1. INTRODUCTION

1.1 Introduction

Land varies considerably in its basic characteristics and its response to the demands made upon it. Such demands include the production of food, fibre, water, and development for residential purposes.

Planners need to match the requirement of land use with the capability of the land to sustain that use, otherwise degradation will occur and productivity will decline. Alternatively, when a less-than-ideal land use must proceed, then the appropriate level of management must be implemented to minimise future degradation. Prior knowledge of soil and land limitations can prevent unnecessary and costly mistakes. Information obtained through land capability assessments can provide the necessary data to assist local government with planning decisions and the preparation of planning strategies for the future.

This report provides information for broad-scale planning, based on an assessment of the physical characteristics of the land, for the area that includes the Cathedral Range and the Acheron River valley between the townships of Buxton and Taggerty. It does not provide recommendations for land use and no allowance has been made for social or economic considerations which may influence planning proposals. It is primarily an examination of potential consequences and levels of management required for a range of land uses.

1.2 Location

The Cathedral Range lies adjacent to the Maroondah Highway approximately 100 km NE of Melbourne (see Figure 1.1) and provides a spectacular scene approaching from Alexandra to the north, or while passing adjacent to it between Taggerty and Buxton. Runoff from the Range enters the Acheron River; a tributary of the Goulburn River.

