stone artefacts. Looking S towards hilltop. Note evidence of fire.
- 6 Naturally split quartz pebble on hillside. *in situ* where found. 22cm of measure exposed.
- 7 Site CC2: General view across engravings to watercourse with grinding grooves, near standing figure. Looking ENE.
- 8 Site CC2: Engravings on sub-horizontal rock surface. Looking N. 20cm measure.
- 9 Site CC2: Grinding grooves in dry stream bed. Flow direction from right to left. Note sediment over watercourse. Looking WSW towards location of engravings uphill. 2 metre tape.
- 10 Rock shelter with potential archaeological deposit: PAD1. Looking N.

1 INTRODUCTION

This report was commissioned by Collin C. Dongés & Associates, on behalf of PF Formation. It details a survey for Aboriginal archaeological sites over about 20 hectares of land on Lot 3, DP567166 at Maroota, north west of Sydney, NSW (Figures 1 & 2). At this location PF Formation proposes to carry out sand mining operations that will result in the removal of sand and sandstone to a considerable depth below the present land surface (Figures 3 & 4 show the development area and landscape details). Two gully areas within Lot 3 are designated 7(e) Environmental Protection Zones (escarpment) by Hornsby Council and additional exclusion zones are planned around the two separate development areas, for control of sediment and other impact possibilities (Figure 3).

1.1 Summary of Results & Recommendations

A full archaeological survey of the area was carried out in July 1994 and resulted in the identification of four new Aboriginal archaeological sites (1 grinding groove site, 1 engraving and grinding groove site, 2 rock shelters with archaeological deposit) plus one shelter with potential archaeological deposit (PAD). (Figures 4 & 5 show locations). All of the sites are within or close to the designated exclusion zones and it is recommended that they be protected and the area avoided for the duration of the development program. An archaeologist and/or representative of the Metropolitan Local Aboriginal Land Council (LALC) or National Parks and Wildlife Service (NPWS) should advise on protective measures, be present during erection of fencing or identification signs, and carry out regular monitoring.

In addition to the archaeological sites, a previously unmapped occurrence of the geological sequence known as "Maroota Sand" was identified (Figure 4). The sequence contains cobbles and pebbles that could have been useful for the manufacture of Aboriginal flaked stone artefacts. It is suggested that a representative sample of pebbles from the Maroota Sand remnant should be collected by the archaeologist for future research and technological study.

Apart from the above constraints there are no archaeological reasons why the development should not be allowed to proceed as planned.

2 ABORIGINAL CONSULTATION

Aboriginal archaeological sites are protected under the National Parks and Wildlife Act of 1974 (as amended), administered by the Director of NSW National Parks and Wildlife. It is the policy of the NPWS and such bodies as the Australian Association of Consulting Archaeologists (AACA Inc) to support and encourage Aboriginal involvement in the care and control of the part of the Australian heritage which relates to their ancestors. The present study area falls within the territory administered by the Metropolitan LALC. A representative of the Council, Ms Mary Coe, met the archaeologist on-site but was unable to take part in the full field survey. She has agreed to examine the present document and report to the Land Council, who will forward their views separately. It is therefore recommended that a copy of my report be forwarded directly to the Metropolitan LALC.

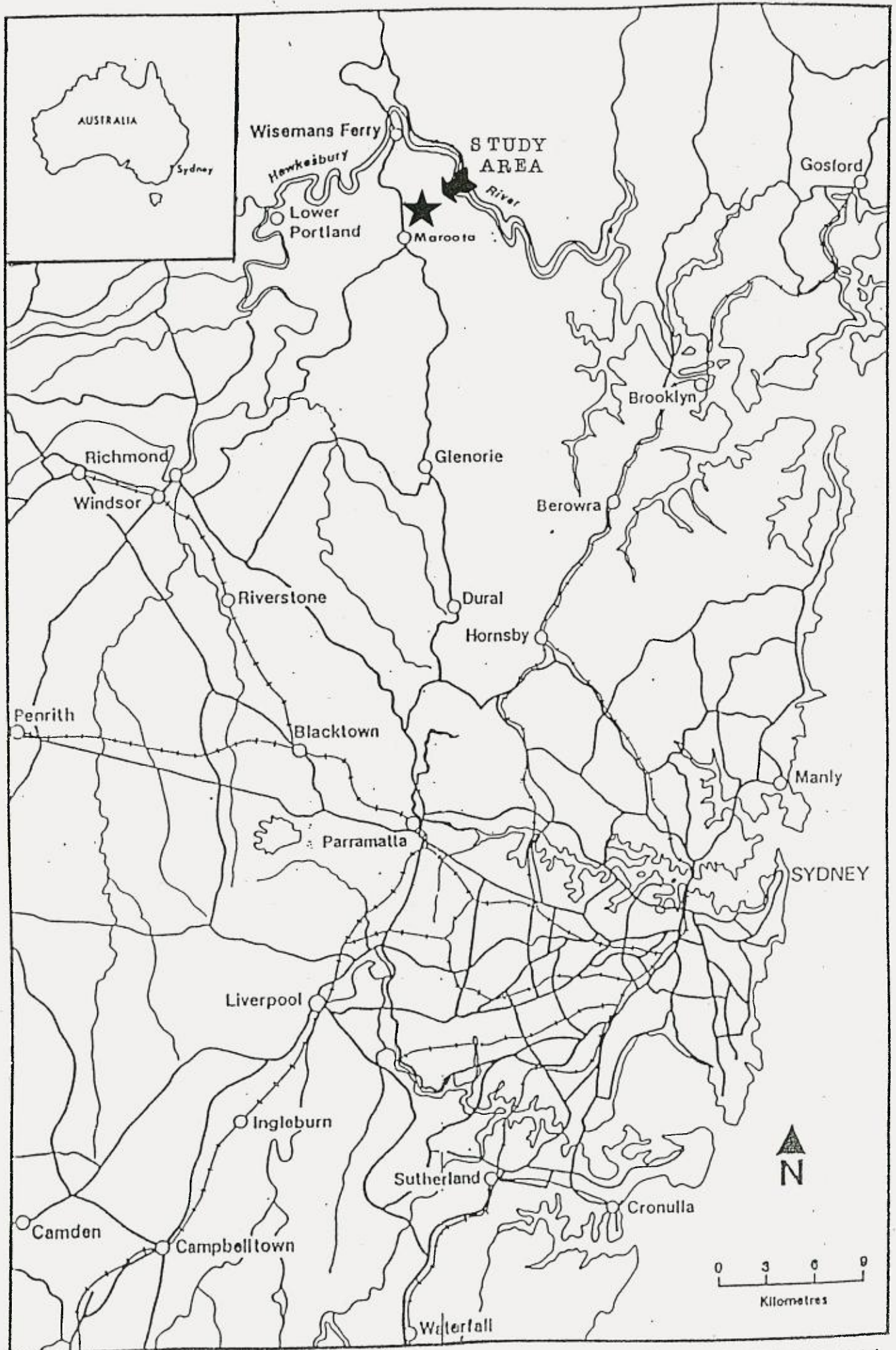
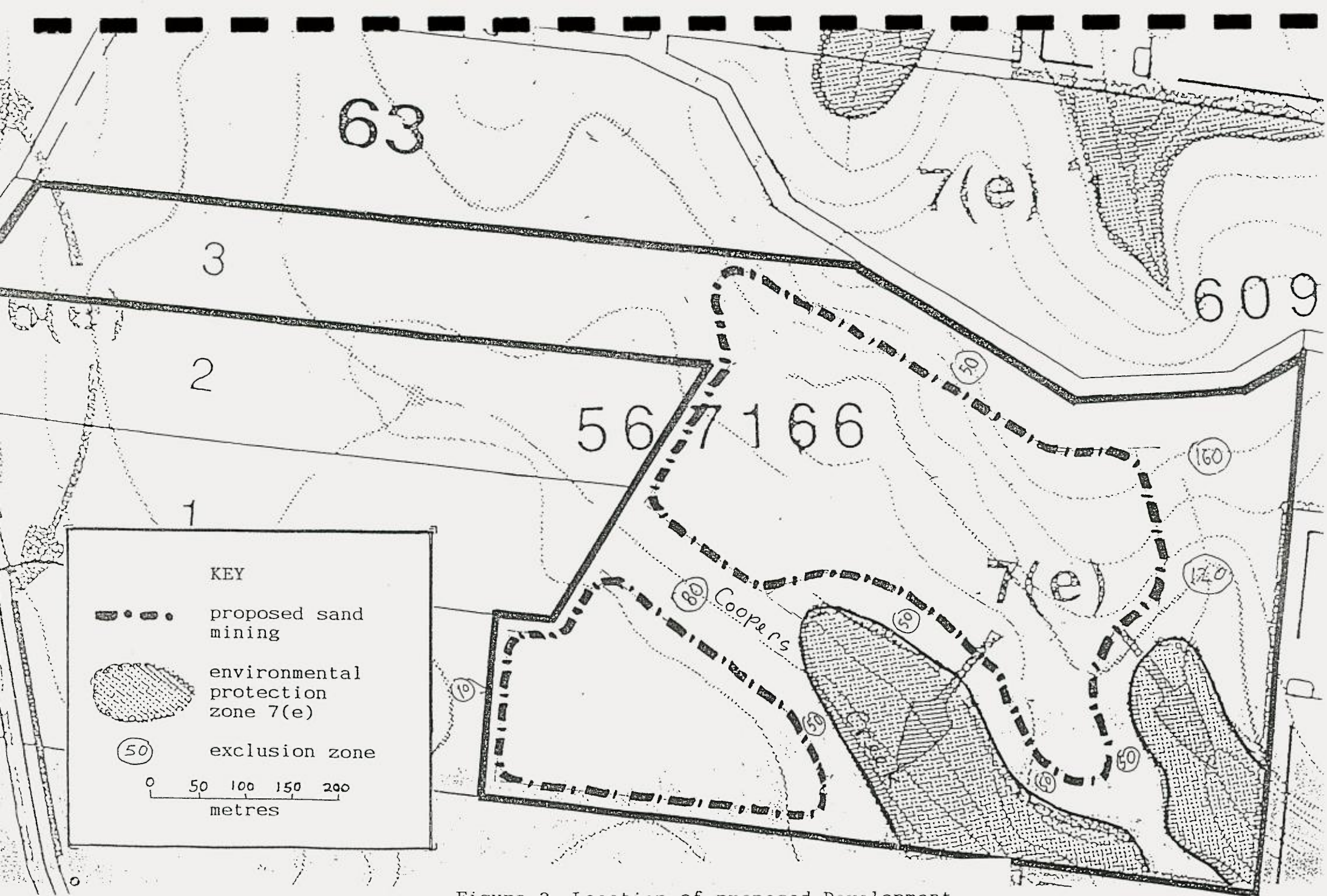

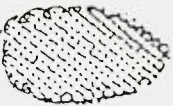



Figure 1: REGIONAL LOCATION



KEY

-  proposed sand mining
-  environmental protection zone 7(e)
-  exclusion zone

0 50 100 150 200 metres

Figure 3 Location of proposed Development and Environmental Protection Zones 1:5000 (base map supplied by client)

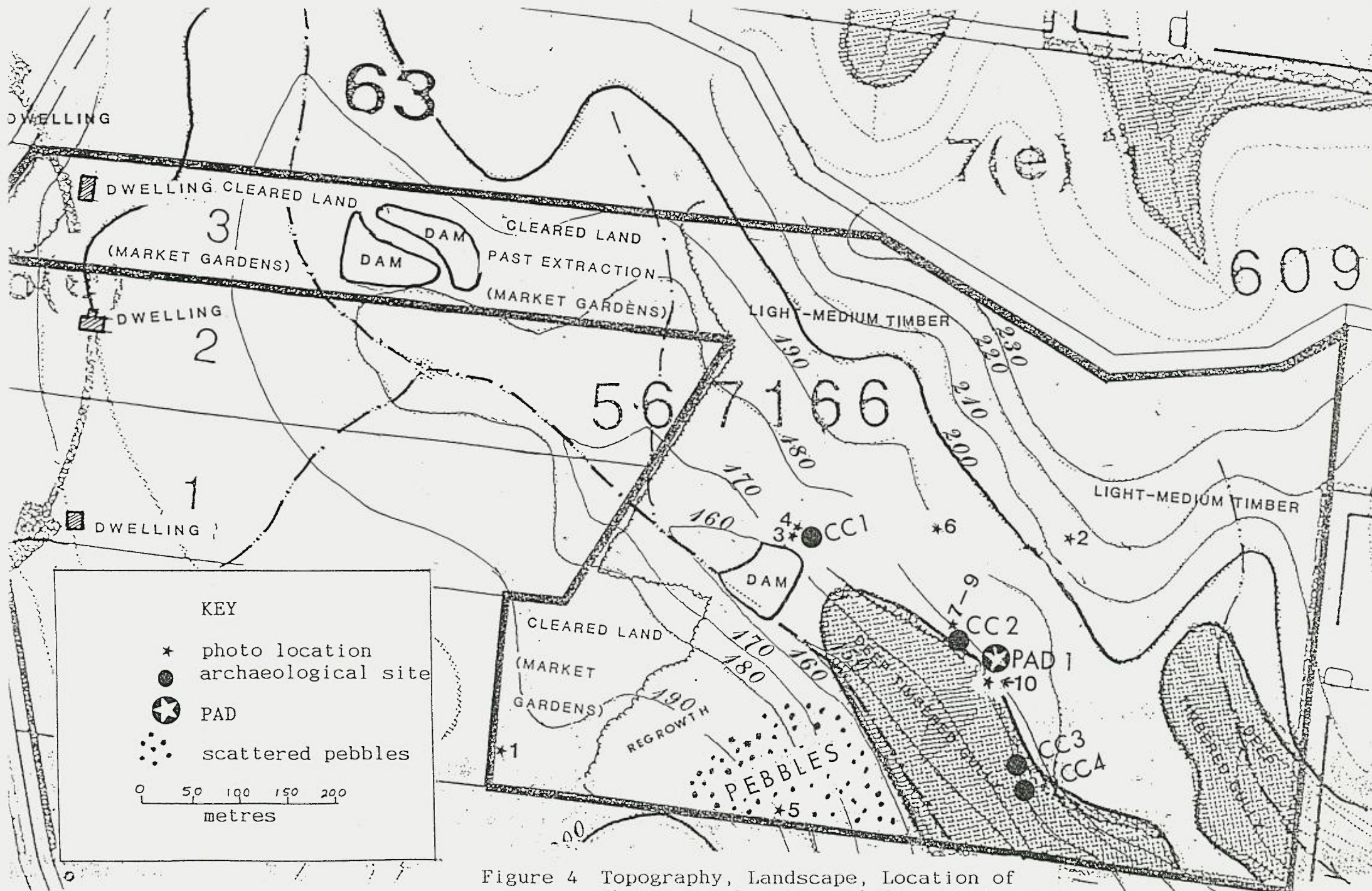


Figure 4 Topography, Landscape, Location of Photos, Archaeological Sites CC1-4 and Potential Archaeological Deposit PAD 1 1:5000 (base map supplied by client)

3 SOURCES OF INFORMATION

The Register of Aboriginal sites, kept by NPWS, is the main source of information about prehistoric and other Aboriginal sites in NSW. The information listed in the Register varies from brief descriptions with vague relocation directions to detailed reports of sites, their environment, interpretation and available documentation.

The NPWS also keeps a file of archaeological reports. The majority of these are the result of surveys in connection with Environmental Reviews (for example EISs or REFs) or more intensive archaeological investigations following such surveys (refer to REFERENCES section of this report for titles relevant to this study).

In addition, information concerning past Aboriginal activities can be gained from the study of artefacts held in museums. The Australian Museum in Sydney is the legal repository for all Aboriginal archaeological material excavated or collected in New South Wales. The Museum holds many stone and other artefacts such as boomerangs, shields and spears, collected throughout the country since European settlement.

In many areas it is also possible to gain information about Aboriginal sites from local residents, however such information varies in quality and credibility.

4 ENVIRONMENTAL CONTEXT

The natural environment of an area influences not only the availability of local resources such as food and raw materials for artefacts but also the likely presence/absence of various archaeological site types and whether or not sites will be preserved.

Changes in the environment through time are important factors in this equation. For example, clearance of natural vegetation in an area can alter groundwater characteristics and lead to variations in the decomposition rates of organic material in an archaeological site. Clearance can also accelerate erosion of some sites and sedimentation of others, depending on their location.

4.1 Climate

The climate of Sydney today is generally moderate. Annual rainfall in the survey area approximates 8-900mm, with slightly more in the first half of the year than the second. Mean annual temperatures at the Sydney Observatory range from 14-21 deg.C., with the highest recorded at 45 deg. and the lowest at 2 deg. In the survey area the temperature range tends to be greater, due to its location relative to the coastline.

Sydney is subject to occasional periods of high intensity rainfall and of hot, dry weather, the latter often resulting in bush fires (as we know only too well this year!). (Climatic information from an Australian Bureau of Meteorology booklet and recent 1:25,000 Topographic Maps).

Climatic factors influenced Aborigines' choice of the past activity areas which have become today's archaeological sites. The same factors have affected the visibility and preservation of these sites. For example, past bushfires may have destroyed organic material such as bone or wooden artefacts and sheetwash during rainstorms may have carried archaeological material to lower levels on a hillside.

4.2 Description and Topography

The survey area covers around 20 hectares and is situated on the eastern edge of the north/south trending Maroota Ridge, about three quarters of a kilometre to the east of the historic Old Northern Road (Figure 2). In the south west, the land slopes down gently north eastwards, towards an incised section of Coopers Creek, a mainly permanent watercourse which runs into the Hawkesbury River about 4 kilometres to the east. Beyond the creek the land rises more steeply, to an east/west tending ridgeline along the north east boundary (Photos 1 & 2 show most of the area from the south west and north east; photo locations are shown on Figure 4). A tributary gully runs southward down the eastern section of the survey area. Overall, the land varies in elevation from around 150m ASL at creek level to around 230m ASL on the north east hilltop (Figures 2 & 4).

The land in the south west has been cleared and modified (there is evidence of surface stripping, with an adjacent field being 10-20cms higher in some places) and is currently being used for market gardening (Photo 1). Adjacent, to the east, there is low shrubby native regrowth on previously cleared land. Tracks, a small water-filled quarry and heaps of excavated soil and rock are present in this area. The hillside between here and the creekline is covered with pebbles, mainly of quartz and quartzite (see Section 4.3, Figure 4 and Photo 5).

A dam has been constructed across Coopers Creek, near the western boundary of the survey area, and various tracks and cleared sections are present near here. Further downstream the creekline is less disturbed and is quite densely vegetated in parts. Tracks also run around and up the wooded northern hillside, where some sections appear to have been stripped of portable surface rock. Numerous exposures of bedrock are present along the hillside, either as discrete outcrops, longer shelflines or small scarps. Scarps become more prominent downstream along Coopers Creek.

Evidence of the severe bushfires in January 1994 is omnipresent, with varying degrees of regrowth evident (see for example Photos 2, 3 & 5). Erosion of surface material is also evident on hillsides, probably exacerbated by fire and previous removal of "bushrock".

