

**REPORT ON A PROPOSED LAND USE
DETERMINATION FOR THE UPPER
DELATITE (MANSFIELD) WATER
SUPPLY CATCHMENT**

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PREFACE

The catchment to the Delatite River is undergoing rapid expansion of use for residential and recreation purposes. The catchment also supplies water for domestic use in the township of Mansfield and for irrigation and domestic use by many private diverters in the catchment itself. The water is currently of generally high quality. However, continued development and use of the catchment places the water supply at increased risk. This accelerated development must be managed correctly and channelled to those areas best able to support such use with least impact on water supply. The Land Use Determination will assist in achieving this.

The Determination takes into account the various types of land within the catchment and the various land uses possible, and specifies the most suitable use and other acceptable uses of the lands.

This report, which presents a Land Use Determination for the Upper Delatite (Mansfield) Water Supply Catchment, concludes a series of investigations initiated by the Authority into this catchment.

The Catchment was proclaimed as part of the Upper Goulburn Water Supply Catchment in 1956. The Authority undertook a broad scale land system survey of the catchment as part of a wider study (Rundle, 1977). More recently, the Authority has undertaken a more detailed study of the Upper Delatite catchment and its capabilities for development (Howe *et al*, In preparation). This report has been used extensively as a source of information for preparation of the Determination and is not referenced directly in the text.

This report builds on the land capability study and on studies by other organizations to provide guidelines for the use and management of land for a variety of purposes in the catchment.

The Authority intends to amend this Determination in future, refining Land Use Category 4, and publishing Guidelines for the development of land for residential and for commercial, recreation and tourist purposes, as indicated in section 1.3.

THE LAND USE DETERMINATION

1.1 General

A Land Use Determination is made by the Soil Conservation Authority pursuant, to section 23 of the *Soil Conservation and Land Utilization Act* 1958. Briefly, the Authority is empowered to determine the most suitable use, other acceptable uses and appropriate management of all or any land in a Water Supply Catchment. The Determination may also be amended as provided for in the Act.

Land Use Determinations are implemented by the Authority, subject to the provisions of the Act and by other Government Departments and Local Government to the extent allowed by relevant legislation.

The Determination provides guidelines to the owners or managers of land in the catchment for the management and care of their land. It aims to allow for a range of land uses and management such that water quality or quantity is not jeopardized by the utilization of the land. The Authority at all times seeks the co-operation of landowners and managers in implementing the Determination.

Managers of Public Land are obliged by the Act to give effect to the Determination insofar as it affects the land they manage. However, the Determination becomes binding on owners or managers of freehold land, only through the imposition by the Authority of Land Use conditions on the use of any such land (under section 23(4)(a) of the Act). The Authority is required to determine costs arising from compliance with these conditions, and apportion them between itself and the land owner/occupier.

1.2 Objectives of the Land Use Determination

The general objective of a Land Use Determination is:

To provide guidelines for the use and management of land based on the sustained use and production from the land, and the maintenance of acceptable quality and quantity of water harvested from the catchment.

Because of the diverse nature of the land use and tenure in the catchment, a number of subsidiary objectives have been identified:

- i. to provide guidelines to individual landholders for the use and management of their land, such that catchment values are not jeopardized;
- ii. to initiate the development of management plans for the development and use of public land (where such plans do not currently exist) such that catchment values are recognised and protected; and
- iii. to influence the consideration of development proposals in the catchment such that the needs of sound catchment management are met.

A Determination aims to achieve a balance between the interests of owners and managers of catchment lands and those requirements of the consumers of the water harvested from the catchment. In doing so, the Determination must take account of a wide range of land uses and the way in which they may interact with a variety of land types, such interaction may adversely affect the water supply catchment. The Determination establishes the mechanism for regulating land use activities should the need arise.

1.3 Explanation of the Determination

The Determination consists of two items:

1. The Table of Land Use Categories (see section 1.5 Table of Land Use Categories). Part A contains a number of general provisions that apply to the use or management of all land in the catchment. Part B

categorizes the various areas of land and identifies the most suitable use of each and may list a number of Provisions of Use applicable to that use. Part C identifies other Acceptable Uses and Provisions of Use for each.

2. The Map, presented as a number of map sheets at a scale of 1:25,000 which shows the Determined Land Use Categories of all land in the catchment (see section 1.6. Determined Land Use Categories).

The Determination places land of the catchment in the following categories:

Category 1: Land Most Suited to Water Protection.

This category comprises land of the environs of the Delatite River and its tributary streams and drainage lines.

The quality of water in the stream system is most sensitive to misuse of this land. Soil erosion or unsatisfactory wastewater disposal on this land may be readily reflected in reduced water quality. A stable soil and vegetative cover may act as a form of water treatment through the trapping and settling of suspended soil particles. Land of this Category acts as a buffer to disturbance and to direct contamination of the water in the stream system.

Where the Authority is of the opinion that current use or management is causing a significant decline in water quality, Land Use Conditions may be imposed requiring improvements to be made to the vegetative cover or other means of stabilizing the site. An example might be a reduction in the intensity of use or constraints on access (fencing).

The major hazard at present is damage to the stream system that is due to stock access from adjacent areas of Category 4 land. (Many minor drainage lines run through freehold land without any stream reservation).

The land is suited to few other uses. This is due to the sensitivity of water quality to the disturbance of this land.

Category 2: Land Most Suited to Catchment Protection.

This category includes both freehold and public land, with the latter being predominant.

The public land includes land recommended by the Land Conservation Council¹ for use as Education Areas and for addition to the Alpine Park system (Land Conservation Council, 1983). Other land in this category consists of certain forested public land and some freehold land. The Authority has identified such land as having a particularly high erosion risk. This erosion risk precludes timber harvesting activities or clearing for pasture establishment without risking significant adverse effects on water quality. It is also likely that a stable grazing regime cannot be maintained without a very high level of management. In the interests of water supply, such land is best retained as or returned to forest cover to ensure continued stability of the area. Acceptable activities on such land may include limited earth or vegetation disturbance for the creation and maintenance of fire prevention and access tracks, or for limited development associated with recreation/education facilities at carefully chosen sites.

While the most suitable long-term use of this land is protective forest, some freehold land of the category is presently cleared and grazed. The Authority accepts this use while the land remains stable. However, in the event of deterioration of the land that, in the Authority's opinion is likely to cause a significant deterioration in water quality, Land Use Conditions may be imposed. Such conditions may require changes in land use or management to achieve acceptable soil stability or protection of the streams from pollution.

¹ Land Conservation Council, 1983. Final Recommendations, Alpine Area, Special Investigation

Category 3: Land Most Suitable to Hardwood Production.

Land of this category is predominantly public land (Reserved Forest) but also includes smaller areas of freehold land. All the land in the category is forested with native Eucalypt species that may constitute a valuable hardwood timber resource.

Forest operations involve infrequent but extensive earth disturbance during harvesting and regeneration, and an extensive road and track network for harvesting and subsequent fire protection and control.

The development of and adherence to appropriate management guidelines is essential to minimize adverse effects from timber production on the water supply catchment. In particular, to hazards associated with the road and track networks and the needs of stream protection. Current Forest Management Prescriptions of the State Forest and Lands Service are, in the main acceptable to the Authority. However, some amendments may be required to take greater cognizance of the needs of catchment protection when these Prescriptions are reviewed.

Much of the land may also be used for low to moderate intensity forms of winter recreation such as cross country skiing and summer recreation such as horse safaris, adventure driving (4WD and trail bike use) and bushwalking without significant adverse effects on water supply. However, some constraints on such activities may be necessary to reduce the impact on the catchment and provisions have been incorporated into the Determination.

Category 4: Land Most Suited to Grazing.

All land in this category is freehold land, predominantly cleared and sporting native or improved pastures. It is located in the western portion of the catchment and generally consists of low rounded hills formed on a variety of parent materials. Cattle are the major stock on these pastures.

Water quality may suffer through erosion following overgrazing. While some seasonal overgrazing may be unavoidable, persistent overgrazing resulting in significant soil erosion is unacceptable to the Authority. Land Use Conditions may be imposed to limit stocking rates or to achieve temporary exclusion of stock from degraded areas if degradation continues.

As development in the catchment progresses, land in this category will be required for development for residential use. However, it is important that the nature and intensity of such development be matched to the capability of the land to support and sustain the use without unacceptable deterioration of the land or water resource.

For this reason it was intended, as part of the preparation of the Determination, to separate land of this category into a number of 'preferred Development Areas' which would identify appropriate areas for different intensities of residential development and use. However, some of the information required to do this is not currently available, and will not become available until the final stages of the preparation of the revised Shire of Mansfield Planning Scheme are reached. This Determination has therefore been made with the intention of revising Land Use Category 4 when the necessary additional information becomes available.

The Authority had also intended to publish Guidelines concurrently with this Determination, for the subdivision, development and use of land for residential and commercial recreation and tourist purposes. However, as these are still being finalized, they will be published separately later. (These Guidelines are referred to in 'Provisions of Use', Land Use Categories 4 and 5 as well as in 'Provisions of Use' Other Uses – Residential Use, Commercial, recreation or tourist facilities, and Subdivision of Land, see section 1.5 Table of Land Use Categories).

Category 5: Land Most Suited for Residential (Village) use.

This land is already subdivided for residential and associated purposes – being the villages of Merrijig and Sawmill Settlement. Both are close to the Delatite River and pose significant hazards to water quality due to the lack of sewerage and reliance on on-site wastewater disposal, and limited opportunities for the treatment of road and urban drainage water.

Minimum standards of management of subdivision for residential purposes include provision of sewerage, control over the discharge of urban run-off and the adoption of sediment management techniques during construction.

Category 6: Land Most Suited to Alpine Recreation.

This category comprises two areas of land recommended by the Land Conservation Council for reservation and use for alpine recreation (Land Conservation Council, 1977).

6a) Mt. Buller Alpine Reserve.

This land was recommended for continuing development for downhill skiing under the supervision of a Committee of Management. The Alpine Resorts Commission is expected to assume management responsibilities as described in section 6.3 Planning Controls and Other Relevant Legislation.

6b) Mt Stirling Alpine Reserve.

This land will be developed for downhill and cross country skiing. Special emphasis will be placed on the development of facilities for cross country skiing.

Development and use of both areas involves substantial hazards to water supply due to the adverse climate, steep slopes, erodable soils and a high concentration of people. Extensive structural works and close day to day management are required to minimize the hazards to the water supply catchment. Preparation of and adherence to appropriate Management Plans and Development Standards are essential to minimize adverse off-site effects while ensuring maximum community benefits from the Resorts.

Other Acceptable Uses:

Road, Tracks and Car Parks

These uses are integrated with other activities and land uses. Therefore all land, except that explicitly categorized for protection of water or catchment, is generally suitable for such uses provided appropriate standards accompany their location, design, construction and maintenance.

Subdivision of Land

Land of Category 4 is generally suitable for subdivision for development and use for residential purposes at a variety of designated intensities of use. The Authority is preparing design and development guidelines for the subdivision and use of land for residential and commercial recreation purposes. These provide technical guidelines for preferred subdivision design, for wastewater disposal and for certain other activities.

The Authority will seek to influence the development of this land when advising the Planning Authorities during the preparation and implementation of Planning Scheme control measures, with respect to land in the catchment.

Recreation

Most land of the catchment is considered suitable for low intensity recreational use with the proviso that the intensity of such use should be no greater than implied by the respective Land Use Category in whom the recreation is proposed. The use envisaged is generally a passive one such as bush walking, horse riding and sightseeing without a requirement for substantial infrastructure (such as toilets, cabins etc.).

Commercial Recreation and Tourist Facilities

This use is more demanding of the environment than the 'recreation' previously discussed. It is expected to involve the construction of buildings and intensive use areas and associated wastewater disposal facilities.

Such use should be limited to Land Use Categories 4 and 5, although the recreation activities may extend into public land (Land Use Category 3).

Grazing

There is limited forest and alpine grazing on public land in the catchment. The Determination recognizes grazing as an acceptable use on such land, subject to certain safeguards. It provides for continued grazing within Land Use Categories 3 and 6b, subject to existing controls and subject to the future exclusion of grazing from some areas being developed for the purpose specified under the 'most suitable use'.

Conservation of Flora and Fauna

This implies minimal active use of the land. Such rather it is 'managed' so as to maintain or enhance the native flora and faunal habitat values of the land. The use poses little hazard to water supply.

Extractive industry, mining, mineral exploration

These are Acceptable Uses of land of Categories 3 and 4. While such uses may involve extensive disturbance, the land is generally capable of sustaining such disturbance without excessive erosion and subsequent deterioration of water quality, provided the appropriate sediment management techniques are employed. Some areas may be unsuitable for certain operations due to specific site characteristics (in particular, proximity to the stream system and steepness of slope) or soil characteristics related to erosion hazard.

Hardwood Production

This is an Acceptable Use on land of Category 4, and in Categories 6a and 6b where approval has been given by the Once-only-logging Working Party.

Adherence to appropriate guidelines for forest management is necessary to minimize adverse effects on the water supply catchment.

Softwood Production

Softwood production is an Acceptable use on land of Categories 3 and 4, with the proviso that some areas may be unsuited due to specific site or soil characteristics and should be excluded from such development.

Development of and adherence to appropriate management guidelines are necessary to minimize adverse effects on the water supply catchment.

1.4 Implementation of the Determination

The Soil Conservation Authority operates primarily as an extension organization. It provides an advisory service to landholders, Local Government and other government bodies with respect to the prevention and control of soil erosion, the use and management of land, and the capability of land to sustain various uses.

However the Authority also has statutory powers with respect to land use and management in water supply catchments. The Authority therefore seeks the co-operation of all landowners and managers in the implementation of the Determination to ensure the continued productive use of the land for the various needs of the community.

There are some forms of land use or management that are not the direct responsibilities of the Authority – such as the regulation of subdivision of land and development for residential use. In such cases the Authority would wish to advise the Responsible Authority both during the preparation of a management plan (such as a Planning Scheme) and in the course of implementation, insofar as matters relating to the Determination are concerned.

While the Authority has determined the most suitable uses for the various types of land in the catchment, other acceptable uses are also identified. The standards of management which are required to ensure such uses are compatible with the needs of catchment protection (in the form of initial design, construction or on-going management) are generally significantly greater than for the specified best use.

Generally, existing land use within the catchment conforms to the provisions of the Determination. However, where it does not and the Authority is of the opinion that there is a need for change in use or management of the land, this may be achieved through the imposition of Land Use Conditions.

1.5 Table of Land Use Categories

UPPER DELATITE (Mansfield) WATER SUPPLY CATCHMENT

PART A GENERAL PROVISIONS apply to all Categories

<p>1. Proposals for the following activities require assessment by the Authority before activities commence.</p> <ul style="list-style-type: none"> a) road, track or carpark construction; b) subdivision of land titles; c) recreation development, including ski village and ski-field developments; d) extractive activity; e) mining or exploration; f) hardwood production or g) softwood production 	<p>6. The Soil Conservation Authority may determine any conditions pursuant to Section 23(1)(c) and impose such conditions pursuant to Section 23(4)(a) of the <i>Soil Conservation and Land Utilization Act 1958</i> with respect to the use or management of all or any land in any Category specifying any action for the purposes of:</p> <ul style="list-style-type: none"> a) implementing any of the "Provisions of Use" b) preventing or limiting soil erosion or reclaiming eroded sites, or c) preserving or improving the quality or yield of water supply. <p>Such conditions may relate to:</p> <ul style="list-style-type: none"> a) the stabilisation or revegetation of exposed or disturbed earth; b) the location of, or design or construction standards of roads, tracks carparks or stream crossings or other earthworks; c) the disposal of road drainage water; d) implementation of Guidelines published or approved by the Authority for this catchment, or <p>other matters as appropriate.</p>
<p>2. The treatment and disposal of septic effluent is to conform to the requirements of the <i>Environment Protection Act 1970</i>, the <i>Health Act 1958</i> and the Shire of Mansfield</p>	
<p>3. The conduct and management of intensive animal industries are to conform to requirements specified in "Guidelines for the conduct of intensive animal industries", Environment Protection Authority and Department of Agriculture, Victoria 1978.</p>	
<p>4. Grazing and earthworks on land over 1 220 m above sea level are under supervisory control of the Soil Conservation Authority, proposals for such activities require early consultation with and subsequent approval by the Authority before commencement.</p>	
<p>5. The use of agricultural chemicals is to conform to the requirements of the <i>Agricultural Chemicals Act 1958</i>, the <i>Environment Protection Act 1970</i> and various Guidelines published by the Environment Protection Authority.</p>	

PART B: LAND USE CATEGORIES

CATEGORY NO.		LAND AFFECTED	MOST SUITABLE USE	PROVISIONS OF USE	
1.	1a.	Land in the catchment within 200 m of the Mansfield offtake, or of the Sawmill Settlement offtake.	Protection of the Mansfield water supply offtake, the Mt. Buller Alpine Village water supply offtake and raceline, the Delatite River, creeks and water courses from the effects of soil erosion and from pollution.	1.	Disturbance of earth or vegetation shall be limited to that required for creation or maintenance of access or works relating to fire prevention or protection, or other approved activities.
	1b.	Land in the catchment within 100 m of Mt. Buller Alpine Village offtake.			
	1c.	Land within 40 m upslope or 10 m downslope of the open raceline forming part of Mt. Buller Alpine Village water supply.			
	1d.	Land within 40 m, or such greater distance as has been specified by the Authority, of the banks of the Delatite River, Timbertop Creek, Buttercup Creek and Baker Creek, as specified on Plan No. S-1335.			
	1e.	Land within 20 m of the banks of all other creeks and watercourses specified by the Authority.			
				2.	Proposals for works which may cause disturbance of earth or vegetation must be referred to the Authority for assessment before works commence.
				3.	The Authority may specify conditions which relate to: <ul style="list-style-type: none"> a) exclusion of stock from particular areas; b) stocking rates; c) re-forestation of particular areas; or d) the location of or design or construction standards of roads, tracks, carparks or stream crossings.

CATEGORY NO.	LAND AFFECTED	MOST SUITABLE USE	PROVISIONS OF USE
2.	Land as specified on Plan No. S-1335, being land recommended for inclusion in the Alpine Park System*, or for reservation as Education Areas*, or land identified by the Authority as being generally of significant erosion hazard due to site and/or soil factors.	Water catchment protection to be retained as or returned to protective forest.	<ol style="list-style-type: none"> 1. Disturbance of earth or vegetation shall be limited to that required for creation or maintenance of essential access or works relating to fire prevention or protection, or other approved activities. 2. Proposals for works which may cause disturbance of earth or vegetation must be referred to the Authority for assessment before works commence. 3. The Authority may specify conditions which relate to: <ol style="list-style-type: none"> a) exclusion of stock from particular areas; or b) re-forestation of particular areas. 4. Land recommended for use as Education Areas or for inclusion in the Alpine Park system may be used as recommended by the Land Conservation Council*. Management of such areas is to be in accordance with a Management Plan approved by the Responsible Management Authority and prepared in consultation with the Soil Conservation Authority.

* Land Conservation Council, 1979. Final Recommendations, Alpine Area.

* Land Conservation Council, 1983. Final Recommendations, Alpine Area., Special Investigation.

