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Conservation resources on private land in the Shire of Otway, Victoria

R.M. Gowans, J.Z. Yugovic and R.D. Myers

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FOREWORD

This study forms part of a pilot project aimed at developing a methodology for the provision of information on a range of conservation resources to assist local government planning in rural Victoria. The need to develop explicit procedures for the provision of this information arose from the Rural Land Mapping Project, Ministry for Planning and Environment.

The information is intended to provide guidance for rural municipalities on land use matters for broad scale planning only. The database presented here is one of several which should be considered when making decisions about land use. Heavy reliance has been placed on existing information, and the future involvement of local organisations and individuals in refining the database is encouraged.

In February 1985, the Shire of Otway Planning Committee resolved to utilise the information contained in this report to assist in the formulation and administration of controls over development and vegetation removal in the Shire. The Committee also adopted the three levels of response outlined on maps A and B, to be followed in consideration of applications for planning permits.

SUMMARY

This report presents the results of an investigation of the conservation resources on private land in the Shire of Otway, Victoria. A range of physical and biological resources are evaluated, and the results are presented in a series of 1:50 000 maps. The information is provided to facilitate the implementation of tree clearing controls by the Shire, and to promote the protection of its significant natural features.

Seventy-two areas of geological and geomorphological significance are identified. These comprise 3 areas of international significance, 19 of state significance, 39 of regional significance, and 11 of local significance.

The assessment of biological resources is undertaken from two viewpoints:

- (a) the identification of sites of conservation significance;
- (b) an assessment of the value of the existing land cover for flora and fauna conservation, erosion control and water quality protection.

Eight sites of biological significance are identified, 7 of state significance and 1 of local significance. The status of wetlands in the Shire is discussed.

Areas are identified in which further investigation is required to assess the impact of land use change on conservation values. Generally these are areas which have recognised values but for which there is little or no detailed information.

The results of this study are translated into three recommended levels of response through the town planning system. The levels reflect the planning response considered necessary to minimise the risk of degradation of the identified resources. The areas to which these responses apply are shown on Maps A and B.

The three levels are:

- I Strict planning controls are required to conserve identified resources, through amendment and strengthening of planning schemes and controls. Development should not take place, unless after consultation with the Dept of C, F & L it is considered that the development would not be detrimental to the identified resources.
- II Planning permits should have attached conditions designed to minimise impact. Where there is a need for specialist advice, Council should refer planning applications to the Colac Regional Office of the Dept of C, F & L for comment and/or drafting of suitable permit conditions.
- III Except for land within proclaimed catchments, proposals for development should not generally require referral to the Dept of C, F & L by Council.

INTRODUCTION

The Shire of Otway is located approximately 160 km south-west of Melbourne and is 190 694 ha in area (Fig. 1). The area contains a considerable diversity of environments, each with its own combination of geology, climate, soils and vegetation. The heavily timbered Otway Ranges, rising to 676 m, dominate much of the Shire. The coastal zone includes cliffs, steep slopes, sand dunes and sweeping beaches.

This study was carried out at the request of the Ministry for Planning and Environment for information on the conservation resources on private land in the Shire.

It is considered that conservation includes all forms of sustained use, and that the productive use of land for agriculture or forestry can incorporate some of the needs of nature conservation by the adoption of practices such as:

- (a) the avoidance of cropping on areas prone to erosion;
- (b) the avoidance of overgrazing;
- (c) the maintenance of tree cover to assist in the control of soil erosion and soil salting;
- (d) the maintenance of tree cover for stock shelter;
- (e) the maintenance of tree cover and wetlands to provide habitat for natural predators of pasture pests.

By adjusting the intensity of land use and by applying appropriate management practices, problems of land deterioration and subsequent reduced productivity can be minimised. Consequent increases in property values and agricultural production provide financial incentives for adopting such practices.

It is not intended that this report be used to identify areas for nature reserves, or that vegetation clearance should cease. The aim is to describe and evaluate the conservation resources on private land so that Council can influence the effects of land use change on the important natural features in, and the long term productivity of, the Shire.

The information is provided to the Shire to facilitate:

- (a) the consideration of subdivision and development proposals in relation to identified conservation resources;
- (b) the formulation of conservation policies on planning and land use matters;
- (c) the drawing up or amendment of an Interim Development Order or Planning Scheme covering conservation matters.

The information presented here indicates only some of the values that should be considered in assessing a development proposal. Which values are given preference in particular areas is for Council to decide, having regard to community attitudes and the many social, economic and environmental considerations which arise from these preferences.

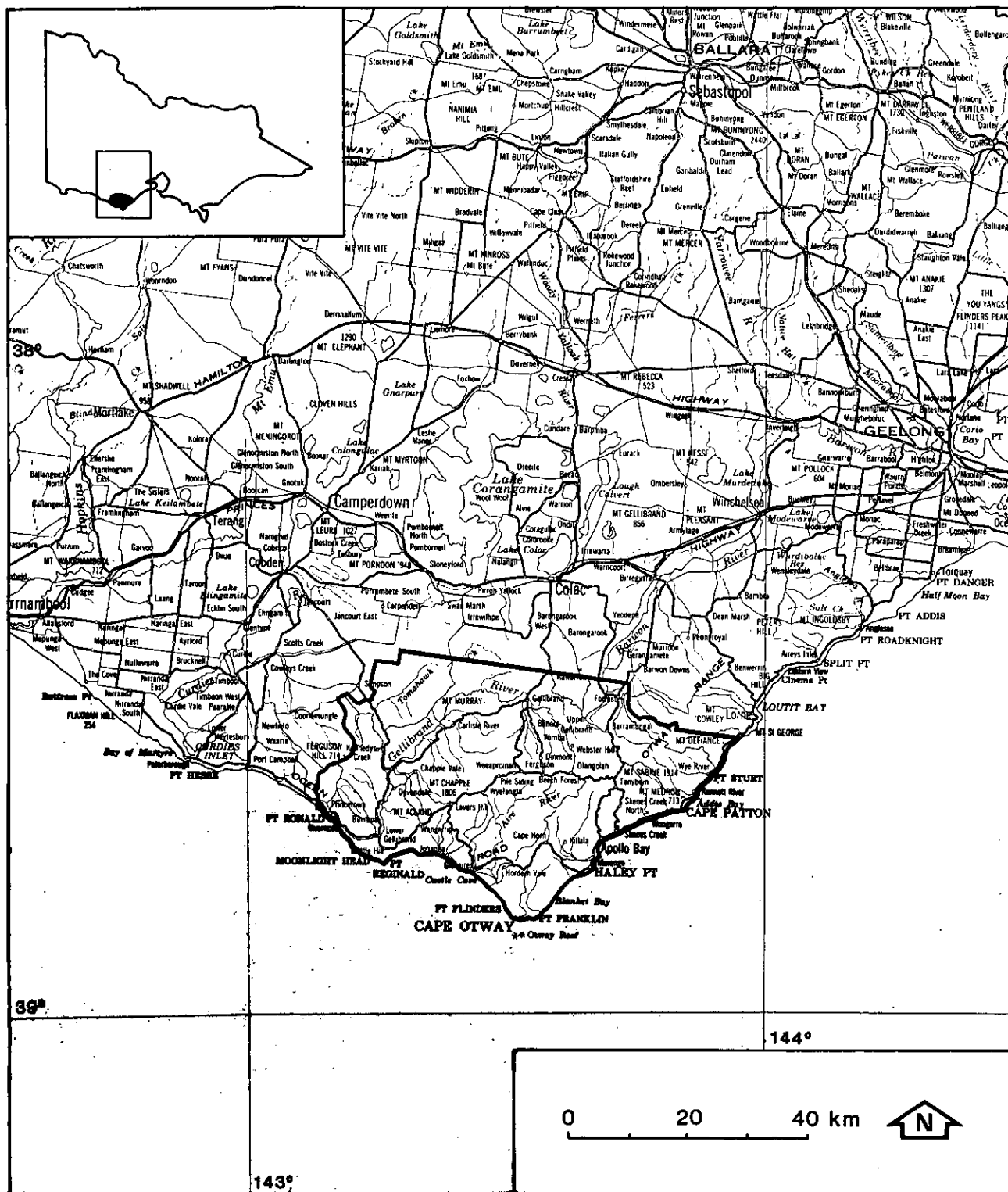


Fig. 1. Location of the Shire of Otway

The information is presented in three parts:

- | | |
|--|---|
| 1. Physical resources
(Map A) | Sites of geological and geomorphological significance are described and mapped. |
| 2. Biological resources
(Maps C, D & E) | The land cover is described and mapped. Assessments of the value of the land cover are conducted for:
(a) flora and fauna conservation;
(b) erosion control and management. |
| 3. Recommended planning
response (Maps A & B) | Recommendations are made concerning conservation policies and planning strategies. |

The overall approach taken in this study is outlined in Fig. 2.

Maps A and B are presented as 35 mm slides at the back of this report. Maps C, D and E are not provided, however copies are available for inspection at the Shire of Otway Council Office (Beech Forest), the Colac Regional Office of the Department of Conservation, Forests and Lands (Colac), and at the Arthur Rylah Institute (Melbourne).

Care must be exercised in the use of the map data because of the generalised nature of the database. The evaluation maps are provided to alert the planner of the need for action, and in general terms, the type of action required. The question of where a development will cause the least environmental impact cannot always be answered on the basis of mapped information alone. On-site investigations may still be necessary where there is a need for detailed information.

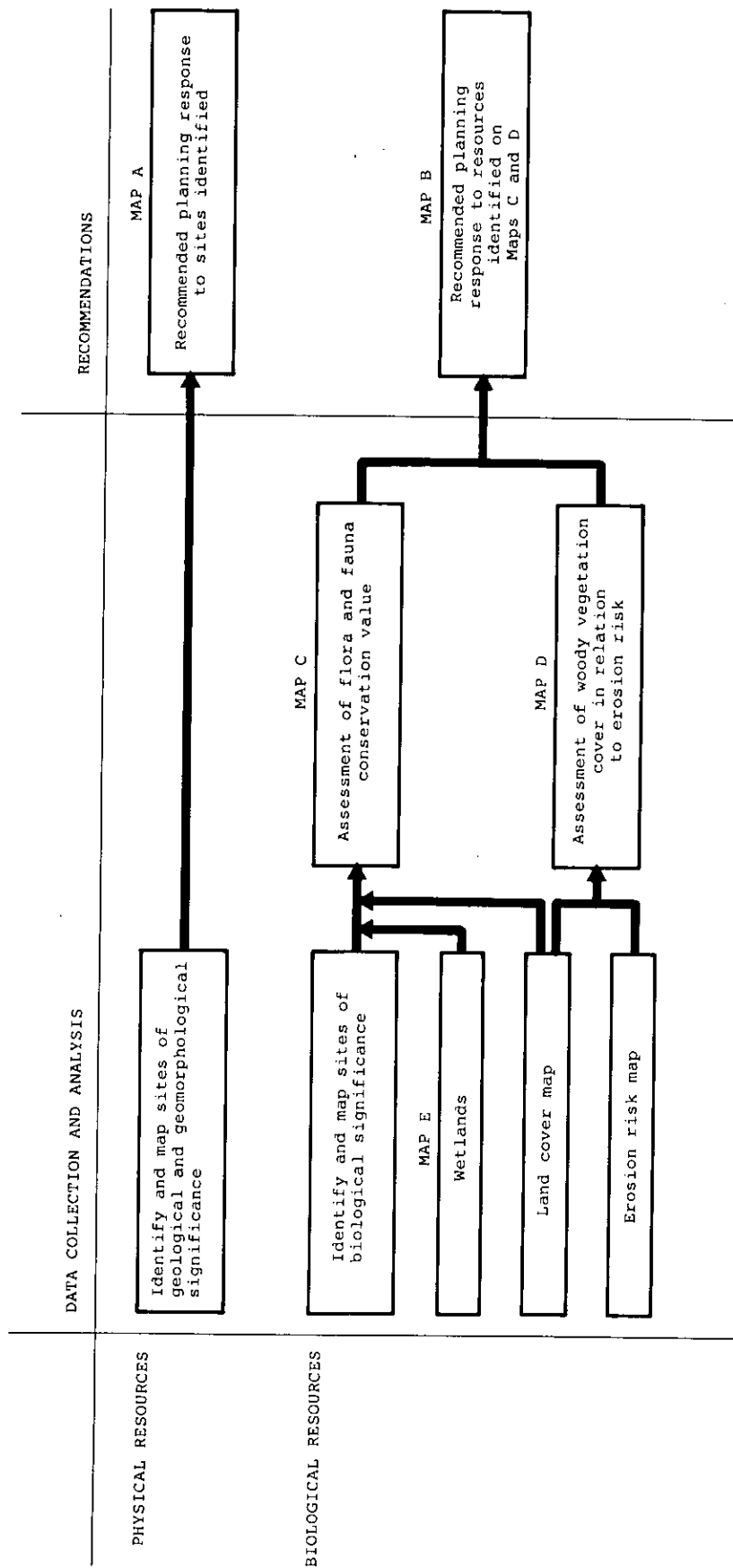


Fig. 2. Outline of the approach taken in this study

PHYSICAL RESOURCES

Sites of geological and geomorphological significance

The information presented here is derived from the report 'Sites of geological and geomorphological significance in the Shire of Otway' (Rosengren 1984). The report identifies sites which are regarded as significant in defining the geological and geomorphological characteristics of the region, or are of broader interest in education and research.