4.3 Geology and Soils

Outcropping bedrock in the survey area is Hawkesbury Sandstone, the main type of rock used for engraved art and artefact-grinding by Sydney Aboriginal groups and also the probable location of most of the useable rock shelters (the latter hypothesis has not been rigorously tested, but see Vinnicombe 1980). Some raw materials for stone artefacts, particularly quartz pebbles (Photo 6) may be found in bands of conglomerate within the Hawkesbury Sandstone.

In the south west of the survey area, sandstone is overlain by what is probably an extension of the Tertiary alluvial sediments known as the Maroota Sand (see Etheridge 1980). A cover of sandy soil in the market gardens of the south west corner thins out eastward to a pebbly lag deposit over sandstone (Photo 5; see Figure 4 for location). Etheridge, in an investigation into the Maroota Tertiary deposit, did not map this particular occurrence but, from its location and pebble types, such an interpretation appears likely to be valid (pers comm, Geological Survey spokesman).

The cobbles and pebbles of the Maroota Sand are up to 10cm long and include quartz, quartzite, petrified wood, jasper, agates, chert, metamorphic rocks and sandstone. According to Etheridge (1980:16) there seem to be two distinct pebble populations, indicating different provenances. Those identified during my survey were mainly quartz and quartzite, with chert, jasper and other materials (so far unidentified) also being present. They appear to belong to the suite that Etheridge suggests may have resulted from reworking of Permian conglomerates. Their suitability for Aboriginal artefact manufacture has not yet been tested by an expert but many look as if they would produce useful flakes.

Other rock used for stone artefacts, such as silcrete (which was flaked) and fine-grained volcanic material such as basalt (mainly used for making ground-edge implements, for example hatchet heads) would have had to be brought from areas further afield, such as the Cumberland Plain or the Nepean-Hawkesbury River gravel beds. There is also a basalt outcrop about one kilometre to the south (Etheridge, 1980:6) and another about 2kms south west, which may have been suitable for artefacts (to date these outcrops have not been checked for their suitability).

The natural soils and sediments on the hillsides generally maintain an acid-tending pH value (refer Chesnut, 1980: 198; see also Hughes 1980, 50-2). Such a tendency, together with the rainfall regime, is a further factor (see 4.1 above) that would tend to accelerate the breakdown of organic material in archaeological sites.

4.4 Vegetation and Fauna

The south western section of the survey area has been cleared of its original vegetation. Part of this area is currently planted with lettuces and part has been allowed to regenerate and is now covered with shrubby regrowth. In addition, there has been clearing, disturbance and the incursion of introduced plant species around the dam and tracklines. However, native forest remains over most of the north eastern hillside and along the creek below the dam (Figure 4 shows details; see also Photos 1 & 2). At the time of the field survey the effects of the January bushfires were still evident (see esp. Photos 2, 3 & 5) but regrowth of trees and shrubs was proceeding slowly.

A list of plants present in the survey area has been prepared by Antcliff Ecological Surveys. It lists around 40 species that are known to be edible and 20 that were used in other ways by Aborigines of the Sydney area. These include *Eucalyptus* and *Allocasuarina spp* (wood used for artefacts and firewood; bark used for artefacts, shelters etc; hollow trunks and branches are homes for possums, honey found in bees' nests), *Typha orientalis* and

Elaeocharis spaceolata (Rushes - Rhizomes edible, leaves used for baskets), *Pteridium esculentum* (Bracken Fern - roots and young shoots edible). *Doryanthus excelsa* (Gynea Lily - root and flower spikes edible, leaves used to make baskets), *Ficus rubiginosa* (Port Jackson Fig - roots used to make baskets, fruit eaten). Edible fruit also include *Exocarpus cupressiformis* (Native Cherry, or Cherry Ballarat), *Cassythia glabella* (Devil's Twine), *Billardiera scandens* (Apple berry), *Persoonia spp* (Geebung), *Dianella caerulea* (Paroo Lily). Nectar can be obtained from a variety of plants present in the area including bottlebrushes, banksias, eucalypts and grevilleas. Edible grubs are often present in the roots and trunks or stems of wattles and some banksias. Perhaps the most useful plant in the area was the Grass Tree - *Xanthorrhoea arborea* & *X. media*. The dried stem was used for spearshafts and fire-making, dried seeds and flowers as tinder, gum as adhesive, nectar and leaf bases were eaten as well as grubs that are often present in the trunk or root areas.

Some of the above are available throughout the year and some, such as fruits and nectar, are seasonal. Regulated firing of specific areas of bushland was carried out by Aboriginal groups in many areas to clear dense undergrowth or drive game from hollows or into traps. Fire also encourages growth, flowering and fruiting of some plants including Gynea Lilies and Grass Trees.

(Information above compiled from Benson & Howell, 1990; Cherikoff & Isaacs 1990; P. Burcher, Antcliff Ecological Surveys - plant list for present Environmental Study).

Useful local terrestrial fauna in the past would have included wallabies, possums, koalas, echidnas, snakes, lizards and various kinds of insects and their larvae. Flying foxes, drawn to the fruits of the Port Jackson Fig (see above), were also popular items on Aboriginal menus around Sydney and are still eaten by many people around the world today.

Yabbies would have been present in rockpools along Coopers Creek, while fish, shellfish and other marine resources would have been available around 2 kilometres downstream, in the estuary that existed prior to sedimentation (the present infill is likely to have occurred since European settlement and logging of forests along the Hawkesbury).

5 ARCHAEOLOGICAL CONTEXT

Based on archaeological evidence from a number of sites it appears that Aboriginal occupation of the Sydney region had commenced by 13,000 years ago (Kohen et al 1984; see also Attenbrow 1987) and possibly much earlier (a date of around 40,000bp from the Cranebrook Terraces on the Nepean River, to the west of the study area, is still under consideration and is hotly debated; see Nanson et al 1987 and cf. Stockton & Holland 1974). Low levels of occupation appear to have been followed by more intensive activity within the past few thousand years (Attenbrow 1987; Kohen 1986; see also McDonald 1990).

The arrival of Europeans in the Sydney area during the late eighteenth century permanently altered the lifestyle of the Aboriginal inhabitants. Haglund (1990:5) states that:

European exploration and settlement of the Sydney region had a disastrous effect both on the Aboriginal inhabitants and on the material evidence of their traditions and landuse. They were rapidly decimated by introduced diseases such as smallpox and influenza, and dispossessed of their land, which caused intergroup conflict and widespread starvation.

Their traditional way of life was severely disrupted and few attempts made by Europeans to record their customs and language. Consequently there has been little information available about the Aboriginal occupants of the region but work is proceeding on gathering information through archaeological studies and oral history.

Early ethnohistoric observations in the Sydney area are severely limited, however it would appear that when the First Fleet arrived in 1788, a number of named Aboriginal groups and sub-groups, each having control over varying aspects of land use in different areas, were present between the Hawkesbury-Nepean River system and the coast (for discussion of the evidence see for example Kohen & Lampert 1987, Rich 1986, Ross 1976). Little is known of the significance of cultural boundaries in the Sydney region, in terms of such factors as land-use and various rights and obligations. Neither is it known how far back in Aboriginal history particular boundaries may have existed.

Notwithstanding the limitations of the data base, ethnohistoric evidence suggests that coastal groups appeared to rely heavily on fish and shellfish and inland groups on terrestrial plant and animal resources.

Early European accounts of the material culture of Sydney's Aboriginal groups appeared to indicate that they used few stone artefacts, particularly near the coast, where shell, bone, wood and even fish teeth and stingray spines were used as spear barbs. Hatchet heads and "death spear barbs" seem to be the main stone artefacts mentioned (see for example observations quoted in Ross 1976 & Rich 1986). However, following nineteenth century identification of stone artefacts in Sydney rock shelters and open sites, it became obvious to researchers that a considerable amount of stone had been used in the past (see for eg Etheridge 1891; Etheridge et al 1896; Etheridge & Whitelegge 1907) and that raw materials varied in type, quantity and frequency, within and between artefact classes. More recent surveys and excavations have further backed up these findings (see for eg. Attenbrow 1992; Haglund 1990; Kohen 1986; Smith 1988).

Raw materials and technological characteristics of stone artefacts used by the Aborigines changed over time. Those in the Sydney area have been defined as belonging to the Eastern Regional Sequence (ERS), spanning the late Pleistocene and Holocene (for detailed definitions and descriptions see for example McCarthy 1948, Attenbrow 1987). Two main phases are distinguished, the Pre-Bondaian and the Bondaian, the latter with several phases, starting about 5000 years ago. The Bondaian is characterised by a greater

proportion of small flaked artefacts compared to the former, plus the introduction of ground-edged implements. In the past 3000 years the proportion of fine-grained siliceous materials such as chert and silcrete appears to have declined in favour of quartz, with an increase in bipolar technology paralleling the change.

Although it may be an artificial distinction, in the Sydney region it has become traditional to group archaeological sites in terms of their geological base. The usefulness of this classification follows from the fact that, where systematic surveys and analyses have been carried out, the relative percentages of certain site types seem to be fairly consistent within geological boundaries. For example, rock engravings, shelter art sites and grinding grooves are the sites most frequently recorded in the ruggedly incised ridges and valleys of the Hawkesbury Sandstone country, whereas stone artefact scatters predominate in the more gentle landscape of the Cumberland Plain, underlain by Wianamatta Group bedrock (see for example Vinnicombe 1980; Attenbrow 1987; Koettig 1988; Smith 1988)

Large scale research into these and other possible correlations has not yet reached a point where site numbers and exact locations can confidently be predicted within specific areas and, in view of the numerous possible variables, it is unlikely that predictions for particular localities will ever be more than general.

Despite the above, there is widespread agreement on the types of sites likely to be found and the broad divisions of topographic location where each might be expected. Expected site types for the Maroota district are listed at the end of this section.

No previous archaeological surveys are known to have been carried out on Lot 3, nor have any archaeological sites been recorded. However a number of surveys have taken place and sites have been recorded in the surrounding district. The surveys include:

- | | |
|----------------------------|--|
| Corkill 1989 & 1991a, c, d | Surveys at Maroota, to the west of present study area, for proposed sandmining developments. No sites identified. |
| Corkill 1991b | Survey to west of Maroota for proposed waste disposal area. One shelter with PAD identified and recommended for sub-surface testing prior to significance assessment. Development did not go ahead and no testing was undertaken. |
| Kelly 1979 | Survey of a proposed bush-rock removal lease, on Crown Land, 3km SW of the study area. No sites found. |
| Koettig 1989 | Survey in former Maroota State Forest, south of present study, for proposed waste disposal area. Around 400 hectares surveyed. 15 sites found, including shelters with art/artefacts, grinding grooves and one engraving. 90 PADs also found & many recommended for testing prior to development (development did not proceed so no shelters were tested). |

- Kohen 1992 Survey at Maroota, of area proposed for sandmining. No sites found. Note that this survey duplicated that of Corkill 1991c.
- McDonald 1986 A survey of the area surrounding "Devil's Rock" Aboriginal engraving site, about 2km to the north. A number of engraving, grinding groove rock shelter and other sites were found.
- McDonald 1992 Survey of proposed "paintball arena" at Canoelands Road, south of Maroota. No sites.
- Ross 1979 Survey prior to proposed sandmining operations about 3km to the SSW. One rock shelter with art and artefacts found outside development area.
- Sullivan & Johnston 1975:
A pipeline survey from Maroota to Somersby.
(details for local area not known)

(Refer to REFERENCE Section of this report for titles of reports copies of which are lodged with NPWS)

In addition W.D. Campbell, a government surveyor, recorded many rock engravings in the Sydney area, and some in the study region, in the late 19th century (Campbell 1899). During the present century F.D. McCarthy, F. Hanson, J. McDonald and I. Sim recorded many of these and others (see Hanson 1947; McCarthy 1983 McDonald 1990 and many volumes of Mankind). McDonald's Sydney Rock Art study for NPWS includes both engraving and drawing/painting/stencil art sites.

Archaeological sites recorded during the above investigations, and others that have been reported on individually are included in Table 1, below. Within 5 kilometres of the study area 72 Aboriginal archaeological sites are recorded in the NPWS Sites Register (see Table 1). These sites contain a total of 80 "traits" (for example a rock shelter site with midden, art and archaeological deposit is counted as 3 "traits". Archaeological deposit usually implies the presence of stone artefacts).

Frequency table for: SITETYPE		# of sites: 72	
Missing values: 0		Weighted total: 82.00000	
Shelter c deposit	5 6.1%	Open camp site	1 1.2%
Midden	1 1.2%	Shelter c midden	0 0.0%
Shelter c art	19 23.2%	Isolated find	0 0.0%
undefined	0 0.0%	Axe grinding groove	20 24.4%
Bora / ceremonial	0 0.0%	Burial	0 0.0%
Rock engraving (0)	32 39.0%	Scarred tree	2 2.4%
Carved tree	0 0.0%	Nat. Myth. (Rit)	0 0.0%
Restricted Site	0 0.0%	Quarry	0 0.0%
Ochre quarry	0 0.0%	Fish trap	0 0.0%
Stone arrangement	2 2.4%	Mound (oven, habit.)	0 0.0%
Mia mia	0 0.0%	Water hole/well	0 0.0%
Contact, Mission	0 0.0%	Abraded grooves	0 0.0%

Table 1: Site traits within 5km of the Study Area
(NPWS MINARK Printout)

It can be seen that rock engravings (32 groups) are the most commonly recorded site trait, followed by grinding grooves (20) and rock shelters with art (19).

The closest known sites are several groups of grinding grooves, less than two kilometres to the south east in a tributary of Coopers Creek, and an engraving site, a similar distance to the south west. The noted Maroota Historic Site complex of engravings, shelters with art and deposit, grinding grooves, a stone arrangement, scarred trees and an open camp site, is about two kilometres to the north.

It is interesting to note that during Koettig's 400 hectare survey of the former Maroota State Forest, on the western slopes of the main north/south ridgeline in 1989, only one engraving site was found, and of the other engraving sites recorded within a 5 km radius of the present survey area, most are on the eastern side of the ridge. Whether this represents a real difference between east and west (cultural boundary? preservation factors? etc) or reflects survey intensity, is not yet clear.

Based on past experience during surveys it is possible to say that there are likely to be many more archaeological sites present but unrecorded, in parts of the region that have not been fully surveyed or where archaeological evidence may be obscured by sedimentation or surface vegetation.

To sum up, topographic and geological features, plus regional site frequencies (Table 1) indicate that the main site types or traits to be expected in the survey area are:

- rock engravings
- grinding grooves
- rock shelters with art, and/or
archaeological deposit
- scarred trees (rare)
- stone arrangements (rare)
- stone artefact scatters (rare)
- burials (in shelters)

6 THE SURVEY

6.1 Survey Procedure

The field survey took place over several days in July 1994. I was assisted in the field by archaeologist John Edgar. A representative of the Metropolitan LALC, Ms Mary Coe, attended on the first day, for an overview of the area. She was unable to take part in the full survey but indicated that a representative of the Land Council should inspect any sites identified, prior to determination of the development proposal.

The entire development area and adjoining sections of the exclusion zones were covered on foot. Areas of exposed rock were examined for engravings and grinding grooves, outcrops for possible rock shelters, large trees for particular types of scars and the ground surface for discarded stone artefacts.

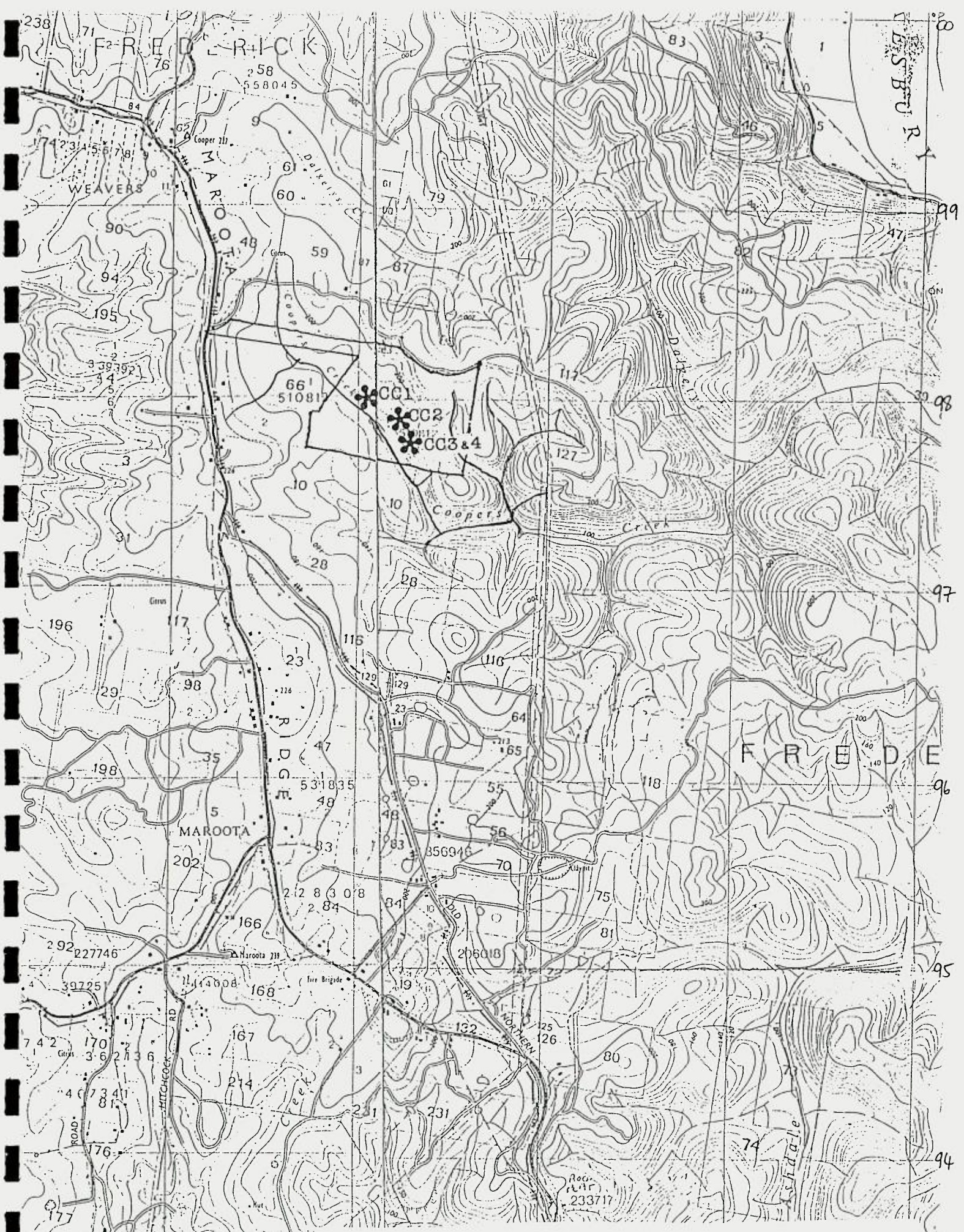


Figure 5 Location of Archaeological Sites CC1-4
 Lower Portland & Gunderman
 1:25,000 Topographic

Maps used in the field were 1:25,000 Topographic and 1:5000 plans with topographic, landscape and general development area details (the latter were provided by the client and form the bases for Figures 3 & 4 of this report).