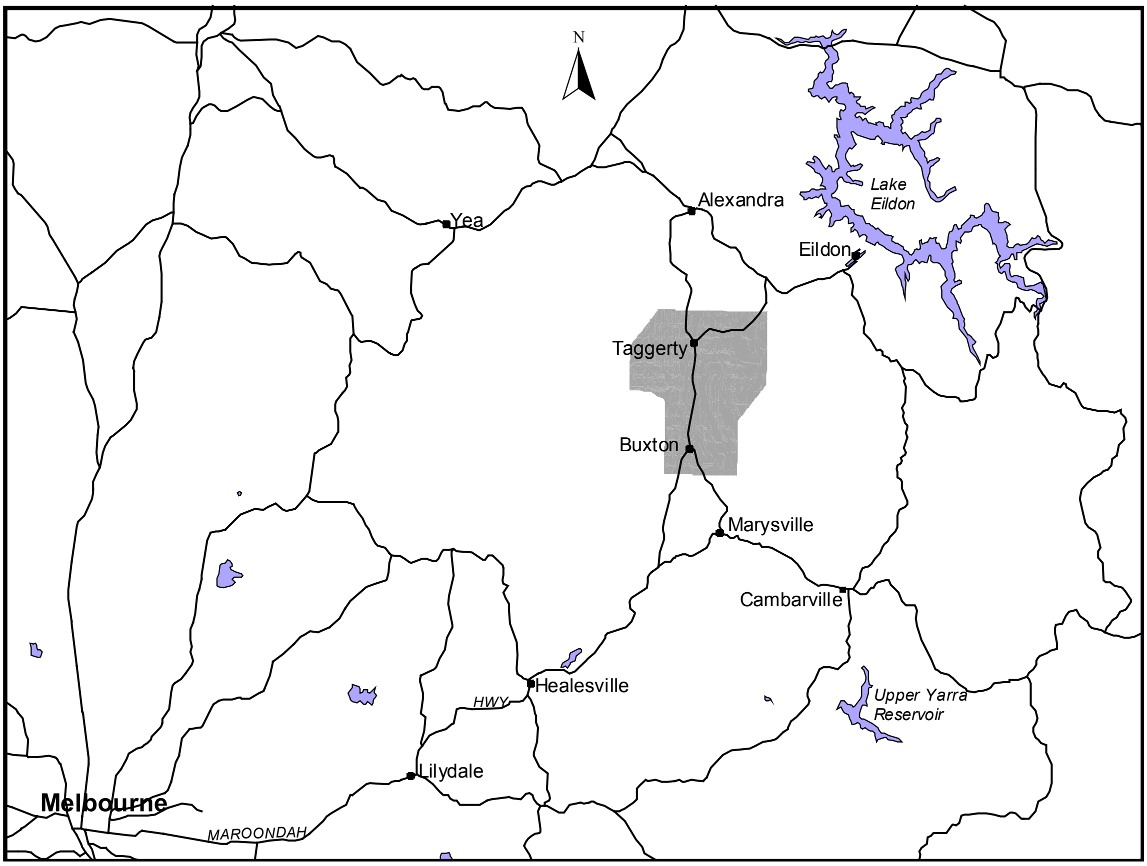

Figure 1.1 Location of the Cathedral Range - Acheron River Valley (hatched)

1.3 Purpose of study

The Cathedral Range - Acheron River valley area provides a tranquil, rural atmosphere and some of the most attractive landscape scenery in Victoria. The vista of Cathedral Range as one travels along the Maroondah highway from Alexandra to Buxton can only be described as breath-taking.

The proximity to Melbourne, Alexandra and Eildon Weir ensures a constant influx of day-trippers and holiday-makers into the area to enjoy the many attractions, particularly the bush-walking, trout fishing and scenic views. As a consequence, there has been an increasing demand for land to be subdivided into rural residential, hobby farms and bush blocks.

In planning for the present and future land use a prime consideration should be to preserve the very qualities and features that make the area so attractive and popular. To achieve this objective and to ensure a sound base for future planning strategies, the regional office of the Department of Natural Resources and Environment requested a land capability study of the area.

1.4 Objectives

Major:

To obtain, collate and present land resource information for the Cathedral Range - Acheron River valley area to the Alexandra Regional Office of the Department of Natural Resources and Environment and the Shire of Murrindindi, in a format that will facilitate the environmentally-wise planning of future land use.

Specific:

(i) To delineate the study area into a series of land units based on geology, topography and soil at a scale of 1:25,000.

(ii) To assess the capability of each land unit to support, without long-term degradation to the environment, particular land uses identified as important in the area, both now and in the future.

These include:

- Agriculture
- Building foundations
- Effluent disposal
- Farm dams
- Rural residential
- Urban residential
- Secondary roads
- Scenic value

(iii) To identify the limitations that restrict the performance of land so that specific conditions can be applied to a landholder or developer, if necessary, to minimise future on-site or off-site degradation.

(iv) To provide information for each land unit relating to groundwater recharge potential, flooding risk, susceptibility and incidence of erosion, salting and acidification, and the depth to hard rock and seasonal water-tables.

(v) To support the Department of Natural Resources and Environment regional office in its extension role to the Shire of Murrindindi.

2. LAND CAPABILITY ASSESSMENT

2.1 Philosophy and principles

Land capability assessment is a method of determining if a land area can sustain a specific use and level of management without causing significant long-term degradation.

The objectives of land capability assessments are:

i) to assist land managers and land use planners to identify areas of land with physical constraints for a range of nominated land uses;

ii) to identify management requirements that will ensure a particular land use can be sustained without causing significant on-site or off-site degradation to land or water quality.

To achieve these objectives it is necessary to know the natural characteristics of the land and understand the effects, both on-site and off-site, that the proposed land use may have on the land itself and the water derived from it.

Land capability assessments provide the means of analysing basic land information and identifying which parameters affect the ability of the land to maintain a desired level of production. A strength of the methodology lies in its association with land systems since the results can be extrapolated, with care, to similar land components and land systems in other areas.

A land system is an area of land, distinct from the surrounding terrain, that has a specific climatic range, parent material and landform pattern. These features are expressed as a recurring sequence of land components. Land system mapping is generally at a scale of 1:100 000 or 1:250 000 and is appropriate for large scale planning exercises, such as regional planning.