A total of 129 were described the Shire. Of these, 72 occur wholly or partly on private land, while 57 are restricted to public land. The number of sites in each significance category is given below:

Significance category	Private	Public	Total
International	3	4	7
National	0	5	5
State	19	17	36
Regional	39	21	60
Local	11	8	19
Unknown	0	2	2
Total	72	57	129

Sites of geological and geomorphological significance were selected on the basis that they either represent a specific characteristic of the region, or they include an outstanding, rare or possibly unique geological or geomorphological feature. The criteria for site selection and significance categories are given in Appendix I.

Each site has been assessed to determine the extent to which the feature of significance is being, or could be, degraded by land use at or near the site. The sensitivity of a site is summarised by allocating it to one of three broad classes described in Appendix II. The allocation to a sensitivity class is independent of the significance rating assigned to a site. In general the level of special management required is greatest for the more sensitive sites.

The three sensitivity classes are as follows:

- Class 1. Sites that are most sensitive;
- Class 2. Sites of moderate sensitivity;
- Class 3. Generally large sites which are unlikely to be obscured or removed.

Sites of geological and geomorphical significance on private land are summarised in Table 1 and are shown on Map A.

Table 1. Sites of geological and geomorphological significance on private land in the Shire of Otway

Site no.	Site name	Significance rating	Sensitivity class	Feature
International significance				
21.3 &	Moonlight Head to Milanesia Beach - coastal cliffs and landslips	I	1	Contains an assemblage of coastal landforms not represented on such a scale elsewhere in Victoria
22.2	Lion Headland	I	1	Continuation of the landform assemblage in 22.1; contains a dinosaur footprint
State significance				
6.1	Simpson - parallel drainage	S	2	The ridge and valley pattern is of considerable significance in determining the landscape evolution of Victoria
7.4	Parallel ridges and valleys	S	2	Similar to 6.1 except that the material comprising the ridges is different (i.e. not Moorabool Viaduct Formation sands)
7.7	Gellibrand River - gorge	S	2	Clearly displays the physiographic effects of recent fault movement
8.9A/B	Carlisle River - perched lakes	S	1	Lake floor sediments of importance in studies of Quaternary climates in south-east Australia
9.3	Gellibrand - Older Volcanics	S	2	Constitutes the westernmost Older Volcanic outcrop in Victoria
9.4	Gellibrand - bentonite quarry	S	2	One of the major bentonite occurrences known in Victoria; of importance in determining the origin of volcanic materials in the Lower Cretaceous sediments in the Otways Group
14.3	Point Ronald - calcarenites	S	2	The site shows a variety of Tertiary and Quaternary sediments representing a wide range of terrestrial, estuarine and marine depositional environments

Table 1. (cont.)

Site no.	Site name	Significance rating	Sensitivity class	Feature
State significance (cont.)				
14.4	Princetown - relict spits	S	2	Distinct landforms that indicate a stage in the development of the river mouth
14.5	Gellibrand River - levees	S	1	Best examples of levee banks on a confined flood plain in Victoria
14.7	Gellibrand River - backswamp	S	1	A site of considerable interest for studies of fluvial landforms and sediments
15.2	Chapple Creek Ford - fossil plants	S	1	One of the few known sites in the inland part of the Otway Ranges to yield megafloral remains
18.2	Barham River (East Branch) landslide control site	S	1	A reference site that displays the nature of land surfaces prior to European settlement
19.7	Sugarloaf Hill - emerged stack and terrace	S	2	Illustrates the complexity of the evolution of coastal slopes in the Otway Ranges
23.8	Aire River - dune and buried cliff	S	2	A useful site for studying the relationships between sand supply, wind direction and pre-existing terrain in shaping transgressive dune morphology
23.9	Lake Hordern and Aire floodplain	S	2	Lake Hordern provides a valuable area for palaeoecological investigations as the upper sedimentary sequence in the lake has not been compacted or drained
23.12	Point Flinders - Tertiary	S	1	Displays the contact between Mesozoic and Quaternary sediments and illustrates the process of development of the cliff-top dunes
25.2	Barham River Lagoon	S	2	Largest abandoned tidal meanders of any stream in western Victoria

Table 1. Sites of geological and geomorphological significance (cont.)

Site no.	Site name	Significance rating	Sensitivity class	Feature
State significance (cont.)				
25.4	Marengo - Storm Point to Swell Point	S	1	One of the more complex higher sea level sites on the Otway coast which has not been researched in detail
25.5	The Blowhole	S	1	Of considerable importance in the analysis of Pleistocene sea level changes
Regional Significance				
2.2	Tomahawk Creek - terrace	R	2	Illustrates development of the Tomahawk Creek Valley and contains one of the best preserved terraces in the north-west of the Shire
7.1	Kennedys Creek - alluvium	R	2	One of the longest alluvial sectors in valleys in the far north-west of the Shire
7.2	Kennedys Creek - landslip terraces	R	3	The site displays a process of valley widening and contains a noticeably high number of landslips
7.3	Fault scarp	R	2	Clear display of the erosional and tectonic processes responsible for much of the terrain in the north-west of the Shire
7.9	Gellibrand River - meanders	R	1	Meander patterns illustrate one of the varied characteristics of the longest river in the Otway region
7.10	Gellibrand River - valley	R	2	One of the best inland examples of levee banks
8.1	Gellibrand River - terrace	R	3	Alluvial terraces are not common on this part of the Gellibrand River
8.2	Bunker Hill - fault and Older Volcanic basalt	R	3	Represents one of the few surface outcrops of volcanic rocks in the Otway region

Table 1. (cont.)

Site no.	Site name	Significance rating	Sensitivity class	Feature
Regional significance (cont.)				
8.4	Carlisle River - erosion terrace	R	2	Well preserved terrace remnant in an area where the terrace record is fragmentary
8.6	Gellibrand - basalt dyke	R	2	One of the few examples of Older Volcanic materials in the Otway Shire
8.7	Carlisle River - dry valley	R	3	Illustration of the nature of valley development in the Tertiary formations on the north western flank of the Otways
8.8	Carlisle River - avulsion channel	R	2	Longest single abandoned channel section in the Gellibrand River system
9.1	Gellibrand River - channel	R	3	Of interest in determining the rates of channel incision along the Gellibrand River
9.2B	Loves Creek - brown coal and limestone	R	1	Outcrops are important in displaying aspects of the Tertiary geology of the northern Otway area
9.5	Gellibrand - 'shale pit'	R	2	Historical significance for its use as a ballast source for the now dismantled narrow gauge railway
9.6	Gellibrand - Tertiary gravels	R	2	Coarseness of the gravel beds is unusual in the Tertiary sediments of the Gellibrand area
10.2	Gellibrand - landslips	R	2	Landslips and wind gaps demonstrate the processes of valley development
14.1	Princetown - La Trobe Creek and escarpment	R	2	The capping of Port Campbell limestone is the only extensive occurrence of this formation in the Otway Shire
14.9	Moonlight Head - australites	R	2	Australites (a small button shaped glossy type of meteorite) have been recorded

Table 1. Sites of geological and geomorphological significance (cont.)

Site no.	Site name	Significance rating	Sensitivity class	Feature
Regional significance (cont.)				
15.3	Burrupa - Gellibrand river confined floodplain	R	-	Illustration of three phases in the development of the Lower Gellibrand valley
15.4	Wattle Hill	R	2	Main area of exposure of the Moonlight Head beds which are important in determining the regional structure of the area
15.5	Colac Tree Road	R	2	Illustrates a common landform sequence on the north-west flank of the Otway Ranges
15.6	Johanna Falls	R	2	Rock outcrop may correlate with the formations of the coastal cliffs at Lion Headland
16.6	Johanna Heights - landslip	R	3	Terrain is representative of the southern flank of the Otway Ranges
18.6	Skenes Creek - black coal	R	2	Site has extensive exposures of black coal seams
18.7	Rusty Road Falls	R	2	Unusual coastal waterfall with vertical face
18.8	Wild Dog Creek - gorge	R	2	Good reference and teaching site showing the tectonic and erosional processes that have shaped the Otway coast
18.9	Apollo Bay - escarpment and terrace	R	2	Illustrates problems in determining age and origin of coastal escarpments and terraces in the Otway area
18.11	Skenes Creek - terrace	R	2	May represent remnants of shore platforms formed at a higher Pleistocene sea level
19.9	Cape Patton - Tertiary sediments	R	2	One of a small number of high level early Tertiary sediments found in the Otway Ranges
22.3	Johanna River - floodplain	R	3	Forms the only alluvial valley deposit between the Aire and Gellibrand valleys

Table 1. (cont.)

Site no.	Site name	Significance rating	Sensitivity class	Feature
Regional significance (cont.)				
23.1	Johanna - dune	R	1	The valley shows clearly the influence of faulting, sea level change and successive episodes of dune formation
23.6	Spud Point	R	2	Outcrops are used to determine the stratigraphy of the Aire Basin Tertiary sediments
23.10	Fishing Point	R	3	Of interest for its type section status
23.11	Hordern Vale - Aire River	R	3	Useful for comparison with the Gellibrand River floodplain
24.1	Hamilton Creek	R	3	Important as an illustration of unconformity between formations
24.2	E.S. Hill - precipitation ridge	R	2	Representative of one of the major geological and geomorphological boundaries in the Otway Shire
24.3	Parker River	R	3	Illustrates a geomorphological process similar to that at the mouth of the Johanna River
25.1	Apollo Bay - terraces	R	2	Examples of terrace levels along the eastern Otway coast
Local significance				
4.2	Kawarren - river capture	L	1	Illustrates an unusual stage of drainage development
6.2	Simpson - landslip	L	3	Illustrates a process of mass erosion on slopes developed on Gellibrand Marl
7.5	Carlisle River - Gellibrand River backswamp	L	1	Illustrates an unusual process of valley slope development
7.6	Kennedys Creek - swamp	L	2	Illustrates the influence of faulting in controlling depositional sectors of this creek

Table 1. Sites of geological and geomorphological significance (cont.)

Site no.	Site name	Significance rating	Sensitivity class	Feature
Local significance (cont.)				
8.3	Gellibrand River - levee and backswamp	L	1	One of several small backswamps of the Gellibrand River
10.1	Forrest - Barwon River (West Branch) - landslips	L	2	Shows the response of deeply weathered Otway Group sediments on undercut valley slopes
15.1	Chapple Creek - backswamp	L	2	Represents the best unmodified floodplain swamp of Chapple Creek
17.5	Paradise - landslip	L	3	Example of earth movements in the Apollo Bay area
18.3	Wild Dog Creek - landslip	L	3	Example of a mass movement process common on the steep cleared slopes in the Apollo Bay area
18.4	Barham Valley	L	3	Demonstrates a process of valley widening
25.3	Barham River - isolated hill	L	3	The hill indicates previous river movement and subsequent alluviation

BIOLOGICAL RESOURCES

Land clearance in the context of European settlement has been necessary for the development of Victoria. However the extent and intensity of clearance has resulted in many land degradation problems. These include: soil erosion, soil salting, the degradation of water resources, and a reduction in the range and abundance of much of the native biota. Accordingly, there has been a trend among rural Shires for some years to adopt policies which seek to control the removal of vegetation.