6.2 Survey Results

Four new archaeological sites were identified during the survey - one grinding groove site, one with rock engravings and grinding grooves and two rock shelters containing stone artefacts. In addition, one rock shelter with potential archaeological deposit (PAD) and two features of archaeological interest (a potential source of stone for artefacts and a natural quartz "event") were found (Figures 4 & 5 show locations).

The sites were named Coopers Creek 1-4 (CC1-4) and the rockshelter with potential archaeological deposit PAD1. Site details follow, site plans are to be found in Appendix I of this report.

ARCHAEOLOGICAL SITES CC1-CC4

Site Name CC1

Site Type Grinding Grooves

Map Reference Gunderman 1:25,000: 314050 6297970

Distance to Water On-site (ephemeral), c50 metres - (permanent)

Topographic Location Lower ridgetop, approx 170m AHD

Location Relative to Development Near exclusion zone/development area boundary. Development area is higher than site.

Photo Nos 3,4

Appendix Figure # 1,2

Description/Comments The grooves are in the sandstone bed of a very minor watercourse running towards Coopers Creek. They are situated above a waterfall over a small rocky scarp, to the north of a dam across the creek. Two groups of grooves are visible in the narrow channel between low, sandy banks. Group 1 consists of 9 grooves over a distance of about 5 metres - 7 above and 2 below a small rockpool. Group 2 is 20m upstream and consists of 11 definite and 2 doubtful grooves around a keyhole-shaped rockpool. The rock surface in both areas is fairly stable but the grooves appear to have been subject to some weathering. Local hillside sediments are very mobile and may have covered further grooves along the watercourse. Vegetation consists of eucalypt forest with shrubby understorey, presently regenerating after bushfires.

Dimensions - Group 1

<u>Groove #</u>	<u>Length</u>	<u>Width</u>	<u>Depth</u>
	(centimetres)		
1	34	9	2
2	33	9	2
3	20	5	0
4	25	4	0
5	26	6	0
6	30	8	1
7	10	4	0
8	22	8	2
9	25	9	1

Dimensions - Group 2

<u>Groove #</u>	<u>Length</u>	<u>Width</u> (centimetres)	<u>Depth</u>
1	26	6	1
2	19	6	1
3	22	8	2
4	26	8	2
5	19	6	2
6	31	8	2
7	29	8	2
8	25	6	1
9	25	7	2
10	30	6	2
11	28	5	1
d1*	20	7	1
d2*	39	5	1

* d = doubtful

Site Name CC2

Site Type Engravings & Grinding Grooves

Map Reference Gunderman 1:25,000: 314200 6297900

Distance to Water On-site (ephemeral); c100 metres (permanent)

Topographic Location Lower ridgeside, approx 175m AHD

Location Relative to Development Within exclusion zone around Environmental Protection Zone 7(e). About 30m from development area. Development area is higher than site.

Photo Nos 7-9

Appendix Figure # 3,4

Description/Comments

Engravings: These are located on the sub-horizontal surface of a large, rounded sandstone outcrop about 20m above and 100m NE of Coopers Creek. There are two figures, each about 70cm long, 25cm apart. Figure 1 looks like a ?flightless bird. Figure 2 looks like an animal with very thin legs and tail (?dog). They are in the "simple figurative" outline style made by the pecked and abraded groove technique. The rock surface is presently stable, with a thin growth of lichen over much of the surface. The figures are easily visible in normal light but are better seen when the sun is low, under night lights or when wet.

Grinding Grooves: These are located about 10m downhill to the ENE of the engravings, in a shallow rock-lined watercourse tending south towards Coopers Creek. Eleven grooves are visible over a distance of about 2m. Four of these are partly covered with sandy sediment that currently blocks the watercourse downstream. During the survey there was no running water but water was present in a small rock pool upstream. The rock surface appears fairly stable and is stained with iron leached from surrounding rocks and sediments.

Grinding Groove Dimensions - Site CC2

<u>Groove #</u>	<u>Length</u>	<u>Width</u> (centimetres)	<u>Depth</u>
1	28	7	1
2*	23	7	2
3*	30	9	3.5
4*	28	10	2
5*	42	9	2
6	23	8	1
7	30	7	<0.5
8	24	4	<0.5
9	29	7.5	1.5
10	24	5	<0.5
11*	5	5	0.5

* partially covered by sediment

Site Name CC3

Site Type Shelter with deposit

Map Reference Gunderman 1:25,000: 314270 6297780

Distance to Water <100 metres (permanent)

Orientation (degrees): 245

Topographic Location: Lower ridgeside, approx 170m AHD.

Location Relative to Development Within Environmental Protection Zone (7e) about 60m from development area. Development area is higher than site.

Excavation Potential: Good

Site Dimensions (maxima, in metres)

Shelter Length: 6 Width: 3 Height: 2

Deposit Area: 90% Depth: >30cm some areas

Description/Comments: SW facing overhang in sandstone outcrop, 30m N of CC4. Highly active honeycomb weathering of walls and roof (sand and black manganese grains predominate). Sandy floor slopes down from east to west (10-18° slope). Open on three sides but sheltered from north. Tunnel through rock north of shelter (c1.5m wide). Some wash through of sediment from upslope likely but little other disturbance visible. Minimal European impact evident. One stone artefact found in dripline (Appendix I plan gives location).

Artefact details: Red silcrete ?redirecting flake
1.6 x 1.8 x 0.2cm

Photo Nos None

Appendix Figure # 6

Site Name CC4
Site Type Shelter with deposit
Map Reference Gunderman 1:25,000: 314270 6297750
Distance to Water <100 metres (permanent)
Orientation (degrees): 270
Topographic Location: Lower ridgeside, approx. 170m AHD.
Location Relative to Development Within Environmental Protection Zone (7e) about 70m from development area. Development area is higher than site.
Excavation Potential: Excellent
Site Dimensions (maxima, in metres)

Shelter Length: 8 Width: 3 Height: 2
 Deposit Area: 95% Depth: >30cm some areas

Description/Comments: West facing sheltered overhang in sandstone outcrop, 30m S of CC4. Level floor from N-S, 10° maximum slope down W from near mouth of shelter. Sandy floor over most of shelter and outside. Generally undisturbed and little influx of upslope sediment apparent. Two basalt flakes from ground implement found on surface near back of shelter (see Appendix I, Figures 7 & 8 for location and illustrations). One dog femur in good condition found at N end of shelter (no other bones).

Artefact details: 2 fine grained pale grey basalt flakes with grinding on dorsal surfaces.
 1: 4.8 x 4.2 x 0.7
 2: 3.1 x 3.0 x 0.6

Photo Nos None

Appendix Figure # 7,8

ROCKSHELTER WITH POTENTIAL ARCHAEOLOGICAL DEPOSIT

Shelter Name PAD 1
Site Type Rockshelter with potential archaeological deposit
Map Reference Gunderman 1:25,000: 314240 6297870
Distance to Water 20m (ephemeral); 110m (permanent)
Orientation SSW
Topographic Location: Lower ridgeside, approx. 180m AHD.
Location Relative to Development Approximately on exclusion zone/development area boundary. Development is higher than site.
Excavation Potential: Good Photo Nos 10
Site Dimensions (maxima, in metres)

Shelter:	Length	Width	Height
Area 1	4	2.5	1.2
Area 2	3.5	2.2	1.3

Deposit: Area: ? Depth: >30cm

Description/Comments: SSW facing sheltered overhang in sandstone outcrop, 50m SE of CC2. Honeycomb & cavernous weathering. Some stable walls. Sandy floor, little disturbance, no European debris within shelter. Two quartzite pebbles, 1 inside shelter (broken), 1 outside (whole) - probably carried to shelter from pebbly area on hillside to west, across Coopers Creek (Fig.4) either by Aborigines or more recent visitors.

ADDITIONAL FEATURES

In addition to the sites and PAD, the identification of "Maroota Sand" pebbles and cobbles suitable for artefact manufacture is of archaeological interest (see Section 4.3 above, Figure 4 for location & Photo 5). No artefacts were found nearby and it is not clear whether: 1) pebbles and cobbles were removed from the area prior to flaking; 2) flaking debris has been washed downhill or covered with sediment; 3) the present outcrop was previously covered with sediment or vegetation; or 4) the pebbles were not utilised for other reasons. Two unflaked quartzite pebbles found at PAD 1 probably originated from the pebble deposit. Excavation of rockshelters CC1, CC2 and PAD1 would help to clarify whether or not local stone was utilised in the manufacture of artefacts.

Another relevant find was an *in situ*, naturally fractured quartz pebble (see Photo 6). The pebble had split into a number of pieces, either during bush fires or as the result of some kind of impact. The pebble was partly buried in sediment and the majority of fractured pieces were semi-upright, clustered together in their original positions. If the pieces had been found scattered around they could easily be mistaken for Aboriginal artefacts. These details are not relevant to the present project but are included in order to document a point that is germane to current taphonomic debates in archaeology. It is suggested that many quartz pieces found around the landscape by archaeologists and identified as artefacts may indeed be the result of events such as that which has occurred here.

6.3 Discussion and Assessment

Apart from the locality above Coopers Creek where archaeological sites and places of interest were identified, there are no other sections of the survey area where sandmining should be opposed on archaeological grounds. The location of sites in relation to the proposed development, their significance and recommendations for management are discussed below.

Relative Location (Refer to Figures 4 & 5)

Only one of the archaeological sites identified during the survey appears to be in direct danger of impact from the proposed sandmining program (however see Significance below). This is the grinding groove Site CC1, near the dam across Coopers Creek. The site consists of two groups of grooves, the most northerly of which is likely to be just within the development zone.

Site CC2 is probably within the exclusion zone between the development and the 7(e) Environmental Protection Zone along Coopers Creek. Sites CC3 and CC4 are probably within the 7(e) Zone.

The rockshelter potential site PAD1 is appears to be near the border between the exclusion zone and the development area and therefore in possible danger.

The Maroota Sand pebble and cobble lag deposit, which has been identified as a potential source of stone for the manufacture of Aboriginal artefacts, is within the proposed mining area and will be destroyed by the development.

Significance

The necessity for retaining or allowing destruction of sites must be assessed in terms of their cultural and archaeological significance.

Evaluation of Significance (See Bowdler, 1984; Koettig, 1988 and Ross, 1986 for a fuller discussion).

Aboriginal sites are valuable in a number of ways:

- to the Aboriginal community (as a link with their past).
- to the general public (educational and heritage value).
- to the scientific community (for research).

1. ABORIGINAL SIGNIFICANCE: This covers a number of aspects not related to archaeological significance and must be determined through consultation with Aboriginal groups, in this case the Metropolitan Local Aboriginal Land Council. The Council will report their views separately, having studied this report.

2. PUBLIC SIGNIFICANCE: This concerns the potential for using a site to educate people about the past, in cultural and environmental terms. It also relates to the heritage value of particular sites as representative examples of past lifestyles. As the present group of sites is on private land the latter aspect is probably of most relevance here. This will be discussed in conjunction with the third type of significance, below.

3. SCIENTIFIC SIGNIFICANCE: This relates to a site's potential for research and is based on condition/integrity, structure, contents and representativeness (the latter being partly based on the rarity or commonness of the site).

The following assessment of the scientific significance of the present suite of sites and potential sites (for the sake of brevity both are referred to as sites below) is based on preliminary recordings made during the survey and on the limited predictive value of available archaeological and environmental context data.

As the exclusion zones around the proposed development have been designed in order to protect adjoining land from adverse impact, it should theoretically only be necessary to discuss the significance of sites within the development area itself. However, for two main reasons, in this case I think it important to also assess sites within the exclusion zones.

Firstly, considering the likely magnitude of the development and its topographic location, particularly the northern section, the designated exclusion zones are not very wide. To date the boundaries of the various zones have not been pegged out and the relative locations of some of the sites are not very precise. Consequently I feel that any features of archaeological significance within the zones should be assessed in conjunction with those in the development area. Significant sites should be given some form of protection and clearly identified, to guard against inadvertent damage.

An additional reason for assessing the sites as a group concerns the fact that they are a group and there seem likely to be cultural connections between them, or between the sites and the environment, which might be established by further research. For example, questions of contemporaneity - if the remainder of the broken ground artefact in CC4 was found during excavation and could be fitted together, would it fit the grinding grooves? Or - did the people using the rock shelters make flaked artefacts out of the local stone (we know they used at least one piece of non-local silcrete in CC3)? Again - did the basalt for the artefact in CC4 come from a local source? Do the engravings represent known species of animals and are the remains of these species present in the shelter deposits (eg the ?dog engraving at CC2 and the dog bone at CC4)? There are many lines of enquiry that could be followed.

Condition/integrity All the sites are in quite good condition. The rockshelter deposits appear relatively undisturbed, the engravings and the grinding grooves are quite clear (although some of the latter are somewhat weathered).

Structure & Contents Without excavating it is not possible to say anything much about the structure and contents of the rockshelter sites but excavating potential is assessed as good-excellent, with all shelters having deposits of >30cm in places. As noted above, there are a number of questions that spring to mind concerning the three artefacts already identified. Similarly, many lines of enquiry could usefully be instigated concerning the grinding grooves and the engravings, involving taphonomic, stylistic and other factors.

Representativeness The sites are the only ones to have been recorded within one kilometre of the survey area, however, this is more likely to be a factor of the lack of systematic survey than an actual absence of sites. For instance, it is probable that many more are present downstream along Coopers Creek, towards its junction with the Hawkesbury.

Of the three site-types represented, only the shelters with artefacts are rare in the region - as noted in Section 5, only 2 have previously been recorded within 5 kilometres of the survey area, again this is likely to relate to survey intensity rather than actuality.

Thirty two engraving sites and 20 grinding groove sites have been recorded in the same area. Without further research into species resemblance it is not possible to say whether the engraving motifs are rare, however they conform to a general pattern of motif distribution in the Sydney region (see Koettig 1988; McDonald 1986 & 1990).

The pebble and cobble Maroota Sand deposit is present elsewhere in the district, but no research has been carried out into its relationship with Aboriginal sites. Neither have the stones themselves been expertly assessed for flakability (apart from a brief examination by an archaeological stone-knapper). If a representative sample of available cobbles and pebbles is collected, it should not be necessary to retain the deposit intact and the sandmining program for this area need not be affected. As no Aboriginal artefacts were found and the possibility of sub-

surface archaeological deposits seem unlikely in the relevant area, no NPWS permit is necessary prior to the development.

The above discussion has focussed on the representativeness of individual sites and site-types. As a group, however, the complex may not be so commonplace, at least in terms of what has been recorded to date. To date I don't have statistics to back up this assertion but, if it is correct, once again survey intensity is likely to be involved.

Evaluation On present evidence the scientific significance of the small group of sites and potential sites found during the present project is assessed as high. It is therefore recommended that all except the Maroota Sand pebble and cobble deposit be retained and protected from possible damage for the duration of sandmining. Regular monitoring of the sites should be carried out by an archaeologist or a representative of the Metropolitan LALC or NPWS. Full details of these recommendations follow.

7 RECOMMENDATIONS

The following recommendations are made on the basis of:

1. The legal requirements of the National Parks and Wildlife Act of 1974 (as amended) which states that it is illegal to deface, damage or destroy an Aboriginal relic without the prior written consent of the Director of the NSW National Parks and Wildlife.
2. A comprehensive survey of the area of Lot 3, DP567166 proposed for sandmining and adjacent exclusion zones.
3. A search of records concerning studies and previously recorded archaeological sites in the area.

Subject to the considerations of the Metropolitan Local Aboriginal Land Council it is recommended that:

1. Archaeological sites CC1-CC4 and rockshelter PAD1 should be clearly identified and protected for the duration of sandmining in the area. It is suggested that exclusion fencing should be erected around the grinding groove and engraving sites and some kind of a sediment barrier emplaced uphill from these and from the rockshelter sites. The type and placement of the fences and barriers should be discussed with an archaeologist and/or a representative of the Metropolitan LALC or of NPWS, who should be present during their erection.
2. Regular monitoring of the sites should be carried out by the same personnel, during mining and subsequent regeneration of the area, to check on their condition and avert possible damage. It is suggested such monitoring be at six monthly intervals.
3. In the event that any archaeological material is found during development, operations in the area should cease immediately and NPWS should be contacted to expedite an assessment of the situation.

