ENVIRONMENTAL PLAN

FOR

PAINKALAC CREEK CATCHMENT

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(A Research Group from Environmental Science,
Monash University, Victoria)

1979

This report was initiated and supported by Aireys Inlet
District Association (A.I.D.A.)

PREFACE

This preliminary Report has been prepared by a three man team of graduates enrolled for the M.Env.Sc. degree.

The commissioning schedule provided for 150 hours work, which would have covered the assessment of the fairly considerable body of available information on the area. The actual contribution by the team greatly exceeded that minimum, and enabled a fairly comprehensive overall review. In doing so they have identified a number of aspects which would require additional examination and investigation in follow up studies.

The Report is in two parts. Part I contains an assessment of the area based on observations by the team and an evaluation of the information in Part II. It should fulfil its purpose as an initial environmental assessment.

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Director,
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ACKNOWLEDGEMENTS BY A.I.D.A.

The reasons which prompted AIDA to commission this report are set out in the Task Proposal. AIDA is grateful to the team members for an energetic and well-balanced response to the objectives.

The report is considered a very helpful gathering together of available information relevant to the ecology of this attractive and unique area. The recommendations are regarded as worthy of full consideration by planning bodies and householders alike. Accordingly AIDA is happy to bring it to the notice of both groups and trusts that further studies of particular related matters will be carried out.

AIDA expresses its thanks to the Departments and Statutory Authorities who made important material available to the team. Thanks are also due to all the members of the 1979 AIDA committee with particular reference to Messrs B. Williams and I. Noble and Miss Joan Forster, and especially Mr. Guy Tuddenham who acted as chief liaison officer with the team and contributed most generously of his time in editing and assembling the report in its present form. The secretarial staff of Environmental Science provided very willing support with the typing. The cover was designed and printed within the Geography Department and the Chemistry Department provided the use of their Xerox machine for the printing.

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TASK PROPOSAL

from Aireys Inlet and District Association (AIDA)

to Environmental Science, Monash University

SUBJECT Preliminary Strategy Plan and Environment Welfare Study of Painkalac Creek Catchment and Physiographic Basin - Its History and Development, Past, Present and Future and its relevance for the Aireys Inlet District through the 1980s.

BACKGROUND A number of limited historical accounts of the development of the district have been carried out. Some fact and some fiction exists in the early history of this area. Maps and early documents have been collected which reflect the pioneer settlement of the area. Many gaps exist and no concerted study has produced an overall understanding of the region.

In the early 1970s AIDA organized a number of study weekends in conjunction with the Environment Studies Association of Victoria. These weekends resulted in a number of group studies led by trained personnel which produced small reports and a basic understanding of the fauna and flora of the area. More recently interest in the Angahook Forest Park developed by the Forests Commission of Victoria in consultation with AIDA and Angair, and of which the Painkalac Creek catchment basin forms part, has sparked fresh interest in obtaining a better understanding of the natural balance of the area, and how it can be opened up for recreational use with minimum potential environmental damage.

However, there are problems. Natural occurrences of fires and floods are now being controlled and used by man to his own ends without a full understanding of the effects of the activities on the environment. The pathogenic root fungus disease (Phythophora cinnamomi) has been introduced by man into the Otways area and may well be present within the catchment zone.

Probably the greatest threat comes from the potential population expansion of the region which is inevitable in the next decade. Barwon Heads and Torquay have already experienced the pressures and

problems of large scale and rapid expansion of both permanent and itinerate (holiday) populations and Anglesea is also following suit. We must face the inevitability of a similar expansion in the population of the Aireys Inlet District in the 1980s and would wish to do this with an adequate understanding of the environment which we presently have.

The region lies within the area of operation of the Geelong Regional Commission and is administered at the local government level by the Shire of Barrabool. Interim planning policy exists to cover the potential development of the area and, provided adequate evidence is obtained and documented, it should be possible to invoke sympathetic and constructive planning policies to maintain an aesthetically pleasing and nature conserving future environment for the region. The sleeping hollow may be awoken by other than the passing traffic but hopefully its awakening can take place with the minimum of raucous commercialism and high pressure dealings which are so evident elsewhere within our society.

OBJECTIVES The primary objective of this study is the development of a preliminary strategy plan for the management of the study area and surrounding districts. Objectives 1, 2 and 3 (below) are seen as necessary to the development of this strategy plan and a considerable body of data already exists within AIDA, the correlation of which, at an early stage, should enable a rapid assessment of any further necessary studies. Emphasis should be placed on objectives 4 and 5. The detailed objectives of the study are:

1) To define the geological structure and the geomorphic units (landscape elements) of the Painkalac Creek river basin.
2) To correlate existing fauna and flora studies of the area and produce a basic ecological map of existing vegetational patterns and make recommendations for further detailed studies required.
3) To survey the history of development of the Aireys Inlet District and to correlate existing data.
4) To assess the likely environmental effects of the Water Reticulation Scheme, currently being developed to service the Aireys Inlet District, both upstream and downstream from the dam site in terms of water flow, water quality, pollution potential and ecological requirements to the maintenance of seasonal salinity balance.
5) To ascertain the existing planning proposals for development within the region and to make recommendations as to any rules, restrictions or requirements which could be helpfully adopted by the relevant planning and approving authorities in order to retain the general nature and character of the several ecological environments included within the survey area.

6) To make recommendations for further studies which should be carried out to enhance understanding of the region and monitor future changes in environmental factors.

ORGANISATION The project is to be supervised by Dr. E.H.M. Ealey. Liaison with AIDA will be through the Chairman of the Environmental Sub-Committee of AIDA (or his nominee). AIDA committee members will assist in all ways possible during this study but there will be no firm commitment of manpower to this project. The study will be carried out by a group of three or more graduate students over a ten week period as part of their assessment requirements towards their Master of Environmental Science degree. The undergraduate training of the group involved should bracket the fields of Biology, Geology, Civil Engineering, Town Planning, Sociology and History. The final team selection is to be left to Dr. Ealey who will be responsible for the organisation and presentation of the data obtained.

SCHEDULE The main study will be carried out during March-May 1979 with the final report due by June 1979. Overall a minimum of 150 man hours of graduate time will be involved in this project.

COST The major cost of this study will be borne by Monash University as part of its teaching commitment for the training of post-graduate students. AIDA will contribute an amount of $500 towards the costs incurred in undertaking this survey at a distance from Melbourne.

TERMINATION Termination of this study may be initiated by either the University or AIDA in the event that satisfactory progress is not able to be made on this project. In the event of project termination from either side, any unexpended monies from the AIDA fee would be refunded.

REPORT The final report on this study is to be completed by the end of June 1979. The report is to be presented in two parts in a manner similar to that produced for a similar group study entitled "Proposals for the Management of Andrew Yandell Reserve" by Crawford, M. (et. alia) (1978). Part 1 of the report should consist of a summary of the results together with all recommendations, and should be accompanied by appropriate maps and diagrams as required in a format suitable for photocopying for quality reproduction. The reports, as far as practical, should be in foolscap or A4 format. The reports will become the property of AIDA who reserve the right to photocopy same for sale to the general public for fund raising towards further environmental projects in this area. However, the authors reserve the right to publish the details of the study in appropriate scientific journals after consultation with the AIDA committee. Acknowledgement of AIDA's role in initiating and supporting this study shall appear on the title page of all reports originating from the study.

K.W. Macdonald

Ken McDonald - President AIDA

PART I

OF A TWO PART REPORT

CONTENTS (PART I)

INTRODUCTION

This study of the Painkalac Creek catchment was done for the Aireys Inlet District Association through the Monash University Environmental Science Course.

Areas of research included the geology and geomorphology, history, ecology, investigation of the likely environmental effects of the water reticulation scheme, assessment of the existing planning proposals and formulation of recommendations for future studies to enhance understanding of the region and future changes in environmental factors.

Studies by the group were restricted to the lower catchment area and Aireys Inlet environs. The upper catchment area was not examined in any detail except by aerial photograph interpretation. Appendix I shows the area studied by the group. This report has been compiled in limited time and cannot be considered a definitive environmental study; it should be used as a guide to indicate future environmental problems.

At present the Aireys Inlet and Painkalac Creek catchment have no serious environmental problems. Planning is along sound lines for a transquil coastal town. The foreshore committees are active and good relationships exist with the Barrabool Council for foreshore preservation.

To retain the character of the area, whilst allowing reasonable growth the following points are considered of importance.

(i) Preservation of the river flats as non-residential land.

(ii) Monitoring of the effect of the water reticulation scheme on soil drainage and effluent pollution problems.

(iii) Careful management of the coastal dunes.

(iv) Preservation of the estuarine ecosystem.

Following is a list of recommendations to preserve the Painkalac Creek environment. Details of support for recommendations are also given.

RECOMMENDATIONS

1. Further studies be made of the possible means of sewage disposal, to avoid effluent problems in the catchment area.

2. A soil survey be carried out to determine the drainage capabilities and the effluent carrying capacity of the soils in the area.

3. The density of housing be limited in the hills overlooking Painkalac Creek flats.

4. Buildings be sited, painted and constructed to fit the environmental setting.

5. No further real estate development or building construction be permitted on the flats of the Painkalac Creek.

6. Monitoring of *E. coli* levels be continued on a regular basis.

7. The stream entering the Painkalac Creek from Wybellena Drive area be monitored for pollutants.

8. The Water Trust's current policy of releasing inflowing water during the summer be formalized and made public.

9. Consideration should be given to the possible changes downstream of the dam due to the reduction of detritus in the lower portion of the Painkalac Creek.

10. Access be restricted to the open face eastern end of the sand dune near the mouth of the Painkalac Creek.

11. The Foreshore Committees of Fairhaven and Aireys Inlet continue preservation of coastal landforms; and that Council support be continued.

12. No further housing developments be allowed on the coastal sand dune.

13. That on an opportunity basis the Council purchase the two houses on the western end of the sand dune.

14. Council complete as soon as possible the purchase of the property immediately west of Inlet Road near the junction of Great Ocean Road and the building be demolished.

15. Part of the housing estate south of the Great Ocean Road and west of Gilbart Street be purchased by the Council and that it be made a public recreation area.

16. Commercial zoning be restricted to the northern side of the Great Ocean Road along to Eambra Road.

17. That the Forests Commission prepare and make public for comment a management plan for the recreational use of the Angahook Forest Park and that a management prescription for forestry operations within the reserve including the Painkalac Creek Catchment be prepared.

18. Vehicle access be prohibited into the dam.

19. Trail bikes be prohibited from walking tracks in the Angahook Forest Park.

20. No development or further clearing of the catchment area above the dam be allowed.

21. Further studies to be made on the extent, effect and control of *Phytophthora cinnamomi* (cinnamon fungus).

22. Further studies be carried out concerning the introduction of endemic fish into the dam and creek.

23. Australian Heritage Commission to examine and classify the historical features of Aireys Inlet such as Angahook cottage, Pearse's hut.

24. The habitats of the native birds be protected.

25. The public and relevant authorities be made aware of the need to eradicate noxious weeds in the catchment area.

26. Power boats be prohibited from Painkalac Creek.

27. No camping to be permitted on the Painkalac Creek floodplain or in the region immediately overlooking the floodplain south of Boundary Road.

28. Further studies be carried out on road design and construction with consideration to environmental aspects.

29. Immediate stabilization of cuttings along the Great Ocean Road be carried out.

30. The Council locate a new rubbish tip preferably outside the Painkalac Creek catchment area.

31. The old gravel quarry on Berthon Hill be immediately revegetated.

SUPPORT FOR RECOMMENDATIONS

1. Probably the greatest potential threat to the present ecosystem of the lower Painkalac Creek is the sewage and sullage from the increased water supply combined with the increase in density of housing on the hills overlooking the flats.

   The soil is variable in its capacity to cope with the likely increase in effluent. The clay horizons of the soil will absorb effluent up to a certain capacity and are coping with the current levels of waste water. It is possible that with increased volumes of waste water, movement along the sand-clay interface could occur. This water would then appear as stinking springs at the Painkalac Creek mouth and the Allen Noble Sanctuary. A similar problem occurred at Anglesea and was only finally overcome by the installation of a sewerage scheme.

   Studies on the capacities of soils are carried out by the Soil Conservation Authority and further studies of the soils of the Painkalac Creek catchment are strongly recommended. The long term, but expensive, solution is a sewage disposal scheme for the area. Alternative methods apart from dumping the raw sewage into the ocean need to be applied. A study of suitable sewerage schemes has been commenced and should be given high priority.

2. The ability of the soil to cope with increased water load from the water reticulation scheme is not fully known. This ability should determine, to a large extent, the form and type of future development and provide valuable data on run-off pollution of the Painkalac Creek. A survey of soil type (with particular emphasis on the clay soils) depth, texture, absorption and temperature related to aspect and slope is considered to be of great importance for future environmental planning.

3. To preserve the rural aesthetically pleasing environment of the hills above the cleared flats and to avoid build up of seepage effluents from household waste water and septic system, future size of real estate development should be restricted.

The houses in the Aireys Inlet District should be restricted to a maximum of about 800 houses. Development should be consolidated within the present built up area, before allowing further housing development. The area bounded by the Bambra, Aireys, Boundary and Great Ocean Roads is presently mainly zoned rural conservation but could be zoned rural residential in the future to allow further development. This rezoning would need to be conditional upon the suitability of soil capacity for sewage disposal. A preservation order on native vegetation would be a necessary condition of a rezoning scheme.

Building permits within the rural landscape zone, along the Bimbadeen Road, should be carefully evaluated with regard to location of septic tanks and disposal of the anticipated increase disposal of household water.

4. Many new houses in the lower reaches of Painkalac Creek, are being constructed to preserve the beauty of the natural environment. Restrictions on shape, size, location and colour of houses should be enforced to preserve the natural bush appearance. Such constraints are now becoming commonplace, e.g. the Westernport Region and Shire of Healesville.

5. Crucial to the aesthetic value of this district are the rural flats of the Painkalac Creek and the forested hills acting as a backdrop to the relatively small Aireys Inlet community. The flats should be designated a rural conservation zone.

The flats of the Painkalac Creek are generally unsuitable for development. Sections of the flats are subject to inundation. The construction of the reservoir will have minimal effect on the flood situation. The flats are not suitable for septic tanks and require a more expensive means of sewage disposal.

An example of undesirable development on these plains is the new residence on the northern side of the Great Ocean Road at the western end of the existing commercial zone. This property appears to be at least in part in the flood zone. If a complete sewerage scheme is introduced suitable limited development may be possible. Recreational facilities such as ovals or a golf course could be provided.

6. *E. coli* determinations are an important indicator or bacteria pollution from effluent. The lower Painkalac Creek is potentially an area of high bacterial pollution due to contamination from surrounding human habitats.

Monitoring of *E. coli* levels in the creek has been carried out by Water Trust over a period of three years approximately every two months at four locations as indicated on map number 2. The results indicate that the only significant *E. coli* contamination at present originates from the grazing of cattle on the flats. This is well within acceptable levels. The readings indicate negligible pollution resulting from the present housing density. With the advent of increased housing and the reticulated water supply the *E. coli* monitoring should be continued on a regular basis to provide a reliable indicator of bacteria levels as regional development continues.

Additional monitoring of phosphate levels would be worthwhile as a check on levels of household detergent entering the creek. It may be desirable to monitor other mineral ion concentrations such as nitrate.

7. Considerable housing development is currently taking place on the estate in the vicinity of Wybellena Drive with the construction of sealed roads and stormwater drainage systems to cope with the rapid run off from the steep roads. Stormwater, household waste water and sewage effluent from the housing estates is also concentrated into the Wybellena Creek. This creek drains directly into the Painkalac Estuary at the western corner 800 metres from the mouth and as such could become a serious source of pollution to that ecosystem. Presently the lower portion of the estuary provides a safe quiet swimming area for young children. Water made unsafe by pollution from Wybellena Creek must be prevented. To help guard against this danger an added *E. coli* sampling point should be located on the Wybellena Creek immediately above its entrance to the estuary to isolate and monitor pollutants from this source.

8. The Aireys Inlet Water Trust has stated that as part of its water management policy it will undertake to harvest no water during the summer period. This policy guarantees that an equivalent volume of water entering from the upstream end of the reservoir will be

released during the summer period. Provided this release is frequent the summer flow in the lower reaches of Painkalac Creek should not be affected. This policy should be put in writing and well publicized to allay the fears of the public concerning summer water flow.

Flow records indicate that there may be minimal flow for many months. By careful water management in the Spring it may be possible to release a flushing flow if required during the Summer period. This policy will of necessity need to be integrated with the natural and forced opening of the mouth of the creek to the sea. A controlled flushing of this sort can be used for two purposes. The first is to flush bacteria and pollutants out of the estuary and the second is to affect salt concentration within the estuary.

9. A concern about the water quality downstream of the dam is related to the naturally high level of detritus in the creek. In the likely event of the detritus settling to the bottom of the dam the habitats of microorganisms dependent upon the detritus may change. This in turn is likely to affect the current stable ecosystem in the lower portion of the creek with unknown and possibly damaging effects to water quality in the estuary. Further consideration should be given to this possibility. The barrier effect of the dam itself to upstream migration of organisms should also be investigated.

10. The environment of the mouth of the Painkalac Creek is significantly dependent on the presence of the large coastal dune. Without the dune the area would be constantly windswept and the estuary filled by wind driven beach sand. The protection provided by the dune from the strong coastal southerly sea breezes is paramount to the quality of recreational enjoyment and the present habitat of the Painkalac Creek and the central valley of Aireys Inlet.

The dune is reasonably stabilized at present except for a minor blowout some 200 metres from the river mouth and the terminal eastern slope. The blowout can be readily rectified by temporary restricting access to this portion of the dune. The erosion of the eastern extremity of the dune is potentially more hazardous.

As a recreation spot the open sand face is especially popular with children due to its location immediately adjacent to the mouth of the creek which is the focal point of beach usage. Consequently the extreme eastern end of the dune is particularly sensitive to erosion. Due to the dune's importance to the ecosystem of the estuary it needs immediate protection. Protection can be provided in two ways, by restricting access to the open sand face, and by re-establishing vegetation cover.

In the longer term continued restriction of access to the whole eastern end will be necessary to disperse usage further west down the dune. Special consideration will need to be given to providing adequate access to the wind protected estuary side of the dune. Restriction of access is likely to be unpopular and explanatory notices should be erected on-site, in the parking area on Inlet Road and in the township. This could be undertaken by the relevant foreshore committee with support of the Barrabool Shire.

11. There are two foreshore committees, the Fairhaven and Aireys Inlet Foreshore Committees. Painkalac Creek is the arbitary dividing line of responsibility between these committees. Both these committees receive good support from the Barrabool Shire Council.

Excellent work has been carried out by the foreshore committees, with council aid, in the reclamation and stabilization of eroded gullies and the establishment of car parking areas. The access track from the Inlet Road to the beach at the mouth of the Painkalac Creek is an example of a worthwhile project maintained by the Aireys Inlet Foreshore Committee.

The Fairhaven Foreshore Committee has responsibility for about two kilometres of beach including the heavily used area around the Life Saving Club. The Aireys Inlet Foreshore Committee controls a similar length of coastline. Much of this coastline is inaccessible and it requires little attention. The eastern end of the main sand dune at the Painkalac Creek mouth is nearly 1½ kilometres from the Fairhaven Surf Club and it is recommended that responsibility for this section of the beach be transferred from the Fairhaven Foreshore Committee to the Aireys Inlet Foreshore Committee.

12. The coastal dune is of vital importance to the ecosystem of the Painkalac Creek. Further construction on the dune would destroy its fragile ecosystem and restrict use of the dune to a few when it should be available for general public use.

13. The housing developments on the western end of the dune are some risk to the stability of the dune and a potential threat to the vegetation and overuse of the dune at this point. Aesthetically they distract from the natural beauty of the area. They should be purchased on an opportunity basis and removed so that complete control of the coastal dune can be maintained for public rather than private use.

14. A derelict garage stands on a property to the south west of the junction of the Great Ocean Road and Inlet Road. This is an eyesore and serves no useful purpose. It is recommended that the property once purchased by the Council should be held for public purposes after the building has been demolished and removed. The land where the building now is could be used as a parking area overlooking the lagoon and serving the proposed recreational park in the Inlet Estate.

15. The open area opposite the commercial area on the Great Ocean Road has recently been subdivided. Construction of housing in this area will adversely affect the open character of Aireys Inlet. A number of blocks back directly onto the Allen Noble sanctuary and bacterial and chemical pollution of this sanctuary is likely. Subsequent effects on the bird life of the sanctuary are unknown but are not likely to be favourable if pollution of that swamp becomes extreme.

The blocks fronting onto Great Ocean Road and those to the western edge and rear of the estate should be purchased by the Council. This land should be made into a public recreation area for children with limited parking along the Great Ocean Road section. The present foot track to the mouth of the Painkalac Creek should be continued on the northern side of Inlet Road to provide access from this recreational area to the beach.

16. On the Painkalac Creek flats fronting the northern side of the Great Ocean Road a small commercial development consists of a large general hardware store, a general store and a small restaurant. Other commercial outlets are situated in the Post Office General Store area. A B.Y.O. restaurant and the Inlet Hotel are situated a kilometre to the east of the Painkalac Creek.

It is desirable that the commercial zone on the flats should not become ribbon development along both sides of the Great Ocean Road. This would create a traffic blockage and a greater hazard to pedestrians. Although on the wrong side of the Great Ocean Road for beach access it would seem impractical to rezone the present commercial area.

The study group considered the possibility of zoning part of the new Inlet Estate immediately south of the highway as a new commercial area. For practical reasons, and to avoid ribbon development of the commercial zone, it is suggested that zoning be restricted to the present commercial zone along the northern side of the Great Ocean Road east to Bambra Road.

17. The recreational management of the Angahook Park is at present satisfactory with walking trails and facilities. Some tracks, such as the Ironbark Spur, have use restricted by road barriers. The maintenance of the tracks is a Forest Commission responsibility, except that Bambra Road is scheduled for development as a C.R.B. through road.

It is considered that the collation of an individual management plan for the area for public circulation and comment upon its recreational aspects would be beneficial to the Angahook Park and to the people of Aireys Inlet.

The plan should identify what tracks are closed and by what barriers and give the usual details of Management Prescriptions with respect to operations in the water catchment area of Painkalac Water Supply Area. A typical example is given in Appendix 5E.

18. To protect the quality of water in the reservoir access should not be encouraged to the dam site. Direct road access would serve little purpose and all vehicle access should be prohibited apart from that necessary for fire and forestry management purposes.

Foot access should be permitted from a carpark road head within 2 kilometres of the reservoir. The Forests Commission should be approached to limit all public vehicle access to the dam as part of the Angahook Forestry Park management plan.

19. The cinnamon fungus is spread by man's activities. Trail bikes brought into the region could be carrying the disease and cause new areas of damage. Trail bikes disturb the native fauna and flora of an area and cause erosion of existing tracks. Their use in the Angahook Forest Park should be stopped and the Forests Commission be approached to incorporate this in their management policy for the park.

20. The upper catchment area is well covered with sclerophyll forest and vested in the management of the Forests Commission. The relative remoteness and natural untouched aspect of the catchment area contributes greatly to the quality of water in the stream and reservoir and to the splendid natural habitat for a number of birds and animals no longer found abundantly across Victoria.

It is considered important that this habitat and water quality be preserved. Any clearing or introduction of extensive vehicle tracks should not be allowed.

21. Cinnamon fungus is a pathogenic root fungus that attacks and slowly kills many types of vegetation. Its effect can be seen in many forests throughout Australia. Many of the eucalypts between Anglesea and Jan Juc are dying from the fungus. It is spread by the introduction of contaminated soil mainly by machinery but can also be introduced by foot traffic.

In the Western Australian jarrah forests cool burning to remove forest debris has encouraged the growth of *Banksia* sp. which is now dominating much of the forests undergrowth at the expense of *Wattle* sp.. The fine fibrous roots of the *Banksia* sp. promote the growth and the spread of the fungus. The *Wattle* sp. are a natural control of cinnamon fungus which only germinate after hot burning. By hot burning contaminated forests the *Wattle* sp. are encouraged to grow and hence help to eradicate cinnamon fungus. This is a drastic measure and it is far better to avoid the contamination of forest areas by restricting vehicular traffic and thoroughly removing soil from vehicles before moving them from one area to another.

According to Tuddenham (pers.comm.), the fungus appears to be present in the Painkalac Creek catchment and at present seems to be obviously affecting *Xanthorrhea* sp. (Grass Trees).

Because the control of this fungus is so complicated further studies will have to be undertaken in conjunction with the Forests Commission of Victoria. The first step would be to determine the extent of fungus infections of the forest.

22. The Painkalac Creek catchment is a discrete catchment not connected to inland or other systems. Because of this, and the absence of clearing of the upper catchment, except for a small area of cultivated farmland and pasture, the Painkalac Creek would appear to provide a unique opportunity for the fostering and stocking of endemic fish such as the grayling. This species is somewhat endangered in Victoria and is quite a popular game fish.

It is considered that stocking the dam with trout would be an inferior alternative to the grayling or other endangered Victorian native fish. Australian Bass may be a suitable alternative to grayling. It is suggested that the Water Trust approach the Fisheries and Wildlife Division for further advice and help with this matter.

23. None of the historic features of Aireys Inlet have as yet been examined for classification by the Australia Heritage Commission. The task of this Commission is to make a comprehensive inventory of all the places in Australia which can be considered of national value. The obvious features to be considered for the National Estate Registrar are Angahook cottage, Pearse's hut and the Split Point Lighthouse and its associated dwellings. These buildings, along with others in the area, have already been listed by the National Trust. It is considered that Lugg's cottage has deteriorated too far to warrant preservation.

24. The general area of the Otway Ranges is the habitat of many rare birds. The Angahook Forest Park, the Painkalac Creek area, particularly the marshy swamp ground both upstream and downstream from the highway, and the Allen Noble Sanctuary are important refuges for birds. The freehold land immediately to the north of the Boundary Road - Bambra Road intersection is also important. Special consideration should be given to the preservation of these habitats. Examples of ways of protecting these habitats are, leaving fallen logs on the undeveloped public land and, planting flora native to the region whenever possible.

Blackberry infestations at the edges of the Allen Noble Sanctuary have been cleared by Council workers in the past. This has disadvantaged rare birds making use of this habitat. Blackberries are not native to the area and must be controlled. Consideration should be given to providing appropriate native vegetation within the Sanctuary before the remaining blackberry areas are cleared.

25. Noxious weeds such as boneseed and blackberry have the potential to become serious pests in the Painkalac Creek environs of the catchment. Blackberry bushes were encountered by the study group in the vicinity of the Duck Ponds and this weed is likely to provide a minor problem in the upper reaches of the catchment.

Further field studies to identify and quantify exotic weeds *in situ* along the creek would be beneficial and may need to be periodically repeated.

26. Power boating on the Painkalac Creek is not a problem at present due to the lack of suitable launching places. The maintenance of the present level of launching facilities is recommended. This will restrict the use of the waterway to small craft that can be carried.

Power boats would be undesirable on the estuary. The noise and other pollution resulting from the use of power boats would be damaging to the bird habitats. The wake of craft is damaging to the shoreline and fast moving craft would be a hazard for children swimming in the lagoon.

Use of the waterway should be restricted by the appropriate authority to sail and manpowered boats.

27. Currently much of the creek flats are zoned rural landscape. As the establishing of camping grounds in a rural landscape zone is allowed some decision on this prospect must be made in the near future. At present a small camping area just outside the Painkalac catchment area is located on the Great Ocean Road on the eastern side of Aireys Inlet. This camping ground is heavily booked during peak holiday periods suggesting future pressure for and possible commercial gain in establishing further camping facilities.

Possibly a small camping ground carefully controlled on the vacant land near Angahook cottage is feasible but certainly not acceptable until after the area is sewered. The mouths of the Erskine River at Lorne and the Barham River at Apollo Bay, which once provided safe swimming for young children, have been rendered unsafe by camping areas on their banks. A camping facility this close to the Painkalac Estuary would also cause further pressure on the delicate environment of the dune area by increasing the numbers of people wishing to use this as a recreational site. The dune is already an area of population pressure in summer.

Perhaps this region should be preserved more for the 'day-trippers'. Increasing camping facilities at Aireys Inlet would decrease the recreational benefit derived from visiting the area for many individuals. This view can be readily rationalised considering the numerous areas currently catering for the camper.

28. Present road developments in the general area are causing concern. In the vicinity of Wybellena Drive extensive use is being made of sealed roads, with standard concrete kerb and gutter. This has an impact on the natural bushland aesthetics and concentrates and funnels immediate stormwater run off. However, with the steep topography the sealing of the roads is considered to be the practical solution and the environmental impact acceptable. The use of formal concrete kerb and gutters is not desirable and the use of dish gutters or roll over kerbing or other alternatives should be investigated.

An example of undesirable development is that to the east of the Painkalac Creek flats in the general vicinity of Aireys Street Construction on road reserves is not being carried out with due regard concerning erosion, drainage and preservation of the existing trees. (See photograph 10 in Appendix 7).

It is appreciated that areas such as Wybellena present problems with regard to road construction due to the steepness of terrain, heavy run offs and the requirement for low maintenance. Narrow roads present problems in the passing of large vehicles such as fire trucks and do not provide as good a fire break as the wider sealed pavements. It is essential to obtain a balance between practical and aesthetic considerations in road construction.

Further studies should be carried out to consider methods of road sealing and construction of drainage suitable to the local environment.

29. The heavy clay soils have been cut back as steep batters on the northern side of the Great Ocean Road. Under heavy water load this soil becomes unstable. A land slip has occurred in the area to the west of the bridge over the Painkalac Creek causing interference to road traffic and blocking one lane for several months in 1978/79.

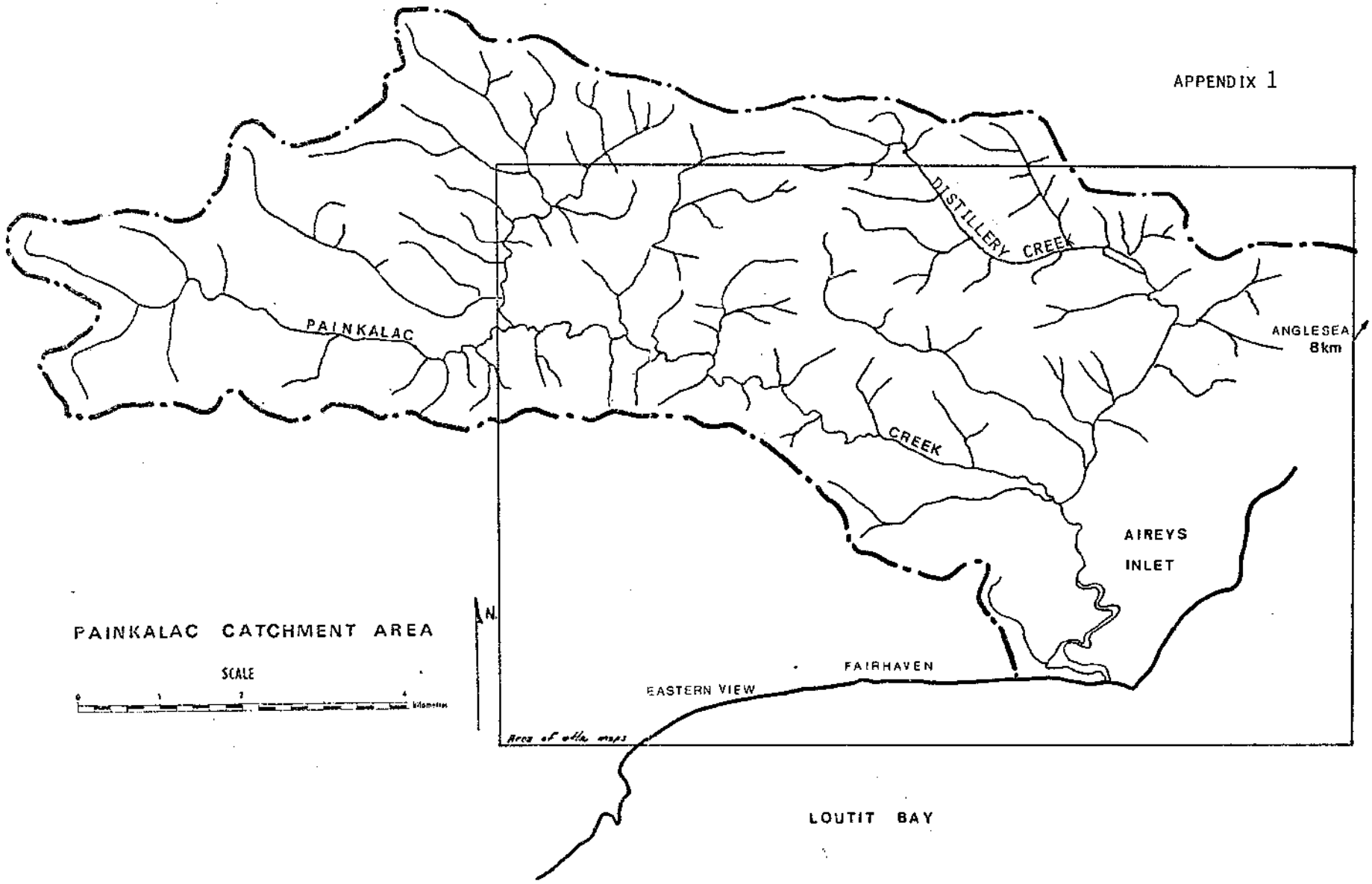
The cutting mentioned above is subject to erosion and needs lattice-work brick or steel or vegetation stabilization to bind the soil. This project should be implemented soon to guard against further landslips.

This is the responsibility of the Country Road Board.

30. The present Council rubbish tip located along the Distillery Creek is almost full. An alternative site will have to be found. For regular garbage collection the costs and benefits of cartage to the open cut mine workings at Anglesea should be carefully assessed and another site for local use developed, preferably outside the catchment of the Painkalac Creek to guard against pollution of ground water.

31. The old gravel quarry on Berthon Hill is currently eroding and needs to be immediately stabilized by revegetating the area with native plants.

APPENDIX 1



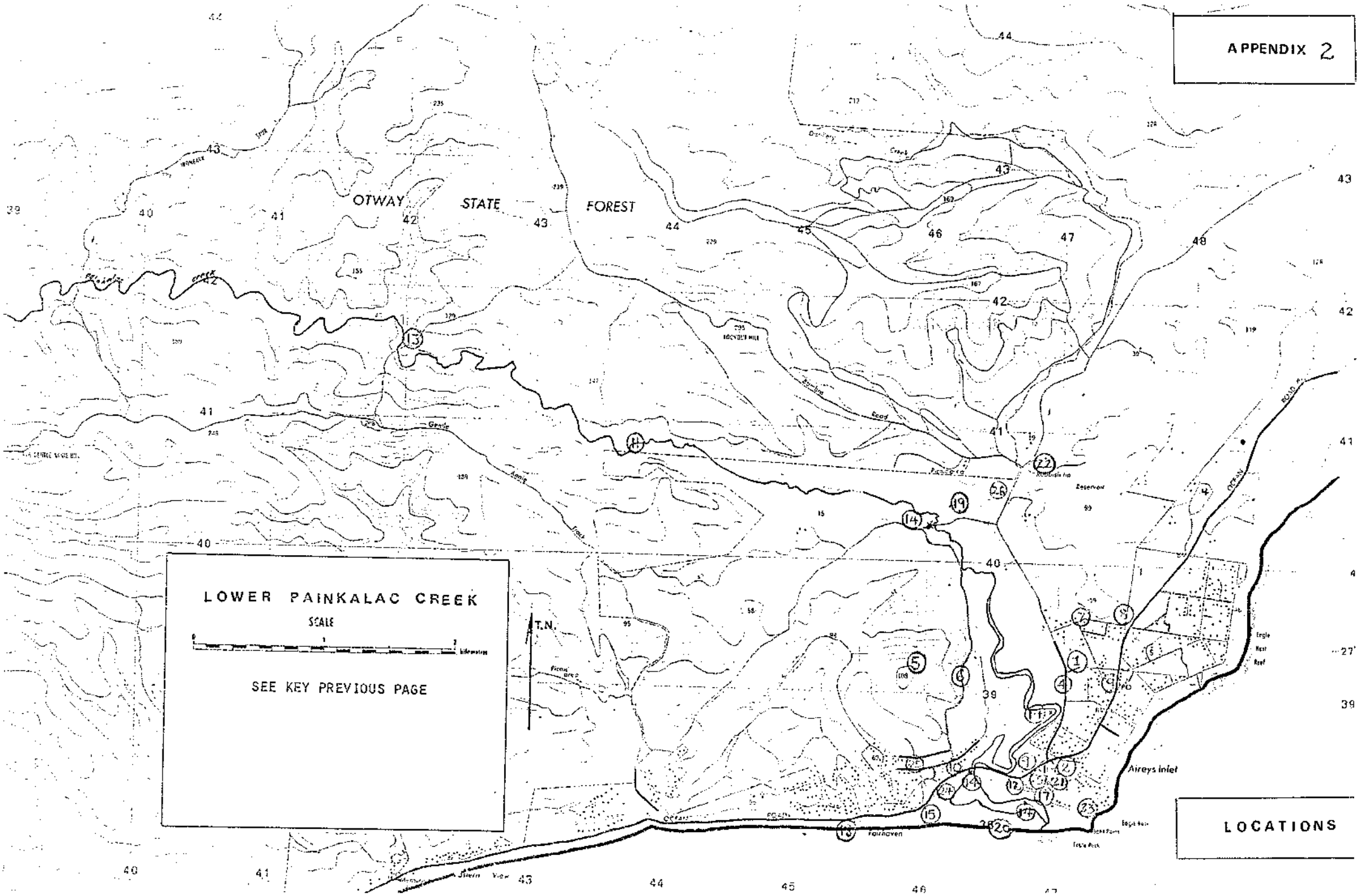
PAINKALAC CATCHMENT AREA

SCALE

0 1 2 4 kilometres

KEY FOR LOCATIONS MAP

1. Aireys Road
2. Allen Noble Sanctuary
3. Angahook Cottage
4. Bambra Road
5. Berthon Hill
6. Bimbadeen Road
7. Boundary Road
8. Camping Ground
9. Commercial Area
10. Cutting on Great Ocean Road
11. Dam Site
12. Derelict Garage
13. Duck Ponds
14. *E. coli* Monitoring Points
15. Houses on Western End of Dune
16. Inlet Estate
17. Inlet Road
18. Life Saving Club
19. Lugg's Cottage
20. Main Dune Area (Painkalac Estuary)
21. Pearse's Hut
22. Rubbish Tip
23. Split Point Lighthouse and Associated Dwellings
24. Wybellena Creek
25. Wybellena Drive
26. Distillery Creek Swamp


APPENDIX 2
OTWAY STATE FOREST
LOWER PAINKALAC CREEK
SCALE
SEE KEY PREVIOUS PAGE
LOCATIONS
Airey's Inlet
Fairhaven

PART II

OF A TWO PART REPORT

CONTENTS (PART II)

INTRODUCTION

Part II of the report contains the background information to the recommendations and support for recommendations found in Part I.

Following are details about the geology and geomorphology, ecology, history, planning and water reticulation scheme of the Painkalac Creek Catchment. Appendices and photographs are also included.

GEOLOGY AND GEOMORPHOLOGY

GEOLOGY (See map, Appendix 2A)

The Painkalac Creek catchment and environs are part of the Tertiary Otway Basin which makes up all the western coast of Victoria from southern Port Phillip Bay to southern South Australia. Forming part of the Otway Basin is the triangular shaped Port Campbell Embayment. It stretches overland from the Nepean Peninsula west to Warrnambool and contains all the land down to the coast. Included in the Port Campbell is the Otway Ranges High (Otway Ranges) made up of Lower Cretaceous rocks.

Painkalac Creek flows through the NE edge of the Otway Ranges High into the Tertiary sediments of the Port Campbell Embayment. The rock types are of two distinct eras, the Mesozoic and the Cainozoic.

Mesozoic Era (240 my - 65 my ago)

The oldest rocks in the area are of Lower Cretaceous age (135 my - 65 my) and occur in the main part of the Painkalac Creek catchment. These rocks are part of the Otway Group and are composed of fine grained feldspathic sandstone with interbeds of mudstone, shale, conglomerates and thin coal beds with plant remains. A good example of these rocks can be seen in the masonry quarry on Bambra Road, near Lookout Hill.

Douglas (1969a, in Douglas 1976) described deposition of the sediments as "... largely deposited in an extensive flood plain with braided streams contributing homogeneous silts and clays, possibly ... supplemented by volcanism".

During the Lower Cretaceous basement faulting, uplift and subsidence divided the Otway Basin into several structural units. With uplift the Otway Ranges High became a tectonically positive area. This period of tectonism was probably associated with the rifting that occurred between the Australian plate and the Antarctic plate as the two previously joined land masses split apart. Smaller scale, faulting, subsidence and deposition continued through to the Cainozoic Era.

Cainozoic Era (65 my - 0 my ago)

In the Otway Basin the rift valley between the Australian and Antartic landmasses continued into the early Tertiary with rapid separation occurring in the late Paleocene (55 my ago; Weissel and Hayes, 1972, in Douglas *et al.* 1976).

Full development of the Otway Basin occurred during the Tertiary Period (65 my - 1.8 my ago). Subsidence and minor faulting continued with the deposition of terrigenous clastics laid down on alluvial plains and marginal marine environments.

The oldest Cainozoic rocks represented in the area are the Tertiary (Palaeocene - Late Eocene, 65 - 45 my) Eastern View Formation which unconformably overlie the Lower Cretaceous Otway Group. The formation is made up of rocks comprised of consolidated gravel, sand, silt, clay and brown coal. The coal is present in commercial quantities and is mined at the Anglesea coal field.

The Demons Bluff Formation conformably overlies the Eastern View Formation. At Aireys Inlet the Anglesea Member and Angahook Member make up the Demons Bluff Formation. (Late Eocene to Late Oligocene, 45 my - 30 my ago). The Anglesea Member is a lithologically homogeneous and poorly stratified unit of brownish black, to brownish grey, carbonaceous, pyritic clayey silt and fine sands. Good exposures can be seen in the road cuttings of Berthon Hill.

Overlying the Anglesea Member is the Angahook Member of the Demons Bluff Formation. This spectacular unit is represented at Aireys Inlet by black to green black olivine basalt, the only igneous rock found in the area. Fine examples of this unit can be seen in the cliffs just NE of the mouth of the Painkalac Creek.

The only member of the overlying Torquay Group represented is the Point Addis Limestone Member of the Jan Juc Formation (Late Oligocene 30 - 22.5 my ago). At Aireys Inlet this member unconformably overlies the Demons Bluff Formation. Good exposures can be seen at Split Rock and

in the coastal cliffs NE of the mouth of the Painkalac Creek. Deep fissures in the underlying basalt are filled with calcarenite (calcareous sandstone) of the overlying limestone (see photograph 1, Appendix 7). The Point Addis Limestone Member is represented by 23 metres of sandy bryozoal calcarenite containing echinoid ("sea urchin") fragments. The rock is friable and easily dissolved in water, and consequently caves have been cut into the coastal cliffs by the sea waves.

The youngest rocks in the Aireys Inlet area are represented by Recent (1.5 - 0 my ago) unconsolidated sediments found on the beach and flood plain of the Painkalac Creek. The beach sediments are composed of beach and dune sands composed mainly of medium grained, well rounded quartz grains and shell fragments. The flood plain sediments are alluvials of sand, silt and clay derived from erosion of the rocks in the catchment area. The flood plain and beach zone sediments are easily eroded and transported by wind, water and gravity. These elements continually reshape the beach, sand dune and flood plain.

Economic Geology

No minerals of economic importance have been found in the vicinity. On Bambra Road, near Lookout Hill, there is a small disused masonry stone quarry. On top of Berthon Hill are several cleared areas that may have been quarried for road metal.

GEOMORPHOLOGY (See maps, Appendices 1A and 2B)

The Painkalac Creek system can be divided into three main geomorphological units -

(1) Catchment
(2) Flood Plain
(3) River mouth, Dune and Beach.

Catchment

The Painkalac Creek has a total catchment area of approximately 40 sq. km of which 95% is in the foothills of the Otway Ranges.

It is a juvenile stream and valley system with considerable energy causing erosion and dissection. The dendritic drainage has cut asymetrical and V shaped gorges and valleys through the hard sandstones of the Otway Ranges. The catchment slopes are well forested with eucalypts which help to hold the soils. In summer the stream almost stops flowing but in winter it may flood several times. During such times the stream has high energy and capacity for carrying loads of silt which is dumped as the stream flows from the steep mountain tract to the flat flood plains.

Flood Plain

Painkalac Creek and its valley change from a juvenile to a mature river system near the geological contact of the Otway Group and the Eastern View Formation. Flowing out of the resistant steep Otway Ranges it flows through gently sloping sands and clays that are easily eroded. After the rivers steep decent and sudden slowing down the load of silt and debris is dropped making a wide flood plain through which the river slowly meanders. During floods the river breaches its low banks and flows across the flood plain concurrently eroding and depositing sediments. Flooding may cut a new river course through the flood plain.

At Painkalac Creek the mouth is usually barred by a sand berm. This dams the water and, if not removed by river, sea or man, the water floods across the river flats adding layers of alluvium to the sediments of the flood plain.