The value of native vegetation in agricultural areas is well documented (Natural Resources Conservation League of Victoria 1978; Kile et al. 1980; Oates et al. 1980; Bird 1981; Davidson 1981, 1982; Altieri 1983; Dengate 1983; Mayse 1983). The benefits include: reduced stock losses through the use of trees as shelter, pasture pest control (for example through the use of vegetation to attract birds which feed on pasture pests), and erosion control. In many parts of Victoria programs are underway to re-establish native vegetation to overcome land management problems. Consequent increases in property values and agricultural production provide financial incentives for adopting such practices.

The presence of native vegetation on private land is also of considerable importance for biological conservation, indeed in many parts of the State such areas form an essential complement to an inadequate reserve system on public land. These areas support resident populations of native plants and animals, and facilitate the movement of species by providing corridors or stopovers between large areas of habitat on public land.

Maintaining undisturbed native vegetation on private land may not be possible in a primarily agricultural situation. However by retention or re-establishment of native vegetation cover, for example in areas of high erosion risk, an important contribution to biological conservation can be made while simultaneously addressing practical farm management problems.

This assessment is presented in three parts. The first section provides information on known sites of biological significance. The second section provides an assessment of the existing land cover for flora and fauna conservation, incorporating the sites of significance identified previously. The third section provides an assessment of the value of the existing land cover in the control and management of erosion.

Sites of biological significance

A major component of this study was to collate information obtained from published sources and from local organisations and individuals. In assessing the conservation status of a feature, consideration has been given to the distribution of the feature both within the Shire and elsewhere within the State, and the extent to which it is represented in reserves.

Cape Otway site

Site no.	1
Significance	Botanical (State)
Location	3 km north-east of the Cape Otway Lighthouse (Fig. 3)
Area	265 ha
Description	Remnant of very rare woodland and forest formations growing on unconsolidated calcareous sand dunes. Manna Gum (<i>Eucalyptus viminalis</i>) woodland occurs on the dune crests and in some of the interdune corridors which are otherwise vegetated by Manna Gum - Messmate Stringybark (<i>E. obliqua</i>) open-forest.
Status	Occurrences of eucalypts on calcareous sand dunes are very rare in Victoria, and all are on private land.
Value	The largest occurrence of eucalypts on calcareous sand dunes in the State. The only other occurrences, near Nelson, western Victoria, are of very limited extent (C. Anderson, pers. comm.). Rare genetic variants of Manna Gum and Messmate Stringybark occupy the site and are the subject of continuing research by Dr P. Ladiges of the University of Melbourne and Dr C. Anderson of Monash University. The area is documented as a 'Site of special scientific interest in the Victorian coastal region' by the Ministry for Planning and Environment.
References	Anderson & Ladiges (1978; 1982); Anderson (1982a, b); Barson & Calder (1976); Carr (1970); Ladiges & Ashton (1977); LCC (1976); Pitt (1981).
Management guidelines	
Grazing	Exclude grazing if possible, otherwise keep stock numbers to a minimum and remove stock at regular intervals (particularly during spring) to allow regeneration. Grazing has been responsible for major floristic change in the understorey, and for the establishment and spread of introduced plants throughout the site. Fenced plot experiments have shown that the native vegetation regenerates when grazing is excluded (C. Anderson, pers. comm.).
Fire	Fire management should be undertaken on the advice of the appropriate authorities (e.g. Country Fire Authority, Department of Conservation, Forests and Lands). Management considerations should include the detrimental effects of frequent burning e.g. over-dominance by Bracken, and fire control by methods other than fuel reduction burning e.g. slashing or earth breaks.

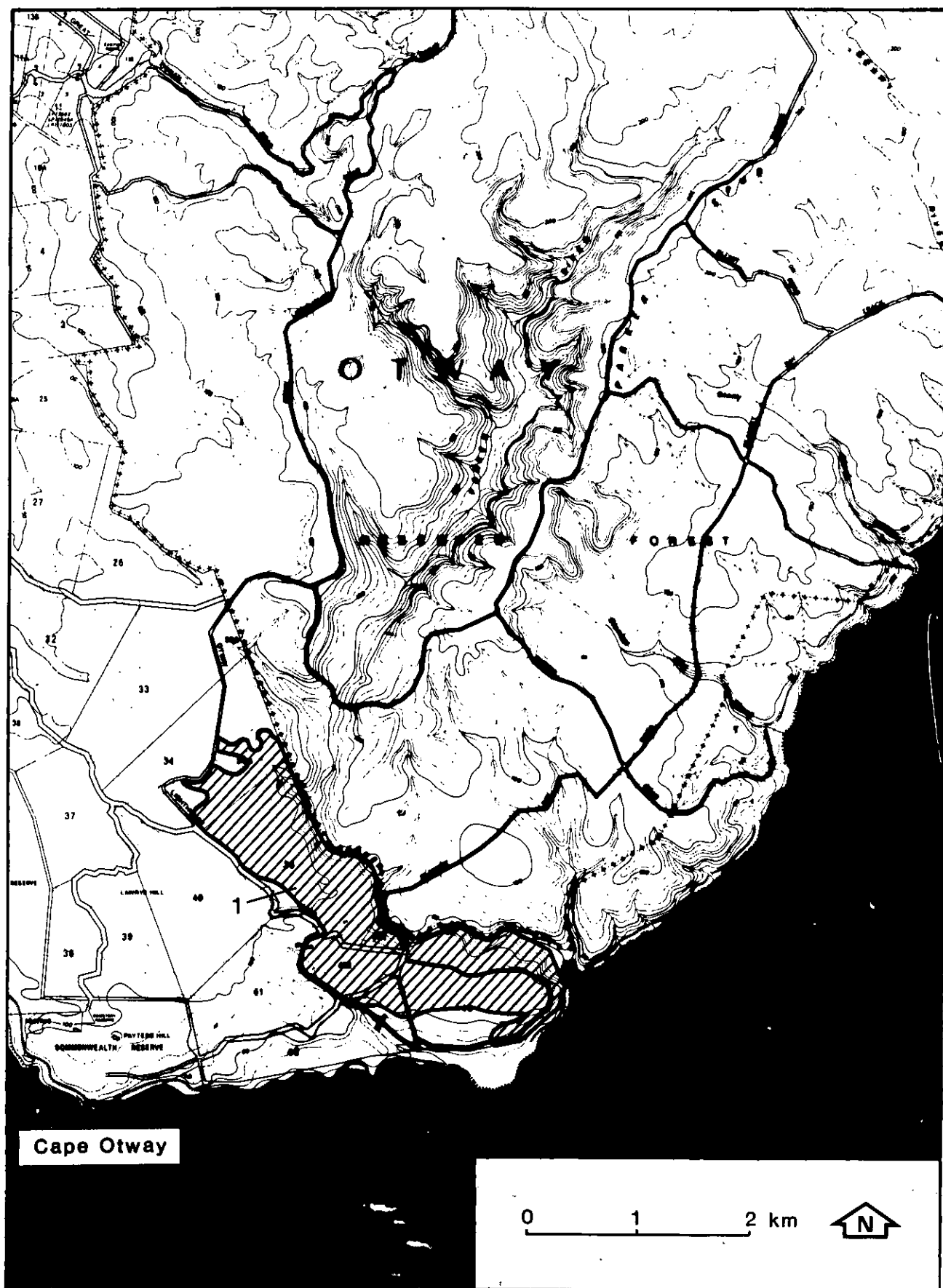


Fig. 3. Site no. 1

Weeds	Exclude grazing if possible. Minimise physical disturbance of soils and vegetation. Establish program for removal of noxious weeds and other invasive species.
Logging	Prevent large scale logging. Small scale selective logging for farm use is considered appropriate. Promote the retention of old trees with hollows and fallen logs.
Subdivision, development & recreation	Avoid development of this site. If development must proceed, cluster development only. Lot sizes should be as large as possible and clearing, building and road-making should be minimised. Retention of native vegetation and replanting with indigenous species should be encouraged. The site is large enough to accommodate the construction of picnic and camping facilities provided these are situated near the perimeter of the site.
Rainforest sites	
Site nos	2, 3, 4, 5, 6
Significance	Botanical (State)
Location	see Figs 4 & 5
Area	17, 7, 45, 31, 12 ha resp.
Description	Cool temperate rainforest. Otherwise termed closed-forest, this vegetation type occurs as small stands in sheltered gullies in the wetter parts of the Otway Ranges. It has a scattered distribution, ranging from the headwaters of the Johanna River in the west, to the headwaters of Smythe Creek in the east. Myrtle Beech (<i>Nothofagus cunninghamii</i>) is typically the dominant tree species. Mountain Ash (<i>Eucalyptus regnans</i>) may form a sparse emergent stratum.
Status	Vulnerable. Rainforest is widespread in the Otways but is nowhere abundant. Only a small proportion of the rainforest that existed prior to European settlement remains. Summer wildfire constitutes a major hazard for this vegetation type; a single, extensive fire could destroy many of the surviving stands. Also, many stands are presently experiencing an epidemic of Beech dieback, a disease that kills mature Myrtle Beech, and which is now widespread in the Otways. The most isolated and least disturbed stands are the most likely to escape infection.
Value	The cool temperate rainforests of the Otway Ranges form the western extremity of this vegetation type in Australia. The forests are geographically isolated from other rainforests in Victoria and have a different species composition, although Myrtle Beech is still dominant. Since only a small proportion of the rainforest that existed prior to European settlement remains, all surviving stands are important for conservation. The importance of rainforest is recognised by the Department

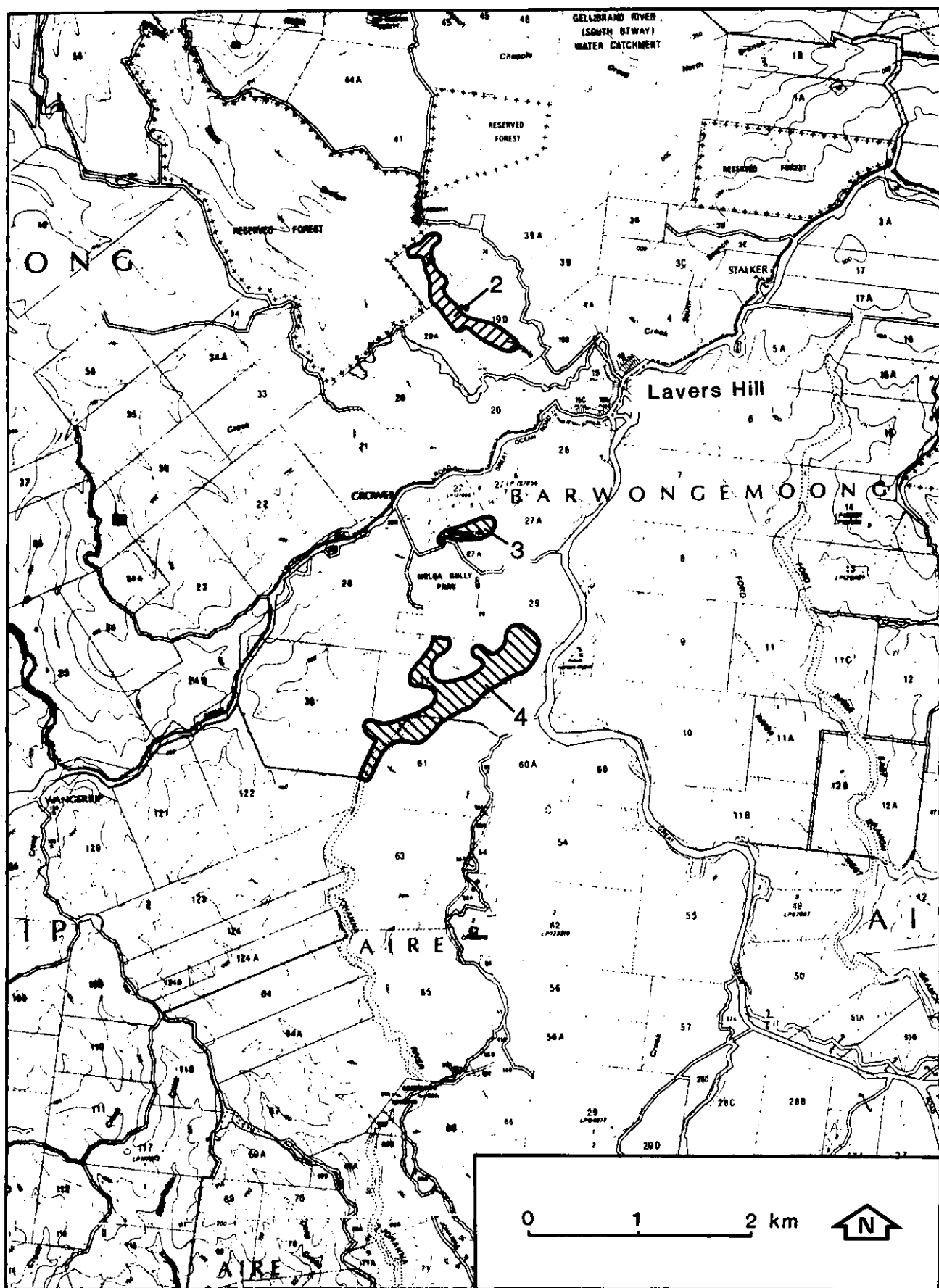


Fig. 4. Site nos 2, 3, 4



Fig. 5. Site nos 5, 6

of Conservation, Forests and Lands whose logging prescriptions for the Otway State Forest specifically call for the retention of all Myrtle Beech stands.