It is further recommended that:

Three copies of this report be sent to:
Cultural Heritage Co-ordinator
Central Region
National Parks & Wildlife Service
PO Box 95
PARRAMATTA 2124

One copy of this report be sent to:

Sites Officer
Metropolitan Local Aboriginal Land Council
PO Box 1103
Strawberry Hills 2012

REFERENCES

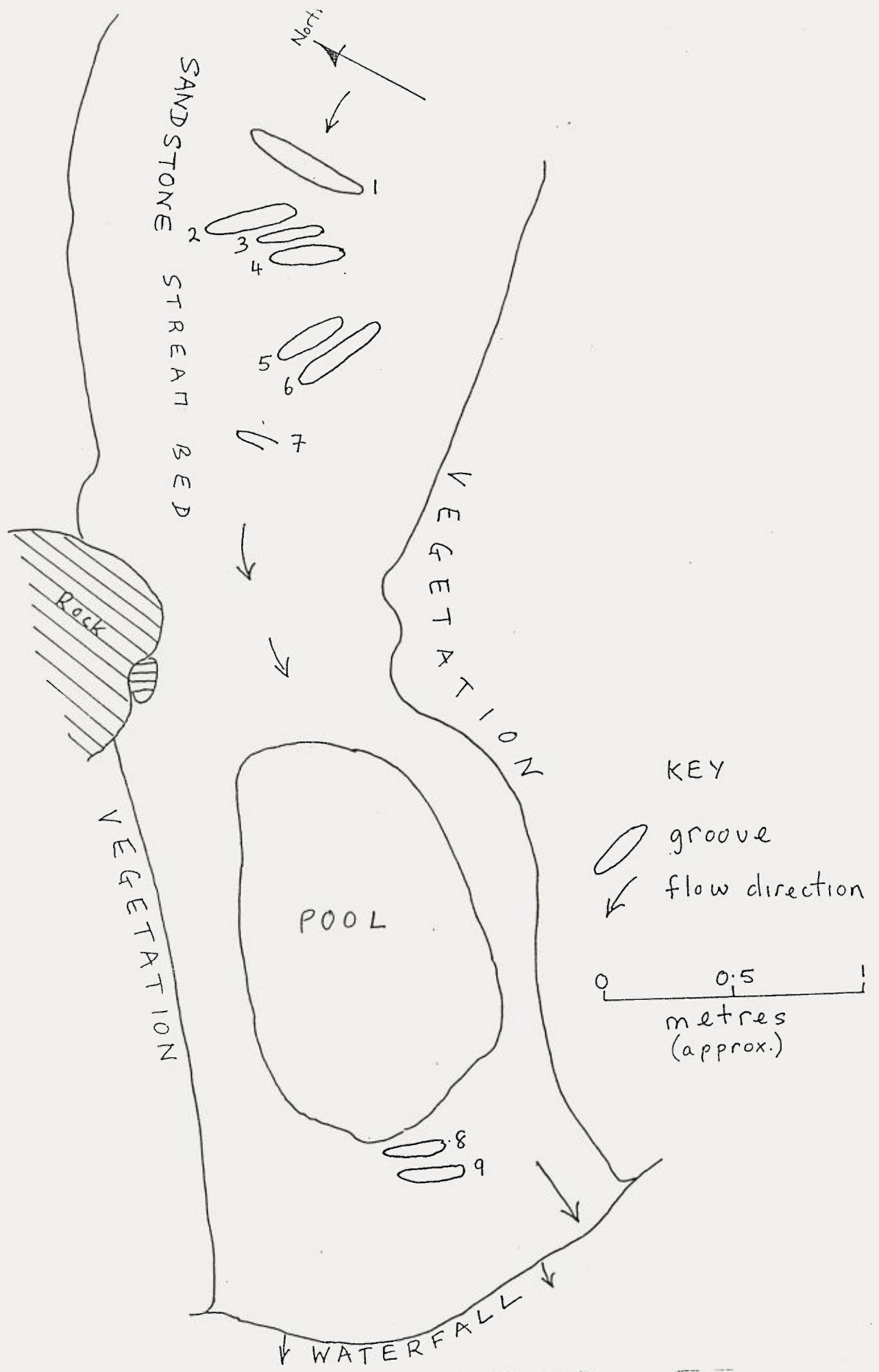
- Attenbrow V. 1987 The Upper Mangrove Creek Catchment: A Study of Quantitative Changes in the Archaeological Record. PhD Thesis, Sydney University.
- 1992 Port Jackson Archaeological Project - Stage II. Preliminary Report to NSW NPWS on excavations undertaken at NPWS Site No 45-6-2097, in January 1992. Report to NPWS.
- Benson D. & J. Howell
1990 Taken for Granted: the Bushland of Sydney and its Suburbs. Kangaroo Press, Sydney.
- Bowdler S. 1984 Archaeological Significance as a Mutable Quality. In S. Sullivan & S. Bowdler (eds) Site Surveys and Significance Assessment in Australian Archaeology:1-9. ANU, RSPacS, Canberra.
- Campbell W.D. 1899 Aboriginal Carvings in Port Jackson and Broken Bay. Memoirs of the Geological Survey of NSW. Ethnological Series No.1.
- Cherikoff V. & Isaacs J.
c1990 The Bush Food Handbook. Ti Tree Press, Balmain.
- Chesnut W.S. 1980 Engineering Geology. In C. Herbert (Ed) Geology of the Sydney 1:100,000 Sheet, 9130. Geol. Surv. of NSW, Dept of Mineral Resources.
- Corkill T. 1989 Archaeological Survey of Proposed Sandmining Extension at Maroota, NSW. Report to Collin Dongés Pty Ltd.
- 1991a Addendum to Archaeological Survey of Proposed Sandmining Extension at Maroota, NSW: Proposed Haulage Road. Report to Collin Dongés Pty Ltd.
- 1991b Survey for Aboriginal Archaeological Sites on Portions 208, 211 & 222, Maroota, NSW. Report to Camp Scott Furphy Pty Ltd. NPWS: C2147
- 1991c Survey for Aboriginal Archaeological Sites on Portions 29 & 196, Maroota, NSW. Report to Nexus for Monaldo Pty Ltd. NPWS: C2157
- 1991d Survey for Aboriginal Archaeological Sites on Lot 1, Portion 31, Maroota, NSW. Report to Nexus for Messrs Teofilo & Accurso. NPWS:C2158
- Etheridge L.T. 1980 Geological Investigation and Resource Assessment of the Maroota Tertiary Alluvial Deposit. Unpub Geological Survey Report No. GS1980/201. Geological Survey of NSW, Dept of Mineral Resources.

- Etheridge R. Jr
 1891 Notes on "rock shelters" or "gibba-gunyahs" at
 Dee Why Lagoon. Records of the Australian
 Museum 1:171-4.
- Etheridge R. Jr & Whitelegge T.
 1907 Aboriginal workshops on the coast of New South
 Wales and their contents. Records of the
 Australian Museum 6:233-250.
- Etheridge R. Jr, David T.W.E. & Grimshaw J.W.
 1896 On the occurrence of a submerged forest with
 remains of the dugong, at Shea's Creek, near
 Sydney. J & Proc of the Roy Soc of N.S.W.
 30:158-185.
- Haglund L. 1990 Department of Housing Project 144 Residential
 Estate - Narellan: Archaeological
 Investigation of Archaeological Sites 2 and 5.
 Report to Benjamin M.T. Chow & Associates.
- Hanson F.G. 1947 Aboriginal Rock Carvings in the Broken Bay
 Area. 3 Volumes held by NPWS. NPWS: C1315
- Hughes P.J. 1980 The geomorphology of archaeological sites on
 the south coast of New South Wales. Australian
 Archaeology 11:50-52.
- Kelly A. 1979 Unreserved Crown Land West of Maroota: bush
 rock lease. NPWS: C488
- Koettig M. 1988 Ku-ring-gai Municipality Heritage Study:
 Aboriginal Sites. Report to Ku-ring-gai
 Council. NPWS: C1531
- 1989 Survey for Aboriginal Sites near the
 Headwaters of Little Cattai Creek near
 Maroota, northwest Sydney. Report to MWMA.
- Kohen J. 1986 Prehistoric settlement in the western
 Cumberland Plain: resources, environment and
 technology. Unpub. PhD thesis, School of Earth
 Sciences, Macquarie University, Sydney.
- 1992 An archaeological survey of a sand mining site
 at Portion 196 and Portion 29, Maroota, NSW.
 Report to Taylor, Thompson & Witting.
- Kohen J. & R.J. Lampert
 1987 'Hunters and Fishers in the Sydney Region'. In
 D.J. Mulvaney and J.P. White (eds) Australians
 to 1788: 343-365. Fairfax, Syme & Weldon
 Associates, Sydney.
- Kohen J., Stockton E & Williams M.
 1984 Shaw's Creek Rockshelter: a prehistoric
 occupation site in the Blue Mountains
 piedmont, eastern New South Wales. AO
 19(2):57-73.

- McCarthy F.D. 1983 Catalogue of Rock Engravings in the Sydney-Hawkesbury District, NSW. Set of Volumes. NPWS.
- McDonald J. 1986 Maroota Historic Site: survey for Aboriginal sites. Report to NPWS. NPWS: C916
- 1990 Sydney Basin Aboriginal Heritage Study. Stage III. Report to NPWS. NPWS: C1818
- 1992 Archaeological survey of proposed paintball arena: DP818221, Canoelands Road, Glenorie. Report to Aussie Paintball Games Pty Ltd. NPWS: C2364
- Nanson G., Young R. & Stockton E.
1987 Chronology and palaeoenvironment of the Cranebrook Terrace (near Sydney) containing artefacts more than 40,000 years old. AO 22(2):72-78.
- Rich E. 1986 Parramatta River Heritage Study. In Parramatta Regional Environmental Study. Open Space and Recreation. Dept of Environment & Planning.
- Ross A. 1976 What the First Fleet saw. Unpublished B.A. Hons thesis, Dept of Anthropology, Uni. of Sydney.
- Ross A. (ed) 1986 Planning for Aboriginal Site Management: A Handbook for Local Government Planners. NPWS Publications.
- Ross B. 1979 Archaeological resource assessment - Maroota sand deposit. NPWS: C633
- Smith L. 1988 Aboriginal Site Planning Study in the Sydney Basin: Stage 1 - the Cumberland Plain. Interim Report: Site survey and site analysis on the Cumberland Plain. Report to the NPWS.
- Stockton E.D. & Holland W.N.
1974 Cultural sites and their environment in the Blue Mountains. AFAO 9:36-65.
- Sullivan K. & Johnston R.
1975 Archaeological survey of Maroota to Somersby section of Moomba-Sydney-Newcastle pipeline.
- Vinnicombe P. 1980 Predilection and Prediction: a study of Aboriginal Sites in the Gosford-Wyong region. Report to NPWS. NPWS: C921

APPENDIX I
PLANS FOR
ARCHAEOLOGICAL SITES
CC1-4

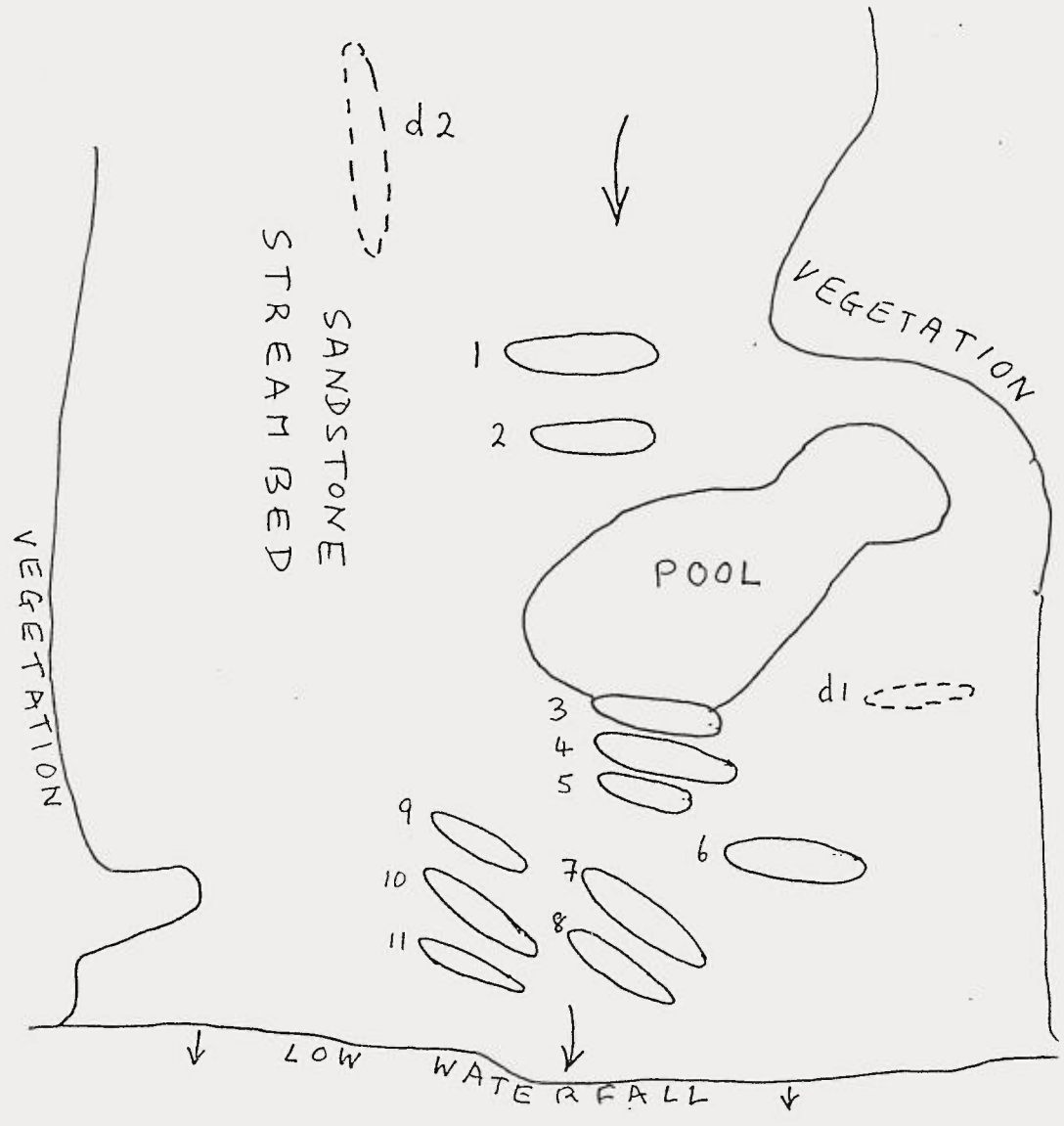
- 1 Site CC1: Grinding Grooves
Group 1
- 2 Site CC1: Grinding Grooves
Group 2
- 3 Site CC2: Engravings
- 4 Site CC2: Grinding Grooves
- 5 Key for Rock Shelter Sites
- 6 Site CC3: Floor Plan &
Cross Section
- 7 Site CC4: Floor Plan
- 8 Site CC4: Cross Section & Artefacts



1 Site CC1: Grinding Grooves Group 1

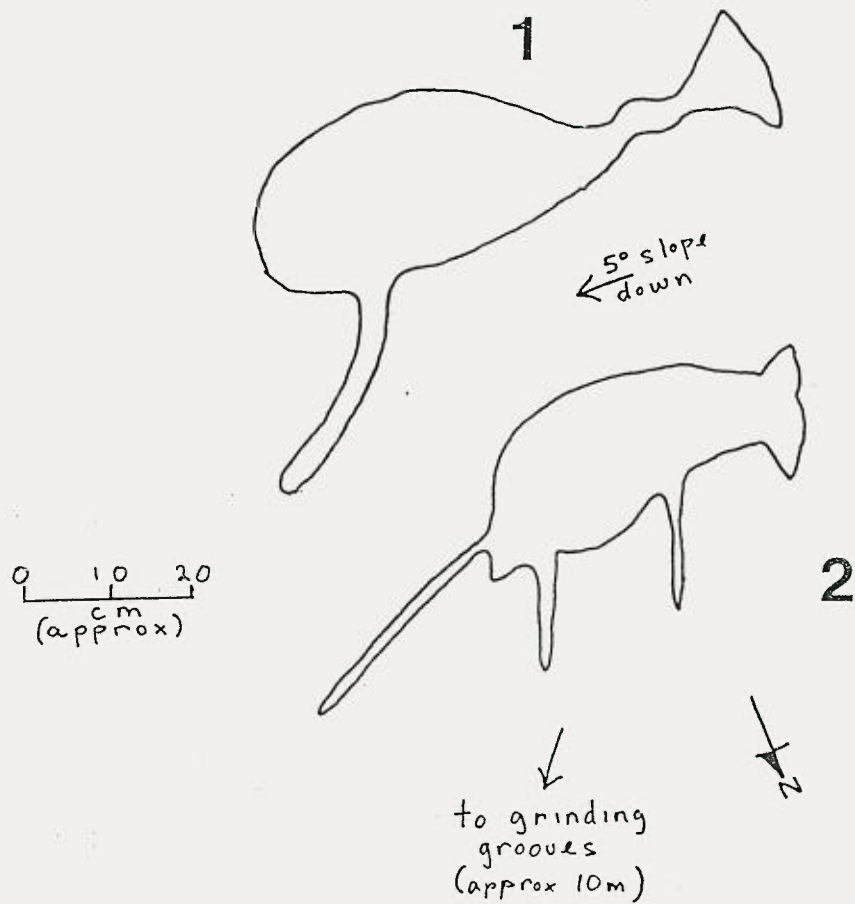


KEY
○ groove
↙ flow direction

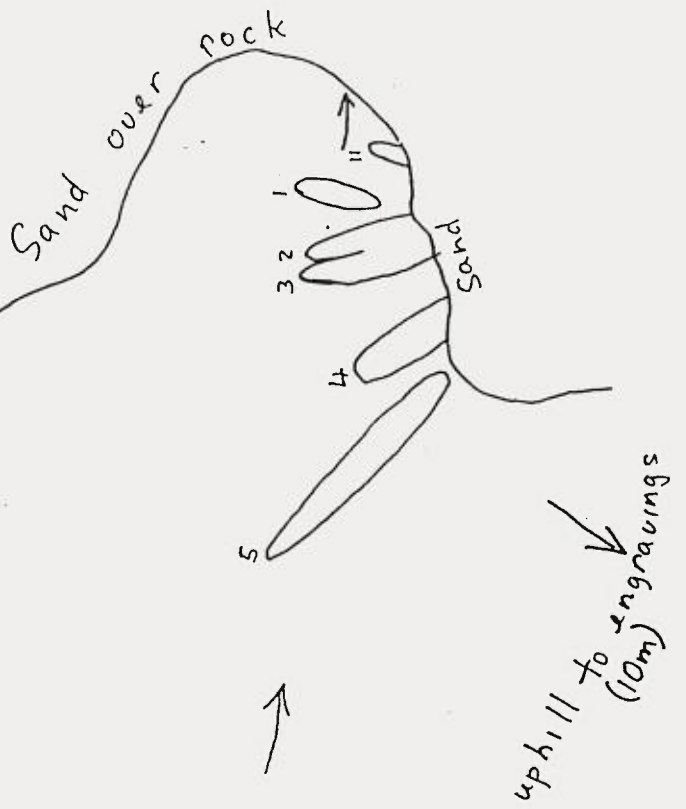
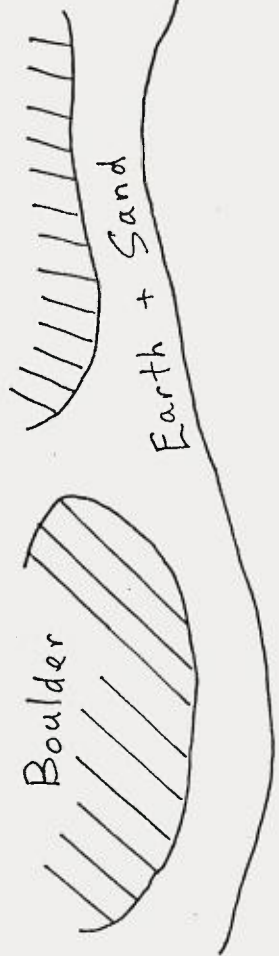
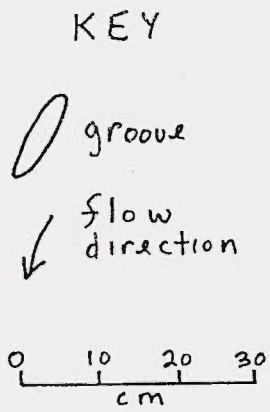


0 0.5 1
metres
(approx)

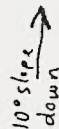
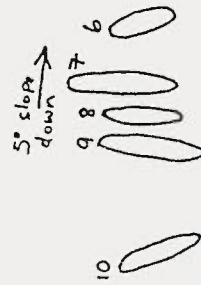
2 Site CC1: Grinding Grooves
Group 2




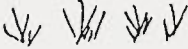

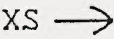
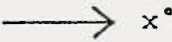