CATEGORY NO.	LAND AFFECTED	MOST SUITABLE USE	PROVISIONS OF USE
3.	Land as specified on Plan No. S-1335, generally being forested Public Land.	Hardwood timber production.	<ol style="list-style-type: none"> 1. Forest operations are to be in accordance with management guidelines approved by the Authority. Consultation with the Authority is required in the preparation of cutting plans. 2. The Authority may specify conditions which relate to: <ol style="list-style-type: none"> a) exclusion of particular areas from the clearing of vegetation; or b) re-forestation of particular areas.
4.	Land as specified on Plan No. S-1335 generally being cleared freehold land.	Grazing, some parts may be suited to development for varying intensities of residential use or for commercial recreation or tourist purposes.	<ol style="list-style-type: none"> 1. Activities associated with land subdivision or subsequent residential use and development must take account of soil conservation and water catchment protection needs. These activities are to be in accordance with Guidelines published by the Authority for this catchment. Such activities include: <ol style="list-style-type: none"> a) subdivision design or layout; b) siting or access provisions; c) wastewater disposal; and d) erosion and sediment control. 2. The Authority may specify conditions which relate to: <ol style="list-style-type: none"> a) method, extent, timing or location of the clearing of timbered land; or b) management of land after clearing. 3. The Authority may specify conditions which relate to: <ol style="list-style-type: none"> a) number, type or timing of stock grazing; b) treatment and disposal of effluent from animal industries or other agricultural wastes; c) areas suitable for intensive agricultural uses or d) cultivation rotations

CATEGORY NO.		LAND AFFECTED	MOST SUITABLE USE	PROVISIONS OF USE	
5.		Land as specified on Plan No. S-1335, being land already subdivided into small allotments for residential and associated uses.	Residential and associated uses on small, fully serviced allotments.	1.	Activities associated with residential use and development must take account of soil conservation and catchment protection needs. These activities are to be in accordance with Guidelines published by the Authority for this catchment. Such activities include. a) siting or access provisions; b) wastewater disposal.
6.				2.	The Authority may specify conditions relating to: a) disposal of urban drainage water.
6a.	Land as specified on Plan No. S-1335, being land of the Mt. Buller Alpine Reserve.	Alpine recreation, as recommended by the Land Conservation Council*.	1.	Management is to be in accordance with a Development Plan approved by the Responsible Management Authority and prepared in consultation with the Soil Conservation Authority.	
6b.	Land as specified on Plan No. S-1335, being land of the Mt. Stirling Alpine Reserve.	Alpine recreation, as recommended by the Land Conservation Council*.	2.	Proposals for works which may cause disturbance of earth or vegetation must be referred to the Authority for assessment before works commence.	
			3.	Developmental and management specifications and standards will be prepared by the Authority relating to: a) planning and development of new projects; b) the stabilisation or revegetation of disturbed or bared earth; c) road alignment; design or drainage; d) timing extent or conduct of earth disturbance or vegetation modification activities; or e) management of stock adjacent to or within resort areas.	

* Land Conservation Council, 1979. Final Recommendations, Alpine Area.

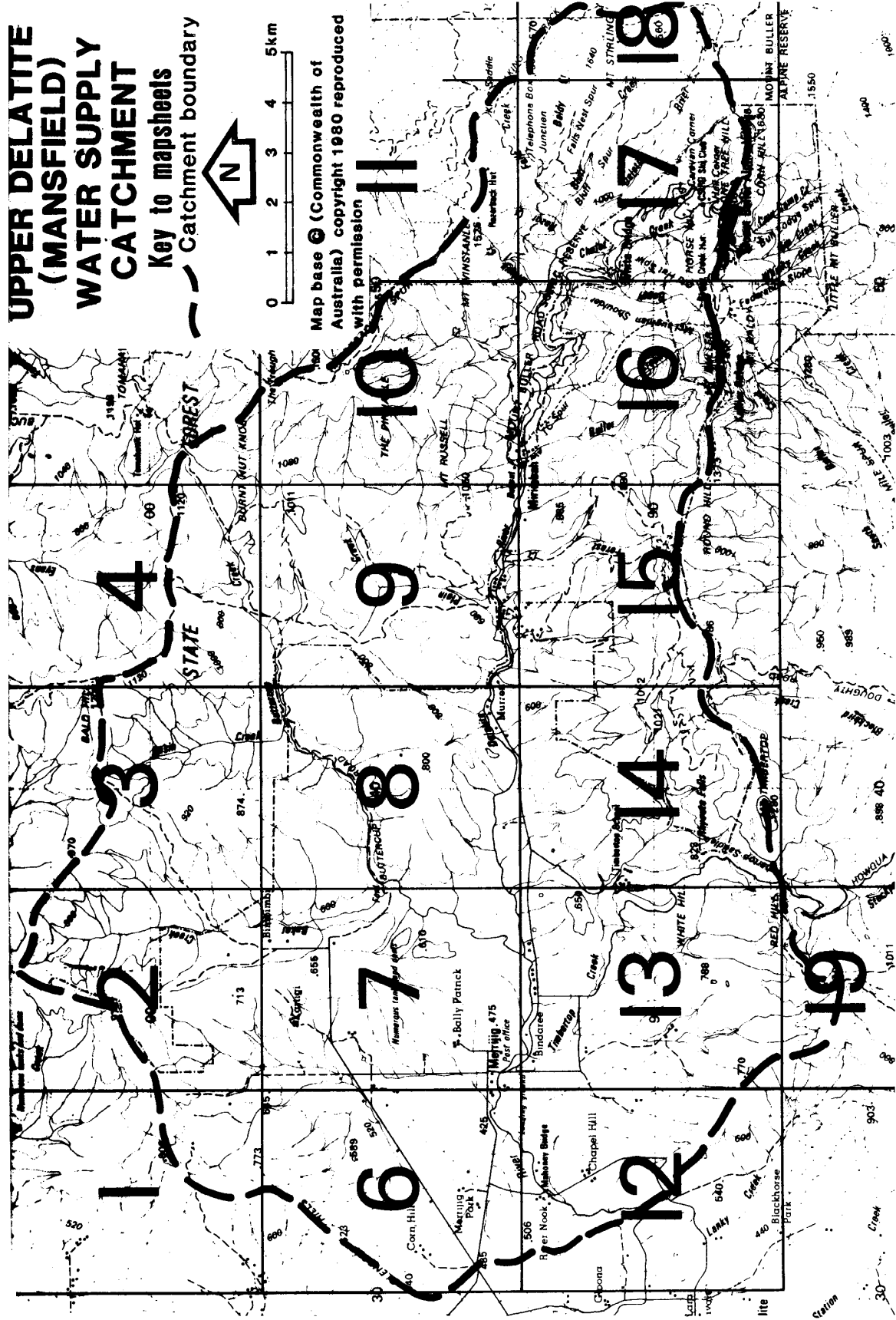
* Land Conservation Council, 1983. Final Recommendations, Alpine Area Special Investigation.

PART C: OTHER USES

CATEGORY	LAND USE CATEGORIES	PROVISIONS OF USE
Conservation of Flora and Fauna	1a, 1b, 1c, 1d, 1e, 2, 3, 4, 5, 6a, 6b	1. Management of land of Category 3 is to be in accordance with a Management Plan approved by the responsible Management Authority and prepare in consultation with the Soil Conservation Authority.
Roads, tracks and carpark	1a, 1b, 1c, 1d, 1e, 2, 3, 4, 5, 6a, 6b	1. The advice of the Authority must be obtained prior to commencement of earthworks. 2. The Authority may specify conditions relating to: a) the disposal of drainage water; b) the stabilisation of batters, road or carpark surfaces, or c) exclusion of particular areas from use.
Subdivision of Land	3 (freehold land), 4	1. Subdivision requires consideration of soil and water conservation management needs and is to be in accordance with Guidelines published by the Authority for this catchment.
Residential Use	3 (freehold land), 4	1. Residential use of land must take account of soil conservation and catchment protection needs, and is to be in accordance with Guidelines published by the Authority for this catchment. 2. The advice of the Authority must be obtained prior to the commencement of siting or construction of houses or effluent disposal fields.
Recreation	1b, 1c, 1d, 1e, 2, 3, 4, 5, 6a, 6b	1. The intensity of use shall accord with the intent of the relevant "most suitable use" category. 2. The Authority may specify conditions relating to: a) exclusion of particular areas from use; b) the extent, timing or conduct of adventure driving or horse safaris, or c) the design location or stabilisation of cross-country ski trails or down-hill ski runs.
Grazing	3, 6b	1. The Authority may specify conditions which relate to: a) number, type or timing of stock grazing, or b) temporary or permanent exclusion of stock from particular areas.





CATEGORY	LAND USE CATEGORIES	PROVISIONS OF USE
Commercial recreation or tourist facilities	3, 4, 5	<ol style="list-style-type: none"> 1. The intensity of use shall accord with the intent of the relevant "most suitable use" category. 2. The advice of the Authority must be obtained prior to the commencement of siting or construction of recreation facilities or intensive-use areas. 3. The Authority may specify conditions relating to: <ol style="list-style-type: none"> a) exclusion of particular areas from development or use, or b) the extent, timing or conduct of adventure driving or horse safaris.
Extractive industry, mining, mineral exploration.	3, 4, 5	<ol style="list-style-type: none"> 1. The advice of the Authority must be obtained prior to the commencement of earthworks. 2. The Authority may specify conditions relating to: <ol style="list-style-type: none"> a) provision of access; b) the conduct, timing or extent of operations; c) the disposal of drainage water; d) the rehabilitation of disturbed areas or e) the exclusion of particular areas from operations.
Hardwood production	4	<ol style="list-style-type: none"> 1. Forest operations are to be in accordance with management guidelines approved by the Authority. Consultation with the Authority is required in the preparation of cutting plans. 2. The Authority may specify conditions which relate to: <ol style="list-style-type: none"> a) exclusion of particular areas from the clearing of existing vegetation or b) re-forestation of particular areas.
Softwood production	3, 4	<ol style="list-style-type: none"> 1. Clearing and preparation of land for plantation establishment and all forest operations are to be in accordance with management guidelines approved by the Authority. 2. The Authority may specify conditions relating to: <ol style="list-style-type: none"> a) the timing, method or extent of clearing operations, or b) particular areas to be excluded from clearing and plantation establishment.

1.6 Determination Maps




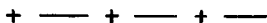



**UPPER DELATITE (MANSFIELD) WATER SUPPLY CATCHMENT
LAND USE DETERMINATION**



LEGEND

	Catchment boundary
	Category boundaries
	Rivers and creeks
	Parish boundary

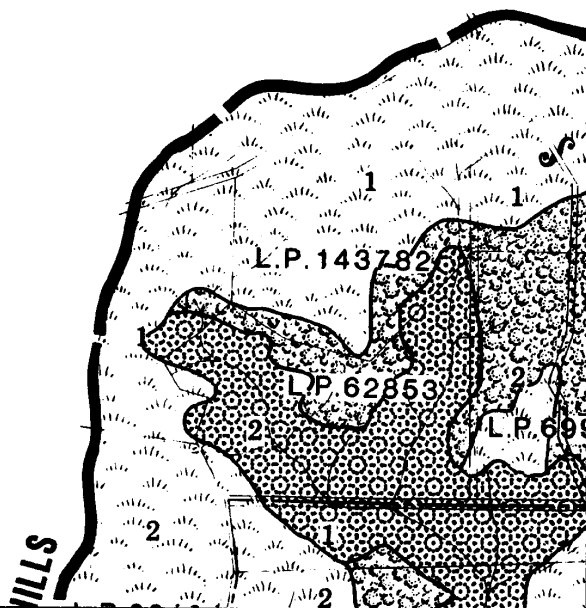
CHANGUE

	Parish name
	Crown allotment boundary
	Crown allotment number
	Public land boundary
	Stream frontage reserve

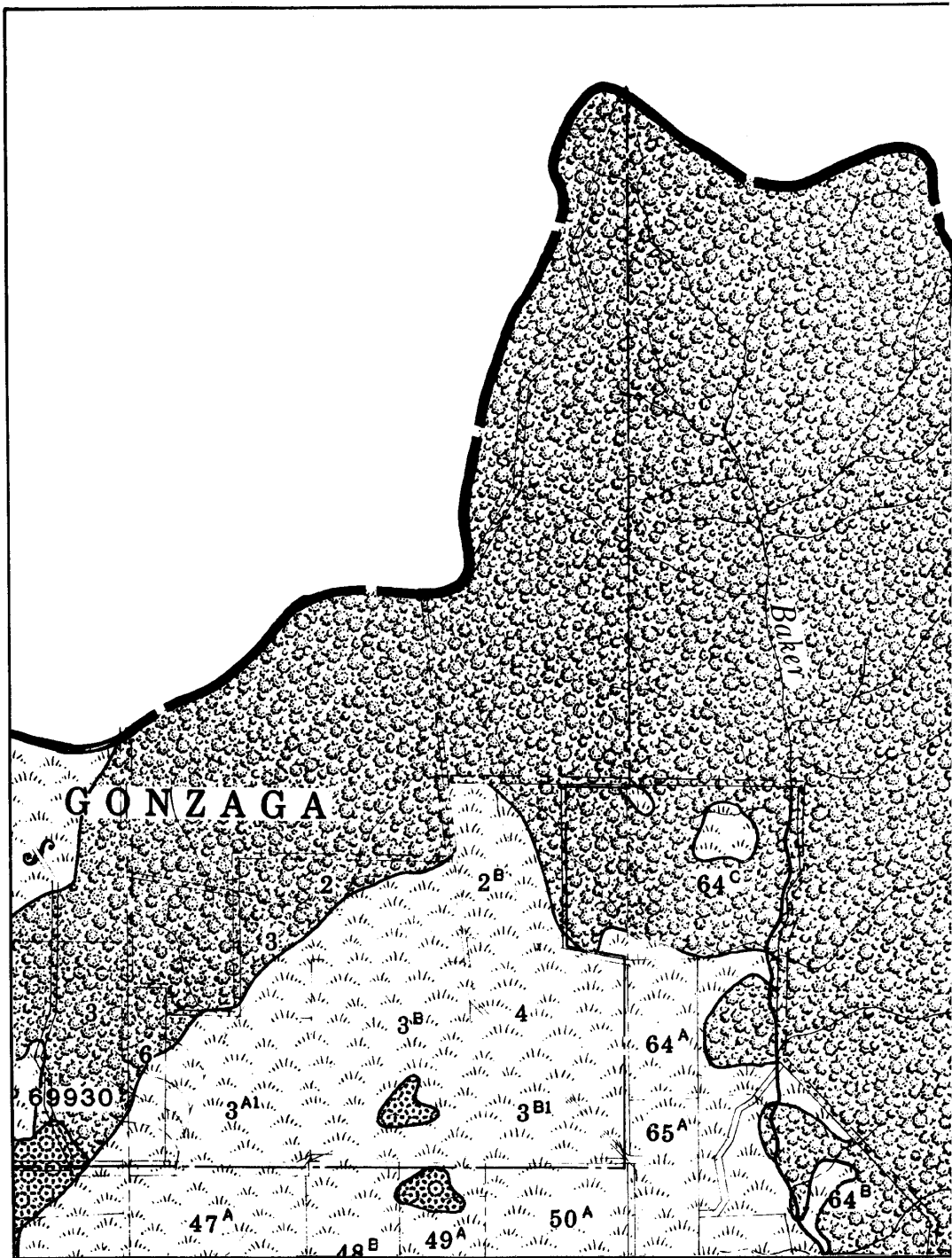
MERRIJIG

	Township
	Road

Note: Land Use Categories 1d and 1e are represented as linear features rather than to scale, due to limitations imposed by mapscale.



LAND USE DETERMINATION		S-1335		KEY TO ADJOINING MAPS
UPPER DELATITE (MANSFIELD)		0	1km	
WATER SUPPLY CATCHMENT		SHEET 1	1:25 000	
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Category 1b	Category 2	Category 6a		
Category 1c	Category 3	Category 6b		
Category 1d	Category 4			

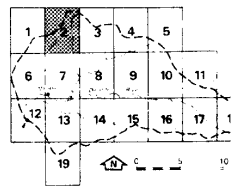


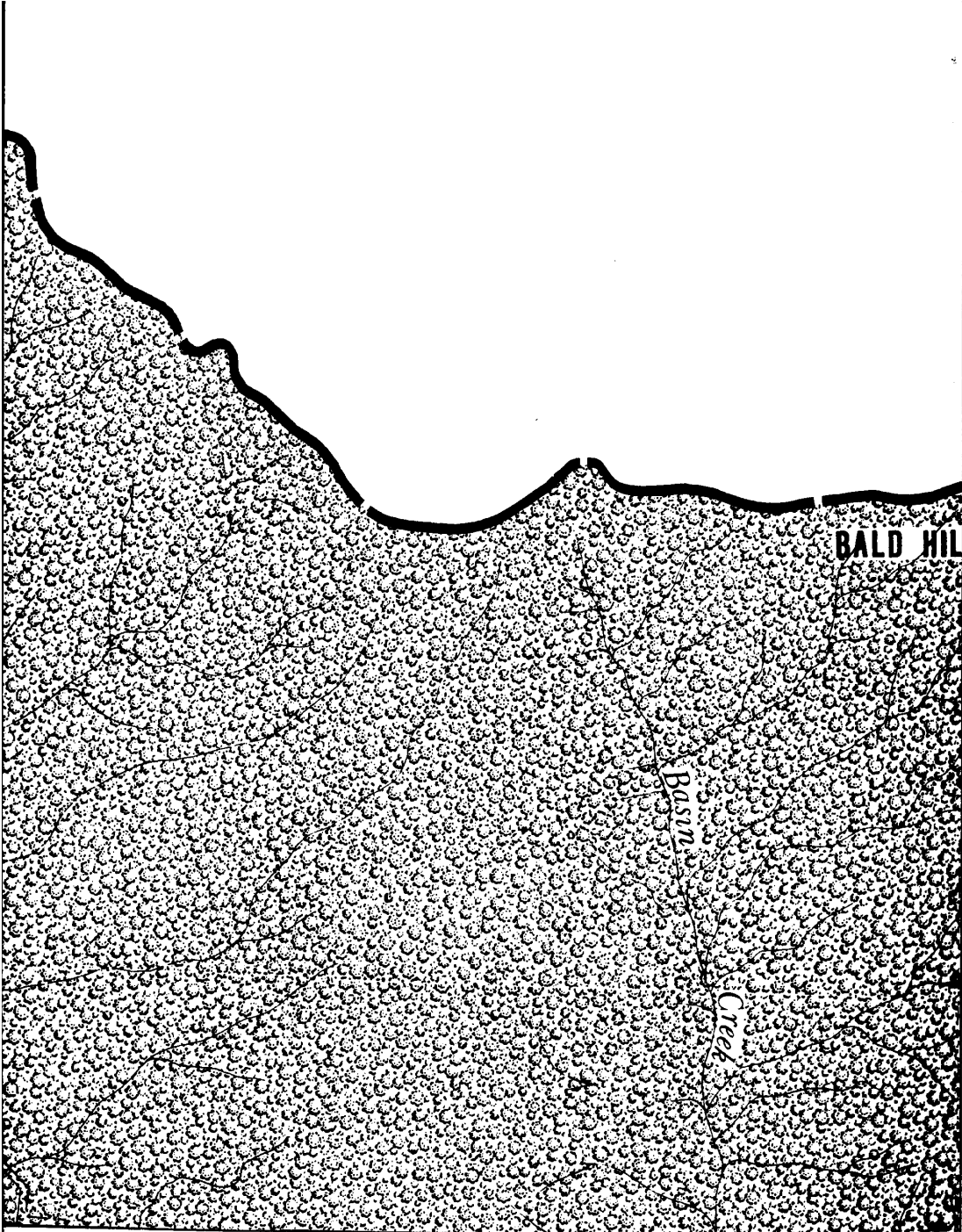
LAND USE DETERMINATION
 UPPER DELATITE (MANSFIELD)
 WATER SUPPLY CATCHMENT

S-1335
 SHEET 2
 0 1km
 1:25 000

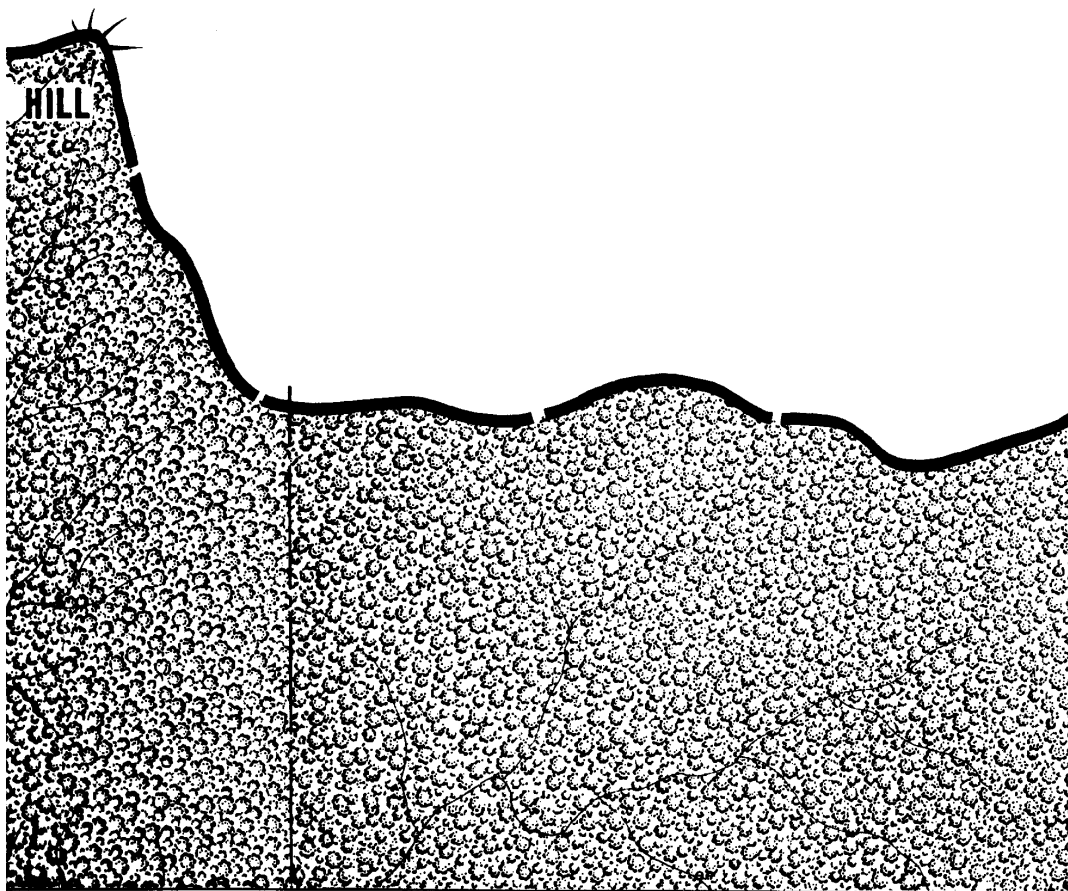
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| | Category 1d | | Category 4 | | |