References Busby & Bridgewater (1977); Emison et al. (1975); Hook (1982); Howard & Ashton (1973); LCC (1976); Parsons et al. (1977); Pitt (1981); Specht et al. (1974).

Management guidelines

Buffer zones	Rainforest management necessitates that physical disturbance to soils and vegetation be prevented or minimised. Consequently, it is essential that each rainforest is surrounded by a naturally vegetated buffer zone capable of absorbing the effects of human activities. The buffer zone should include the slopes and ridges adjacent to the rainforest and as much of the upstream catchment as possible. It should also extend a short distance downstream of the rainforest (200 m would be adequate). All development in the buffer zone should be of low intensity only, e.g. picnic facilities. Buffer zones are frequently vegetated by mature mountain forest, which is in itself a significant vegetation type.
Logging	Exclude logging from rainforests and buffer zones to retain existing conditions. Logging greatly alters the species composition of rainforests, most noticeably by replacing Myrtle Beech with Blackwood and Mountain Ash. Logging also accelerates the spread of Beech dieback.
Fire	Exclude fire to retain existing conditions. Fire is extremely destructive of rainforest (several centuries may be required for full recovery) and promotes its replacement by eucalypt forest.
Roads	Avoid construction of vehicular tracks or roads. These accelerate the spread of introduced species and Beech dieback, and alter the floristics of the rainforest in their vicinity.
Weeds	Minimise or prevent physical disturbances to soils and vegetation. Appropriate measures should be taken to control the spread of introduced species provided these measures do not conflict with conservation values. The advice of the Department of Conservation, Forests and Lands should be sought.
Grazing	Exclude stock to retain existing conditions. Stock damages the vegetation and assists the spread of introduced species.
Subdivision	Exclude subdivision from rainforests. These areas are generally unsuitable for subdivision.
Recreation	Foot access only with controlled points of entry. Picnic and camping facilities should be located outside rainforest (in buffer zone).

Prinetown Swamp Greenhood site

Significance	Botanical (State)
Site no.	7
Location	Prinetown, adjacent to Great Ocean Road, 150 m north-west of the Latrobe Creek bridge (Fig. 6)
Area	7 ha
Description	Important occurrence of the endangered Swamp Greenhood (<i>Pterostylis tenuissima</i>). A population of several hundred individuals occurs below dense Woolly Tea-tree (<i>Leptospermum lanigerum</i>) scrub.
Conservation status of species	The Swamp Greenhood is regarded as endangered throughout its range from Picanninny Ponds, South Australia to Wilsons Promontory, Victoria. The species only occurs under Woolly Tea-tree in near-coastal areas. Cattle grazing, clearing and draining of swamps, and weed infestations resulting from pasture fertilisation have adversely affected the species. Only 6 populations are known to remain in Victoria, 5 of which are on private land. About 10 populations have disappeared in the last decade.
Value	One of the largest remaining populations of an endangered species. The site is immediately adjacent to the Prinetown State Game Reserve which is not known to contain any <i>P. tenuissima</i> colonies despite the presence of Woolly Tea-tree.
Reference	Mr C. Beardsell, Botany Dept, La Trobe University.
Management guidelines	
Physical disturbance	Prevent physical disturbances to soils and vegetation. <i>P. tenuissima</i> is easily eliminated by grazing or even partial clearing.
Hydrological disturbance	Any proposed changes to the hydrological regime of the Latrobe Creek Swamp should be assessed for possible effects on <i>P. tenuissima</i> .
Weeds	The site is being invaded by an introduced Rush (<i>Juncus fontanesii</i>) which is assisted by runoff from fertilised pasture nearby. Appropriate measures should be taken to control this and other exotic species provided these measures do not conflict with conservation values. The advice of the Department of Conservation, Forests and Lands should be sought.
Visitor pressure	Some plants have been removed by orchid collectors who trample the site as do orchid photographers. These activities are highly undesirable although difficult to control.

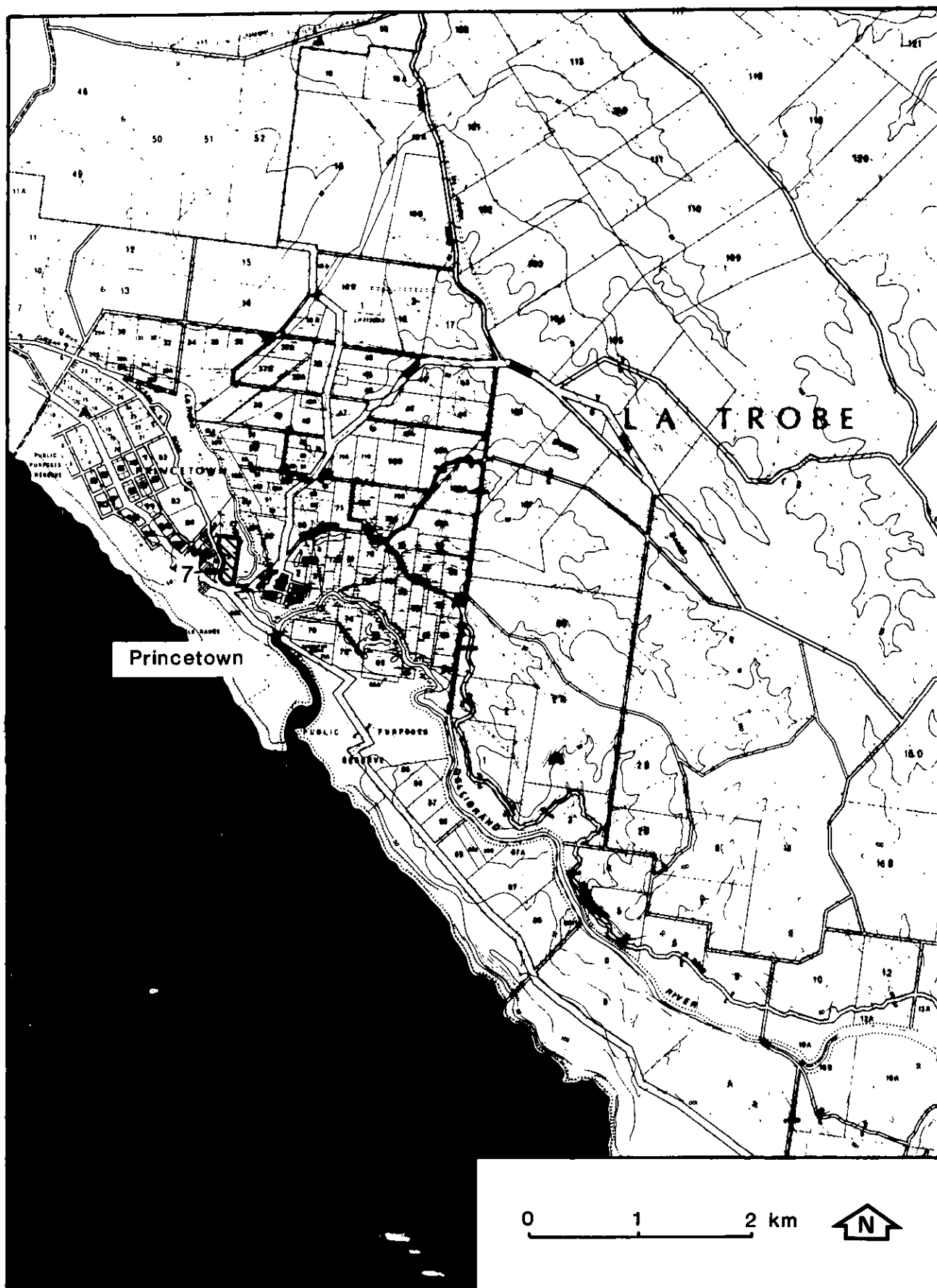


Fig. 6. Site no. 7

Marengo heathland site

Significance	Botanical (regional)
Site no.	8
Location	750 m west of Marengo (Fig. 7)
Area	24 ha
Description	Coastal heathland near Marengo. It occurs on a small outlier of sands and gravels (Wangerrip Group sediments) overlying the older sandstones and mudstones (Otway Group sediments) of the Otway Ranges. The soils developed on this parent material are nutrient poor, and have an impeding horizon which causes waterlogging of the topsoil in winter and drought in summer. This has resulted in the development of almost treeless heathland dominated by Prickly Tea-tree (<i>Leptospermum juniperinum</i>) and Scented Paper-bark (<i>Melaleuca squarrosa</i>).
Status of coastal heathlands within Otway Shire	Reasonable. Coastal heathlands are largely restricted to the Moonlight Head, Cape Otway and Marengo areas, although they were probably more widespread prior to settlement. Most surviving heathlands occur within the Otway National Park. A portion of the Marengo heathland occurs on public land within the proposed Marengo Flora Reserve (LCC 1978).
Value	<p>The site contains an important example of the vegetation of the Apollo Bay district prior to settlement, and has considerable conservation, educational, recreational and landscape values. The Marengo Flora Reserve will include some of the heathland, however it is not clear whether this small reserve (16.2 ha) will be either fully representative of the heathland vegetation, or viable in the long-term without a buffer of native vegetation.</p> <p>The uncommon Horned Orchid (<i>Orthoceras strictum</i>) has been recorded from just outside the proposed reserve.</p>
References	Parsons et al. (1977); Pitt (1981).
Management guidelines	Since subdivision of the site has already occurred, it is apparent that the heathland will be greatly reduced in area in the near future. However, constraints should be placed on the clearing of native vegetation adjacent to the proposed Marengo Flora Reserve to enhance the viability of this reserve. Strips of native vegetation should be retained within the site so that some of the local character of the area can be preserved. Detailed guidelines for achieving these aims cannot be provided without conducting additional investigations.