River Mouth, Dune and Beach

(see photograph 2, Appendix 7)

The sea is the dominant shaping force in this part of the river system. The prevailing ocean swells have turned the river mouth to the east and dammed its flow with a steep berm and sand dune. The dammed river mouth has caused a small lake to form behind the sand dune. Several times a year the sand dam is breached by rough seas or by river floods allowing the lake water to be flushed and renewed with a mixture of sea and river waters. In winter the river does not always have sufficient energy to break through the barrier and flooding occurs on the flood plain. To avoid floods a bull-dozer is sometimes used to push away the sand barrier allowing the flood plains and lake to drain.

The sand dune is approximately 800 metres long and 12 metres high. High winds affect the area and without the dune's cover of thick vegetation the dune would be severely eroded. In several small pockets the vegetation has gone allowing erosion and blowouts to develop (see photograph 3, Appendix 7). More erosion will occur as people walk along these vegetation free "pathways". A thin calcrete stratum is visible on the beach front between high and low tide. This rock unit helps to dissipate the energy of the waves and so to some extent stops erosion of the dune by rough seas. The calcrete layer is breaking (pers. comm. Mr. G. Tuddenham) and the seaward side of the sand dune is thus undergoing more rapid erosion.

Soils of the Lower Painkalac Creek

A study of the land capabilities in the vicinity of the Aireys Inlet residential development was carried out and published by the Soil Conservation Authority in December 1977. This study used the concept of land systems and land components following the approach of Gibbons and Downes (1964) in 'A Study of the Land in South Western Victoria'.

Information from the 1977 Report by Pitt, Howe and Jakimoff forms the basis for recommendations on drainage and planning throughout the report.

Extracts from this report are included in Appendix 2C.

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ECOLOGY

The ecology of the area is related as a unit by climate, aspect, soil types, morphology and proximity to that of the Otway Ranges region.

FLORA

The vegetation of the catchment can be classified into the following vegeation blocks:

- coastal zone
- lower estuary
- river flats
- coastal woodland slopes
- inland forest

The Coastal Zone comprises the coastal dune and the exposed weathered cliffs from the estuary outflow to Split Rock. A difference exists in the height and form of the vegetation on the exposed and sheltered sides of the stable sand dune. Species lists for a coastal dune block were prepared by the Environment Studies Association in 1972 and 1975 and included in Appendix 3B and 3C.

Destruction of the vegetation by over use and wind exposure is apparent on the eastern end of the coastal dune at the mouth of the Painkalac Creek.

Coastal Tea-tree (*Leptospermum laevigatum*) was introduced in the Aireys Inlet area in the 1930's. It has specifically been used as a windbreak and erosion control measure along the coastal cliffs. The tea-tree has flourished and has largely taken over areas on the cliff tops in the vicinity of the lighthouse.

The Lower Estuary consists of saltmarsh, reed swamp, heathland, cultivated grassland and woodland margin. Nine land units were identified by the Environment Studies Association (1973). A copy of this report is given in Appendix 3D.

The Painkalac River Flats have been cleared and cultivated with pasture for stock grazing. Much of it is subject to occasional inundation and carries a dense grass cover.

The Coastal Woodland Slopes are exposed to strong ocean winds from the south and the stunted trees are a mixture of brown stringybark (*E. baxterii*) messmate and peppermints. The understorey can vary from grasses to heaths and also to sclerophyll shrubs, depending on soil and fire frequency. This vegetation block, bordering on the Aireys Inlet community is subject to fuel reduction burning by the Country Fire Authority.

The Inland Forest consists of three broad categories:

- Ironbark forest type - red ironbark (*Euc. sideroxylon*) dominant.
- Stringbark forest type - brown stringybark (*Euc. baxterii*) and messmate (*Euc. obliqua*) dominant types
- Smooth bark gum forest type - blue (*Euc. globulus*) and grey gum (*Euc. cypellocarpa*) dominant.

These forests are entirely within the Angahook Forest Park under the management of the Forests Commission Victoria. Unique features are the stands of red ironbark, the best in Victoria (Frankenberg, 1971), and an isolated colony of *Cheiranthe lincaris* in Distillery Creek (L.C.C. 1973). Species Lists for plants in the park are given in Appendices 3E and 3I. guide brochure is given in Appendix 3J.

The root fungus disease *Phythophthora cinnamomi* has been reported in the area since 1970 and is apparent as a die back disease amongst grass trees in the vicinity of Bambra Road and bulldozed forestry tracks. This fungus is usually introduced and initially spread by contaminated earth moving equipment. It spreads in the soil and can be expected to spread downhill by water movement. In Western Australia it has been shown that cool burning for fuel reduction encourages the growth of banksia species which spread the disease as it competes with wattle, some species of which inhibit the root fungus disease. However, it was noted that affected grass trees were situated among stands of wattle. This disease is a very real danger particularly to the unique stands of Red Ironbark.

Noxious Weeds. A number of proclaimed species were noted in the area, e.g. Boneseed (*Chrysanthemoides monilifera*), blackberry (*Rubus fruticosus*). Authorities are aware of these problems and in the case of boneseed A.I.D.A. has done an excellent job in controlling the spread. However, some infestations remain, particularly in the bush area between Bimbadeen Road and Wybellena Drive. Further information on noxious weeds in the district are detailed by Parsons, Noxious Weeds of Victoria, Inkata Press, 1973.

FAUNA

Very little is known about most of the native animals in the Painkalac catchment or in the large Otway ecological unit. But with the fast dwindling extent of natural forests in Victoria; this area is becoming an increasingly important last refuge for endangered species; such as the king parrot, satin bower bird, native cat (Quoll) sugar and yellow bellied gliders. The Fauna of the area can be categorised as follows:

- mammals
- reptiles
- amphibians
- birds
- fish
- macro-invertebrates

A list of mammals of the Victorian forests with those identified in the Otway region is given in Appendix 3K (Heisler 1971). A second species list compiled from data from the Forests Commission, National Parks Service: Mammal Survey Group and various conservation groups with the assistance of Dr. A.K. Lee (Victorian Public Interest Research Group - 1977) is given in Appendix 3L. Other notes on the mammals are described by Cowley 1971 in Appendix 3I.

The absence of the wombat, lyrebird and greater glider from the area is noted. Also the koala is thought to be not native to the Otways but has been introduced in Angahook Forest Park. The koalas primary food source, the manna gum (*Euc. viminalis*) is common in the wetter gullies and may become widespread in the area in time (P.I.R.G. - 1977).

The reptilian fauna of the area is notable only for the absence of the tree goanna. A species list is given in Appendix 3M (Rawlinson 1977).

Five amphibian species of frogs and toads are common in the Otway ranges (P.I.R.G. 1977). Settlement generally offers little danger for frogs.

A list of birds of the Angahook Forest Park (Wheeler 1970) is given in Appendix 3N and Dorward (1977) reports:

> "Aireys Inlet itself supports a small number of water birds - herons, ibis, grebes, swans and a few duck - but the swamp habitats around and just upstream of the inlet provide good habitat for Moorhen, Swamphen, Banded Tandrail, Japanese Snipe, Cisticola, grassbirds and white fronted chats. The ocean beach and cliffs are not good habitats for birds. In the coastal scrub to the west of the inlet there are Rufous bristlebirds and Singing honeyeaters, with Silvereyes, Yellow-faced honeyeaters, White-eared honeyeaters, Yellow-winged honeyeaters and two species of wattlebirds, all of which are common. The coastal forest has a diverse avifauna, including four species of lorikeet, a number of parrots (including Blue-winged parrots in the summer), Yellow-faced, Fuscous, White-plumed, Yellow-tufted, White-naped, Brown-headed honeyeaters, Eastern spinebills (honeyeaters are especially common when the red ironbark is in flower) and many small insectivores. The rare Grey goshawk is a resident and other raptors include the Brown goshawk, Collared sparrowhawk, Peregrine and Little Falcon. About four pairs of Powerful owls are believed to inhabit the nearby gullies and Barking owls are occasionally seen. Owlet nightjars and White-throated nightjars are also resident. Beautiful firetails are found in the denser gullies, but are rare, and hylacolas (*Sericornis* spp.) are occasionally seen in low scrub."

In November 1975 The Environment Studies Association in conjunction with the A.I.D.A. carried out a botanical survey and listed the native trees and shrubs which could revegetate the river environs. A bird species list with the associated habitats, for future consideration in the management of the area, was prepared at that time, see Appendix 3C.

Fish: The aquatic habitat of the study area can be divided into estuarine and freshwater components. The Painkalac Creek estuary is at present a very good habitat for fish. The majority of species in the estuary are marine fish which enter when the mouth is periodically open to the sea. The native Estuary Perch is common and also Bream, Yellow Eye Mullet, Black Mullet and Australian Salmon live and feed in the estuary when conditions are suitable. (McCarrahr, 1975) These species remain within the regions of high salinity and need to be considered in any heavy freshwater discharge from the new water storage dam. Mountain galaxias and eels frequent the length of the Painkalac freshwater section. (Renowden, 1968)

Further fish population studies would be beneficial to determine the suitability of the water storage reservoir for native fish such as Blackfish, Australian Bass and perhaps the rare Grayling. Dr. McCarrahr, head of the Freshwater Section, Fisheries and Wildlife, has studied many aspects of the Painkalac fish population and has the basis for a report on hand.

The establishment of a native fishing stream administered by the Fisheries and Wildlife would be an interesting concept.

The Macro-Invertebrates fauna of the Painkalac are studied and categorised by C. Yule (1978) before and during the construction of the water storage dam to monitor the effect of water disruption and turbidity. Extracted species list from this honour thesis is given in Appendix 3P. Bird reports in Dorward (1977) that the beach from the Painkalac Creek mouth to Eagles Nest is the only known locality of the rare polychaete worm (*Rhamphorbranchidae*) a tube dwelling worm living in the rocks at low tide.

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HISTORY

BEFORE THE WHITE MAN

The aboriginal people settled mainly on the coastal zones and its immediate hinterland. The coastal zone had obvious advantages; a mild climate, ample water supplies, and a plentiful food supply of fish, birds, shell fish and other animals.

All that remains of the aboriginal people are middens. The middens were the communal eating sites of the coast dwellers and consist of heaps of shells with a few flints, animal bones and tools found amongst them.

The middens of the Waturon tribe, a small Otway group belonging to the Witowurrong Nation, can still be found at Aireys Inlet about a metre below the level of the main sand dune. A larger midden containing a wider collection of artifacts has also been reported further inland, north of Painkalac Creek.

The impact of the aborigines on the environment of the area was insignificant. Fire used a hunting tool by the Otway aborigines had only minor effects upon the vegetation communities. The discarded materials from feeding and craftwork are believed to have made a positive contribution to dunal stability. Other wastes were dispersed causing little or no environmental problems.

SINCE THE WHITE MAN

Since the arrival of the White Man the utilization of the environment has steadily increased. The first to arrive were the sealers in the 1790's. William Buckley lived in the area after escaping from the Sorrento prison settlement in 1803. The 1830's led to the development of many communities along the south west coast of Victoria to serve isolated farming, fishing and timber industries.

Next these communities began to meet the demands of recreational activities. Recently many communities have started to act as dormitory suburbs for Geelong.

Some coastal towns have become empty shells for most of the year with a disproportionate number of elderly residents and a proliferation of facilities to cater for the influx of summer holiday makers. Having no coastal port or suitable sheltered waters for anchorage, Aireys Inlet has developed more slowly than its neighbouring communities. The holiday maker has not totally transformed Airys Inlet to a tourist centre although many of the houses in the area are occupied only during the summer holiday period.

EARLY PIONEERS

John Moore Cole Airey, J.P., Lieut. R.N. was granted a licence to graze the area in 1842. Born in 1821, the son of a British Army General, John M.C. Airey was a veteran of the Crimean War before taking up a station called Anglohawk or Eyrie behind the present site of Aireys Inlet and east of Painkalac Creek. This he added to his property called Happy Valley situated at the mouth of Swampy Creek, present site of Anglesea, which he was granted in 1839. The Anglohawk run was taken over from J. Airey in January 1846 by Thomas R. Carter.

The present town was named after either J.M.C. Airey or his brother George Sherbrooke Airey (G.S. Airey). G.S. Airey had interests elsewhere in Victoria including a lease on a 50,000 acre property on the Goulburn River which he took up in 1839 and ran approximately 9,000 sheep until the lease was cancelled in April 1883. An early reference in the Latrobe Library concerning the origin of the name Aireys Inlet states

> - Airey's Inlet :- G.S. Airey, brother of Crimean Officer, J.M.C. Airey, mentioned in Kinglake's Crimea gave it its name.

However, it seems most likely that Aireys Inlet was named after J.M.C. Airey due to his Crimea reputation and his early occupation of the district.

The area was first surveyed in February 1846 by William Urquhart. A following survey by George Douglas Smythe contract surveyor for the colonial government, was done in June 1846. Soon afterwards John Herd took up the Aireys Inlet run west of Painkalac Creek which he held from 1848 to 1855. During this time Thomas Butson Pearse (sometimes spelt Pearce) built a bark slab hut on land owned by Thomas R. Carter. The hut was probably built to replace original buildings destroyed by bush fires on Black Thursday, 8 February 1851. It is typical of those favoured by the earliest pioneers. The hut is being restored on its original site by the local council.

T.B. Pearse, born Widdicombe, England, 1809 and Martha (sometimes called Hannah) Speering, born Bristol 1819, were married in Australia and had eight children. They moved from Moorabool Street, South Geelong, where Pearse was a butcher, to Aireys Inlet in the 1850's. Pearse took over 640 acres of the Anglohawk run. They are regarded as the district's first permanent settlers.

T. Pearse died in a riding accident in 1862. Mrs Pearse in partnership with Robert McConachy ran the property until her death in 1870. Pearse and his wife are buried on the cliff tops near the lighthouse. Their graves are now covered by a cairn erected in 1960, the plaque reads:

"This cairn marks the resting place of
Thomas Butson Pearse
died on the 9th August 1862 aged 53 years
and his wife
Martha Pearse
died on the 10th April 1870 aged 51 years
early pioneers of this district."

Pearse's slab hut is located east of the Angahook homestead, one of the most historically important homes on the Great Ocean Road. Angahook is also the name of the Parish in which the house still stands. It could be a curruption of the word Anglohawk, the pastoral run held by

J. Airey. Angahook cottage is made of Barrabool stone quarried in the nearby hills. The main part of the present house was built for John Rout Hopkins after he leased the Anglohawk run from 13 January 1871. The homestead has been reported (Smyth *et al* 1977) as being built in 1862. The Winchelsea Shire rate book does not record a residence until 1876 and a more likely date of construction.

The cottage has been updated and added to, but the earliest construction is mainly unchanged. The house contains much of its original furnishings. The library, now also used as a dining room, contains the remnants of what is probably the oldest continuous private library in Victoria. It was started by William MacMullen in the early 1890's and contained 3600 volumes. These have been culled leaving approximately a thousand of the original books. The buffalo grass which has spread over much of the dune area surrounding the cottage was hand planted by Mrs MacMullen to combat drifting sand.

William MacMullen, a Geelong wine merchant, rented Angahook from J.R. Hopkins in the 1880's. It was not until the MacMullen family purchased Angahook with eight acres of land, on the 6th February 1890 that they lived there permanently.

MacMullen can be considered to be one of the first persons to use Aireys Inlet solely as a holiday resort and a place at which to retire. The house is still in the possession of MacMullen's descendants. MacMullen left the house to his daughter, Fanny (Mrs George Noble) who, in turn, left it to her son, Allen Noble. About 1916 Mr and Mrs George Noble moved from Angahook to Anglesea and Mr and Mrs Robert Noble moved in. Mrs Robert Noble was Susan MacMullen, sister of Fanny, two brothers marrying two sisters. When Robert Noble died in 1944, Mr and Mrs Allen Noble moved from Birregurra to Angahook. Allen Noble died in 1964 and much of the property was sold and has since been subdivided. Angahook cottage is currently occupied by Clare Roberts, daughter of Allen Noble.

The Noble family was part of Aireys Inlet long before the 1890's. James Noble (the father of George and Robert Noble) first bought land in the area in 1868. The first survey of the Parish of Angahook was carried

out by J.E. Gilbert in 1868. Land sales on the 21st April 1868 saw J. Noble purchase 938 acres, G.F. Belcher 273 acres and Benjamin Berthon 284 acres. James Noble erected a residence in the area in 1869 and added a further 1202 acres to his holdings in 1878. The Noble family appears to have used the Aireys Inlet residence as a holiday resort, the family interests being concentrated mainly in Geelong.

The Allen Noble sanctuary lies east of Pearse's hut and Angahook cottage. It is a natural soak which was named after the late Allen Noble of 'Angahook'. Although dry in 1914, 1939 and 1970 it generally affords an excellent protected area for native birds. The sanctuary has been indicated on maps as such since the 1900's.

Benjamin Berthon was granted a lease in March 1872 for the region west of Aireys Inlet where he and his brother, William, built a homestead. The property, called Wybellena was run by William when Benjamin died in 1873. William died in 1901, the property remaining in the family until auctioned in the mid 1950's. Wybellena was largely a seaside residence for the Berthon family who moved in permanently in 1880.

Until about 1890 there were approximately a dozen families in the district. Mr and Mrs Alfred Blake had a small hotel on the river flat near the river. The Grand Hotel was destroyed by fire shortly after 1898. Esther Blake was the first (unofficial) postmistress appointed on the 1st April 1893.

Mr and Mrs James Hasty had a cottage which was used as a butcher's shop and later as a post office. James Hasty was the first official postmaster. The Victorian Post Office Directories of 1895-6 were the first to give an entry for Aireys Inlet. Hasty also had stables on the flat and ran a mail coach service into Swampy Creek (Anglesea). This met Cobb and Co. Coaches from Geelong which came in via Torquay and Jan Juc (Bellbrae).

In the early 1890's Mr and Mrs Thomas Lugg arrived at Aireys Inlet. Henry Lugg, the father of Thomas, had already settled there earlier. The couple's old farmhouse, now disused and rapidly deteriorating, still remains surrounded by the remnants of its garden on the Bambra Road.

The actual year of construction of the house is uncertain but was probably 1891. The Lugg family had an apple orchard. The 134 acre Lugg property was sold to Walter and Mary Hartley in 1942.

The Hartleys had moved to Airey's Inlet in 1919 and were granted 930 acres in August 1922. This property, 'The Glen', was originally cleared by John Sutherland whose homestead (The Nook) is still standing at Moggs Creek. In 1936 200 acres of 'The Glen' reverted to the Crown as permanent forest.

The first large scale land subdivision of land in the Parish of Angahook followed after J.R. Hopkins sold land in 1887. 56 allotments close to Eagle Rock and Pierce's Creek were auctioned in Geelong in December 1889. A further 47 allotments were auctioned in November 1890.

'Mountain House', which was used as guest house, was built in the 1890's by Jack Anderson. The property, surrounded by pines planted in 1907, has been a caravan park since 1955.

Shipwrecks had been numerous along the coastline of western Victoria for more than half a century when, in 1889, it was decided to build a lighthouse at Aireys Inlet. The Victorian Government Gazette states that on the 6th August 1890 notice was given to mariners that a lighthouse was being built at Eagle Nest Point (Aireys Inlet). On 3rd July 1891 notice was given to mariners that the lighthouse would operate from September 1st, 1891.

The Split Point Lighthouse dominates the coastline for many kilometres. It is a white masonry tower 110 feet high and the focal plane is 218 feet above high water. The light was originally kerosene operated but was converted to automatic acetylene working in 1919. Previously the light was tended by light keepers who resided in three associated dwellings built at the same time as the lighthouse.

After the departure of the light keepers, the Commonwealth Government having taken control of the lighthouse from the State Government in 1915, retained the cottages renting them at £4.4.0 per week during the holidays.

In 1935 the Government divided the lighthouse estate into 13 lots and sold these off to the public, the vacant lots fetching about £ 20 while those with houses went for several hundred pounds.

The furnishings went with the cottages and the cottages still contain the built-in fittings and other furnishings dating back to 1891.

The preceding account of the history of Aireys Inlet is limited, particularly in the description of events since 1890's. Appendix 4A is a list of key dates since 1900 not included in the main body of the account.

REFERENCES FOR FURTHER READING:

Before the White Man

1. 'The Life of William Buckley' by John Morgan. This book includes many early reflections on the Otway aborigines.

2. 'The Aboriginals of the Otway Area' by N.H. Scarlett from 'The Otway Region Symposium', Royal Society of Victoria Proceedings, 28 July 1977, Vol. 89.

Since the White Man

1. C. Smyth *et al.* 'A Coastal Retreat', 1977. Published by the Victorian Public Interest Research Group.

For a more complete account of the history of Aireys Inlet and district see text by I.F. McLaren not yet published.

ACKNOWLEDGEMENTS

Thanks are given to Mrs R. Landell and I.F. McLaren for helping to compile the information contained in this historical account of Aireys Inlet.

PLANNING

The planning authority for the area is the Geelong Regional Planning Commission. The scheme is administered by the Barrabool Shire Council.

The planning scheme currently in force is only an Interim Development Order (I.D.O.). This is shown in Appendix 5A for the study area. A number of amendments have been made to the I.D.O. by the Council through the Geelong Planning Commission and a new scheme was approved by that body on 25/5/78. The scheme has been submitted to the Town and Country Planning Board for ministerial approval prior to gazettal. The gazetted scheme can be expected to come into full operation later in 1979. An annotated plan extract of the proposed planning scheme is given in Appendix 5B. Aireys Inlet is seen as a tranquil area of natural beauty and the study group considers that fundamentally, the peaceful and tranquil atmosphere should be protected to provide an alternative to suburban living and a quiet haven for retirement.

Highly developed urban facilities are not seen as essential for a small quiet coastal town and the introduction of these facilities would have a marked impact on the town's character. It would change from a bushland resort to a dormitory suburb for the city of Geelong.

Land is not a scarce commodity at Aireys Inlet and a slow controlled growth is seen as more desirable than intensive high population suburban density subdivision development.

Five points of prime importance in the preservation of the appearance and character of the area are:

- The open river flats of the Painkalac Creek
- The preservation of the coastal dune and estuarine environment
- The conservation of the native tree cover on the slopes above the Painkalac Creek
- Reasonable constraints on construction, colour and siting of houses
- The logical future requirement for a sewerage system.

Provided water connection is required prior to building approval a working limit on the number of new houses built over the next ten years would be the capacity of the new water reticulation scheme or any sewerage related restrictions. These restrictions would come from a further definitive study on the effluent carrying and absorption capacity of the clayey soils of the area. A sewerage scheme and treatment plant would be an expense to residents but is the natural planning progression for preservation of the environment of the Painkalac estuary.

The Ocean Road presents a major hazard in the bisection of the town, the construction of a bypass road would be very expensive and although desirable does not appear feasible from a practical economic point of view. The present commercial area on the Painkalac Creek flats is not ideally located as it necessitates beach users crossing the Ocean Road to go to the shops. However a relocation of the commercial zone appears unwarranted as long as adequate and safe parking can be planned by limiting the access from the main highway in the vicinity of the shops.

The Interim Planning Development Order (I.D.O.) is for the most part supported as it is. It categorises the urban block near the lighthouse as an Area of Special Significance. The Wybellena Drive Estate is classified as a Preservation Order Area.

The areas above Wybellenna Estate on the Bimbadeen Drive are classified 'Rural Landscape' and importantly the river flats on the eastern side of the Painkalac Creek are classified the same. At face value this would leave open the way for subdivisions of 8 ha. or greater sized allotments. However as this existing I.D.O. is now rather dated and soon to be replaced by the new Geelong Regional Planning Scheme further detailed comment is not considered important.

The Proposed Planning Scheme (Appendix 5 B) is described in detail in by-laws and ordenances. It carries some amendments and changes from the existing I.D.O. and selected extracts are included in Appendix 5B.

Most notable of these changes is the reclassification of the Painkalac River flats. On the eastern side of the creek some 10 ha. of the area subject to inundation has been rezoned as Rural Floodland. The subdivision limit for this zoning is one allotment for each 60 ha., which means it cannot be further subdivided. The remaining area remains

as Rural Landscape (subdivision limit: 1 allotment for each 8 ha.) and could potentially be subdivided into two residential blocks.

A significant change has occurred on the western side of the creek with most of the area being rezoned from floodland to rural landscape (subdivision limit: 1 allotment for each 8 ha.) clearing the avenue for potential 8 ha. development along Bimbadeen Road from a zoning point of view.

Both these reclassifications are considered a step towards rationalising the zoning along the Painkalac but neither seem to completely zone the floodplain land which is subject to occasionally flooding. Further studies of the demarcation and survey of this line is recommended. The rezoning on the eastern side, whilst it would open the way for only two residential blocks is not in the best aesthetic interests of the local environment and further rezoning of the whole river flats to Rural-General Farming or Rural-Conservation to ensure no residential development of the flats is recommended.

On the western side of the Painkalac Creek it is considered that the top three allotments between the Bimbadeen Drive and the Painkalac Creek should be held pending the delineation of the inundation line as private residential development here would alter the present rural landscape albeit in a minor way unless it was very carefully controlled.

The flora and fauna reserve to the east of Distillery Creek is still zoned Rural (Conservation). It is recommended that this be added to the Angahook Forest Park under the management responsibility of the Forests Commission. (See Location 26 on Appendix 2)

Allotment 19E and the eastern part of allotment 19 contains a swamp which is of considerable significance for the conservation of birdlife. This should be repurchased by the State and reclassified as Public Open Space Reserve for fauna and flora or added to the Angahook Forest Park.

Rezoning has taken place in allotment 22 (above Fairhaven Development) with the addition of a Reserved Residential Area and a Residential Category C Area. There is an increase of land rezoned to State Forest from rural conservation zoning (1 allotment for each 60 ha). This is the individual application of a general policy of allowing limited subdivision on the allotment 22 area (15 - 20%) with the remainder reverting to the Angahook Forest Park (see Appendix 3 C for report by E.S.A., 1973). This is an

excellent policy for the area but the other allotment 22 areas should not be subdivided in any circumstances. Another reclassification has established a special reserve for the channel of the Painkalac Creek in allotment 19, 15 metres wide in the upper area and 20 metres wide lower down. An anomaly here is apparent where the creek principally flows underground through marshy land. There is no reservation, not even for the defined but subsidiary channel to the north-east of the marshland.

REFERENCES

ANON, 1978 : The Geelong Regional Planning Scheme, Report of The Geelong Regional Commission.

ANON, 1979 : The Geelong Regional Interim Development Order, Report of the Geelong Regional Commission.

ANON, 1979 : The Barway Coastal Study. Report prepared for the Coastal Management and Co-ordination Committee, Victorian Department of Crown Lands and Survey.

ENVIRONMENT STUDIES ASSOCIATION OF VICTORIA, 1973 : Study Week-end on Land Use and Town Planning in the Aireys Inlet District October 12-14 1973. (Unpublished) Reports prepared in conjunction with Aireys Inlet and District Association, see Appendix 3D.

WATER RETICULATION SCHEME

By mid-1979 a small dam will have been constructed on the Painkalac Creek by the Aireys Inlet Water Trust (for location see Appendix 2B). Yule (1978) says that the dam will have a capacity of 410 megalitres and by 1990 will serve an estimated 700 houses in the Aireys Inlet - Fairhaven area with an annual water consumption of 290 megalitres. During winter after the initial loss of rainfall runoff, due to soakage in the catchment, heavy rainfall causes a high stream discharge which will fill the dam in one day. Yule (1978) says that on 29th October, 1978 the discharge of Painkalac Creek at the damsite was 567 megalitres. This amount of water would fill the empty reservoir in less than one day. Appendix 6A shows the maximum monthly creek flows for the years 1974 - 1978. From the flow figures it can be seen that there is a marked difference in winter and summer flow. During winter the creek may flood while in summer the creek flow can be very small.

Noble (1979 pers. comm.) says that during summer the Aireys Inlet Water Trust will not harvest any water flowing into the dam and may also release some of the dam's water just prior to summer to flush the water in the lower reaches of the creek and estuary. These continual water releases will help to decrease too high concentrations of salt, pollutants and bacteria in the lower reaches. It is undesirable to allow the flood plain and estuary waters to stagnate too long during summer when the population and hence pollution increases. Hopefully as much water as possible will be periodically released from the dam to allow continual flushing. If these standards are adhered to the dam will have very little influence on the streamflow of Painkalac Creek.

The quality of water in Painkalac Creek is quite acceptable for human consumption although it is a little turbid which increases in winter with more sediments held in suspension (Yule, 1978). Appendix 6B show some analyses of water samples taken above and below the dam during February (summer), May (autumn) and August (winter) during 1978. An increased winter stream flow is reflected by the decreased

concentrations of inorganic and alkaline ions. Because the catchment area is near the coast some air-borne salt is dissolved in the rainfall and contributes to the stream's salinity. In summer low rainfall and high evaporation increases the salinity of the stream especially in the shallow regions of the flood plain and estuary. Sea water entering the estuary also contributes to high salt contents. The saline waters reach up to the pasture lands of the flood plain, and when flooding occurs, can kill the pasture grasses.

The upper catchment area is forested with eucalypts that drop their leaves and are washed into the stream. These leaves are a major food source for micro-invertebrates, which in turn are a food source for eels and small native trout that live in the Painkalac Creek (Yule, pers. comm.). The dam will restrict the flow of leaves down the stream and hence will decrease the downstream food supply. This may cause a marked decrease in food for streamlife downstream but is considered unlikely as the stream receives debris from other trees below the dam.

It is not known whether the creek contains any fish that migrate downstream to the estuary to spawn. If this type of fish occurs the dam will probably stop their movements upstream and downstream.

If native fish, such as grayling, were introduced to the dam it might prove an ideal breeding ground. Further studies would be needed to investigate this possibility and its effects on the water quality.

There is very little algae and weed growth in the upper catchment due to the turbid and tannin stained water blocking light necessary for plant photosynthesis. In the lower flood plain weed and algae are increasing due to increases in concentrations of plant nutrients. These nutrients (e.g. nitrogen compounds) come from animal (mainly cattle and human) wastes and fertilizers that flow from the surrounds into the water. A comparison of Rose's 1930 photograph of the lagoon at the Noble sanctuary and a modern photograph (photograph 7, Appendix 7) show the incredible increase in weed growth due to pollutants flowing into the lagoon and feeding the plants. This sort of plant growth would normally have occurred

in the waters of the flood plain but the high salt content from the sea-water has slowed the growth. Animal overstocking of the flood plain pastures and poor sewage disposal in the surrounding areas will cause an increase in weed growth and increase bacterial activity.

At present the Aireys Inlet Water Trust measures *E. coli* concentrations several times per year at different locations on the lower reaches of the Painkalac Creek flood plain. *E. coli* concentrations are indicative of the amount of animal pollutants added to the stream. Waste water from the Wybellena Drive housing flows into the stream in the lower flood plain and is likely to contain significant levels of pollutants. To ascertain the concentrations of these pollutants, and to help understanding of how to rectify any severe pollution from Wybellena Drive, water analyses should be done on the Wybellena stream just above its junction with the Painkalac Creek estuary. The concentrations of the pollutants in the stream will probably rise during summer when more water will be used by the holiday populations.

Prior to the building of the dam water in each household was restricted to bore and tank rain water. With the dam and "unlimited" supplies of water the population will use more water than in the past. More water will be used for washing, sewage disposal and gardens. As the sewage wastes increase, the clayey and sandy soils of the area will not contain the waste liquids which will flow through the soils and run into Painkalac Creek causing contamination. The geology of much of the suburban area shows alternating strata of sands and clays. With increasing addition of liquids to the strata the clay-sand interfaces will be lubricated causing minor landslides on road cuttings and other steep slopes. Appendix 2C shows the soil characteristics as unsuitable for septic effluent.

Future disposal of the increasing amounts of sewage is the biggest problem facing the Painkalac Creek environment. If the flood plain and estuary waters become polluted due to inflowing sewage from septic tanks the Aireys Inlet environment will be ruined and the area will become a health hazard. Further studies will have to be done as soon as possible to examine the feasibility of different sewage disposal

methods. The study group would also need to examine the housing areas requiring alternative sewage disposal, the methods of introducing the new scheme with as little possible disruption to the environment and, most importantly, the costs involved.

In general the dam will have very little influence on stream flow or water quality if water is released to keep the stream flowing as much as possible. The major problem will come with more housing development and increased water usage which will cause increased sewage that, unless controlled by an alternative sewage scheme, will flow into the stream.

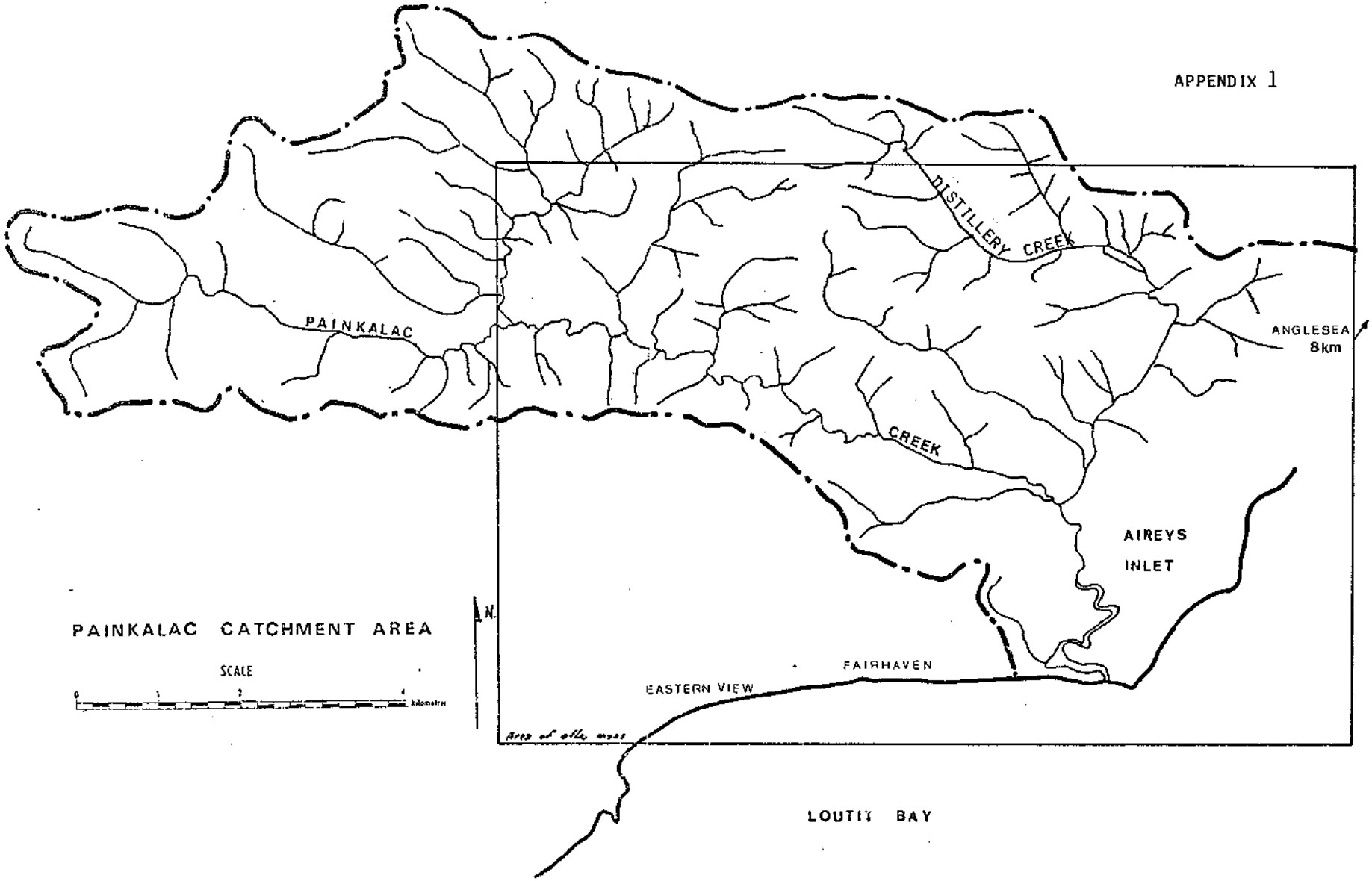
REFERENCES

ROSE, C., 1930 - Photographs of Aireys Inlet. Archives, State Library

YULE, C.M. 1978 - Fauna-substrate Relationships in a Victorian Coastal Stream with Consideration of the Impact of Dam Construction. Unpublished 1978 Honours Thesis, Zoology Department, Monash University.

LIST OF APPENDICES

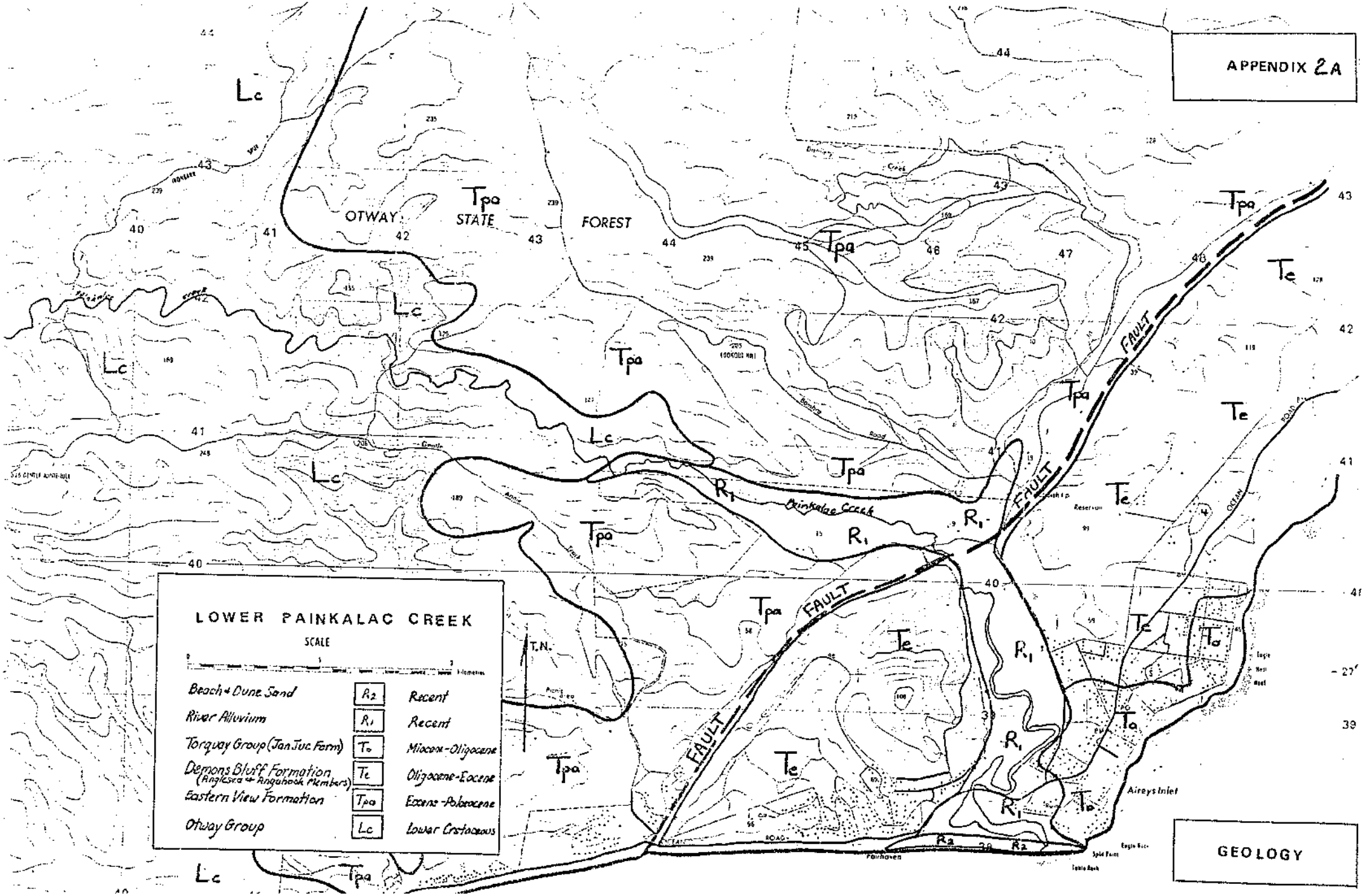
APPENDIX 1

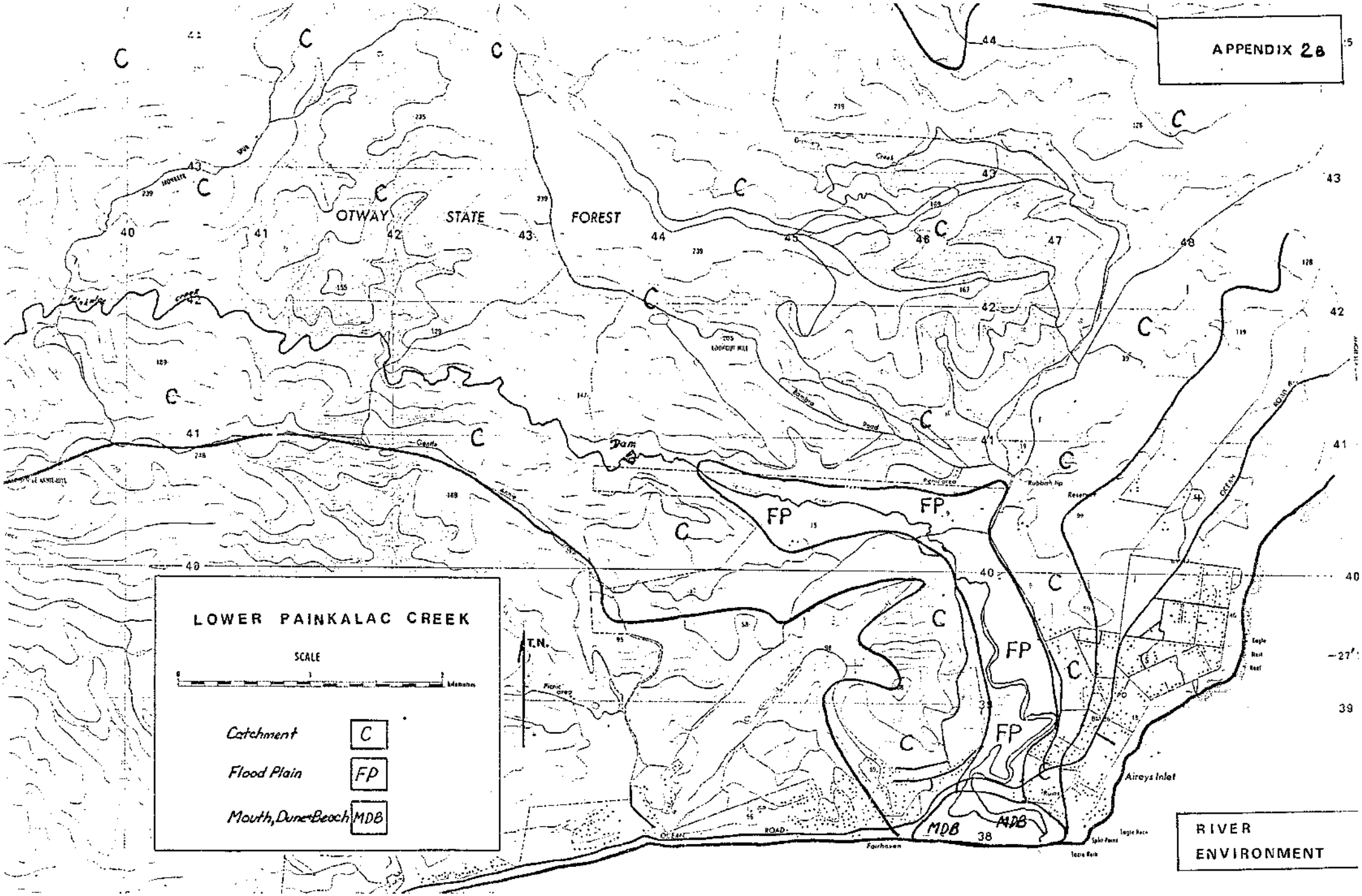


PAINKALAC CATCHMENT AREA

SCALE

0 1 2 4 kilometres


APPENDIX 2A
LOWER PAINKALAC CREEK
SCALE
Beach + Dune Sand
R2
Recent
River Alluvium
R1
Recent
Torquay Group (Jan Juc Form)
To
Miocene-Oligocene
Demons Bluff Formation (Anglesea + Anglebook Members)
Te
Oligocene-Eocene
Eastern View Formation
Tpa
Eocene-Paleocene
Otway Group
Lc
Lower Cretaceous
OTWAY STATE FOREST
FAULT
Painkalac Creek
Airey's Inlet
Fairhaven
GEOLOGY


APPENDIX 2B
OTWAY STATE FOREST
LOWER PAINKALAC CREEK
SCALE
Catchment C
Flood Plain FP
Mouth, Dune Beach MDB
T.N.
Aireys Inlet
RIVER ENVIRONMENT

APPENDIX 2c

THE LAND SYSTEMS AND LAND COMPONENTS

The land systems delineated and described in this study have been prepared from the report: "A Study of the Land in the Catchments of the Otways and Surrounding Plains" (Soil Conservation Authority, unpublished). Each land system table describes the land for the complete land system as delineated in this report, and not just that part which occurs within the Painkalac Creek study area. Thus, several land systems include name components which do not occur within the present study areas. Also some of the vegetative specimens listed for each component may only occur further inland away from the coast (such as E. leocoxylon). The areas of the land systems and the proportions of components within each land system do however refer specifically to the present study areas.

Explanation of terms and parameters in land system descriptions:

1. Rainfall figures include the range of average annual rainfalls within the land system and the average monthly rainfall for driest and wettest months of the year, the months being listed in brackets.

2. Temperature figures listed are all mean daily temperatures, that is the midpoint between the recorded maximum and recorded minimum temperature. The annual average of these means is listed together with the average monthly means for the coldest (July) and hottest (February) months of the year.