LAND USE DETERMINATION		S-1335	
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WATER SUPPLY CATCHMENT		1:25 000	
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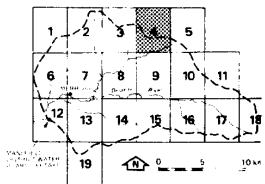


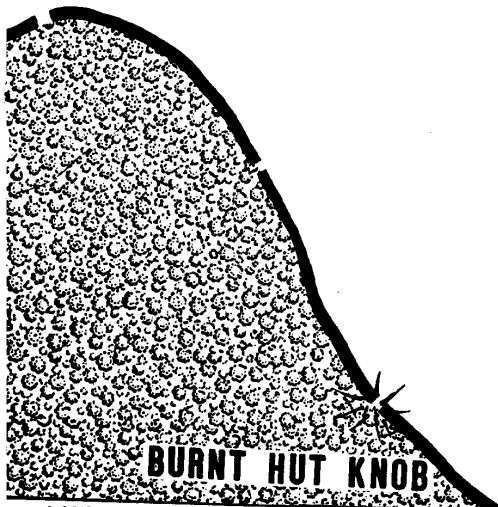
LAND USE DETERMINATION
UPPER DELATITE (MANSFIELD)
 WATER SUPPLY CATCHMENT

S-1335
 SHEET 4
 0 1km
 1:25 000

KEY TO ADJOINING MAPS

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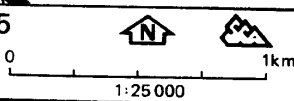




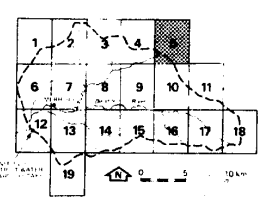
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LAND USE DETERMINATION
 UPPER DELATITE (MANSFIELD)
 WATER SUPPLY CATCHMENT

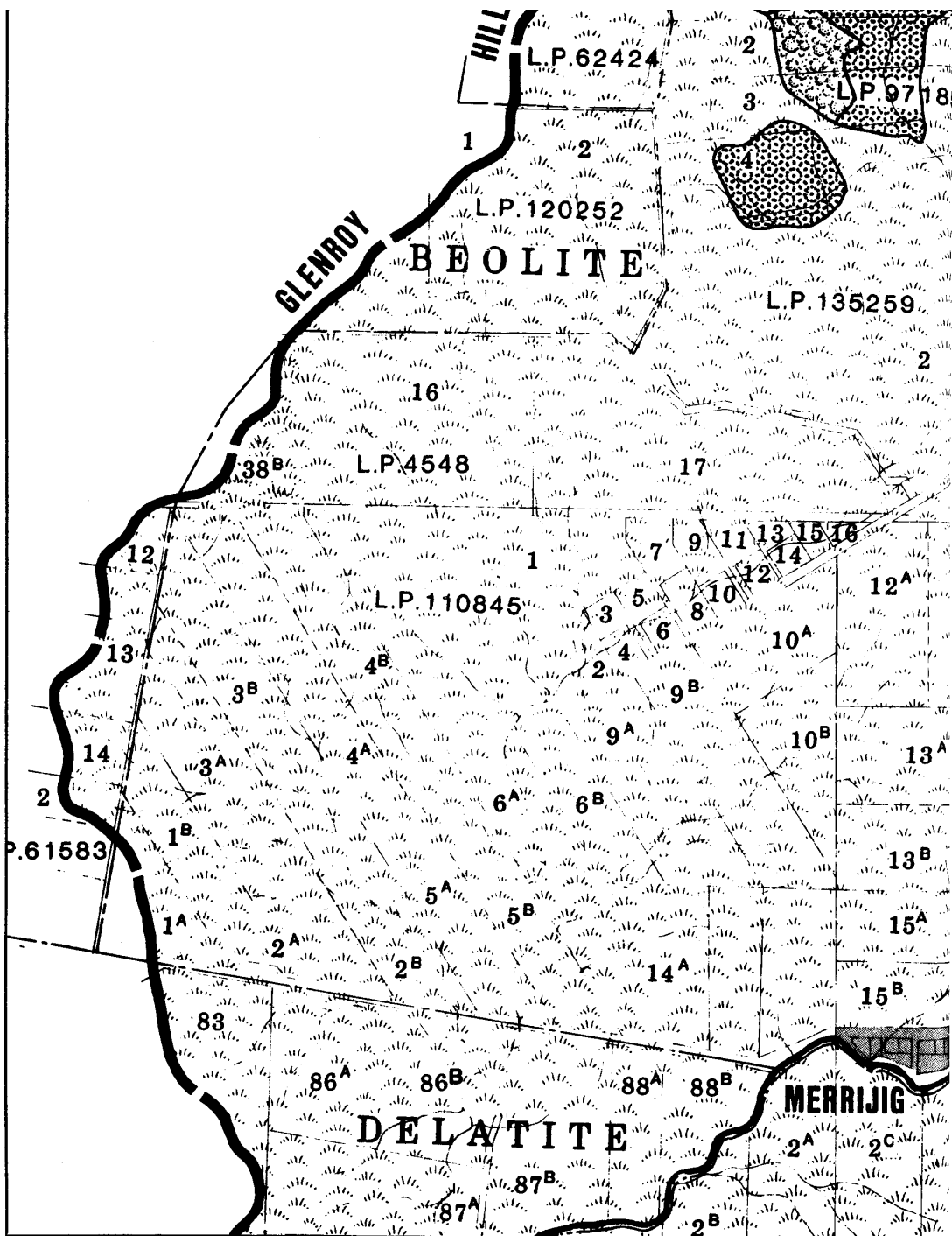
S-1335
 SHEET 5



KEY TO ADJOINING MAPS



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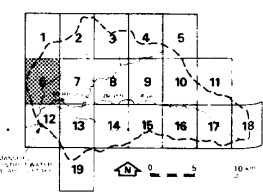


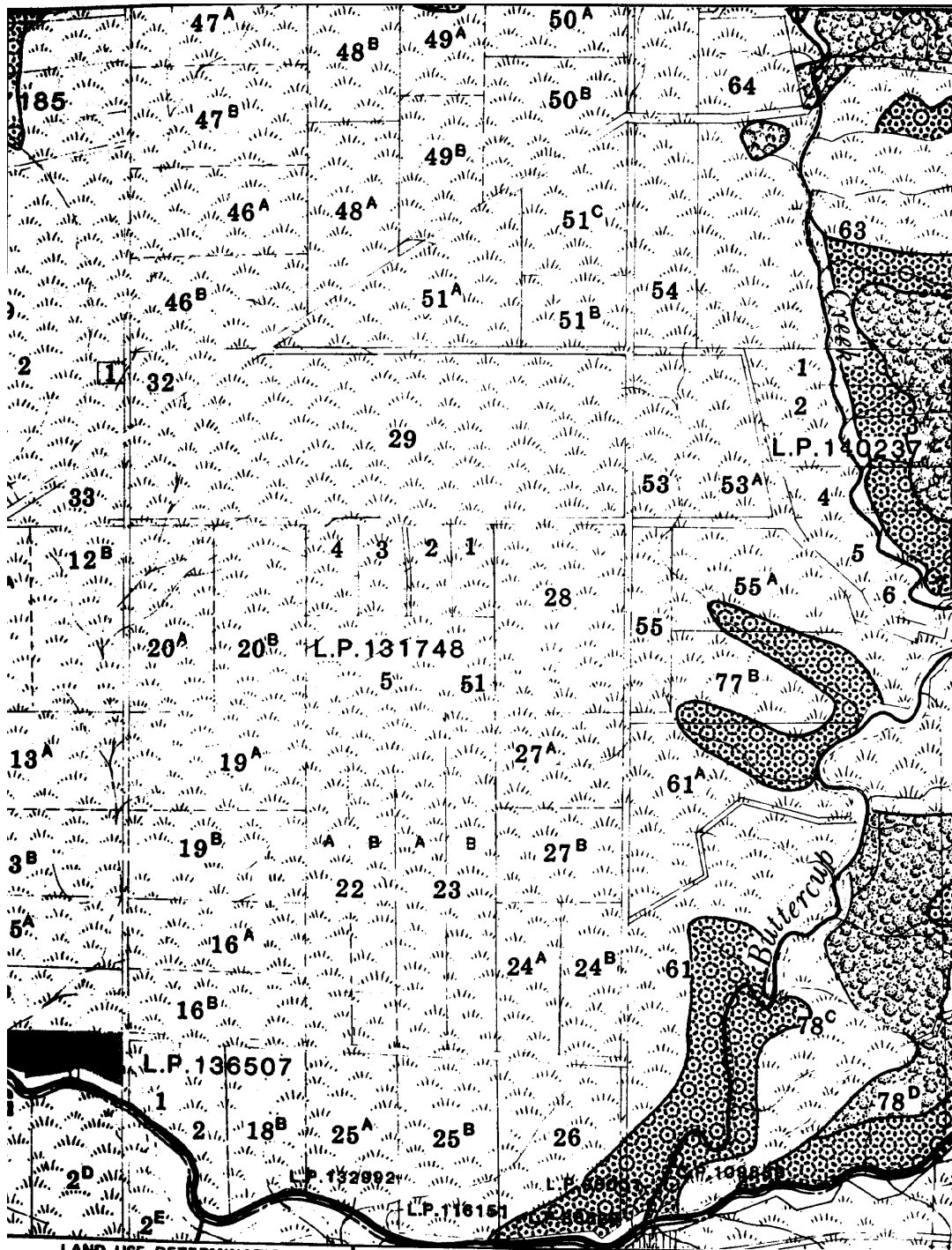
LAND USE DETERMINATION
 UPPER DELATITE (MANSFIELD)
 WATER SUPPLY CATCHMENT

S-1335
 SHEET 6
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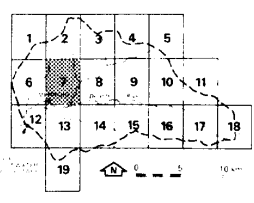
LAND USE DETERMINATION
UPPER DELATITE (MANSFIELD)
 WATER SUPPLY CATCHMENT

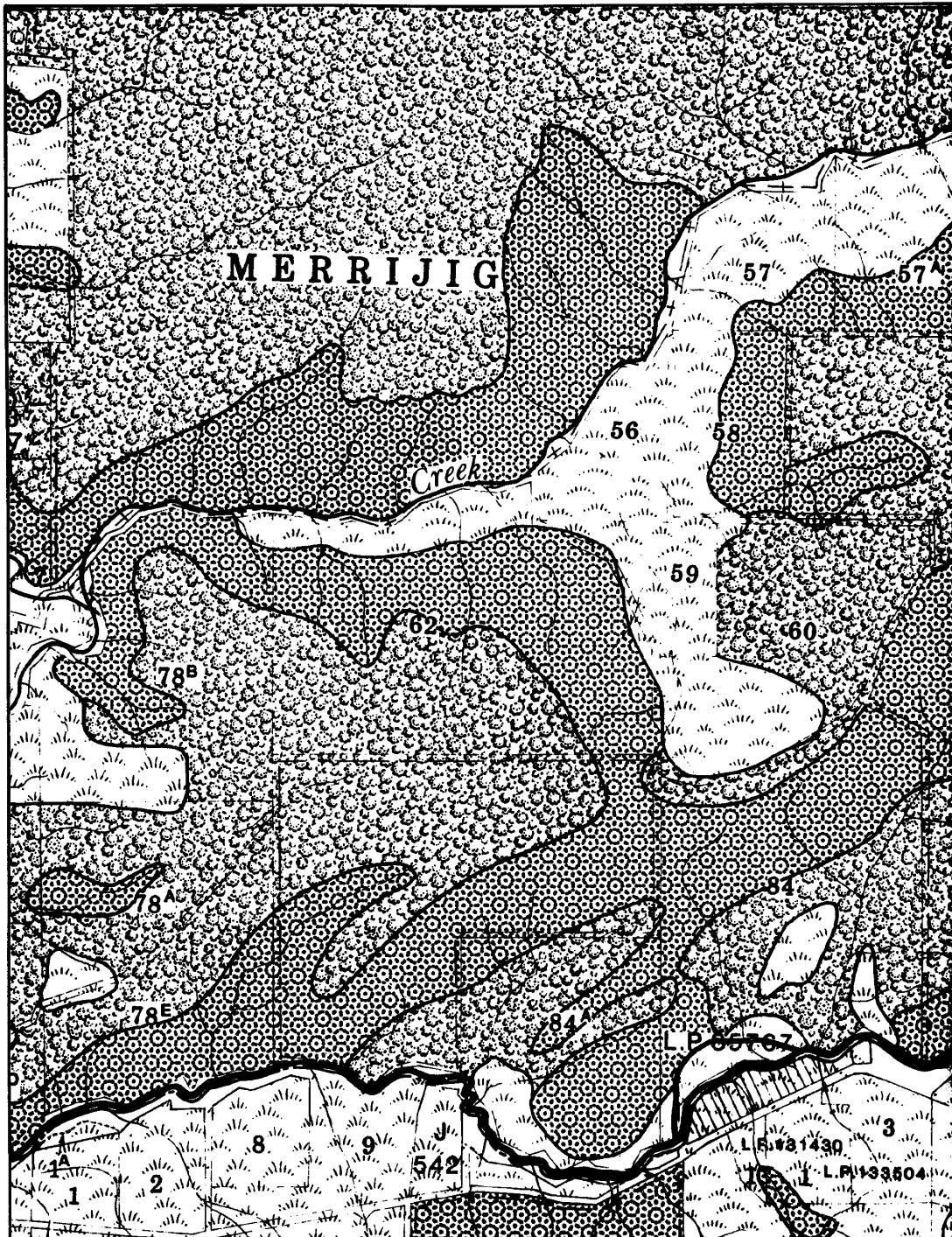
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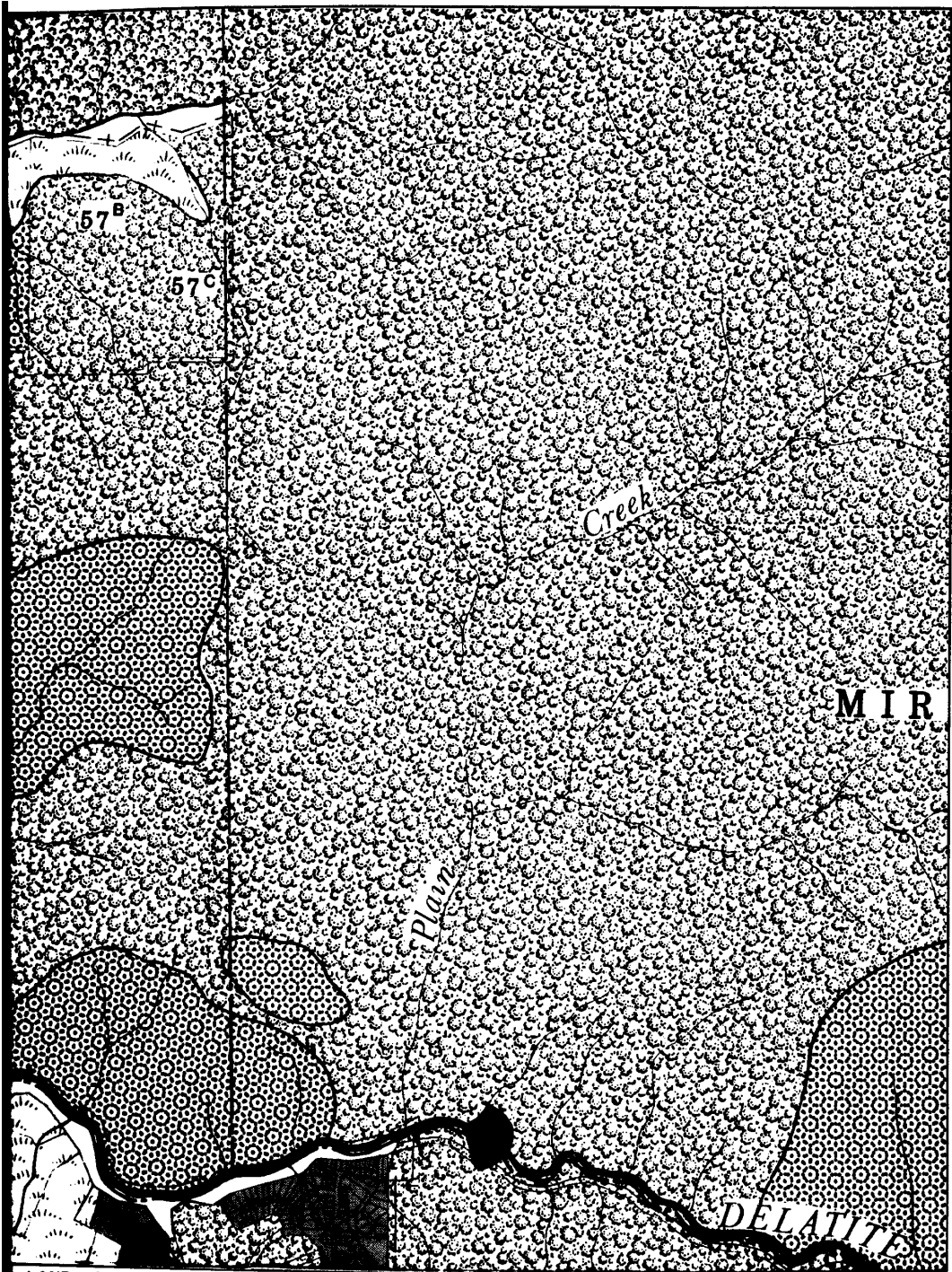
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KEY TO ADJOINING MAPS