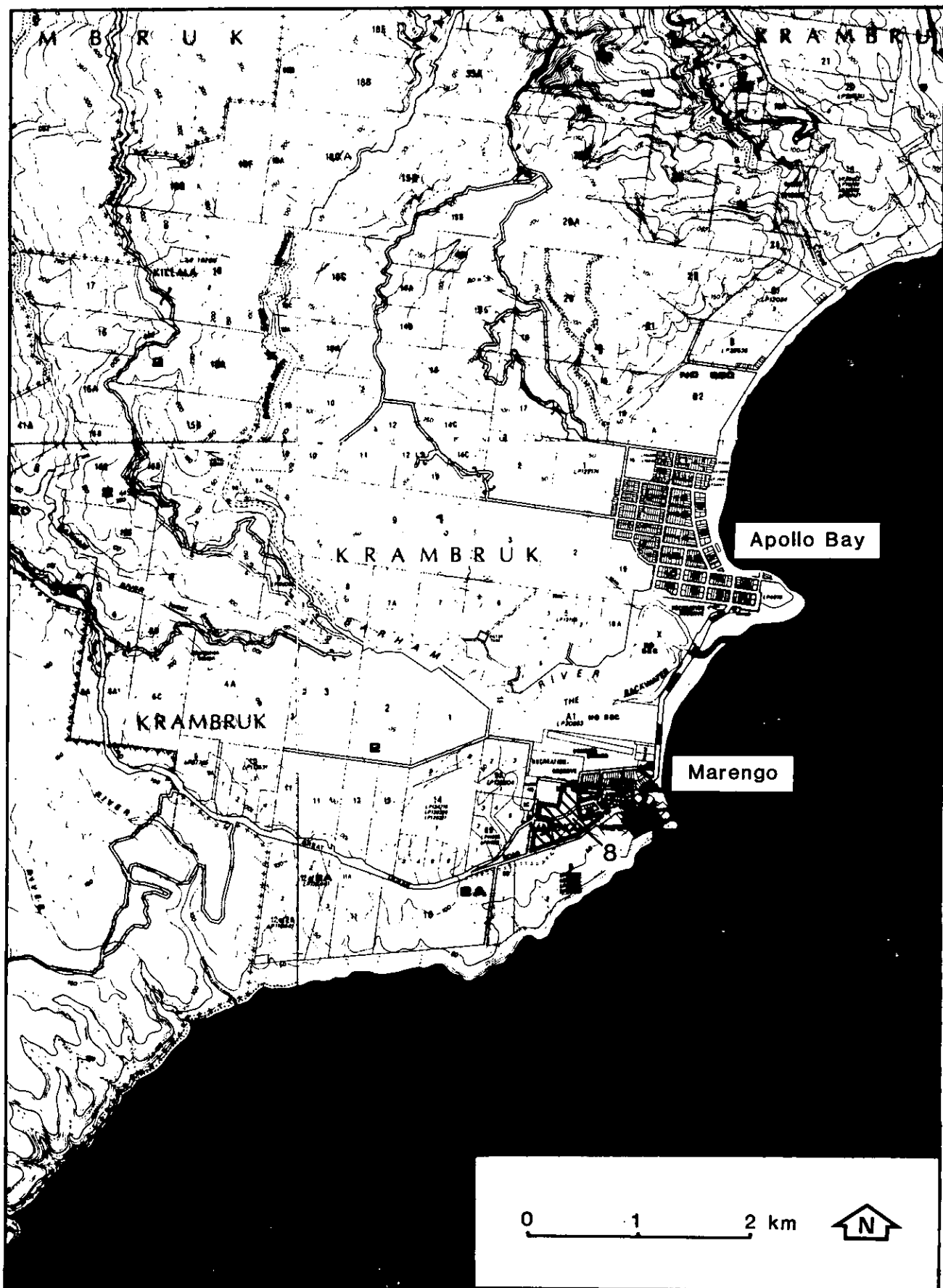


Fig. 7. Site no. 8

Wetland sites

Significance Botanical and zoological (Collectively the wetlands of the Otway Shire are of regional significance; individual wetlands are not evaluated in this study.)

Location Shown on Map E, copies of which may be seen at the locations listed on p. 3.

Area	Prior to settlement (ha)	Present (ha)
Natural	1102	904
Artificial storages	0	211
Total	1102	1115

Description and evaluation The following information is largely derived from the work of Corrick (1982). Wetlands in the Otway Shire were mapped from 1:43 000 black and white aerial photography flown in 1966. Only wetlands greater than 1 ha in area were considered. Following field inspection the wetlands were classified according to water depth, period of inundation, salinity regime and vegetation type.

The data in this study are presented at a scale of 1:50 000. All areas which support characteristic wetland vegetation and/or retain surface water for some or all of the year are mapped as wetland. In addition to showing wetland locations and types, Map E shows areas which were formerly wetland but which have now been drained. The area and types of wetland in the Shire are summarised in Table 2.

Since European settlement there has been an 18% reduction in the area of natural wetland in the Shire. All drained areas were deep freshwater marsh, and this is still the most extensive wetland type in the Shire. Freshwater meadows and shallow freshwater marshes are restricted to private land, and are therefore vulnerable to alteration through grazing or drainage.

Wetlands provide a specialised habitat for over 100 species of waterbird in Victoria, as well as for many amphibian, fish, and invertebrate species. Some species have very specific habitat requirements, and each wetland type supports a different range of plants and animals. Any significant reduction in the area or diversity of wetlands in the Shire would adversely affect wildlife populations in the region.

Table 2. Wetlands in the Shire of Otway

Wetland type	Private land		Public land	
	Area (ha)	No. of wetlands ^A	Area (ha)	No. of wetlands ^A
Freshwater meadow				
Herb-dominated	26	4	0	0
Shallow freshwater marsh				
Herb-dominated	97	15	0	0
Deep freshwater marsh				
Shrub-dominated	40	3	30	4
Reed-dominated	417	5	163	4
Open-water	8	1	90	3
Permanent open freshwater				
Impoundment	5	3	206	4
Semipermanent saline				
Salt pan	2	1	3	1
Salt flat	10	2	2	1
Permanent saline				
Shallow	0	0	3	2
Deep	0	0	11	2
Intertidal flat	0	0	2	1
Total	605	30^B	510	22^B

A Some wetlands extend across the public/private land boundary

B Two or more subcategories may be found within a single wetland

Management guidelines

Physical disturbances to soils and vegetation should be minimised. This also applies to the zone of vegetation above the high-water level, which provides a buffer as well as additional feeding areas and roosting sites.

The natural water regime should be maintained, as this determines vegetation type and the fauna which a wetland can support.

Domestic stock can damage natural wetlands, so stock numbers should be limited where possible and access restricted to defined watering points.

When storage dams are constructed, their wildlife value can be improved by proper design, with provision of islands, adequate vegetation cover, and restricted stock access.

Where there is a need for specialist advice on wetland management, Council should consult the Colac Regional Office of the Department of Conservation, Forests and Lands.

Assessment of flora and fauna conservation value

The flora and fauna conservation value of an area is considered to be its relative contribution to the conservation of the indigenous flora and fauna of the Shire. A detailed inventory of all areas of private land could not be undertaken in the time available for this investigation. Consequently this assessment is of a broad nature, and is based on the following attributes:

- (a) the presence of native vegetation;
- (b) the presence of significant species;
- (c) the presence of significant habitat types.

In general these attributes can be related to land cover. Accordingly, an analysis of the existing land cover in the Shire forms the basis of this assessment.

A land cover map was compiled, based on the vegetation map of public land in the LCC report on the Corangamite Study Area (1976), interpretation of 1:50 000 black and white aerial photography, and limited field survey. The land cover units are listed below and are described more fully in Appendix III.

Map unit	Land cover type
1	Open-forest
2	Closed-forest
3	Regenerating eucalypt forest
4	Non-eucalypt regrowth scrub
5	Coastal vegetation
6	Scattered eucalypts over native understorey
7	Woodland - heathland
8	Scattered trees on agricultural land
9	Closed-scrub
P	Softwood plantation
W	Wetland
A	Agricultural and urban areas
C	Clearing

The following criteria were used to assess the land cover units (see Appendix IV for a discussion of the criteria):

1. Areas of special interest - sites of biological significance.
2. Degree of disturbance. Land cover units were defined as either:
 - Native vegetation - substantially intact;
 - Degraded native vegetation - substantially altered;
 - Cultural vegetation - native vegetation substantially replaced by introduced vegetation.
3. Area and exposure. The area of native vegetation and its exposure to cultural vegetation.

The application of these criteria is shown in Table 3, which is followed by a description of the significance categories. The results are presented on Map C, copies of which may be seen at the locations listed on p. 3.

Table 3. Assessment of flora and fauna conservation value

Criterion	Class limits	Conservation significance category
Sites of biological significance	State significance	A
	Local or regional significance	B
	Wetlands (Unit W)	B
Degree of disturbance	Native vegetation (Units 1, 3, 5, 7, 9)	
	Area ¹ >150 ha	B
	Area ¹ <150 ha	
	Exposure ² <85%	B
	Exposure ² >85%	C
	Degraded native vegetation (Units 4, 6)	C
	Cultural vegetation	
	Scattered native trees (Unit 8)	C
Area and exposure	Entirely cleared (Units A, C, P)	D
	Applies to native vegetation only (above)	

- 1 The area (ha) of native vegetation on private land combined with the area (ha) of any contiguous native or degraded native vegetation on either public or private land. Note: where the private land component is less than 25 ha, the land is automatically placed in category C.
- 2 The percentage of perimeter shared with cultural vegetation (Units 8, A, C, P).

Category A. Conservation value very high. This category only includes areas which are significant on a State basis, for example:

- (a) an area providing habitat for a large proportion of the total Victorian population of an animal species;
- (b) an area containing a habitat type which has a limited distribution in Victoria;
- (c) an area containing an occurrence of a plant species or community which is rare or restricted in Victoria.

Category B. Conservation value high. Generally includes the larger, relatively undisturbed areas of native vegetation, corridors linking large areas of native vegetation, and wetlands. Often there is no detailed inventory data available for these areas. Some areas have been utilised for grazing or timber cutting, however substantial recovery should occur if disturbances

cease. Known areas of regional and local significance are included here.

Category C. Conservation value moderate. Generally comprised of the smaller areas of native vegetation, and scattered trees on agricultural land.

Category D. Conservation value low. Includes areas of predominantly cultural vegetation (e.g. softwood plantations, introduced pastures, urban areas) and drained wetlands.

This assessment is based on reconnaissance level information, and should not be used as a substitute for site investigations when detailed information is required. The lack of detailed investigation introduces the possibility that significant features have not been identified. However, having selected the most likely areas, with a trend towards greater detail as particular planning applications arise, the ranking may be revised.

Future land use change may require a review of this assessment, which is considered to be an initial step in an ongoing process of data collection and map refinement. Map C should be updated as more ecological information on the planning area becomes available.

Assessment of woody vegetation cover in relation to erosion risk

This assessment identifies areas where particular land cover types (woody vegetation) and areas of erosion risk are co-incident. Consideration, in the assessment of planning applications, can then be given to the retention or improvement of woody vegetation cover for protection against soil erosion.

Local government controls on vegetation clearance relate predominantly to woody vegetation, hence the emphasis of this assessment is on woody vegetation cover.

Soil erosion has been considered in terms of both on-site and off-site effects. On-site effects include:

- (a) loss of a significant portion of the soil resource (e.g. from clearing activities) and a subsequent decline in site production potential;
- (b) impairment of council roads and drains by erosion or deposition of soil as a result of construction and development activities.

Off-site effects include:

- (a) deposition of eroded material in streams altering flow patterns, drainage rates and stream values as faunal habitat;
- (b) transport of suspended soil material causing a deterioration in water quality which may interfere with industrial or domestic uses of the water or with stream values as faunal habitat;
- (c) transport of nutrients to the stream which may reduce the beneficial uses of the water elsewhere.

Two factors were considered when identifying areas of value in the control and management of erosion:

- (a) The coincidence of particular land cover units and areas of erosion risk. This was obtained by overlaying an erosion risk map with the land cover map.
- (b) The position in the landscape of certain land cover units. Vegetation adjacent to water courses and drainage lines has been mapped. The land in these areas is valuable for erosion and water quality control.

Areas of cover are assigned to five categories (A, B, C, D or E) which reflect the level of vegetation management required for each erosion risk class (Table 4). The erosion risk classes are described in Appendix VI. The erosion risk information was provided by the Land Protection Service. The results of this assessment are shown on Map D, copies of which are available for inspection at the locations listed on p. 3.

Table 4. Land cover - erosion risk combinations

Land cover	Erosion risk class		
	5 & 4	3	2 & 1
Areas of woody vegetation cover (Units 1, 3, 4, 6, 7, P & W)	A	B	C
Areas of nil to sparse woody vegetation cover (Units 8, A & C)	D	E	E

Note: Vegetation adjacent to water courses (Units 2, 5 & 9) are assigned to Category A.

The assessment categories and the implications for vegetation management are discussed below:

- Category A. Areas of severe to high (Class 5 & 4) erosion risk with woody vegetation cover. Management of the vegetation cover should be as described by the Land Protection Service for areas of severe to high erosion risk land. In general land clearance should be avoided where practicable with management aimed at maintaining or improving vegetation cover.
- Category B. Areas of moderate (Class 3) erosion risk with woody vegetation cover. Management of the vegetation cover should be as described by the Land Protection Service for areas of moderate erosion risk land. Proposals involving land clearance will require special management consideration to avoid erosion and water quality problems.

Category C. Areas of low to minimal (Class 2 & 1) erosion risk with woody vegetation cover. Management of the vegetation cover should be as described by the Land Protection Service for areas of low to minimal erosion risk land. Proposals involving land clearance are unlikely to cause severe erosion or water quality problems under normal management. However other considerations may be of concern such as proximity to water courses or water storages.