3. Climatic limitations to plant growth have been listed. During winter, growth restrictions are due to low temperatures. Trumble (1939) chose an average monthly temperature less than 10°C as the criterion for only moderate pasture growth, with temperatures below 5°C as the criterion for little or no growth. During summer, growth restrictions are usually due to available soil moisture. After potential evapotranspiration passes above incident precipitation, the soil starts to dry seasonally.

Sandy soils have low available water capacities and may dry out beyond wilting point within a matter of days, while well structured loams with high levels of organic matter may still possess soil moisture between field capacity and wilting point two months later.

4. Elevation of the land system lists the highest and lowest points of the land system above sea level.

5. Local relief is the average change in elevation from the drainage lines to the crests of hills.

6. The structure of the native vegetation has been classified according to Specht's classification system (1972) (See Appendix A).

7. Permeability of the soils has been estimated according to a 5 classed system. It refers to the vertical hydraulic conductivity of the solum and is limited by the most impermeable soil horizon. Very high permeabilities are typical of sands which are excessively drained and retain little moisture, while very low permeabilities are typical of soils with non porous heavy clays where water ponds for long periods following rain. However, these permeabilities refer only to soil properties, as distinct from site drainage which is a function of the position in the landscape.

8. Soil depth has been listed as the depth to unweathered rock or the depth to a cemented layer that severely restricts root penetration and water movement.

9. All existing land uses are listed. Active recreation refers to activities such as trail bike riding, four wheel drive vehicles and dune buggies. Passive recreation refers to pursuits such as picnicking, camping and bush walking.

	COMPONENT	1	2	3	4	5	6	7
	PROPORTION %	20	5	10	25	25	5	10
CLIMATE	RAINFALL (mm)	ANNUAL: 600–800						
	TEMPERATURE °C	MONTHLY RANGE: 35° (JAN) – 8° (AUG) ANNUAL: 14° MONTHLY RANGE: 9° – 17°						
	SEASONAL GROWTH FACTORS	PERIOD WHEN AVERAGE MONTHLY TEMPERATURE < 10°C : JULY PERIOD WHEN PRECIPITATION < POTENTIAL EVAPOTRANSPIRATION: MID OCTOBER — EARLY APRIL						
GEOLOGY	AGE LITHOLOGY	Highly variable sediments of Eocene age consisting mainly of unconsolidated clayey silts, sands, gravels, tuffs, tuff breccia, groundwater ironstone and sandstone						
TOPOGRAPHY	LANDSCAPE	Moderately dissected hills lying below and on the seaward side of the lateritic plateaux						
	ELEVATION m	0-195						
	LOCAL RELIEF m	50						
	DRAINAGE PATTERN	Rectangular						
	DRAINAGE DENSITY km/km²	1.6						
	LANDFORM	Hill						Land slip
	POSITION	Exposed slopes under strong coastal influence	Slopes, crests	Lower slopes, drainage lines	Middle slopes	Upper slopes, crests	Steep slopes	
	SLOPE (RANGE) %	20(5-45)	9(5-5)	8(1-15)	15(5-35)	10(1-20)	45(25-55)	5→?
	SLOPE SHAPE	Linear/Irregular	Linear	Concave	Convex	Convex	Linear	Irregular
NATIVE VEGETATION	STRUCTURE	Open scrub	Woodland	Open forest	Open forest	Open forest	Open forest	(Variable—mainly low woodlands).
	DOMINANT STRATUM SPECIES	E. obliqua Casuarina stricta E. sideroxylon	E. viminalis E. radiata E. baxteri	E. sideroxylon E. obliqua	E. sideroxylon E. obliqua	E. obliqua E. sideroxylon E. baxteri	E. obliqua E. baxteri E. sideroxylon	E. sideroxylon E. obliqua Melaleuca lanceolata Casuarina stricta
SOIL	PARENT MATERIAL	Calcareous sand, unconsolidated clay, silt, sand and gravel	Unconsolidated sands and gravels	Unconsolidated clay, silt and sand	Unconsolidated clay, silt and sand, sandstone	Deeply weathered clays, silts and sands	Lateritic ironstone, sandstone	Unconsolidated clays, silts and sands. Some aeolian sand.
	GROUP	(Variable sodic duplex soils)	Grey sand soils, Uniform texture	Yellow-brown sodic duplex soils, coarse structure	Yellow-brown duplex soils, coarse structure	Mottled yellow and red duplex soils	Stony red ational soils	(Variable sodic duplex soils)
	SURFACE TEXTURE	Sandy loam	Loamy sand	Fine sandy loam	Fine sandy loam	Sandy loam	Sandy loam	Sandy loam
	PERMEABILITY	Moderate	Very high	Very low	Very low	Moderate	Very high	Moderate
	DEPTH	> 2	> 2	> 2	>2 (0.7 on sandstone)	> 2	0.2	>2
	LAND USE	UNCLEARED AREAS: Nature conservation, active and passive recreation, landscape conservation, gravel extraction, environmental education. CLEARED AREAS: Beef cattle grazing on mainly unimproved pastures, residential subdivision, recreational facilities.						
SOIL DETERIORATION	CRITICAL LAND FEATURES, PROCESSES, FORMS.	Native vegetation is sensitive to salt pruning and disturbance. Highly dispersible soils on steep slopes are prone to sheet erosion, gully erosion and tunnel erosion.	Low inherent fertility and high permeability leads to nutrient decline. Weak structured surface soils with low water holding capacity are prone to sheet erosion	Sodic, highly dispersible subsoils are prone to gully and tunnel erosion	Sodic, highly dispersible soils are prone to gully and tunnel erosion. Weak structured surface soils over slowly permeable subsoils on steep slopes are prone to sheet erosion	Low inherent fertility (including strong adsorption of phosphorous) and leaching of permeable A horizons leads to nutrient decline	Stony shallow soils with low organic content weak structure and low water holding capacity on steep slopes are prone to sheet erosion	Native vegetation is sensitive to salt pruning and disturbance. Marine erosion of highly dispersible soils maintains active landslips and earthflows.

ACTIVITY / LAND FEATURE	Car Parks & Roads	Intensive use areas	Camp Sites	Paths & Trails	Building Foundations	Septic Effluent Absorption fields	Playing Fields	Earthen Dams	Source of Road Fill	Source of Topsoil	Source of Sand
SLOPE	4	4	3	3	C: 3	3	4	3	4	3	3
FLOODING	0	0	0	0	0	0	0	0	0	0	0
SITE DRAINAGE	0	0	0	0	0	0	0		1	0	0
DEPTH TO WATER-TABLE	0				0	0		0		0	0
PERMEABILITY			0			0		2			
UNIFIED SOIL GROUP	3				A: 3 B: 1			2	3		2
GRAVEL (Fragments .2 to 7.5cm)		0	0			0	0			0	0
STONES (Fragments 7.5 to 25cm)	0	0	0	0	0	0	0	0	0	0	0
BOULDERS (Fragments) 25cm	0	0	0	0	0	0	0	0	0	0	0
OUTCROP	0	0	0	0	0	0	0	0	0	0	0
DEPTH TO ROCK	0	0	0		0	0	0	0	0		3
SHRINK-SWELL	2				A: 2 B: 1			2			
DISPERSIBLE CLAYS	2	2	2	2	2	2	2	2	2	2	
A HORIZON TEXTURE		0	1	1			0			0	
A. HORIZON DEPTH								1	3	2	0
ORGANIC MATTER									0	1	2
pH										2	
SOLUBLE SALTS										0	
LAND SLIPS	3	3	2	2	3	3	3	3	4	4	4

ACTIVITY / LAND FEATURE	Car Parks & Roads	Intensive use areas	Camp Sites	Paths & Trails	Building Foundations	Septic Effluent Absorption fields	Playing Fields	Earthen Dams	Source of Road Fill	Source of Topsoil	Source of Sand
SLOPE	2	1	1	1	A:1 B:2	1	2	2	1	1	1
FLOODING	4	4	4	2	4	4	3	3	4	4	4
SITE DRAINAGE	2	3	3	2	2	2	2		3	2	2
DEPTH TO WATER-TABLE	4				3	4		1		3	3
PERMEABILITY			0			0		1			
UNIFIED SOIL GROUP	3				A:3 B:1			2	3		4
GRAVEL (Fragments .2 to 7.5cm)		0	0			0	0			0	0
STONES (Fragments 7.5 to 25cm)	0	0	0	0	0	0	0	0	0	0	0
BOULDERS (Fragments) 25cm	0	0	0	0	0	0	0	0	0	0	0
OUTCROP	0	0	0	0	0	0	0	0	0	0	0
DEPTH TO ROCK	0	0	0		0	0	0	0	0		4
SHRINK-SWELL	2				A:2 B:1			2			
DISPERSIBLE CLAYS	1	1	1	1	1	1	1	1	1	1	
A HORIZON TEXTURE		0	0	0			0			0	
A. HORIZON DEPTH								1	3	3	0
ORGANIC MATTER									2	2	2
pH										1	
SOLUBLE SALTS										0	
LAND SLIPS	0	0	0	0	0	0	0	0	0	0	0

MAP UNIT: Ag4

ACTIVITY / LAND FEATURE	Car Parks & Roads	Intensive use areas	Camp Sites	Paths & Trails	Building Foundations	Septic Effluent Absorption fields	Playing Fields	Earthen Dams	Source of Road Fill	Source of Topsoil	Source of Sand
SLOPE	3	2	2	2	A:3 B:2 C:1	2	3	3	2	2	2
FLOODING	0	0	0	0	0	0	0	0	0	0	0
SITE DRAINAGE	1	2	2	1	1	1	1		2	1	1
DEPTH TO WATER-TABLE	0				0	0		0		0	0
PERMEABILITY			0			0		1			
UNIFIED SOIL GROUP	3				A:3 B:1			2	3		2
GRAVEL (Fragments .2 to 7.5cm)		0	0			0	0			0	0
STONES (Fragments 7.5 to 25cm)	0	0	0	0	0	0	0	0	0	0	0
BOULDERS (Fragments) 25cm	0	0	0	0	0	0	0	0	0	0	0
OUTCROP	0	0	0	0	0	0	0	0	0	0	0
DEPTH TO ROCK	0	0	0		0	0	0	1	1		3
SHRINK-SWELL	2				A:2 B:1			2			
DISPERSIBLE CLAYS	1	1	1	1	1	1	1	1	1	1	
A HORIZON TEXTURE		0	1	0			0			0	
A. HORIZON DEPTH								1	3	3	0
ORGANIC MATTER									0	3	1
pH										2	
SOLUBLE SALTS										0	
LAND SLIPS	2	2	1	1	2	1	2	1	3	3	3

MAP UNIT: Ag7

ACTIVITY / LAND FEATURE	Car Parks & Roads	Intensive use areas	Camp Sites	Paths & Trails	Building Foundations	Septic Effluent Absorption fields	Playing Fields	Earthen Dams	Source of Road Fill	Source of Topsoil	Source of Sand
SLOPE	4	4	4	4	A:4 B:4 C:3	4	4	4	4	4	4
FLOODING	0	0	0	0	0	0	0	0	0	0	0
SITE DRAINAGE	2	3	3	2	2	2	2		3	2	2
DEPTH TO WATER-TABLE	0				0	1		0		1	1
PERMEABILITY			N/A			N/A		N/A			
UNIFIED SOIL GROUP	3				2			2	3		4
GRAVEL (Fragments .2 to 7.5cm)		0	0			0	0			0	0
STONES (Fragments 7.5 to 25cm)	0	0	0	0	0	0	0	0	0	0	0
BOULDERS (Fragments) 25cm	0	0	0	0	0	0	0	0	0	0	0
OUTCROP	0	0	0	0	0	0	0	0	0	0	0
DEPTH TO ROCK	0	0	0		0	0	0	0	0		0
SHRINK-SWELL	2				A:2 B:1			2			
DISPERSIBLE CLAYS	2	2	2	2	2	2	2	2	2	2	
A HORIZON TEXTURE		0	1	1			0			0	
A. HORIZON DEPTH								2	0	4	0
ORGANIC MATTER									0	3	0
pH										0	
SOLUBLE SALTS										2	
LAND SLIPS	4	4	4	4	4	4	4	4	4	4	4

BELLBRAE LAND SYSTEM

	COMPONENT	1	2	3	4
	PROPORTION %	10	60	20	10
CLIMATE	RAINFALL (mm)	ANNUAL: 600 – 650 MONTHLY RANGE: 30 (JAN) — 65 (AUG)			
	TEMPERATURE °C	ANNUAL: 14° MONTHLY RANGE: 10° – 18°			
	SEASONAL GROWTH FACTORS	PERIOD WHEN AVERAGE MONTHLY TEMPERATURE < 10°C : JULY PERIOD WHEN PRECIPITATION < POTENTIAL EVAPOTRANSPIRATION : EARLY OCTOBER — EARLY APRIL			
GEOLOGY	AGE LITHOLOGY	Limestone, marl and calcareous clayey silt of Miocene age			
TOPOGRAPHY	LANDSCAPE	Rolling hills dissected out below the Gherang Gherang plateau			
	ELEVATION m	5 – 75			
	LOCAL RELIEF m	60			
	DRAINAGE PATTERN	Dendritic			
	DRAINAGE DENSITY km/km²	3.0			
	LANDFORM	Hill			
	POSITION	Upper slopes	Middle slopes	Steeper slopes	Lower slopes, drainage lines
	AVERAGE SLOPE (RANGE) %	5 (3–9)	11 (5–14)	15 (7–20)	7 (1–9)
	SLOPE SHAPE	Linear	Linear	Convex	Concave
NATIVE VEGETATION	STRATUM	Open forest	Open forest	Open forest	Open forest
	DOMINANT STRATUM SPECIES	E. viminalis E. sideroxylon E. obliqua	E. leucoxylon E. sideroxylon E. viminalis Occasional Melaleuca lanceolata	E. viminalis E. ovata Acacia melanoxylon	E. viminalis E. sideroxylon E. leucoxylon E. ovata
SOIL	PARENT MATERIAL	Truncated lateritic profile remnants	Marls, calcareous clays and deeply weathered limestone	Limestone	Colluvial limestone, clays, lateritic material
	GROUP	Brown duplex soils, coarse structure	Yellow-brown calcareous sodic duplex soils, coarse structure	Red calcareous gradational soils	Yellow sodic duplex soils
	SURFACE TEXTURE	Fine sandy loam	Fine sandy loam	Fine sandy clay loam	Loamy sand
	PERMEABILITY	Low	Moderate	High	Moderate
	DEPTH m	> 2	> 2	0.7	> 2
	LAND USE	CLEARED AREAS: Dairy farming, beef cattle grazing, residential subdivision, cropping MINOR UNCLEARED AREAS: Forest grazing, active and passive recreation, hardwood forestry for fuel, posts and poles			
SOIL DETERIORATION	CRITICAL LAND FEATURES, PROCESSES, FORMS	Sodic, dispersible subsoils are prone to gully erosion and slumping and rilling.	Highly dispersible subsoils are prone to gully erosion and slumping.		Highly dispersible subsoils are prone to gully and tunnel erosion.

MAP UNIT: Bb3

ACTIVITY / LAND FEATURE	Car Parks & Roads	Intensive use areas	Camp Sites	Paths & Trails	Building Foundations	Septic Effluent Absorption fields	Playing Fields	Earthen Dams	Source of Road Fill	Source of Topsoil	Source of Sand
SLOPE	3	2	2	2	[illegible]	2	3	3	2	2	2
FLOODING	0	0	0	0	0	0	0	0	0	0	0
SITE DRAINAGE	0	0	0	0	0	0	0		1	0	0
DEPTH TO WATER-TABLE	0				0	0		0		0	0
PERMEABILITY			2			0		4			
UNIFIED SOIL GROUP	2				A:2 B:1			1	3		4
GRAVEL (Fragments .2 to 7.5cm)		0	0			0	0			0	0
STONES (Fragments 7.5 to 25cm)	0	0	0	0	0	0	0	0	0	0	0
BOULDERS (Fragments) 25cm	0	0	0	0	0	0	0	0	0	0	0
OUTCROP	0	0	0	0	0	0	0	0	0	0	0
DEPTH TO ROCK	2	3	3		2	4	3	4	4		4
SHRINK-SWELL	1				A:1 B:0			1			
DISPERSIBLE CLAYS	0	0	0	0	0	0	0	0	0	0	
A HORIZON TEXTURE		0	1	1			0			0	
A. HORIZON DEPTH								1	4	4	0
ORGANIC MATTER									0	1	2
pH										2	
SOLUBLE SALTS										0	
LAND SLIPS	0	0	0	0	0	0	0	0	0	0	0

	COMPONENT	1	2	3	4	5
	PROPORTION	25	25	8	7	35
CLIMATE	RAINFALL mm	ANNUAL: 625 MONTHLY RANGE: 30 (JAN) - 60 (AUG)				
	TEMPERATURE °C	ANNUAL: 14° MONTHLY RANGE: 10° - 18°				
	SEASONAL GROWTH FACTORS	PERIOD WHEN AVERAGE MONTHLY TEMPERATURE < 10°C: JULY PERIOD WHEN PRECIPITATION < POTENTIAL EVAPOTRANSPIRATION: OCTOBER — EARLY APRIL				
GEOLOGY	AGE LITHOLOGY	Estuarine sand, silt, clay and plant remains of Recent age.				Thin veneers of aeolian sand
TOPOGRAPHY	LANDSCAPE	Flat estuarine lowlands with braided channels				
	ELEVATION m	0-4				
	LOCAL RELIEF m	1				
	DRAINAGE PATTERN	Dermoid				
	DRAINAGE DENSITY km/km²	Not applicable				
	LANDFORM	Marine terrace	Swamp			
	POSITION		Upper surfaces	Lower surfaces	Free water surfaces	Areas adjacent to sand dunes
	AVERAGE SLOPE(RANGE) %	1(0-2)	0(0-1)	0	0	1(0-2)
	SLOPE SHAPE	Convex	Linear	Linear	Not applicable	Irregular
NATIVE VEGETATION	STRUCTURE	(Ungertain-cleared)	Low shrubland	Closed grassland	Not Applicable	Sedgeland
	DOMINANT STRATUM SPECIES		Arthrocnemum arbusculum	Frankenia pauciflora Samolus repens Arthrocnemum arbusculum		Scirpus nodosus
SOIL	PARENT MATERIAL	Estuarine clay, silt and sand	Estuarine clay, silt and plant remains	Estuarine clay, silt and plant remains	Estuarine clay, silt and plant remains	Aeolian sand, shell grit over estuarine clay, silt and plant remains
	GROUP	Yellow sodic duplex soils	Saline soils	Saline soils	Saline soils	Grey sand soil, weak structured clay underlay
	SURFACE TEXTURE	Sandy loam	Silty clay loam	Silty clay	Silty clay	Sandy loam
	PERMEABILITY	Moderate	Very low	Very low	Very low	Low
	DEPTH	> 2	> 2	> 2	> 2	> 2
LAND USE		CLEARED AREAS: Some of the higher areas cleared for grazing, cropping and recreational facilities. UNCLEARED AREAS: Nature conservation. Refuse disposal				
SOIL DETERIORATION	CRITICAL LAND FEATURES, PROCESSES, FORMS	Sodic subsoils with high groundwater tables of high salinity are prone to soil salting, soil pugging and sheet erosion.	Occasional influx of estuarine saline water on clays of low mechanical strength leads to soil salting and soil pugging.	Regular influx of estuarine saline water on clays of low mechanical strength leads to soil salting and soil pugging.	Presence of saline water prevents most uses.	Sodic subsoils with low permeability and high groundwater tables of high salinity are prone to soil pugging and soil salting.

MAP UNIT: Cn1

ACTIVITY / LAND FEATURE	Car Parks & Roads	Intensive use areas	Camp Sites	Paths & Trails	Building Foundations	Septic Effluent Absorption fields	Playing Fields	Earthen Dams	Source of Road Fill	Source of Topsoil	Source of Sand
SLOPE	0	0	0	0	0	0	0	0	0	0	0
FLOODING	2	2	3	1	4	3	2	0	2	2	2
SITE DRAINAGE	2	3	3	2	2	2	2		3	2	2
DEPTH TO WATER-TABLE	0				0	1.		0		0	0
PERMEABILITY			0			0		2			
UNIFIED SOIL GROUP	3				3			2	3		0
GRAVEL (Fragments .2 to 7.5cm)		0	0			0	0			0	0
STONES (Fragments 7.5 to 25cm)	0	0	0	0	0	0	0	0	0	0	0
BOULDERS (Fragments) ≥ 25cm	0	0	0	0	0	0	0	0	0	0	0
OUTCROP	0	0	0	0	0	0	0	0	0	0	0
DEPTH TO ROCK	0	0	0		0	0	0	0	0		3
SHRINK-SWELL	2				A:2 B:1			2			
DISPERSIBLE CLAYS	0	0	0	0	0	0	0	0	0	0	
A HORIZON TEXTURE		0	1	1			0			0	
A. HORIZON DEPTH								1	3	3	0
ORGANIC MATTER									2	3	1
pH										1	
SOLUBLE SALTS										0	
LAND SLIPS	0	0	0	0	0	0	0	0	0	0	0

MAP UNIT: Cn2

ACTIVITY / LAND FEATURE	Car Parks & Roads	Intensive use areas	Camp Sites	Paths & Trails	Building Foundations	Septic Effluent Absorption fields	Playing Fields	Earthen Dams	Source of Road Fill	Source of Topsoil	Source of Sand
SLOPE	0	0	0	0	0	0	0	0	0	0	0
FLOODING	4	4	4	4	4	4	4	4	4	4	4
SITE DRAINAGE	4	4	4	4	4	4	4		4	4	4
DEPTH TO WATER-TABLE	4				3	4		1		4	4
PERMEABILITY			3			4		2			
UNIFIED SOIL GROUP	3				3			2	3		4
GRAVEL (Fragments .2 to 7.5cm)		0	0			0	0			0	0
STONES (Fragments 7.5 to 25cm)	0	0	0	0	0	0	0	0	0	0	0
BOULDERS (Fragments) 25cm	0	0	0	0	0	0	0	0	0	0	0
OUTCROP	0	0	0	0	0	0	0	0	0	0	0
DEPTH TO ROCK	0	0	0		0	0	0	0	0		4
SHRINK-SWELL	3				3			2			
DISPERSIBLE CLAYS	0	0	0	0	0	0	0	0	0	0	
A HORIZON TEXTURE		2	0	2			2			3	
A. HORIZON DEPTH								0	0	0	0
ORGANIC MATTER									3	2	2
pH										3	
SOLUBLE SALTS										4	
LAND SLIPS	0	0	0	0	0	0	0	0	0	0	0

MAP UNIT: Cn3

ACTIVITY / LAND FEATURE	Car Parks & Roads	Intensive use areas	Camp Sites	Paths & Trails	Building Foundations	Septic Effluent Absorption fields	Playing Fields	Earthen Dams	Source of Road Fill	Source of Topsoil	Source of Sand
SLOPE	0	0	0	0	0	0	0	0	0	0	0
FLOODING	4	4	4	4	4	4	4	4	4	4	4
SITE DRAINAGE	4	4	4	4	4	4	4		4	4	4
DEPTH TO WATER-TABLE	4				3	4		1		4	4
PERMEABILITY			3			4		2			
UNIFIED SOIL GROUP	3				3			2	3		4
GRAVEL (Fragments .2 to 7.5cm)		0	0			0	0			0	0
STONES (Fragments 7.5 to 25cm)	0	0	0	0	0	0	0	0	0	0	0
BOULDERS (Fragments) 25cm	0	0	0	0	0	0	0	0	0	0	0
OUTCROP	0	0	0	0	0	0	0	0	0	0	0
DEPTH TO ROCK	0	0	0		0	0	0	0	0		4
SHRINK-SWELL	3				3			2			
DISPERSIBLE CLAYS	0	0	0	0	0	0	0	0	0	0	
A HORIZON TEXTURE		2	0	2			2			3	
A. HORIZON DEPTH								0	0	0	0
ORGANIC MATTER									3	2	2
pH										3	
SOLUBLE SALTS										4	
LAND SLIPS	0	0	0	0	0	0	0	0	0	0	0

MAP UNIT: Cn4

ACTIVITY / LAND FEATURE	Car Parks & Roads	Intensive use areas	Camp Sites	Paths & Trails	Building Foundations	Septic Effluent Absorption fields	Playing Fields	Earthen Dams	Source of Road Fill	Source of Topsoil	Source of Sand
SLOPE	0	0	0	0	0	0	0	0	0	0	0
FLOODING	4	4	4	4	4	4	4	4	4	4	4
SITE DRAINAGE	4	4	4	4	4	4	4		4	4	4
DEPTH TO WATER-TABLE	4				3	4		1		4	4
PERMEABILITY			3			4		2			
UNIFIED SOIL GROUP	3				3			2	3		4
GRAVEL (Fragments .2 to 7.5cm)		0	0			0	0			0	0
STONES (Fragments 7.5 to 25cm)	0	0	0	0	0	0	0	0	0	0	0
BOULDERS (Fragments) 25cm	0	0	0	0	0	0	0	0	0	0	0
OUTCROP	0	0	0	0	0	0	0	0	0	0	0
DEPTH TO ROCK	0	0	0		0	0	0	0	0		4
SHRINK-SWELL	3				3			2			
DISPERSIBLE CLAYS	0	0	0	0	0	0	0	0	0	0	
A HORIZON TEXTURE		2	0	2			2			3	
A. HORIZON DEPTH								0	0	0	0
ORGANIC MATTER									3	2	2
pH										3	
SOLUBLE SALTS										4	
LAND SLIPS	0	0	0	0	0	0	0	0	0	0	0

MAP UNIT: Cn5

ACTIVITY / LAND FEATURE	Car Parks & Roads	Intensive use areas	Camp Sites	Paths & Trails	Building Foundations	Septic Effluent Absorption fields	Playing Fields	Earthen Dams	Source of Road Fill	Source of Topsoil	Source of Sand
SLOPE	0	0	0	0	0	0	0	0	0	0	0
FLOODING	2	2	3	1	4	3	2	0	3	2	2
SITE DRAINAGE	3	3	3	3	3	3	3		3	3	3
DEPTH TO WATER-TABLE	2				1	2		3		2	2
PERMEABILITY			2			2		0			
UNIFIED SOIL GROUP	3				3			2	3		2
GRAVEL (Fragments ,2 to 7.5cm)		0	0			0	0			0	0
STONES (Fragments 7.5 to 25cm)	0	0	0	0	0	0	0	0	0	0	0
BOULDERS (Fragments) > 25cm	0	0	0	0	0	0	0	0	0	0	0
OUTCROP	0	0	0	0	0	0	0	0	0	0	0
DEPTH TO ROCK	0	0	0		0	0	0	0	0		3
SHRINK-SWELL	3				3			3			
DISPERSIBLE CLAYS	0	0	0	0	0	0	0	0	0	0	
A HORIZON TEXTURE		0	1	1			0			0	
A. HORIZON DEPTH								1	4	1	0
ORGANIC MATTER									3	1	2
pH										2	
SOLUBLE SALTS										1	
LAND SLIPS	0	0	0	0	0	0	0	0	0	0	0

	COMPONENT	1	2	3	4	5
	PROPORTION %	20	50	25	2	3
CLIMATE	RAINFALL mm	ANNUAL: 600 - 750 MONTHLY RANGE: 30 (JAN) - 75 (AUG)				
	TEMPERATURE °	ANNUAL: 14° MONTHLY RANGE: 10° - 18°				
		PERIOD WHEN AVERAGE MONTHLY TEMPERATURE < 10°C : JULY PERIOD WHEN PRECIPITATION < POTENTIAL EVAPOTRANSPIRATION : MID OCTOBER — EARLY APRIL				
GEOLOGY	AGE LITHOLOGY	Aeolian sand and shell grit of Recent age			Cemented deposits (calcarenite and travertine).	
TOPOGRAPHY	LANDSCAPE	Longitudinal coastal dunes to the east of the Otway Ranges				
	ELEVATION m	0-25				
	LOCAL RELIEF m	15				
	DRAINAGE PATTERN	Not applicable - complete internal drainage				
	DRAINAGE DENSITY km/km²	Not applicable				
	LANDFORM POSITION	Foredune Windward exposed slopes	Shifting dunes Leeward and windward slopes	Older, more stable dunes Gentler slopes	Steeper slopes	Interdune corridor
	AVERAGE SLOPE (RANGE) %	40(10-65)	30(5-65)	9(0-20)	15(5-30)	3(0-7)
	SLOPE SHAPE	Irregular	Irregular	Convex	Linear	Concave
NATIVE VEGETATION	STRUCTURE	Tussock grassland	Open heath	Low woodland	Low woodland	Uncertain-possibly open heath
	DOMINANT STRATUM SPECIES	Spinifex hirsutus Tetragonia tetragonioides	Helichrysum paralium Leucopogon parviflorus	Melaleuca lanceolata Leptospermum laevigatum Leucopogon parviflorus	Melaleuca lanceolata Leucopogon parviflorus Acacia longifolia	Helichrysum paralium
SOIL	PARENT MATERIAL	Coarse sand, shell grit	Coarse sand, shell grit	Coarse sand, Shell grit	Calcarenite, coarse sand	Calcarenite, travertine
	GROUP	Yellow calcareous sand soils, uniform texture	Yellow calcareous sand soils, uniform texture	Brown calcareous sand soils, uniform texture	Stony black calcareous sand soils, uniform texture	Red calcareous gradational soils
	SURFACE TEXTURE	Coarse sand	Coarse sand	Loamy sand	Loamy sand	Sandy loam
	PERMEABILITY	Very high	Very high	Very high	Moderate	Very low
	AV. DEPTH m	>2	>2	>2	>2	0.3
	LAND USE	UNCLEARED AREAS: Passive and active recreation, foreshore access, nature conservation, sand extraction. MINOR CLEARED AREAS: Recreational facilities, refuse tip, foreshore access, residential subdivision				
SOIL DETERIORATION	CRITICAL LAND FEATURES, PROCESSES FORMS.	Cyclical marine erosion and accretion place these areas in a constant state of seasonal flux. Native vegetation is sensitive to trampling and disturbance. Weak structured sand soils with low water holding capacities are prone to wind erosion. Low inherent fertility and high permeability leads to nutrient decline.	Native vegetation is sensitive to trampling and disturbance. Weak structured sand soils with low water holding capacities are prone to wind erosion. Low inherent fertility and rapid leaching leads to nutrient decline	Weak structured sand soils with low water holding capacities are prone to wind erosion. Low inherent fertility, high alkalinity and rapid leaching lead to nutrient decline	Weak structured sand soils with restricted permeability and low water holding capacities on steep slopes are prone to sheet erosion. Low inherent fertility and high alkalinity lead to nutrient decline	Low permeability and weak structure lead to sheet erosion (very few areas remain which have not been eroded back to calcarenite pavement).

MAP UNIT: Pr1

ACTIVITY / LAND FEATURE	Car Parks & Roads	Intensive use areas	Camp Sites	Paths & Trails	Building Foundations	Septic Effluent Absorption fields	Playing Fields	Earthen Dams	Source of Road Fill	Source of Topsoil	Source of Sand
SLOPE	4	4	4	4	A:4 B:4 C:3	4	4	4	4	4	4
FLOODING	0	0	0	0	0	0	0	0	0	0	0
SITE DRAINAGE	0	1	2	1	0	0	1		0	2	0
DEPTH TO WATER-TABLE	0				0	0		0		0	0
PERMEABILITY			3			0		4			
UNIFIED SOIL GROUP	2				0			4	1		0
GRAVEL (Fragments .2 to 7.5cm)		0	0			0	0			0	0
STONES (Fragments 7.5 to 25cm)	0	0	0	0	0	0	0	0	0	0	0
BOULDERS (Fragments) 25cm	0	0	0	0	0	0	0	0	0	0	0
OUTCROP	0	0	0	0	0	0	0	0	0	0	0
DEPTH TO ROCK	0	0	0		0	0	0	0	0		0
SHRINK-SWELL	0				0			0			
DISPERSIBLE CLAYS	0	0	0	0	0	0	0	4	0	0	
A HORIZON TEXTURE		2	3	3			1			3	
A. HORIZON DEPTH								0	0	4	
ORGANIC MATTER									0	4	0
pH										4	
SOLUBLE SALTS										0	
LAND SLIPS	3	3	3	3	3	3	3	3	4	4	4

MAP UNIT Pr2

ACTIVITY / LAND FEATURE	Car Parks & Roads	Intensive use areas	Camp Sites	Paths & Trails	Building Foundations	Septic Effluent Absorption fields	Playing Fields	Earthen Dams	Source of Road Fill	Source of Topsoil	Source of Sand
SLOPE	4	4	4	4	A:3 B:4 C:5	3	4	4	4	4	4
FLOODING	0	0	0	0	0	0	0	0	0	0	0
SITE DRAINAGE	0	1	2	1	0	0	1		0	2	0
DEPTH TO WATER-TABLE	0				0	0		0		0	0
PERMEABILITY			3			0		4			
UNIFIED SOIL GROUP	2				1			4	1		0
GRAVEL (Fragments .2 to 7.5cm)		0	0			0	0			0	0
STONES (Fragments 7.5 to 25cm)	0	0	0	0	0	0	0	0	0	0	0
BOULDERS (Fragments) 25cm	0	0	0	0	0	0	0	0	0	0	0
OUTCROP	0	0	0	0	0	0	0	0	0	0	0
DEPTH TO ROCK	0	0	0		0	0	0	0	0		0
SHRINK-SWELL	0				0			0			
DISPERSIBLE CLAYS	0	0	0	0	0	0	0	3		0	
A HORIZON TEXTURE		2	3	3			1			3	
A. HORIZON DEPTH								0	0	4	0
ORGANIC MATTER									0	4	0
pH										4	
SOLUBLE SALTS										0	
LAND SLIPS	2	2	2	2	2	2	2	2	2	2	2

MAP UNIT Pr3

ACTIVITY / LAND FEATURE	Car Parks & Roads	Intensive use areas	Camp Sites	Paths & Trails	Building Foundations	Septic Effluent Absorption fields	Playing Fields	Earthen Dams	Source of Road Fill	Source of Topsoil	Source of Sand
SLOPE	3	2	2	2	A:2 B:2 C:1	2	3	2	1	2	2
FLOODING	0	0	0	0	0	0	0	0	0	0	0
SITE DRAINAGE	0	1	2	1	0	0	1		0	2	0
DEPTH TO WATER-TABLE	0				0	0		0		0	0
PERMEABILITY			3			0		4			
UNIFIED SOIL GROUP	2				A:1 B:0			4	1		0
GRAVEL (Fragments .2 to 7.5cm)		0	0			0	0			0	0
STONES (Fragments 7.5 to 25cm)	0	0	0	0	0	0	0	0	0	0	0
BOULDERS (Fragments) 25cm	0	0	0	0	0	0	0	0	0	0	0
OUTCROP	0	0	0	0	0	0	0	0	0	0	0
DEPTH TO ROCK	0	0	0		0	0	0	0	0		0
SHRINK-SWELL	0				0			0			
DISPERSIBLE CLAYS	0	0	0	0	0	0	0	3	0	0	
A HORIZON TEXTURE		1	2	2			1			2	
A. HORIZON DEPTH								1	3	3	3
ORGANIC MATTER									0	3	0
pH										2	
SOLUBLE SALTS										0	
LAND SLIPS	0	0	0	0	0	0	0	0	0	0	0

LAND CAPABILITY ASSESSMENTS

The following tables summarise the capabilities of the land components for selected land uses. The limiting parameters are listed in brackets. For some components it has been necessary to give alternative capabilities depending on the actual slope or other parameter. (Pitt, Howe, Jakimoff, 1977).

Abbreviations:

C	Dispersible Clays	Hd	Deposit Thickness
Cl	Soluble Salts	L	Landslips
D	Site Drainage	O	Organic Matter
E	Erodibility	Ob	Overburden
F	Flooding	Ou	Outcrop
G	Gradient	P	Permeability
Gr	Gravel	pH	Soil Reaction
Ha	Depth of A Horizon	S	Shrink-Swell
Hb	Depth of Hard Rock	T	A Horizon Texture
		U	Unified Soil Group.

Example of notation: Ag1 (Car Park) : POOR: < 15% G.
(and Roads) (U.G.L.)
UNSUITED: > 15%
(G)

Interpretation: Those areas of Ag1 with slopes less than 15% have poor capabilities for car parks and roads, the limiting parameters being slope, unified soil group, and the hazard of landslips. Areas with slopes steeper than 15% are unsuited, the limiting parameter being the slope.

LAND CAPABILITY RATING FOR ON-SITE EFFLUENT DISPOSAL (Septic Tank Absorption Fields)

LAND FEATURES AFFECTING USE	CAPABILITY RATING				
	VERY GOOD (0)	GOOD (1)	FAIR (2)	POOR (3)	UNSUITED (4)
SLOPE	0 to 5%	> 5% to 8%	> 8% to 15%	> 15% to 30%	> 30%
SITE DRAINAGE	Excessively Well Drained, Well Drained	Moderately Well Drained	Imperfectly Drained	Poorly Drained	Very Poorly Drained
FLOODING	None	None	Less than once in 100 years	Once between 100 yrs. & 25 yrs.	More than once in 25 years
DEPTH TO SEASONAL WATERTABLE	More than 300 cm	< 300 cm to 150 cm	< 150 cm to 100 cm	< 100 cm to 75 cm	Less than 75 cm
PERMEABILITY	More than * 0.4 ml/cm^2/hr	< 0.4 to 0.3 ml/cm^2/hr	< 0.3 to 0.2 ml/cm^2/hr	< 0.2 to 0.1 ml/cm^2/hr	Less than 0.1 ml/cm^2/hr
DEPTH TO ROCK OR IMPERVIOUS LAYER	More than 200 cm	< 200 cm to 150 cm	< 150 cm to 100 cm	< 100 cm to 75 cm	Less than 75 cm
GRAVEL (Fragments 0.2 to 7.5 cm)	Less than 5% (of soil volume)	> 5% to 20%	> 20% to 40%	> 40% to 75%	More than 75%
STONES (Fragments 7.5 to 25 cm)	Less than 2% (of soil volume)	> 2% to 10%	> 10% to 30%	> 30% to 60%	More than 60%
BOULDERS (Fragments > 25 cm)	Less than 0.02% (of soil surface)	> 0.02% to 0.2%	> 0.2% to 5%	> 5% to 20%	More than 20%
ROCK OUTCROP	None	0 to 0.1% (of soil surface)	> 0.1% to 3%	> 3% to 15%	More than 15%
DISPERSIBLE CLAYS	Less than 6%	> 6% to 10%	> 10% to 16%	More than 16%	-

* 0.4 ml/cm^2/hr = 6.0 cm/hr drop in head

MAP UNIT / ACTIVITY	ANGLESEA 7 Ag 7	ANGLESEA 4 Ag 4	ANGLESEA 3 Ag 3
CAR PARKS AND ROADS	Unsuited (G.,L.)	Poor:<15%G. (G.,U.) Unsuited:>15%G. (G.)	Unsuited (F.)
INTENSIVE USE AREAS	Unsuited (G.,L.)	Fair:<15%G. (D.,L.,G.) Poor:>15%G. (G.)	Unsuited (F.)
CAMP SITES	Unsuited (G.,L.)	Fair:<15%G. (D.,G.) Poor:>15%G. (G.)	Unsuited (F.)
PATHS AND TRAILS	Poor to unsuited (L.,G.)	Fair:<15%G. (G.) Poor>15%G. (G.)	Fair (F.,D.)
BUILDINGS FOUNDATIONS Stumps / Slabs / Piles	Unsuited (L.)	Poor (U.) Poor (G.) Poor (U.)	Unsuited (F.) Poor (U.)
SEPTIC EFFLUENT ABSORPTION FIELDS	Unsuited (L.)	Fair:<15%G. (G.) Poor:>15%G. (G.)	Unsuited (F.)
PLAYING FIELDS	Unsuited (L.)	Poor:<15%G. (G.,L.) Unsuited>15%G. (G.)	Poor (F.)
EARTHEN DAMS	Unsuited (L.)	Fair:<12%G. (G.,U.,S.) Poor:>12%G. (G.)	Fair to Unsuited (F.,G.,U.,S.)
SOURCE OF ROADFILL	Unsuited (L.)	Poor (U.,Ob.,L.)	Unsuited (F.)
SOURCE OF TOPSOIL	Unsuited (L.)	Poor (Ha.,O.,L.)	Unsuited (F.)
SOURCE OF SAND	Unsuited (U.)	Poor (Hd.)	Unsuited (F.,U.)

MAP UNIT / ACTIVITY	ANGLESEA 1 Ag 1
CAR PARKS AND ROADS	Poor:<15%G (U.,G.,L.) Unsuited:>15%G (G.)
INTENSIVE USE AREAS	Poor:<25%G. (G.,L.) Unsuited>25%G. (G.)
CAMP SITES	Pair:<15%G. (G.,C.,L.) Poor:>15%G (G.)
PATHS AND TRAILS	Fair:<15%G. (E.,L.,G.) Poor:>15%G. (G.)
BUILDINGS FOUNDATIONS Stumps / Slabs / Piles	Poor-Unsuited (L.,U.,G.)
SEPTIC EFFLUENT ABSORPTION FIELDS	Poor (L.,G.)
PLAYING FIELDS	Poor:<15%G. (L.,G.) Unsuited>15%G (G)
EARTHEN DAMS	Poor (L.,G.)
SOURCE OF ROADFILL	Unsuited (G.,L.)
SOURCE OF TOPSOIL	Unsuited (G.,L.)
SOURCE OF SAND	Unsuited (G.,L.)

MAP UNIT / ACTIVITY	ANGLESEA 1 Ag 1	ANGLESEA 2 Ag 2	ANGLESEA 3 Ag 3
CAR PARKS AND ROADS	Poor:<15%G (U.,G.,L.) Unsuited:>15%G (G.)	Fair<8%C. (U.,G.) Poor:>8%G (G.)	Unsuited (F.)
INTENSIVE USE AREAS	Poor:<25%G. (G.,L.) Unsuited>25%G. (G.)	Good:<8%G (D.,G.,T.) Fair:>8%G. (G.)	Unsuited (F.)
CAMP SITES	Fair:<15%G. (G.,C.,L.) Poor:>15%G (G.)	Fair (G.,D.,T.)	Unsuited (F.)
PATHS AND TRAILS	Fair:<15%G. (D.,L.,G.) Poor:>15%G. (G.)	Fair (G.,T.)	Fair (F.,D.)
BUILDINGS FOUNDATIONS Stumps Slabs Piles	Poor-Unsuited (L.,U.,G.)	Fair (G.) Fair (G.) Good (G.)	Unsuited (F.) Poor (U.)
SEPTIC EFFLUENT ABSORPTION FIELDS	Poor (L.,G.)	Good:<8%G. (G.) Fair:>8%G. (G.)	Unsuited (F.)
PLAYING FIELDS	Poor:<15%G. (L.,G.) Unsuited>15%G (G)	Fair:<8%G. (G.) Poor:>8%G. (G.)	Poor (F.)
EARTHEN DAMS	Poor (L.,G.)	Unsuited (P.,U.)	Fair to Unsuited (F.,G.,U.,S.)
SOURCE OF ROADFILL	Unsuited (G.,L.)	Poor (Cb)	Unsuited (F.)
SOURCE OF TOPSOIL	Unsuited (G.,L.)	Poor (T)	Unsuited (F.)
SOURCE OF SAND	Unsuited (G.,L.)	Fair (G.,C.Cb)	Unsuited (F.,U.)

ACTIVITY \ MAP UNIT	BELLERAE 3 Bb 3	POINT ROADKNIGHT 1 Pr 1	POINT ROADKNIGHT 2 Pr 2
CAR PARKS AND ROADS	Poor:<15%G. (G.) Unsuited:>15%G. (G.)	Unsuited (G.,E.)	Poor:<15%G. (G.,E.) Unsuited:>15%G. (G.)
INTENSIVE USE AREAS	Poor (Hb.)	Unsuited (G.,E.)	Poor:<25%G. (G.,E.) Unsuited:>25%G. (G.)
CAMP SITES	Poor (Hb)	Unsuited (G.,E.)	Poor:<25%G. (G.,E.,T.) Unsuited:>25%G. (G.)
PATHS AND TRIALS	Fair:<15%G. (G.) Poor:>15%G. (G.)	Unsuited (G.,E.)	Poor:<25%G. (G.,E.,T.) Unsuited:>25%G. (G.)
BUILDING FOUNDATIONS Stumps. Slabs. Piles	Fair (G.,U.,Hb) Poor (G.) Fair (G.,U.,Hb)	Unsuited (G.,E.) Unsuited (G.,E.) Poor (G.,E.,L.)	Poor (G.,E.) Poor to Unsuited (G.,E.) Fair to Poor (G.,E.)
SEPTIC EFFLUENT ABSORPTION FIELDS	Unsuited (Hb)	Unsuited (G.)	Fair:<15%G. (G.) Poor:>15% to 30%G. (G.)
PLAYING FIELDS	Poor (G.,Hb)	Unsuited (G.,E.)	Poor:<15%G. (G.) Unsuited:>15%G. (G.)
EARTHEN DAMS	Unsuited (P.,Hb)	Unsuited (G.,P.,U.)	Unsuited (P.,U.)
SOURCE OF ROADFILL	Unsuited (Hd.,Ob)	Unsuited (G.,E.,L.)	Poor:<25%G. (G.,E.) Unsuited:>25%G.(G)
SOURCE OF TOPSOIL	Unsuited (Ha.)	Unsuited (G.,E.,O.,L.,pH)	Unsuited (G.,E.,O.,pH)
SOURCE OF SAND	Unsuited (U.)	Unsuited (G.,E.,L.)	Fair to Poor:<25%G. (G.) Unsuited:>25%G. (G.)