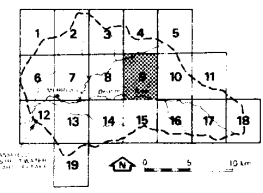
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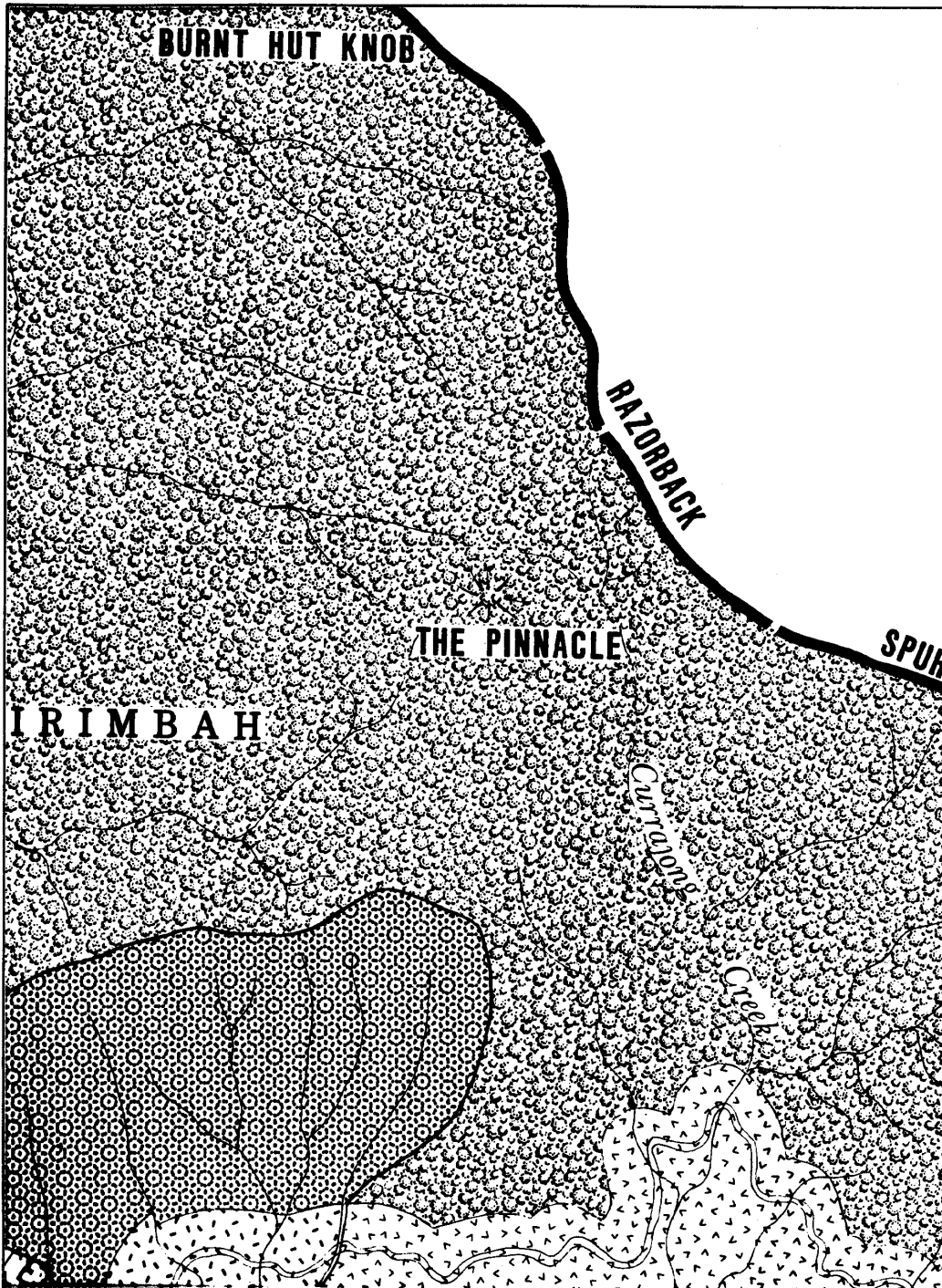
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 WATER SUPPLY CATCHMENT

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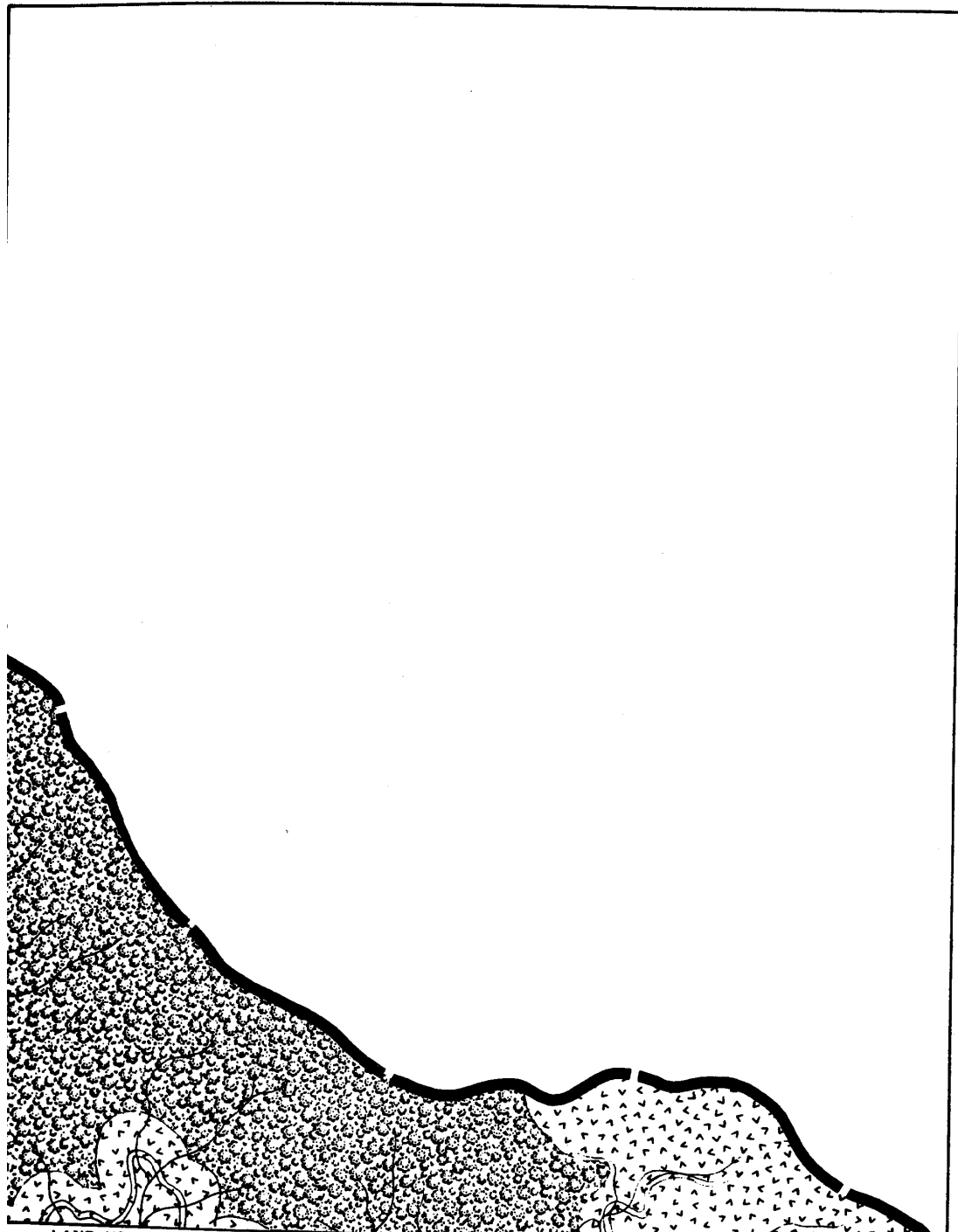
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| | Category 1c | | Category 3 | | Category 6b |
| | Category 1d | | Category 4 | | |



LAND USE DETERMINATION		S-1335			KEY TO ADJOINING MAP SHEETS
UPPER DELATITE (MANSFIELD)		SHEET 10	 1:25 000		
WATER SUPPLY CATCHMENT					
Category 1a Category 1b Category 1c Category 1d	Category 1e Category 2 Category 3 Category 4	Category 5 Category 6a Category 6b			

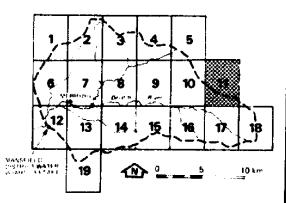


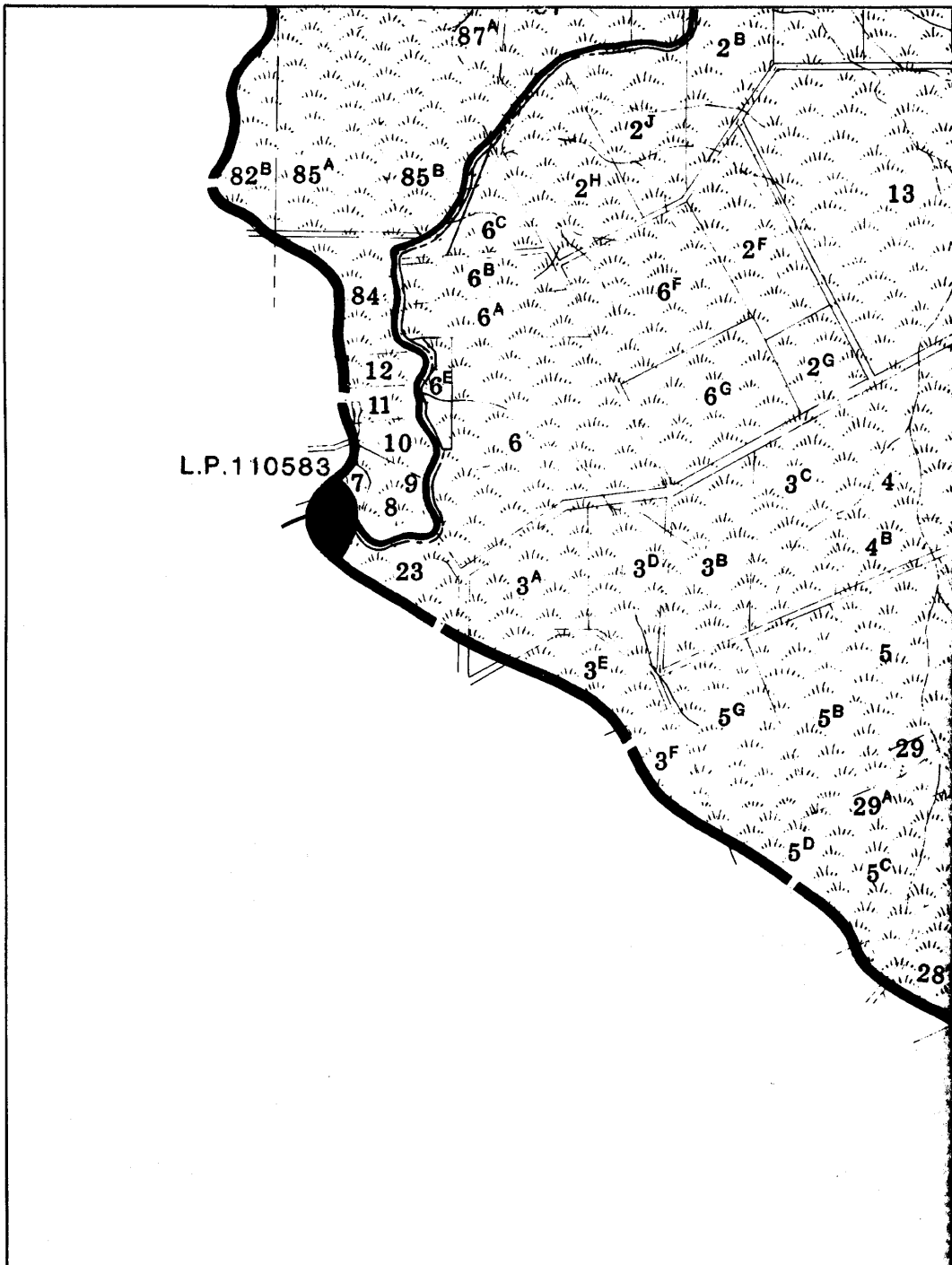
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 WATER SUPPLY CATCHMENT

S-1335
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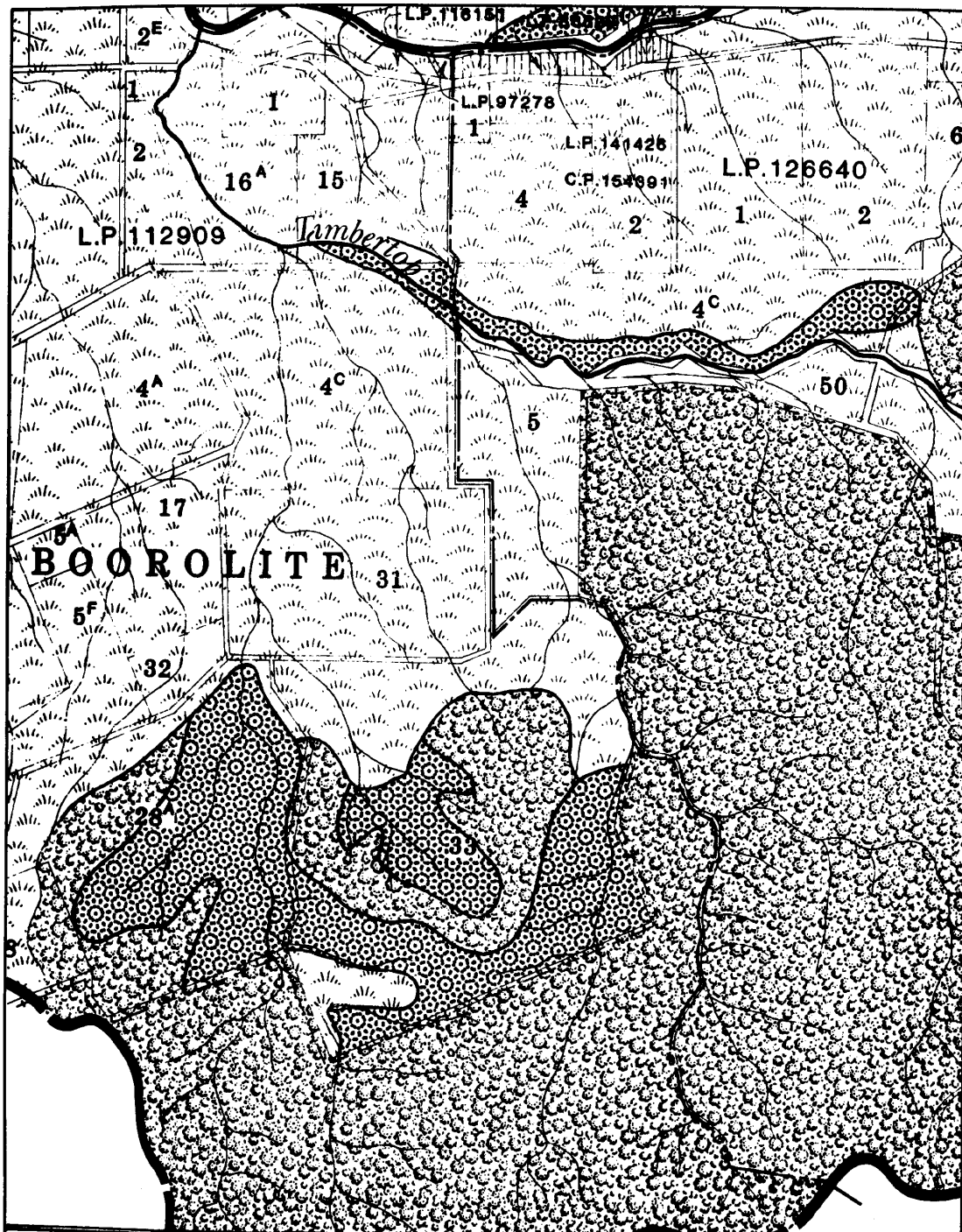
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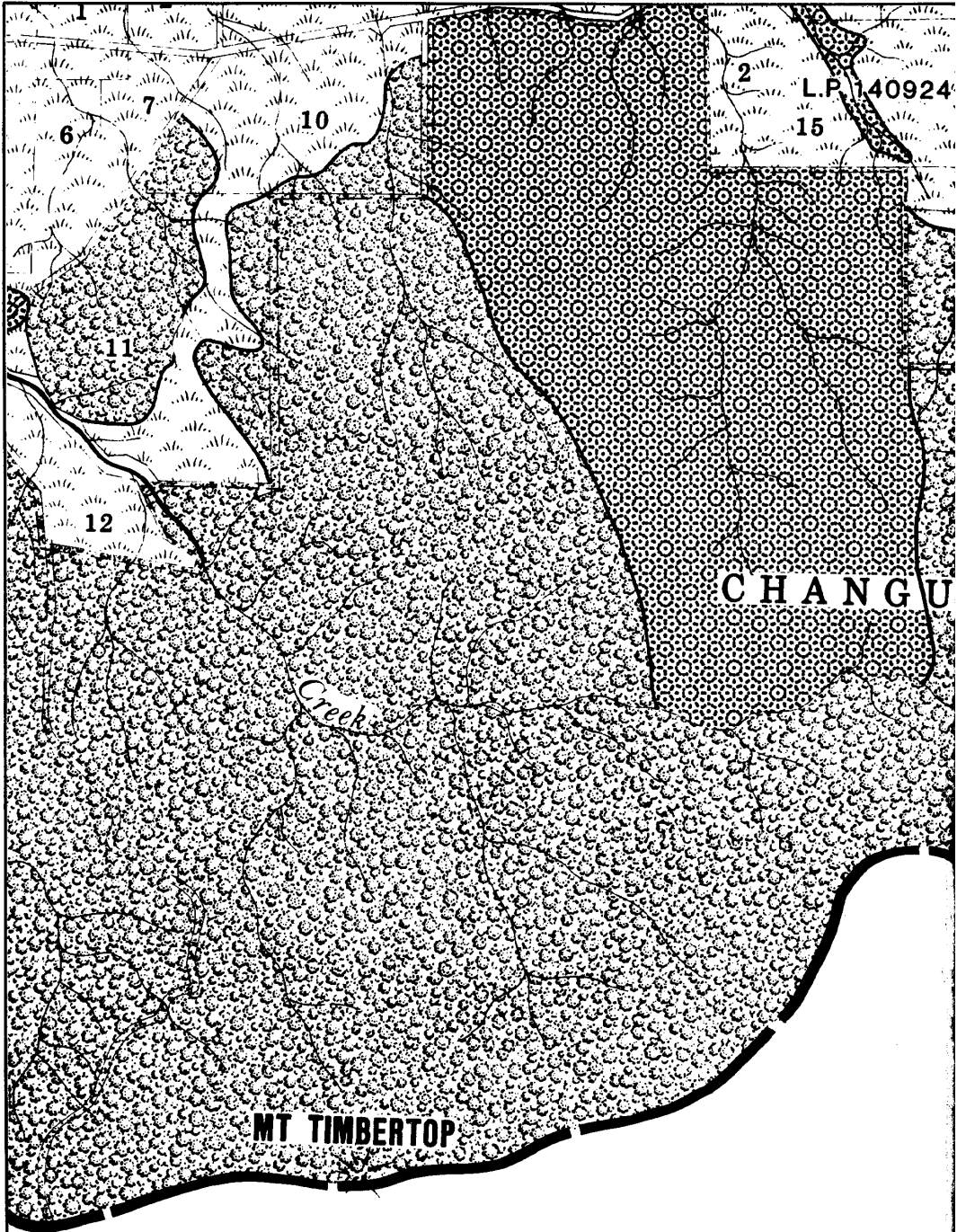