Category D. Areas of severe to high (Class 5 & 4) erosion risk with nil to sparse woody vegetation cover. Management should aim to improve woody vegetation cover.

Category E. Areas of moderate to minimal (Class 3, 2 and 1) erosion risk land with nil to sparse woody vegetation cover.

The erosion risk assessment for this study is based on an assessment of the predominant erosion hazard rating of each land system (Appendix V). Land systems are complex units and some land within each land system may have a greater or lesser erosion risk than the average rating assigned to that land system (the erosion risk categories are described in Appendix VI). However, this information is provided for broad scale planning, and decisions on development involving vegetation clearance within a land system should be made on the basis of the hazard assigned to land within that land system, the experience with previous development in particular areas and the appropriate advice from the regional soil conservation specialist. This approach is consistent with a progressive trend towards greater detail in the light of particular planning applications.

This assessment has been conducted on all private land including land within catchments proclaimed by the Land Protection Service. Land use determination within proclaimed catchments is the responsibility of the Service and where a determination has been made it should be consulted for detailed information on land use controls.

RECOMMENDED PLANNING RESPONSE

The assessment of the physical and biological resources are translated below into three broad levels of planning response through the town planning system. This is not an attempt to equate different ranking systems nor does it offer a procedure for arriving at an overall value for a site by summing the results of the various assessments. The emphasis is placed on the level of response which is consistent with the available data. The translation procedure is shown in Fig. 8 and the results are presented on Maps A and B.

Recommendation 1. Council should use Maps A and B as a basis for the formulation and administration of planning controls over land use, development, and vegetation removal on private land in the Shire.

More particularly it is recommended that the following levels of response be adopted:

Level I response

Recommendation 2. Strict planning controls are required to conserve resources in Level I response areas, through amendment and strengthening of planning schemes and controls. Development should not take place, unless after consultation with the Department of Conservation, Forests and Lands it is considered that a certain use or development would not be detrimental to the identified resources.

Recommendation 3. Council actively pursue a policy of co-operation with landholders to achieve conservation of resources in Level I response areas, including the use of legal agreements with owners.

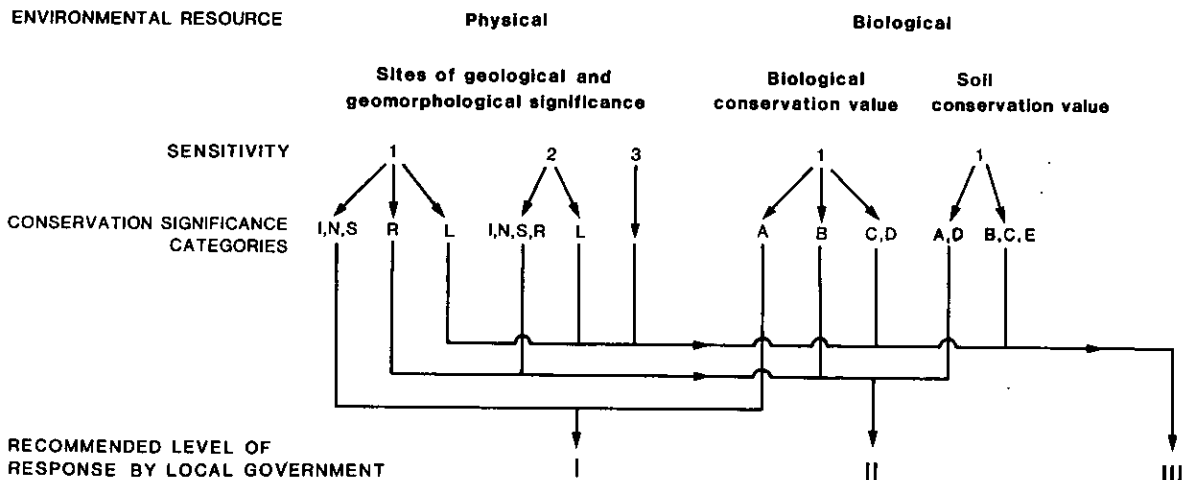
A level I response is recommended for 7 sites of biological significance and 10 sites of geological and geomorphological significance. The latter areas are predominantly coastal sites and their protection would not significantly affect development. Indeed promotion of these features would generate significant tourist interest.

Level II response

Recommendation 4. Planning permits should be required for vegetation removal or for any other use or development, including the drainage of wetlands, in Level II response areas. Permits should have attached conditions designed to minimise the impact of development on resources in these areas.

Recommendation 5. Where there is a need for specialist advice on Level II response areas, Council should refer planning applications to the Colac Regional Office of the Department of Conservation, Forests and Lands for comment and/or drafting of suitable permit conditions.

A Level II response is recommended on severe to high erosion risk land, all wetlands, and areas of high value for flora and fauna conservation. Additionally there are 38 sites of geological and geomorphological significance.



Recommended level of response by local government

Level I

Strict planning controls are required to conserve resources, through amendment and strengthening of planning schemes and controls. Development should not take place, unless after consultation with the Dept of C, F & L it is considered that a certain use or development would not be detrimental to the identified resources. Council should actively pursue a policy of co-operation with landholders to achieve conservation of resources, including the use of legal agreements with owners.

Level II

Planning permits should be required for vegetation removal or for any other use or development, including the drainage of wetlands. Permits should have attached conditions designed to minimise the impact of development on resources. Where there is a need for specialist advice, Council should refer applications to the Colac Regional Office of the Dept of C, F & L for comment and/or drafting of suitable permit conditions.

Level III

Except for land within proclaimed water catchments, proposals for development should not generally warrant referral to the Dept of C, F & L by Council.

Sensitivity

An assessment of the extent to which the feature is being or could be degraded by land use at or near the site.

1. High (includes all biological features)
2. Moderate
3. Low

Conservation significance categories

Physical

- I. International
- N. National
- S. State
- R. Regional
- L. Local

Biological

Biological conservation value

- A. Very high
- B. High
- C. Moderate
- D. Low

Soil conservation value

- A. Severe-high erosion risk land with woody vegetation cover
- B. Moderate erosion risk land with woody vegetation cover
- C. Low-minimal erosion risk land with woody vegetation cover
- D. Severe-high erosion risk land with nil to sparse cover
- E. Moderate-minimal erosion risk land with nil to sparse cover

Fig. 8. Recommended planning response

Level III response

Recommendation 6. Except for land within proclaimed catchments, proposals for development in Level III response areas should not generally require referral by Council. However land managers should be conscious of potentially damaging actions which may be caused by inappropriate development.

Level III response areas include the smaller areas of native vegetation, scattered trees and cleared land (most of the study area). Large areas occur in the west of the Shire, along the ridge between Lavers Hill and Beech Forest, and on the coastal plain between Marengo and Skenes Creek. Also included here are the less sensitive geological and geomorphological sites of local significance.

Recommendation 7. Where development is proposed for land adjacent to a site of significance, consideration should be given to minimising the effect of the development on the feature of significance, and ensuring that an adequate buffer is provided should this be necessary.

Recommendation 8. Where development is proposed for land adjacent to a State Game Reserve, consideration should be given to ensuring that an adequate buffer is provided to minimise any problems that may arise during the hunting season.

Recommendation 9. Council should encourage the retention and re-establishment of native vegetation on all areas of private land, through educational and promotional activities.

An approach to formulating planning policies and controls based on the mapped information generated by this study is provided in Appendix VII.

While the focus of this report is on the planning response, all possible measures should be taken to increase landowner awareness of the location and importance of significant areas. Protection of many areas depends to a large extent on environmentally sensitive farm management practices; these should be encouraged as such practices will ultimately benefit landowners.

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Appendix I. Criteria for selection of sites of geological and geomorphological significance and significance categories (from Rosengren 1984)

Sites have been selected on the basis that they display one or more of the following characteristics:

Geological:

- (a) An outcrop or other exposure which has been used as the type locality of a geological material e.g. the coastal cliffs north-west of the mouth of the Gellibrand River which form the type section for the Gellibrand Marl.
- (b) A site which displays a contact between formations, e.g. the angular unconformity between the Mesozoic and Tertiary sediments visible in the coastal cliffs east of Pt Margaret.
- (c) An area with extensive outcrop that is used to determine the lithological and structural characteristics of a rock formation or group, e.g. the sedimentary beds exposed between Moonlight Head and Castle Cove.
- (d) An exposure of a geological structure, e.g. the small plunging folds at the western end of Milanesia Beach, or the scarp of the Colac Fault north west of Carlisle River.
- (e) Beds that contain fossil material, e.g. the outcrops at the Chapple Creek Ford on Morris Track which contain fossil plant remains.
- (f) Sites which display a rare mineral, e.g. the bentonite at Gellibrand, or are of historical interest for the record of past mining or quarrying activity, e.g. the Gellibrand shale pits.

Geomorphological:

- (a) Sites which show the influence of lithology (rock type) in landform development, e.g. the distinctive hill east of Gellibrand corresponding to the outcrop of Older Volcanic basalt.
- (b) Landforms that display the control exercised by geological structures, e.g. the ramparts on the shore platforms near Wye River or the parallel drainage patterns in the northwest of the Shire near Simpson.
- (c) Sites which display the action of a geomorphological process e.g. weathering at Rotten Pt, stream potholing above Cumberland Falls, and the landslip that blocks the Barwon River to form Lake Elizabeth.
- (d) Landforms or materials that clearly reflect the action of a geomorphological process that is not operative at the present time or does not operate with the same intensity, e.g. the coastal terraces at Marengo which indicate higher Pleistocene sea levels and the abandoned boulder beach at Boggaley Creek.
- (e) Sites which are representative of the major landform units of the Otway Ranges and the adjacent plains and piedmont downs, e.g. the section of the Gellibrand River south of Carlisle River where the valley is constricted and the flood plain has well developed levee banks.

Significance categories

All sites have been assigned a significance rating as either international, national, state, regional, local, or unknown significance. The latter category is used where there is insufficient information about the site to allow a significance assessment to be made. In some cases this is due to the site not being located during field work and the assessment is based on aerial photograph interpretation only. Supplementary information could be made available about these or other new sites at a later stage.

Factors considered in determining the significance rating were:

- (a) The contribution the site makes to understanding in the earth sciences in relation to geology and/or geomorphology on a local, regional, state, national, or international basis.
- (b) Frequency of replication, i.e. the site is a unique, rare or unusual example of a geological formation and/or surface morphology.
- (c) Degree of disturbance and/or quality of display of outcrop structure, or landform.
- (d) Value as a reference and research site which displays classic characteristics of a geological formation and/or a relict or active geomorphological process.
- (e) Need for further investigation - where there is doubt as to the nature or origin of the feature, or where little detailed investigation has been undertaken.
- (f) Where landforms and/or outcrops provide spectacular landscape.

The actual rating assigned to a site is determined by evaluating the degree to which the six criteria outlined above are fulfilled.

International significance. These are landforms, structures, rock formations or fossils which are rare in the world and/or by the nature of their scale, state of preservation or display are comparable with examples known internationally. They include some of the fossil sites and the coastal slopes near Lion Headland. They would be included in an international register of sites of scientific significance.

National significance. A site of national significance is either unusual or unique in Australia and has been so little disturbed or modified that the essential properties of the site are clearly displayed. The site represents a major contribution to the research and teaching of the earth sciences in Australia and has the potential for further research, often in several fields. This applies to some of the fossil plant sites where species are recorded that are uncommon or unknown in other Mesozoic rocks in the continent.

State significance. These sites include features which are important in the context of developing an understanding of the geological and geomorphological development of Victoria. They include several stratigraphic sites, e.g. the type sections of Tertiary rocks in the Aire, Johanna, and Princetown districts, and the river gorge and rapids of the Aire River.

Regional significance. These sites include landforms or rock types representative of the Otway region, for example the meander patterns of the Gellibrand River, or some of the common structural features of the Otway Group rocks, e.g. the dip and jointing of the arkose in the shore platforms near Skenes Creek.

Local significance. These are typically clear examples of very common landforms, e.g. the constricted lower valley of the Barham River near Paradise or the backswamps of the Chapple Creek at Chapple Vale.