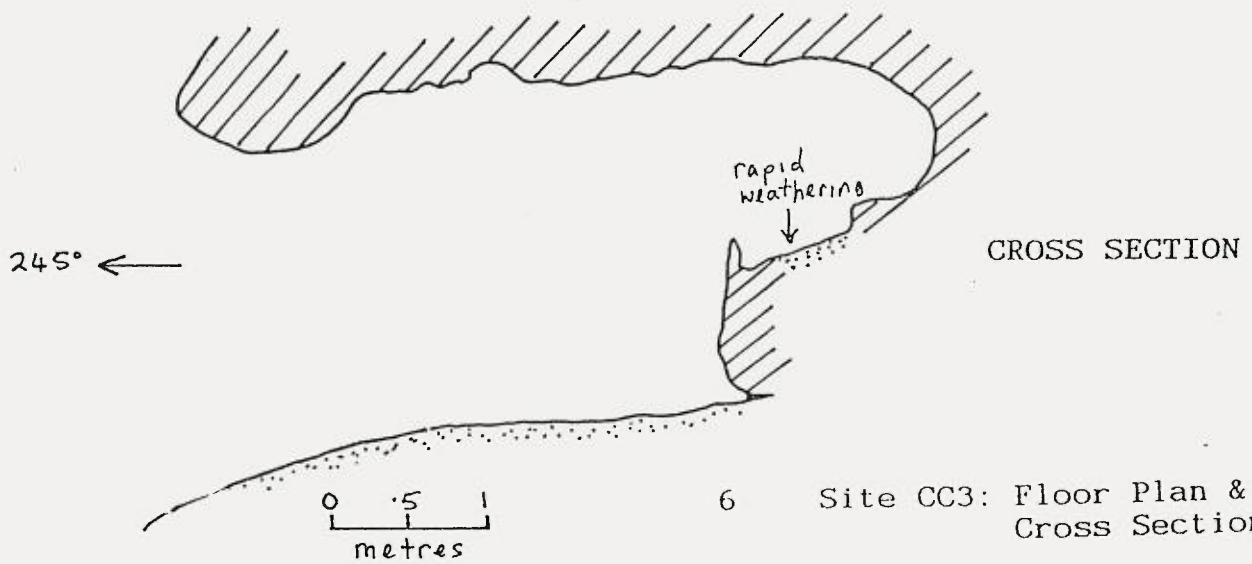
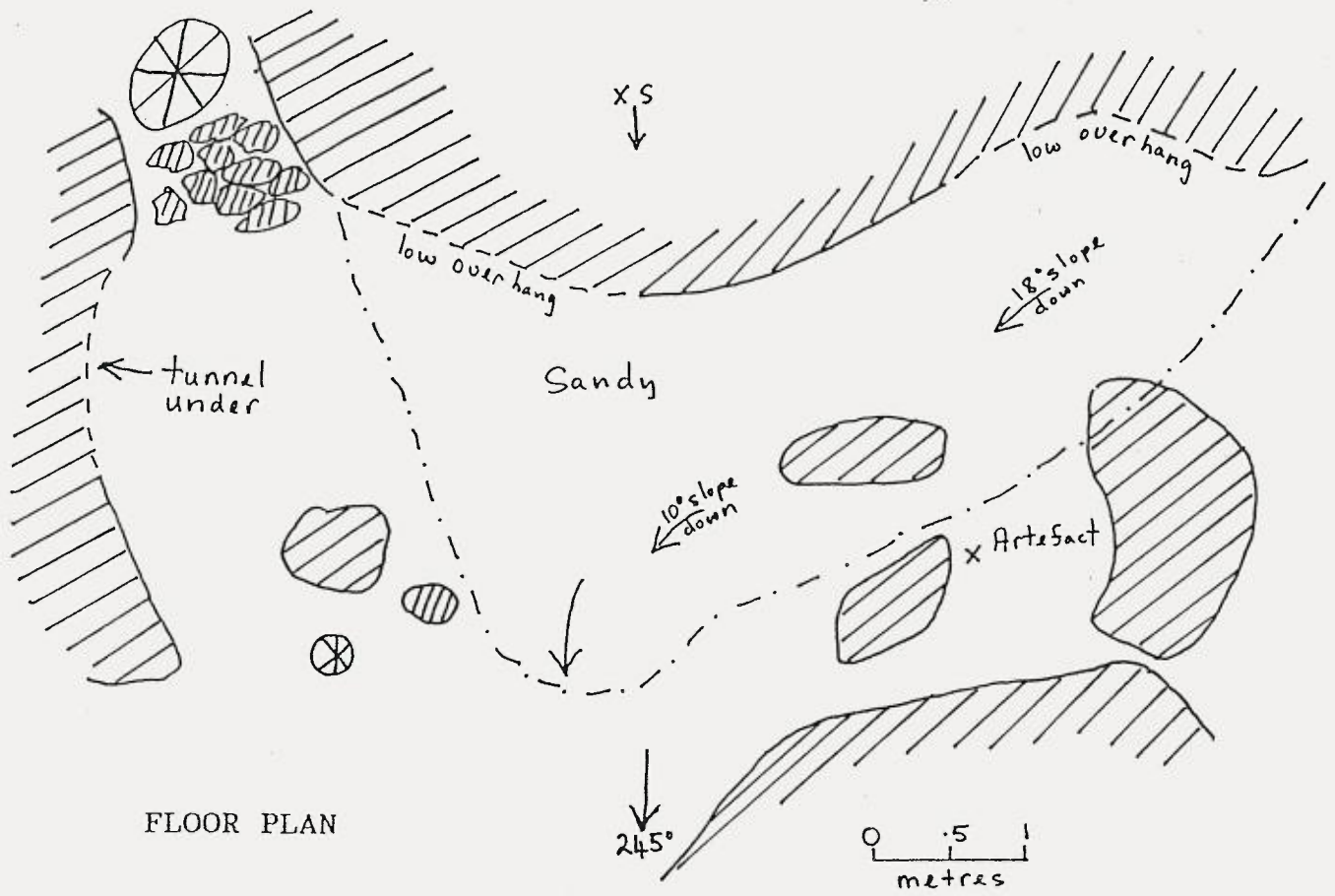
3 Site CC2: Engravings



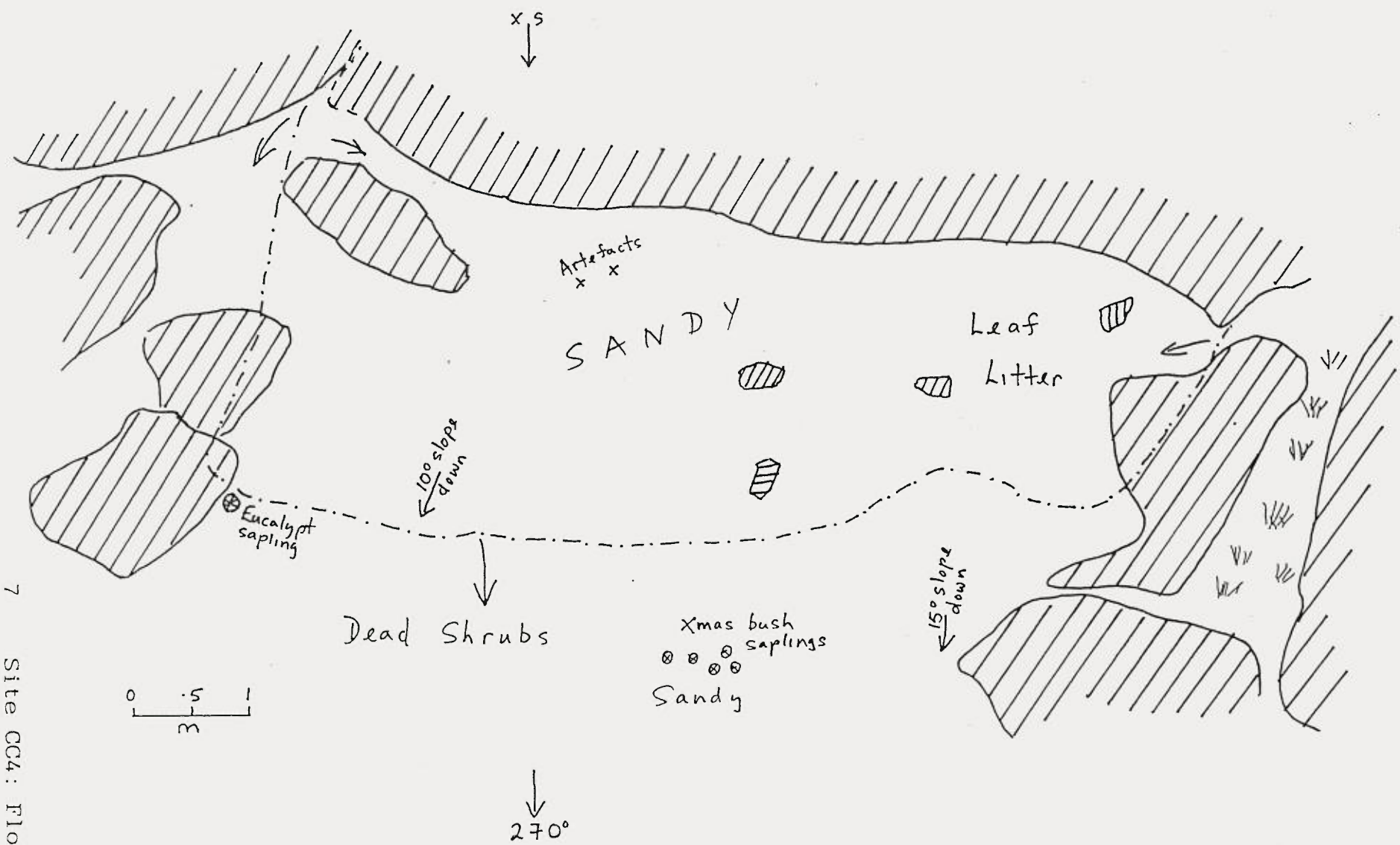
SANDSTONE STREAM BED



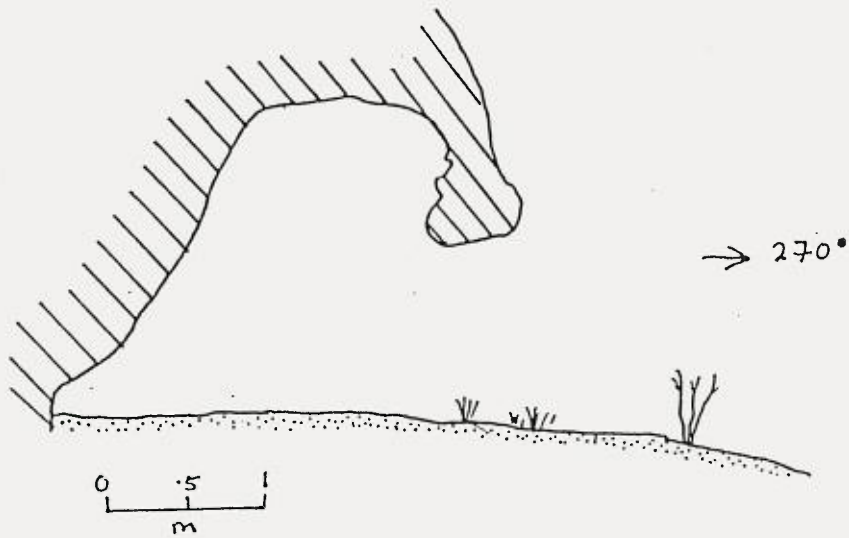
	Rock
	Sediment/Deposit
	Tree
	Vegetation
	Dripline
	Cross-section Line
	Orientation



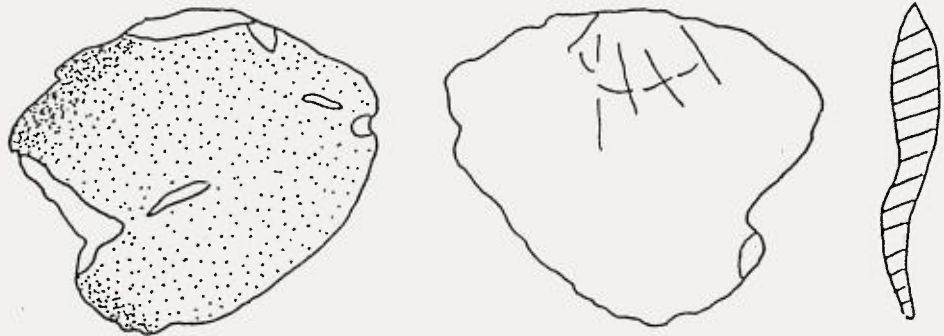
6 Site CC3: Floor Plan & Cross Section



7 Site CC4: Floor Plan

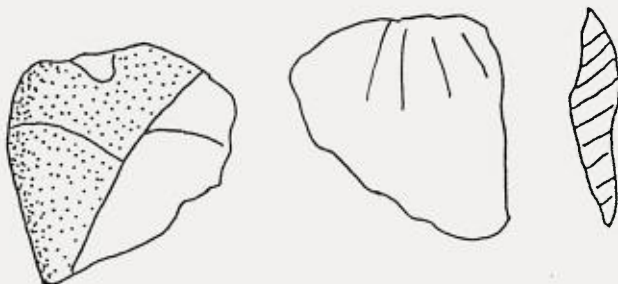


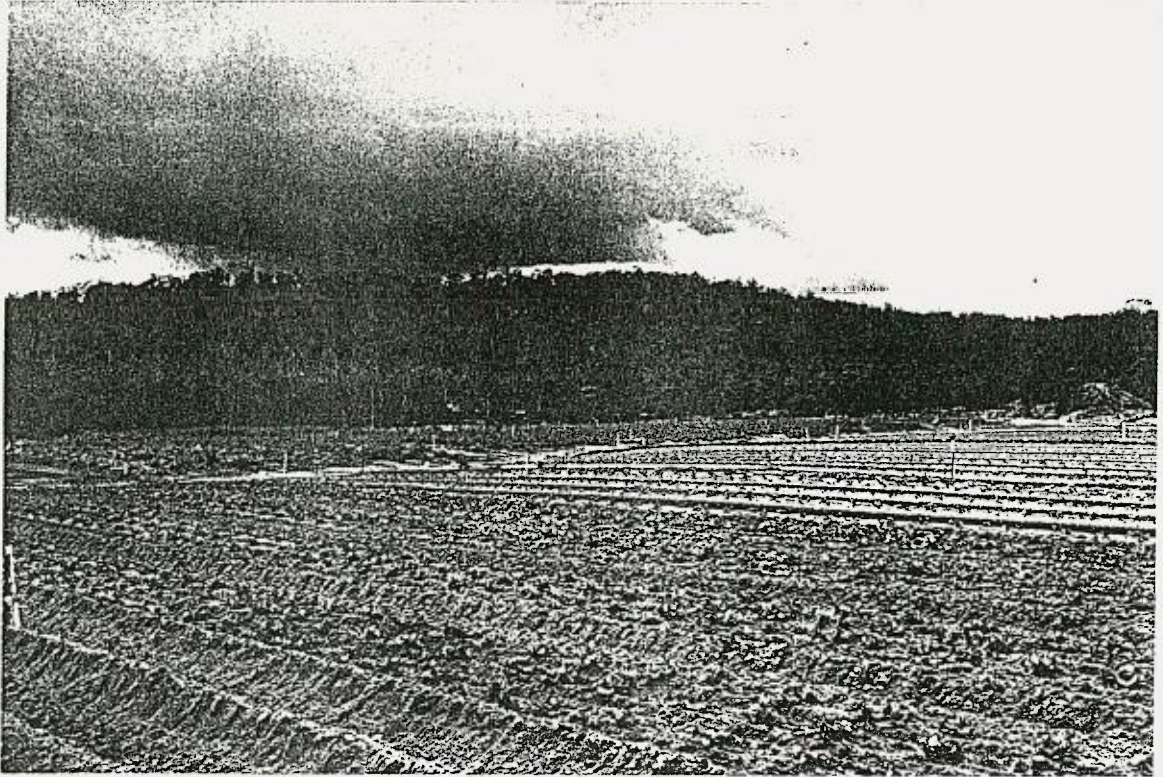
1



ACTUAL SIZE

2





1 Survey area from SW corner, looking NE. Northern boundary is along wooded ridgetop (photo 2).



2 Survey area from NE corner, looking SW to Market Garden (photo 1). Note evidence of bushfire.



3 Grinding Groove Site CC1, Group 1.
Looking SE. 20cm measure.



4 Grinding Groove Site CC1, Group 2.
Looking SE. 60cm of measure exposed.



- 5 Scattered pebbles on southern hillside, indicating residual presence of Tertiary "Maroota Sand", a raw material source for Aboriginal stone artefacts. Looking S towards hilltop. Note evidence of fire.



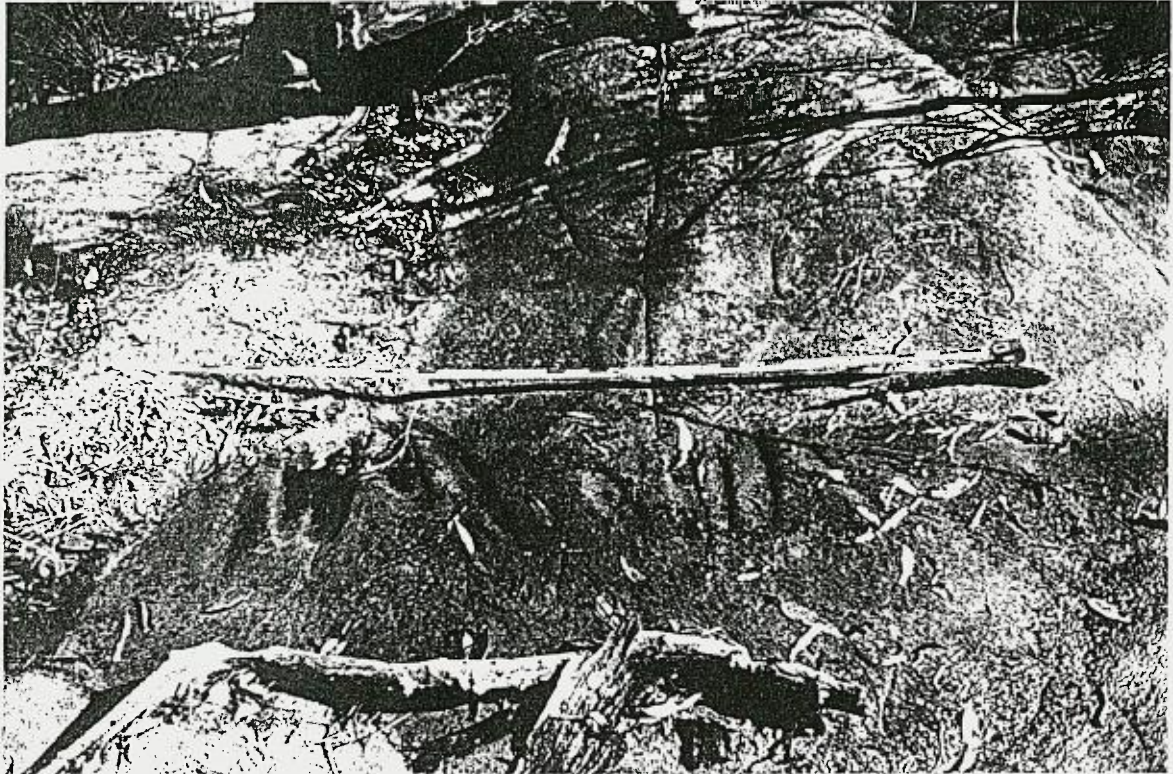
- 6 Naturally split quartz pebble on hillside. *in situ* where found. 22cm of measure exposed.