A land component is an area of land, distinct from adjacent components because of specific slope, soil, aspect and/or vegetation characteristics. A land unit in this study may be the same as a land component, however the larger mapping scale of 1:25,000 may allow land components to be divided into distinct areas based on more specific soil and topographical characteristics.

The ratings provided by a land capability assessment are not intended to restrict development of land, but rather to identify the principal constraints of that land for a specified land use. It is a matter for the land manager or land-use planner to decide if the cost of overcoming the constraints is justified. Where particularly severe physical constraints exist, it will be necessary to ensure that proposed developments are only permitted subject to compliance with conditions relating to the management of that land. Alternatively it may be appropriate to preclude that use from that area of land. It should be stressed that the imposing of such conditions on development permits is quite a proper exercise of planning responsibility.

2.2 Land resource mapping: methodology and constraints

Mapping an area of land can be a complex task as many differences arise due to interactions between climate, geology and topography. While it is possible to measure and determine some of the land characteristics such as slope, rock outcrop, and soil type, other characteristics such as site drainage, and permeability are less easily determined.

The main objective of land resource mapping is to identify areas of land that are uniform with respect to the land characteristics which affect land use. These areas of land have a similar land use capability and are likely to respond in a similar way to management. By mapping areas of land with a limited range of variability, the resultant map provides the basis for land capability assessment (for specific methodologies, refer Appendix 3).

The following procedure has been adopted by the Land and Catchment Protection Branch as standard practice in land capability studies.

i) The geological boundaries are obtained from existing maps and verified in the field at the appropriate mapping scale.

ii) The broad landform pattern and then the landform elements, which usually correspond to the final land units, are identified from air-photos using a binocular stereoscope. This forms the basis of the land system/land component concept.

iii) Extensive field work ensures that the land units are consistent with respect to parent material, slope, position in the landscape, soil type, drainage and native vegetation.

iv) A representative site for each land unit is selected, preferably one that has original native vegetation and/or an undisturbed soil profile. The incidence of any land degradation in each land unit is recorded.

v) From a soil pit or large exposure of the soil profile at each selected site, a detailed soil profile description is recorded. Colour photographs are taken and soil samples collected for the purpose of physical and chemical analyses (see Appendix 4 and the corresponding tables for each land unit in Section 4 for details).

vi) The permeability of the soil profile is measured during the winter-spring months when the soils are at or near field capacity (see Appendix 3).

vii) The land unit boundaries are drawn onto a clear sheet and scanned into a Geographic Information System where the data is combined with base-map information on roads, contours and streams to produce a final map of the study area with appropriate headings and legend.

viii) Land capability ratings for those land uses relevant to the Shire are then derived from the climatic, land and soil data available for each map unit. Separate land capability assessment maps are prepared for specific land uses.

ix) The accompanying report includes a data summary for each land unit as well as some guidelines on land management.

2.3 Assessment procedure

A land capability rating table lists those land characteristics such as slope, site drainage or soil depth which may affect the ability of the land to support a specified activity. These land characteristics are then quantified and graded into five classes for the land use being assessed and each land unit within the study area is given a capability rating according to the tables shown in Section 2.4.

It is the most limiting factor that determines the "Capability Class", which can then be related to the degree of limitation for that land use and the general level of management that will be required to minimise degradation (Table 2.1).

A capability rating of Class 1 represents essentially no restraints to the proposed land use whilst a rating of Class 5 indicates a very low capability to sustain the land use; that is, limitations exceed the current level of management skills and technology available and severe deterioration of the environment is likely to occur if the land use persists. A Class 3 or 4 will require certain levels of management otherwise a particular land use will not be sustained and the environment will deteriorate.