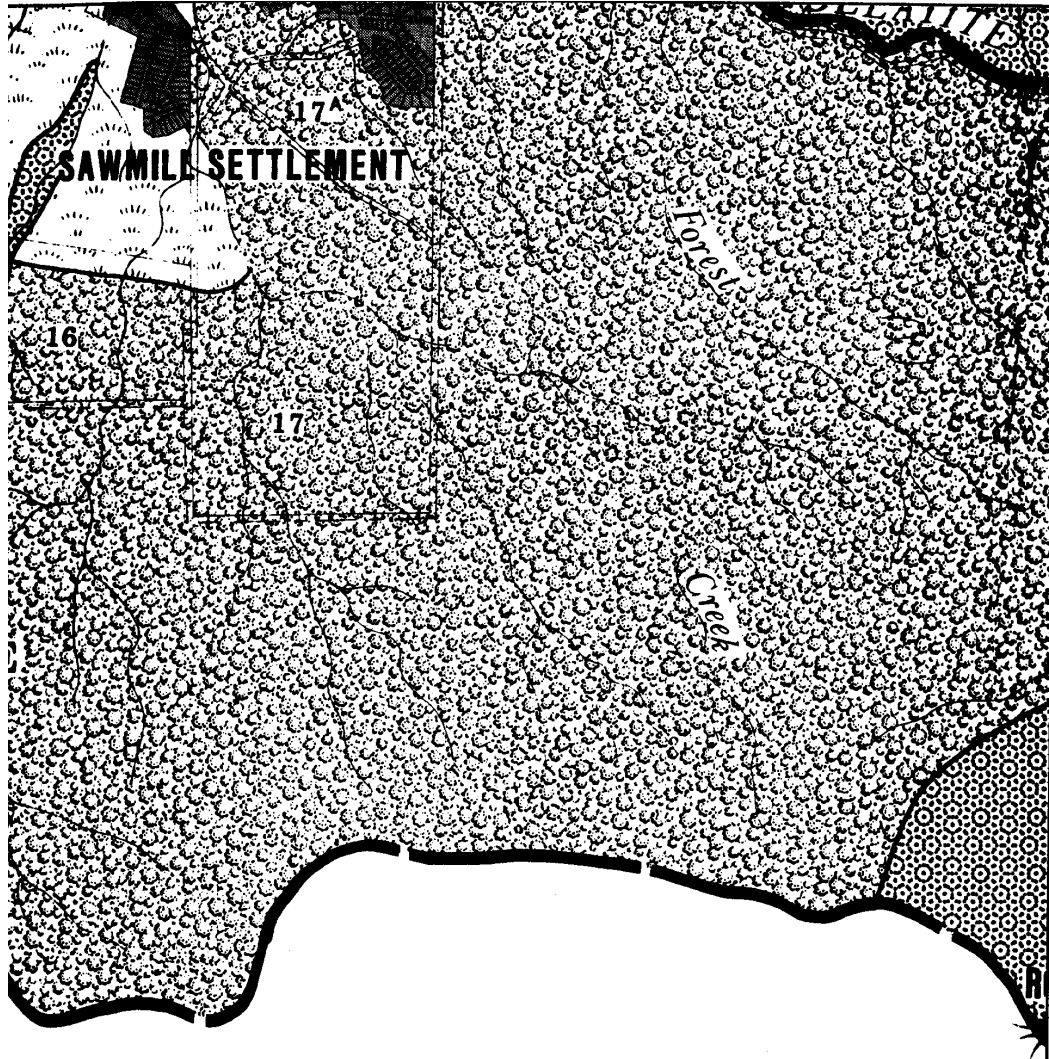
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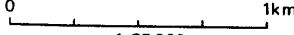











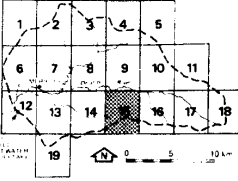


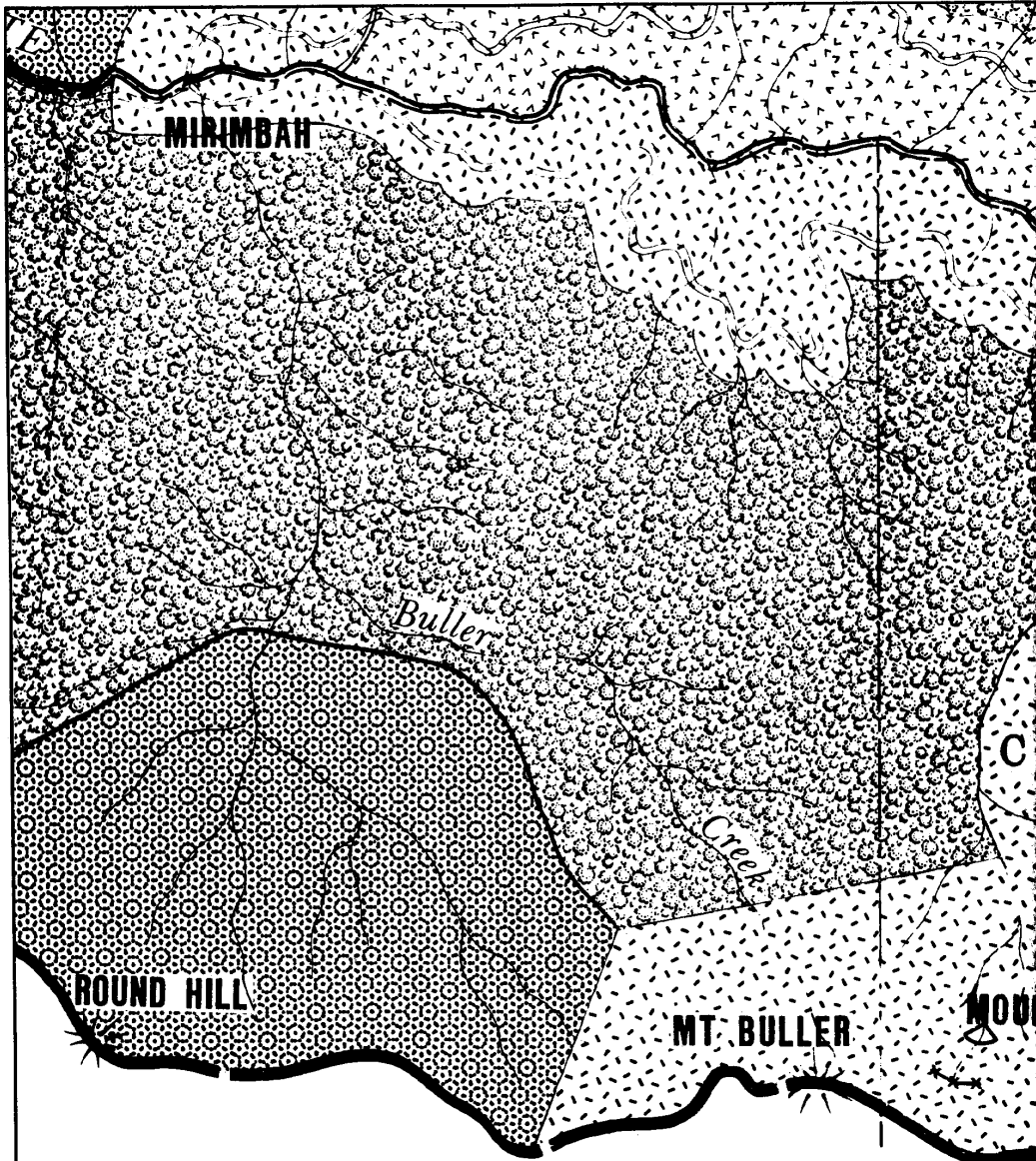
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LAND USE DETERMINATION		S-1335			KEY TO ADJOINING MAPS
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Category 1c	Category 3	Category 6b			
Category 1d	Category 4				

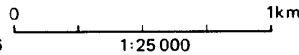


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LAND USE DETERMINATION
 UPPER DELATITE (MANSFIELD)
 WATER SUPPLY CATCHMENT

S-1335

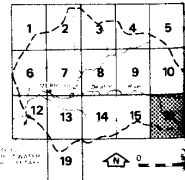


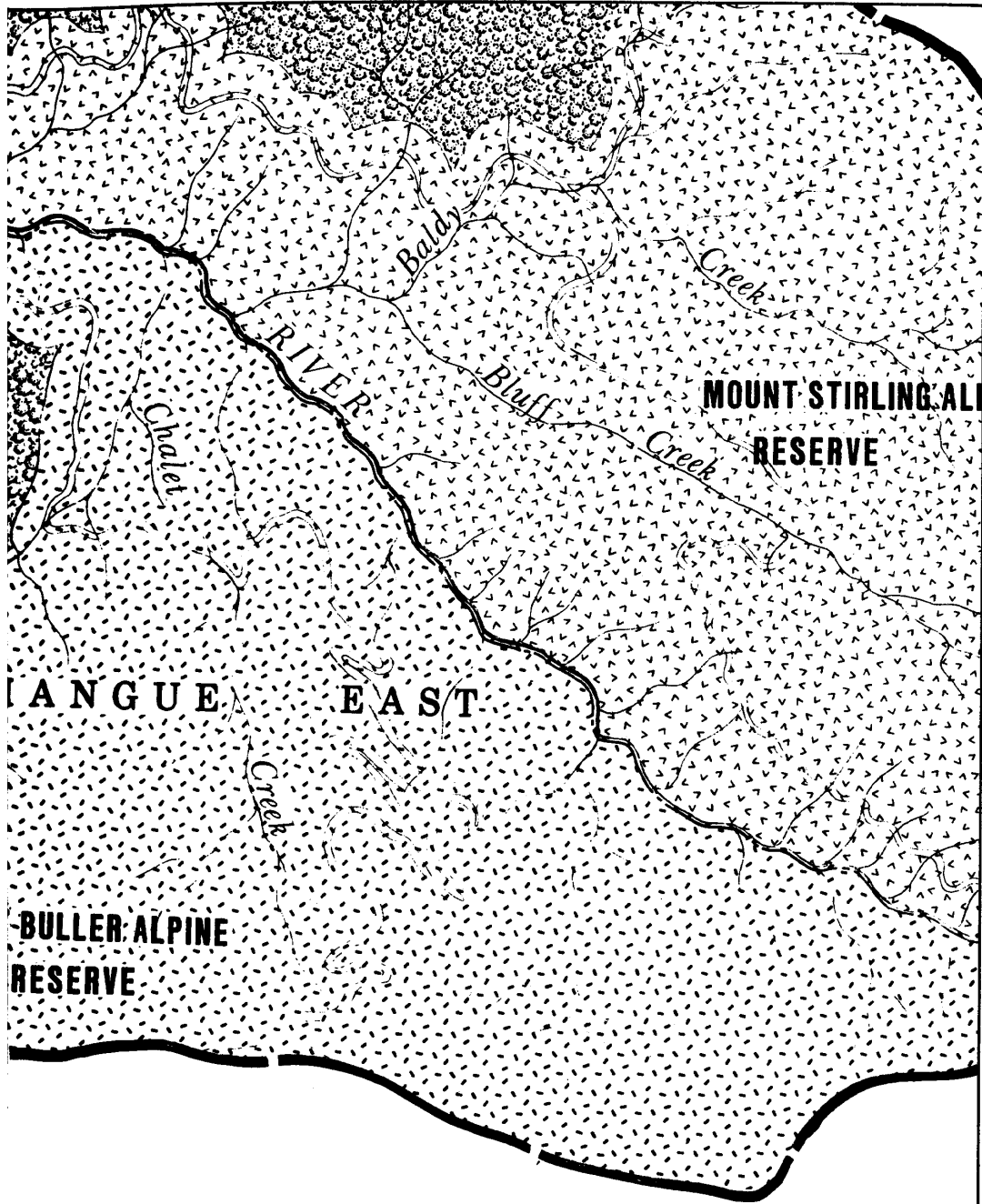
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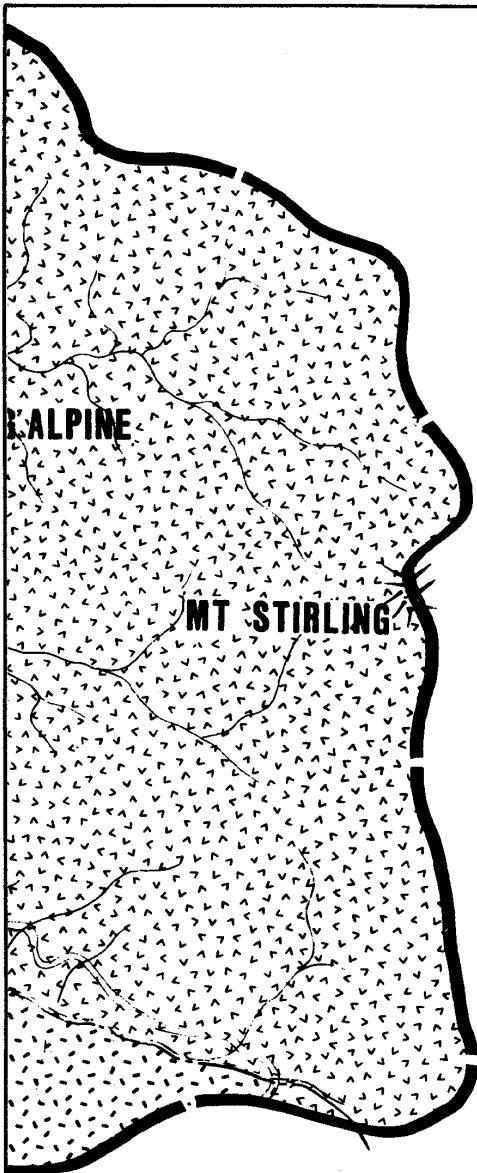
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LAND USE DETERMINATION		S-1335		
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Category 1a Category 1b Category 1c Category 1d	Category 1e Category 2 Category 3 Category 4	Category 5 Category 6a Category 6b	KEY TO ADJOINING MAPS 	



LAND USE DETERMINATION
 UPPER DELATITE (MANSFIELD)
 WATER SUPPLY CATCHMENT

S-1335



0 1km

SHEET 18

1:25 000

KEY TO ADJOINING



Category 1a



Category 1e



Category 5



Category 1b



Category 2



Category 6a



Category 1c



Category 3



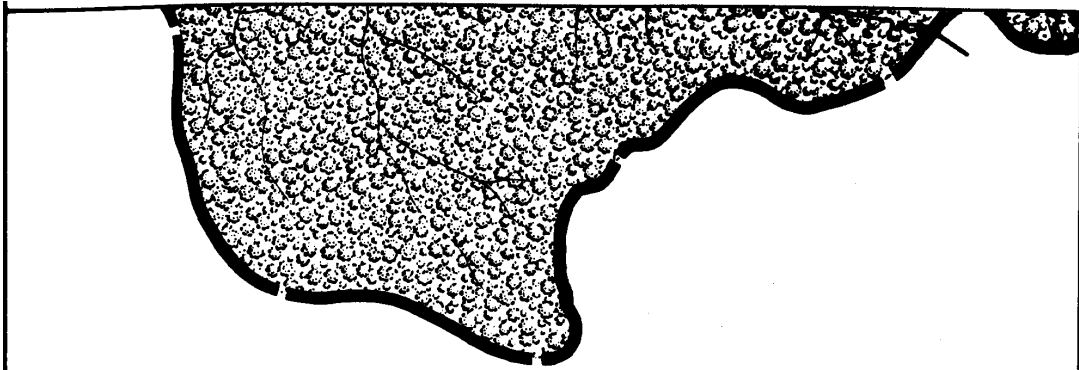
Category 6b



Category 1d



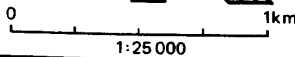
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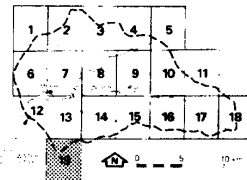
LAND USE DETERMINATION
 UPPER DELATITE (MANSFIELD)
 WATER SUPPLY CATCHMENT

S-1335

SHEET 19



KEY TO ADJOINING MAPS



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| | Category 1d | | Category 4 | | |

2. INTRODUCTION

The Delatite River is a major tributary of the Goulburn River which drains into Lake Eildon, a large irrigation storage of 3,319,100 ML capacity on the northern slopes of the Great Dividing Range (Figure 2.1).

The Delatite River also provides domestic water from Mansfield (population: 2,000), Merrijig and Mirimbah/Sawmill Settlement (permanent population: less than 200, seasonal winter population: approximately 2,000). The Mt. Buller Alpine Resort draws from Boggy Creek, a tributary of the Delatite River at higher elevation.

This report is concerned with the Upper Delatite River (Mansfield) Water Supply Catchment which supplies water to Mansfield and including the sub-catchments which supply these other settlements.

The Catchment has an area of approximately 240 sq km, extending due westwards from Mt. Stirling for 30 km to the offtake on the Delatite River. Physiography varies from rugged mountain slopes and small alpine plains to low rolling hills and narrow alluvial plains. Some 70% of the catchment is timbered, with the remainder under native, semi-improved and improved pasture.

Land use on both freehold and public land is changing rapidly. Public land, once used for timber production, grazing and limited recreation, is being developed and used for intensive and extensive recreation (major ski resort development, and bushwalking/horse safari/adventure driving respectively).

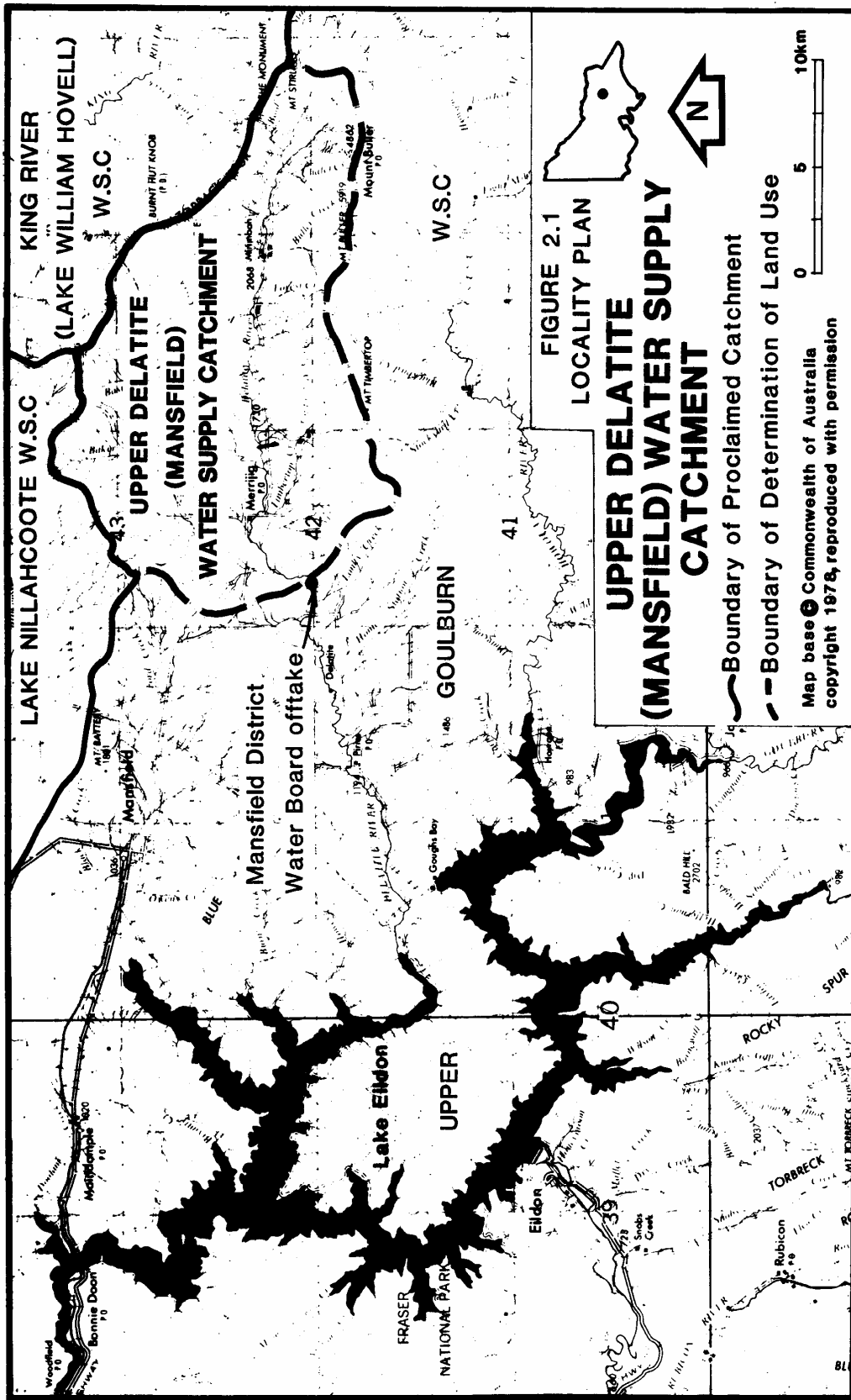
Freehold land is undergoing a change from conventional farming enterprises to development for urban and rural residential use.