7 Site CC2: General view across engravings to watercourse with grinding grooves, near standing figure. Looking ENE.



8 Site CC2: Engravings on sub-horizontal rock surface. Looking N. 20cm measure.



9 Site CC2: Grinding grooves in dry stream bed. Flow direction from right to left. Note sediment over watercourse. Looking WSW towards location of engravings uphill. 2 metre tape.



10 Rock shelter with potential archaeological deposit: PAD1. Looking N.

APPENDIX "G" - Trail Maintenance Guidelines



GUIDELINES FOR THE PLANNING CONSTRUCTION & MAINTENANCE OF TRAILS

1. INTRODUCTION

Access roads of low engineering standard are widely used on the grazing and timbered lands in New South Wales. They form a network through state forests, national parks, private property and Crown Lands. Their use is widespread for logging roads, fire trails, stock movement and recreation. Additionally they provide access to power and water supply lines.

These roads tend to follow the natural landform of the land closely. Construction usually consists of minimum earthworks and culverting. The natural road surface is rarely gravelled. Maintenance following initial construction is minimal, and usually left until the surface has severely eroded and access is restricted.

By constructing the roads with crossfall drainage and trafficable cross banks, it is possible to minimize erosion damage and the need for maintenance. Establishment and maintenance of vegetation on the roads further reduces erosion.

These guidelines outline the principles which apply in planning, constructing and maintaining trails to minimise soil erosion and control runoff.

It must be recognised that erosion can:

- (a) contribute to inferior water quality and the siltation of streams;
- (b) be a major factor in destroying trafficability of trails;
- (c) cause serious safety problems.

Consideration of erosion control measures at the planning and construction stage will reduce the cost and increase the effectiveness of trail maintenance programmes:

The guidelines are based on the understanding that there is a very wide variation of geology, soils, topography, vegetation and climate over the State and even within the length of a single trail. Such variations make it impossible to provide recommendations which can be applied to all situations. Where special erosion problems occur on specific trails, the Soil Conservation Service should be consulted.

Definitions of terms used in the guidelines have been included at the end of this leaflet.

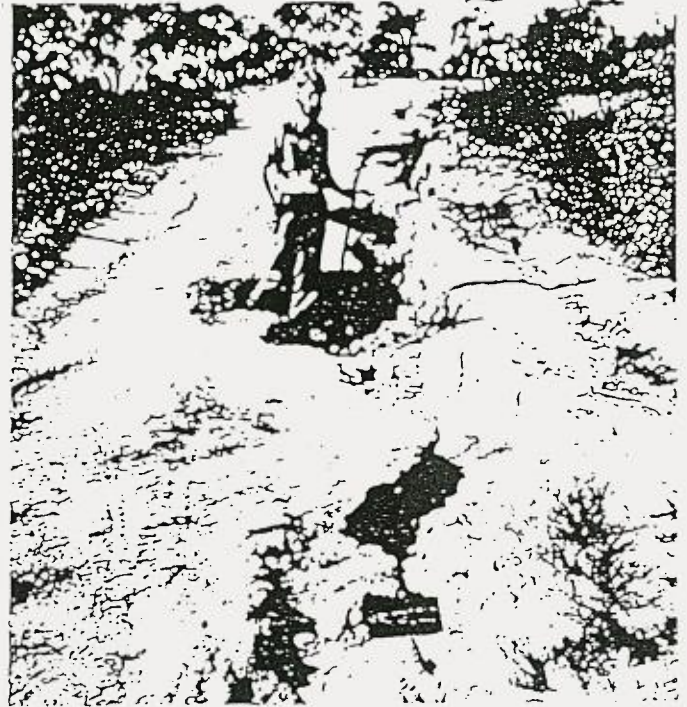


Figure 1 Trafficability is seriously impaired when undrained low standard roads become eroded.



Figure 2 Deep rill erosion caused by inadequate drainage

2. PRE-PLANNING

Erosion of low standard roads can quickly destroy the trafficable surface of the roads and yield significant volumes of silt to streams. At the planning phase, careful consideration of the following points will ensure that the trail construction will minimise erosion and reduce maintenance requirements.

- The purpose of the trail
 - Type and volume of traffic
 - Possible use by unauthorised vehicles and consequent problems
 - Soil erosion hazards present along the trail
 - Drainage lines and other trail crossings
 - Topographic restrictions (steep slopes, rock outcrops, swampy areas, etc.)
 - Potential mass movement areas
 - Vegetation type, density and size.
- Feasibility of proposed construction – should an alternative site be examined?

Alternative routes to the proposed trail should be assessed in the office and the field using all available information. Selection of the route should aim to minimise soil and vegetation disturbance. Wherever possible the trail should be constructed simply by slashing or blading the surface vegetation. Blading of soil should only occur where it is necessary to build a "trail bench" on sideslopes, to form drainage line approaches or make rough surfaces trafficable.

3. LOCATION

Trails should be located to minimise the risk of sediment entering drainage lines and generally, should be kept well above flood levels. They should be far enough from a stream to provide an effective vegetative buffer to contain any sediment flowing from the trail.

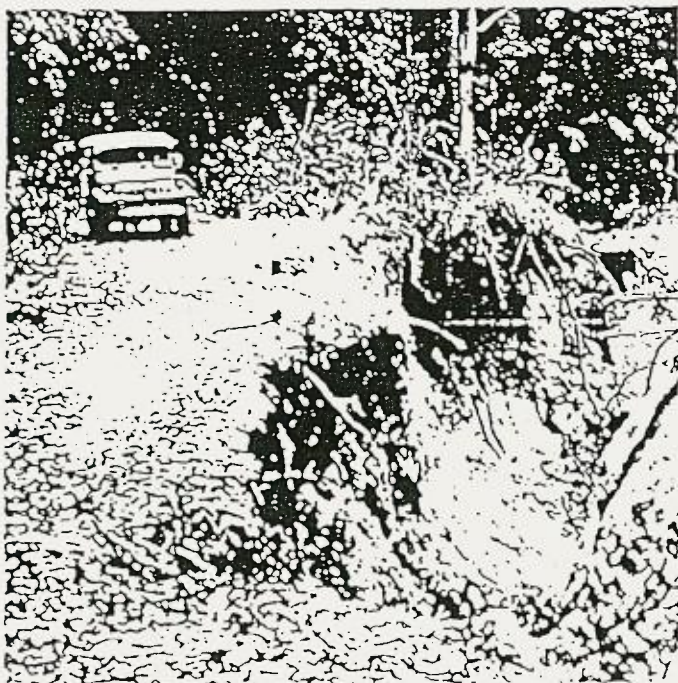


Figure 3 Gully erosion affecting access as a result of poor trail location

Avoid physical features which may indicate the possibility of mass movement problems, such as:

- High "erosion hazard" soils – Class C and Class D (refer Section 13 – Definitions)
- Slopes with steps, clay beds, hummocky topography

Crossing at mid-slope of long, steep unstable gradients especially where bed rock is highly weathered is not recommended. Also avoid opening up moisture laden toe slopes to form a cut batter.

4. GRADES

Gradients limiting effective trail drainage are reached well before those limiting the passage of most four-wheel drive vehicles. Sections of ineffectively drained trails can quickly become untrafficable, especially if located on Class B, C and D soils.

Generally speaking, the grade of a trail should be less than 10° . However, short lengths of steeper grade may be needed to negotiate difficult sections, or to take advantage of favourable terrain and are acceptable.

In designing sections with grades exceeding 10° it will be noted that effective, trafficable cross banks can only be built on trails to approximately 12° grade. Consequently, sections steeper than 12° will require special drainage works.

Trails on Class D soils should not be built on sloping land nor should they be formed mechanically.

Where it is necessary for grades to exceed 15° on Class A and B soils and 12° on Class C soils, surface preparation (gravelling) and more sophisticated road drainage will be required.

5. SURFACE DRAINAGE

5.1 Crossfall Drainage

Crossfall drainage is often sufficient to ensure control of runoff. This form of drainage reduces runoff along the road to a minimum, as runoff is directed across the road surface and over the road batter. The low profile fill batters associated with this standard of road can withstand the dispersed flow of crossfall drainage. To ensure effectiveness of the crossfall, any earth windrow which develops at construction on the downslope side of the road

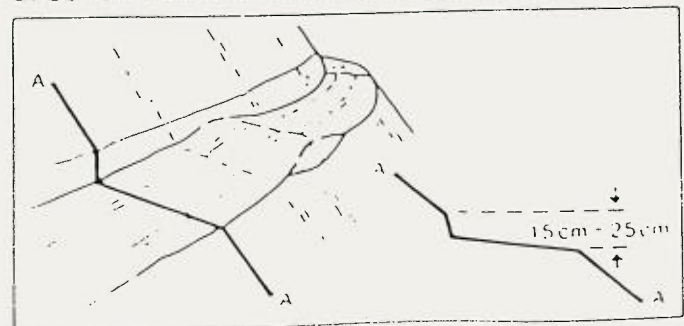


Figure 4 Crossfall drainage of the road shown, instead of blading

should be removed. Care should be taken to overcome wheel rutting which can lead to concentration of water and resultant erosion.

There are two forms of crossfall drainage: outfall and infall (refer Section 13 Definitions). Outfall drainage is preferred and should be used except when:

- Fill batters are unconsolidated and likely to erode.
- Fill batters exceed 1.5 m in height.

In these situations infall drainage should be used and table drains, drop down drains and culverts will also be required. Without adequate culverts, table drains quickly erode, often endangering the trafficability of the road.



Figure 5 Gullying of table drains is a serious erosion problem and a danger to road users.

5.2 Cross Banks

Where runoff cannot be controlled by crossfall drainage, cross drains or cross banks may be used. Trafficable cross banks are recommended. Correctly located and built these banks provide effective, cheap, long term, low maintenance road drainage. Cross banks are more likely to be required immediately following construction, when disturbed areas are unconsolidated. They are most efficient if constructed at right angles to the trail. However, diagonal banks may be required to:

- Obtain sufficient gradient
- Direct water to the most suitable outlet.

In choosing sites for cross banks common sense will dictate the most suitable outlet in the vicinity of the recommended location.

On new trails, or those affected by erosion, cross banks should be constructed at the spacing indicated below.

Road Grade	Cross Bank Spacing		
	Soil Class A	Soil Class B	Soil Class C
Up to 8°	70 to 90 m	60 to 70 m	20 to 30 m
8° to 12°	60 to 70 m	50 to 60 m	•
12° to 16°	40 to 60 m	•	•
16° to 20°	30 to 40 m	•	•
20° to 22°	20 to 30 m	•	•

Note (1) • Indicates that trails should not be constructed on these soil types within the slope range.

Note (2) Where trails are constructed on slopes exceeding 12°, only light and infrequent traffic should be permitted.

Notwithstanding the above guidelines the stability of the trail in operation will eventually dictate the need for, and location of, cross banks.



Figure 6 Trafficable cross banks can be comfortably negotiated and provide effective drainage when sited and built correctly.

6. CROSS BANK CONSTRUCTION

A suitable outlet point must be selected for the bank, one that is not blocked by a stump or rock. The outlet should be located so that water will spill into undisturbed vegetation and can't flow back onto the road. The roadline should be ripped to a depth of 20 to 30 cm for a length of one or two tractor lengths back from the chosen outlet point. If loose earth is pushed down the roadline into a bank, commence at the uphill side of the road and work towards the outlet side. Sufficient loose earth must be used to give the required dimensions after shaping and compaction. Depending on the size of the machine being used, up to eight blade-

fuls of earth may be required.

A grade across the road of approximately 1:20 will ensure that water does not pond in the channel of the bank. The bank can be shaped with the blade, and the entire length of the bank should be track or wheel rolled to obtain maximum compaction and a smooth, even bank. A sweep with the blade will clean the channel of the bank. The small bank of earth resulting at the outlet end can be left to act as a silt trap and water spreader. This should be pushed far enough so that draining water can clear the road effectively.

If an eroded table drain has to be filled to build a bank, the bank at that point must be well compacted with extra earth to allow for slumping and to cope with the concentration of runoff in the table drain.

7. EARTHWORKS

Trail construction should be done with minimum disturbance of soil and vegetation both on, and adjacent to, the trail.

Trails should follow the contour of the land as much as possible to minimize the amount of cut and fill and soil disturbance.

Batters to 1.5 m height should be cut vertically to minimise the area of disturbed soil exposed. Batters to this height may suffer from initial slumping but will generally stabilize with follow-up maintenance.

Fill batters on all soil classes should be no steeper than 2:1 and flatter where possible to encourage effective revegetation naturally or by reseeded. Batters higher than 1.5 m on Class B, C and D soils may require special stabilization works such as drop-down drains, hay mulching etc.

No vegetative debris should be incorporated in fill batters as this results in poor compaction with hollows and slumping occurring as the vegetation dies.

"Borrow" areas should not, for preference, be located near drainage lines or creeks because of the danger of sediment polluting the stream. When necessary, "borrow" areas should be limited in size, worked in such a way to reduce the danger of sediment leaving the borrow pit and revegetated progressively as the pit is worked out.

Wherever practicable, topsoil and litter (free of timber debris) should be stockpiled – in a recoverable position for respreading over disturbed areas. This material contains valuable seed and nutrients which will greatly assist revegetation.

8. TIMBER DESTRUCTION

Clearing should be limited to 0.5 m either side of the trail.

9. DRAINAGE LINE CROSSING

Crossing of drainage lines should be via fords, culverts or bridges. Log crossings should

not be used as they obstruct flood flows and often create turbulent flow and consequent erosion.

Fords are preferable to culverts or bridges as their associated works are minimal. They should not be used where the creek has a deep cross section which requires considerable excavation to provide the approach to the crossing.

Culverts should never be used where debris blockages are likely.

Culverts should be laid as close as possible to the natural alignment of the drainage line, to avoid diverting the flow into the stream banks or creating scour of the drainage line.

Soil and vegetation disturbed during construction of drainage line crossings should be kept to a minimum. Such disturbed areas may need to be reseeded and protected from erosion.

Timber, scrub, soil or debris should not be dumped in drainage lines but stacked well above flood level.

Corduroy or stone paving should be used on low slope, boggy soft soil areas, to avoid excessive soil disturbance and maintain a trafficable surface.

THE PROVISIONS OF SECTION 26D OF THE WATER ACT AS THEY REFER TO THE DESTRUCTION OR INJURY OF TREES IN THE BED OR WITHIN 20 METRES OF THE BANKS OF PRESCRIBED STREAMS APPLIES.

10. REVEGETATION

The degree of revegetation required on disturbed areas may apply as follows:

- No revegetation required – forest litter and native flora will provide natural vegetation and stabilisation.
- Short term revegetation – provided by annual grasses (e.g. wimmera ryegrass) or cereals (e.g. rye corn, oats or japanese millet) and fertilizer. Long term stability will be provided by forest litter and native flora.
- Long term revegetation – using perennial grasses and clovers, with or without a cover crop such as oats, cereal rye corn, japanese millet and fertilizer.
- Use of sod or other vegetative material in specialised situations.
- Use of shrubs and trees such as some silver leafed poplars and shrub willows in situations such as those requiring de-watering or affected by unstable soils.

When revegetation is considered necessary it should be carried out immediately following the disturbance while the soil is still loose, irrespective of the growing seasons.

It may be necessary to apply a maintenance dressing of fertilizer.

11. MAINTENANCE

It is essential that a sound cover of vegetation and/or forest litter develops on the surface of the

trail, on batters and the approaches to drainage line crossings.

Frequent maintenance is essential, especially in the early years after construction, to ensure effective erosion control and trail stability.

All trails should be inspected at least annually and following heavy traffic usage, or exceptionally heavy rainfall, to determine maintenance requirements.

Destruction of vegetation should be restricted to the removal of excess vegetation preferably by slashing or spraying. Unnecessary grading or blading should be avoided to minimise soil disturbance.

Crossfall drainage should be encouraged by removing any windrow along the outside edge of the trail.

The location, spacing and size of cross banks should always be studied when considering the maintenance programme. A sound guide to bank spacing will be indicated by the distance of water run on a trail before rilling commences. Cross bank outlets should permit the free flow of water.

The outlet of culverts, drains, etc. should be examined at each maintenance inspection and, if necessary, problems corrected.

Material slumping from cut batters should be left untouched if it does not unduly restrict the operating width of the trail. If it is necessary to remove material, care should be taken to avoid undercutting the toe of the batter.

The removal of timber and scrub should be the minimum necessary to maintain safety on the trail. Timber should be felled and wherever practicable stumps left intact instead of being bulldozed. This is especially important above cut batters and adjacent to, and in, drainage lines.

No timber, scrub, soil or debris should be dumped in drainage lines but should always be stacked well above flood level.

Debris deposited near drainage line crossings should be removed during maintenance.

The use of crossfall surfacing and cross banks largely eliminates the need for blading the surface of the road, itself a disturbance and creator of an erosion hazard. The stabilized road surface and protective vegetative cover on the bank outlets combine to provide a reduction in road erosion.

12. CONCLUSION

By applying the principles of these guidelines to design and maintenance of trails, access should be available at all times.

The use of crossfall surfacing and trafficable cross banks offers a cheap and easy method of controlling runoff and erosion on low standard roads. Their use will help ensure that roads remain trafficable and that vehicles are not hindered or halted by surface rilling and table drain gullying.

13. DEFINITIONS

Batter

The face of an embankment or cutting, produced as a result of earthmoving operations involving cutting and filling.

Batter Drop-Down

A constructed and stabilized drain to carry runoff down the trail batters, typically down the line of greatest slope.

Cross Bank

A hump of earth constructed across a trail so that runoff is effectively diverted from it.

The cross bank is formed by digging a trench up to 20 to 30 cms deep on a graded line across the trail, using the excavated earth to form a bank on the down slope side.

The gradient of the trench should be enough to provide adequate drainage. If the gradient is too steep it will speed the flow of water and this can cause erosion. A gradient of approximately 1:20 is recommended.

The formed bank must be consolidated and with batters shaped no steeper in relation to the trail surface than 1:5.

Cross banks are designed to handle larger anticipated flows than cross drains.

Cross Drain

A drain of various form that baulks the flow of water down a trail and diverts it across the trail's surface. The capacity of the drain is defined by its cross-section.

Cross drains are designed to handle smaller anticipated flows than cross banks but larger flows than can be controlled by crossfall drainage.

Crossfall Drainage

Drainage which occurs when the surface of a trail has sufficient cross slope to cause water to flow across and off the surface, rather than along it. Where the water flows into the hillside it is termed INFALL, and where flow is away from the hillside it is termed OUTFALL.

The minimum cross slope required to achieve such crossfall drainage is 1:25. For safety reasons the maximum crossfall used should generally not exceed 1:10.

Culvert

A pipe or similar structure used to direct water under the trail.

Earth Windrow

A longitudinal ridge of soil created due to spillage at the edge of a bulldozer blade during earthmoving operations. Windrows may build up along the edges of trails during their construction and maintenance. This may prove useful in directing runoff to a stable outlet in which case it is called a WINDROW DRAIN. However, in other circumstances it may prevent runoff leaving the trail, causing erosion.

Erosion Classes in Relation to Soil Types

Class A— Low Soil Erodibility	Brown and red soils derived from finer sediments and metasediments.
Class B— High Soil Erodibility	Red soils on fine granites, fine sandstones and basalt.
Class C— Very High Soil Erodibility	Grey and yellow soils derived from granites, sediment and metasediment, especially coarse grained types.
Class D— Extreme Soil Erodibility	Unconsolidated sediment. As a general rule, trails should not be built on Class D soils.