MAP UNIT / ACTIVITY	CONNEWARRE 4 Cn 4	CONNEWARRE 5 Cn 5	POINT ROADKNIGHT 3 Pr 3
CAR PARKS AND ROADS	Unsuited (F.)	Poor (D.,U.,S.)	Poor:<15%G. (G.) Unsuited:>15%G. (G.)
INTENSIVE USE AREAS	Unsuited (F.)	Poor (D.)	Fair:<15%G. (G.,E.) Poor:>15%G. (G.)
CAMP SITES	Unsuited (F.)	Poor (F.,D.)	Poor (P.)
PATHS AND TRIALS	Unsuited (F.)	Poor (D.)	Fair:<15%G. (G.,T.,E) Poor:>15%G. (G.)
BUILDING FOUNDATIONS Stumps. Slabs Piles	Unsuited (F.)	Unsuited (F.)	Fair (G.,E.) Fair to Poor (G.) Good (G.,E.)
SEPTIC EFFLUENT ABSORPTION FIELDS	Unsuited (F.)	Poor (F.,D.)	Fair (G.,E.)
PLAYING FIELDS	Unsuited (F.)	Poor (D.)	Fair: < 8%G. (G.,E.) Poor: > 8%G. (G.)
EARTHEN DAMS	Unsuited (F.)	Poor (W.,S.)	Unsuited (P.,V.)
SOURCE OF ROADFILL	Unsuited (F.)	Unsuited (Ob)	Poor (Ob)
SOURCE OF TOPSOIL	Unsuited (F.)	Poor (D.)	Poor (Ha,O.)
SOURCE OF SAND	Unsuited (F.)	Poor (Hd.,D.)	Poor (Ob.)

SOILS OF THE OTWAY RANGES

Brown gradational soils

On southerly and easterly facing slopes of the Otway Ranges, in moist and sheltered environments, these gradational profiles seem to dominate over the duplex soils found on drier aspects. Surface horizons consist of dark brown clay loams, rich in organic matter, and persist to about 20 cm. They gradually change to brown, well structured clays. At about 90 cm weathered parent material is encountered. Nutrient levels are high, the main limitations to plant growth coming from high acidity (surface soil has a pH of about 4½) and low levels of calcium. Profiles are moderately permeable, but high intensity rainstorms can lead to damaging surface runoff. The clay subsoils are susceptible to slip failure when saturated following prolonged rains.

Brown duplex soils

More commonly encountered in these parts of the Otway Ranges are duplex profiles. They occur in the drier positions of the landscape such as north and west facing slopes, and crests. Profiles typically have both very dark brown clay loam A_1 horizons, and greyish brown clay loam A_2 horizons. Sporadic bleaching is sometimes evident in the A_2 horizon. At a depth of about 30 cm, an abrupt change to brown medium clay B horizons places these soils into the duplex category. Structures are well developed and the B horizons continue to about 90 cm where weathering parent material is encountered. Dispersibility is generally only slight, but where they are exposed to salt bearing coastal winds, sodium ions have replaced other cations on the exchange complex of the clays such that moderate dispersive tendencies may be encountered. The soil reaction trend is again acid ranging from 4½ at the surface to about 5½ in the subsoil. Moderate levels of bases and other plant nutrients in the Lower Cretaceous sandstones and mudstones has resulted in comparatively good fertility levels in these soils. Permeabilities are slower than in gradational soils on the same parent material, but they are still quite high. Proneness of these soils to slip failure and earthflows when saturated with prolonged rains presents problems on steep slopes.

Red-yellow duplex soils

These soils are found on steep slopes and crests in some of the younger landscapes developed on Tertiary sediments. They are of only minor occurrence in this present study occurring to the west of Moggs Creek township. They are more common further inland. Surface horizons consist of dark brown fine sandy loam A_1 horizons underlain by greyish brown sandy loam A_2 horizons. Structures are only weakly developed and occasional sporadic bleaching is present in the A_2 horizon. At about 20-25 cm depth, an abrupt change to a moderately structure clay with faint coarse red, yellow and grey mottling occurs. These clay subsoils are moderately dispersible and persist to about 90 cm where the C horizon of unconsolidated silty clay is encouraged. Soil reaction trend ranges from a pH of 5 near the surface to almost neutral at about 90 cm. Nutrient levels are moderately low with deficiencies in P, K and N all being common. However, these soils have not been as intensively weathered and leached as other older soils on Tertiary sediments.

Yellow sodic duplex soils

These soils are found on Tertiary sediments in the drier parts of the study areas, and particularly in the lower parts of the landscapes. Typically they possess both A_1 and A_2 horizons with fine sandy loam and sandy loam textures respectively. An abrupt change to moderately structured yellow or yellow-brown clay is encountered at about 30 cm depth. These B horizons continue to about 1 m where unconsolidated silt and clay parent material is encountered. The soils reaction trend varies from mildly acid near the surface to slightly alkaline in the subsoil. The clay B horizons are quite dispersible and the levels of sodium on the exchange complex are usuaally high. Rising groundwater tables following changes in land use may bring these salts to the surface and cause salt toxicity problems.

Yellow-brown duplex soils, coarse structure

These soils are found on Tertiary sediments associated with old landforms. Typically they possess a dark brown fine sandy loam A_1 horizon about 10 cm deep overlying a gryeish brown A_2 horizon. At 30 cm depth, an abrupt change to a heavy clay B horizon is encountered. These clays have well developed

coarse structures with low or very low permeabilities. The depth is variable. Where they have developed on Tertiary sandstone, C horizon material is encountered at between 60 cm and 1 m. Where they have developed on unconsolidated clays, the heavy clay subsoils continue to about 120-140 cm. The soil reaction trend is mildly acid, and the clays are quite dispersible. Nutrient levels are low, and deficiencies in P, K, N and other nutrients are common.

Yellow-brown sodic duplex soils, coarse structure

These soils are similar to the ones above, except that they have developed in positions of the landscape such that soluble salts have accumulated in the subsoil. They have usually developed on sediments partly alluvial in nature, such that the depth of the B horizon is 120-140 cm. Changes in land use may lead to mobilization of these soluble salts by rising groundwater tables, and accompanying salt toxicity problems.

Yellow-brown calcareous sodic duplex soils, coarse structure

Where exposures of Tertiary limestone, marl and calcareous clays have been exposed to the same weathering and leaching phenomenon which have resulted in the formation of the above soils, similar profiles have again developed with the additional properties of alkaline soil reaction trends and accumulations of lime in the subsoil. Typically, these soils possess dark brown fine sandy loam A_1 horizons and greyish brown sandy loam A_2 horizons overlying yellow-brown clay B horizons at about 25 cm depth. The structures of the B horizons are well -eveloped with large coarse peds separated by shiny slickensided faces. At about 120 cm, weathering parent mate:ial with a sandy clay texture is encountered. Nutrient levels are slightly higher than on other soils on Tertiary sediments, but deficiencies in some nutrients such as P are still common. Clay subsoils are highly dispersible and various forms of erosion can occur. Soil reaction trends range from a pH of 5½ near the surface to 8½ in the deep subsoil. Subsoils are normally sodic as well as calcareous.

Brown duplex soils, coarse structure

On the higher parts of these landscapes with calcareous parent material, deep weathering remnants from former climatic periods are often present. Where soil profiles belonging to these former climates have remained intact, they belong to other soil groups discussed below. Where the base of the old profiles have been exposed by dissection into the old surfaces, however, heavy textured duplex profiles have been formed. These soils have many properties in common with the yellow-brown duplex soils, coarse structure, the main differences being mildly alkaline subsoils and heavier textured topsoils. Surface textures are loam or fine sandy clay loams and a weakly developed A_2 horizon is normally present. At about 25 cm depth, dark brown heavy clay B horizons are encountered with well developed coarse structures and low permeabilities. At about 120 cm, a gradual change to red and white mottled clays occurs, these being the remnants of the former deeply weathered profiles. Nutrient levels are low and deficiencies in N, P and K are common. The clay subsoils are quite dispersible and various forms of erosion can occur.

Mottled yellow and red duplex soils

These soils are found on Tertiary sediments on the higher gentle parts of old landscapes. Typically they possess shallow sandy loam A_1 horizons with bleached sandy loam or loamy sand A_2 horizons for about 40 cm depth. An abrupt change to a fine structured medium clay B horizon is often overlain by a small amount of ironstone gravel. Red and yellow mottles dominate these clays. The B horizons persist for about 140 cm where the mottling becomes coarser and the structure becomes weaker. Profiles are acid with a pH of about 5½ throughout. Permeability is moderate, but nutrient levels are invarbly low. High levels of sesquioxide rich clays result in a strong adsorption of applied phosphate making it unavailable to plants. The clays show very little dispersive tendency and are quite stable on road batters.

Mottled yellow and red duplex soils with ironstone

These soils are found on lateritic plateau remnants. Profiles are deep and consist of A_1, A_2 and B horizons to about 1 m, with properties similar to the above soils. Below this an often discontinuous indurated layer of lateritic ironstone is encountered. It is normally about 50 cm deep (it

may be much deeper). Under the indurated layer, another clay horizon (the mottled zone of traditional laterite profiles) is encountered, consisting of red and white mottled clays with weak structures and persisting for several meters. Permeability is restricted in some areas by the indurated layer, but normally, sufficient cracks allow water to drain through this barrier. Nutrient deficiencies are very common, as these soils have very low levels of P, K and N, and have strong phosphate adsorption tendencies.

Variable sodic duplex soils

Along the coastal exposures of Tertiary sediments, numerous different soils belonging to previously discussed groups have been sufficiently modified by the coastal environment to warrant this separate group. Accretions of aeolian calcareous sand to the topsoil and continual leaching with water high in sodium and chloride ions derived from salt spray have resulted in certain properties peculiar to this group. Surface textures are mostly sandy loams, rich in organic matter, and these persist to about 25 cm where variably coloured, mottled and structured clays are found (depending on the original group to which this soil belonged prior to coastal modification). Soil reaction trend usually ranges from 8½ or 9 near the surface to about 7 in the subsoil. Clay subsoils have high levels of saturation with sodium ions and are usually highly dispersible. As such they are very unstable soils and sensitive to disturbance of any kind. High chloride levels also exist in these soils and care must be taken to protect metal structures placed in or on these soils.

Grey sand soils, clay underlay

Slightly similar in genesis to the above soil group are the borders of the swamps at Aireys Inlet and to the east of Torquay which have been partially covered by thin sand sheets from neighbouring coastal dunes. Surface layers of these polygenetic soils consist of black silty loams, rich in organic matter. They persist for variable depths, but at an average of 50 cm, clay subsoils are encountered. The sudden change in texture at this interface, and their general low position in the landscape results in water-logging for most of the year. Structures of the clay laters are weakly developed. Both layers are quite alkaline with a pH of about 8½, and high levels of chloride ions are also found. Permeability is low due to restriction by the weak structured clay layer.

Saline soils

These soils are confined to the estuarine swamps at Aireys Inlet and to the east of Torquay. They occur within the extreme tidal limits such that they are all inundated at times with saline water. Typically they consist of grey and yellow mottled silty clay, high in organic matter and completely lacking in structure. Polygonal cracking of the surface occurs if they dry out. Levels of free cations and anions are high, as illustrated by high electrical conductivities. Uses of these soils are severely restricted by the periodic inundation with saline water to which they are subjected, and the corrosive nature of the free soluble salts.

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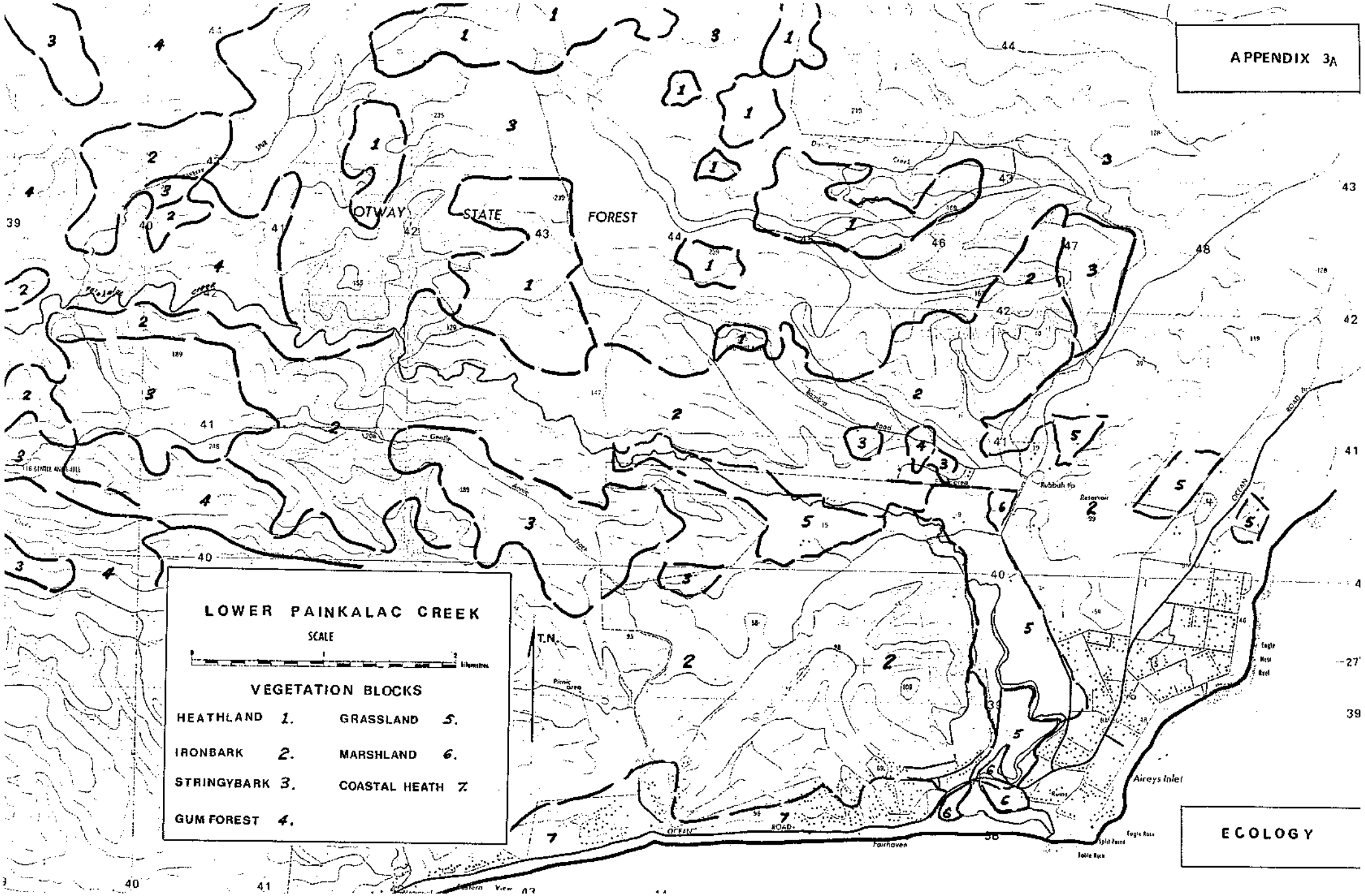

APPENDIX 3A
OTWAY STATE FOREST
LOWER PAINKALAC CREEK
SCALE
VEGETATION BLOCKS
HEATHLAND 1.
IRONBARK 2.
STRINGYBARK 3.
GUM FOREST 4.
GRASSLAND 5.
MARSHLAND 6.
COASTAL HEATH 7.
T.N.
Airey's Inlet
ECOLOGY

ENVIRONMENT STUDIES ASSOCIATION
MOGGS CREEK : APRIL 1972

APPENDIX 3B

HEATHLAND AND FOREST

1. Vegetation

Two communities at Moggs Creek were examined, chiefly by means of quadrats, and profile diagrams for each were also made.

a) In the Dry Heath about half a mile inland from the coast, four 10 m x 1 m quadrats were examined. On a slight westerly slope two of these (adjoining and at right angles) had a canopy height of .2 m with a 90% cover. Sixteen to nineteen species were present, those have more than 25% ground cover being Casuarina pusilla, Leptospermum myrsinoides and Hypolaena fastigiata. The community had not been burned for at least seven years, as determined from Banksia growth.

On a slight easterly slope the canopy height was .3 m, with a 95% cover, and over twenty (21 & 27) species were present, the same three being dominant. This has not been burned for at least ten years.

The soils under these communities were sandy and highly acidic (pH 4.0 - 4.2) in the A_1 horizon, and a moist clayey B horizon was found at 18-22". This was bright orange, indicating the presence of leached iron oxide. The A_1 horizon of heathland soils close to the foreshore dunes was reported to have pH 5.5.

b) In the Dry Sclerophyll Forest two quadrats were examined, each being 10 x x 5 m. Here the canopy was at 15-18 metres, and with a 70-80% cover. Whilst 14-18 species were present in each quadrat, only the Ironbark Eucalyptus sideroxylon was dominant. The soils here were clayey, but were not examined in detail. Profile diagrams were produced of this stand.

The Messmate forest between the above two communities seemed to be transitional between them, having a fairly dense stand of Eucalyptus obliqua and a bracken and heath understorey. However, this was not examined in detail.

2. Vegetation Species Lists:

Dry Heath quadrats	Dry Sclerophyll Forest quadrats
Casuarina pusilla	Eucalyptus sideroxylon
Leptospermum myrsinoides	E. bicostata (? globulus)
Hypolaena fastigiata	-----
-----	Leptospermum juniperinum
Lepidosperma concavum	Acacia verticillata
L. semiteres	Danthonia sp.
Gahnia radula	Schoenus apogon
Patersonia fragilis	Centrolepis strigosa
P. sp.	Viola hederacea
Orthoceras strictum (orchid)	(thistle)
Banksia marginata	Acaena anserinifolia
Isopogen ceratophyllus	Anagallis arvensis
Monotoca scoparia	Centaurium pulchellum
Epacris impressa	Poa australis
Leucopogon virgatus	Dianella revoluta
Brachyloma ciliatum	Astroloma humifusum
Comesperma calymega	Acacia verniciflua
Aotus ericoides	Gahnia radula 17
Dillwynia sericea	
D. glaberrima	Not in quadrats
Platylobium obtusangulum	Acacia melanoxylon
Sphaerolobium vimineum	A. mucronata
Haloragis tetragyna	Eucalyptus obliqua
Pimelea spathulata	E. viminalis
P. glauca	Pteridium esculentum
Hibbertia fasciculata	Spyridium parvifolium
Cassythia glabella	
Boronia pilosus	
Tetratheca ciliata	
Goodenia sp.	

3. Conservation of Communities

It was noted with concern that the interesting Dry Heath community did not fall within any permanent reservation. Consequently, in order to conserve a viable stand of this low coastal heath it is recommended that the Angahook Forest Park be extended to include allotments 22D and 22E as a matter of urgency, and also (i) 22H (Crown land) and (ii) 22C with 21A, in that order of priority.

Preservation of these areas would involve control of public access, nature trails serving both pedestrian control and interpretative functions, and fire control. It was noted that whilst a Forest Park gave priority to recreational and aesthetic considerations, selective logging and economic management were nevertheless an integral part of their concept.

4. Birds

No complete bird lists were obtained, but in the Ironbark forest, Crimson Rosellas, Blue Wrens, Flame and Scarlet Robins, White Throated Tree-Creeper, Grey Thrush, Golden Whistler, and Borwn and Striated Thornbills were seen. Only Ravens and Pied Currawongs were seen in the vicinity of the Dry Heath.

THE CREEK ENVIRONMENT.

1. Introduction

Moggs Creek has been most noticeably influenced by Man near the mouth where clearing of native flora has enabled exotic species such as buffalo and paspalum grasses to firmly establish. Buffalo grass occupied 10% at Gradrat 1 immediately above the bridge on the Ocean Road.

No sampling of water was done, but the surface had a scummy appearance near the bridge not seen at the Guide Camp. This might partly be due to slackening of flow, but household drainage would be mainly responsible. There was a recently dug drain two feet deep across the flat from houses about ¼ mile above the bridge.

Several steep sections of the creek bank 30 or 40 feet high have evidently been used as slides by children, and were denuded of all vegetation over a width of several yards.

Introduced plants have brought about considerable change in various sections. Eight exotic plants were listed as escapees from cultivation, while 16 were noted as weeds of garden or pasture. Some of these exotics are particularly bad or potentially harmful, that is they will destroy the ecological character of the area.

Worst is possibly Chrysanthemoides monaliferum (South African Boneseed) spread by blackbirds and noticed in all parts. It has escaped from cultivation. Another escapee, Phormium tenax (N.Z. Flax) is spreading along the creek. Pinus radiata has been planted above the Guide Camp, and is liable to spread by self-seeding.

Crocosma aurea (Golden Copper-tip) and Watsonia bulbillifera have escaped from cultivation and are increasing. Watsonia, spreading along the creek by its bulbils, has in places occupied 50% of the ground.

Paspalum dilatatum (Golden Crown-grass) and Stenotaphrum secundatum (Buffalo Grass) are abundant around habitation and the Ocean Road. Dolichos lignosus (Snail Creeper) is very bad along most of the creek. It, too, has escaped from cultivation.

Bracken, though native, has increased through the clearing of natural creekside cover till it now forms a tangled mass with Wire-gras to a height of 6 or 7 feet. Apart from bracken, ferns are not found in lower sections but five species were growing on one patch of creek bank near the Guide Camp.

Seven transects and seven quadrats were made on either side of the stream in a variety of vegetation types and on a variety of creek bank profiles.

One hundred and ninety species of native vascular plants were listed.

2. Stream Ecology

(a) General Remarks

Moggs Creek was sampled for aquatic life from the Ocean Road bridge to approximately ¾ mile up from the Guide Camp. There was a noticeable change of species as one proceeded upstream from slightly saline to fresh water.

Both bivalves and gastropods were found downstream (far more bivalves). This shows the water is little polluted as these species are rare in polluted waters. A polychaete worm was found (Family Nereideae). These exist only a short distance from the coast. Shrimps of the genus Paratyra were very widespread at all sampling points.

Nymphs of Mayflies (Ephemeroptera), Caddis flies (Trichoptera), Stone Flies (Plecoptera), and Dragonflies (Odonata) were numerous upstream. In the freshwater, species were more diverse and organisms were generally more abundant.

We were unable to measure the salinity of the water, but took pH readings using a very inaccurate method and found pH was about neutral at all sites.

Rough neutral checks were taken to measure velocity. In general the stream was slow moving although it contained both rapids and deep pools. The water was extremely muddy. This was probably due to recent rains rather than Man's intrusion.

Because of the shaded nature of most of the stream it is low in biological productivity, and this could account for the low number of species. We found no evidence of Tubificid worms, indicating good oxygenation of the stream and probably little organic pollution.

There is little evidence of Man's effect on the stream.

(b) Summary and Discussion of Results

Six sample areas in and around the creek were chosen, samples of water taken from each, and plants, insects and vertebrates identified.

Site 1. The bridge at Great Ocean Road was the area of maximum human influence. Site 2 and 3 were close to heathland, (especially 2), and the rest were in forested country.

It was found that the degree of salinity of the water, rate of flow, the degree of human influence and the type of ecosystem all contributed to determining the fauna of the area.

At site 1, much human interference was noted. Exotic plants were prevalent and trees less numerous, traffic was frequent, and there was more litter than elsewhere along the creek.

In this area many house flies (Musca domestica) and some Cabbage Butterflies were seen. These were less numerous at the other sites. Introduced brids (Starlings, House Sparrows, Skylarks and Goldfinches) were numerous. The bridge site, being near the sea, had several marine species, e.g. Silver and Pacific Gulls, Crested Terns.

Rocks along the banks provided a habitat for Water Skinks. In the creek itself, Galaxias were found in groups of 2 to 8 individuals, but were difficult to identify or catch.

Ample evidence of Rabbit infestation - droppings and warrens abounded. Welcome Swallows abundant.

Site 2. The fauna here was less influenced by humans, was largely heathland type - Grey Fantails, Scarlet Robins, Blue Wrens, etc. Many immature Crimson Rosellas flew above the creek, several Yellow-winged Honey-eaters feeding on native plants. Many Galaxias were seen but were very elusive.

Site 3. Water Striders identified on the surface. Similar heathland bird species present. Robbit and Wallaby droppings prevalent.

Site 4. Further into forest, fewer heathland species, more forest birds. Grey Fantails and several species of Thornbill attracted by the large number of insects. A number of mammal traps were set overnight and one Bush Rat (Rattus fuscipes) was caught.

Site 5. Further upstream past the Guide Camp, a Common Grass Skink was found in remnants of a Red Ironbark. Many insectivorous birds. Several Dragonflies and ubiquitous Mosquitoes.

Site 6. Near the Guide Camp, had a good representation of birds: Thornbills, Fantails Cuckoos, Southern Yellow Robin and others.

3. CONCLUSIONS

Looking at the results as a whole, exotic and animal species occurred to the greatest extent where there was maximum human interference. The habitat around the creek determined the animal species found there. Nectar-feeding species were found mainly on the heathlands where nectar-bearing plants were commonest; insectivorous species in the heathlands and the understorey of the forest.

Total no. of species found:	birds	26
	mammals	3
	lizards	2
	insects	7 orders

The area surrounding the creek contains a variety of almost intact habitats which support a large number of animal species. Man's intrusion and alteration of the area must be minimised if the present native species and habitats are to be maintained.

THE SAND DUNE ECOSYSTEM

Introduction

A topographical analysis shows several distinct zones:

(a) Primary Dune (approx. 1o' wide, 2' high)
(b) Primary Trough
(c) Secondary Dune:
  (i) Seaward face (steep)
  (ii) Seaward lip (almost vertical)
  (iii) Plateau (undulating)

From the primary dune to the road was approximately 100 ft.

1. Vegetation

(a) Primary Dune - relatively sparse, denuded badly around walkway areas.
Species observed: Spinifex hirsutus, Cakile maritima
Ammophila arenaria

(b) Primary Trough - surprising abundance of species for such an exposed area.
Species observed:

Carpobrotus	Olearia axillaris
Scirpus nodosus	Poa australis
Tumbleweed	Ammophila arenaria
Sonchus sp.	Lagaris ovata
Spinifex hirsutus	

(c) Secondary Dune

(i) Seaward face - growth thinned out from trough to relatively sparse around the upper middle slope. Growth then became thicker around the base of the lip.

Species observed:

	Ammophila arenaria	Sonchus sp.
	Spinifex hirsutus	Scirpus nodosus
	Poa australis	Geranium sp.

(ii) Unstable seaward lip - actual face almost completely bare, growth at base relatively abundant for an exposed site.

(iii) Plateau - growth becomes much denser and size of plants increases greatly.

Species observed:

peak of secondary dune:	Spinifex hirsutus	Leucopogon parviflorus
	Geranium	Lagaris ovata
	Stipa compacta	Tumbleweed
	Olearia axillaris	Ammophila axillaris
"secondary trough"	Ammophila arenaria	Geranium sp.
	Leucopogon parviflorus	Sonchus sp.
	Olearia axillaris	Pimelea sp.
	Dichondra repens	Poa australis
	Scirpus nodosus	Lagaris ovata
	Spinifex hirsutus	Rhagodia baccata
"tertiary dune"	Scirpus nodosus	Spinifex hirsutus
	Correa alba	Pimelea sp.
	Ammophila arenaria	Leucopogon parviflorus
	Stipa compacta	Stenotaphrum secondatum
	Geranium sp.	

Other species found: Tetragonia implexicoma, Lignum adpressa Swainsonia sp., Dianella sp.

2. Soil Structure

(a) Primary Dune. Soils profiles showed the first twelve inches to be a mobile phase with plant roots not appearing until below this zone. Lower areas showed some evidence of structuring. pH 8.0 at surface, 7.8 at 4 ft.

(b) Primary Trough. The surprisingly rich plant growth in this area was seen to be due to layers of rich soil beneath the surface. These were presumed to have originated from soil falls off the unstable secondary dune lip. They also apparently carried down the wide variety of plant species. pH 6.5 at surface, rising to 7.3 at about 4 ft.

(c) Secondary Dune. This area showed deep structuring in the hind area suggesting parent rock origin rather than sand dune heritage. The soil was significantly more acidic than the lower primary dune area, varying from pH 6.5 - 6.7 at the surface to 8.0 at about 4 ft.

3. Human Tolerance

The beach is used for three different activities: fishing and general recreation, swimming and surfboard riding. The first has already damaged the dune area so savagely that it has had to be fenced off from the public.

The study area extended from the creek outlet to the tennis courts, a distance of about 1000 yards. Three distinct aspects were studied.

(a) Access Tracks. It was found that the number of tracks was surprisingly high. There were a greater number of tracks on the seward side (one/17 yds) than were seen from the roadside (one/24 yds) - this indicated a general branching of tracks after leaving the road.

The tracks generally provided little damage in the upper dune area, but damage to the peak and face of the secondary dune and to the primary dune were severe. In many cases, deep vees were cut through the secondary dune causing both erosion and vegetation loss. The primary dune was generally denuded for not only the immediate frontage to the track, but also for extensive surrounding areas.

(b) Car Parking Areas. Towards the far end of the beach several car parks had developed on the top of the dunes. The damage from the car parks themselves was not severe, however, the associated damage to the fore dune areas was extensive. In some areas this damage led to severe erosion of the secondary dune face.

(c) Litter Problem. Litter was quite extensive coming from two sources, beach users and passing vessels. Beach users provided a less serious litter problem in that provision of litter bins and toilet facilities would greatly reduce it. Litter from passing ships however appears to be more serious as very large objects are commonly washed up.

4. CONCLUSIONS

The dunes show very low tolerance to human trespass and if access to the beach is to be desired then this should be designed in such a way as to cause minimal damage to the secondary dune face and especially to the primary dune. In areas where the primary dune had been damaged, extensive accompanying erosion appeared to be caused to the secondary dune face. Thus it can be seen that primary dune protection is imperative. This protection can most simply be obtained by limitation of the number of walkways to a very small number spread between the appropriate areas of usage. These walkways should be constructed so as to allow access over these sensitive zones.

The car parks present seem desirable, but should not be extended greatly. Proper design should be introduced so as to control entry to the beach via single walkways, each constructed as as to cause minimal structural damage to the dune.

The litter problem in general is worrying, but is to a great degree controllable. Litter bins and possibly toilet facilities appropriately place, could greatly reduce beach user litter. However litter from passing ships provides a more serious problem largely beyond the control of local authorities.

Overall, the study suggests that the sand dunes left in their natural state are quite stable, but when interfered with, show very low tolerance. The beach itself however shows very high tolerance to normal beach usage. If the beach use is to continue however, controls must be instigated to protect the dunes from further erosion or else complete dune breakdown is feasible.

APPENDIX 3 C

AIREYS INLET AND
DISTRICT ASSOCIATION

ENVIRONMENT STUDIES
ASSOCIATION OF VICTORIA

REPORT ON THE STUDY OF THE RIVER ENVIRONMENT AT AIREYS INLET

ON

SATURDAY 8TH AND SUNDAY 9TH NOVEMBER 1975

The study was designed to supplement basic resource information already held relating to the river and its environs, and to provide an opportunity for discussion of policies appropriate for the conservation of this important part of the Aireys Inlet environment.

Eighteen people worked in three groups under the expert guidance of Helen Lee from the Melbourne University Botany School, and Malcolm Jack from the Town and Country Planning Board.

The land survey group, comprising Ian Noble, Syd Heron, Norm McPhee, Ken Hayes, Ron Burton and Brian Williams, roughly delineated the very considerable area of interesting public land adjacent to the river along the flats.

The botanical survey group comprising Helen Lee, Pauline Noble, Beryl Heron, Joan Forster, Nicolette Hooper and Maureen Davidson prepared a list of plant species found in the area and listed the native trees and shrubs which could satisfactorily revegetate the river environs. A bird list, with the associated habitats which should be considered in the management of the area, was also prepared.

The land use and town planning group comprising Malcolm Jack, Jean Orams, Vivien Stringer, Mrs Heller, Sue Solomon and Barbara McKenzie investigated matters which should be taken into account to maintain the peaceful atmosphere and natural beauty of the area.

The detailed reports are hereunder:-

LAND SURVEY GROUP

The group roughly surveyed the river reserve land between Boundary Road and Beach Road, as shown on the map herewith.

There was some uncertainty as to whether or not some areas were public land, and the group considered that the Association should check out the ownership of this land.

The river reserve land was both extensive and interesting and well worth incorporating in plans for conservation of the river environment.

BOTANICAL SURVEY GROUP

The area investigated was the public land along the river flats between the bridge crossing the river at the junction of Boundary Road and Bimbadeen Drive and the Ocean Road Bridge. Several vegetation types can be recognised although all are somewhat modified following disturbance and invasion by introduced species.

These zones are:-

1. Remnant of forest at the northern end of the area.

2. Native grassland.

3. Reed swamp and mud flats.

4. Altered forest and native grassland.

Description of the Zones

1. Forest

Several hectares of forest remain and in this the tree, shrub and ground cover layers can be recognised. The chief tree species are eucalypts, including ironbark, manna gum and swamp gum, with an understorey of mixed shrubs. In the ground cover are herbs, grasses and sedges including many introduced species.

2. Native Grassland

The original limits of the native grassland are difficult to define due to extensive clearing and grazing of the river flats. On the west bank of the river the northern boundary was probably as it appears now, in the vicinity of the bend in the river below the original "Wybellena" house. On the east bank the boundary could have been further upstream. This area was almost certainly treeless, but has probably always had scattered shrubs through it. The dominant feature is a species of Poa which forms large tussocks up to 1 metre high. The wattle prickly moses, coast beard heath, sweet bursaria and boobialla are among shrubs, which are common now on the native grassland, particularly on the edge of the river.

3. Reed Swamp and Mud Flats

The native grassland merges into reed swamp, presumably where the water table is higher and the soil more saline. This area is very flat and subject to periodic inundation. The most abundant species is the sea rush, tussocks of which grow to about 1½ metres high. The mud flats are mostly free of tussocks but the higher parts are colonised by beaded glasswort, creeping monkey flower, water buttons and other herbs. Many of these herbs extend back into the reeds adding to the ground cover there.

When the river is open to the sea it is tidal, the water banking up at high tide and being released at low tide. The tidal influence extends upstream beyond the big bend opposite the cattleyards on the Bambra Road and as a result the mud flats and many of the plants found on the flats near the bridge also extend to this point. The mud flats form a narrow border to the river channel at low tide and are covered at high tide.

4. Altered Forest and Native Grassland

It is probable that on the west bank the forest extended southwards down the river valley to a point approximately level with the "Wybellena" house. Many fine ironbarks still remain on the bank to this point. The east bank has been more extensively cleared and grazed and the extent of the original forest is hard to determine. Some very old manna gums remain in the vicinity of the cattle pens on the Bambra Road and many younger trees of the same species remain opposite on the west bank. Occasional specimens of the typical forest shrubs occur along the banks immediately adjacent to the river. The ground cover has been greatly altered due to the introduction of pasture grasses and various weeds.

Species Lists

The species list (Appendix I) is not complete as collection of all species is not possible in one or two days. Some identifications could not be taken beyond the generic level, partly due to insufficient flowering material being available, but also to technical difficulties encountered, e.g. many rushes and grasses hybridise and require an expert to sort them out.

Since the trees and shrubs may be of more general interest, and are likely to form the basis of any replanting which may be done, these are listed separately. The number or numbers appearing after the common names indicates the zones in which they were collected, e.g. Eucalyptus sideroxylon, red ironbark, 1, 4 indicates that this species occurs in the forest zone 1 and in the altered forest and grassland zone 4. An asterisk appearing before the name, e.g. *Pinus radiata denotes a species introduced to Victoria.

THE LAND USE AND TOWN PLANNING SURVEY GROUP

Overall Goal for Aireys Inlet

To retain as far as possible the peaceful and tranquil atmosphere and the natural beauty of the town.

To do this necessitates restricting the influences of man.

1. Growth of Geelong

It is estimated that the population of Geelong will grow to approximately a quarter of a million by year 2000. This will in turn create problems for the nearby coastal towns, including Aireys Inlet, as they will become dormitory suburbs and recreation areas for this Geelong population.

2. Water Reticulation

The decision to provide water reticulation seems to be the kernel of the problem of man's influence. The resultant pollution into the river (already apparent from houses in Wybellena Drive) and increased population will inevitably change the peaceful nature of the town, the beauty and the ecology of the river and surroundings.

3. Subdivision and Urban Facilities

Present areas provided for subdivision should be gradually utilised without further encroachment into bush areas (compare Lorne restrictions). Urban facilities are not essential in a coastal town - the aim is to prevent the imposition of a suburban environment. If possible, the minimum lot size should be restricted to a higher minimum of approximately 8,500 square feet. Subdivisions such as Wybellena should not be allowed in future.

4. Pollution, Drainage and Tidiness

An active policy should be followed to prevent further desecration, e.g. expert knowledge can be sought from such authorities as C.F.A., E.P.A., State Rivers and S.C.A. to augment arguments that conventional subdivisions should be amended according to the slope and features of and land. Drainage need not be of conventional kerb and channel type (compare Lorne), but sympathetic to the environment. Regular pollution readings should be taken of the river, especially during the summer. Tidiness should be promoted.

5. Road Access and Road Design

Steep slopes need to be sealed to prevent erosion and skidding as in Philip Street and Aireys Street. The Council should be asked to retain the rural appearance of the roads by sealing the minimum width for safety with the maximum retention of trees and vegetation. Access roads, not thoroughfares, should be considered in some places, e.g. Philip Street and Eagle Rock Parade. The town is disadvantages by being bisected by the Great Ocean Road.

6. Recreation Uses

Township is situated between the two recreational features of the sea and the bush. Its attraction stems from existing pastimes, e.g. surfing, boating, bushwalking, birdwatching, rather than from commercially introduced amenities.

7. Housing - Siting and Appearance

Encourage housing that blends with the surrounds, e.g. that is not silhouetted against the skyline, is well planned and well maintained, and is not garish in colour and material. As much as possible prevent a scarred landscape appearance by both houses and roads. Encourage preservation of historic features, e.g. bark hut and Angahook, light-house complex and the Pearce grave.

8. Clearing Native Vegetation (and planting)

There should be minimum clearing of trees. If you destroy a tree, plant another. List of trees and plants could be forwarded with rate notice (possible task for botanical section of A.I.D.A.). Encourage hand pulling beneseed and protection of existing bird and wildlife sanctuaries. Regulations with penalties should be enforced for destruction of natural trees on public land.

9. Foreshore Amenities - toilets, kiosk, etc.

Minimal facilties only should be provided. Toilets should be discreetly placed and preferably not on cliffs. Kiosk not essential.

10. Commercial Facilities

Adequate for present needs as major shopping carried out in Geelong. Expansion of town's commercial facilities would being pressure for "progress" that is inconsistent with the major attraction of the town.

(a) Parking - additional angle parking adjacent to the Post Office could be provided.

(b) Traffic safety at Valley shopping centre. Too many entrances and exits for a position on the inside of curve.

11. Offroad Vehicles

Trail bikes, dune buggies, four wheel drive vehicles, etc., should be banned from all beach, sand dune and estuary areas to prevent erosion, noise pollution and the destruction of the bush.

12. Parking

Should be provided in relatively unobtrusive locations and controlled in size and access. Car parks should be well designed using low log pine barriers and each area should be for a small number of cars. Parking should be prohibited on the ocean side of the highway unless essential for reasons of safety.

13. Industry and Farming

Farming has been the only industry in the estuary area and should continue as it does not interfere with the overall goal for Aireys Inlet.

14. Erosion

Selected east-west roads running uphill should be sealed to prevent gully-type erosion. Dune and vegetative erosion exists, e.g. Inlet Road and Fairhaven. No development should be allowed on steep unstable slopes. Vegetation can often alleviate or prevent erosion.

15. Council

The Council should continue to receive encouragement for carrying out its works in a way which is sympathetic to the environment. It should also be made clear to the Council that caravan parks and extensive commercial developments are not favoured.

APPENDIX 3D

Aireys Inlet and
District Association

Environment Studies
Association of Victoria

STUDY WEEKEND ON LAND USE AND TOWN
PLANNING IN THE AIREYS INLET DISTRICT
OCTOBER 12th to 14th 1973

REPORT OF HEATHLAND STUDY GROUP

Particular attention was given to the examination of Allotment 22H, parish of Angahook, in order to compare it with nearby areas of reserved forest. A species list was prepared, considering both the dry heath and forest communities, and noting the abundance of each species.

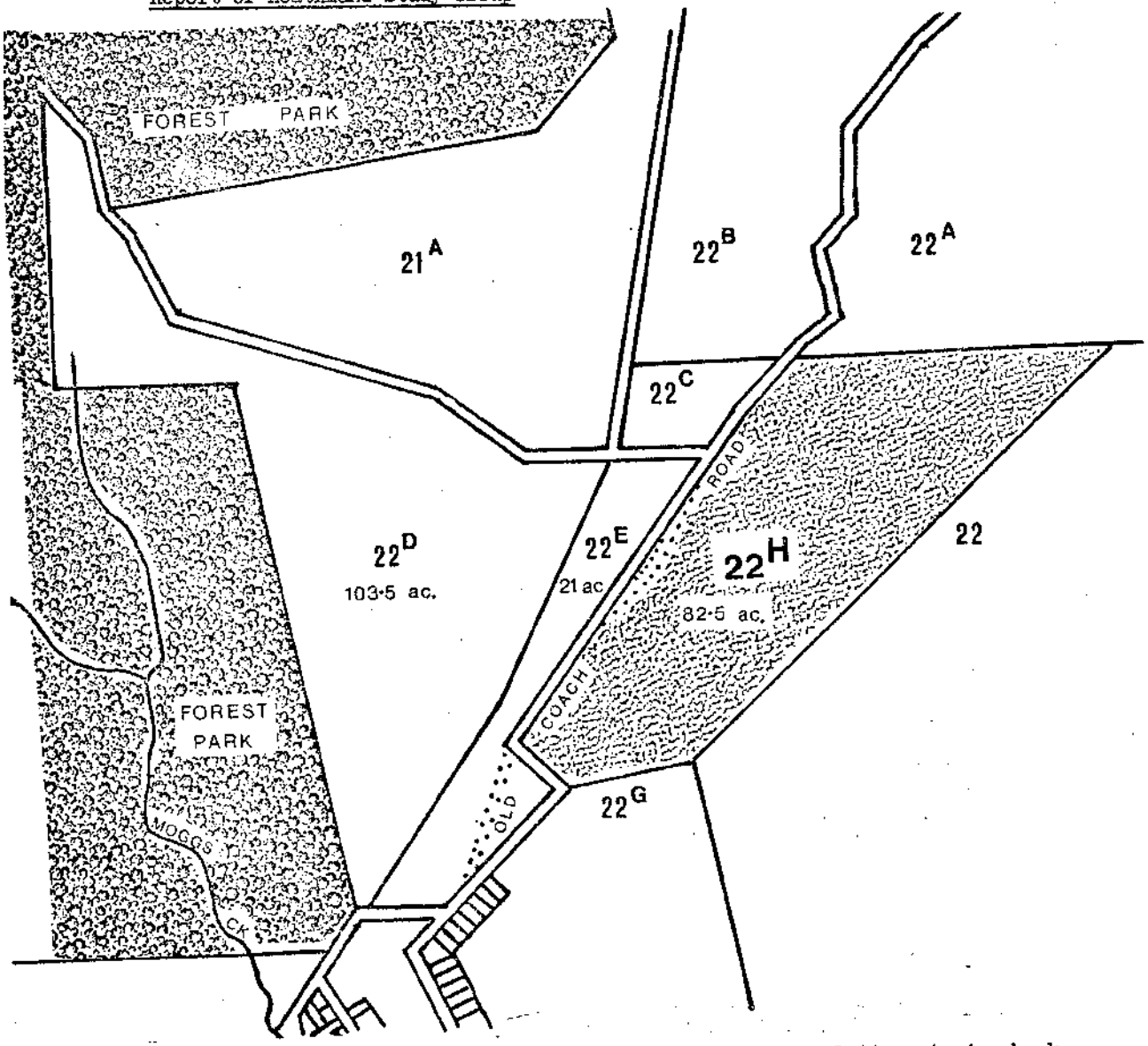
It is recommended that in view of the lack of other such areas of low coastal dry heath in the Angahook Forest Park, allotment 22H (being 82.5 acres of presently unallocated crown land) be added to the Park. This would contribute a very valuable element to the range of communities represented.

Furthermore it is recommended that this action be complemented by the acquisition of Allotments 22D and 22E (totalling about 125 acres) which would then link 22H with the present extent of the park, and in particular conserve all of south-facing heathland and forest through to the eastern boundary of 22H. This boundary itself approximately coincides with a pronounced ironstone ridge running NE-SW and about 350 feet high.

Geologically the eastern part of the allotment is lateritic sandstone of the Demon's Bluff Formation. Some sand has been deposited over part of this. The western part of the allotment is on the older Eastern View Formation. At present no part of the Demon's Bluff Formation is included in the Forest Park.