Table 2.1 Land capability classes

CLASS	CAPABILITY	DEGREE OF LIMITATION TO DEVELOPMENT	GENERAL DESCRIPTIONS AND MANAGEMENT GUIDELINES
Class 1	Very good	The limitation of long term instability, engineering difficulties or erosion hazards do not occur or they are very slight.	Areas with high capability for the proposed use. Standard designs and installation techniques, normal site preparation and management should be satisfactory to minimise the impact on the environment.
Class 2	Good	Slight limitations are present in the form of engineering difficulties and/or erosion hazard.	Areas capable of being used for the proposed use. Careful planning and the use of standard specifications for site preparation, construction and follow up management are necessary to minimise the impact of the development on the environment.
Class 3	Fair	Moderate engineering difficulties and/or moderately high erosion hazard exist during construction.	Areas with a fair capability for the proposed use. Specialised designs and techniques are required to minimise the impact of the development on the environment.
Class 4	Poor	Considerable engineering difficulties during development and/or a high erosion hazard exists during and after construction.	Areas with poor capability for the proposed use. Extensively modified design and installation techniques, exceptionally careful site preparation and management are necessary to minimise the impact of the development on the environment.
Class 5	Very poor	Long term severe instability, erosion hazards or engineering difficulties which cannot be practically overcome with current technology.	Performance of the land for the proposed use is likely to be unsatisfactory. Severe deterioration of the environment will occur if development is attempted in these areas.

2.4 Land capability rating tables

In this report each land capability rating table (refer to Tables 2.2, 2.3, 2.4, 2.5 and 2.6) has the following structure:

i) the level of management required to sustain the land use without degradation of the soil or environment, is specified,

ii) the criteria which directly influence land use are identified,

iii) class limits are assigned to each criterion ranging from Class 1 (no limitations) to Class 5 (extreme limitations).

There has been no attempt to rank the criteria in order of importance since the objective of having class ratings is to identify the kind of limitation and its severity. It is recognised that criteria may interact, but an underlying objective of this study is to provide the information in a usable form rather than have a convoluted series of alternative pathways that would be too complex for the intended user to follow.

Where there are known interactions between different criteria, they are discussed and the possible results outlined, however it is the responsibility of the planner or land manager to assess the importance of the limiting factor(s) and whether improved management or additional financial input can reduce or overcome the limitation. For example, when building a farm dam in land units Dgc2 and Tfe major limitations occur and both areas have a capability rating of 4. For Dgc2 the steep slopes and high susceptibility to landslips cannot be overcome without huge expense and an ever-present risk of major off-site problems, such as the whole system failing. On the other hand, Tfe has dispersibility and permeability problems that would cause a dam to leak badly. By importing a more dispersible clay to line the dam or by using a sealing compound such as Bentonite the Class 4 rating can be lowered to Class 3 with only a small additional cost and management input. There are many situations where major limitations have been overcome by introducing a higher level of management to run a profitable enterprise without causing long-term land or water degradation. Unfortunately the opposite is also true.

Theoretically, a single land quality could be used to rate land performance, but there is the risk of such a feature masking the true parameters that affect the land use, thus preventing a change to a more appropriate land use or level of management. Land use and land management practices will continue to change and if the community is concerned about long-term sustainability of specific land uses, then the limitations of the soil, the various processes of land degradation and the possible off-site effects must be recognised. Once a limitation to land use is identified, steps can be taken to overcome or minimise the degradation that would result if the land use continued.

The method of assessing the Scenic Value of a landscape feature does not fit easily into that of the traditional land capability assessment for land uses such as agriculture, farm dams or septic tank effluent disposal. Scenic Value takes into account parameters that are quite different, such as visual impact, proximity to public thoroughfares, and the frequency/number of the passing population. Therefore it has been necessary to construct a land capability assessment table for Scenic Value (Table 2.7) that differs from the preceding assessment tables and the reader is advised to study it carefully, with reference to Appendix 1 for explanations of the criteria that influence Scenic Value, so that the method of arriving at the final rating can be fully appreciated.