The purpose of selecting sites of significance is to represent the array of landform and land forming processes that comprise the present landscape. Many sites display features that are relict, in that they represent geological processes (either climatically or tectonically controlled) that are no longer active. However, in some cases, the sites are of interest for their dynamics in that the landforms are subject to change over time, at a rate that can be measured and analysed.

Appendix II. Sensitivity classes for sites of geological and geomorphological significance (from Rosengren 1984)

Each site has been assessed to determine the extent to which the feature(s) of significance is being or could be degraded by current land use, or would be affected by a change in land use at or adjacent to the site. The sensitivity of site characteristics is summarised by allocating it to one of three broad classes described below. The allocation to a sensitivity class is independent of the significance rating assigned to a site.

Class 1. These are sites most sensitive to change, either because the feature is small and hence easily obscured, removed or detached, or is of 'delicate' structure and so liable to be broken, displaced, mobilised or damaged in a direct physical sense. The interference may be direct e.g. burial or quarrying of a rock outcrop or the regrading of a slope. It may however be indirect, e.g. vegetation clearing adjacent to a lake alters run-off and groundwater movement causing the lake to rapidly infill, or dry out and allow deflation of an important pollen bearing peat horizon.

Class 2. These are sites of moderate sensitivity which may tolerate some degree of accelerated change and still retain the essential features of significance. This may be due to the site being large or consisting of numerous similar forms which are independent or self-contained in the properties they display.

Class 3. These typically are large sites displaying a macro variation in relief or geology which is unlikely to be obscured or removed. The site may demonstrate a major terrain pattern, e.g. a recurrence of ridges and valleys, and intensive or point disturbance will not alter this essential broad geometrical characteristic.

Appendix III. Description of land cover units

In the following description, cover refers to projective foliage cover (after Specht 1970).

Unit 1. Open-forest

Open-forest is widespread in the Shire and is characterised by the presence of closely spaced trees providing 30-70% cover. Tree heights range from about 70 metres in areas of high moisture and nutrient availability to less than 15 metres in areas where soil moisture is limiting.

In high rainfall areas, typical species are Mountain Ash (*Eucalyptus regnans*), Messmate Stringybark (*E. obliqua*), Mountain Grey Gum (*E. cypellocarpa*), Blue Gum (*E. globulus*), and Manna Gum (*E. viminalis*). There is usually a shrub layer of broad-leaved species, and a ground layer of ferns, grasses and other herbs.

Where rainfall is lower, tree heights are reduced and the understorey is replaced by species tolerant of drier conditions. The most common trees in these areas are Messmate Stringybark, Brown Stringybark (*E. baxteri*) and Narrow-leaf Peppermint (*E. radiata*), with Swamp Gum (*E. ovata*) in poorly drained areas.

Open forest is sub-classified according to height and maturity:

- 1a - height <15 m;
- 1b - height 15-28 m;
- 1c - height 28-40 m;
- 1d - height >40 m, immature;
- 1dM - height >40 m, mature, distinguished from Unit 1d by well-spaced rounded tree crowns.

Unit 2. Closed-forest

In sheltered high rainfall areas, Myrtle Beech (*Nothofagus cunninghamii*) dominates a closed-forest community, with cover greater than 70%. Blackwood (*Acacia melanoxylon*) is locally common. The understorey contains moisture-demanding ferns, other herbs, and shrubs. Stand height is variable and generally greater than 30 metres.

Unit 3. Regenerating eucalypt forest (0-10 years)

The vegetation of this unit results from recent timber harvesting operations - generally clear-felling of open-forest. In practice some mature emergents remain amid an even-aged stand of trees. Mature tree cover is less than 30% and the height of regeneration is variable but less than 15 metres.

Unit 4. Non-eucalypt regrowth scrub

This unit comprises degraded native vegetation lacking a eucalypt overstorey due to disturbance. The unit is structurally and floristically variable, and includes Austral Bracken (*Pteridium esculentum*) fernland, closed-scrub (*Cassineae aculeata*, *Leptospermum* spp. *Acacia* spp. etc.), and Blackwood (*Acacia melanoxylon*) closed-forest.

Unit 5. Coastal vegetation

This unit is a mosaic of open to closed-scrub (taller than 2 m), grassland and sedgeland. Eucalypts are absent.

Unit 6. Scattered eucalypts over native understorey

This is disturbed native vegetation resulting from the elimination of some, but not all eucalypts from an area, so that cover is reduced to between 5 and 30%.

Unit 7. Woodland - heathland

A mosaic of heathland, woodland, and closed-scrub; found on infertile soils. Tree species include Messmate Stringybark, Brown Stringybark, Narrow-leaf Peppermint, Shining Peppermint (*E. willisii*), Manna Gum and Bog Gum (*E. kitsoniana*). Tree height is less than 15 m and cover is less than 30%. There is usually a dense understorey of shrubs and herbs. Under adverse conditions, tree growth is reduced and trees may be eliminated altogether. In general the heathland component increases towards the coast and in near-coastal areas the unit is predominantly of this type.

Unit 8. Scattered trees on agricultural land

This unit includes agricultural areas in which some native tree cover has been retained. Trees are of variable height and provide 5-30% cover.

Unit 9. Closed-scrub

Closed-scrub of Prickly Moses (*Acacia verticillata*) and Scented Paperbark (*Melaleuca squarrosa*). This unit is generally found as linear features along drainage lines in the western part of the Shire.

Unit P. Softwood plantation

Plantations of Radiata Pine (*Pinus radiata*) are grown on both public and private land in the Shire of Otway. Stands of other introduced coniferous species are also found on public land. Stands of degraded native vegetation, mostly Blackwood, occur along some drainage lines.

Unit W. Wetland

This unit contains areas where semi-aquatic or aquatic plant species are dominant, and includes areas of standing water (temporary or permanent). Vegetation includes submergent aquatic herbland, Beaded Glasswort (*Sarcocornia quinqueflora*) salt marsh, Common Reed (*Phragmites australis*) reedswamp, and Woolly Tea-tree (*Leptospermum lanigerum*) closed-scrub.

Unit A. Agricultural and urban areas

Agricultural areas are dominated by introduced species. Groves of Cypress (*Cupressus* sp.) occasionally occur and Willows (*Salix* spp.) are frequent along river banks. Indigenous eucalypts form up to 5% cover. Land within townships is included in this unit.

Unit C. Clearing

These are areas that supported little or no vegetation at the time of aerial photography. Included are areas cleared of vegetation, quarries, and areas of erosion.

Appendix IV. Criteria for assessment of flora and fauna conservation value on private land

Many planning studies have aimed at selecting areas for retention as nature reserves (Helliwell 1976; Tubbs & Blackwood 1971; Wright 1977; van der Ploeg & Vlijm 1978), and a range of criteria have been used (see Margules & Usher (1981) for a review). This study, however, is concerned with the evaluation of private land so that consideration can be given to the conservation value of the land cover when considering planning applications involving vegetation clearance.

Present day land use planning does not start with an undisturbed landscape where options for conservation or development are still equally open. In most areas conservation planning has to fit around developments that occurred or were initiated at a time when there was little concern for the environment. Past activities have resulted in the clearance of large areas of land, and to a lesser extent this process continues.

Ratcliffe (1977) introduced the concept of sites of scientific interest as a primary nature conservation strategy. The concept is perhaps more meaningful for the protection of cultural (historical or archaeological) and physical (geological or geomorphological) features than it is for certain biological features. While it is appropriate to highlight the need to protect sites of recognised importance, for many species of flora and fauna the protection of sites alone has limited meaning. For example migratory birds and birds of prey must be protected by land management on at least a regional basis. Consequently while the identification of significant sites is an important strategy, there is a need to adopt a regional approach to biological resource management. This includes combining intensive protection measures at particular sites with a broad regional strategy designed to maintain viable populations of the flora and fauna in the region. With respect to private land the regional approach involves the adoption of environmentally sensitive management practices by local governments and by landowners. These can often be achieved without substantially detracting from the primary use of the land.

The flora and fauna conservation value of an area is considered to be its relative contribution to the conservation of the indigenous biota of the Shire. A detailed inventory of all areas of private land could not be undertaken in the time available for this investigation. An hierarchical approach to data collection was selected. This involves the progressive accumulation of information on the planning area. Detailed investigations should be conducted in areas considered to be valuable as planning applications arise.

The attributes which contribute most to flora and fauna conservation value are:

- (a) the presence of intact native vegetation;
- (b) the presence of significant plant or animal species;
- (c) the presence of significant habitat types e.g. wetlands.

In general, these factors can be related to land cover. Consequently flora and fauna habitats can be considered in terms of the land cover units described in Appendix III. The cover units reflect broad wildlife habitats and are similar to those adopted in past faunal surveys of the Otway region

(Emison et al. 1975; Bennett 1982). Such broad categories contain a variety of plant communities and faunal habitat types, and provide poor resolution of specific faunal preferences. However, it is important, because of the requirement to produce mapped information, to select cover units that can be readily mapped from aerial photographs. In addition, if the results are to be useful in implementing tree clearance controls, the cover units must reflect the extent of woody vegetation cover.

Where the data for a quantitative assessment are lacking, interpretations have to be made on features or inferred qualities that are considered to be important and the extent to which the values fall short of an assumed ideal. This is the traditional approach of land evaluation procedures. The essential data for these procedures is a list of relevant criteria plus a statement of their class limits or grade limits.

The criteria used in this study are as follows:

- (a) Areas of special interest - sites of significance
These are places of recognised scientific interest. The significance rating (local, regional, state, national or international) refers to the geographic area in which the feature forms an important component e.g. if the feature is of regional significance, then its elimination would affect the status of that feature in the (Otway) region but not necessarily in the State.
- (b) Degree of disturbance
Land cover units are grouped according to the extent of modification to the dominant stratum. Pre-European settlement vegetation cover was estimated with the aid of land systems information (Pitt 1981) and field investigation of remnant vegetation. Three categories were selected to reflect an increasing departure from an assumed undisturbed state:
 - (i) native vegetation (Units 1a-d, 2, 3, 5, 7 & 9);
 - (ii) degraded native vegetation (Units 4 & 6);
 - (iii) cultural vegetation (Units 8, A, C & P).

Native vegetation units are those in which the vegetation cover is substantially intact. Some areas may have been utilised for grazing or timber cutting, however recovery should occur within a relatively short time if disturbances cease. Degraded vegetation units are those in which the cover have been altered due to severe disturbance. Recovery of these areas to their estimated undisturbed state is likely to be a long process if it occurs at all. Cultural vegetation units are those in which the native vegetation has been effectively eliminated and replaced by introduced species.

An assessment based on the condition of the dominant stratum is an approximation only, as this does not take understorey or ground conditions into account. However it provides a useful starting point for detecting areas of importance in flora and fauna conservation.

- (c) Size
For most of the Australian biota the area required for a population to maintain viability is not known, but in general, large areas of habitat are preferable to small and/or fragmented areas. Accordingly stands of native vegetation have been ranked according to their area in combination with other attributes.

(d) Exposure of boundaries

Cultural areas are a source of introduced species and these are likely to become established in disturbed zones such as along bushland boundaries where light levels are higher, or in grazed areas where domestic stock alter understorey conditions. Once established, introduced species often become permanent components of the flora, thereby degrading the quality of the vegetation.

A measure of the likelihood for disturbances from external factors is used to discriminate between areas of similar size and cover category. This criterion provides a measure of the extent of exposure to cultural areas in relation to total perimeter and applies only to native vegetation.

On the basis of the criteria discussed above, the land cover was evaluated for its value in flora and fauna conservation. Four categories (A, B, C & D) of significance were adopted. The application of the criteria to the land cover units is shown in Table 4.

The assessment is based on those characteristics and qualities of the land cover units which contribute most to flora and fauna conservation values. The land cover map units are used to predict areas of likely conservation value. Site information from limited field work and existing data sources has been used to extrapolate to broader areas and in most cases these latter areas have not been surveyed in detail. It is important to consider this assessment as the first step in an ongoing process, through which data are regularly collected. It should not be used as a substitute for site surveys when detailed information is needed. As more ecological information on the planning area is obtained the map base and evaluation should be refined.

Sensitivity

Biological features are generally more sensitive to land use change than physical features. As the intensity of land use increases, so generally does the loss of natural biological features. Consequently all biological features are considered highly sensitive to land use change (cf. sites of geological and geomorphological significance).