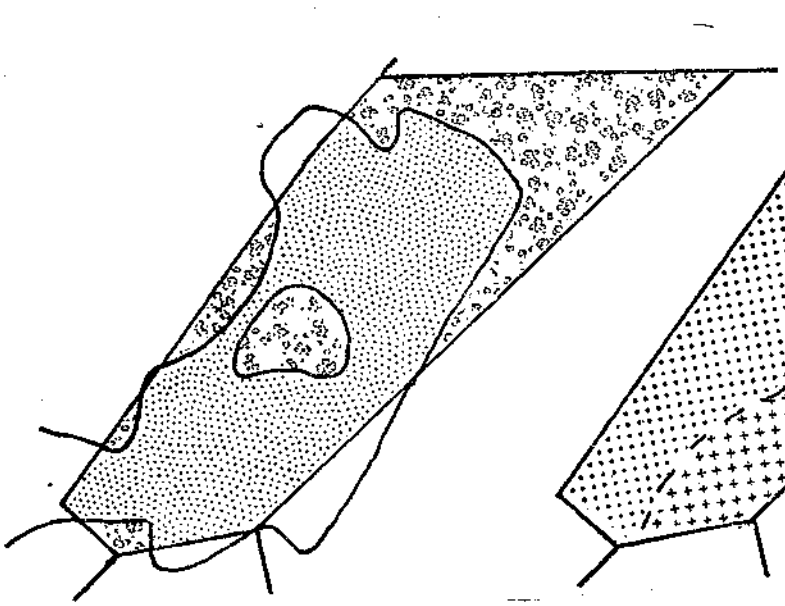
Thus the three allotments together would complete the Park's coverage of all the upper watershed of Moggs Creek, would together add about 70 acres of excellent dry heath to the Forest Park, and in addition 22H would extend the Park's geological coverage.

These recommendations are in line with those made following an Environment Studies Course in the area in 1972.

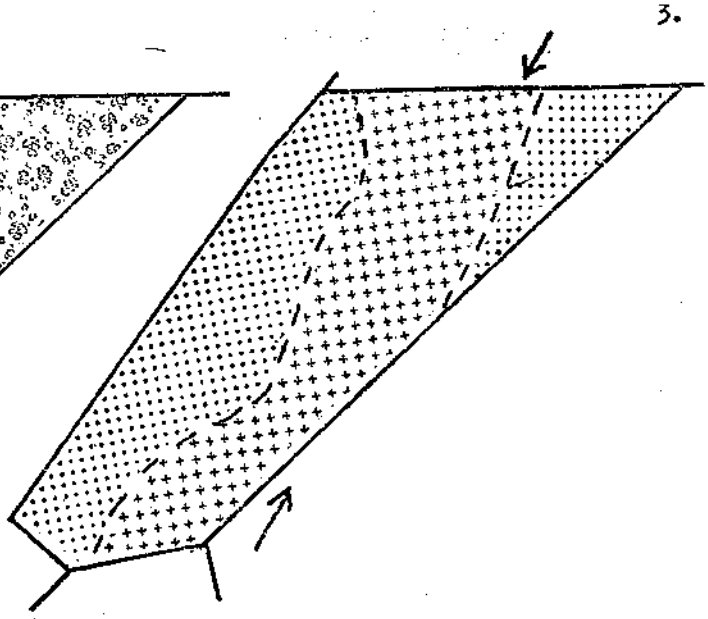


Location Map showing Allotment 22H with 22D and 22E in relation to Angahook Forest Park. (The main watershed between north and south approximately coincides with the surveyed road alignment between 21A and 22D.)

Report of Heathland Study Group



Distribution of Dry Heath (dots) and forest (pattern). Approximate



Distribution of Sandy topsoil (dots) and Laterite (crosses). Very approximate. Ridge line indicated by arrows.

Plant list for Angahook allotment 22H

Compiled 13.10.73 by Environment Studies course. Not exhaustive.
Species rated from 1 (uncommon) to 5 (very common).

Species	Common name	Heath	Forest
Lycopodium deuterodensum	lycopodium	1	
Pteridium esculentum	bracken		5
Lindsaya linearis	screw fern	2	
Poa australis	tussock grass		2
Stipa sp.	spear grass	2	
Briza minor	grass	1	
Schoenus apogon	bog rush	1	
S. sp. grassy	bog rush	3	
S. sp.	bog rush	1	
Gahnia radula	saw sedge	1	
Lepidosperma concavum	saw sedge	2	
L. semiteres	saw sedge	1	
Hypolaena fastigiata	rope rush	3	
Xanthorrhoea australis	grass tree	2	
X minor	grass tree	1	
Lomandra filiformis	mat rush		1
L. longifolia	mat rush		1
Dichopogon strictus	chocolate lily		1
Thysanotus patersonii	fringe lily	1	1
Dianella revoluta	flax lily		1
Burchardia umbellata	milkmaid	2	
Chamaescilla corymbosa	Blue squill	1	
Patersonia fragilis	purple flag	3	
Thelymitra ixioides	sun orchid	1	1
T. flexuosa	sun orchid	1	
T. antennifera	rabbits ears	1	
Diuris sulphurea	tiger orchid		1
Microtis parviflora?	onion orchid	1	
Caladenia dilatata	spider orchid		1
C. carnea	pink fingers		1

Species	Common Name	Heath	Forest
Casuarina pusilla	dwarf sheoak	4	
Isopogon ceratophyllus	cone bush	2	
Persoonia juniperina	geebung		1
Hakea ulicina	furze hakea	2	1
Banksia marginata	banksia	2	1
Lomatia ilicifolia	Lomatia	1	
Exocarpus cupressiformis	wild cherry		1
Clematis aristata	clematis		2
Cassythia pubescens	dodder-laurel	1	
Drosera auriculata	tall sundew	2	
D. glanduligera	scarlet sundew	1	
Bursaria spinosa	bursaria		1
Acacia suaveolens	sweet wattle	1	1
A. verniciflua	varnish wattle		1
A. diffusa	spreading wattle	2	
A. mucronata	sallow wattle		2
Gompholobium ecostatum	wedge pea	1	
Sphaerolobium vimineum	globe pea	1	
Aotus ericoides	aotus	1	
Dillwynia glaberrima	smooth parrot pea	2	1
D. sericea	showy " "	2	1
Platylobium obtusangulum	flat pea	2	1
Kennedya prostrata	running postman		1
Hovea heterophylla	hovea	1	
Boronia nana	dwarf boronia	1	
Tetratheca ciliata	pink eye	2	1
Comesperma volubile	love creeper	1	1
Amperea xiphoclada	broom spurge		1
Hibbertia stricta	guinea flower	1	
H. sericea	guinea flower	3	
H. fasiculata	guinea flower	2	
Viola hederacea	Ivy-leaf violet		1
V. siberiana	tiny violet		1
Pimelea glauca	smooth rice flower	2	
P. octophylla	nodding, downy rice flower	1	
Leptospermum juniperin um	prickly tea tree	1	2
L. myrsinoides	silky tea tree	4	1
Eucalyptus obliqua	messmate		5
Haloragis tetragyna	raspwort	2	1
Hydrocotyle hirta	pennywort		1
Monotoca scoparia	broom heath	1	
Leucopogon virgatus	beard heath	2	
Epacris impressa	common heath	2	
Brachyloma ciliatim?		1	
Centaurium pulchellum	centaury		1
Wahlenbergia gracilenta?	bluebell		1
Goodenia lanata	goodenia	3	
Stylidium graminifolium	trigger plant		2
Brachycome sp.	blue daisy		1
Helichrysum obtusifolium	everlasting	2	
Craspedia uniflora	billy buttons	1	

STUDY WEEK-END ON LAND USE AND TOWN PLANNING IN THE AIREYS INLET DISTRICT.

OCTOBER 12TH TO 14TH, 1973.

REPORT OF RIVER ENVIRONS GROUP

A. LAND TENURE

The area studied was almost entirely public land, some being controlled by the Shire of Barrabool (the river flats north of the Ocean Road, and the area south of the road but east of the river) and the remainder being reserved Crown land (a narrow river frontage, and the area south of the Ocean Road but west of the river and including the sand dunes). In the south west of the area studied a small part of the open space forming the river environs is private property.

B. LAND UNITS

Nine land units with characteristic land form and vegetation were recognised and their boundaries mapped using aerial photographs and field checks. These are shown on map 1.

(1) Heathland

This area had a generally south-east aspect with slopes up to 10° being recorded. More than 20 plant species were observed but not all were identified. The proportion of ground covered by each species was estimated from 3 plots each 1 m x 5 m. The dominant plants were:-

silver banksia (cover ranged from 2 - 50%)
coast beard-heath (0 - 40%)
daisy-bush (0 - 40%)
various grasses (30 - 70%)

The shrubs were generally from 0.5 - 1 m in height. Other species included, prickly tea-tree, silky guinea-flower, bear's ears, ivy-leaf violet, bidgee-widgee, heath wattle, milkmaids, dwarf wedge-pea, running postman, purple swainsonia, common onion orchid, wattled mat-rush, varnish wattle, austral centaury, austral bracken, wood-sorrel and messmate stringybark.

Boneseed, a noxious weed, was becoming established on disturbed soil along the Ocean Road.

(2) Saltmarsh

This area had a uniform slope of less than 1° towards the river. At least twelve plant species were observed. Their distribution and relative abundance appeared to be closely allied to soil moisture conditions, and a marked zonation could be seen. The low lying areas most frequently subject to inundation supported the least number of species and had the sparsest ground cover.

Estimates of cover at three successively higher parts of the salt marsh produced the following results (figures show cover at low, middle and high parts of the marsh):-

bare ground	25%	5%	0%
streaked arrow-grass	70	0	0
creeping brookweed	70	25	5
beaded glass-wort	5	70	40
grasses (including salt grass)	0	40	70

Other species identified on the higher areas were variable plantain, water-buttons and common sea-heath. The vegetation was generally less than 0.3 m in height.

Chaffy saw-sedge up to 1 m in height occurred in a narrow fringe between the salt marsh and adjoining heathland, and as isolated tussocks on some low hummocks within the salt marsh.

(3) Sheltered dune
(4) Exposed dune

These two units were not closely examined as they had been investigated in some detail by a study group in April 1972. However the marked difference in the height and form of the vegetation on the exposed and sheltered sides of the dune was noted, as was the presence of a large number of species including moonah, cushion-bush, climbing lignum, purple swainsonia, guinea-flower, coast beard-heath, tussock grass, geranium and seaberry saltbush.

(5) Saltmarsh and Reed Swamp

This generally flat area had a hummocky surface resulting in a mosaic of different vegetation types. Shallow depressions supported saltmarsh vegetation while the low rises supported dense reeds.

(6) Scrubland

This generally flat area was at a slightly higher elevation and would not be subject to inundation. A dense scrub of common boobialla and coast beard-heath up to 4 m in height dominated the area. A number of grasses and herbs formed a low sparse ground cover.

(7) Reed Swamp

Dense reeds less than 1 m tall cover a low lying part of the river's flood plain north of the Ocean Road. This area would be subject to periodic inundation.

(8) Grassland

Dense grass covers most of the river's flood plain. This area has in places been cultivated and would be subject to infrequent inundation.

(9) Forest Margin

The public land includes just the margin of the low open forest that covers the hill slopes to the west of the river's flood plain. The main tree species is messmate stringybark with some red ironbark, while the most prominent understorey species is varnish wattle.

C. GEOLOGY

The heathland and open forest areas occur on the Eocene deposits known as the Demons Bluff Formation. They include clayey silt and very fine sand with coarse quartz and gravel beds.

All other areas occur on Recent deposits. The dunes are of sand while the salt marsh and river flood plain are alluvial deposits of sand, silt and clay.

D. EVIDENCE OF USE

Part of the heathland area adjacent to the Ocean Road has been considerably disturbed by road works and is being used as an informal car park and as an access route to the river for fishing.

A vehicular track from the Ocean Road crosses the heathland and saltmarsh before skirting the sand dune. Some soil erosion was noted where the track drops steeply down to the saltmarsh and where it crosses the marsh deep wheel ruts have formed. The altered water regime along these ruts has resulted in a change in the composition of the vegetation, water buttons now being the dominant species. Trail bikes are using parts of the saltmarsh closest to the river for mud scrambles.

Destruction of vegetation by trafficking of people ([redacted]) was noted on the dunes particularly towards the mouth of the river. The problems associated with this were considered by the 1972 Study Group.

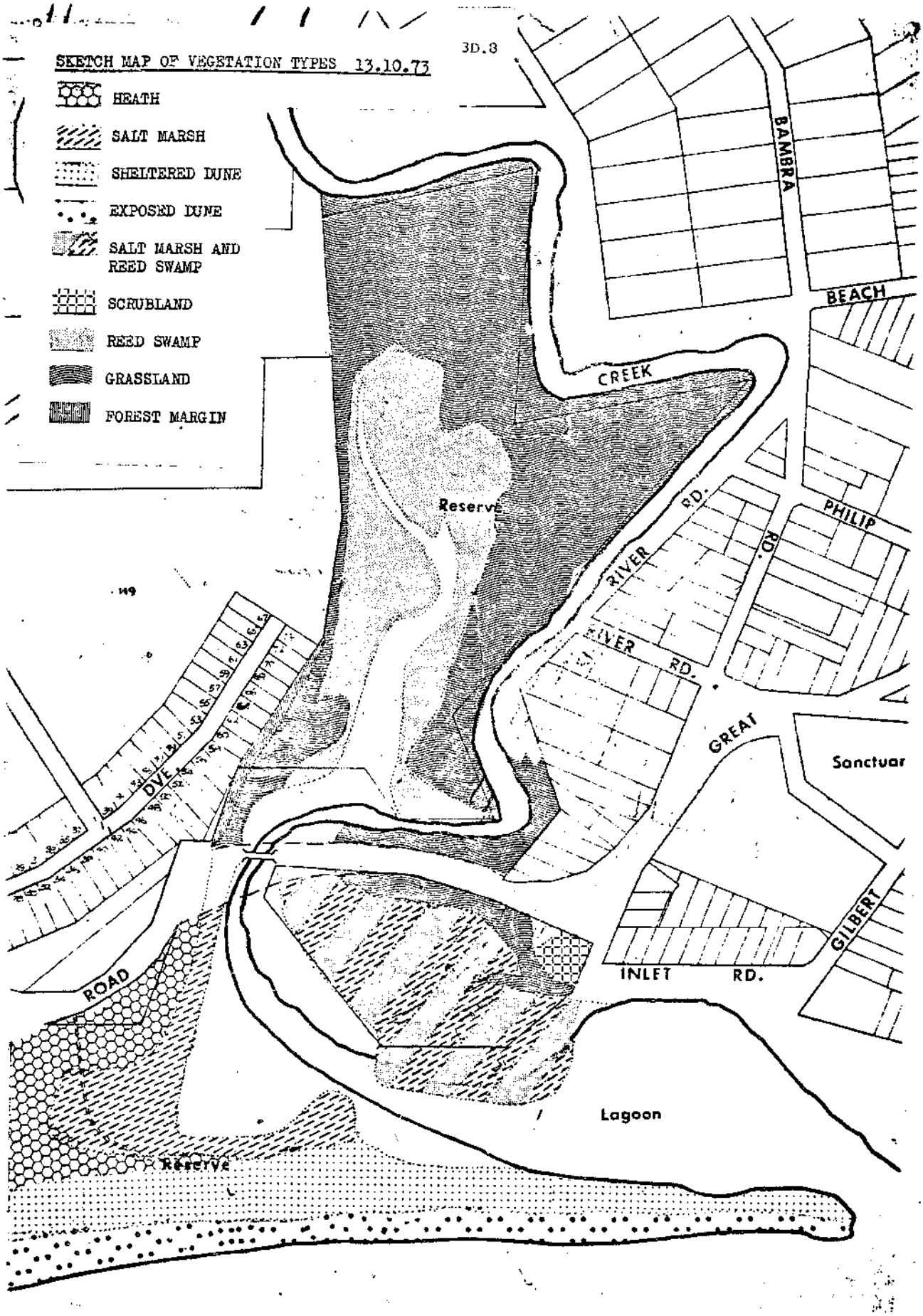
An abandoned building in the scrubland area is surrounded by many weed plants and garden escapees and there is evidence of rubbish dumping including a car wreck. A fox's hole was found in this area also.

The river flood plain appeared to be little used but an open storm water drain had recently been constructed from the Wybellena estate across the grassland to the river.

E. Conclusions

From a nature conservation point of view the most important part of the area studied is the heathland-saltmarsh-dune area west of the River. It has by far the greatest variety of land forms and plant species.

It includes the two most fragile land types - the saltmarsh and the dunes, and is at present the most heavily used area. Active steps will have to be taken if its conservation value is to be preserved. The heathland, which adds to the diversity of the area, is in poor condition due to road works and the recent invasion of bone seed. Unless corrective action is taken it will soon lose its conservation value.


SKETCH MAP OF VEGETATION TYPES 13.10.73
HEATH
SALT MARSH
SHELTERED DUNE
EXPOSED DUNE
SALT MARSH AND REED SWAMP
SCRUBLAND
REED SWAMP
GRASSLAND
FOREST MARGIN
BAMBRA
BEACH
CREEK
Reserve
RIVER RD.
PHILIP
RIVER RD.
GREAT
Sanctuar
DVE
ROAD
INLET RD.
GILBERT
Lagoon
Reserve

AIREYS INLET AND DISTRICT ASSOCIATION

ENVIRONMENT STUDIES ASSOCIATION OF VICTORIA

STUDY WEEK-END ON LAND USE AND TOWN PLANNING IN THE AIREYS INLET DISTRICT.

OCTOBER 12TH TO 14TH, 1973.

REPORT AND SUMMARY OF FINDINGS OF TOWN PLANNING GROUP

AIM OF GROUP

To appraise the planning of the Town and offer criticisms and suggestions.

Because of the limited time available, a study area was selected. This comprised an area bounded by Aireys St., in the north (including and imaginary continuation of Aireys St., westward of the Bambra Rd., to an intersection with the creek) Anderson St., Frazer Drive, Albert Ave., the Ocean Rd., southward to the rear of Richardsons Store and the creek.

It was agreed to make an appraisal of the town and then study four main points:-

1. Present uses of the township.
2. Future desirable uses.
3. Existing planning control,
4. Desirable planning measures.

DETAILS OF APPRAISAL

1. Present uses of Township

It was obviously necessary to conduct a survey of the study area and this was done by surveying the area systematically, making detailed observations of each allotment and noting these on an observation sheet. As surveys of this type would normally be made by persons expert in property appraisal, the results of this survey are intended only as a guide to further study and discussion. The survey did however highlight the following points:-

(a) Of 243 allotments surveyed, only 106 carried buildings. Thus in the area studied, almost 60% of the sites were undeveloped. (this compares to a figure contained in a report by the Shire Planning Officer and quotes by Mr. Pearce of 770 undeveloped sites out of a total of 1,038 in the entire "township" area, which is almost 75%.)

(b) Of the 106 sites which had been developed, approximately 20% carried buildings which were considered to be either structurally unsound or showing signs of poor maintenance. Although this was a subjective judgement by untrained assessors, the members of the group were unanimous on this point.

(c) Commercial sites are few and are restricted to two principal areas. The remainder of the town is devoted to home sites of which relatively few appear to be permanently occupied.

(d) There are several buildings of historic interest.

(e) Street layout is bad in some areas and the Ocean Road bisects the town and is a major hazard.

2. Future desirable uses.

The Group considered the most notable feature of the town to be the lack of commercial exploitation, and this coupled with the natural beauty of the surrounding area combines to provide an atmosphere which seems worthy of preservation. The continually increasing demand for week-end or vacation homes within easy reach of Melbourne almost pre-determines the future development of Aireys Inlet. Members of the group felt that although further development is inevitable the area should be allowed to develop slowly by bona-fide private development and not by speculative commercial real estate developers.

The area should be retained as a low population resort which will suit the demands of conservation conscious people. It should avoid reproducing the type of suburban conditions from which its residents are attempting to escape, and which are found in most other resort towns closer to Melbourne.

To this end, commercial sites should be restrained to the two present areas, minimum subdivision size should be increased from column 3 to column 5 (i.e. from 5,750 square feet to 8,500 square feet), services should be kept to minimum levels, roads should be sealed only where traffic density or steep grades make it essential, and some control should be exercised on the clearing of natural timber on building sites. Every effort should be made to encourage the building of houses which blend with the surrounding area.

3. Existing Planning Control.

Although both the Town and Country Planning Board and the Geelong Regional Planning Authority are concerned with coastal development, matters within the town itself come under the control of the Shire Council and the Country Roads Board. Recommendations for alterations to existing conditions should probably be directed initially to these two bodies.

4. Desirable Planning Measures.

The Group saw the need for future planning to encompass two broad objectives.

1. To retain as far as possible the peaceful atmosphere and natural beauty of the town.

2. To make such changes as will both improve the facilities of the town and ensure its future development along suitable lines.

The group did not generally support the theory proposed by Mr. Pearce, that because land is a scarce commodity town development should be along the lines of the best types of suburban high density development such as flats or multi-unit buildings. In general, support was given to the argument that one of the principal functions of a town such as Aireys Inlet is to provide an escape from suburban living and a quiet haven for retirement.

The Ocean Road was seen as a major hazard, both in its bisection of the town and in the unfortunately high speed limit. Every effort should be made to have the speed limit reduced to 35 m.p.h. and the possibility of a by-pass road should be the subject of future study. A by-pass road from (say) Urquharts Bluff to Moggs Creek would do a great deal to help preserve the township and environs of Aireys Inlet, and reduce the rapidly increasing pressures on beaches, cliffs, the river mouth and the sand dunes between the Inlet and Moggs Creek.

ANGAHOOK FOREST PARK

The 2916 hectare Angahook Forest Park was set aside and declared as such on March 26, 1970.

Vegetation: The vegetation of the park includes plant communities that have developed on the two major geological formations of the Otways (Tertiary and Cretaceous) under much drier climatic conditions that exist elsewhere in the region. The annual rainfall in the park area is less than 700 millimetres but exceeds 1000 millimetres in most other areas of the Otways.

Four major vegetation types are found in the park.

(i) Heathland - This is particularly rich in wildflower species. Shining peppermint *(Euc. nitida)* is the dominant tree species.
(ii) Ironbark forest type - red ironbark *(Euc. sideroxylon)* is the dominant eucalypt. Selected stands will be managed to maintain them as healthy and vigorous examples of this forest type.
(iii) Stringybark forest type - brown stringybark *(Euc. baxteri)* and messmate *(Euc. obliqua)* dominant.
(iv) Gum forest type - blue gum *(Euc. globulus)* and grey gum *(Euc. cypellocarpa)* dominant.

A dense melaleuca swamp covering about 1.2 hectares exists in Ferntree Gully as do an array of ferns including king fern and small groves of rough tree fern.

Fauna: The vegetation types provide a wide range of heath and forest habitats for native fauna.

Mammals known to occur in Distillery Creek are echidna, brown-pouched mouse, short-nosed bandicoot, ringtail possum, silver-grey possum, grey kangaroo, black-tailed wallaby, red-necked wallaby, koala and potoroo.

Birds of particular note which are regularly seen in the park include the powerful owl, white-throated nightjar, rufous bristlebird, southern emu-wren, and beautiful firetail.

Geology: The Eastern View Coal Measures are the predominant geological feature of the park. They comprise gravel, sand, clay and brown coal deposits laid down in the early Tertiary period. Most other Tertiary deposits in the Otways were deposited towards the close of the period.

Along the western margin of the park, rocks typical of the main Otway Range are exposed. They are arkose, felspathic sandstone and mudstone of Lower Cretaceous origin.

Small areas of Quaternary (recent) origin comprising fluviatile and swamp deposits of silt and gravel are found along Salt and Distillery Creeks.

COMMON PLANTS OF ANGAHOOK FOREST PARK

A list of some of the common plants of the park and the habitats in which they are most likely to be seen.

HABITATS

1 Red ironbark forest
2 Wetter stringybark-gum forest
3 Drier stringybark-gum forest
4 Wet gullies and along creeks
5 Heathland

SCIENTIFIC NAME	COMMON NAME	HABITAT				
		1	2	3	4	5
Cyathea australis	Rough Tree Fern				*	
Todea barbata	King Fern				*	
Blechnum nudum	Fishbone Fern				*	
Blechnum minus	Soft Water Fern				*	
Blechnum procerum	Hard Water Fern				*	
Lindsaya linearis	Screw Fern					*
Pteridium esculentum	Bracken	*	*	*	*	
Polystichum proliferum	Common Shield Fern				*	
Adiantum aethiopium	Common Maidenhair Fern				*	
Sticherus lobatus	Spreading Fan Fern				*	
Gleichenia circinta	Pouched Coral Fern				*	
Lycopodium deuterodensum	Bushy Club Moss			*		
Selaginella uliginosa	Swamp Selaginella					*
Tetrarrhena juncea	Wire Grass		*	*	*	
Poa australis	Tussock Grass	*		*	*	*
Gahnia radula	Thatch Saw Sedge	*	*	*		*
Gahnia sieberana	Brickmaker's Sedge				*	
Hypolaena fastigata	Tassel Rope Rush					*
Dianella revoluta	Spreading Flax Lily	*	*	*		
Lomandra filiformis	Wattle Mat Rush	*	*	*		*
Lomandra longifolia	Long Mat Rush		*		*	
Xanthorrhoea australis	Austral Grass Tree			*		*
Casuarina littoralis	Black Sheoke					*
Casuarina pusilla	Dwarf Sheoke					*
Persoonia juniperina	Prickly Geebung			*		*
Isopogon ceratophyllus	Horny Conebush			*		*
Banksia marginata	Silver Banksia			*		*
Hakea ulicina	Furze Hakea			*		*
Grevillea aquifolium	Holly Leaf Grevillea			*		
Exocarpus cupressiformis	Cherry Ballart	*	*			
Amyena pendula	Drooping Mistletoe	*	*	*		
Clematis aristata	Clematis				*	
Cassytha melantha	Large Dodder-laurel	*				*
Cassytha glabella	Tangled Dodder-laurel			*		*
Drosera whittakeri	Scented Sundew			*		

SCIENTIFIC NAME	COMMON NAME	HABITAT				
		1	2	3	4	5
Bursaria spinosa	Sweet Bursaria	*	*			
Acaena anserinfolia	Bidgee Widgee		*			
Acacia dealbata	Silver Wattle			*		
Acacia diffusa	Spreading Acacia	*		*		*
Acacia stricta	Hop Wattle		*			
Acacia verniciflua	Varnish Acacia	*		*		
Acacia myrtifolia	Myrtle Wattle			*		
Acacia melanoxylon	Blackwood				*	
Acacia verticillata	Prickly Moses	*	*	*	*	*
Acacia mucronata	Sallow Wattle		*	*		
Acacia suaveolens	Sweet Wattle					*
Pultenea daphnoides	Long Leaf Bush Pea	*	*			
Dwillwynia glaberrima	Heathy Parrot Pea					*
Daviesia brevifolia	Leafless Bitter Pea					*
Platylobium obtusangulum	Common Flat Pea			*		*
Goodia latifolia	Golden Tip				*	
Indigofera australis	Austral Indigo	*				
Kennedya prostrata	Running postman					*
Geranium pilosum	Cut-leaf Crane's Bill	*			*	
Oxalis corniculata	Yellow-wood Sorrel		*			
Tetratheca ciliata	Pink Eye			*		
Amperea xiphoclada	Broom Spurge			*		
Pomaderris apetala	Hazel Pomaderris				*	
Pomaderris elliptica	Oval Pomaderris	*				
Spyridium parvifolium	Dusty Miller	*				
Hibbertia fasciculata	Bundled Guinea Flower					*
Viola hederacea	Ivy-leaf Violet	*	*			
Eucalyptus baxteri	Brown Stringybark			*		
Eucalyptus obliqua	Messmate		*	*		*
Hibbertia stricta	Erect Guinea Flower					
Eucalyptus sideroxylon	Red Ironbark	*				
Eucalyptus viminalis	Manna Gum				*	
Eucalyptus ovata	Swamp Gum		*			
Eucalyptus cypellocarpa	Grey Gum		*		*	
Eucalyptus globulus	Southern Blue Gum	*			*	
Eucalyptus bicostata	Victoria Blue Gum		*			
Eucalyptus radiata	Narrow Leaf Peppermint		*			
Eucalyptus nitida	Shining Peppermint					*
Eucalyptus aromaphicia	Apple Box		*	*		
Leptospermum juniperinum	Prickly Tea Tree			*		*
Leptospermum myrsinoides	Silky Tea Tree					*
Melaleuca squarrosa	Scented Paper Bark				*	
Haloragis tetragyna	Raspwort		*	*	*	
Hydrocotyl hirta	Hairy Pennywort		*			
Epacris impressa	Common Heath	*	*	*		*
Astroloma humifusum	Cranberry Heath	*				
Styphelia serrulata	Honey Pot	*	*	*		
Monotoca scoparia	Prickly Broom Heath			*		*
Leucopogon ericoides	Pink Beard Heath					*
Centaurium palchellum	Asustral Centaury	*	*			
Prostanthera lassianthos	Christmas Bush				*	
Plantago varia	Variable Plantain	*				
Coprosma quadrifida	Prickly Currant Bush				*	
Goodenia ovata	Hop Goodenia	*			*	
Olearia lyrata	Snowy Daisy Bush				*	
Olearia myrsinoides	Silky Daisy Bush		*			
Olearia lepidophylla	Club Moss Daisy Bush			*		
Olearia argophylla	Musk Daisy Bush				*	
Cassinia aculeata	Common Cassinia(Dogwood)	*			*	
Helichrysum obcordatum	Grey Everlasting			*		
Senecia lautus	Groundsel	*	*			

LIST OF VASCULAR PLANTS NOTED IN THE ANGLESEA AND AIREYS INLET DISTRICT

by J. H. Willis

also

FUNGI NOTED IN ANGAHOOK FOREST PARK

by J. H. Willis

To 12/10/45: 432 indig. & 80 alien spp. 1.

LIST OF VASCULAR PLANTS NOTED IN THE ANGLESEA & AIREY'S INLET DISTRICTS

(including Angahook Forest Park) → (P.19), incl. unmarked orchids.

Information from various observers, 1943 → (Orchid records from 1928)

* Denotes a naturalized alien species.

(P19) ← ✓ " " " species in Angahook Forest Park. (202 spp.)

(P20) ← † " " " species in Reserve for Native Flora, adjoining Eumerella Scout Camp, 285 ac.

Unmarked species are in (P20), excepting unmarked orchids which are in (P19)

FERNS & FERN ALLIES (28 spp.)

Selaginellaceae
✓ Selaginella uliginosa

Lycopodiaceae
✓ Lycopodium deuterodensum

Osmundaceae
✓ Todea barbara

Schizaeaceae
Schizaea
asperula
bifida
fistulosa

Gleicheniaceae
Gleichenia
✓ dicarpa (non circinnata)
microphylla

✓ Sticherus tener (non S. lobatus)

Hymenophyllaceae
Hymenophyllum
✓ cupressiforme

Cyatheaceae
✓ Cyathea australis

✓ Dicksonia antarctica

Culcita dubia

Dennstaedtiaceae
Hypolepis
✓ ?punctata (Moggs Ck.)

†✓ Pteridium esculentum

✓ Histiopteris incisa

Lindsaeaceae
†✓ Lindsaea linearis

Adiantaceae
✓ Adiantum aethiopicum

✓ Pellaea falcata

✓ Cheilanthes tenuifolia

Aspidiaceae
✓ Polystichum proliferum (Moggs Ck.)

Aspleniaceae
✓ Asplenium flabellifolium

Blechnaceae
Blechnum
✓ cartilagineum
✓ Chambersii (syn. lanceolatum)
✓ nudum
✓ minus
✓ wattsii (non. procerum)

✓ Doodia media (Moggs Ck.)

SEED PLANTS

CONIFERS

*Pinaceae
* Pinus
* caribaea
* pinaster
† * radiata

FLOWERING PLANTS

MONOCOTYLEDONS

Juncaginaceae
Triglochin procera (mouth Anglesea R.)

Gramineae (27 indig. spp.)
* Ehrharta
* longiflora

†✓ Microlaena stipoides

Tetrarrhena
✓ distichophylla
✓ juncea

* Briza
* maxima
* minor

* Dactylis glomerata

Puccinellia stricta (mouth Anglesea R.)

* Catapodium rigidum

Distichlis distichophylla (mouth Anglesea R.)

Poa
†✓ Sieberana
✓ labillardieri
* annua

† * Vulpia bromoides

* Lolium
* perenne

Gramineae (contd.)

Bromus
* unioloides
* mollis

Agropyron scabrum

* Hordeum
* hystrix

* Parapholis incurva (mouth Anglesea R.)

* Aira caryophyllea

* Holcus lanatus

* Ammophila arenaria (dunes)

Dichelachne
crinita
micrantha (syn. sciurea)

Deyeuxia
† ✓ quadriseta

Agrostis
* semiverticillata
* tenuis
billardieri
† avenacea

* Polypogen
* monspeliensis

* Lagurus ovatus

Amphipogon
strictus var. setifer

Eragrostis brownii

Sporobolus
* africanus
virginicus (mouth Anglesea R.)

Phragmites
australis (syn. communis) (mouth Anglesea R.)

Danthonia
✓ pallida
† geniculata
† setacea
† eriantha

Stipa
† semibarbata
elatior
† pubescens

Paspalum
* dilatatum

* Pennisetum
* clandestinum

* Stenotaphrum
* secundatum

Spinifex hirsutus (dunes & beach)

Hemarthria uncinata

✓ Themeda australis

Cyperaceae (27 indig. spp.)

Cyperus
tenellus
lucidus
* eragrostis

Scirpus
nodosus
antarcticus
cernuus
inundatus

Cyperaceae (contd.)

✓ Tetraria capillaris

Schoenus
† breviculmis
brevifolius
tenuissimus
✓ apogon
turbinatus (± 9 miles W. of Anglesea)

Baumea [Cladium]
✓ tetragona
† acuta
juncea

Gahnia
✓ ? clarkei
✓ sieberana
filum (mouth Anglesea R.)
† ✓ radula

Lepidosperma
† gladiatum (sea cliffs)
† concavum
congestum
✓ elatius
✓ laterale (narrow- & broad-leaved)
† semiteres
filiforme

Tricostularia
pauciflora

✓ Caustis pentandra

Restionaceae

† ✓ Hypolaena fastigiata

Empodisma minus [syn. Calorophus laterriflorus]

Centrolepidaceae

Centrolepis
aristata
fasciculuris
† strigosa

52-16

Juncaceae
Luzula
✓ 'campestris' (agg.)
Juncus
maritimus (mouth Anglesea R.)
✓ pauciflorus (Moggs Ck.)
† ✓ pallidus
* capitatus
planifolius
† caespiticius
bufonius
homalocaulis
holoschoenus

Liliaceae (18 spp.)
Xanthorrhoea
† ✓ australis
minor (Enid Bowerman Reserve)
Lomandra
† micrantha
✓ filiformis
† ✓ multiflora
✓ longifolia
Chamaescilla
† ✓ corymbosa
Caesia parviflora

Dichopogon strictus
Thysanotus
† ✓ patersonii
? tuberosus
† dichotomus

Bulbine bulbosa

Liliaceae (contd.)
Tricoryne elatior
Laxmannia
† sessiliflora

Dianella
† ✓ revoluta

Anguillaria dioica
Burchardia
† ✓ umbellata

Hypoxidaceae
Hypoxis glabella

Iridaceae
* Romulea longifolia
* Sisyrinchium
* iridifolium
Patersonia
† fragilis
✓ longiscapa (+ Gum Flat)
* Ixia polystachya
* Sparaxis grandiflora
* Gladiolus
* cuspidatus

Orchidaceae (71 spp.)
Thelymitra
grandiflora
✓ pauciflora
† aristata
ixioides
mucida (Gum Flat - r.)
matthewsii
† rubra
carnea
fusco-lutea
flexuosa
† tenuifera

Orchidaceae (contd.)
Calochilus
campestris
herbaceus (syn. saprophyticus)
robertsonii

Diuris
longifolia
maculata
sulphurea

Orthoceras strictum
Microtis
unifolia

Prasophyllum
despectans
nigricans
† morrisii
archeri
brevilabre
australe
elatum
odoratum
patens
frenchii

Caleana major
Paracaleana minor
Arthrochilus huntianus
[Spiculaea huntiana]
(near Gum Flat)
Chiloglottis
reflexa

Acianthus
caudatus
reniformis
† ✓ exsertus
Eriochilus cucullatus
Lyperanthus
† nigricans
suaveolens
Leptoceras fimbriatum

Orchidaceae (contd.)

Caladenia
✓ menziesii
† dilatata
patersonii
clavigera
tessellata
✓ reticulata
deformis
latifolia (mouth Anglesea R.)
✓ carnea (2 forms)
congesta
angustata
✓ iridescens
tutelata (hybrid of Glossodia)
✓ Glossodia major
Corybas
diemenicus
dilatatus
unguiculatus

Pterostylis
✓ barbata
† parviflora
foliata
alpina
alata
concinna
pedunculata
† ✓ nana
nutans
curta
† longifolia
† vittata

Gastrodia sesamoides
Dipodium punctatum

DICOTYLEDONS

Casuarinaceae
Casuarina
† stricta
✓ littoralis (Ironbark Gorge)
† ✓ pusilla

Proteaceae
✓ Persoonia juniperina
† ✓ Isopogon ceratophyllus
Conospermum mitchellii
✓ Grevillea aquifolium (loc.)
Hakea
✓ ulicina
sericea (rare)
† ✓ Lomatia ilicifolia
† ✓ Banksia marginata

Santalaceae
Exocarpos
✓ cupressiformis

Loranthaceae
Muellerina
✓ eucalyptoides (on Euc. cypellocarpa)
Amyema pendulum
† ✓ (on Euc. obliqua)

Polygonaceae
Rumex
* crispus
✓ brownii (Mogg's Ck.)
* acetosella
Polygonum
* aviculare
✓ minus (Mogg's Ck.)
Muehlenbeckia
adpressa

Chenopodiaceae
Hemichroa pentandra (mouth Anglesea R.)
Rhagodia
† baccata (cliffs & flats on Anglesea R.)
nutans
Chenopodium
Enchylaena tomentosa
Threlkeldia diffusa
Salicornia quinqueflora (mouth Anglesea R.)

Amaranthaceae
Ptilotus
macrocephalus (Noble & Jacksons Sts., Anglesea-r.)

Aizoaceae
Carpobrotus
† rossii (cliffs)
Tetragonia
† implexicoma (cliffs & Anglesea R. flats)

Portulacaceae

Caryophyllaceae
Spergularia media (mouth Anglesea R.)
Stellaria
✓ pungens
✓ flaccida

Ranunculaceae
- Clematis
  - microphylla
  - ✓ aristata
- Ranunculus
  - * repens
  - ✓ rivularis (Moggs Ck.)

Cassythaceae (from Lauraceae)
- Cassytha
  - † ✓ glabella
  - † ✓ melantha
  - † pubescens

*Fumariaceae
- * Fumaria bastardii

Cruciferae
- * Raphanus
  - * raphanistrum
- Cakile
  - maritima (beaches)
  - edentula (" ")
- Cardamine
  - * hirsuta

Droseraceae
- Drosera
  - † ✓ planchonii
  - † ✓ auriculata
  - peltata
  - glanduligera
  - pygmaea
  - † ✓ whittakeri

Crassulaceae
- Crassula,
  - sieberana
  - macrantha

Tremandraceae
- Tetratheca
  - ✓ ciliata
  - ? ericifolia

Pittosporaceae
- Bursaria
  - † ✓ spinosa (large-leaved coastal & small-leaved inland forms)
- Marianthus,
  - ✓ procumbens (Ironbark Gorge)
- Cheiranthera
  - ✓ linearis (Distillery Ck.)
- ✓ Billardiera scandens
- * Pittosporum undulatum (introd.)

Rosaceae
- Rubus
  - parvifolius
  - ? * procerus
- Acaena
  - † ✓ anserinifolia
  - ovina

Mimosaceae (16 indig. spp.)
- * Albizia lophantha
- Acacia
  - ~~verticillata~~
  - acinacea (Scout Camp area)
  - † armata
  - † ✓ dealbata
  - ✓ genistifolia (syn. diffusa)
  - gunnii (syn. vomeriformis)
  - longifolia var. Sephcrae (constat)
  - mearnsii
  - ✓ melanoxylon
  - ✓ mucronata var. longifolia
  - ✓ myrtifolia
  - oxycedrus
  - † ✓ pycnantha
  - ✓ stricta (Moggs Ck.)
  - ✓ suaveolens
  - † ✓ verniciflua
  - † ✓ verticillata († var. ovoidea — coastal heaths)

Papilionaceae (31 indig. spp.)
- Gompholobium
  - † ebstatum
  - huegelii
- Sphaerolobium vimineum
- Viminaria juncea
- Daviesia
  - ✓ virgata (Ironbark Gorge)
  - † ✓ brevifolia
- Pultenaea
  - ✓ daphnoides
  - gunnii
  - † ✓ humilis
  - ✓ juniperina var. planifolia (Moggs Ck.)
  - largiflorens
  - ✓ ? laxiflora (Lookout Hill)
  - † mollis (angustifolia form - Lookout Hill)
  - † ✓ scabra
  - stricta
  - tenuifolia
- Aotus ericoides
- Dillwynia
  - cinerascens
  - † ✓ glaberrima
  - hispida
  - ? retorta
  - ✓ sericea
- Platylobium
  - † ✓ obtusangulum († var. spinulosum — N.E. of Peters Hill)
- Bossiaea
  - prostrata
  - cinerea
- ✓ Hovea heterophylla
- ✓ Goodia lotifolia
- * Teline (from Genista)
  - * linifolia
- * Chamaecytisus
  - * prolifer

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Papilionaceae (contd.)

* Medicago
  * polymorpha
* Melilotus indica (near sea)
* Trifolium
  * arvense
  * dubium
  * campestre
  * glomeratum
  * repens
  * subberraneum

Lotus
* corniculatus

✓ Indigofera australis

Swainsona
lessertiifolia (coastal cliffs & dunes)

* Vicia
  * sativa
  * angustifolia

✓ Kennedia prostrata

Hardenbergia violacea

* Dolichos lignosus (coast)

Geraniaceae

Pelargonium
australe

Geranium
✓ Solanderi (near G. pilosum)

Oxalidaceae

Oxalis
✓ corniculata
* purpurea

Zygophyllaceae

Zygophyllum
billardieri (coastal cliffs)

Rutaceae

Boronia nana

Correa
alba (sea cliffs)
† ✓ reflexa

Polygalaceae

Polygala
* myrtifolia

Comesperma
✓ volubile
ericinum
calymega

Euphorbiaceae

Phyllanthus
✓ hirtellus

Poranthera
microphylla

† ✓ Amperea xiphoclada

Stackhousiaceae

✓ Stackhousia monogyna

Rhamnaceae

Pomaderris
✓ aspera
† oraria (coastal cliffs)
✓ ferruginea (Ironbank Gorge (near P. ellipitica) & Point Addis road)
✓ elachophylla

Spyridium
✓ parvifolium
† vexilliferum (low coastal heaths)

† Cryptandra tomentosa

Malvaceae

✓ Gynatrix pulchella (Moggs Ck.)

Lawrencia spicata (salt marsh at mouth of Anglesea R.)

Sterculiaceae

Lasiopetalum baueri (sea cliffs at Scout Camp area)

Thomasia petalocalyx (heath near sea cliffs)

Dilleniaceae

Hibbertia
† ✓ fasciculata
† ✓ australis
✓ stricta
aciculariis
† sericea

Hypericaceae

Hypericum
† ✓ gramineum

Elatinaceae

✓ Elatine gratioloides

Violaceae

Viola
† ✓ hederacea
† ✓ sieberana

Thymelaeaceae

Pimelea
? glauca
✓ humilis
† ✓ linifolia
octophylla
phylicoides
serpyllifolia (sea cliffs)

Myrtaceae (20 spp.)
Eucalyptus
✓ aromaphloia
✓ baxteri
✓ bicostata
✓ globulus (Moggs Ck.)
† goniocalyx (syn. cluecophora)
✓ Cypellocarpa
macrorhyncha
✓ nitida (non dives)
† ✓ obliqua
† ✓ ovata
✓ radiata
† ✓ Sideroxylon (Ironbark Gorge)
✓ viminalis
(+ var. racemasa)

Leptospermum
(?) * laevigatum (introd. near coast)
† ✓ myrsinoides
† ✓ juniperinum

Melaleuca
✓ squarrosa
† lanceolata (mouth Anglesea R. and sea cliffs)

Baeckea
✓ ramosissima (Scout Camp area)
✓ sp. (very small white pendent flowers)

Calytrix tetragona (N. of Urquharts Bluff & W. of Mt. Ingoldsby)

Lythraceae
✓ Lythrum hyssopifolia (Moggs Ck.)

Onagraceae
Epilobium
✓ billardierianum (Moggs Ck.)

Haloragaceae
Haloragis
✓ micrantha
✓ teucrioides
† ✓ tetragyna

Umbelliferae
Hydrocotyle
† ✓ laxiflora
✓ hirta
sibthorpioides
✓ foveolata (+ Scout Camp area)

Platysace
✓ heterophylla

Trachymene
? anisocarpa

† Xanthosia pusilla

Apium prostratum (cliffs & mouth Anglesea R.)

Ericaceae
* Erica lusitanica

Epacridaceae (15 spp.)
Epacris
† ✓ impressa
obtusifolia

Sprengelia incarnata
† ✓ Astroloma humifusum

Leucopogon
† ✓ virgatus
✓ ericoides
† parviflorus (coast)
✓ glacialis (Lookout Hill)

✓ Lissanthe strigosa (+ Scout Camp area)

Monotoca
✓ scoparia
elliptica (coast)

Epacridaceae (contd.)
Acrotriche
† ✓ serrulata
affinis (sea cliffs)
✓ prostrata

Brachyloma
ciliatum

Primulaceae
* Anagallis
* arvensis (+ var. caerulea)

Samolus repens (mouth of Anglesea R.)