This intensification of use places river water quality at risk and requires the adoption of specific management techniques for the protection of the water supply catchment.

The Department of Planning and Environment is assisting the Shire of Mansfield in updating planning controls to provide for the orderly development of land throughout the Shire.

The Authority has noted with concern some of the changes in land use taking place in the catchment, and has prepared a Land Use Determination to guide the existing and future use and management of catchment lands. This is aimed at minimising conflicts between land development and land use on one hand and the water supply on the other. The Determination is intended to complement rather than duplicate Statutory Planning controls and should be seen in this context.

Figure 2.1 Locality Plan



3. WATER SUPPLY HAZARDS

Three aspects of water supply are of concern: quality of water harvested, quantity of water harvested, and seasonal availability of water (perenniality of flow).

3.1 Water Quality

The quality of water for domestic use may be affected by the accession to the stream system of; soil particles (sediment/turbidity); various nutrients (nitrates, phosphates); and pesticides, heavy metals, organic colloids or colour. Quality may also be affected by the growth of algae or other plants introducing unpleasant tastes or odours, or by contamination with pathogenic bacteria or viruses from human or animal contact or from various human or animal wastes.

Increased turbidity also necessitates greater care being taken during the treatment of water by chlorination.

Residential Use

Uncontrolled development of land for more intensive residential use could become the most significant hazard to water quality in the catchment. The failure of on-site effluent treatment and disposal systems, the inappropriate placement of stream crossings, the inadequate control and disposal of urban run-off, and soil erosion from construction sites and roads are all potential sources of contamination.

Urban type residential use is an intensive use of the land which can result in production of large volumes of septic wastewaters and urban run-off water, and substantial areas of earth and vegetation disturbance. All of these factors are known to predispose an area to the production of a low quality run-off water and if the development is located in close proximity to the river there is little scope for natural clarification (physical, chemical or biological) of sediment before run-off water enters the stream system.

There is a pressing need for the development and use of land in this catchment to be matched both to the capability of the land to sustain use and to the needs of water production. This is exemplified by a number of existing subdivisions presently undergoing development which, because of their proximity to the Delatite River, are potentially a major source of pollution in the catchment.

In the interests of sound water supply catchment management, it is essential that existing and future village developments be sewered and that future developments be located away from sensitive stream environs and drainage lines.

Stock

Uncontrolled access by stock to the stream system is a lesser but significant cause for concern. Stock may initiate or exacerbate stream bank erosion, and there is some evidence that stock with free access to streams tend to defecate/urinate disproportionately in and around the stream. Both may adversely affect water quality, particularly when close to the offtake where there is little opportunity for dilution or attenuation to occur before diversion into the supply system.

The control of access through fencing out of the sensitive areas of the stream system may be warranted to protect the water supply.

Persistent overgrazing of pastures or forest areas exposes the earth to erosion and detached sediment reaching the stream system will result in deterioration of water quality. Deterioration of quality may be due to the accession of soil particles (sediment/turbidity) or due to other substances (such as nutrients, bacteria or heavy metals) being carried by the soil particles.

Timber Production

Forestry activities pose a significant hazard to water quality if appropriate surface management and sediment control techniques are not used.

Operations typically involve a number of activities which may pose specific hazards to water quality: extensive disturbance or exposure of soil for extended periods, an extensive road and track network, and many stream crossings.

A significant proportion of the catchment has been allocated to hardwood production and will therefore be subject to periodic disturbance. Bared or disturbed earth is more vulnerable to erosion than is well vegetated earth and the road network may, if not properly designed, drained and constructed, serve as channels to direct low quality runoff water into the stream system. Harvesting operations initially lead to a greater infrastructure of permanent roading for fire suppression purposes. Uncontrolled use of these roads by off-road vehicles intensifies the hazard to water quality.

Sub-alpine Activities

The sub-alpine climate poses specific and significant difficulties for the development and use of land within the Alpine Reserves. At various times, unacceptable levels of deterioration of water quality are likely to occur. Specific management techniques are therefore essential to contain adverse on- and off-site effects.

Ski resort development and operation is an intensive use of a relatively small area of land under adverse climatic conditions. The development and maintenance of access roads and ski slopes involves extensive earth disturbance. The onset of adverse climatic conditions limits the period suitable for the establishment of protective vegetative cover so that the timing of operations is a critical factor. The daily operations of a resort generate copious quantities of human wastes in an environment ill-suited to the treatment and safe disposal of such wastes. The combination of these factors forms such a major hazard to water quality that wastewaters from the Mt. Buller Alpine Village are discharged outside of the catchment.

Management of the development and operation of a resort in an alpine environment requires a higher degree of forward planning and day-to-day supervision to contain adverse on- and off-site effects within acceptable levels than does development in other areas at lower altitudes of the catchment.

Seasonal grazing at higher elevations may contribute to water quality problems in localised sites (such as springs and moss beds) however construction of small stock dams away from the stream system has reduced the problem.

Landslips are known to occur in the sub-alpine areas as a result of tree clearing or undercutting of steep slopes during road construction and will contribute additional sediment and turbidity to the stream system. Particular care is needed in the planning stage of road construction to avoid landslip prone areas where possible and to design appropriate stabilisation measures where such areas cannot be avoided.

3.2 Water Quantity

Water quantity is more a function of total precipitation (rainfall and snowfall) than land use, however the total yield and perenniality of flow will be affected by modification or depletion of the catchment's vegetation.

Extensive modification through drainage or filling of the source areas (bogs, soaks and springs) high in the catchment is likely to affect the seasonal flow pattern, resulting in higher peak flows in late winter and spring during snow-melt. Such increased peak flows would result in reduced seasonal flow over summer and may result in stream bank erosion and subsequent reductions in water quality.

The water supply catchment for Mt. Buller Alpine Village (Boggy Creek) is facing a particular risk. Summer flow depends almost entirely on natural water release from a large moss bed. Two ski tows operate within the catchment and any damage to the moss bed, either through slope grooming or maintenance or by further development is likely to be reflected in reduced summer flows over a period when the supply system is already barely adequate.

There is substantial evidence² that the regeneration following harvesting by clear-felling of ash forests in broadly similar environments has resulted in a significant long term reduction in annual yield. However, while the effect of logging of the forests in the Delatite catchment on annual runoff is uncertain, any reduction may be important during periods of low flow.

² MELBOURNE AND METROPOLITAN BOARD OF WORKS, 1980. Summary of Technical Conclusions to 1979

Current investigations being con-ordinated by the Experimental Catchment Consultative Committee may resolve the issue. Any reduction in annual or seasonal flows will accentuate the requirement for some form of additional water storage.

4. DETAILS OF WATER SUPPLY

4.1 Water Yield

The Delatite River is not gauged within the catchment to the Mansfield offtake. The closest gauging point is at Tonga Bridge, some 8 km downstream of the Mansfield offtake. This gauging station has a catchment area some 50% larger (totalling 368 sq km). Readings of river level have been made since 1947.

The mean annual flow gauged at this point since 1947 is 129,000 ML, with minimum and maximum record annual flows of 33,700 ML in 1967/68 and 300,000 ML in 1955/56 respectively³. Low flows occur during the period January to April and high flows from July to October (see Figure 4.1). The estimated mean annual flow of the Delatite River at Mirimbah is 26,000 ML (from a catchment of 38 sq km), however this is regarded as an underestimation¹.

Approved diversions from the Delatite River in the catchment total over 300 ML per annum - 220 ML for irrigation and 80 ML for domestic consumption.

Even during years of low flow, the total annual flow is far in excess of requirements in Mansfield and by private diverters. While seasonal shortages are experienced in Mansfield, these are a function of limited storage capacity rather than insufficient river flow.

4.2 Water Quality

Table 4.1 indicates that there is a general decline in water quality as the river flows down the catchment, consistent with the expectation that the greater the development within the catchment the greater will be the contribution to deterioration in water quality. Both electrical conductivity (EC) and turbidity readings are higher in the downstream portion of the catchment, indicating a progressive decline in water quality down the river. It is likely that diffuse rather than point sources are the major contributors to the decline in water quality.

Limited stream fauna sampling in the vicinity of Mt. Stirling⁴ indicates some degradation of sampled streams has occurred. This has been tentatively attributed to sediment generated by logging operations. Other streams not sampled were expected to show some changes due to many decades of varying levels of direct disturbance, sediment, accession, nutrient enrichment and reduced vegetative cover in the catchment⁴.

Water sampling in Falls Creek (Mt. Stirling) indicated good quality water during periods of low flow, with some reduction in quality expected at higher flows.

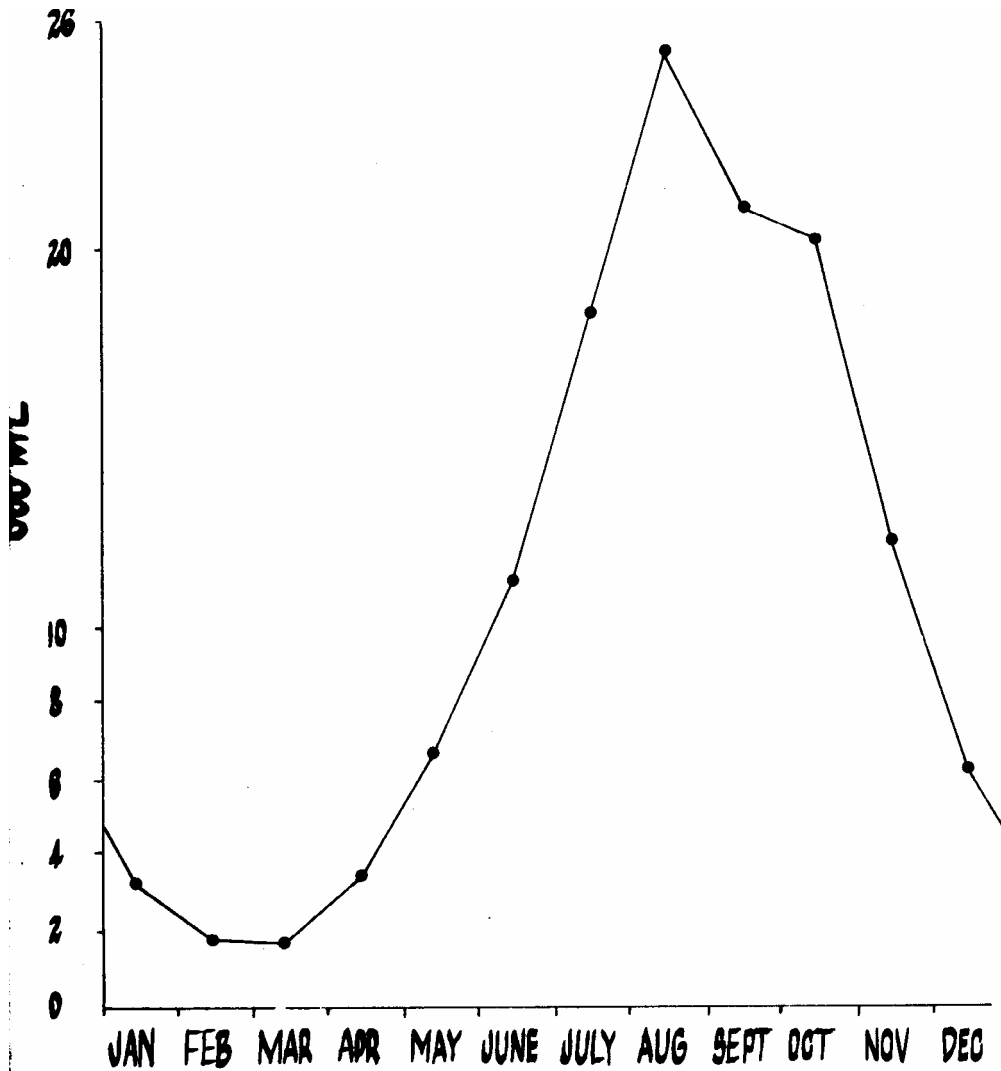
Sampling is continuing in order to establish baseline data. This will be used in evaluation of the possible effects of the Mt. Stirling development on the stream system, and to indicate the possible need for changes in sediment control and other aspects of management practices as warranted by the requirements of stream protection.

While the hazards to water quality in this catchment are many (section 3.1), bacterial contamination is the only quality parameter currently of concern. Water diverted from the river for domestic consumption should be chlorinated due to unacceptable levels of *Escherichia coli*³ (indicating possible contamination by human wastes). The State Rivers and Water Supply Commission considered that recorded *E. coli* levels, while not excessive of current standards (see Table 4.1) for water for domestic consumption.

³ STATE RIVERS AND WATER SUPPLY COMMISSION, 1983. Delatite River Catchment Water Resource Assessment.

⁴ LODER AND BAYLY, 1983. Mount Stirling Alpine Resort Review of Development Proposals and Environmental Effects Statement and the Assessment by the Minister for Planning and Environment.

Figure 4.1 - Delatite River at Tonga Bridge - Average Recorded Monthly flow (1947-81)



Source: State Rivers and Water Supply Commission, 1983
Delatite River Catchment
Water Resource Assessment

Table 4.1 - Water Quality - Delatite

Parameter	Falls Creek at Telephone Box Junction			Delatite River 0.5 km U/S of Mirimbah			Delatite River at Merrilig			Delatite River at Tonge Bridge			Drinking Water Quality ¹				
	N ⁺	Min.	Mean	N ⁺	Min.	Mean	N ⁺	Min.	Mean	N ⁺	Min.	Mean	Max.	90%*	Current objectives	Desirable long term levels	
Flow (ML/day)																	
E.C. (uS/cm)	6	20	26	44	6	18	25	30	38	47	66	36	88	380	120	2500	830
Turbidity (NTU)	6	<1	1.1	1.9	6	<1	1.5	3.6	6	1.6	2.1	2.6	4.3	13	25	25	5
Temperature (°C)	6	1.5	4.8	8.0	6	2.8	6.2	11.0	6	2.5	7.9	15.0	26.0	22.5			
pH																	
Dissolved oxygen (mg/L)																	
Total Phosphorus (mg/L)	6	.007	.010	.018	5	.009	.013	.017	5	.011	.017	.025					
E. coli (org/100 ml)	8	18	47	84	8	2	30	112	8	18	147	420					

¹ No. of samples recorded Desirable Quality For Drinking Water In Australia, 1980. Department of Health, National Health & Medical Research Council, Australian Water Resources Council.

* 90th percentile, i.e. 90% of readings > figure given

SOURCE: State Rivers and Water Supply Commission, 1983. Delatite River Catchment Water Resource Assessment.

90 % of samples less than 2

0

2

<6.5,

7.0-

8.5

>9.2

Other parameters - electrical conductivity and turbidity levels are all below maximum desirable levels (Table 4.1), while dissolved oxygen and total phosphorus levels are considered acceptable⁵.

4.3 Water Supply Systems

4.3.1 Mansfield

Water is diverted from the Delatite River at a low level weir, some 15 km south east of Mansfield, near Hearn's Land, Booroolite. Water is gravitated via a pipeline to a 50 ML service basin on the outskirts of Mansfield.

Current annual usage by the Mansfield District Water Board is 660 ML, with a diversion capacity limited to 3 ML/day by the diversion system. The annual use is expected to reach 900 ML by the year 2,000¹.

The supply system is barely adequate to meet current demands in summer due to low summer flow and limited diversion and storage capacity. Peak daily demand over summer exceeds the capacity of the system and the limited storage capacity of the system would be rapidly exhausted if restrictions on water use were not imposed. Augmentation of the system is being investigated.

Regular testing of water quality indicates the need for routine chlorination before reticulation due to unacceptable bacterial levels in the raw river water. There is also some detention of water between diversion and reticulation allowing limited sedimentation and purification, however little opportunity for this occurs during periods of peak demand over summer.

4.3.2 Merrijig

Merrijig has no reticulated water supply system. Current needs are met by separate diversions from the Delatite River under private or domestic/commercial permits.

Approved diversions total some 10 ML annually.

4.3.3 Mirimbah/Sawmill Settlement

Sawmill Settlement has been supplied by information diversions from Forest Creek for many years. Recently, moves were made to have this supply formally administered.

The major diversion gravitates water from Forest Creek to holding tanks south of Sawmill Settlement. The system supplies some ten residences and has the capacity to service many more. Several other schemes supply a smaller number of allotments. Intermittent testing indicates generally high quality water.

Plans for the water supply for Sawmill Settlement (as proposed by the Mansfield District Water Board) include diversion of water from the Delatite River just upstream of Sawmill Settlement, and pumping to holding tanks to the south. Long term plans may include a large catchment-fed storage on an adjacent creek, supplemented as necessary from the Delatite River.

4.3.4 Mt. Buller Alpine Village

The Mt. Buller Alpine Village obtains its water supply from a small (60 ha) catchment at the top of Boggy Creek. The catchment includes a large moss bed which maintains a high degree of perenniality of flow.

Water is pumped from an offtake on the creek to a reservoir higher on the mountain prior to reticulation. There is also an open channel in the catchment which intercepts some run-off and diverts it directly into the reservoir.

Current peak winter use is approximately 0.4 ML/day, and peak summer use approximately 0.04 ML/day. The water is tested for bacterial contamination monthly over winter and every three months at other times of the year. Records show consistent low levels of bacteria. The water is not treated (other than by limited detention).

The supply system is insufficient for the demand over the late summer period when the flow is at its lowest.

⁵ State Rivers and Water Supply Commission, 1983. Delatite River Catchment Water Resource Assessment

5. BIOPHYSIOGRAPHY

5.1 *Physiography*

The Delatite River drains part of the Eastern Highlands massif on the north western face of the Great Dividing Range. The Upper Delatite (Mansfield) Water Supply Catchment drains an area extending west from Mt. Buller and Mt. Stirling at elevation of 1,805 and 1,745 m respectively, to a low level weir and offtake (400 m elevation) on the Delatite River.

The Timbertop Fault/monocline bisects the catchment at approximately 900 m elevation, running in a NNE/SSW direction (see Figure 5.1).

The western lowlands consist of that part of the catchment to the west of the faultline. These are initially cuesta-form with steep strike faces and gentler dip slopes, becoming more subdued further west where low rounded hills, river flats and terraces predominate. The Glenroy Hills mark the north western boundary of the catchment.

East of the faultline, two broad climatic zones can be identified. The eastern uplands are subject to a sub-alpine climate including extended periods of snow cover, while the central area is subject to a cool temperate climate within only intermittent snow cover.

The eastern uplands comprise the highest portion of the catchment (Mt. Buller, Mt. Stirling and associated peaks) typified by sharp ridges and long steep slopes down to an incised drainage system, and some dissected lower crests.

These eastern uplands gradually give way to the central area as the elevation drops to the west. The physiography here is similar to that of the eastern uplands but, as the elevation falls, the slopes shorten to produce a moderately steep ridge and ravine land surface.

The western lowlands, which include much of the freehold land, are more complex than much of the rest of the catchment, more complex in terms of physiography and in terms of catchment management. The relative levels of detail relating to the public and to the freehold land contained in this report reflects this greater complexity.