Mitre Drain

A drain to conduct runoff from the shoulders of a trail to a disposal area away from the road alignment.

Table Drain

The side drain of a road running adjacent and parallel to the shoulders, and comprising part of the road formation.

Trail

A road of minimal construction standards which closely follows the natural landform and is constructed with a minimum of culverts and earthworks. The surface is rarely gravelled and, following initial construction, receives little maintenance. Construction standards provide for intermittent, but reliable, loaded four-wheel drive travel in fair weather conditions and generally at low speeds. More extensive use, or use during wet conditions, may lead to rapid deterioration of the trail.

14. ADDITIONAL INFORMATION

For further advice and assistance, the Head Office and Regional Offices of the Soil Conservation Service of N.S.W. are listed below:

Head Office

3rd Floor, Export House, 22 Pitt Street,
Box R201, Royal Exchange Post Office,
SYDNEY, N.S.W. 2000
Phone: 27-7235 or 27-9551 (STD 02)

Northern Region

Parry Shire Building, 468-472 Peel Street,
P.O. Box 601,
TAMWORTH, N.S.W. 2340
Phone: 66 1988 (STD 067)

Eastern Region

Soil Conservation Service Office,
Cnr. Guernsey and Susan Streets,
P.O. Box 130,
SCONE, N.S.W. 2337
Phone: 45 1344 (STD 065)

South East Region

N.S.W. Government Offices,
159 Auburn Street, P.O. Box 390,
GOULBURN, N.S.W. 2580
Phone: 23 0600 (STD 048)

Western Region

Hay Street, P.O. Box 77,
CONDOBOLIN, N.S.W. 2877
Phone: 95 2033 (STD 068)

Riverina Region

N.S.W. Government Offices,
43-45 Johnston Street, P.O. Box 10,
WAGGA WAGGA, N.S.W. 2650
Phone: 23 0400 or 23 0475 (STD 069)

Macquarie Region

Cnr. Anson and Kite Streets, P.O. Box 53,
ORANGE, N.S.W. 2800
Phone 63 8278 (STD 063)

North East Region

Cnr. Clyde and Forth Streets, P.O. Box 177,
KEMPSEY, N.S.W. 2400
Phone: 62 1391 or 62 1392 (STD 065)

Acknowledgements:

R.J. Cathcart C.J. Marshall K.J. O'Neill-Fuller

APPENDIX "H" - Submission to Director of Department of Planning
re Modification of Plan of Management

Consultants in:
Town Planning,
Surveying,
Leisure Planning,
Environmental Analysis,
Property Development.

939 Old Northern Road,
P.O. Box 244,
DURAL, N.S.W. 2158
AUSTRALIA
Tel: (02) 651 1469 or 651 2784
FAX. No. (02) 651 3352

COPY

Our Ref: 718/3

4 October 1994

The Director
Department of Planning
175 Liverpool Street
SYDNEY NSW 2000

Dear Director

Subject: **Application for Amendment of Plan of
Management. Draft Sydney Regional
Environmental Plan No. 9(2).
Extraction Industry.**

1. This is a request made under the provisions of cl 13(2) of subject R.E.P. This clause apparently empowers any party, subject to consultation with your goodself, to seek to review of or amend the Plan of Management which is referred to in the following paragraph.
2. Clause 13(1) of S.R.E.P. No. 9(2) requires that sand extraction at Maroota *"shall proceed in accordance with the guidelines established in the document entitled "Plan of Management for Extractive Resources at Maroota N.S.W.", prepared by Resource Planning Pty. Ltd., June, 1991"*
3. Within that Plan of Management document, at its point 3.6.4, is found the following statement:

"Guidelines controlling construction and alignment of internal haul roads for the study area are documented in Section 4.4.3".
4. At its section 4.4.3, the document, after stating that *"it is unrealistic to present a finalised internal haulage route alignment"*, goes on to advise that *"a conceptual haulage route has been shown on Figure 26."* [Note: In fact, however, the line of route is shown on Fig. 29 and not on Fig. 26.]

It further states:

"The haulage route depicted has been aligned to meet NAASRA intersection and sight distance requirements, minimum access points to the Main Road system and minimum disturbance to existing dwellings. Any alternative internal haulage system proposed should at minimum meet these design criterion."

5. We are presently preparing, on behalf of our client, P.F. Formation, a proposal to extend past extraction operations upon Lot 3, D.P. 567166, part Por 66, Parish of Frederick, Hornsby Council area at Maroota. (Your reference S90/03458/001, relates.)
6. It is an essential part of this extraction proposal that our client company transports resource material between said Lot 3 and its Central Processing Plant site on Por 198 Parish of Cornelia, Baulkham Hills Council area, at Maroota.
7. Whereas the conceptual haulage route shown at Figure 29 of the Plan of Management does provide a physical link between Lot 3 and Por 198, there are many factors which render this particular line of linkage impractical. These factors will be later discussed in this submission.
8. Our client company has long been aware of the many and varied difficulties involved with the use of the so-called conceptual route. It is also aware of the minimum internal haul road design criteria as specified in the Plan of Management and as quoted in the latter part of our point 4 above.
9. Clause 10 of the originally gazetted S.R.E.P. No. 9 requires that Council shall take the Plan of Management into account in assessing any development application.
10. Because our client company has long known of its plans to extend its Hornsby Council (Lot 3 and other) operations, it has been endeavouring, for some years now, to have Hornsby Council give some consideration to an alternative internal haul road route which satisfies both the minimum design criteria and the planning intent of the conceptual route shown in the Plan of Management.
11. In light of the copy correspondence at Attachment 1 hereof it is relevant that
 - the alternative haul road route as suggested in our early correspondence with Council is essentially that for which support is now being sought, and that

- our proposed route was put to Council well before the Plan of Management was completed.
12. Despite our further representations nothing further, apart from non-fulfilled suggestions of a multi-party meeting, has eventuated in this matter. Council has shied clear of giving any commitment of support for the suggested alternative route. R.E.P. No. 9 (2) has now overtaken the prior R.E.P. and we must now ask whether you, as distinct from Council, will provide the support required by our client company to encourage it to continue its efforts to firm-up access rights over what, seemingly, is the only realistic, practical internal haulage road route available to it.

Impediments to the use of the conceptual route shown in the Plan of Management

13. As previously stated, within the final Plan of Management the proposed haul road route was eventually shown as Figure 29 and not as Figure 26 as indicated in the text of the report. A photo-reduced copy of that Figure 29 is at Attachment 2.
14. With reference only to that stretch of the Attachment 2 haulage road route lying between the north-west corner of Port 117, Parish of Cornelia, and Lot 3, D.P. 567166, the following factors mitigate against its use:
- 14.1 The central part of lot 1, D.P. 595538 has been found to contain a significant population of the rare and endangered plant *Kunzea rupestris*.
- 14.2 Road surveys carried out by a firm of Registered Surveyors along that stretch of Old Northern Road fronting Lot 10, D.P. 752029 and Lot 1, D.P. 204159, indicate that sight distances at the point where the conceptual haul road crosses the Main Road are far from adequate. They could not be improved without the carrying out of major vegetation clearing and earthworks within the Main Road reserve, and
- 14.3 The proposed route traverses at least three properties whose owners are vehemently opposed to either sand extraction or the use of their land for haul road purposes. It also passes through the properties of other owners who, to date, have expressed no interest in extraction.

The Suggested Alternative Route

15. At Attachment 3 is a copy plan, already submitted to your officers, which shows the principles of an alternative line of haul road route as favoured by our client company. All parts of this route traverse the holdings of persons who have either lodged extractive industry development applications; had preliminary drilling carried out or, in one other case, given written advice that they are happy to have the haul road on their land.
16. Noting that the Attachment 3 plan is dated March 1994, it is relevant that the following points have arisen since that time:
 - 16.1 We have come into possession of a 4 February 1994 aerial photograph which clearly shows the location of a substantial, well-trafficable fire trail route which was cleared and constructed from Lot 3, D.P. 567166 to Lot 28, D.P. 752014 at the time of the recent, January 1994, serious bush fire event. Attachment 4 is an unmarked copy of part of that photo. Attachment 5 is the same photo with identifying markings.
 - 16.2 Baulkham Hills Council has recently rejected a s102 application in which the owner and extractor of Por 196 and 29, Parish of Cornelia, had sought to haul sand south along Old Northern Road rather than along the haul road route running to Wisemans Ferry Road through Portions 196, 29, 198 etc.
 - 16.3 The owner of the southern part of Lot 28, D.P. 752014, (Mr. Vella), while not wishing to show preference for any haul road route, has advised Hornsby Council that he has no objection to it approving his current extraction application conditionally upon his agreeing to, among other things, the use of part of his land for the haul road here under discussion.
 - 16.4 The owners of the northern, smaller part of Lot 28, D.P. 752014, Mr. and Mrs. Jones, have provided Hornsby Council with a letter agreeing to the use of part of their land for haul road purposes, and
 - 16.5 One of the two owners of Lot 10, D.P. 752029, Mr. Paul Camilleri, has likewise provided Hornsby Council with a similar letter.
17. In the matter of that stretch of proposed haul road shown on Attachment 2 as running south and east from the south-east corner of Por 29, Parish of Cornelia, to a point near the north-east corner of Lot 3, D.P. 555184 (on Old Northern Road), our client company has now provided Baulkham Hills Council with copies of letters of agreement from all but one of the affected landowners. The one outstanding landowner has promised his letter of consent but it has not yet reached our client's office.

18. At this stage, the above-discussed belated letter of consent being of no real concern, the only impediments to the linking-up of the total haul road route as proposed by our client and as shown at Attachment 3 are:
 - 18.1 the failure of our client company to have gained the consent of the owners of Por 29 and 196;
 - 18.2 the failure of our client company to have gained the consent of the owners of Lot 1, D.P. 204159 (corner of Old Northern Road and Old Telegraph Road), and
 - 18.3 the failure of our client company to have gained the consent of the remaining half owner of Lot 10, D.P. 752029.
19. In the matter of point 18.1 above, Baulkham Hills Council's refusal of the s102 application as discussed at point 16.2 above carries with it the compulsion for the owners of Por 29 and 196 to themselves use, and to provide others with, haul road access through these two portions.
20. In the matter of point 18.2, Baulkham Hills Council now has before it an application for extraction of that land, Lot 1, D.P. 204159. It is within the power of Council to approve that application subject to the provision of haul road access rights to others. This, however, does not guarantee that such access would be provided. The owners may simply decide not to extract. They are also, as a matter of interest, the owners of the above Pors 29 and 196.
21. In the matter of point 18.3, our client only needs indication of official support for the concept of the modified haul road route as here proposed, and as shown on Attachment 3, and it will intensify its efforts to obtain this half-owner's consent.
22. Despite the fact that, for some time yet, there may be missing links in the ownership chain which make up this total route, our client believes that the above style of official support for the requested modification of the Plan of Management internal haul road will greatly enhance its prospects of ultimately achieving its favoured route.
23. There would appear to be strong local support for the concept of keeping haulage vehicles off that stretch of Old Northern Road which passes Maroota Primary School. Baulkham Hills Council's recent refusal of the above-discussed s102 application would seem to indicate its reflection of this public support.

24. The route as proposed, although not yet fully achievable, is in a location which
 - 24.1 is more readily attainable in the future than is the conceptual route as shown in the approved Plan of Management, and which
 - 24.2 better satisfies the written requirements of that Plan (see our point 4) than does the aforesaid conceptual route.
25. If our client company can aim to use an officially encouraged internal haul road it can carry its Lot 3, D.P. 567166, material in 40 tonne capacity off-road vehicles which travel on a route which avoids the main road system and the school and many dwellings which front it.
26. If, on the other hand, it is given no encouragement to achieve, and thus cannot use, such an internal route, it will be forced to carry its material in more than twice that number of vehicles (of 18 tonne capacity), along the public road system and past the school and dwellings which front it.
27. At this stage, because of lack of firm decision and encouragement, our client company has instructed us to prepare our Lot 3, D.P. 567166 Environmental Impact Statement on the basis that its Lot 3 material will be:
 - 27.1 processed on Lot 3 or on Por 198, and
 - 27.2 transported from Lot 3 to Por 198 either
 - 27.1.1 along an internal haul route from Lot 3, D.P. 567166 to Por 198;
 - 27.1.2 along Old Northern Road, Wisemans Ferry Road and through Water Reserve 35733, or
 - 27.1.3 along Old Northern Road to the Crown Road adjoining the north boundary of Por 117, Parish of Cornelia, and thence via the Baulkham Hills Council section of the haul road route to the Por 198 processing plant.
28. Only one of these routes, that at 27.1.1, meets and can better the minimum design criteria referred to in the Plan of Management (again see our point 4).

29. The need to address the above alternative options will produce a more than usually complex, tedious, bulky and cumbersome E.I.S. document. However, despite the number of alternative routes and impact consequences it will contain, it is fundamentally obvious, given the provisions of Clause 13 of Sydney Regional Environmental Plan No. 9 (2), that Hornsby Council will not be able to determine the application until you have made and recorded a decision in the matter of the location of the Maroota internal haul road system.
30. We also bring to your notice the fact that Hornsby Council is even now under pressure to determine a development application to extract Mr. Vella's property, part Lot 28, D.P. 752014. Failing the taking of action (compulsory acquisition for road purposes, perhaps) to establish an east-west road link through Lot 1, D.P. 204 159 (see point 20 above), Hornsby Council will be left with only two alternatives in approving a transportation route from Mr. Vella's land to his market place(s).
- 30.1 It will have to require Mr. Vella's resource material to be transported south along Old Telegraph Road at prohibitively expensive upgrading cost, and to the ire of local residents, OR
- 30.2 It will have to enable him to upgrade and use the northern junction of Old Telegraph Road with Old Northern Road.

If Council chooses the above 30.2 option, the upgrading of this intersection will encourage heavy vehicle traffic flows which make an absolute mockery out of Baulkham Hills Council's recent decision to refuse to allow heavy extraction vehicles to use that stretch of Old Northern Road passing Maroota Primary School (see point 16.2). It will also make a mockery of and possibly prejudice the outcome of its yet more recent determination to defend that decision before the Land and Environment Court.

Further, once this concept of the use of the junction of Old Telegraph and Old Northern Roads for sand transport is immortalised by a Council consent which also thumbs its nose at the intent of the aforesaid Plan of Management, a mockery is made of that Plan and the parties which contributed to its preparation.

If option 30.2 is adopted, the concept of an internal haul road system to serve the perhaps 50 to 60 year needs of Maroota sand mining might as well be scrapped.

31. Given the provisions of cl 13(2) of S.R.E.P. No. 9(2), we are of the view that Council can most likely not resolve the Lot 28, D.P. 752014 (Vella) transport route hiatus without consulting with you. Likewise, we believe that it is now only you and your Department who and/or which can make the decisions necessary to prevent both the making of the above mockeries and to keep heavy sand trucks off the Maroota public road system during the lives of perhaps the next three or four generations of Maroota residents.
32. We sincerely hope that the above situation is resolved; that you will agree to the modification of the haul road route, and that our client company is given the encouragement to seek and obtain the as yet outstanding owners' consents prior to Council's consideration of its Lot 3, D.P. 567166 development application.

We anxiously await your reply.

Yours faithfully

COLLIN C. DONGÉS & ASSOCIATES PTY LIMITED

per

A handwritten signature in black ink, appearing to read "Collin C. Dongés", is written over a horizontal line. The signature is cursive and somewhat stylized.

THE COUNCIL OF THE SHIRE OF HORNSBY

File B718

1

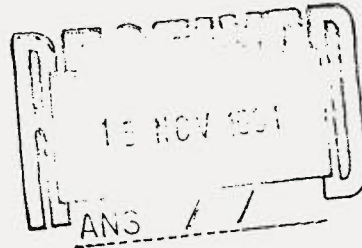
296 Pacific Highway, Hornsby
Postal Address: Box No. 37, P.O. Hornsby 2077
DX 9655 HORNSBY Fax: 476 2610

PERSONAL PAYMENTS AND ENQUIRIES
8.00 A.M. to 4.00 P.M.
MONDAYS TO FRIDAYS

PLEASE ADDRESS ALL COMMUNICATIONS
TO THE SHIRE CLERK

TELEPHONE: 477 0777
8.30 A.M. to 4.30 P.M.
MONDAYS TO FRIDAYS

Collin C Donges & Associates Pty Limited
P O Box 244
DURAL NSW 2158



Attention: Mr C C Donges

Dear Sir

Road Transportation of Extractive Materials from Maroota

Reference is made to your letter dated 23rd September, 1991, concerning the concept of an internal haul road to serve PF Formations extractive sites at Maroota. Council would support re-routing of the heavy trucks off Old Northern Road, away from Maroota Village, as it would improve the amenity and safety of the school and village.

Although the proposal has merits, a commitment of support cannot be given as Council is required to consider the interests of all residents, developers and interest groups prior to the endorsement of a proposal. To this end Council, in conjunction with Baulkham Hills Shire Council and the Department of Planning, have prepared a draft Plan of Management for the extractive resources at Maroota. The draft plan accompanied by a Draft Development Control Plan will be exhibited shortly. The Draft Management Plan does address an overall strategy for the area, including transport routes.

With regard to the concept route, the following comments are offered:

- * the proposal intersects with both Old Northern and Old Telegraph Roads, the realignment of this intersection north of Portion 31 would reduce the number of possible traffic conflict points.
- * a small part of the sketch route within Portion 10 would pass through land zoned Environmental Protection - Valley/Escarpment 7(e).

THE COUNCIL OF THE SHIRE OF HORNSBY

296 Pacific Highway, Hornsby

Postal Address: Box No. 37, P.O. Hornsby 2077

DX 9655 HORNSBY

Fax: 476 2610

PERSONAL PAYMENTS AND ENQUIRIES
8.30 A.M. to 4.00 P.M.
MONDAYS TO FRIDAYS

PLEASE ADDRESS ALL COMMUNICATIONS
TO THE SHIRE CLERK

TELEPHONE: 477 0777
8.30 A.M. to 4.30 P.M.
MONDAYS TO FRIDAYS

Page 2

* Agreement would have to be reached between the two Councils, your client and the R.T.A. as to appropriate Section 94 levies for road maintenance and the implication of transferring material between the Shires.

With regard to your client's specific question concerning vehicles from Portion 63 and Lot 3 D.P. 567166 transporting material to the central processing plant, no objection would be raised provided:

- (i) any traffic control requirements of the R.T.A. and Council are complied with prior to commencement; and
- (ii) the Section 94 levies for road maintenance will not be adversely affected.

It may be appropriate to organise a meeting between you, your client, Baulkham Hills Shire Council, the Roads and Traffic Authority and Council to further discuss the proposal. Council would be willing to host such a meeting.

Further information regarding this matter may be obtained by contacting Mr D Green (477-0737), between 8.30 am and 4.30 pm, Monday to Friday.