Loganiaceae
Mitrasacme pilosa

Gentianaceae
* Cicendia
* filiformis

Sebaea
albidiflora (mouth of Anglesea R.)

Centaurium
* minus
† ✓ * pulchellum

Apocynaceae
Alyxia buxifolia (sea cliffs)

Boraginaceae
Cynoglossum
australe (cliffs)
suaveolens

Convolvulaceae
† ✓ Dichondra repens

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Solanaceae

Lycium
* ferocissimum

Solanum
laciniatum (sea front)
* nigrum

Scrophulariaceae

† Gratiola latifolia

✓ Mazus pumilio (Moggs Ck.)

Veronica
gracilis
✓ calycina

Parahebe
✓ derwentiana (Moggs Ck.)

Labiatae

Prostanthera
✓ lasianthos (Distillery Ck. & Ironbark Gorge)
nivea (Point Addis road)

Mentha
✓ australis (Moggs Ck.)

Myoporaceae

Myoporum
insulare (coast)
✓ viscosum (Moggs Ck.)

Plantaginaceae

Plantago
* lanceolata
✓ varia
* coronopus (mainly coastal)

Rubiaceae

Opercularia
† ✓ varia
† ovata

Coprosma
✓ hirtella (Ironbark Gorge)
✓ quadrifida (Distillery Ck.)

Asperula
✓ conferta

Campanulaceae

Wahlenbergia
gracilenta
quadrifida
gymnoclada
✓ stricta

Lobeliaceae

✓ Pratia pedunculata (Ironbark Gorge)

Lobelia
✓ gibbosa
alata (coastal marsh)

Goodeniaceae

Goodenia
† ✓ ovata
† ✓ geniculata
✓ lanata

Selliera radicans (mouth Anglesea R.)

Scaevola pallida

Brunoniaceae

Brunonia australis

Stylidiaceae

Stylidium
✓ graminifolium
perpusillum
inundatum

Leveenhookia dubia

Compositae (43 indig. spp.)

Lagenophora
✓ gracilis

Brachycome
uliginosa
graminea (salt-marsh at mouth Anglesea R.)
multifida (Ironbark Gorge)

* Aster subulatus (mouth of Anglesea R.)

* Conyza
✓ * canadensis (Moggs Ck.)

Vittadinia trilobа

Olearia
✓ argophylla (Distillery Ck. & Ironbark Gorge)
✓ axillaris (coastal cliffs & dunes)
✓ ? lepidophylla
✓ lirata (Ironbark Gorge etc.)
✓ myrsinoides
pannosa (Point Addis road - v. rare)
ramulosa
✓ teretifolia

Gnaphalium
* candidissimum
luteo-album
involucratum
† ✓ japonicum
* ? purpureum

✓ Cassinia aculeata

Compositae (contd.)

Helichrysum
apiculatum
scorpioides
?rutidelepis
obtusifolium

† paralium (coastal cliffs & dunes)
† ✓ dendroideum
✓ obcordatum

Leptorhynchos
linearis
squamatus

Rutidosis
multiflora

† Ixodia achilleoides

Calocephalus brownii (coastal cliffs)

Craspedia glauca

✓ Sigesbeckia orientalis (Moggs Ck.)

Cotula
coronopifolia } both in salt marsh, mouth of Angleseark.
reptans }

Senecio
✓ linearifolius
✓ vellioides (Cronbark Gorge)
✓ * elegans (coastal dunes)
lautus
† quadridentatus
† ✓ hispidulus
? glomeratus
squarrosus

Bedfordia
arborescens (Cronbark Gorge)

* Chrysanthemoides
* monilifera

* Arctotheca
* calendula

✓ * Cirsium vulgare

Microseris scapigera

* Hypochoeris
* radicata

* Picris echioides

Sonchus
* oleraceus
✓ * asper
† megalocarpus (coastal cliffs & dunes)

Compiled by
J.H. Willis
12/10/1975

FUNGI NOTED IN ANGAHOOK FOREST PARK, during E.S.A.V. course at Anglesea, 11 & 12 Oct. 1975.

† = previous records outside the Reserve.

AGARICOID

Agaricus vinaceus

Amanita
- pulchella
- umbrinella

Cortinarius
- fibrillosus
- sp. (small, brown, in Dermocybe section)

Flammula excentrica

Hygrophorus miniatus

Inocybe sp. (flat-topped)

Laccaria laccata

Mycena
- ?subcapillaris (white, pinhead-size)
- viscido-cruenta

Omphalia chromacea

Pleurotus nidiformis (luminous) — on ironbark stumps.

Russula
- emetica
- mariae

Schizophyllum commune

BOLETOID

† Boletellus ananas [?syn. Strobilomycesananiceps) — Eumeralla Scout Camp, 3.5.1964

POLYPOROID

Dictyopanus rhipidium

Phellinus gilvus

Trametes cinnabarina [syn. Pycnoporus coccineus]

HYDNOID

Hydnum repandum [syn. Dentinum crocideus]

THELEPHOROID

Stereum
- fasciatum [syn. S. lobatum]
- hirsutum
- vellereum

GASTEROMYCETES

OTHER GROUPS

Heterotextus peziziformis

Discina terrestris

† Underwoodia beatonii — under Melaleuca lanceolata, on S. side of Anglesea River mouth, 18.8.1968.

J.A. Willis
13/10/1975.

APPENDIX 3H

PLANTS AT THE LOOKOUT OCTOBER 11TH 1977

	Common: Name	Botanical Name	Comments
Lilies etc.	Blue Squill	*Chamaescilla corymbosa*	Bright blue, opens in sun.
	Milkmaids	*Burchardia umbellata*	White flowers, umbels, pink und
	Many-flowered Mat-rush	*Lomandra multiflora*	Masses or tiny yellow flowers.
	Twining Fringe-lily	*Thysanotus patersonii*	Purple, twining, opens in sun.
	Black-anther Flax-lily	*Dianella revoluta*	Deep blue, anthers black
	Short Purple Flag	*Patersonia fragilis*	Stalks very short, flowers low.
	Dwarf Wire-lily	*Laxmannia sessiliflora*	Low plant, 3 petalled white flowers.
Orchids	Wallflowers	*Diuris longifolia*	Orange and brown, (called donkey).
	Twisted Sun-orchid	*Thelymitra feluosa*	Small, yellow, stem twisted.
10.	Dotted " "	*T. ixioides*	Blue or purple, dots on petals.
	Salmon " "	*T. rubra*	Salmon colour.
	Slender " "	*T. pauciflora*	Flowers pale, open only in sun.
	Rabbit's Ears	*T. antennifera*	Pale gold, black antenna.
	Fringed Spider	*Caladenia dilatata*	Green, purple stripes.
Grass	Kangaroo Grass	*Themeda australis*	Tall, nodding heads.
Sedge	Elegant Spear Grass	*Stipa elegantissma*	Shining spreading heads.
	Grey-beard Grass	*Amphopogon strictus*	Green mat, seldom flowers.
	Thatch Saw-sedge	*Gahnia radula*	Black, leaves with saw edge.
Dicots			
	Dwarf Sheoak	*Casuarina pusilla*	Male and female plants.
20.	Horny Conebush	*Isopogon ceratophyllus*	Flowers in yellow brushes.
	Silver Banksia	*Banksia marginata*	Underleaves silver, flowers yellow.
	Tangled Dodder-laurel	*Cassthya glabella*	Thin tangledstems, red fruits.
	Sundew	*Drosera auriculata*	Carnivorous, pale pink flowers.
	Scented Sundew	*D. whittakerii*	Red rosettes, white flowers done.
	Common Apple-berry	*Billiardera scandens*	Lemon bells, twining stems.
PEAS	Dwarf Bush Pea	*Pultenea humilis*	Bright orange-red flowers.
	Creeping Bossiaea	*Bossiaea prostrata*	Small yellow flowers.
	Little-red-riding-hoods	*Gompholobium ecostatum*	Orange red hoods.
	Running Postman	*Kennedia prostrata*	Bright red flowers, prostrate.
30.	Common Aotus	*Aotus ericoides*	Almost finished, yellow-red flowers.
	Showy Parrot-pea	*Dillwynia glaberrima*	Divided standard, healthy leaves.
	Common Flat-pea	*Platylobium obtusecongulum*	Pointed leaves, yellow flowers.
	Leafless Globe-pea	*Sphaerolobium vinimium*	Yellow flowers along stalks.
	Love creeper	*Comesperma volubile*	Twining blue flowers.
	Blue Milk-wort	*C. calymega*	Spikes of blue flowers.
	Black-eyed Susan	*Tetratheca ciliata*	Pinky-mauve bells.
	Scented Candles	*Stackhousia monogyna*	Creamy stalks of flowers.
	Propeller Bush	*Spyridium vexiliferum*	3 Cream bracts, flowers in centre.
	Erect Guinea-flower	*Hibbertia stricta*	Golden flowers, thin leaves.
40.	Silky Guinea-flower	*H. sericea*	Golden flowers, wider leaves.
	Small St. John's wort	*Hypericum graminicum*	Orange, erect flowers.
	Wild Violet	*Viola hederacea*	White & purple flowers.
	Woolly Rice Flower	*Pimelia octophylla*	Cream heads, very downy. nodg.
	Dwarf Rice-flower	*P. humilis*	White heads, short stems.
	Messmate stringy-bark	*Eucalyptus obliqua*	Stunted form.
	Silky Tea-tree	*Leptospermum sericea*	White, prostrate, some pink.
	Coastal Tea-tree	*L. laevigeratum*	White flowers, greyish leaves.
	Prickly Tea-tree	*L. juniperinum*	White flowers, prickly leaves.
	Centurium pulchellum	*Century*	Pink flowers, stalks erect.
50.	Goodenia geniculata	*Bent Goodenia*	Yellow flowers, stalks bend.
	Small-fruit Fan-flower	*Scaveola albida*	Pale blue flowers, mat bush.
	Grass Trigger-plant	*Stylidium graminifolium*	Pale, stalks of flowers, senste.
	Curling Everlasting	*Helychrysum scorpioides*	Yellow, curled petals.
Daisies	Blunt Everlasting	*H. obtusifolium*	White clusters, yellow centres.
	Common Everlastings	*H. apiculatum*	Orange, small clusters.
	Yam	*Microseris scapigera*	Yellow, like dandelion but leaves thinner and more erect.
	Cypress-leaf Daisy-bush	*Olearia teretifolia*	Masses white flowers, head compact.
	Scaly Buttons	*Leptorhynchus squamatus*	Yellow button heads, stems1'.
	White-beard Heath	*Leucopogon virgatis*	White, fluffy, tiny flowers.
60.	Prickly Cryptandra	*Cryptandra tomentosa*	Flowers white, later reddish.

Extract from Report for F.C.V. APPENDIX 31

by R. D. Cowley

NOTES ON THE OTWAY RANGES

(i) Mountain forest: This is defined as all mountain ash forest and adjoining mixed species forests where the mature stand height exceeds 130 ft. This coincides closely with the boundary of the high rainfall understorey species such as musk (Olearia argophylla). The 130 ft. boundary corresponds roughly with the 60 inch rainfall isohyet on the northern slopes of the Otway ridge and the 45 inch rainfall isohyet on the southern slopes.

Predominant species are Eucalyptus regnans, obliqua, viminalis, ovata, globulus and cypellocarpa.

There are about 91,000 acres of mountain forest on reserved forest in the Otways and about 11,000 acres on Crown Land, giving a total of about 102,000 acres.

(ii) Foothill forest: This is defined as all forest with a mature stand height of 50 and 130 ft.

Predominant species are Eucalyptus obliqua, cypellocarpa (mainly on northern side of the ridge), globulus (mainly on southern side of the ridge), baxteri, viminalis and radiata.

There are about 127,000 acres of foothill forest on reserved forest in the Otways and about 21,000 acres on Crown land, giving a total of about 148,000 acres.

(iii) Unproductive forest: This is defined as all areas in which the mature stand height is less than 50 ft.

Predominant species are Eucalyptus baxteri, dives and nitida.

Unproductive forests fall into two categories:

(i) dense but stunted tree cover on exposed coastal situations,

(ii) predominantly heathland with a relatively open cover of stunted trees on poor soils which have developed in many areas on Tertiary sediments.

There are about 19,000 acres of unproductive forest on reserved forest in the Otways and about 36,000 acres on Crown land giving a total of about 55,000 acres.

UNUSUAL FEATURES

The ecology of the Otways has never been studied in any detail. While superficially resembling mountain forests of the Central Highlands and South Gippsland, the Otway forests are quite unique. They have been isolated from other mountain areas of Victoria for about 3 million years by the basalt plains which extend west from Port Phillip Bay, and they have been isolated from Tasmania for about 1 million years by the flooding of Bass Strait at the end of the Great Ice Age.

The Otway forests include some of the highest rainfall communities in Victoria. They are the western limit of many plantand animal species found along the east coast and Dividing Range of Australia.

A few of the many strange features of the Otways that require study and explanation are:-

(i) presence of species found only in the Otways, for example: Leptorhynchus gatesii (a button flower from Lorne, Victaphanta compacta (the Otway snail).

(ii) presence of varieties of certain species found only in the Otways, for example:
Platylobium obtusangulum var. spinulosum (a flat pea from Anglesea heathland) and a fleshy round leaf form of Acacia myrtifolia from Cape Otway.

(iii) absence of Atherosperma moschatum (sassafras) which occurs in all other mountain forests of Victoria and Tasmania.

(iv) presence of kingparrot, satin bower bird, yellow bellied (or fluffy) glider and sugar glider in the Otways and other Victorian mountain forest but not in Tasmania.

(v) widespread presence of Phebalium squamea (satin box) and isolated occurrences of other species such as Correa backhousiana which occur in Tasmania but nowhere else in Victoria.

(vi) absence of lyrebird, pilot bird and greater glider from both Otways and Tasmania although habitat appears to be suitable.

(vii) presence of species apparently confined to Otways and Grampians for example, Leucopogon glacialis (a bearded heath) Conospermum mitchelli and the smoky mouse (Pseudomys fumeus).

(viii) isolated occurrence of Victorian species known from only a few localities for example: Eucalyptus kitsoniana, Cyathea marcescens (skirted tree fern).

(ix) isolated western occurrence of Gippsland plant species such as Boronia muelleri (near Glenaire), Helischrysum rogersiana (Carlisle heathland), Sarcochilus australis (Butterfly orchid).

(x) presence of Eucalyptus sideroxylon but not E. leucoxylon and E. hemipholia which are usually associated with it.

FAUNA

Very little is known about most native animals in the Otways. Even the distribution of the smaller and less conspicuous species is not known. Apart from ensuring that examples of all major habitat types are left in a reasonably natural condition (ecological reserves) the greatest contribution foresters can make to wildlife conservation is to help obtain and record some of the basic information on species present, their distribution, abundance and apparent habitat preference.

MAMMALS

(i) POTOROO. This animal is the smallest and most primitive living member of the kangaroo family.

Once common over much of coastal south-eastern Australia it is now regarded as quite uncommon. The species is plentiful and widespread in the Otways which appears to be one of its remaining strongholds. Its favoured habitat is damp localities with dense undergrowth.

(ii) TIGER CAT. Formerly widespread over its mainland range which extended from south-eastern South Australia to Northern Queensland this species is now quite uncommon. The Otways appears to be one of its remaining strongholds. Its habitat is mainly rain forest and wet sclerophyll forest where it shelters in hollow logs or rock piles.

(iii) SWAMP PHASCOGALE. Originally thought to inhabitat only tussock grassland of Tasmania and the Bass Strait islands this species in recent years has been trapped in the coastal vegetation complex at several points on the Victorian coast, including Hut Gully east of Aireys Inlet.

(iv) BROAD TOOTHED RAT. Fossil evidence indicates this species was once widespread throughout south-eastern Australia. It now appears to be a relic species which survives as isolated colonies in areas which provide it with the cold humid or alpine conditions that it requires. It has been recorded on two occasions from the Otways. The first in 1933 when a male was trapped near a bracken covered clearing in thick forest at the head of the Gellibrand River at about 1800 feet elevation. The second occasion was in 1968 when bones of this species were identified from fresh owl pellets collected from the floor of an old hut at the site of Mackies mill near Mt. Cowley.

(v) SMOKY MOUSE. This species was unknown until 1933 when four specimens were collected at Olangolah near Beech Forest. The habitat was a thick undergrowth of scrub, riddled with runways of the bush rat and it seemed probable that the mouse makes its home in fallen logs since no small burrows were discovered. It has never been relocated in the Otways but since 1962 it has been found in good numbers at two localities in the Grampians. It is not yet known from any other localities.

(vi) Two species now thought to be confined to Tasmania but which fossil evidence shows were formerly widespread on the mainland are the Tasmanian wolf (Thylacinus cyocephalus) and the Tasmanian devil (Sarcophilus harrisii). There have been a number of reports, spread over many years from both naturalists and bush workers, of sightings of thylacine like animals in the Otways. If either of these species ever are relocated on the mainland it is likely that it will be in the more remote and inaccessible parts of the Otways where suitable habitat has remained.

BIRDS

(i) WHITE GOSHAWK. Occurs in the timbered mountain areas of coastal northern and eastern Australia from Derby (W.A.) to Tasmania and Kangaroo Island (S.A.). It is moderately common in the Otway Ranges and in Tasmania but in all other southern parts of its range it is rare.

(ii) GROUND PARROT. This terrestial species has a very discontinuous and scattered distribution along the coast of south-western and south-eastern Australia including Tasmania. Its habitat is coastal and adjacent montane heathland which has been burnt from 3 to 7 years previously. The species has suffered greatly from destruction of it habitat and is now extremely rare in all mainland areas. In the Otways it is known to inhabit the Gellibrand - Devondale belt of heathland and has been recorded breeding in this area. It is a very shy and elusive bird - whose habits appear to be mainly nocturnal It has not been actually seen in the area since the early 1960's. Other heath areas at Cape Otway and in the eastern part of the Otways were probably inhabitated by the bird before settlement.

(iii) WHITE THROATED NIGHTJAR. Occurs in forested areas of near coastal districts down the entire length of the east coast of the mainland showing a preference for drier ridges and stony areas. It is a rare species. Angahook Forest Park is the most westerly known occurrence of this species. It is known to have nested in the park area.

(iv) RUFOUS BRISTLE BIRD. Occurs in a very narrow coastal strip from Torquay (Vic.) west to the mouth of the Murray, and again in a very narrow coastal strip 50 miles long from Cape Leeuwin north to Cape Naturaliste in W.A.. Its habitat is dense-coastl vegetation, tea-tree thickets and wire grass. The species is rare in Western Australia but is not uncommon in its Victorian range, particularly in the Otway Ranges where it can be found well inland in dense mountain ash forest.

(v) SOUTHERN EMU WREN. Occurs in the coastal and adjacent mountain areas of south-western and south-eastern Australia including Tasmania. Its habitat is damp scrubby heathland of coastal and mountain areas. It is a shy sedentary species and because undisturbed areas of its habitat in Victoria are few it is regarded as a rather rare species in this State. In the Otways it is found in the Angahook Forest Park and the heathland eastwards, and in the belt of heathland running from Gellibrand, through Carlisle River to Devondale.

(vi) BEAUTIFUL FIRETAIL. Occurs in the coastal and adjacent mountain areas from Newcastle (N.S.W.) to Kangaroo Island (S.A.) and Tasmania. Its habitat includes thick belts of coastal scrub and tea-tree and thickly wooded gullies. It is a shy species and appears to have decreased considerably in recent years. It is now considered rare. In the Otways it is found from Angahook to Glenaire.

(vii) SATIN BOWER BIRD. Is found in densely forested areas of the Dividing Range from the Atherton Tableland (Qld.) to the Otways, but is not found in Tasmania. In the Otways it is distributed in small numbers as far west as Devondale.

NATIVE MAMMALS KNOWN TO OCCUR IN THE OTWAYS

ECHIDNA (Tachyglossus aculeatus)

Widespread.

PLATYPUS (Ornithorhynchus anatinus)

Widespread; common at Lake Elizabeth.

NATIVE CAT (Dasyurus viverrinus)

Relict colonies, no recent reports; drier forest areas.

TIGER CAT (Dasyurus maculatus)

Uncommon; rocky areas in wetter forest; breed only in dense cover but range widely.

WHITE-FOOTED DUNNART (Sminthopsis leucopus)

At least one record from coastal area; habitat is sparsely wooded areas.

TUAN (Phascogale tapoatafa)

Recorded near Queenscliff in 1963. Probably is scattered through the drier forest areas of the Otways.

BROWN PHASCOGALE (Antechinus stuartii)

Widespread, all forest areas.

SWAINSON'S PHASCOGALE (Antechinus swainsonii)

Less common, thick undergrowth in wetter forest and heathland.

SWAMP PHASCOGALE (Anetchinus minimus)

Damp coastal heathland; trapped in Gahnia undergrowth at Hut Gully.

SHORT-NOSED BANDICOOT (Isoodon obesulus)

Drier and more open forest areas and heathland.

LONG-NOSED BANDICOOT (Perameles nasuta)

Recent records from Timboon, Cobden, Forrest and Wensleydale; dry sclerophyll forest and woodland.

BRUSH-TAILED POSSUM (Trichosurus vulpecula)

Widespread.

RING-TAILED POSSUM (Pseudocheirus peregrinus)

Widespread.

KOALA (Phascelarctos cinereus)

Reported to have been widespread before the 1919 wild fires. Recent records from near Anglesea and at the Grey River scenic reserve where some were released.

AUSTRALIAN FUR SEAL (Arctocephalus dorigerus)

Likely to be seen along all parts of the Otway coast.

FLUFFY GLIDER (Petaurus australia)

Tall forest areas; recent records from the Grey, Elliott and Parker River areas.

SUGAR GLIDER (Petaurus creviceps)

Widespread but not plentiful.

PIGMY GLIDER

Known to occur at Barwon Downs and Wensleydale

WOMBAT (Vombatus ursinus)

Formerly occurred in the eastern Otways

GREY KANGAROO (Macropus giganteus)

Widespread; heathland and forest areas with sparse scrub

BLACK TAILED WALLABY (Wallabia bicolor)

Widespread; very common.

RED-NECKED WALLABY (Macropus rufogriseus)

Uncommon, favours less scrubby areas; most records from the western part of the Otways.

POTOREE (Potorous apicalis)

Widespread; dense undergrowth in heathland and forest

BUSH RAT (Rattus fuscipes)

Widespread; thick undergrowth

SWAMP RAT (Rattus lutreolus)

Widespread; wet heathland, Lake Elizabeth

SMOKY MOUSE (Pseudomys fumeus)

Only known occurence is at Olangolah where this species was trapped in thick undergrowth in 1933.

BROAD-TOOTHED RAT (Mastacomys fuseus)

Trapper at Olangolah in 1933. Bones of this species identified in owl pellets collected near Mt. Cowley in 1968.

GOULD'S WATTLED BAT (Chalinolobus gouldi)

Widespread; forest dweller

LONG-EARED BAT (Myctophilus geoffreyi)

Widespread; forest dweller

GREY-HEADED FRUIT BAT (Pteropus poliocephalus)

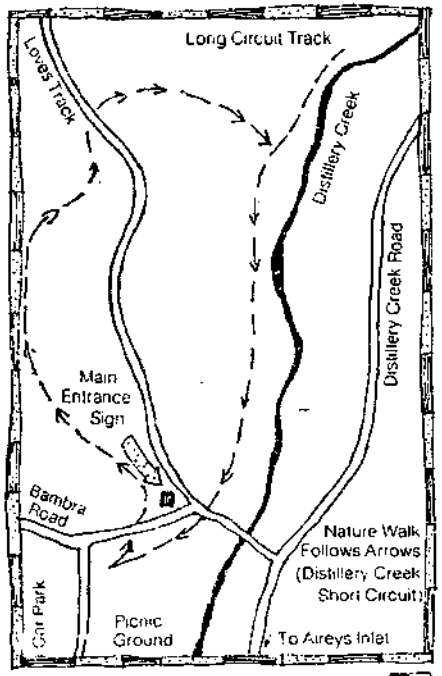
Uncommon vagrant; Lorne area in the 1940's

ANGAHOOK FOREST PARK NATURE WALK

FORESTS COMMISSION, VICTORIA

This walk begins and ends at the Distillery Creek picnic ground, and follows the "Distillery Creek Short Circuit" walking track.

The track is about 1½ km long and takes about 30 minutes at a leisurely pace.



FORESTS COMMISSION, VICTORIA

ANGAHOOK FOREST PARK NATURE WALK

FORESTS COMMISSION, VICTORIA

ANGAHOOK FOREST PARK

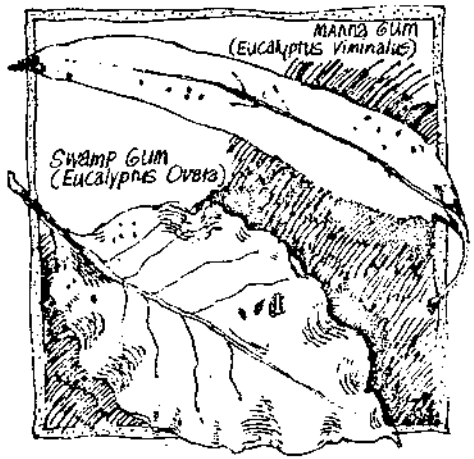
The Forests Commission has designed this walk to help visitors and family groups enjoy the scenery and the plant and animal life of the Angahook Forest Park. The numbered posts along the track mark the features described in this guide. Please help us conserve this area and remember that all native plants and animals in the Park are protected.

1 Distillery Creek Picnic Ground
Before you begin the walk, study the trees in the picnic ground. You will notice the majority are straight, tall trees with dark trunks. Feel how rough and tough the bark is, this rusty coloured bark that gives these trees their name — Ironbark. Ironbark growing in the Angahook Forest Park is the only species of ironbark found naturally in Victoria, and it is known as the red ironbark *(Eucalyptus sideroxylon)*

As you start along the track, notice how many different kinds of shrubs and smaller plants exist in the forest. The trees are nearly all red ironbarks.

2 Mixed Species Forest
Can you recognise any of the trees in this part of the forest? Ironbarks are here, but there are others too, that have lighter coloured bark that is quite smooth towards the top of the trunk and on the branches. These are called gum-barked trees or simply Gums.

The trees with wide green leaves are called Swamp Gums, while those with narrow, bluish leaves are Manna Gums.



3 The Young Forest
Most of the big trees living in the forest now are only about 50 years old — which is really quite young for trees. Before these trees began growing, there was an older forest at Angahook — but most of the older trees have disappeared. Can you see anything that might explain why they have gone? Why do some trees have blackened trunks?

4 The Snig Track
This overgrown snig track is a reminder of one way the forest is used by man. Up until the 1950s, some trees from this forest were chopped down and carted away to be used as poles and fence posts, or for firewood. Notice how the plants of the forest are beginning to grow back on this road. Can you see any other evidence of man's activity here?

5 Types of Eucalypt bark
So far we have found two types of Eucalypt trees — the Ironbarks and the Gums. Here we meet a third type, called Stringybarks. The bark of Stringybark trees is rough and stringy, and extends all the way up the trunk and along the branches. See if you can find a Stringybark tree.

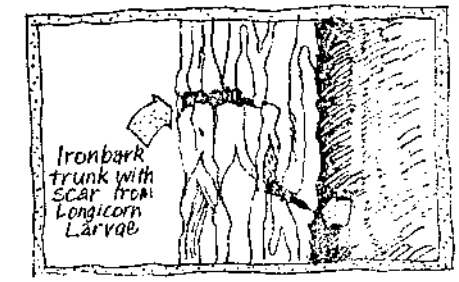
Be careful not to tear off any bark — the tree needs bark for protection, and the bark is also a home for insects and spiders.

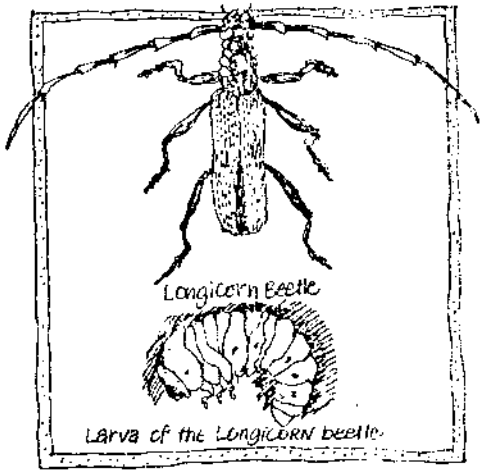
6 Death and Decay
Up in the top of a tree on the left of the track is a tangled mass of vine. This is the Dodder-laurel, a plant with no roots or leaves and grows as a parasite on other plants. Eventually the Dodder-laurel will probably kill this tree, then without any sap to live on itself it too will also die.

On the other side of the track, the ground is covered in leaf-litter — dead leaves and twigs that the wind has pruned off nearby trees. Many insects, ants and beetles feed on the leaf-litter, breaking it down and returning it to the soil as humus. As you continue along the track, watch for tree stumps covered with grey dirt — these are the nests of bullants.

The nature walk continues on the other side of the road (Loves Track). As you cross, keep your eyes open for the kangaroos and wallabies that sometimes hop along this road.

7 The Longicorn Beetle
On the trunks of some of the red ironbark trees you may be able to see marks cut into the bark across the trunk. These marks are caused by the larvae of the Longicorn beetle, which hatch out of eggs laid in the bark and eat away the soft inner bark.

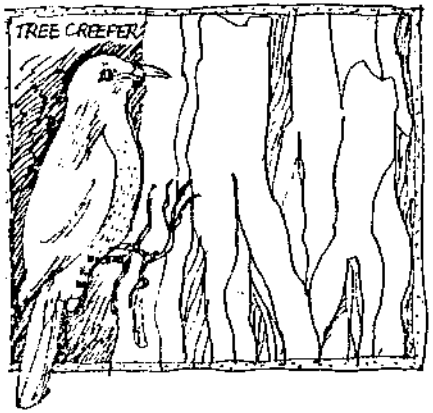




3J.2

\TURE WALK

f you are very observant you could see a small grey nd white bird (the tree creeper) that hops up these unks looking for insects to eat



8 The Water Course
The small water course under the bridge only carries running water after heavy rain, but the moisture in the ground soak s seeps downhill, keeping the soil cool and damp for most of the year. Can you see any special plants that only grow in cool moist places?

9 The Damp Soak
When rain falls on the forest, some of it runs off the top of the ground and into the little creeks that lead into the rivers and finally to the sea. The plants of the forest catch a lot of rain, which drips slowly off their leaves and into the ground.

What happens to this moisture in the ground? If you look down in the gully on the right, you will notice a part of the forest that looks greener and thicker than the forest on your left. Can you think why it is so green?

10 Decaying Logs
See the old logs turning back into soil under the trees and the grass? Logs like this are sometimes homes for native animals like echidnas, bandicoots and marsupial mice.

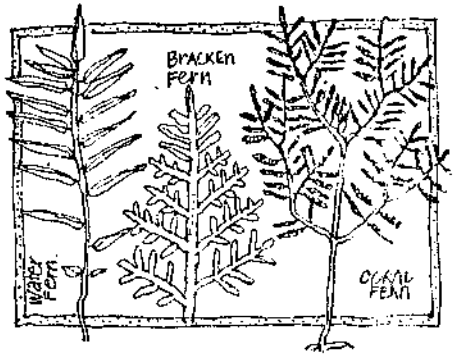
At the junction of the Distillery Creek Short Circuit Track and the Long Circuit, take the track to the right which goes back to the picnic area.

11 The Distillery Creek Swamp
All along the left of this last section of the track is a swampy area beside the Distillery Creek. Can you see any plants in the swampy area that you haven't seen along the track?

The gums in this area are often visited by koalas that live in the park. Look carefully up in the tops of the trees and you could see one sleeping in the branches or feeding on the leaves.

12 The Native Cherry
The bushy green tree on the left of the track here is a Native Cherry, which is a favourite nesting tree for small birds. The fruit of the native cherry is edible, but small; and the foliage provides good shelter.

13 The Distillery Creek
Close to the creek, the main plants are ferns. See how many different types you can find. Did you see the tall tree fern as you walked past? It looks like a big green umbrella.



Sometimes, if you keep very quiet, you can see or hear frogs and fish in the creek here. Listen for the birds that feed in the swampy area too.

14 The Red Soil
Many years ago this tree was blown over in a storm. Can you think where all the red earth on the track came from?

15 The Peppermint Trees
Remember the three different types of Eucalypt we have looked at today? See if you can remember their names. Down here near the creek, where the soil has plenty of moisture all year round, another type called Peppermint grows. These trees get their name from the strong smell of their leaves. The bark of the Peppermint eucalypts looks a bit like that of the Stringybarks, but is thinner and finer. Can you recognise the other trees in this area?

16 The Melaleucas
As the track leaves the swamp to return to the picnic area, there is a sudden change back to the red stringybark forest. Along the border of the wet gullies, shrubs called Melaleucas or paperbarks often grow. Look carefully at the bark of these plants, but remember not to damage it.

The picnic area is about 100 metres away on the right (along the main road). We hope you have enjoyed the walk.

MAMMALS OF THE VICTORIAN FORESTS

No.	Forest Type* or Region.	Component Sections+
1.	Sub Alpine Complex	Sub alpine Woodland (LOW OPEN FOREST), Grassland (CLOSED GRASSLAND) & Herbfield (CLOSED HERBFIELD).
2.	Mountain Forests	Mountain ash, alpine ash & messmate with dense undergrowth but excluding Otway Ranges. (TALL OPEN FOREST).
3.	Otways Region	TALL OPEN FOREST, mixed Eucalypt species forest (OPEN FOREST) and fringes of scrub (CLOSED SCRUB) and heathland (CLOSED HEATHLAND).
4.	Grampians Region	Mixture of vegetation types ranging from TALL OPEN FOREST through WOODLAND to CLOSED HEATHLAND and incl. fringes of Red Gum.
5.	Stringybark Forests	OPEN FOREST with variable understory and eucalypt species (excl. 3 or 4). Regional subdivisions: West (W), South-West (S.W.), Central (C), North-East (N.E.), Gippsland (G) and East Gippsland E.G.)
6.	Ironbark–Box Forests	Mainly Grey Box and Red Ironbark with sparse understory. (OPEN FOREST).
7.	Red Gum Forests	Principally of the Murray River (OPEN FOREST – WOODLAND).
8.	Mallee Region	Mallee Eucalypts and Heath (OPEN SCRUB, HEATH) with Pine and Belar (LOW OPEN FOREST or LOW WOODLAND), Black Box and Red Gum Flats (WOODLAND) or Brown Stringybark and Yellow Gum (OPEN SCRUB).
9.	Miscellaneous	Heathlands (OPEN or CLOSED) not in the Otway or Grampians Regions, or specified forest margins and isolated tracts.
10.	Waterways & Wetlands	Streams or sheets of water.
11.	Conifer Plantations.	Predominantly Pinus radiata.

KEY

H. – Requires hollows for shelter or breeding.
U. – Requires dense undergrowth.
C. – Common to very common.
UC. – Uncommon.
R. – Rare to very rare.
A. – Accidental to Victoria.

* Rare in Victoria but common in some other localities.

* Boundaries defined on map — Forests of Victoria — (1:2,000,000) Forests Commission, 1971.

\+ Structural forms of vegetation given in Capitals as defined on p.46 — "The Australian Environment" — 4th Edition, 1970.

MAMMALS OF THE VICTORIAN FORESTS
AREAS WHERE MOST LIKELY TO BE SEEN

NAME	FOREST TYPE OR REGION											Requirements	Status	NOTES
	1	2	3	4	5	6	7	8	9	10	11			
Echidna *Tachyglossus aculeatus*	X	X	X	X	X	X	X	X	X		X		C	Widely distributed, seldom seen
Platypus *Ornithorhynchus anatinus*										X			C	In freshwater throughout Victoria
Quol *Dasyurus viverrinus*		X	X	X	X				X				R*	Relict colonies only — Dargo, Corangamite
Tiger cat *Dasyurops maculatus*		X	X		X				X			U	UC	Rocky areas — Breed in dense cover only but widely ranging.
Tuan *Phascogale tapoatafa*		X	X		X	X						H	C	Not 5(W)
Brown phascogale *Antechinus stuartii*	X	X	X	X	X						X	H	C	
Yellow footed phascogale *Antechinus flavipes*				X		X		X				H	C	Sparsely wooded areas.
Dusky phascogale *Antechinus swainsonii*	X	X	X	X	X				X		X	U	C	Moist sites.
Swamp phascogale *Antechinus minimus*			X						X			U	UCN	Damp coastal heath-land of W. Victoria.
Fat-tailed dunnart *Sminthopsis crassicaudata*				X		X		X					C	Sparsely wooded areas.
White-footed dunnart *Sminthopsis leucopus*			X						X				RN	Sparsely wooded areas — Buchan, Otways.
Slender-tailed dunnart *Sminthopsis murina*								X					RN*	Big Desert the only authentic record
Long nosed bandicoot *Perameles nasuta*		X	X		X							U	C	Wetter forests
Barred bandicoot *Perameles gunnii*									X				UCN	West Victoria. Relict colonies only.
Short nosed bandicoot *Isoodon obesulus*		X	X	X	X							U	C	Drier forests.

MAMMALS OF THE VICTORIAN FORESTS
AREAS WHERE MOST LIKELY TO BE SEEN

NAME	FOREST TYPE OR REGION											Req'ments	Status	NOTES
	1	2	3	4	5	6	7	8	9	10	11			
Brush tailed possum *Trichosurus vulpecula*		X	X	X	X	X	X	X			X	H	C	
Bobuck *Trichosurus caninus*		X										H	C	Central and Eastern Victoria.
Leadbeaters possum *Gynobelideus leadbeateri*		X										H	UC	Restricted to regrowth ash and similar species.
Pigmy possum *Cercartetus nanus*	X			X	X				X			HU	C	Usually heath type understory uncommon in highlands.
Mundarda *Cercartetus concinus*								X				H	UCN	Mallee heath with Myrtaceous and Proteaceous shrubs
Burramys possum *Burramys parrus*	X												VRN	North east. Rocky areas with alpine heath.
Yellow-bellied glider *Petaurus australis*		X	X		X							H	C	Excluding mountain ash. Nomadic.
Squirrel glider *Petaurus norfolcensis*									X			H	R	E. Victoria. Grey box, nomadic.
Sugar glider *Petaurus breviceps*		X	X	X	X							H	C	Widespread, nomadic.
Feather-tail glider *Acrobates pygmaes*		X	X	X	X	X		X				H	C	
Koala *Phascolarctos cinereus*		X	X	X	X								C	Present distribution reflects liberation prgramme.
Ring-tailed possum *Pseudocheirus peregrinus*		X	X	X	X		X				X	H	C	
Greater glider *Schoinobates volans*		X			X							H	C	Confined principally to slopes of Dividing Range. Not W. of Ballarat.
Wombat *Vombatus ursinus*		X			X						X	U	C	Not in W. Victoria. Moist sites.
Grey kangaroo *Macropus giganteus*			X	X	X	X	X	X			X		C	Sparsely wooded forest, often nomadic.
Red kangaroo *Megaleia rufa*								X					CN	Inland plains in N. Victoria.
Euro *Macropus robustus*					X								AN	Visitor to north and east.
Black-tailed wallaby *Wallabia bicolor*	X	X	X		X							U	C	Central and eastern Victoria.

MAMMALS OF THE VICTORIAN FORESTS
AREAS WHERE MOST LIKELY TO BE SEEN

NAME	FOREST TYPE OR REGION 1	2	3	4	5	6	7	8	9	10	11	Reqr'ments	Status	NOTES
Red-necked wallaby *Wallabia rufogrisea*		X	X	X			X						C	Not 5(C) or 5(N.E.)
Brush-tailed rock wallaby *Petrogale penicillata*			X	X									R	Cliffs and rocky areas. Relict colonies in Grampians and E. Victoria
Potoroo *Potorous sp.*		X	X	X				X				U	UC	Damp sites. Mainly southern Victoria.
Blackfaced kangaroo *Macropus fuliginosus melanops*								X					UC	Mallee scrub.
Bush rat *Rattus fuscipes*	X	X	X		X				X		X	U	C	Widespread.
Swamp rat *Rattus lutreolus*		X	X	X	X				X				R	Damp sites. Widespread.
Smoky mouse *Pseudomys fumeus*			X	X									R	Relict colonies, not recorded in Otways for 25 years.
Silky mouse *Pseudomys albocinereus*								X				U	UC	Favours heaths, population densities very variable.
New Holland mouse *Pseudomys novaehollandiae*					X							U	RN*	One known colony, Tyabb. Heath understory.
Heath rat *Pseudomys shortridgei*				X					X			U	UC	Open forest, heaths on sandy soils
Broad-toothed rat *Mastocomys fuscus*	X	X	X		X							U	R	Restricted, rare, of high rainfall areas.
Hopping mouse *Notomys mitchelli*								X					UCN	Big Desert only.
Eastern water rat *Hydromys chrysogaster*										X			C	Inland and coastal waterways, widespread.
DISTRIBUTIONS VERY TENTATIVE *Grey-headed fruit bat* *Pteropus poliocephalus*					X								AN	Visitor of far eastern Victoria in summer and more rarely central Victoria.
Little red fruit bat *Pteropus scapulatus*					X								AN	
Horseshoe bat *Rhinolophus magaphyllus*					X								C	Cave dweller, Buchan district only.
Large footed Myotis *Myotis adversus*					X X								UCN	Cave dweller, few known colonies, far eastern to far western Victoria.
Bent wing bat *Miniopterus schreibersii*				X	X								C	Cave dweller, all near water, widely distributed.

MAMMALS OF THE VICTORIAN FORESTS
AREAS WHERE MOST LIKELY TO BE SEEN

NAME	FOREST TYPE OR REGION 1	2	3	4	5	6	7	8	9	10	11	Requirements	Status	NOTES
DISTRIBUTIONS VERY TENTATIVE														
Yellow-bellied bat *Taphazous flaviventris*									X			H	RN	Very few records for Victoria.
Little bat *Eptesicus pumilus*				X	X			X				H	C	Also caves in north.
Goulds bat *Chalinolobus gouldi*		X	X	X	X			X				H	C	Widely distributed, also urban.
Chocolate bat *Chalinolobus morio*					X			X				H	UCN	Fairly widely distributed.
Lesser long-eared bat *Nyctophilus geoffroyi*		X	X	X	X	X		X				H	C	
Broad-nosed bat *Scoteinus balstoni*				X			X	X				H	C	
Little mastiff bat *Tadarida planiceps*							X	X				H	C	Far west Victoria along Murray River
White striped bat *Tadarida australis*					X			X				H	RN	Temperate Aust., particularly Mallee
Introduced Species – Feral														
Goat *Capra hircus*				X	X								UC	Grampians, Lerderderg Gorge.
Horse (Brumby) *Equus caballus*	X	X			X								C	Mountains of N.E. and E. Gippsland.
Fallow deer Dama Dama *Dama Dama*									X				VR	Kentbruck area, originally in Yarra Valley.
Red deer *Cervus elephas*				X	X						X		UC	Grampians, Snowy River, Mt. Cole, Ballarat Plantn.
Hog deer *Cervus porcinus*									X				RN	Coastal scrub and heath lands east of Westernport, E.G.
Sambur *Cervus unicolor*		X			X								C	Central Highlands, north and south of Divide.
Fox *Vulpes vulpes*	X	X	X	X	X	X	X	X	X		X		C	Widespread.
Feral dog and dingo *Canis familiaris*	X	X	X		X								C	Central and east Victoria particularly the ranges.
Cat *Felis catus*		X	X	X	X	X	X	X	X				C	Widespread.
Hare *Lepos europaeus*									X				UC	Scattered – forest margins.

MAMMALS OF THE VICTORIAN FORESTS
AREAS WHERE MOST LIKELY TO BE SEEN

NAME	FOREST TYPE OR REGION 1	2	3	4	5	6	7	8	9	10	11	Reg'ments	Status	NOTES
Rabbit *Oryctolegus cuniculus*	X	X	X	X	X	X	X	X	X		X		C	Widespread.
Ship rat *Rattus rattus*	X	X	X	X	X	X	X	X	X		X			Scattered – well established in association with man.
Brown rat *Rattus norvegious*													CN	Urban only
Mouse *Mus musculus*	X	X	X	X	X	X	X	X	X		X		C	Fluctuating density.
Pig *Sus scrofa*							X		X				UC	Along Murray River.
Ferret *Putorius putorius*													RN	Escapes – do not appear to survive long.
Squirrel *Sciurus corolinensis*													RN	Ballarat Gardens.

This list was compiled by Mr. A. Heislers from published information, personal research and liaison with the Fisheries and Wildlife Department through Mr. R.M. Warneke.

MAMMALS

Compiled from data from the Forests Commission, National Parks Service, Mammal Survey Group and various conservation groups with the assistance of Dr. A.K. Lee, Monash University.