5.2 *Geology*

The catchment has a complex geology. It contains a wide range of rock ages and rock types and has a long history of geologic movement (see Figure 5.1). Extensive erosion and deposition have occurred within the catchment.

The eastern uplands and the central area are the result of numerous uplifts and deformations from mid-Devonian times which have resulted in the exposure of granitic outcrops such as those at Mirimbah and Mt. Stirling, together with their associated metamorphic aureoles. Minor Tertiary basalt cappings occur near Mt. Buller. The granites give way to late Devonian volcanics around Mt. Timbertop to the west.

Older sedimentary rocks (Cambrian and Ordovician) which have been uplifted, shattered and exposed to weathering also occur around Mt. Timbertop.

West of Mt. Timbertop, the Devonian volcanic, sedimentary and granitic terrain of the central area gives way to the red Carboniferous mudstones and sandstones of the western lowlands. These are steeply tilted at this interface, resulting in the development of a scarp and dip topography. Further west and towards the river, the tilt of the sedimentary rock decreases rapidly, producing low rounded but geologically-controlled topography which flattens out nearer the river. Folding of the Carboniferous sediments has produced an anticline (Glenroy Hills) which forms the north western boundary of the catchment.

5.3 *Soils*

Soil development may vary with parent material, climate, topography (especially slope, position and aspect), biological activity and relative time. In this catchment, the parent material is generally the dominant factor, but is less significant in the eastern part of the Delatite catchment where strong climatic influences are also evident.

Soil profile development spans the range from shallow organic sandy loam soils in the sub-alpine region to deep duplex clay soils on the lower parts of the catchment.

Soils of the eastern uplands are commonly shallow and have high levels of organic matter with a coarse mineral fraction (sandy loams). They are often friable, have a fine crumb structure and low bulk density, and, while of moderate permeability, are highly erodible once disturbed.

Soils in the Timbertop area, derived from Upper Devonian granitic rock are generally moderately deep, well drained and massive, coarse in texture, acidic, and moderately to highly erodible. Shallow variants occur on the steeper slopes. These are acidic mineral soils, moderately - to strongly structured, and highly erodible.

Red and brown gradational soils have developed on the shattered older Cambrian and Ordovician sediments in the Timbertop area. They are acidic, moderately-structured and somewhat friable, and of heavier texture than the nearby granitic soils. They exhibit hard-setting A2 horizons and stony B horizons, and are of moderate permeability and moderate erodibility.

Soils derived from colluvial processes are generally deep gritty uniform to gradational soils, becoming yellow or red duplex soils on the lower slopes.

Immediately west of the Timbertop Fault/monocline, there are generally shallow, stony and friable, moderately - to strongly-structured red or brown gradational soils of moderate permeability and erodibility. Soils on the steeper slopes are generally shallower and stonier.

Further west, where the land is more gently sloping and the climate drier, soils are generally more strongly developed, producing deeper gradational and deep yellow and red duplex soils with hard-setting A2 horizons, moderate to poor drainage and moderate shrink-swell potential. These soils are moderately erodible. However the low permeability may place some limitations on wastewater disposal by ground absorption that will require a larger than normal disposal area.

Shallow dark uniform clays of low permeability, moderate erodibility and moderate to high shrink-swell potential. These soils are moderately erodible. However the low permeability may place some limitations on wastewater disposal by ground absorption that will require a larger than normal disposal area.

Shallow dark uniform clays of low permeability, moderate erodibility and moderate to high shrink-swell potential occur sporadically on the gentle dip slopes.

There is a range of soils in the main drainage lines and terraces, varying from sandy soils to dark cracking clays with poor drainage, variable shrink-swell characteristics and highly erodible once disturbed or bared. Rocky drainage lines with a minimum of soil development may also occur sporadically throughout the eastern lowlands.

5.4 Climate

The majority of the catchment is subject to a cool temperate climate with the upper reaches experiencing sub-alpine conditions.

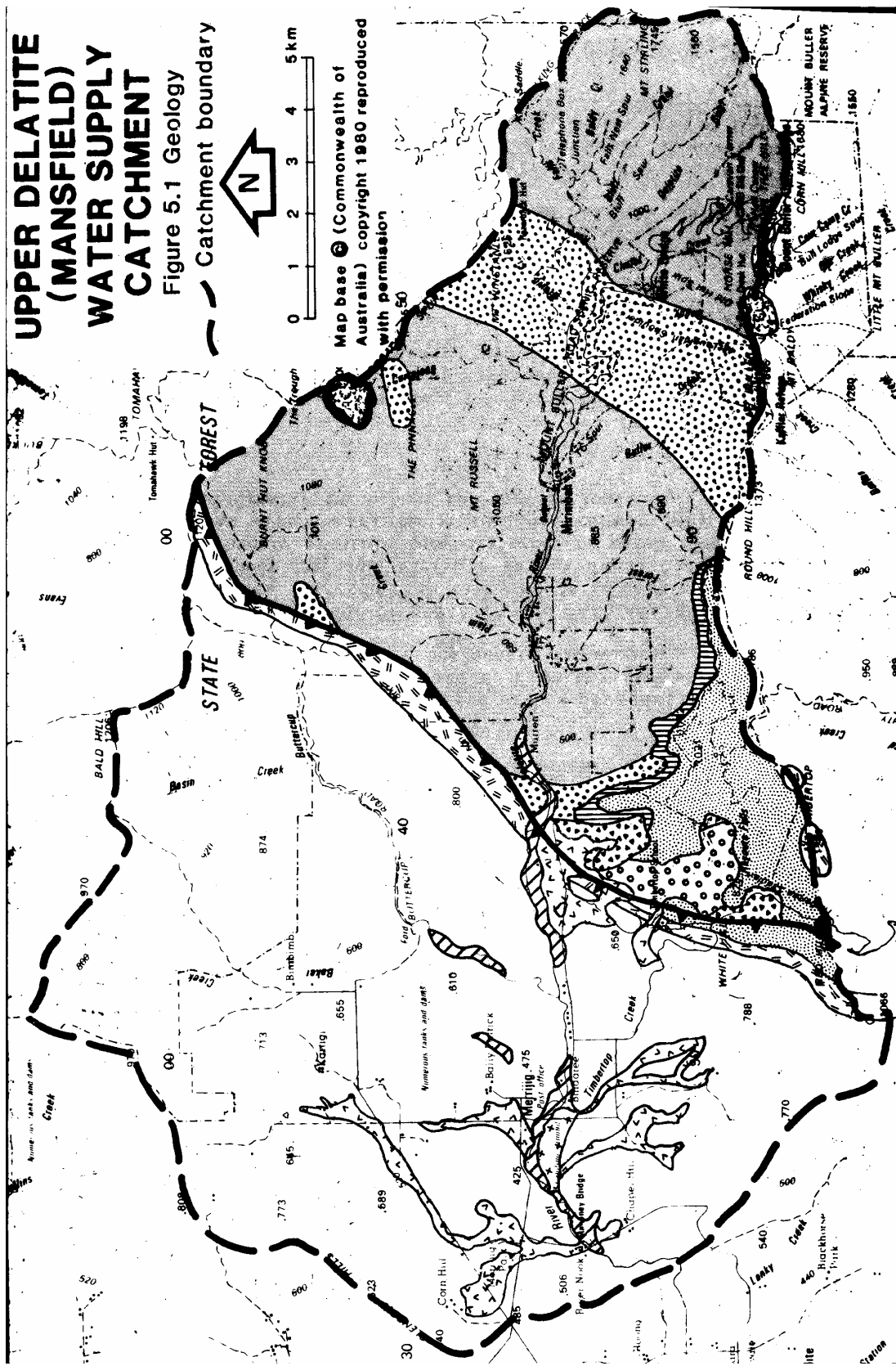
Annual precipitation ranges from in excess of 1,600 mm at Mt. Buller to approximately 750 mm near the offtake⁶.

Rainfall accounts for virtually all of the annual precipitation at the lower altitudes. However as the altitude exceeds 1,200 m, snowfall contributes an increasing proportion of the total precipitation. Snow accumulates on the higher altitudes over winter and snowmelt begins to exceed snowfall at about the end of September, extending the period of high runoff.

Monthly rainfall in the lower reaches of the catchment reaches a nadir over summer, then builds up steadily to a maximum in late winter (Figure 5.2). A similar pattern I experienced at Timbertop but the monthly totals are substantially higher. Mt. Buller, Mt. Stirling and surrounding peaks experience generally higher rainfall again, except that over the winter, much of the moisture falls as snow at these higher elevations.

⁶ Land Conservation Council. 1977. Report on the Alpine Study Area

Figure 5.1 Geology



KEY TO FIGURE 5.1

GEOLOGY OF THE CATCHMENT

Quaternary



Qra Deposits of alluvial flats; gravel, sand, silt.



Qrc Scree and fan deposits; 'gully' alluvium, gravel, sand silt often ill sorted.



Qrt High level terrace deposits, clay, silt, sand, gravel.

Tertiary



Tvo Basalt; dense, blue black, glassy, rarely vesicular.



Te Sub-basaltic gravel, sand, clay, quartzite ('grey billy').

Carboniferous



Cl Conglomerate, pebbly sandstone, siltstone, often purple coloured.



Clt Conglomerate, sandstone, mudstone.

Devonian



Dv Basal flows of glassy rhyolite; higher units of coarse grained ignimbritic rhyodacite.



Du Conglomerate, arkosic conglomerate sandstone, arkose, with pronounced cross-bedding; siltstone.



m Metamorphic aureoles; hornfels. spotted sediments.



Dgm Medium grained hornblende granodiorite; also aplitic hornblende granodiorite. Subordinate granite, diorite, gabbro.

Ordovician



Ols Sandstone, thick bedded and ill sorted, interbedded siltstone, minor gritstone.

Cambrian



Bnj Intermediate to basic volcanics, minor pyroclastics and dolerite intrusives. The rocks have been altered by low grade metamorphism.



Timbertop Fault/monocline

[Sources:

Douglas, J C, and Ferguson, J A (Eds.). 1976. Geology of Victoria.

Marsden, M A H. Upper Devonian and Carboniferous. in Douglas and Ferguson, 1976.

Department of Minerals and Energy. Geological Survey of Victoria: Warburton Mapsheet SJ55-6 (1:250 000).]

There are few reliable data on temperatures within the catchment, however the general pattern is of warm to hot dry summers with occasional summer thunderstorms, and cool to cold winters with frequent frosts at lower altitudes. Extended periods of snow cover and near - or sub-zero temperatures occur at the higher altitudes during winter.

Mansfield (of similar altitude to the lower portion of the catchment) experiences average monthly maximum and minimum temperatures of 29.4°C and 10.2°C respectively during January, and average monthly maximum and minimum temperatures are expected to range from 31°C and -12°C⁷.

An annual average of 150 frosts are expected, mostly during winter, but may occur at any time of the year in the alpine areas above the treeline. Snow is expected to fall, on average, 60 days of the year, most often in July and August⁸.

5.5 Vegetation

The native vegetation types and their distribution in the catchment are largely dependant upon the interactions of climate, topography (dominantly elevation and aspect), geology and soils. Climatic variation is the dominant factor and accounts for much of the distribution of various vegetation types.

The distribution of the various broad vegetation types identified in the catchment is shown in Figure 5.3.

Vegetation of the higher altitudes consists of a mosaic of sub-alpine woodlands and heathlands of snow gums and various shrubs, tussock grasslands dominated by *Poa* spp. and a few areas of characteristically prostrate vegetation associated with snow patches.

Other eucalypt species, such as mountain gum and candlebark, begin to occur in the more favourable sites as the elevation falls.

Open forest, dominantly of alpine ash occurs on the eastern uplands and grades into the central area, becoming more common on the southerly aspects or as the elevation drops. The alpine ash may be associated with mountain gum and a sub-storey of acacias such as hickory and silver wattle between 1,100 and 1,450 m elevation. Mixed species of eucalypts dominate as the elevation falls further.

Uncleared portions of the western lowlands are dominated by open forest of mixed species. Their distribution reflects the climatic gradient - alpine ash and mountain grey gum occupy the wetter sheltered sites, and blue gum, candlebark, brown stringybark and narrow leaf peppermint become more common as the environment becomes drier. Isolated stands of brittle gum occur on the fine grained sedimentary soils near Timbertop.

Further west on the steeper Carboniferous sediments, narrow-leaf peppermint dominates associations with messmate and blue gum. Steeper and drier slopes further west carry stands of yellow box and long-leaf box, occasionally with brown stringybark; candlebarks are confined to the wetter sites.

The low rolling land around Merrijig is largely cleared but remnants of red gum, yellow box and red box occur, with red gum limited to wetter sites lows in the landscape.

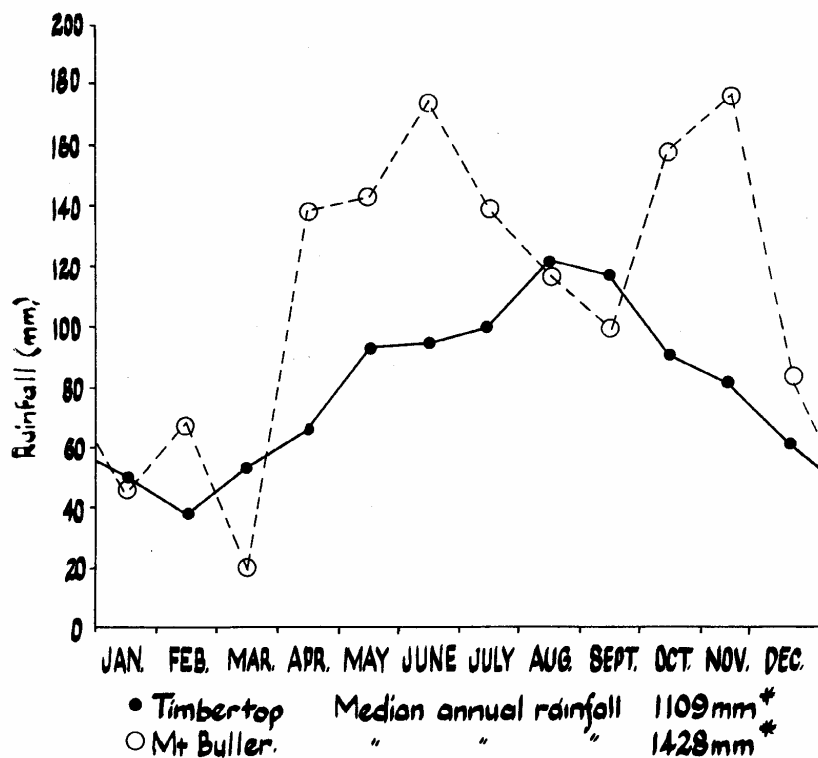
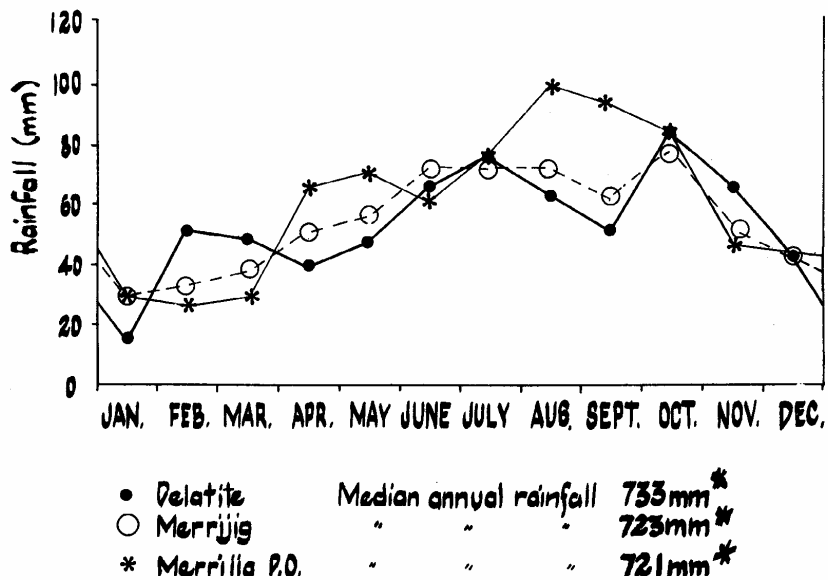
Pasture land has been improved to varying degrees in terms of pasture species and of fertility. Some areas have been sown to permanent pasture dominated by ryegrass/*Phalaris*/cocksfoot and clovers and fertilised accordingly. Other areas have been oversown with such pasture species but been inadequately fertilised and have partially reverted to native grasses. Other areas have had little pasture improvement or fertiliser, and are dominated by a range of annual species, mainly grasses.

There are some small plantations of *Pinus radiata* in the catchment see Figure 5.3).

⁷ LODER AND BAYLY, 1983 Mount Stirling Alpine Resort. Development Proposal and Environmental Effects Statement.

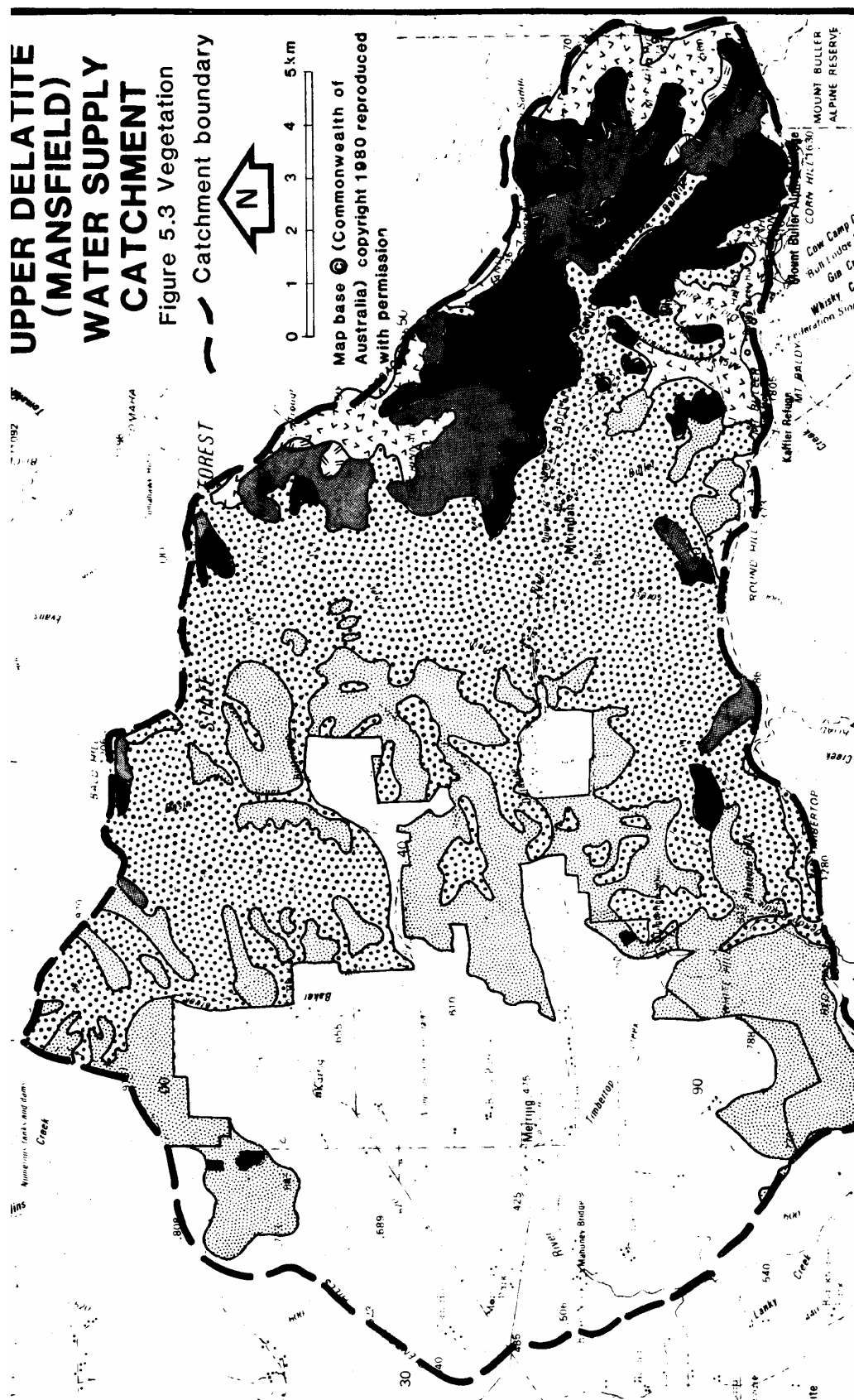
⁸ Land Conservation Council, 1974. Report on the Melbourne Study Area.