Yours faithfully
MAX EASTCOTT
General Manager

Per: 
R J BUGGY
Executive Manager
Development & Environment Division

2 November, 1991

Council ref: P.70/10/28; 6800/ML3; 6800/MP63

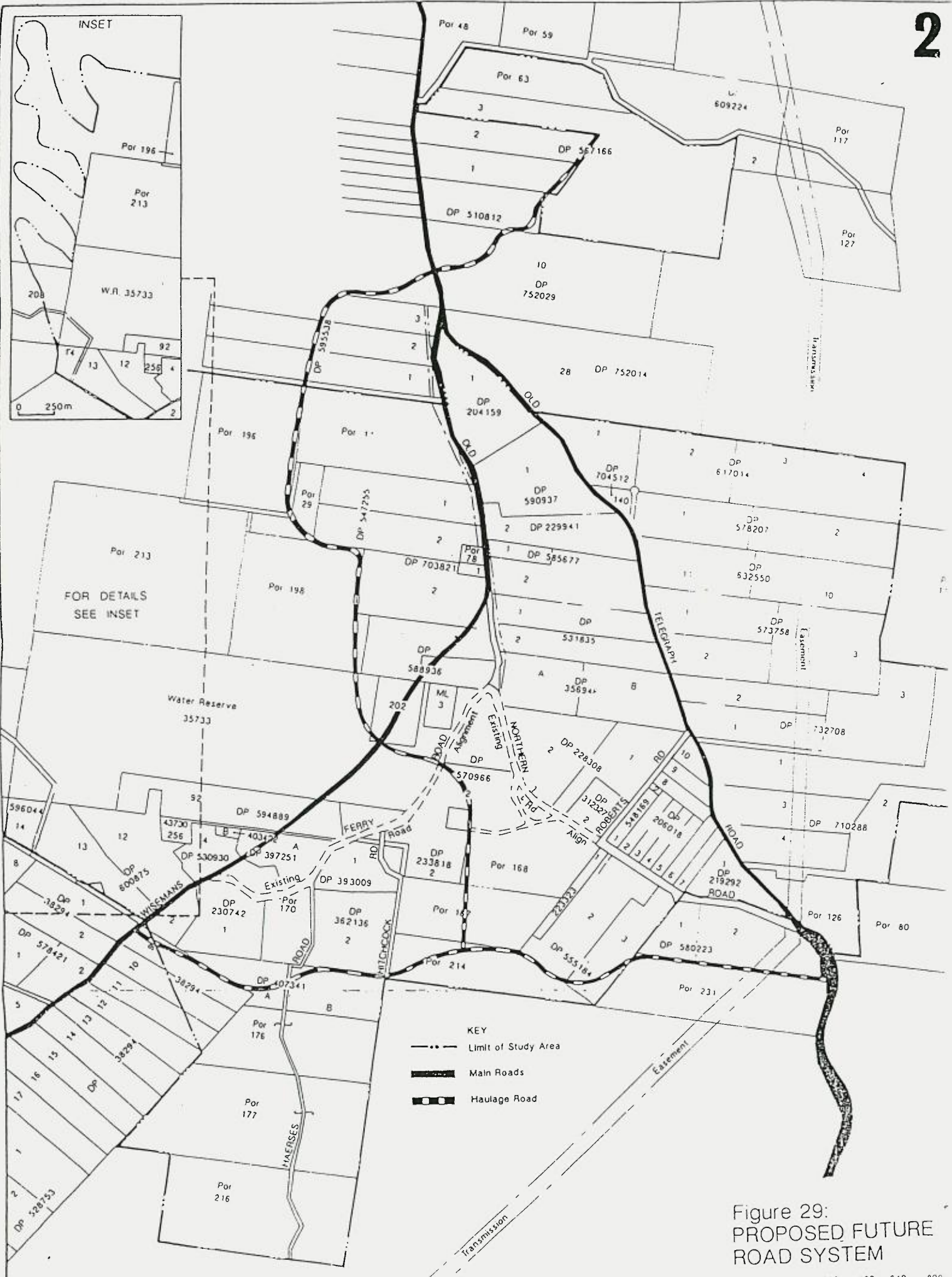


Figure 29:
PROPOSED FUTURE
ROAD SYSTEM

0 160 320 480 640 800
metres

P.F. FORMATION HAS CONSTRUCTED, BUT WISHES TO ABANDON THE USE OF, THIS INTERSECTION

THE OWNER OF THIS PROPERTY ADVISED BHILLS COUNCIL THAT HE DID NOT WANT A HAUL ROAD ACROSS HIS LAND, BECAUSE THE ROUTE IS FLEXIBLE COUNCIL AGREED WITH HIS WISHES. P.F. FORMATION WAS THUS FORCED TO SEEK/NEGOTIATE AN ALTERNATIVE ROUTE.

ALL OWNERS HAD AGREED TO PROVIDE HAUL ROAD ACCESS

CURRENTLY BEING EXTRACTED BY P.F. FORMATION

OWNERS HAVE AGREED TO ACCESS BY P.F. FORMATION AND BY OTHER PARTIES AS APPROVED BY THEM, THE OWNERS

LANDS HELD BY GOUSKOS INTERESTS

LANDS CURRENTLY SUBJECT OF AN EXTRACTION APPROVAL CONDITIONAL ON USE OF INTERNAL HAUL ROAD AND ABANDONMENT OF PRESENT USE OF CROWN ROAD AND OLD NORTHERN ROAD

P.F. FORMATION EXTRACTION AND CENTRAL PROCESSING PLANT SITE. OWNER HAS AGREED TO FREE ACCESS BY ALL EXTRACTORS

P.F. FORMATION HOLDS LICENCE TO BUILD AND USE HAUL ROAD NOW THROUGH CROWN LAND AND HAS AGREED TO MODIFY LICENCE SO THAT ALL EXTRACTORS CAN USE ROAD SUBJECT TO SHARING OF LICENCE FEE

ORIGINAL PLAN OF MANAGEMENT RECOMMENDED RELOCATION OF PARTS OF MAIN ROAD SYSTEM IN THIS LOCALITY. BECAUSE OF PUBLIC OBJECTION THE PROPOSAL WAS DROPPED TO COUNCIL'S DEVT. CONTROL PLAN

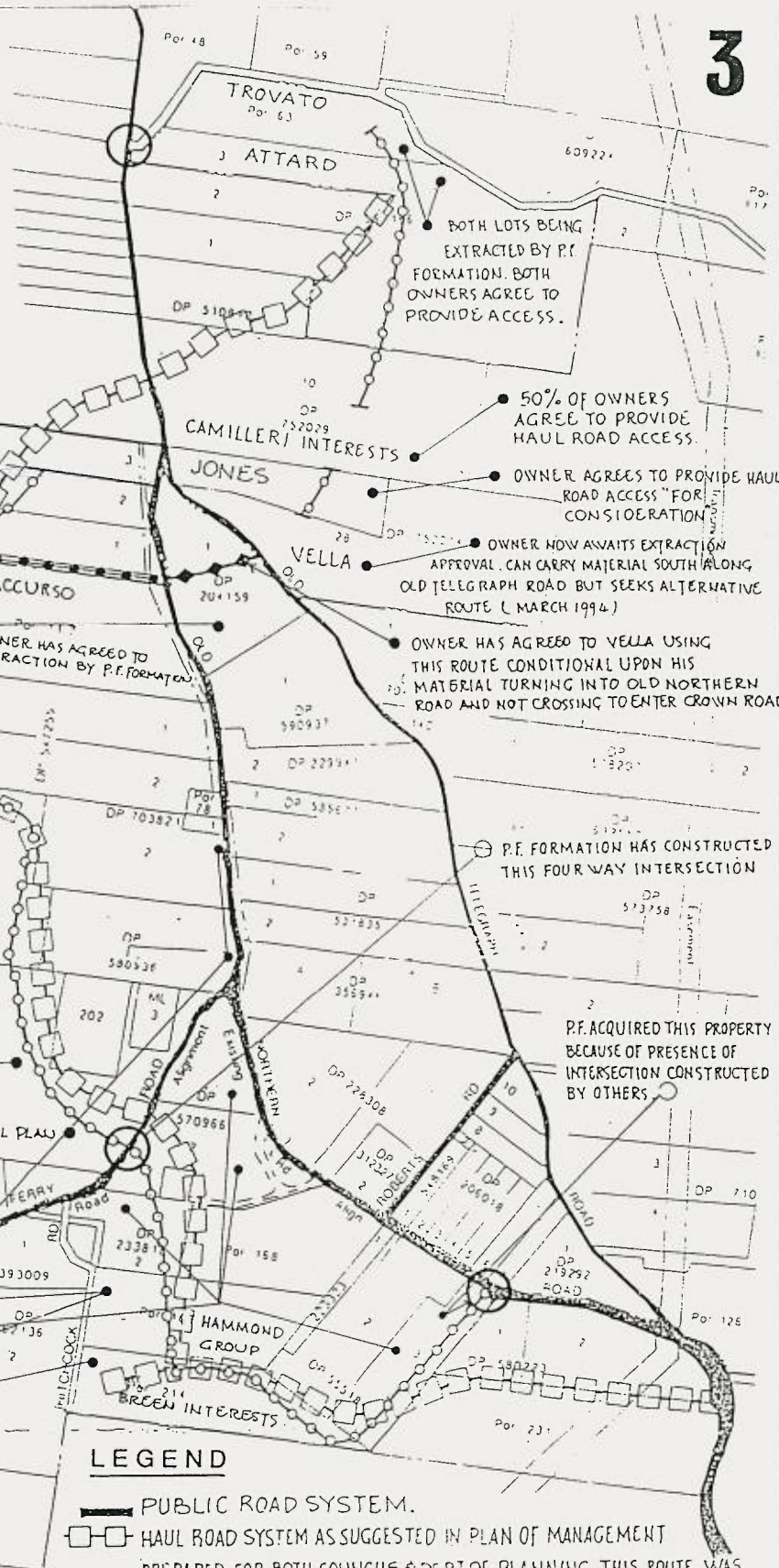
P.F. FORMATION CURRENTLY EXTRACTING FROM THIS SITE

LANDS ACQUIRED BY P.F. FORMATION INTERESTS

BOTH OWNERS AGREE TO USE FOR INTERNAL HAUL ROAD PURPOSES

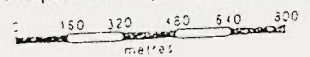
SKETCH PLAN SHOWING STATUS OF HAUL ROAD PLANNING MAROOTA MARCH 1994

PREPARED VIDE INSTRUCTIONS FROM P.F. FORMATION. *Hollenhorst* 3 MARCH '94



LEGEND

- PUBLIC ROAD SYSTEM.
- HAUL ROAD SYSTEM AS SUGGESTED IN PLAN OF MANAGEMENT PREPARED FOR BOTH COUNCILS & DEPT OF PLANNING. THIS ROUTE WAS GIVEN MORE FLEXIBILITY IN FOLLOWING DEVT CONTROL PLANS.
- ACCESS ROUTE NEGOTIATED BY OR ON LAND ACQUIRED BY P.F. FORMATION AND NOW PARTLY IN USE BY THAT COMPANY
- ACCESS ALONG THIS CROWN ROAD IS AVAILABLE TO ALL BUT HAS LONG BEEN SUBJECT TO B'HILLS COUNCIL CONSTRAINTS ON EXTRACTIVE VEHICLES TURNING INTO OR OUT OF OLD NORTHERN ROAD.
- ◆— ROUTE FAVOURED IN 15 FEB 1994 B'HILLS COUNCIL OFFICERS' REPORTS.
- ◇— P.F. FORMATION HAS A LIMITED COUNCIL, DEPT OF LANDS & N.P.W.S. APPROVAL TO USE THIS PART OF THE CROWN ROAD BETWEEN PORTIONS 29 & 196.
- *—*—* ROUTE FAVOURED BY DEPT. OF LANDS & NATIONAL PARKS & WILDLIFE SERVICE.



APPENDIX "I" -

Department of Water Resources. Need for
Groundwater Model

Mr. Paul McCabe
Collin C. Donges & Associates Pty. Limited
939 Old Northern Road
P.O. Box 244
DURAL NSW 2158

7843

John Ross
181627B
Your Ref. B646

11/8/89

Dear Mr. McCabe,

Plan of Management
Maroota Extraction Area
Sydney Regional Environmental Plan No. 9

I refer to your letter of 4th April 1989 concerning the need to develop a groundwater model as a tool for the management of sand extraction in the Maroota area.

The Department considers that there is no need for a regional groundwater model or explicit groundwater management guidelines to be formulated at the present time. Currently the Department's management strategy is to allow sand extraction to the water-table with no mining below it.

Before supporting the development of a groundwater model, the Department would need to assess the value and significance of the groundwater resources contained within the Maroota sand deposit. Whether the resources are worth protecting would depend on the costs and benefits to agriculture and the extractive industries.

Should economic studies suggest that groundwater resources are worth preserving and the pressure on the sand resource for aggregate becoming significant, then the Department would initiate the collection of data and in the longer term support a groundwater model.

If the groundwater resources are considered significant, then management data needs to be collected. The Department is already collecting bore locations and usage data through its licensing system under Part V of the Water Act. However much more additional data, particularly water level data, needs to be collected over probably 5-10 years.

Once sufficient data is available, then and only then, should a regional groundwater model be developed to calibrate and verify groundwater responses.

When the model has been properly evaluated it could then be used as a predictive management tool and stringent groundwater management guidelines can be developed and implemented.

Should the groundwater resources be deemed of little or no value, then there is no necessity to develop a model or strict guidelines.

The groundwater issue needs to be addressed in any Local Environmental Plan/Management Plan for extractive industries at Maroota and also in the review of the Sydney Regional Environmental Plan No.9 - Extracting Industries.

It would be up to the Baulkham Hills and Hornsby Shire Councils and the Department of Planning to prepare and review these planning instruments. This Department would be pleased to examine these instruments and to assist in providing comment and information as required.

The Department considers that there is no need for a meeting to be arranged involving Councils, the Department of Planning and your company to discuss groundwater modelling at this time.

Yours faithfully



J. Harkham
Manager Investigations
Technical Services Divisions

APPENDIX "J". - Proponent Company's Letter relating to refuelling techniques



24 SMITH STREET
EMU PLAINS, N.S.W. 2750
TELEPHONE: (047) 35 5033
FACSIMILE: (047) 35 3155

Collin C Donges & Associates Pty Ltd
P O Box 244
MURRAL NSW 2158

28th November 1990
Ref: 494

Dear Collin

RE: 13.11.90 LETTER FROM WATER RESOURCES.


With reference to the above letter we have made several alterations to our methods of refuelling to alleviate the possibility of fuel spillages.

Firstly our stationary plants now run from their own bulk fuel tanks which are located alongside each plant and which only require refuelling approximately once a month by our local fuel agent who has an automatic shut off valve fitted to his tanker, making spillages almost impossible. This replaces the previous method whereby our own bulk tanker would refill the small fuel tank of each item of plant every afternoon.

Secondly, we have fitted an automatic shut off hand gun to the bulk fuel tank where our mobile equipment refuels. To date this is working quite well.

I trust that these measures are satisfactory to the Dept of Water Resources.

Yours faithfully


John Graham
Managing Director

APPENDIX "K" - Department of Water Resources Letter relating to
depth of extraction.

**Water Resources**File
B850

Collin C. Donges & Associates Pty Limited
PO Box 244
DURAL NSW 2158

Telex: 121188
Facsimile: (02) 895 7281
Telephone: (02) 895 6211
Ext: 7441
Contact Name: John Ross
Our Reference: 0028575
Your Ref.: B859 3
[AKW1324#]
18-2-93

Attention: Mr Collin Donges

Dear Sir,

Re: Lot 1, DP 595538, Old Northern Road, Maroota - Consent Conditions

Thank you for your letter of 29 January 1993 concerning the above consent conditions, in particular No 29. The Department makes the following comments.

Ideally both Councils and sand extractors in this Maroota area should be aware of the different groundwater systems associated with the different formations existing there.

Basically the Tertiary Maroota Sand formation is an important local aquifer supplying water to shallow bores, wells and farm dams. The DWR management strategy for groundwater in this formation is that it should be protected and therefore sand extraction should not be allowed below the water table. The water table varies from site to site and over time. It is understood that the 180 m AHD figure is an average water table height, quoted for another extraction proposed in this area. However it is not relevant in the case of Lot 1, DP 595538 as no Maroota Sand occurs on this Lot.

The other formations in the area are eluvial sands (weathered in place sandstone) overlying deeper Hawkesbury Sandstone. This sand formation is less extensive and only has a minor perched aquifer associated with it. The main groundwater resources in these areas are located in the deeper Hawkesbury Sandstone with water tables at least 20 m below the surface. There is no known use of the eluvial groundwater system so the DWR's position is to allow total extraction with no limit on the depth. P.F. Formation has constructed large sandstone ponds which act as surface water dams, drainage areas for groundwater seeps, and recharge ponds for deeper sandstone aquifers.

In the case of this development proposal the 180 m AHD condition clearly should not apply. The Department has no objection to the proponent extracting to R L 168 m AHD.

I trust the above information and comment will prove helpful.

Yours sincerely,

John A. Ross
for J F Clarke, Manager
Sydney-South Coast Region

APPENDIX L

MONTH	% CALM DAYS	AVE SPEED WINDS (KM/HR)	MAJOR WIND DIRECTION	HIGHEST WIND SPEED PER HR % OCCURRENCE	PREVAILING WIND DIRECTION
JAN	12	7.25	E	21-30 4%	SW-E
FEB	14	6.63	SW	21-30 8%	S-SW
MARCH	9	6.65	W	21-30 4%	S-NW
APRIL	10	6.65	NW	31-40 2%	SW-NW
MAY	7	9.22	NW	31-40 1%	W-NW
JUNE	8	8.83	NW	31-40 3%	SW-NW
JULY	7	7.29	NW	21-30 10%	W-NW
AUGUST	5	10.23	NW	31-40 6%	SW-NW
SEPT	7	10.17	NW	31-40 3%	SW-NW
OCT	7	12.22	NW	41-50 1%	S-NW
NOV	11	9.85	NW	31-40 3%	S-NW
DEC	11	10.22	E	41-50 1%	SW-E

9 a.m. Winds

MONTH	% CALM DAYS	AVE SPEED WINDS (KM/HR)	MAJOR WIND DIRECTION	HIGHEST WIND SPEED PER HR % OCCURRENCE	PREVAILING WIND DIRECTION
JAN	-	19.35	E	31-40 9%	NE-SE
FEB	2	14.10	E	31-40 8%	NE-S
MARCH	-	14.08	E	31.40 3%	E-SE
APRIL	2	10.52	E	31-40 3%	NE-SE &
MAY	-	11.96	NW	31-40 11%	SW-NW
JUNE	2	12.72	SW	41-50 3%	SW-NW
JULY	-	13.25	W-NW	41-50 1%	W-NW
AUGUST	2	17.54	W	51 2%	W
SEPT	2	17.34	E	41-50 4%	NE-E
OCT	3	16.66	E	41-50 1%	NE-E
NOV	2	21.07	E	31-40 24%	E
DEC	-	23.73	E	41-50 3%	E

3 p.m. Winds