APPENDIX 3L

Key

Habitat: the habitat designations are explained in the text.
Abbreviations used are:
- E – occurring within the eastern study area
- W – occurring within the western study area
- B – occurring in both study areas

Abundance: abbreviations used
- C – common in the study areas
- U – uncommon in the study areas
- R – rare in the study areas

Habits and Biology:
Activity Pattern:
- N – nocturn
- D – diurnal
- A – arboreal
- S – scansorial
- T – terrestrial
- Q – aquatic
- R – aerial

• introduced species

Common name	Scientific name	Habitat								Abundance		Activity Pattern	Niche
		Open Grasslands	Wet Heath	Dry Heath - Coastal Scrub	Woodlands	D.S.F.	C.T.R.W.S.F.	Marine Open Water	Wetlands	EAST	WEST		
Echidna	Tachyglossus aculeatus			B	B	B	B			C	C	D	T
Platypus	Ornithorhyachus anatinus								W	–	U	N	Q
Tiger Cat	Dasyurus maculatus						W				R	N	S
Quoll	D. viverrinus				W						U	N	T
Tuan	Phascogale tapotafa				W						U	N	S
Tasmania wolf	Thylacinus cyocephalus										R	N	T
Tasmanian devil	Sarcophilus harrisii										R	N	T
Swamp antechinus	Antechinus minimus		B	B						C	C	N	T
Brown antechinus	A. stuartii					B	B			C	C	N	S
Swainson's antechinus	A. swainsonii		W		W	W	W		W	–	U	D/N	T
White-footed dunnart	Smithopsis leucopes			B						R	U	N	T
Short nosed bandicoot	Isodon obesulus			B						U	U	N	T
Long nosed bandicoot	Permales nasuta				B	B	W			U	U	N	T
Wombat	Vombatus ursinus	E		E	E	E				C	–	N	T
Koala	Phascolarctos cinereus				B	B				C	U	N	A
Brush-tailed possum	Trichosurus vulpecula			B	B	B				C	C	N	A
Ring-tailed possum	Pseudocheirus peregrinus			B	B	B	B			C	C	N	A
Yellow-bellied glider	Petaurus australis		W	W		W	W			–	R	N	A
Sugar glider	P. breviceps				W	W	W			–	U	N	A
Feather tailed glider	Acrobates pygmaeus				W	W	W			–	U	N	A
Eastern pigmy possum	Cercaetus nanus			B		B				R	R	N	A
Great grey kangaroo	Macropus giganteus			B	B	B				C	C	N	T
Red-necked wallaby	Macropus rufogriseus			W	W	W				–	U	N	T
Black wallaby	Wallabia bicolor		B	B	B	B	B			C	C	N	T
Potoroo	Potorous tridactylus			W	W	W					U	N	T
Grey-headed fruit bat	Pteropus poliocephalus									–	U?	N	R
Yellow-bellied glider	Taphozous flaviventris										U	N	R
Lesser longeared bat	Nyctophilus geoffroyi				W	W	W			–	U	N	R
Bent-winged bat	Minopteris schreibersii										U	N	R
Little bat	Eptisicus pumilus				W	W	W				U	N	R
Gould's wattled bat	Chalinolobus gouldii				W	W	W				U	N	R
White striped bat	Tadarida australis				W	W	W				U	N	R
Little flat bat	T. planiceps										U	N	R
Bush rat	Rattus fuscipes			B	B	B	B			C	C	N	T
Swamp rat	R. lutreolus		B	B	B				B	C	C	N	T
Sewer rat	R. norvegicus•								W	!	U	D/N	T
Black rat	R. rattus•				B					U	U	D/N	T
House mouse	Mus musculus•	B		B		B	B			U	U	D/N	T
Eastern water rat	Hydromys chrysogaster		W						W	–	C	N	Q
Broad-toothed rat	Mastacomys fuscus			W		W	W				R	N	T
Smoky mouse	Pseudomys fumeus						W				R	N	T
Australian fur seal	Arctocephalus pursillos								W		C	–	Q
Rabbit	Oryctolagus cuniculus•	B	B	B	B	B	B			C	C	N	T
Fox	Vulpe vulpes•	B	B	B	B	B	B			C	C	N	T
Cat	Felis catus•			B	B	B	B			C	C	N	T
Hog deer	Axis porcinus•			E	E	E				R	–	–	T

REPTILES

APPENDIX 3M

The list was compiled with the assistance of P.A. Rawlinson, Department of Zoology

The habitats are defined in the text.

Abbreviations used are:

E – occurs in the eastern study area . . .
W – occurs in the western study area . . .
B – occurs in both study areas . . .
within this habitat.

Abundance ratings are.

C – common
U – uncommon
M – marginal
R – rare

and refer to the abundance of the species over the habitats in which they are recorded as present

"Habits and Biology"; the abbreviations used are:

D – diurnal or N – nocturnal
G – ground dwelling or W – water dwelling
A – arboreal/scansorial or F – fossorial /Burrowing
T – thigmotherm or H – heliotherm
O – oviparous or V – viviparous

The "Bassian Zone" refers to the thermal zone in which the reptile exists within the Bassian zoogeographic subregion. The abbreviations used are:

W – warm temperate zone
C – cool temperate zone

Common Name	Scientific Name	Habitat							Abundance		Habits & Biology						
		Open Grasslands	Wet Heath	Dry Coast Complex	Woodlands	D.S.F.	C.T.R.W.S.F.	Wetland	EAST	WEST	D or N	G or W	A/S or F	T or H	O or V	BASSIAN ZONE
Bearded dragon	Amphibolurus barbatus									M	D	G	–	H	O	W
Tree dragon	A. muricatus			W	W	W				U	D	G	A	H	O	W
Marbled gecko	Phyllodactylus marmoratus									M	N	–	A	T	O	W
Spinifex lizard	Delma impar									M	N	G	–	T	O	W
McCoy's skink	Anotis maccoyi					W	W			C	D	G	F	T	o/v	C
Grass skink	Leiolopisma entrecasteauxii	B		B	B				C	C	D	G	–	H	V	C
Garden skink	L. guichenoti			B	B	B	W		C	C	D	G	–	H	O	w/c
Weasel skink	L. mustelina						W			U	D	G	F	T	O	w/c
Three lined skink	L. trilineata	B		B					U	U	D	G	–	H	O	w/c
Coventry's skink	L. coventryi						W			C	D	G	–	H	V	C
Bougainville's skink	Lerista bougainvillii	B			B				U	B	D	G	F	T	V	W
Spencer's skink	Pseudemoia spenceri					W	W			C	D	–	A	H	V	C
Water skink	Sphenomorphus tympanum					V	W		U	C	D	GW	–	H	V	C
Mourning skink	Egernia luctuosa		B						R	R	D	G	F	H	V	W
White's skink	E. whitii	B		B					U	U	D	G	–	H	V	c/w
Southern blue tongue	Tiliqua nigrolutea	B	B	B	B	B			C	C	D	G	–	H	V	C
Common blue tongue	T. scincoides									M	D	G	–	H	V	W
Tree goanna	Varanus varius				E	E			U		D	G	A	H	O	W
Copperhead	Austrelaps superba		B		B	B		B	C	C	D	G		H	V	C
White-lipped snake	Drysdalia coronoides			B	B				U	U				H	V	C
Tiger snake	Notechis scutatus	B		B	B	B	W	B	C	C	D	G	–	H	V	w/c
Brown snake	Pseudonaja textilis									M	D	G	–	H	O	W
Little whip snake	Suta flagellum									M	N	G	–	T	V	

AMPHIBIANS

The list was compiled by A.J. Brook from the field notes of M.J. Littlejohn, A.A. Martin, G.F. Watson and A.J. Brook.

KEY

Recorded abundance:

C – common throughout area
RW – restricted to west edge
RE – restricted to east edge

Habitat: in areas of moisture always

D.S.F. – dry sclerophyll forests
W.S.F. – wet sclerophyll forests

Scientific name	Recorded Abundance East	Recorded Abundance West	Habitats Tadpoles: Frogs
Geocrinia victoriana	C	C	Shallow shaded pools. W.S.F.
Geocrinia laevis	–	RW	Shallow shaded pools Heath D.S.F.
Limnodynastes dumerili	C	C	Dams, swamps etc.
Limnodynastes peroni	C	C	Dams, swamps etc.
Limnodynastes tasmaniensis	C	RW+RE	Temporary & permanent waters
Litoria aurea raniformis	C	RW+RE	Open shaded. Well vegetated
Litoria ewingi	C	C	Temp + permanent waters. Well vegetated
Litoria aurea raniformis	C	–	Temp + permanent waters. Well vegetated
Neobatrachus pictus	–	RW	Most temporary waters
Pseudophryne semimarmorata	C	RW+RE	Most temporary waters
Ranidella signifera	C	C	Temp. + permanent waters

APPENDIX 3N

BIRDS

Key to Bird List

Status:

- VC – very common
- C – common
- M – moderately common
- RR – rather rare
- R – rare
- VR – very rare

Range:
- X – bird's range includes study area and it has been recorded.
- X' – bird's range includes study area but it has not been recorded.

Habitat:
1. Cleared land and grasslands (natural and non-natural)
2. Wet heath and marshes –
   - a. mangrove
   - b. swamp thickets (Melaleuca)
   - c. marsh association
3. Dry heath and coastal scrub –
   - a. Banksia-Casuarina woodland
   - b. Tea-tree scrub
   - c. Dry heath
   - d. dunes-grasslands
4. Woodland – open woodlands, grassy/sclerophyll understorey
5. Dry sclerophyll forest – open forest
6. Wet sclerophyll forest and cool temperate rain forest
7. Intertidal – HWST to LWST
8. Open marine waters
9. Open fresh waters – wetlands.

The list comprises of birds (exclusive of sea-birds) whose ranges include some or all of either study area. Data on this and nomenclature used are as in Wheeler's "A Handlist of the Birds of Victoria" Melbourne University Press: Melbourne 1967. Recordings are from the National Parks Service, the Forests Commission, Point Smythe Conservation Association, Peter Cheals and Sandy Morison.

- ? – denotes edge of species range falling close to edge of a study area and where overlap is uncertain.
- o – species does not breed in Victoria.

Common name	Scientific name	Habitat	W	E	Status
Emu	Dromaius novaehollandiae	1,4,5,6	X	X	M
Stubble quail	Coturnix pectoralis	1	X	X'	C
Brown quail	Synoicus australis	1,3,2bc	X	X'	RR
King quail	Excalfactoria chinensis	1,3,2bc		X'	VR
Painted quail	Turnix varia	1,4,5	X	X'	M
Little quail	Turnix velox	1,4	X		R-C
Peaceful dove	Geopelia striata	4,5	X		C
Diamond dove	Geopelia cuneata	4,5	X		VR
Common bronzewing	Phaps chalcoptera	3,4,5,6	X	X	M
Brush bronzewing	Phaps elegans	3,4,5	X	X	RR
Lewin water-rail	Rallus pectoralis	2bc	X	X'	RR
Striated pardalote	Pardalotus substriatus	4,5,6	X		C
Grey-backed silvereye	Zosterops lateralis	1,3,4,5,6	X	X	VC
White-naped honeyeater	Melithreptus lunatus	4,5,6	X	X	C
Brown-headed honeyeater	Melithreptus brevirostris	4,5,6	X	X	C
Eastern spinebill	Acanthorynchus tenuirostris	1,3,4,5,6	X	X	C
Tawny-crowned honeyeater	Gliciphila melanops	3	X	X	RR
Singing honeyeater	Meliphaga virescens	3	X		M
Yellow-faced honeyeater	Meliphaga chrysops	4,5,6	X	X	VC
White-eared honeyeater	Meliphaga leucotis	3,4,5,6	X	X	C
Yellow-tufted honeyeater	Meliphaga melanops	4,5,6	X		C
White-plumed honeyeater	Meliphaga penicillata	1,4,5	X	X'	VC
Crescent honeyeater	Phylidonyris pyrrhoptera	3,5,6	X	X	M
New holland honeyeater	Phylidonyris novaehollandiae	3,4,5,6	X	X	VC
Fuscous honeyeater	Meliphaga fusca	4,6	X		M-C
Noisy miner	Myzantha melanocephela	4,5a	X	X	VC
Little wattlebird	Anthocaera chrysoptera	3,4	X	X	M
Red wattlebird	Anthocaera carunculata	3,4,5,6	X	X	C
Spiny-cheeked honeyeater	Acanthagenys rufogularis	3,4,5	X'		M
Australian pipit	Anthus novaeseelandiae	1	X	X	VC
Singing bushlark	Mirafra javanica	1,2	X	X'	M
Beautiful firetail	Emblema bellus	3	X	X	R

Banded land-rail	Hypotaenidia philippensis	2bc,1,4	X	X'	RR
Australian spotted crake	Porzana fluminea	2bc	X	X'	M
Marsh crake	Porzana pusilla	2bc,9	X	X'	M
Black-tailed native hen	Tribonyx ventralis	2bc,9	X		R-C
Dusky moorhen	Gallinula tenebrosa	2bc,9	X	X'	C
Swamphen	Porphyrio porphyrio	9	X	X'	C
Coot	Fulica atra	9	X	X'	C-V,C
Great crested grebe	Podiceps cristatus	7,9	X	X'	RR
Little grebe	Podiceps novaehollandiae	9	X	X'	C
Hoary headed grebe	Podiceps poliocephalus	7,8,9	X	X'	C
Black cormorant	Phalacrocorax carbo	7,8,9	X	X	C
Little black cormorant	Phalacrocorax sulcirostris	7,8,9	X	X'	C
Little pied cormorant	Phalacrocorax melanoleucas	7,8,9	X	X	VC
Australian darter	Anhinga rufa	9	?	?	M
Australian pelican	Pelecanus conspicillatus	7,8,9	X	X	M
Whiskered tern	Chlidonias hybrida	9	X	X'	M
Gull-billed tern	Sterna nilotica	7,8,9	X	X'	RR
Crested tern	Sterna bergii	7,8,9	X	X	C
Silver gull	Larus novaehollandiae	7,8,9	X	X	VC
Pacific gull	Larus pacificus	7,8,9	X	X	C
Spur-winged plover	Vanellus novaehollandiae	1,2,7,8,9	X	X	VC
Banded plover	Vanellus dricolor	1,4	X	X'	M
Red-capped dotterel	Charadrius alexandrinus	7,8,9	X	X	C
Black-fronted dotterel	Charadrius melanops	9	X	X'	C
White-headed stilt	Himantopus himantopus	7,8,9	X	X	M
Pied oystercatcher	Haematopus ostralegus	7,8,9	X	X	C
Banded stilt°	Cladorhynchus leucocephalus	7,8,9	X		RR
Banded stilt	Cladorhynchus leucocephalus	7,8,9	X		RR
Red-necked avocet	Recurvirostra novaehollandiae	7,8,9	X		RR
Red-necked stint°	Calidris ruficollis	7,8,9	X	X	C
Curlew sandpiper	Calidris ferruginea	2,7,8,9	X	X	C
Sharp-tailed sandpiper°	Calidris acuminata	7,8,9	X	X	C
Japanese snipe°	Gallinago hardwickii	1,9	X	X'	RR
Brolga	Grus rubicunda	1,2c	X		RR
White ibis	Threskiornis molucca	1,2c,7,9	X	X	C
Straw-necked ibis	Threskiornis spinicollis	1,2c,7,9	X	X	VC
Royal spoonbill	Platalea regia	2c,7,9	X	X	RR
Yellow-billed spoonbill	Platalea flavipes	2c,7,9	X	X'	M
Little egret	Egretta garzetta	2c,9	X		RR
Plumed egret	Egretta intermedia	2c,9	X		RR
White egret	Egretta alba	2c,7,9	X	X'	M
White-faced heron	Ardea novaehollandiae	2c,7,9	X	X	VC
Nankeen night-heron	Nycticorax caledonicus	2c,9	X	X'	M
Brown bittern	Botaurus poiciloptilus	2bc,9	X	X'	RR
Cape barren goose	Cereopsis novaehollandiae	1,2c,9	X	X'	R
Wood duck	Chenonetta jubata	4,5,7,9	X	X'	M
Black swan	Cygnus atratus	7,8,9	X	X	C
Mountain duck	Tadorna tadornoides	1,4,7,9	X	X'	C
Black duck	Anas superciliosa	7,8,9	X	X'	C
Chestnut teal	Anas castanea	7,8,9	X	X'	M
Grey teal	Anas gibberifrons	7,8,9	X	X'	VC
Blue-winged shoveller	Anas rhynchotis	9	X	X'	M
Pink-eared duck	Malacorhynchus membranaceus	9	X	X'	M
Freckled duck	Stictonetta naevosa	9	X		R
White-eyed duck	Athya australis	7,8,9	X	X'	C
Blue-billed duck	Oxyura australis	9	X	X'	RR
Musk duck	Bizucra lobata	7,8,9	X	X'	C

Spotted harrier	Circus assimilis	1	X	X'	RR
Swamp harrier	Circus approximans	1,2,3	X	X	C
Grey (white) goshawk	Accipiter novaehollandiae	5,6	X		R
Australian goshawk	Accipiter fasciatus	4,5,6	X	X	M
Collared sparrowhawk	Accipiter cirrhocephalus	4,5,6	X	X'	R
Wedge-tailed eagle	Aquila audax	1,3,4,5,6	X	X'	M
Australian little eagle	Hieraaetus morphnoides	1,4,5	X		M
White-breasted sea eagle	Haliaeetus leucogaster	7,8	X	X	RR
Whistling eagle	Haliastur sphenurus	1,2c,4,5	X	X'	C
Fork-tailed kite	Milvus migrans	1,4,5	X		RR
Black-shouldered kite	Elanus notatus	1,4	X	X'	M
Little falcon	Falco longipennis	1,4,5,6	X	X'	RR
Peregrine falcon	Falco peregrinus	2,3,4,5,6	X	X	RR
Black falcon	Falco subniger	1,4	X	X'	RR
Brown hawk	Falco berigora	1,3,4,5	X	X	VC
Nankeen kestrel	Falco cenchroides	1,3,4,5	X	X	VC
Boobook owl	Ninox novaehollandiae	4,5,6	X	X'	M
Barking owl	Ninox connivens	4,5,6	X		RR
Powerful owl	Ninox strenua	6	X	X'	R
Barn owl	Tyto alba	1,4,5	X	X'	M
Sooty owl	Tyto tenebricosa	6		X'	VC
Rainbow lorikeet	Trichoglossus haematodus	3a,4,5,6	X	X	RR
Musk lorikeet	Glossopsitta concinna	4,5,6	X	X'	M
Purple-crowned lorikeet	Glossopsitta porphyrocephala	4,5,6	X	X'	M
Little lorikeet	Glossopsitta pusilla	4,5,6	X	X'	C
Yellow-tailed black cockatoo	Calyptorhynchus funereus	3ac,5,6	X	X	M
Gang-gang cockatoo	Callocephalon fimbriatum	4,5,6	X	X	M
Sulphur-crested cockatoo	Kakatoe galerita	1,4,5,6	X	X	VC
Long-billed corella	Kakatoe tenuirostris	1,4,5	X'		RR
Galah	Kakatoe roseicopilla	1,4	X	X	C-VC
Cockatiel	Nymphicus hollandicus	1,4,5	X		RR
King parrot	Aprosmictus scapulanis	6	X	X'	RR
Crimson rosella	Platycercus elegans	4,5,6	X	X	VC
Eastern rosella	Platycercus eximius	1,3,4,5	X	X	VC
Red-rumped parrot	Psephotus haematonotus	1,4	X		VC
Orange-bellied parrot°	Neophema chrysogaster	3,4	X		VR
Blue-winged parrot	Neophema chrysostoma	1,3,4,5,6	X	X	M
Elegant parrot°	Neophema elegans	1,4	X		R
Swift parrot°	Lathamus discolor	4,5,6	X	X'	M
Budgerigah	Melopsittacus undulatus	1,4	X		M
Ground parrot	Pezoporus wallicus	2,3	X	X'	VR
Tawny frogmouth	Podargus strigoides	4,5,6	X	X'	M
Owlet nightjar	Aegotheles cristata	4,5	X		M
Azure kingfisher	Alcyone azurea	9	X	X'	RR
Laughing kookaburra	Dacelo gigas	1,3,4,5,6	X	X	C
Sacred kingfisher	Halcyon sancta	4,5,9	X	X	M
White-throated nightjar	Eurostopodus mystacalis	3ac,4,5	X	X'	R
Rainbow bird	Merops ornatus	3ac,4,5	X		M-C
Spine-tailed swift°	Hirundapus caudacutus	In air over all	X	X'	M
Fork-tailed swift°	Apus pacificus	In air over all	X	X'	RR
Pallid cuckoo	Cuculus pallidus	1,4,5,6	X	X	M
Fantailed cuckoo	Cacomantis pyrrhophanus	4,5,6	X	X	C
Brush cuckoo	Cacomantis variolosus	5,6		X	RR
Black-eared cuckoo	Chrysococcyx osculans	4,5,6	X		R
Horsfield bronze cuckoo	Chrysococcyx basalis	1,4,5,6	X	X	C
Golden bronze cuckoo	Chrysococcyx plagosus	4,5,6	X	X	M
Superb lyrebird	Menura novaehollandiae	6		X	M
Diamond firetail	Emblema guttata	4,5	?	?	M
Red-browed finch	Aegintha temporalis	4,5,6	X	X'	C
Olive-backed oriole	Oriolus sagittatus	4,5,6	X	X'	M
Satin bowerbird	Ptilonorhynchus violaceus	5,6	X		RR
Australian raven	Corvus coronoides	4,5,6	X	X	VC
Little raven	Corvus mellori	1,3,4,5,6	X	X'	C
Forest raven	Corvus tasmanicus	6	X	?	?
White-winged chough	Corcorax melanorhamphos	4,5	X		C
Pied currawong	Strepera graculina	5,6	X	X'	C
Grey currawong	Strepera versicolor	4,5,6	X	X'	M
Grey butcherbird	Cracticus torquatus	4,5,6	X	X	C
White-backed magpie	Gymnorhina hypoleuca	1,3,4,5,6	X	X	VC

Welcome swallow	Hirundo neoxena	In air over all	X	X	VC
Tree-martin	Petrochelidon nigricans	4,5,6	X	X	C
Fairy martin	Petrochelidon ariel	1,4,5	X	X'	C
Grey fantail	Rhipidura fuliginosa	3,4,5,6	X	X	VC
Rufous fantail	Rhipidura rufifrons	6	X	X'	M
Willie wagtail	Thipidura leucopnys	1,2,3,4,5	X	X'	VC
Leaden flycatcher	Myiagra rubecula	4,5,6	X'	X'	RR
Satin flycatcher	Myiagra cyanoleuca	5,6	X	X	RR
Restless flycatcher	Seisura inquieta	4,5,6	X		M
Jacky winter	Microeca leucophoea	4,5,6	X	X	C
Scarlet robin	Petroica multicolor	4,5,6	X	X	M
Flame robin	Petroica phoenicea	4,5,6	X	X	M
Pink robin	Petroica rodinogaster	5,6	X	X	RR
Rose robin	Petroica rosea	6	X	X	RR
Hooded robin	Petroica cucullata	4,5	?		M
Southern yellow robin	Eopsaltrica australis	5,6	X	X	C
Golden whistler	Pachycephala pectoralis	4,5,6	X	X	C
Rufous whistler	Pachycephala rufiventris	4,5,6	X	X	C
Olive whistler	Pachycephala olivacea	3,5,6	X	X	RR
Grey shrike thrush	Colluricincla harmonica	4,5,6	X	X	C
Magpie lark	Grallina cyanoleuca	1,4,5	X	X	VC
Shrike tit	Falcunculus frontatus	4,5,6	X	X'	M
Eastern whipbird	Psophodes olivaceus	3,6		X	M
Black-faced cuckoo shrike	Coracina novaehollandiae	4,5,6	X	X	C
Little cuckoo shrike	Coracina robusta	4,5	X	X'	RR
White-winged triller	Lalage sueri	4,5	X		M-RR
Spotted quail thrush	Cinclosoma punctatum	4,5	X	X	M
Australian ground thrush	Zoothera dauma	3,6	X	X	M
White-fronted chat	Epthianura albifrons	1,2,3	X	X	C
Weebill	Smicornis brevirostris	4,5,6	X	X'	C
Striated thornbill	Acanthiza lineata	4,5,6	X	X'	C
Little thornbill	Acanthiza nana	4,5,6	X	X'	M
Brown thornbill	Acanthiza pusilla	1,3,4,5,6	X	X	VC
Buff-tailed thornbill	Acanthiza reguloides	4,5	X	X	M
Yellow-rumped thornbill	Acanthiza chrysorrhoa	1,4,5	X	X	VC
White-browed scrub wren	Sericornis frontalis	3,5,6	X	X	VC
Heath wren	Hylacola pyrrhopyggia	3	X	X	RR
Field wren	Calamanthus fuliginosus	2,3	X	X	RR
Speckled warbler	Chthonicola sagittata	4,5	?		M
Brown songlark	Cinclorhamphus cruralis	1	X	X'	M
Rufous songlark	Cinclorhamphus mathewsi	4,5	X		M
Rufous bristlebird	Dasyornis broadbenti	3,4,5,6	X		M
Little grassbird	Megaleurus gramineus	1,2	X	X	M
Reed warbler	Acrocephalus stentoreus	2	X	X	M
Golden cisticola	Cisticola exilis	1,2	X	X	M
Southern emu wren	Stipiturus malachuru	2,3	X	X	RR
Superb blue wren	Malurus cyaneus	1,3,4,5,6	X	X	VC
Masked woodswallow	Artamus personatus	1,4,5	X	X'	RR
White-browed woodswallow	Artamus superciliosus	1,4,5	X	X'	C-VC
Dusky woodswallow	Artamus cyanopterus	1,4,5	X	X	C
Orange-winged sitella	Neositta chrysoptera	4,5,6	X	X'	M
White-throated treecreeper	Climacteris leucophaea	4,5,6	X	X	C
Red-browed treecreeper	Climacteris erythrops	5,6		?	RR
Mistletoe bird	Dicaeum hirundinaceum	4,5,6	X	X'	M
Spotted pardalote	Pardalotus punctatus	4,5,6	X	X	C
Yellow-tipped pardalote	Pardalotus striatus	4,5,6	X	X'	RR
Eastern striated pardalote	Pardalotus ornatus	4,5,6	X	X'	C

SPECIES LIST FOR PAINKALAC CREEK

INSECTA

EPHEMEROPTERA

Leptophlebiidae	-	*Atalophlebioides* sp
	-	*Atalophlebia australis*
	-	*Jappa* sp
Siphlonuridae	-	*Tasmanophlebia nigrescens*
Baetidae	-	*Centroptilum* sp
	-	*Bungona* sp
Caenidae	-	*Tasmanocoenis* sp

PLECOPTERA

Austroperlidae	-	*Austroheptura picta*
Gripopterygidae	-	*Leptoperla neboissi*
	-	*L. kimminsi*
	-	*L. bifida*
	-	*L. primitiva*
	-	*Dinotoperla serricauda*
	-	*D. fontana*
	-	*D. brevipennis*
	-	*Riekoperla (williamsi?) karki-reticulata* group
	-	*R. tuberculata*
	-	*R. (rugosa?)*
	-	*Trinotoperla irrorata*
	-	*T. nivata*
	-	*Illiesoperla australis*
	-	*Newmanoperla thoreyi*
Notonemouridae	-	*Austrocercella* sp
	-	*Austrocerca (tasmanica?)*

TRICHOPTERA

Leptoceridae	-	*Triplectides* sp
	-	*Oecetis?* sp 1
	-	*Oecitis?* sp 2
	-	Sp 1
	-	Sp 2
	-	Sp 3
	-	Sp 4
Odontoceridae	-	*Marilia* sp
Calocidae	-	*Tamasia variegata*
Helicopsychidae	-	*Helicopsyche* sp
Atriplectidae	-	*Atriplectides dubius*
Calamoceratidae	-	*Anisocentropus* sp

Extract from Unpublished Honours Thesis, C.M. Yule, Zoology Dept., Monash Univ. 1978

TRICHOPTERA (continued)

Philorheithridae	-	*Aphilorheithrus stopheni?*
Glossosomatidae	-	*Agapetus* sp
Hydropsychidae	-	*Asmicridea edwardsi*
	-	*Cheumatopsyche (modica?)*
Rhyacophilidae	-	*Taschorema evansi*
	-	*Ulmerochorema* sp
Apsilochoreminae	-	*Apsilochorema gisbum*
Philopotamidae	-	*Hydrobiosella* sp
Ecnomidae	-	*Ecnomus* sp
Polycentropodidae	-	*Plectrocnemia australica?*
Hydroptilidae	-	sp 1
	-	sp 2
Family indeterminate	-	1. sp 1
		2. sp 1
		3. sp 1

MECOPTERA

Nannochoristidae	-	*Nannochorista* sp?

COLEOPTERA

Dytiscidae (larvae)	Hydroporinae sp 1
(adults)	sp 1
	sp 2
	sp 3
Psephenidae (larvae)	*Sclerocyphon striatus*
	S. Irregularis
Hydrophilidae (larvae)	sp 1
	sp 2
(adults)	sp 3
	sp 1

Gyrinidae (adults and larvae) - *Macrogyrus* sp

Ptilodactylidae? larva

Helodidae (larvae)	sp 1
	sp 2
	sp 3
	sp 4

Hydraenidae (larva)

Helminthidae (larvae)		*Simsonia tasmanica*
	-	*Simsonia* sp?
	-	*Austrolimneus* sp nov.
	-	*Austrolimneus* sp 2
	-	*Austrolimneus?*
	-	*Notriolus* sp
	-	*Kingolus* sp

COLEOPTERA (continued)

(adults)

- sp 1
- sp 2
- sp 3 - *Kingolus* sp
- sp 4
- sp 5
- sp 6A
- sp 6B
- sp 7A
- sp 7B
- sp 8
- sp 9A
- sp 9B
- sp 10 - *Notriolus* sp 1
- sp 11
- sp 12
- sp 13 - *Notriolus* sp 2

most of the adults are spp of *Austrolimneus* .

HEMIPTERA

Corixidae	-	*Micronecta* sp
	-	*Agraptocorixa* sp
Notonectidae	-	*Anisops* sp
Mesoveliidae	-	*Mesovelia* sp?
Veliidae	-	*Microvelia* sp

ODONATA

Anisoptera
- Aeshnidae
- Gomphidae
- Corduliidae - *Hemicordulia* sp
- Synthemidae

Zygoptera
- Megapodagrionidae
- Coenagrionidae
- Lestridae
- Chlorolestidae
- Protoneuridae

COLLEMBOLA

sp 1

DIPTERA

Tipulidae sp 1
sp 2

Ceratopogonidae sp 1
sp 2
sp 3

Muscidae sp 1

Stratiomyidae sp 1

Culicidae sp 1
sp 2

DIPTERA (continued)

Tabanidae sp 1

Dixidae sp 1

Simuliidae sp 1

Psychodidae sp 1
sp 2

Chironomidae - Tanypodinae
- *Procladius* sp
- *Macropelopia* sp
- *Ablabesmyia* sp
- *Psectrotanypus* sp
- *Pentaneura* sp
- sp 1
- sp 2

Chironominae - Tanytarsini
- *Constempellina* sp 1, sp 2
- *Rheotanytarsus* sp 1, sp 2
- *Micropsectra* sp 1, sp 2
- sp 1
- sp 2
- sp 3

- Chironomini
- *Chironomus* sp
- *Polypodilum* sp 1, sp 2
- *Paracladopelma* sp
- *Cryptochironomus* sp
- *Endochironomus* sp
- sp 1

- Orthocladinae
- *Psectrocladius* sp
- *Eukiefferiella* sp
- *Brillia* sp
- *Thienemanniella* sp
- *Crictopus* sp
- sp 1

- Podominae
- sp 1?
- sp 2
- sp 3?

LEPIDOPTERA

Pyralidae sp 1

ARACHNIDA

ACARINA

Hydracarina - sp 1
- sp 2
- sp 3
- sp 4

Polchalacaridae - sp 1
- sp 2

ARANEAE

Pisauridae - sp 1

CRUSTACEA

DECAPODA

Paratya australiensis

AMPHIPODA

Austrochiltonia australis

CLADOCERA

Simocephalus vetulis
Daphnia carinata

OSTRACODA

Mytilocypris sp

ANNELIDA

OLIGOCHAETA

Naidae - *Pristina idrensis*
- *P. proboscoida*
- *P. aequisita*
- *Slavina appendiculata*
- *Slavina* sp

Enchytraeidae sp 1

Haplotaxidae - *Haplotaxis* sp

Tubificidae sp 1
sp 2

Lumbriculidae - *Lumbriculus variegatus*

HIRUDINEA

Glossiphonidae - *Glossiphonia* sp
sp 1

MOLLUSCA

BIVALVIA

- *Sphaerium* sp
- *Hyridella* sp

GASTROPODA

- *Potamopyrgus* sp
- *Pettancylus* sp
- *Glyptophysa* sp
- *Gyraulus* sp

PLATYHELMENTHES

TURBELLARIA

sp 1

COELENTERATA

HYDROZOA

- *Hydra* sp
- *Cordylophora* sp?

NEMATOMORPHA

GORDIIAE

- *Gordius* sp

APPENDIX 4A

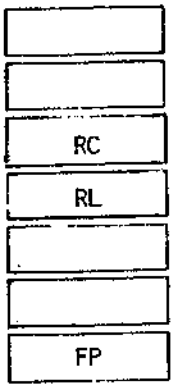
HISTORICAL CHRONOLOGY

1790's	Sealers active in area
1803	William Buckley escapes Sorrento prison to become first resident
1843	John M. C. Airey JP., Lieut. R.N. granted licence to graze the area
1846	First Government Land surveys carried out
1850's	Bark slab hut built by T. B. Pearse
1868	Land sales held on 21st April. James Noble purchased 938 acres at the sale
1889	First large scale subdivision, with the sale by auction of 56 allotments that year and another 47 allotments the year following
1889	Government decision to build a lighthouse
1890	Mr. & Mrs. Thomas Lugg arrived at Aireys Inlet to build "Lugg's Cottage"
1891	Split Point Lighthouse began operation on 1st September
1908	George Noble became the first telephone subscriber in Aireys Inlet
1910	Inlet Hotel granted Roadside Licence
1915	Split Point Lighthouse taken over by Commonwealth Government
1919	Lighthouse converted to automatic operation
1932	The Great Ocean Road was opened on 26th November, the construction of the road had been commenced shortly after World War I to employ returned soldiers
1936	Electricity was connected to Fairhaven on 17th December and to Aireys Inlet on 24 December
1947	General Business and Post Office store transferred to present site on the Great Ocean Road
1957	Bambra Road rubbish tip opened
1965	Water storage scheme for Aireys Inlet and District, initially adopted by the Barrabool Shire
1967	The automatic telephone service was introduced 19 December
1976	Water storage scheme approved by Minister for Water Supply (Mr. Grantier)
1979	Water storage dam on Painkalac Creek completed

APPENDIX 5

REFERENCE

ZONES



Rural (General Farming)

Rural (Intensive Farming)

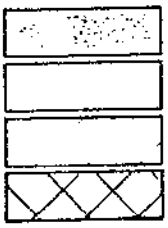
Rural (Conservation)

Rural (Landscape)

Rural (Future Urban)

Rural (Residential)

Rural (Streamside, Foreshore and Floodland)

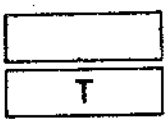


Residential A

Residential B

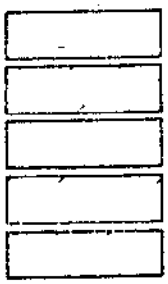
Residential C

Reserved Residential



Resort

Township



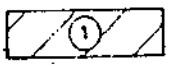
Central Business

District Business

Local Business

Commercial (Office)

Service Business



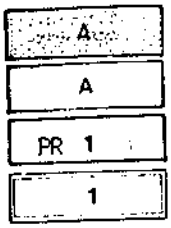
Special Uses (Serially) numbered as in Ordinance

Buildings, Works, Objects and Sites of Architectural, Historical or Scientific Interest

Areas of Special Significance

Preservation Order Area

RESERVATIONS



Public Open Space (Existing)

Public Open Space (Proposed)

Public Purposes (Existing)

Public Purposes (Proposed)

Railway Purposes

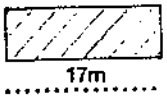
Existing Freeways and Arterial Roads

Proposed Road or Road Widening

Waterways

Municipal Boundary

Planning Scheme Boundary



Special Building Line

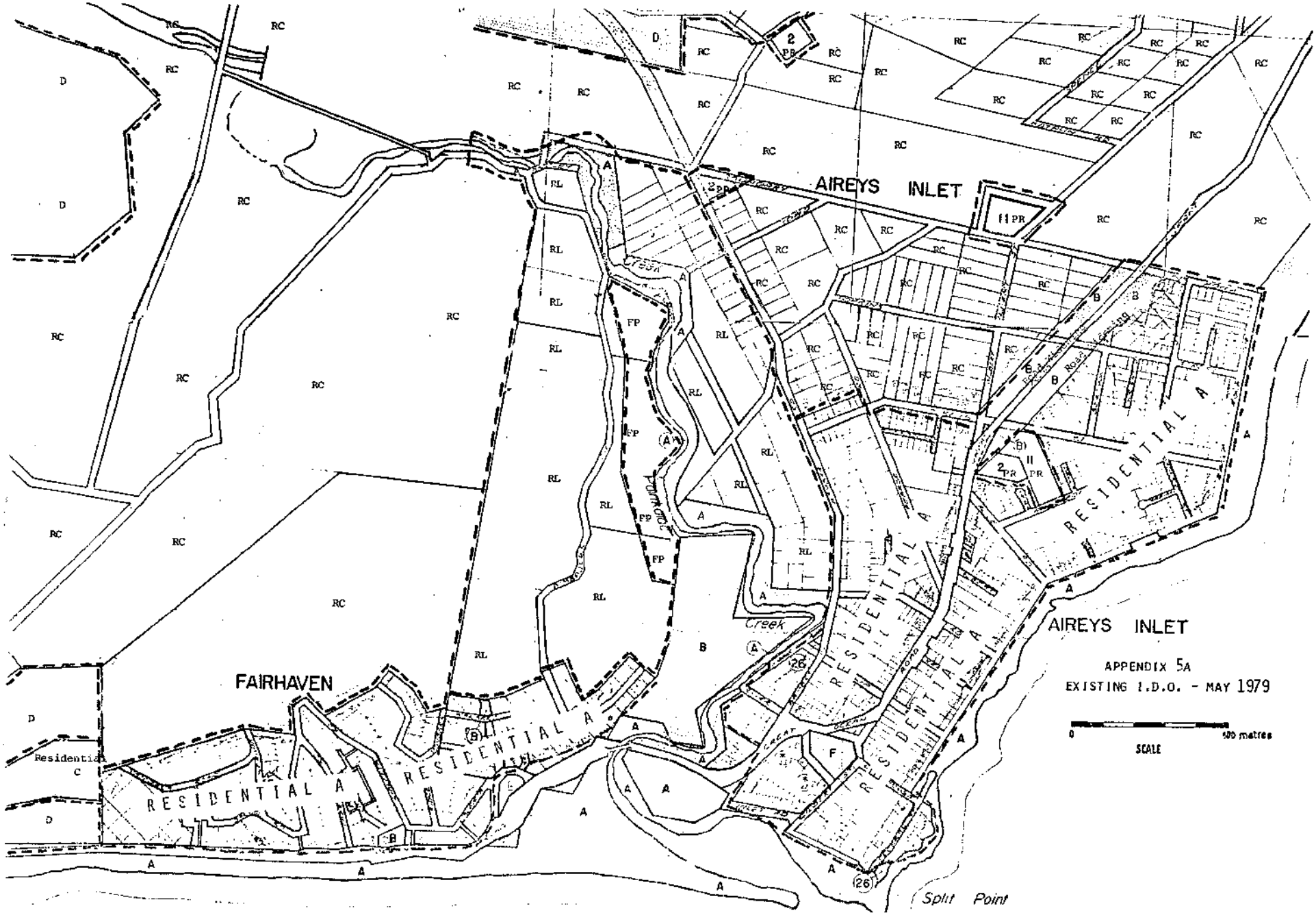
SCHEDULE

PUBLIC PURPOSES RESERVATIONS

1 Hospital
2 Local Government
3 Geelong Harbour Trust
4 Water Works and Sewerage Trusts/Authorities
5 Cemetery
6 Car Park
7 Melbourne and Metropolitan Board of Works
8 Agriculture Department
9 Country Roads Board
10 Crown Lands and Survey Department
11 Education Department
12 Explosives Department
13 Fisheries and Wildlife Department
14 Forests Commission
15 Gas and Fuel Corporation
16 Health Department
17 Mental Health Authority
18 Mines Department
19 Police Department
20 Public Works Department
21 Social Welfare Department
22 State Electricity Commission
23 State Rivers and Water Supply Commission
24 State Government Other
25 C.S.I.R.O
26 Australian Government Other

PUBLIC OPEN SPACE RESERVATIONS

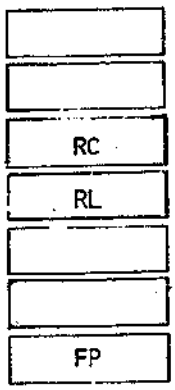
A Foreshore and Streamside Reserve
B Public Park
C Caravan Park
D State Forest
E National Park
F Fauna and Flora Reserve


AIREYS INLET
FAIRHAVEN
AIREYS INLET
RESIDENTIAL A
RESIDENTIAL A
RESIDENTIAL A
RESIDENTIAL A
RESIDENTIAL A
Residential C
Split Point
Creek
Creek
Road
RC
RL
FP
D
A
B
F
APPENDIX 5A
EXISTING I.D.O. - MAY 1979
0
600 metres
SCALE

APPENDIX 5

REFERENCE

ZONES



Rural (General Farming)

Rural (Intensive Farming)

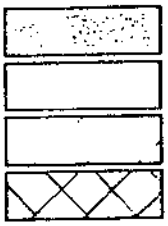
Rural (Conservation)

Rural (Landscape)

Rural (Future Urban)

Rural (Residential)

Rural (Streamside, Foreshore and Floodland)

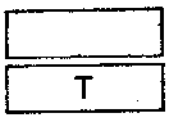


Residential A

Residential B

Residential C

Reserved Residential



Resort

Township

Central Business

District Business

Local Business

Commercial (Office)

Service Business

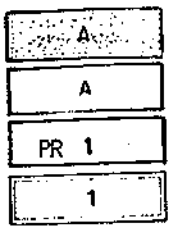
Special Uses (Serially) numbered as in Ordinance

Buildings, Works, Objects and Sites of Architectural, Historical or Scientific Interest

Areas of Special Significance

Preservation Order Area

RESERVATIONS



Public Open Space (Existing)

Public Open Space (Proposed)

Public Purposes (Existing)

Public Purposes (Proposed)

Railway Purposes

Existing Freeways and Arterial Roads

Proposed Road or Road Widening

Waterways

Municipal Boundary

Planning Scheme Boundary

17m

Special Building Line

SCHEDULE

PUBLIC PURPOSES RESERVATIONS

1 Hospital
2 Local Government
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4 Water Works and Sewerage Trusts/Authorities
5 Cemetery
6 Car Park
7 Melbourne and Metropolitan Board of Works
8 Agriculture Department
9 Country Roads Board
10 Crown Lands and Survey Department
11 Education Department
12 Explosives Department
13 Fisheries and Wildlife Department
14 Forests Commission
15 Gas and Fuel Corporation
16 Health Department
17 Mental Health Authority
18 Mines Department
19 Police Department
20 Public Works Department
21 Social Welfare Department
22 State Electricity Commission
23 State Rivers and Water Supply Commission
24 State Government Other
25 C.S.I.R.O.
26 Australian Government Other

PUBLIC OPEN SPACE RESERVATIONS

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B Public Park
C Caravan Park
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E National Park
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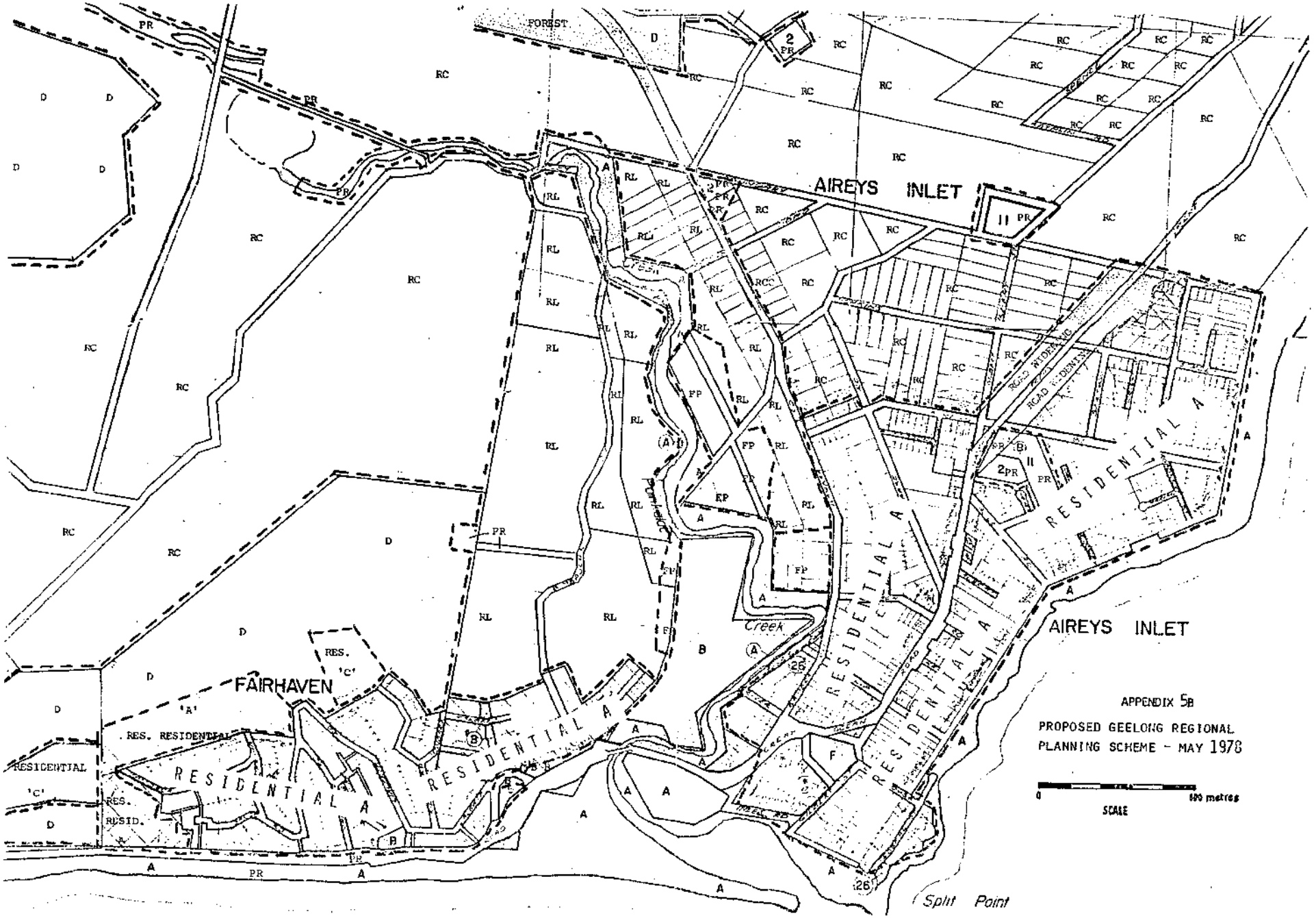
FOREST
AIREYS INLET
FAIRHAVEN
RESIDENTIAL A
RESIDENTIAL 'C'
RES. RESIDENTIAL
RESID.
RES.
'A'
'C'
Creek
Split Point
APPENDIX 5B
PROPOSED GEELONG REGIONAL PLANNING SCHEME - MAY 1978
0
SCALE

APPENDIX 5C

AREA SPECIFICATIONS FOR I.D.O.
- Extract from Part II - Division 3

Table to Clause 18 (1)

COLUMN 1 Zone	COLUMN 2 Maximum Allotment Density Allowed (Hectares)
Rural (General Farming)	1 allotment for each 75 ha
Rural (Intensive Farming)	1 allotment for each 20 ha
Rural (Conservation)	1 allotment for each 75 ha
Rural (Landscape)	1 allotment for each 8 ha
Rural (Future Urban)	1 allotment for each 50 ha
Rural (Residential)	1 allotment for each 1.5 ha
Residential "A"	At the discretion of the Responsible Authority
Residential "B"	At the discretion of the Responsible Authority
Residential "C"	1 allotment for each 0.3 ha
Reserved Residential	At the discretion of the Responsible Authority
Industrial "A"	At the discretion of Responsible Authority
Industrial "B"	At the discretion of the Responsible Authority
Rserved Industrial	At the discretion of the Responsible Authority
Township	At the discretion of the Responsible Authority
Resort	At the discretion of the Responsible Authority

(2) In determining whether or not permission to subdivide shall be granted pursuant to Sub-clause (1) of this Clause and if permission is to be so granted what condition or conditions should be imposed the Responsible Authority shall have regard to:-

(for continuation see page 5D.2)

APPENDIX 5D

AREA SPECIFICATIONS FOR REGIONAL PLANNING SCHEME
Extract from Part II - Division 3

Table to Clause 18 (1)

COLUMN 1 Zone	COLUMN 2 Maximum Allotment Density Allowed (Hectares)
Rural (General Farming)	1 allotment for each 60 ha
Rural (Intensive Farming)	1 allotment for each 20 ha
Rural (Conservation)	1 allotment for each 60 ha
Rural (Landscape)	1 allotment for each 8 ha
Rural (Future Urban)	1 allotment for each 50 ha
Rural (Residential)	1 allotment for each 1.5 ha
Rural (Floodland)	1 allotment for each 60 ha
Residential "A"	At the discretion of the Responsible Authority
Residential "B"	At the discretion of the Responsible Authority
Residential "C"	1 allotment for each 0.3 ha
Reserved Residential	At the discretion of the Responsible Authority
Industrial "A"	At the discretion of the Responsible Authority
Industrial "B"	At the discretion of the Responsible Authority
Reserved Industrial	At the discretion of the Responsible Authority
Township	At the discretion of the Responsible Authority
Resort	At the discretion of the Responsible Authority

(2) In determining whether or not permission to subdivide shall be granted pursuant to Sub-clause (1) of this Clause and if permission is to be so granted what condition or conditions should be imposed the Responsible Authority shall have regard to:-

Part II - Division 3

(a) the density of the proposed development;

(b) street or road layout with regard to the function and use of such streets or roads;

(c) the provision and location of common property including pedestrian access thereto;

(d) the provision and location of public open space;

(e) the area and dimensions of each allotment comprised in the subdivision;

(f) the provision of off-street parking;

(g) the amenity of the neighbourhood;

(h) the provisions of a scheme of development required to be submitted pursuant to Section 21(1) of the Cluster Titles Act 1974;

(i) in respect of land in a Reserved Residential, Resort, Central Business, District Business, Special Industrial, Reserved Industrial or Extractive Industrial Zone any additional requirements which may be imposed pursuant to this Scheme.