Figure 5.2 Median Monthly Rainfall (mm)












*Note these values are not strictly comparable because of differing periods of operation and gaps in the records.

Figure 5.3 Vegetation



KEY TO FIGURE 5.3

VEGETATION OF THE CATCHMENT

Alpine tussock grassland, heathland	<u>Poa</u> spp., other grasses and herbs	
Sub-alpine wooded areas	Dominantly snow gum	
	Dominantly mountain gum, candlebark	
Alpine ash forests	1939 and older regrowth	
	Mature and over-mature	
Mixed species	> 27 m	
	15 - 27 m	
Plantation	<u>Pinus radiata</u>	
Dominantly cleared and sown to pasture.		

Land Conservation Council. 1974. Report on the Melbourne Study Area.

Land Conservation Council. 1977. Report on the Alpine Study Area.

Forests Commission, Victoria, now State Forests and Lands Service. Unpublished data.]

6. LAND TENURE, USE AND MANAGEMENT

6.1 Land Tenure and Use

The catchment covers some 240 sq km; nearly 37% of this (approximately 89 sq km) is freehold and the remainder public land.

The dominant use of the public land has been hardwood timber production and, in certain areas, forest and high plains grazing and alpine recreation. Ash forests are normally harvested by clear felling techniques and mixed species forests, once selectively logged, are also now generally clear felled.

Forest operations are supervised by the State Forests and Lands service according to Prescriptions for Hardwood Harvesting and Regeneration on State Forest - North Eastern Division, 1983; Hardwood Harvesting and Regeneration Plan, Mansfield Forest District, 1982/83 - 1986/87; and Stand Delineation and Operation Schedules developed by the Once-only-logging Working Party.

The level of timber harvesting operations has decreased (in recent years due to cutting out of millable timber supplies and an increased area set aside for summer and winter recreation and for nature conservation/educational purposes. The current annual allocation of timber from the Delatite Block is 7,500 cu m. Lesser volumes are generally harvested.

Grazing in the high country (where approved) is a seasonal activity, with stock numbers and the dates of entry and removal set by the Authority in consultation with the appropriate Alpine District Advisory Committee. Grazing leases are issued annually by the State Forests and Lands Service or the Department of Conservation Forests and Lands.

Victoria's largest and most developed ski resort (Mt. Buller) lies on the south-east rim of the catchment and planning is well advanced for further resort development on nearby Mt. Stirling.

Current capacity of Mt. Buller is approximately 5,300 beds, with a peak daily population of in excess of 15,000 people. Current plans are to increase the accommodation to between 7,000 and 8,000 beds.

The Development Proposal for Mt. Stirling recommends⁹ a Resort with a peak daily population of approximately 13,500, with some 4,000 being accommodated in a village above the snow-line.

The recently created Alpine Resorts Commission will oversee the planning and development of Victorian ski-resorts, including Mt. Buller and Mt. Stirling, and gradually assume all land management responsibilities from current land managers over the next few years.

A Permissive Occupancy for approximately 500 ha in the upper reaches of the Timbertop Creek sub-catchment was granted to the Geelong Church of England Grammar School in 1952 for establishment of a pine plantation. The plantation has not been established and the Occupancy is likely to be reviewed shortly.

The freehold land of the catchment is dominantly cleared and generally sown to permanent pasture for grazing by cattle. Landholdings are becoming increasingly fragmented and the land is undergoing development for residential use (private and commercial), farmlet and semi-urban development.

There has been minor development for softwood plantations (see Figure 5.3).

Table 6.1 indicates the pattern of allotment size in the catchment (base on 1981 figures). There is a substantial number of large allotments, particularly in the Parishes of Merrijig and Booroolite and extensive subdivision of these would greatly increase the allotments in the catchment and thus the potential hazard to water supply. It is important Statutory Planning procedures take into account the needs of sound catchment management in determining appropriate division intensities.

⁹ LODER AND BAYLY, 1983. Mount Stirling Alpine Resort. Development Proposal and Environmental Effects Statement.

Table 6.1 Patterns of Subdivisions

Allotment Size	<1 ha	1-10 ha	10-40 ha	>40 ha
Parish				
Merrijig	1	18	8	27
Beolite	-	-	1	2
Booroolite	5	9	4	29
Gonzaga	-	-	2	7
Delatite	5	19	-	1
Changue	>200	2	5	6
TOTALS	>220	48	20	72

(Source: Shire records, 1981)

Much of the subdivision activity in the Parish of Changue has taken place on land close to the Delatite River. This close proximity of development to the stream system restricts the opportunity for control and purification of runoff water before it enters the stream system.

Subdivision and development of land in the catchment continued up until 1983 and the Interim Development Order was amended to define the Alpine Approach Study Zone. This essentially precluded further subdivision pending the introduction of a Planning Scheme (see Section 6.3).

Development of existing allotments has continued since 1983.

6.2 Land Conservation Council Recommendations

The Land Conservation Council published Final Recommendations for the Alpine Study Area in 1979. These were accepted in the main (as far as the catchment is concerned) by the government of the day and are summarised in Figure 6.1.

A Special Investigation in 1983, primarily to identify land which could be added to the Alpine park system, has recommended few changes for land of the Upper Delatite Catchment. Relevant changes recommended are the inclusion of land near Round Hill in an enlarged alpine park system, the creation of a Natural Features Zone along the Delatite River downstream of Mt. Buller Alpine Village and the amalgamation of land in the previously "Uncommitted" and Timber Production areas into State Forest (used in a descriptive sense rather than as used in the *Forest Act*) to enable unified, efficient and co-ordinated administration and management of such land¹⁰.

The government has accepted the recommendation relating to land to be included in the alpine park system, other recommendations are still under consideration.

6.3 Planning Controls and Other Relevant Legislation

6.3.1 Statutory Planning

The Ministry for Planning and Environment is currently assisting the Shire of Mansfield with the preparation of a consolidated and revised Planning Scheme for the municipality.

¹⁰ Land Conservation Council, 1983. Final Recommendations, Alpine Area, Special Investigation.

Current planning controls for the Upper Delatite Catchment are embodied in the Shire of Mansfield Planning Scheme Interim Development Order. The Order identifies three zones in the catchment:

- a) Alpine Approach Study Zone - introduced in 1983 and covers much of the freehold land in the catchment. Briefly, relevant provisions include: the prohibition of subdivision except under certain specific circumstances; a Planning Permit requirement for any dwelling (construction of a dwelling on existing allotments is not prohibited); and prohibition of sewage treatment. In addition, tourist establishments are allowable subject to Permit and in close proximity to Merrijig to Sawmill Settlement or otherwise more than two kilometres from the Mansfield - Mt. Buller Road;
- b) Rural A Zone - covers a relatively small proportion of the catchment in the Buttercup Creek area. There is little regulation of most activities, including sub-division. This zone originally extended to most freehold land in the catchment. However the Order was amended to place much of the catchment land in the newly created Alpine Approach Study Zones following concern expressed by the Authority and others that more effective controls on development were warranted because of the need for catchment protection and general planning considerations; and
- c) Forest Zone - applies to most of the public land in the catchment. Forest activities, erosion control and stream protection and improvement works are permitted uses in this Zone, other uses require a permit.

Relevant extracts from the current Order are contained in Appendix A.

Two recent amendments to the Order have extended the area available for future intensive residential and tourist development at Sawmill Settlement and near Merrijig. Plans for this development are in preparation and include provision of more than 700 beds in a variety of styles of accommodation.

6.3.2 Soil Conservation and Land Utilization Act

The Soil Conservation Authority, under *the Soil Conservation and Land Utilization Act 1958*, has a primary responsibility in determining appropriate forms of land use and advising on management activities within water supply catchments. It does this through the mechanisms of determining appropriate land use and subsequent imposition of land use controls.

The Premier has also directed (Directive 60/5907) that the Authority has supervisory control over all grazing and soil disturbance activities on land above 1,220 m above sea level.

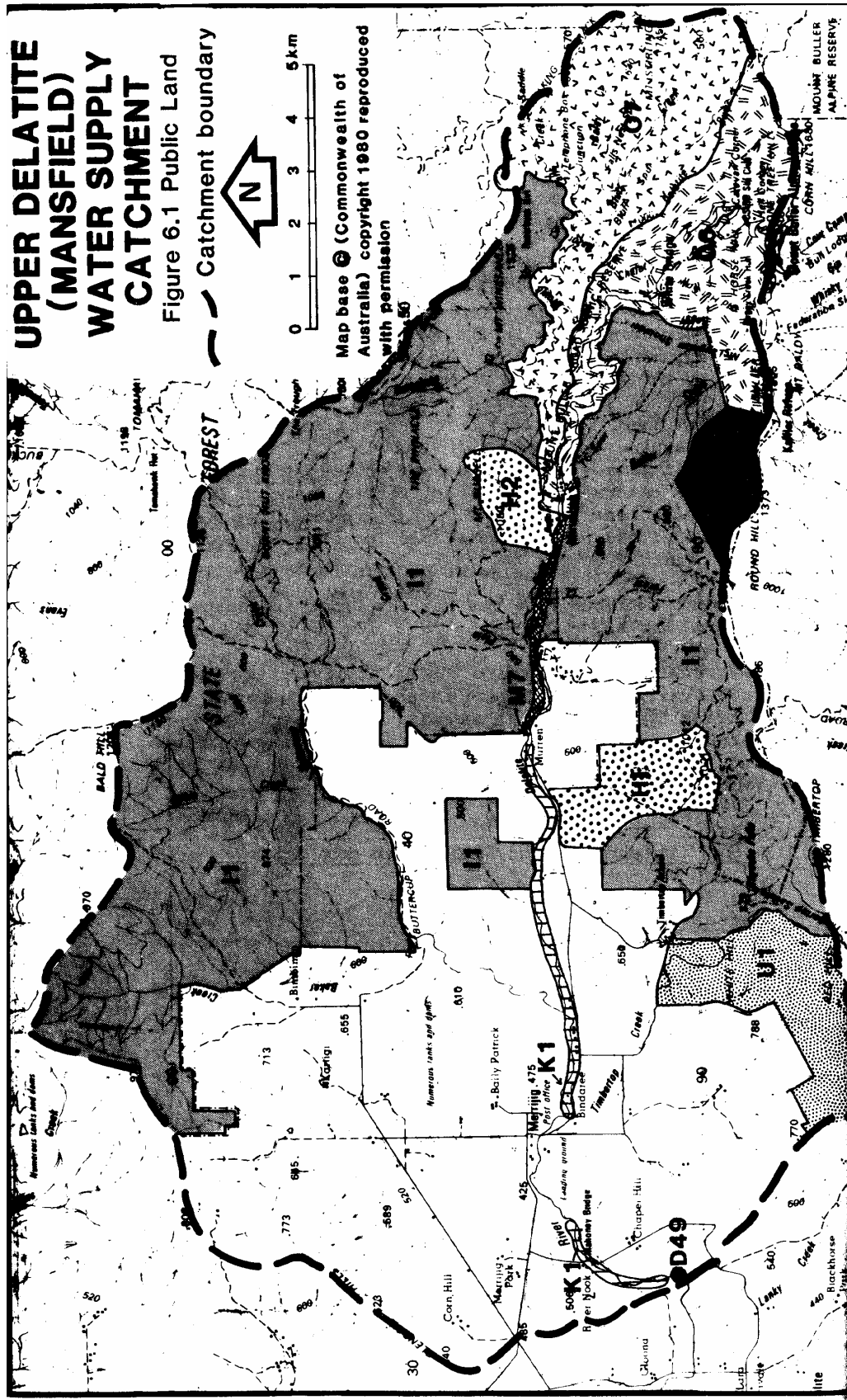
In addition, the Forests (Mt. Buller Alpine Reserve) Regulation 1975 requires the Mt. Buller Management Committee to obtain the approval of the Authority before authorizing the excavation or removal of any soil or stone.

The importance of alpine catchments to the state has been highlighted by the Land Conservation Council - "public authorities managing land within a proclaimed catchment should be conscious of the implications of management decisions on water production and should consult, co-operate, and reach agreement with the water supply authority and the Soil Conservation Authority regarding this type, location and timing of management activities"¹¹.

The Governor-in-Council has, on the recommendation of the Authority, appointed an Alpine District Advisory Committee to assist the Authority in matters concerning land use, soil erosion and soil conservation on alpine land generally. Local Committees provide local contact and recommendations to this District Advisory Committee for consideration. The Upper Goulburn District Advisory Committee performs a similar function with respect to freehold land of the catchment.

¹¹ Land Conservation Council, 1983. Final Recommendations, Alpine Area, Special Investigation.








Figure 6.1 Public Land






KEY TO FIGURE 6.1

PUBLIC LAND USES APPROVED BY THE GOVERNMENT

PUBLIC LAND - Alpine Study Area

	A7	Alpine Park	-	Howqua River
	H1	Education Area	-	Delatite
	H2	Education Area	-	Mt. Russell
	I1	State Forest		
	M7	Natural Features Zone		
	O7	Alpine Reserve	-	Mt. Stirling
	O8	Alpine Reserve	-	Mt. Buller

PUBLIC LAND - Melbourne Study Area

	D49	Water Production		
	K1	Water Frontage Reserves		
	U1	Uncommitted		

APPENDIX A - PLANNING CONTROL

Extracts from the Interim Development Order for the Shire of Mansfield

An interim Development Order for the Shire of Mansfield was adopted on November 21, 1972. There have been a number of amendments gazetted since then, including the inclusion of the Alpine Approach Study zone (Amendment No. 8) which covers much of the freehold land in the catchment (see Figure A.1), and Amendments 10 and 11 which provide for the development of certain land at Sawmill Settlement and near Merrijig for which draft proposals have been put forward.

The following are extracts from the amended Order and should be read in conjunction with Figure A.1.

"3. EFFECT OF ORDER

No land shall be used, subdivided or developed except in accordance with this Order.

4. USE AND DEVELOPMENT OF LAND IN ZONES

Subject to the provisions of this Order land within the zone described in a section to the Table to this Clause:-

- (a) may be used or developed for any of the purposes specified in Column 1 of such section;
- (b) shall not except with the consent of the Responsible Authority be used or developed for any of the purposes specified in Column 2 of such section, and
- (c) shall not be used or developed for any of the purposes specified in Column 3 of such section.

5. SUBDIVISION OF LAND

- (1) Land shall not be subdivided except with the consent of the Responsible Authority.
 - (2) The ratio of depth to frontage for each allotment created under sub-clause (1) shall be to the satisfaction of the Responsible Authority having regard to the purpose for which it is to be used.
- 5A. (1) Land shall not be cluster divided or cluster redeveloped except in the following areas:
- (a) subject to Clause 7, the whole of Crown Allotments 16 17, 17A, Parish of Changue, County of Wonnangatta
 - (b) the township of Mansfield, being that area included in the Township of Mansfield, being that area included in the Township Zone, a shown on the map.
- (2) In its consideration of any application for consent under sub-clause 1) of this clause the responsible authority shall have regard to -
- (a) the density of the proposed development;
 - (b) the street or road layout having regard to the function and use of such streets or roads;
 - (c) the provision and location of common property including access thereto;
 - (d) the provision and location of public open space;
 - (e) the area and dimensions of all lots and common property comprises in the subdivision;
 - (f) the provision of off-street parking;
 - (g) the amenity of the neighbourhood;
 - (h) the provision of a scheme of development required

KEY TO FIGURE A.1.

Interim Development Order (Shire of Mansfield)

- as it applies to land within the Upper
Delatite (Mansfield) Water Supply
Catchment.



Rural 'A'



Forest



Alpine Approach Study Zone.

Table A.1 Use and Development of Land In Zones

ZONE	COLUMN 1	COLUMN 2	COLUMN 3
Section 2 Rural "A"	Farming Forestry Public open space House Building or works ancillary to the above uses	Any purpose not specified or included in any other Column of this table for this zone.	
Section 4 Forest	Forestry Works and operations carried out by the State rivers and Water Supply Commission and the Soil Conservation Authority	Any purpose not specified or included in any other column of this table for this zone.	
Section 5 Alpine Approach Study	Farming Public open space Works ancillary to the above	Building ancillary to any purpose specified in Column 1. Dwelling Sign (relating exclusively to the use of the land on which it is located or to the sale or lease of that land) Tourist Establishment Works and buildings ancillary to the above	Any purpose not specified or included in any Column of this table for this zone.

7. ALPINE APPROACH STUDY ZONE

- (1) Except in the circumstances provided in this Clause, the Responsible Authority shall not consent to subdivision in the Alpine Approach Study Zone.
- (1)(a) In the Alpine Approach Study Zone, the Responsible Authority may consent to the subdivision of certain land in C.As 15, 16, 17 and 17A, Parish of Changue, County of Wonnangatta, and CA 16A, sec. A, Parish of Booroolite.
- (2) In the Alpine Approach Study Zone, the Responsible Authority may consent to a subdivision which will create one or more allotments where:
 - (a) each allotment is to be consolidated with an existing allotment by the approval of a plan of consolidation under the *Transfer of Land Act, 1958*;
 - (b) the purpose of the subdivision is the excise land which is required for public purposes by the Crown, a public authority or a municipality; or
 - (c) the number of allotments to be created by the subdivision is not greater than the number of existing allotments comprising the parcel of land to be subdivided.
- (3) Except for C.As 15, 16, 17 and 17A, Parish of Changue, County of Wonnangatta, and CA 16A, Sec A, Parish of Booroolite, the Responsible Authority shall not consent to the construction of a dwelling on an allotment in the Alpine Approach Study Zone, less than 0.5 hectares in area, unless the allotment existed on the coming into operation of amendment No. 8 to this Order.
- (4) Any dwelling, or other building in the Alpine Approach Study Zone shall be located not less than 200 metres from the Mansfield - Mt. Buller Road unless otherwise explicitly provided in a permit granted by the Responsible Authority.
- (5) The Responsible Authority shall not consent to the use or development of land in the Alpine Approach Study zone for the purposes of a tourist establishment unless:
 - (i) the tourist establishment is to be located in close proximity to the Sawmill Settlement or Merrijig township and wastewater water disposal and water supply services can be integrated with the township service systems; or
 - (ii) the tourist establishment is to wholly or predominantly use rural surroundings for horse riding, walking, or other recreational pursuits which, in the opinion of the Responsible Authority, are appropriate for the proper recreational use of the locality, and any building visible from the Mansfield - Mt. Buller Road is located not less than 2,000 metres from that road.
- (6) The Responsible Authority shall not determine to grant a permit in respect of a tourist establishment on any land in the Alpine Approach Study Zone, unless notice has been given or published in respect of the application for that permit in the following manner:
 - (a) a Notice of Application shall be placed on the subject land;
 - (b) owners and occupiers of adjoining and adjacent land shall be notified in writing of the application;
 - (c) a Notice of Application shall be published twice in the Mansfield Courier; and
 - (d) the following persons shall be notified in writing, of the application
 - (i) The Secretary, Soil Conservation Authority, Melbourne
 - (ii) the Regional Conservation Officer, Soil Conservation Authority, Benalla; and
 - (iii) the Secretary, State Rivers and Water Supply Commission, Melbourne.
- (7) Sections 18B(2) and (3) of the Act shall apply to a notice under sub-clause (6) as if it were a notice given or published under Section 18B(1) of the Act."