Appendix V. Erosion risk assigned to land systems in the Shire of Otway

Erosion risk class	Land system
Class 5 & 4. Areas where there is a severe to high risk associated with land clearance	Aire Forrest Lorne Redwater Creek Yahoo Creek Bunker Hill Mount Mackenzie Chapple Vale Junction Track Porcupine Creek Kennedys Creek Rivernook Carlisle Cape Otway
Class 3. Areas where there is a moderate risk associated with land clearance	Ferguson Hill Gellibrand River (upper) Horden Vale Tomahawk Creek Waarre Wonga
Class 2 & 1. Areas where land clearance would not generally present significant erosion problems	Barwon River Simpson Gellibrand River (lower) Kawarren Mount Sabine Beech Forest

Appendix VI. Description of erosion risk classes

- Class 5. Land with a severe erosion risk. Any land disturbance will require extremely high levels of specialised management input to minimise soil erosion.
- Class 4. Land with a high erosion risk. High levels of specialised land management techniques are required to minimise soil erosion.
- Class 3. Land with a moderate erosion risk. Specialised land management techniques are required to minimise soil erosion.
- Class 2. Land with a slight erosion risk. Generally only limited special management inputs are required to prevent soil erosion.
- Class 1. Land with minimal to very slight erosion risk. Generally no specific conservation management practices are required to prevent soil erosion.

APPENDIX VII. Policies for municipal land use planning (adapted from Compagnoni & Cocks 1981)

The goal of land use planning is to satisfy, as far as possible, all the community's demands on the land allocation process. The objective is to achieve land use consistent with the allocation of land uses within zones according to various response categories (prohibited use, permitted use, preferred use etc.) which satisfy the goal. When community demands conflict (e.g. maintenance of native vegetation cover vs softwood development) the decision over which demand will or will not be met is a decision for Council. Legitimacy is given to such a decision by drawing it from principles promoting values widely accepted with the community. Principles expressed as rules guidelines or policies provide a basis for making consistent decisions about land use across the area to be planned. They should be expressed to facilitate the allocation of possible land uses to particular locations and to particular response categories. Examples of policy types are provided below.

- (a) A prescription policy - asserts that a certain use is committed at a certain location, i.e. all uses other than the committed use are excluded (e.g. recreational use for rainforest sites).
- (b) A preference policy - asserts that on land having certain attributes a particular land use should be actively encouraged (e.g. agricultural use of floodplains, recreational use of floodplains).
- (c) An impact avoidance policy - asserts that on land having certain attributes a particular land use or uses should be discouraged (e.g. clearance on high erosion risk land).
- (d) A prescription policy - asserts that a certain use will be forbidden from land with certain attributes (e.g. development in areas of high conservation significance).

Examples of these policy types relating to a range of land uses are presented below:

Exotic Forestry (Noosa Forest Plan)

Exclude from areas which are:

- 1. highly erodible;
- 2. immediately adjacent to Cooloolo National Park;
- 3. adjacent to major water courses;
- 4. inaccessible (wet);
- 5. too steep;
- 6. of too shallow soils.

Give preference to areas:

- 1. with a high site index;
- 2. in close proximity to existing forestry plantations (to maintain a Park buffer zone);
- 3. unexcluded.

As far as possible, nominate uses other than forestry (an impact avoidance policy) in areas:

1. more likely to erode;
2. high in the catchment;
3. of visually vulnerable skyline;
4. of high runoff potential.

Pine Plantation (Tidbinbilla & surrounds Park Plan)

Exclude from:

1. reserve and significant ridges;
2. areas of low capability for pine plantation;
3. Cotter River water catchment.

As far as possible assign to zones of high attractiveness for pine plantation (preference policy).

As far as possible assign options other than pine plantation is visually vulnerable areas (impact avoidance policy).

Water Based Recreation (Redland Shire)

Exclude areas:

1. designated urban;
2. of high conservation value.

Give preference to areas:

1. which are public land;
2. with a high landscape rating;
3. adjoining public land;
4. outside the water supply catchment;
5. highly accessible to consumers;
6. having high levels of services;
7. on the coastline and in the coastal zone;
8. that are accessible from land areas;
9. suitable for marina construction;
10. outside zones of high conservation value;
11. that will not cause problems of groundwater contamination;
12. such that contaminants will not be a problem downstream, particularly in the Leslie-Hamson Dam catchment.

Recreation (Cocks 1980)

1. locate tourist accommodation in existing towns;
2. choose recreation areas so as to offer a high diversity of recreation opportunities;
3. choose recreation areas and uses so as to dilute human impact on recreation resources;
4. choose areas for recreation having high potential without expensive development, high current utilisation and convenient locations.

Protection (Illawarra Region)

Give preference to protection in areas of sensitive ecosystems or areas in which change would have socially unacceptable consequences, i.e. the following categories:

1. escarpment;
2. cliff top;
3. visually significant landscape;
4. coastal foreshore, foredunes;
5. headland;
6. coastal protection zone;
7. proclaimed water catchments;
8. river corridors;
9. foreshores on lakes, estuaries, coast water bodies;
10. wetlands;
11. wildlife corridors;
12. significant vegetation;
13. important wildlife habitats.

Nature Conservation (Sherwood Forest Plan)

To ensure maximum conservation and improvement of wildlife habitats given preference to areas:

1. which have the most favourable physical condition for wildlife;
2. which are free from intensive public access;
3. which are not part of existing built up areas.

Conservation (Redland Shire)

Exclude areas designated urban.

Give preference to areas:

1. of biological significance including unique areas of high historical and landscape amenity;
2. of undisturbed habitat;
3. with high levels of soil erodibility;
4. in the water supply catchment;
5. of Crown land in existing environmental areas;
6. with no pollution problems;
7. of low ambient noise;
8. adjacent to zones of high marine productivity.

Conservation (Geelong Region)

Exclude land zoned urban.

Give preference to:

1. areas with particular qualities relating to either natural features, significant landscape, habitat or a particular rural environment;
2. other foreshore zones;
3. areas of outstanding flora and fauna;
4. areas of high erosion or run-off potential, or of low ecological carry capacity.

Conservation (Cocks 1980)

As far as possible:

1. allocate primary overwintering areas to conservation;
2. choose areas free of feral predators for fauna conservation;
3. commit all ecologically sensitive areas to conservation uses;
4. choose areas of high water catchment value for conservation;
5. commit all important breeding, nesting and feeding grounds to conservation (including drought refuges for water birds, migratory corridors and isolated timber stands).

Selecting policies, relevant to the Shire of Otway, from the list above, examples illustrating how the mapped information (Maps A and B) might be used to formulate planning controls are provided. Examples are provided for:

- (a) Level I response - Sites of Conservation Significance
- (b) Level II response - Vegetation clearance controls
 - (i) apply to streamside vegetation;
 - (ii) apply to broadzones.

Level I response - Sites of conservation significance

Policies

Give preference to conservation in:

- (i) areas of high conservation, significance; and as far as possible,
- (ii) commit areas of outstanding flora significance to conservation;
- (iii) commit outstanding geological/geomorphological sites to conservation.

Control - Areas of separate special control

Sites of conservation significance

- (a) Sites of conservation significance means areas specified on Maps A and B.
- (b) Purpose of special controls.

The purpose of the special controls over sites of conservation significance is to prevent detriment to the areas.
- (c) Use and development of land on or adjacent to sites of conservation significance.

In considering an application in respect of land on or adjacent to sites of conservation significance the Responsible Authority shall, in addition to other considerations, give particular attention to:

 - (i) whether the proposed use or development will adversely affect sites of conservation significance and, where appropriate, what conditions might be proposed to reduce the impact of the proposed use or development;

- (ii) the desirability of requiring a buffer zone between the proposed use or development and the sites of conservation significance;
- (iii) consultation with persons or bodies skilled in the assessment and management of sites of conservation significance.

Level II response - Vegetation clearance controls

Policies

As far as possible designate as priority conservation areas:

- (a) zones containing significant examples of the major natural vegetation communities in the municipality;
- (b) zones containing native vegetation cover on areas of severe to high erosion risk land;
- (c) wetlands;
- (d) native vegetation and land adjacent to water courses;
- (e) native vegetation on roadside reserves.

Control

Apart from areas of separate special control described previously, the type of controls required to address the above policies are controls on land clearance or vegetation removal controls. Such controls may apply within whole zones or to defined limited areas (roadsides, streamsides). Two examples are provided below; one dealing with controls relating to a defined limited area (land adjacent to water courses), and the other relating to a broad zone (land containing significant vegetation).

Land adjacent to watercourses

- (a) Interpretation of land adjacent to watercourses. Land adjacent to watercourses means land within 200 m of natural watercourse, being those named by clause (g).
- (b) Purpose of controls over land adjacent to watercourses.
The purpose of controls over land adjacent to watercourses is to conserve and enhance the natural beauty and importance of natural watercourse and nearby land. In particular:
 - (i) to prevent pollution and increased turbidity of water in natural watercourses and water storages;
 - (ii) to conserve existing wildlife habitats close to natural watercourses and to ensure stream conditions are suitable for maintenance of fish populations;
 - (iii) to restrict and regulate uses and developments which may interfere with the use of water for agricultural, domestic and recreational purposes.

- (c) Areas of natural beauty and importance.
The areas of land within 200 m of all natural watercourses are specified as being areas of natural beauty.
- (d) Use and development in specified areas.
Notwithstanding any other provisions of this order,
 - (i) building or works shall not be constructed at a distance of less than 200 m from a natural watercourse except in accordance with a permit granted by the Responsible Authority;
 - (ii) trees, shrubs, and other vegetation (other than noxious weeds) shall not be removed or destroyed within 200 m of a natural watercourses except in accordance with a permit granted by the Responsible Authority.
- (e) Subject to clause (f) the Responsible Authority may grant a permit for the construction of buildings and works at a distance of less than 200 m from a natural watercourse, but not less than 30 m from a water course where the Responsible Authority is satisfied that it is not practicable to construct the building or works elsewhere.
- (f) In considering an application in respect of land adjacent to watercourses, the Responsible Authority shall, in addition to other considerations, have regard to:
 - (i) the importance of the adjacent watercourse to the preservation of wildlife (incl. fish) and other aquatic life;
 - (ii) minimising erosion;
 - (iii) the effects of flooding and flood control measures;
 - (iv) the maintenance of water quality in the adjacent watercourses;
 - (v) the views of the Fisheries and Wildlife Service and the Land Protection Service.
- (g) List of named rivers and streams.
The areas of land within 200 m of the following waterways are specified as being areas of natural beauty and interest within the meaning of clause 8A of the Third Schedule to the Town and Country Planning Act:
 - Aire River
 - Barham River
 - Carlisle River
 - Gellibrand River
 - Kennett River
 - Parker River
 - Skenes Creek
 - Smythe Creek
 - Wild Dog Creek
 - Wye River

Land containing significant vegetation

- (a) Interpretation of land containing significant vegetation. Land containing significant vegetation means land within category II defined on Map B in clause (c).

- (b) Purpose of controls over land containing significant vegetation.
The purpose of controls is to conserve and enhance the natural beauty and to promote and protect the essential character of the region. In particular:
- (i) to minimise soil erosion and subsequent increased turbidity of water in natural water courses and water storages;
 - (ii) to minimise soil salting and pasture pest problems;
 - (iii) to conserve existing wildlife habitats;
 - (iv) to promote regeneration of vegetation;
 - (v) to restrict and regulate uses and development which may alter the essential character of the region.
- (c) Areas of natural beauty and importance.
The areas of land designated as Category II (colour code orange) on Map B. This includes the larger areas of intact native woody vegetation and wetlands.
- (d) Use and development in specified areas.
Notwithstanding other provisions of this Order,
- (i) wetlands shall not be damaged except in accordance with a permit granted by the Responsible Authority;
 - (ii) trees, shrubs (other than noxious weeds) shall not be removed or destroyed except in accordance with a permit granted by the Responsible Authority.
- (e) In considering an application in respect of land within category II on Map B, the Responsible Authority shall, in addition to other considerations have regard to:
- (i) the need to prevent erosion;
 - (ii) the habitat value of the area for native fauna;
 - (iii) the particular scenic and landscape character of the area;
 - (iv) the need for fire protection;
 - (v) the need to protect potential aquifer recharge areas;
 - (vi) the significance of the flora;
 - (vii) the views of the Fisheries and Wildlife Service and the Land Protection Service.