19. Rural Zones With respect to all land in Rural Zones:-

(1) No land in the rural zones listed in Column 1 of the Tables to Clause 17 or 18 shall be subdivided into allotments less in area than specified in Column 2 of the Tables and all subdivision shall be in accordance with a permit granted by the Responsible Authority taking into account the provisions of this Clause and any other relevant provision of this Scheme provided that:-

(a) Where land is located within any Rural Zone and abuts reservations for either an arterial road or a proposed arterial road or arterial road widening (as such reservations are prescribed in this Scheme) no allotment shall be created whereby the length of any frontage or other abuttal along the boundary of such reservation is less than 200 metres and in the case of the Rural (Residential) Zone the area is less than 3 hectares.

(b) No land in any Rural Zone shall be so subdivided unless:-

(i) the frontage to any road (not being a Reservation for an arterial road or a proposed arterial road or arterial road widening) is of at least 60 metres:

(ii) any allotment so created shall be capable of containing within its boundaries a rectangle having an area of 1 hectare and a minimum dimension of 80 metres.

Part II - Division 3

(c) Notwithstanding the provisions of the Tables to Clauses 17 and 18 and Sub-clause (1)(b) of this Clause no land in any Rural (Landscape) Zone shall be so subdivided that the frontage to any road is less than 200 metres.

(2) In determining whether or not permission to subdivide such land shall be granted and if permission is to be granted what condition or conditions should be imposed the Responsible Authority shall have regard where applicable to:-

(a) the existing use and possible future development of such land and of contiguous or adjacent lands;

(b) the orderly and proper planning of the zone;

(c) the amenity of the neighbourhood;

(d) the effect of development of the land upon the use or development of other land (whether contiguous or adjacent or not) which has a common means of natural or artificial drainage;

(e) the area and dimensions of each allotment comprised in the subdivision and its suitability for the use proposed therefore;

(f) the need for preserving the natural environment and preventing erosion;

(g) the advisability or otherwise of retaining or establishing native vegetation within specified distances of water courses, roads and property boundaries;

(h) where the land to be subdivided is in a Rural (Residential) Zone the desirability of providing services of water, sewerage, drainage, electricity and gas.

(3) Notwithstanding the provisions of Sub-clause (1) (a) of this Clause the excision of an allotment other than in accordance with the requirements of Column 2 of the Tables to Clauses 17 or 18 may be permitted:-

(a) for the purpose of increasing the area of an existing parcel or allotment or providing an allotment for a public utility service installation.

(b) for the purpose of providing a site for a house for a person who is actively engaged in the farming of the land and who is the owner or an immediate member of his family or an employee of the owner provided that:-

Part II - Division 4

28. Areas of Special Significance and of Natural Beauty and Interest

(1) The whole of the undermentioned areas are hereby specified as being areas of special significance, natural beauty, interest and importance, the conservation and enhancement of the character of each of which is to be effected in accordance with the provisions of this Clause, namely the land included in:-

(a) the areas designated on the Planning Map as being included in Areas of Special Significance; and

(b) the areas designated on the Planning Map as being Preservation Order Areas.

(2) The whole of the lands included in the Rural (Conservation) Zone and the Rural (Landscape) Zone are also hereby specified as being areas of special significance, natural beauty, interest and importance.

(3) The following provisions shall apply with respect to areas specified as aforesaid as being of special significance.

(a) No building or works shall be constructed in an Area of Special Significance except in accordance with the permission of the Responsible Authority. In determining whether such permission should be granted or what conditions, if any, should be specified the Responsible Authority shall have regard to:-

(i) the primary purpose for which the land is zoned;

(ii) the orderly and proper planning of the relevant zone;

(iii) the preservation of the amenity of the neighbourhood;

(iv) the preservation of the natural environment including any important landscape or conservation characteristics of the area and the suitability of the proposed development in relation thereto;

(v) the means of treatment and disposal of all sewage, sullage and other perishable wastes.

(b) No building, work site or object in such area shall be pulled down, removed, altered, decorated or defaced except in accordance with the permission of the Responsible Authority, and the Responsible Authority in granting any such permission shall ensure that any new or replacement building erected on the site concerned shall conform in appearance and character to adjacent buildings and with the character and appearance of the area generally.

APPENDIX 5E

FORESTS COMMISSION, VICTORIA

MANAGEMENT PRESCRIPTIONS WITH RESPECT TO OPERATIONS UNDER FORESTS COMMISSION CONTROL IN THE EAST MOORABOOL CATCHMENT OF THE GEELONG WATER SUPPLY, DAYLESFORD AND GEELONG FOREST DISTRICTS

1. GENERAL

Operations within the catchment are to conform with sound forestry and roading practices and are to be carried out in a manner which will protect the catchment for water supply purposes.

Timber harvesting operations are to be carried out in accordance with a documented utilisation plan prepared at least eight weeks prior to the commencement of each logging year. A copy of the plan is to be held in the District Forest Office. It is the District Forester's responsibility to ensure that the plan is prepared.

In areas to be retained under native forests effective measures are to be taken to ensure that required regeneration is obtained following timber harvesting.

2. PERIOD OF OPERATIONS

Clearing, snigging, and cartage over unsurfaced or inadequately surfaced roads, are prohibited from July to September inclusive, except that:-

(i) Snigging and associated operations may be carried out on areas approved by the Divisional Forester as being suitable for wet weather operations, and which are recorded on the utilisation plan.

(ii) Any of these operations may be carried out if authorised by the Divisional Forester on account of favourable seasonal conditions.

Temporary suspension of snigging and cartage may be imposed at any time by the District Forester during and following heavy rain in such areas and for such periods as he deems necessary to prevent deterioration of the quality of the water supply.

3. SNIG TRACKS AND ROADING

Snigging and cartage through any running stream or swampy area is prohibited. Where practicable extraction is to be planned to avoid snig tracks converging downhill.

Strict attention is to be paid to the disposal of drainage from roads, vehicular tracks, and snig tracks to obviate erosion and the direct discharge of silt into stream channels.

Prior to July each year or prior to leaving an area for a significant period snig tracks and other tracks which are liable to collect and channel surface runoff are to be drained and barred at intervals so that runoff is discharged into the surrounding vegetation and not discharged directly into streams.

Bridges or pipe culverts are to be constructed at all crossings of running streams. Dry stream beds may be crossed by means of temporary culverts or log crossings (corduroy) and these must be removed before the onset of winter conditions. The location and approaches for all crossings are to be approved by the Supervising Forest Officer.

4. LANDINGS AND LOG DUMPS

No landing or log dump is to be constructed within 80 metres of a stream or in a position likely to cause direct discharge of drainage into it. They are to be drained so that runoff is directed into the surrounding vegetation, and where necessary into graded drains so as to settle the sediment before water reaches the stream.

5. CLEARING FOR PLANTATIONS

Clearing is to be confined to areas with slopes generally less than 20 degrees. Slopes in excess of 25 degrees are not to be cleared.

6. RETENTION OF VEGETATION ALONG STREAMS

Clearing, earth works of any description excepting those for approved crossings, and timber utilisation operations, are to be excluded from the following areas:-

(i) In plantations a strip at least 20 metres wide on each bank of winter-running streams or swamps upstream from the high water level of the Korweinguboora Reservoir for a distance of 400 metres.

(ii) A strip 40 metres in width on each bank of the Moorabool River (East branch).

7. DEBRIS IN WATER COURSES

Forest operations are to be carried out in a manner which will ensure that water courses are kept free of resultant heads, logs and similar debris.

8. PRESCRIBED BURNING

The use of fire for silvicultural and protection purposes is to be in accordance with accepted Forests Commission practices and is to be planned so that sufficient litter remains on areas bordering water courses to provide a filter for runoff water. No burning of protective filter strips below plantation clearing areas is to be carried out within two years of the clearing operation.

9. SAWMILLS

The establishment of any sawmill or of any industry converting timber to manufactured products is not permitted unless authorised by the Commission.

10. GRAVEL PITS AND QUARRYING

Drainage from gravel pits and quarries is to be arranged so that it is filtered through a vegetation buffer and not discharged directly into streams.

Standing instruction 254 indicates the requirements of the Soil Conservation and Land Utilisation Act 1958 in relation to excavations less than 6 feet and the Extractive Industries Act in relation to excavations exceeding 6 feet.

11. CAMPING

Camping is only to be allowed if and where approved by the District Forester.

12. SANITARY INSTALLATIONS AND REFUSE DISPOSAL

Pit, earth closet, or other types of sanitary installations which are likely to cause discharge of effluent are to be sited at least 100 metres from any stream, spring, dam or well.

Disposal of garbage and waste material is to be as directed by the District Forester.

13. GRAZING

Grazing is not permitted in reserved forest unless authorised by the Commission.

14. FUEL DUMPS

No fuel dump is to be located or tractor servicing carried out within 100 metres of a running stream. Waste oil is to be removed from the catchment.

15. PESTICIDES AND WEEDICIDES

Use of poisons must conform with the requirements of the Pesticides Review Committee.

16. WILDFIRE

In so far as they are inconsistent with prompt effective suppression of fires these prescriptions shall have no force. Subsequent remedial soil conservation measures may be required.

17. AMENDMENTS AND REVIEW

These prescriptions are to remain in force until amended by the Commission.

The Geelong Water and Sewerage Trust is to be advised of these prescriptions and any amendments thereto.

APPENDIX 6A

TOTAL MONTHLY WATER FLOWS FOR PAINKALAC CREEK*

1974 - 1978 (megalitres)

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1974	n.a.	n.a.	n.a.	176	1411	263	2792	4665	2268	616	113	32
1975	33	13	25	21	43	128	195	1133	1852	3525	966	68
1976	18	10	13	9	13	51	35	167	700+	2707	239	35
1977	20	5	5	7	29	890	947	320	166	n.a.	n.a.	n.a.
1978	n.a.	n.a.	n.a.	n.a.	443	3503	4013	3702	439	568	1822	n.a.

n.a. = not available

* = SR and WSC stream flow figures from gauging station just below dam site from I. Noble (1979). (Unpublished letter to AIDA).

CONCENTRATION OF THE MAJOR INORGANIC IONS AND ALSO TOTAL ALKALINITY AS $CaCO_3$ IN PAINKALAC CREEK IN FEBRUARY, MAY AND AUGUST, 1978

Inorganic ions and alkalinity (mg/litre)	SITE 1				SITE 2				SITE 3				SITE 4				SITE 5			
	DUCK POND				ABOVE DAM				200m BELOW DAM				1.2km BELOW DAM				BRIDGE			
	Feb.	May 16	May 30	Aug.	Feb.	May 16	May 30	Aug.	Feb.	May 16	May 30	Aug.	Feb.	May 16	May 30	Aug.	Feb.	May 16	May 30	Aug.
Total alkalinity as $CaCO_3$	-	23	18	19	41	6	19	21	58	20	20	23	57	20	23	24	48	19	18	23
Chloride as Cl^-	-	160	110	95	153	170	100	91	193	170	100	109	243	170	120	101	227	170	110	105
Sulphate as $SO_4^=$	-	3.1	10	10	< 1	11	9.4	10	<1	10	8	11	9.6	15	15	12	12	16	13	14
Calcium as Ca^{++}	-	11	9	5.8	12	11	9	5.9	15.6	12	10	7.5	14	12	11	6.8	12	12	9	7
Magnesium as Mg^{++}	-	16	12	8.3	14.4	17	12	8.7	18	18	12	11	21	18	15	10	20	18	13	10
Sodium as Na^+	-	-	48	48	84.5	70	48	48	98	70	48	57	136	78	56	56	130	78	56	57
Potassium as K^+	-	2.4	2	8.6	3.3	2.2	2	2	4	2.4	2.4	2.7	5	2.6	2.6	2.1	4.6	2.9	2.4	2.2

- = no record

from Yule, C.M., 1978: Fauna-substrate Relationships in a Victorian Coastal Stream with Consideration of the Impact of Dam Construction. Unpublished. 1978 Hons. Thesis, Zoology Dept., Monash University

APPENDIX 7 - PHOTOGRAPHS

Set 1 - This contains photographs taken in April, 1979. The scenes depicted are referred to in the body of the report.

Set 2 - Historical terrestrial photographs from the Rose Series available from the Latrobe Library, Melbourne.

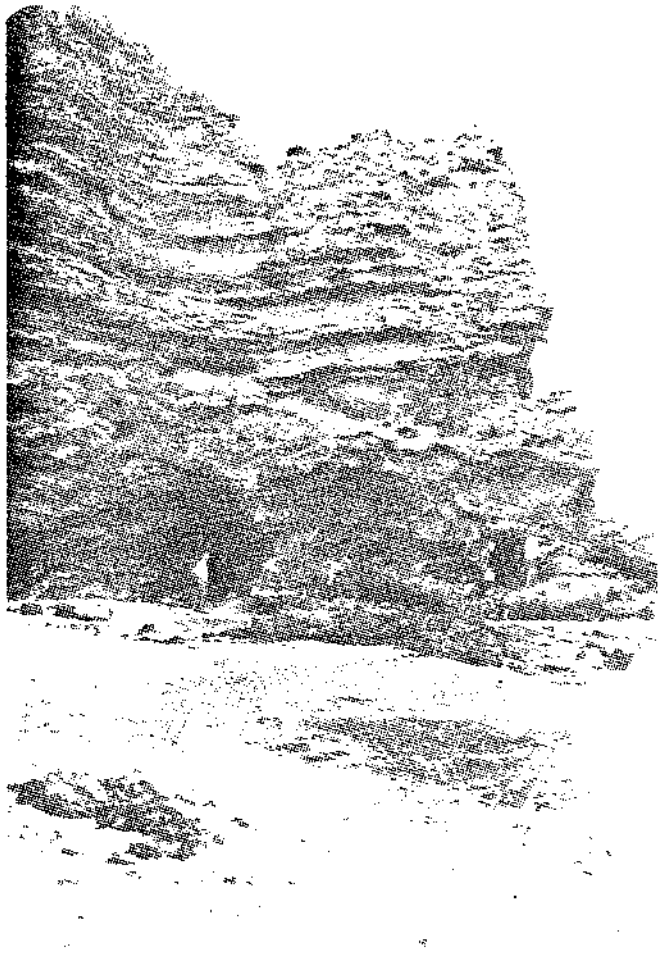

Photo 1 : Split Point showing the Point Addis Limestone Member overlying the black basalt of the Angahook Member.

Photo 2 : Looking west across the Painkalac Creek estuary, dune and beach. Note the extensive growth of tea-tree in the foreground. In the background can be seen Wybellenna Road estate and the unprotected road cutting on Great Ocean Road.

Photo 3 : Looking west along Nireys Inlet beach. Erosion of the eastern end of the sand dune can be seen.

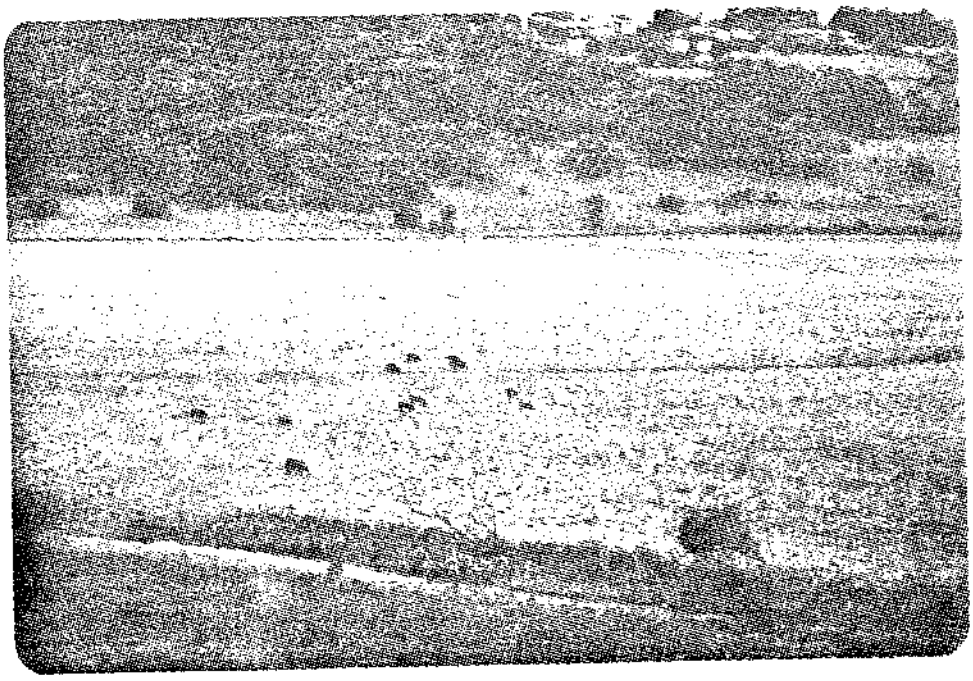

Photo 4 : Looking east across part of the Painkalac Creek flood plain.

Photo 5 : Dry sclerophyll forest in the catchment area.

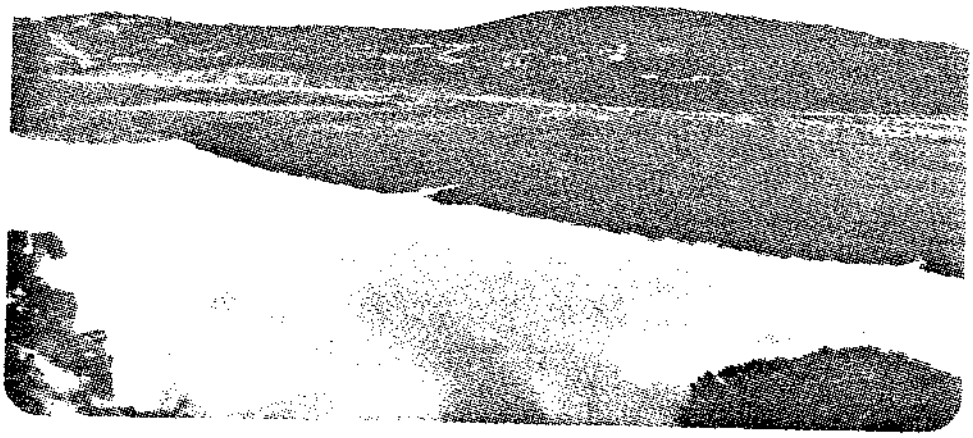

Photo 6 : Looking across the estuary to Berthon Hill. Note the salt marsh (foreground) which occurs through much of the flood plain.

Photo 7 : Reed and weed growth in the lagoon at the Allen Noble Sanctuary. Roses photographs (c. 1930) show no weed in the lagoon.

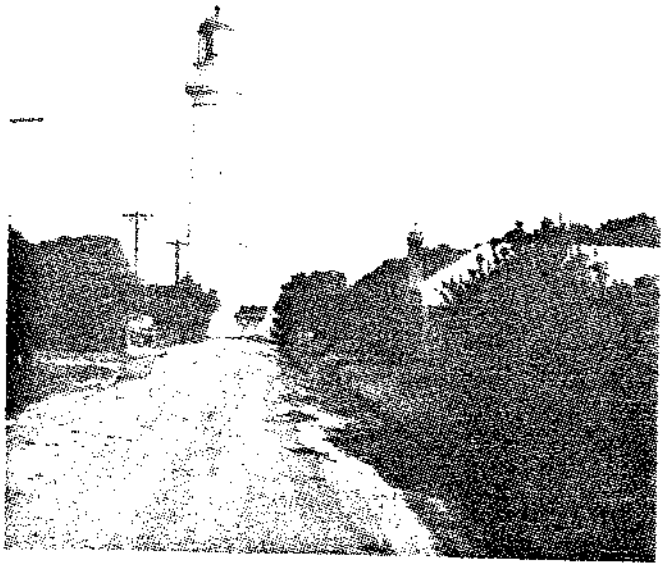

Photo 8 : Split Point Lighthouse and original keeper's stable.

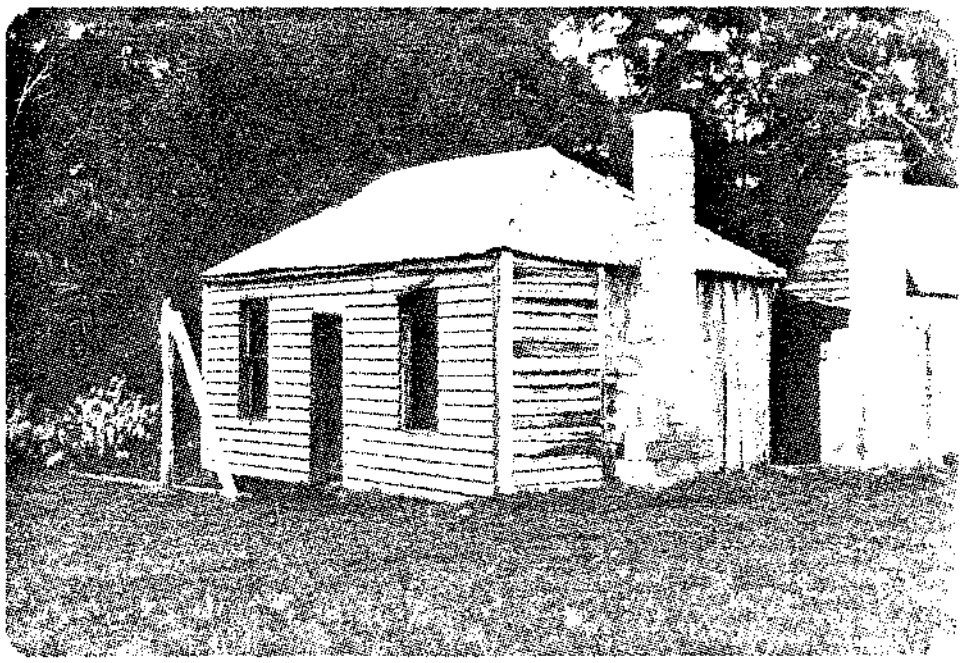

Photo 9 : Lugg's Cottage, on the flood plain near Distillery Creek.

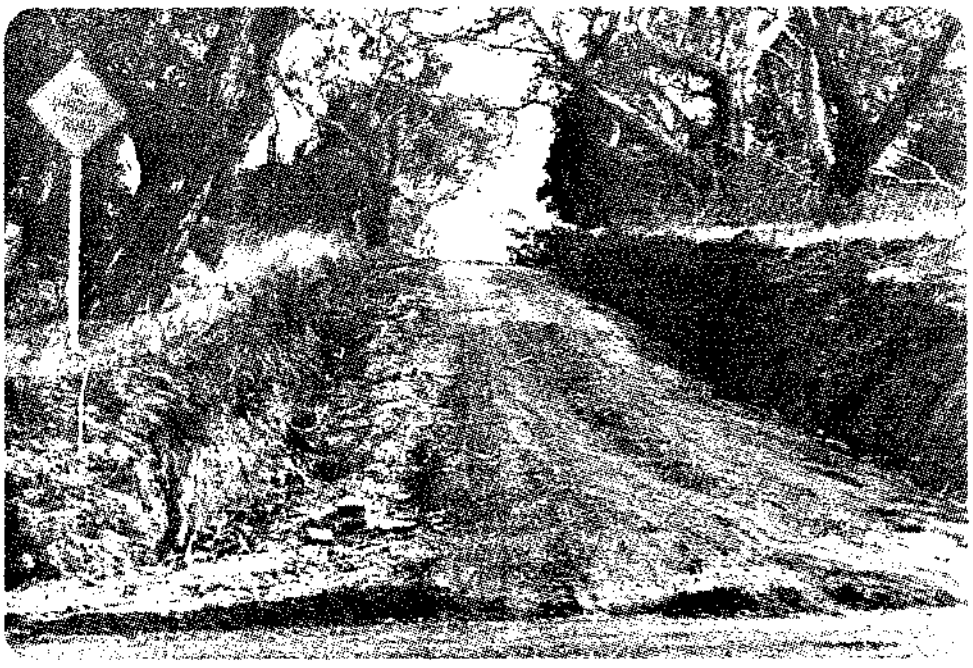

Photo 10 : Corner of Pearse Road and Aireys Street. A poorly constructed and surfaced road subject to severe erosion.

Photo 11 : The erosion scar on Berthon Hill, needing immediate stabilization against further erosion.

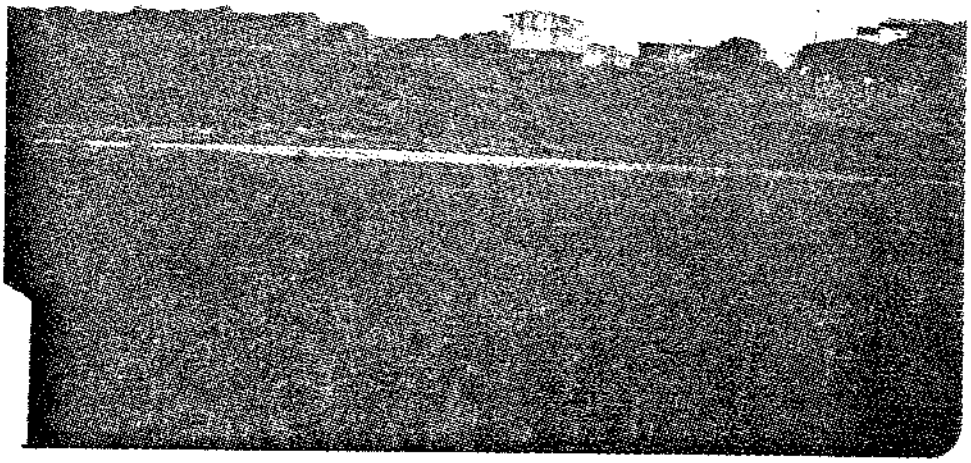

Photo 12 : A house built on the western end of the sand dune.

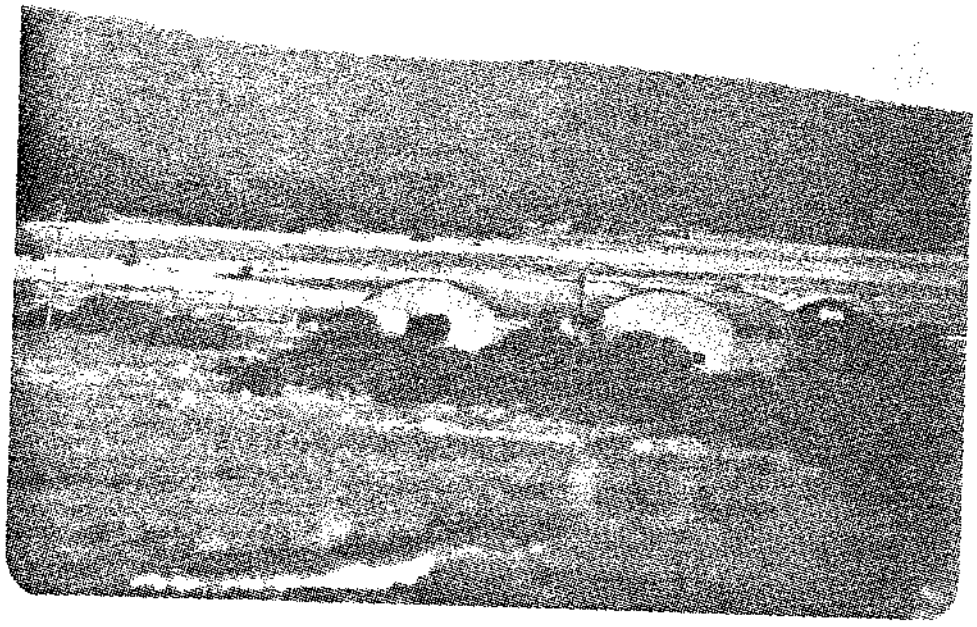

Photo 13 : Old garage on the corner of Inlet Road and Great Ocean Road.

HISTORICAL PHOTOGRAPHS

The Rose Series of photographs of Victoria were taken circa 1930. The following nine photographs of Airey's Inlet are from that collection. It is worth noting the extensive clearing at that time. Some of the scenes can be directly compared with the previous 1979 photographs numbered 1 to 13. The general vegetation recovery of the region is apparent from this comparison.

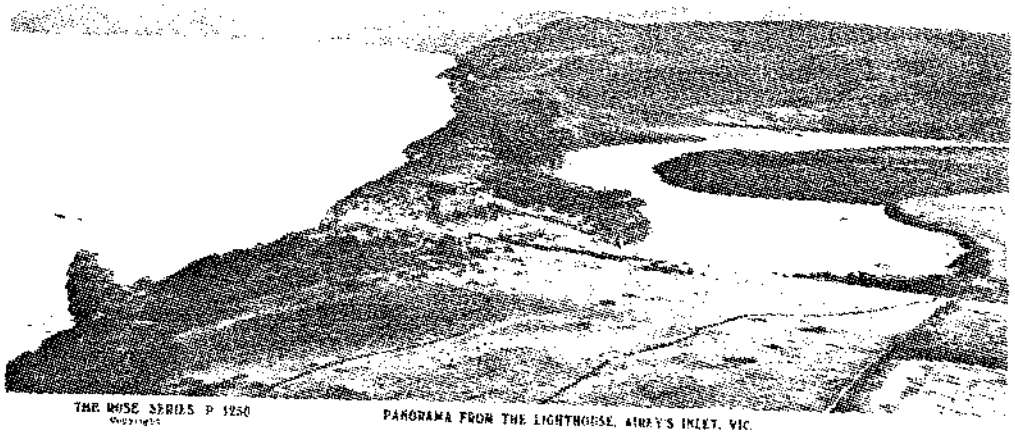

Photo 14 : Panorama from the Lighthouse (compare with photograph 2).

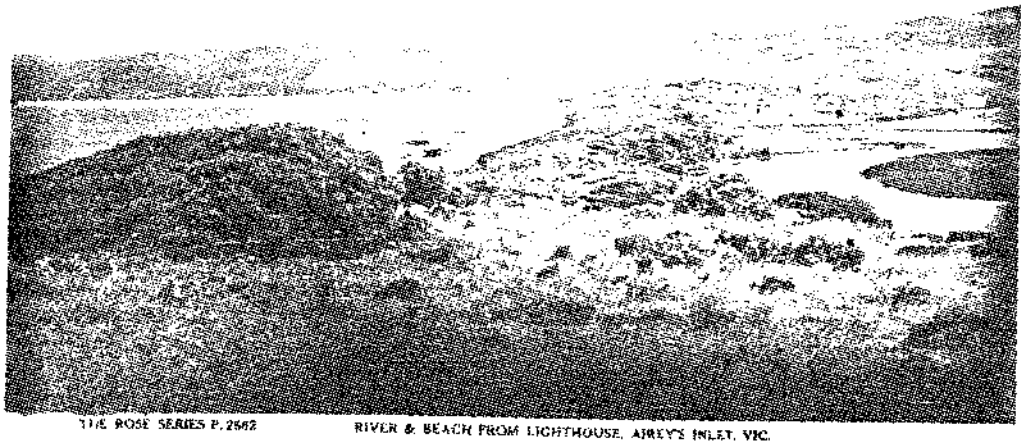

Photo 15 : River and beach from lighthouse, Aireys Inlet. (Compare with photograph 2).

Photo 16 : Painkalac Creek. (Compare with photographs 4 and 12).

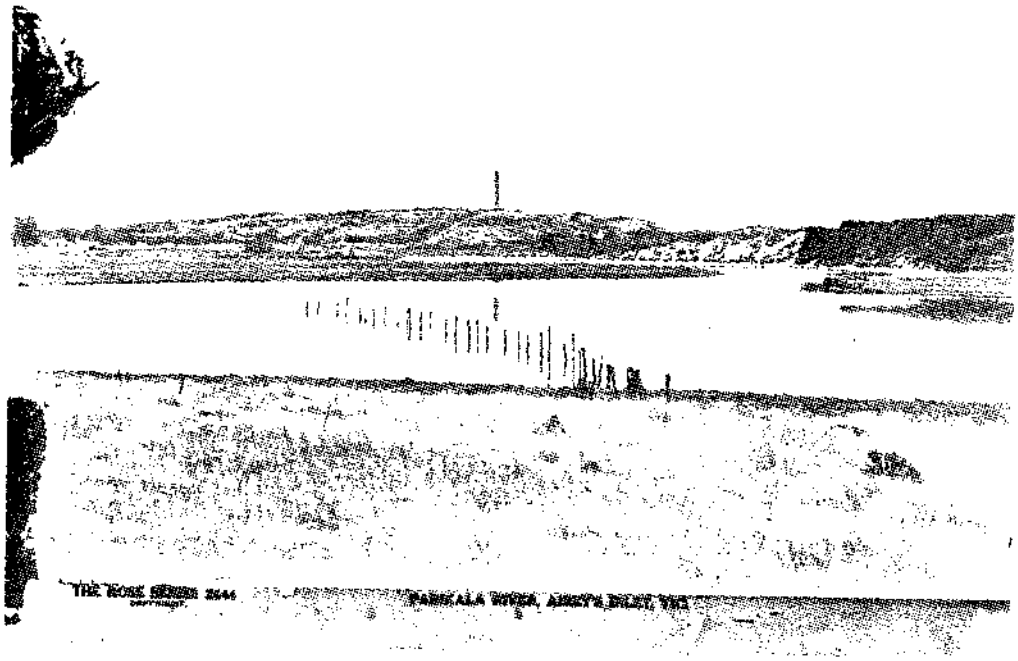

Photo 17 : Painkalac River, Aireys Inlet. (See photograph 6).

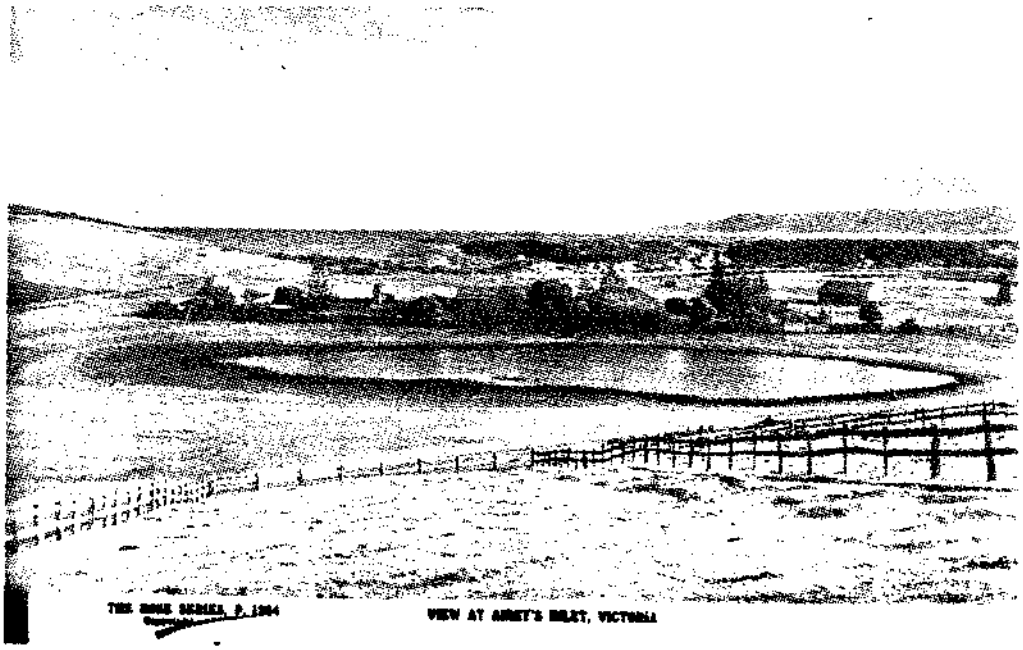

Photo 18 : Allen Noble Sanctuary. (Compare with photograph 7).

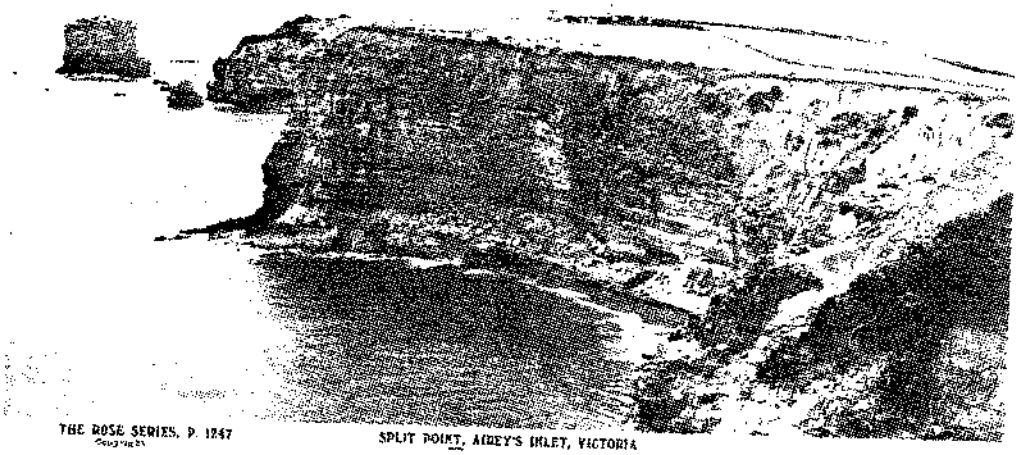

Photo 19 : Split Point Lighthouse. (See photograph 8).

Photo 20 : Painkalac Creek.

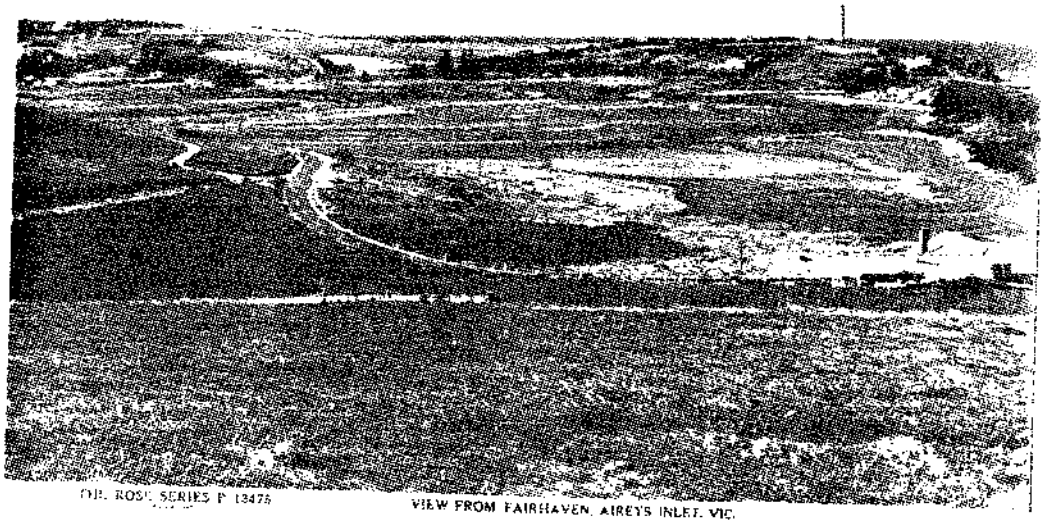

Photo 21 : View from Fairhaven.

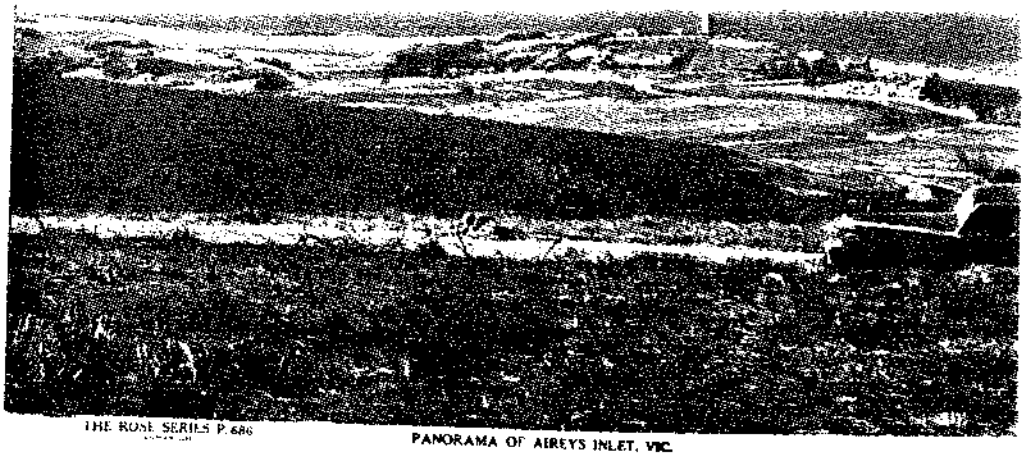

Photo 22 : View from Berthon Hill.