The physical location of each land unit may occur in a number of different locations simply because the same geomorphic processes have been involved, and the same capability rating for a specific land use would apply. Not so for Scenic Value - a beautiful river gorge, crossed by a busy highway has a high Scenic Quality and a high Scenic Value (Class 1) but further downstream and around a bend, the gorge is inaccessible and hidden from view: the Scenic Quality remains high but the Scenic Value has been reduced (Class 3).

This is the first attempt in these reports to recognise and evaluate the scenic value of the landscape. The scenic value of an area works in two directions - to be seen from or to be seen. For example, a rugged peak may be an ideal location for a lookout tower but it may also present a spectacular skyline to travellers on a highway down in the valley. Future landuse activities along the road or on the peak should not detract from the scenic value of one with respect to the other.

Table 2.2 Land capability assessment for agriculture

Land is assessed for agricultural production on the basis of climate, topography and the inherent characteristics of the soil. It is a general assessment that identifies the versatility and potential productivity of an area for a range of crops and pastures. It is assumed that commonly-used management practices will occur, particularly in relation to cultivation and fertiliser application. Supplementary water application is not anticipated. This assessment has been based on cropping which is a more intensive land use and requires a higher level of management than grazing.

PARAMETERS INFLUENCING AGRICULTURAL PRODUCTION		LAND CAPABILITY RATINGS				
		Class 1	Class 2	Class 3	Class 4	Class 5
C: Climate	Length of growing season (months)	12 - 11	10 - 8	7 - 5	4 - 2	< 2
T: Topography	Slope (%)	< 1	1 - 3	4 - 10	11 - 32	> 32
S: Soil	Condition of topsoil *	25 - 21	20 - 16	15 - 11	10 - 6	5 - 1
	Depth of topsoil (mm)	> 300	300 - 160	150 - 110	100 - 50	< 50
	Depth to rock/hardpan (m)	> 2.0	2.0 - 1.5	1.5 - 1.0	1.0 - 0.5	< 0.5
	Depth to seasonal watertable (m)	> 5.0	5.0 - 2.0	2.0 - 1.5	1.5 - 1.0	< 1.0
	Total amount of water (mm) available to plants *	> 200	200 - 151	150 - 101	100 - 51	50 - 0
	Index of permeability/rainfall *	Very high	High	Moderate	Low	Very low
	Dispersibility of topsoil (Emerson) *	E6, E7, E8	E3(1), E3(2), E4, E5	E3(3), E3(4)	E2	E1
	Gravel/stone/boulder content (v/v %) *	0	1 - 10	11 - 25	26 - 50	> 50
	Electrical conductivity(μs/cm^{-1}) *	< 300	300 - 600	600 - 1400	1400 - 3500	> 3500
	Susceptibility to sheet/rill erosion *	Very low	Low	Moderate	High	Very high
	Susceptibility to gully erosion *	Very low	Low	Moderate	High	Very high
	Susceptibility to wind erosion *	Very low	Low	Moderate	High	Very high

* See Appendix A

NB: The potential agricultural productivity of an area can thus be classified by the CTS criteria (Climate, Topography and Soil) e.g. the 'ideal' prime agricultural areas would be denoted by C_1 T_1 S_1 compared with another area that had, for example, a 5-7 month growing season, slopes of 3% and a depth to rock/hardpan of only 0.7 m, denoted by C_3 T_2 S_4

Table 2.3 Land capability assessment for building foundations

Areas capable of being used for the construction of buildings of one or two stories. It is assumed that any excavation will be less than 1.5 m and can be completed by a tractor-backhoe or equipment of similar capacity. Two methods of construction are considered:

i) Concrete slab - 100 mm thick and reinforced
ii) Stumps or strip footings

PARAMETERS INFLUENCING BUILDING FOUNDATIONS	LAND CAPABILITY RATINGS				
	Class 1	**Class 2**	**Class 3**	**Class 4**	**Class 5**
Slope (%) i) Slab ii) Stumps/footings	 0 - 1 0 - 5	 2 - 5 6 - 10	 6 - 10 11 - 30	 11 - 30 30 - 45	 > 30 > 45
Drainage *	Rapidly drained	Well drained	Moderately well drained	Imperfectly drained	Poorly drained
Depth to seasonal watertable (m)	> 5	5 - 2	2 - 1	1 - 0.5	< 0.5
Proportion of stones and boulders (v/v %)	0	1 - 10	11 - 20	21 - 50	> 50
Depth to hardrock (m)	> 1.5	1.5 - 0.75	0.75 - 0.51	0.5 - 0.25	< 0.25
Susceptibility to slope failure *	Very low	Low	Moderate	High	Very high
Linear shrinkage (%) * i) Slab ii) Stumps/footings	 < 12 < 6	 13 - 17 7 - 12	 18 - 22 13 - 17	 22 - 30 18 - 22	 > 30 > 22
Flood risk	Nil	Low	Moderate	Moderate/high	High

* See Appendix 1

NB: Pole-construction buildings are more tolerant of slope but less tolerant of linear shrinkage than buildings with stumps or strip footings however other factors become increasingly important, such as erosion risk, susceptibility to slope failure, depth to hard rock and accessibility.

Table 2.4 Land capability assessment for on-site effluent disposal

Areas capable of absorbing effluent from a standard, anaerobic, all waste, septic tank connected to a single family dwelling (approximate output of 1000 litres per day+) by means of

i) absorption trenches
ii) transpiration beds*

PARAMETERS INFLUENCING EFFLUENT DISPOSAL	LAND CAPABILITY RATINGS				
	Class 1	**Class 2**	**Class 3**	**Class 4**	**Class 5**
Slope (%) *	< 3	3 - 10	11 - 20	21 - 32	> 32
Flooding risk *	Nil	Low	Moderate	High	Very high
Drainage *	Rapidly drained	Well drained	Moderately drained	Imperfectly drained	Poorly/very poorly drained
Depth to seasonal watertable (m)	> 2.0	2.0 - 1.5	1.5 - 1.0	1.0 - 0.5	< 0.5
Depth to hard rock/impermeable layer (m)	> 1.5	1.0 - 1.5	1.0 - 0.75	0.75 - 0.5	< 0.5
Number of months/year when average daily rainfall > K_{sat} *	0	1	2	3	> 3
Permeability (K_{sat} mm/day) *	> 500 **	500 - 100	100 - 50	50 - 10	< 10

+ 10 mm/day is equivalent to disposing of 1000 l/d along a 0.5 x 200 m trench
* See Appendix 1
** Permeabilities > 1000 mm/day could pollute groundwaters

Table 2.5 Land capability assessment for farm dams

This table should only be considered for farm dams less than or equal to 1000 m^3 in capacity which have a top water level less than 3 m above the original ground surface at the upstream side of the wall.

PARAMETERS INFLUENCING THE CONSTRUCTION OF FARM DAMS	LAND CAPABILITY RATINGS				
	Class 1	**Class 2**	**Class 3**	**Class 4**	**Class 5**
Slope (%) *	3 - 7	0 - 3	7 - 10	10 - 20	> 20
Linear shrinkage (%) *	0 - 5	6 - 12	13 - 17	18 - 22	> 22
Suitability of subsoil *	Very high	High	Moderate	Low	Very low
Depth to seasonal watertable (m)	> 5		5 - 2		< 2
Depth to hard rock (m)	> 5	5 - 3	3 - 2	2 - 1	< 1
Permeability (K_{sat} mm/day) *	< 1	1 - 10	11 - 100	101 - 1000	> 1000
Dispersibility of subsoil (Emerson)	E3	E4, E5a, E5b	E5c, E5d	E2	E1, E6
Susceptibility to slope failure	Very low	Low	Moderate	High	Very high

* See Appendix 1

The following criteria were considered but have not been included for reasons given in Appendix 1.

Criteria not included:

- Rock outcrop*
- Depth of topsoil*
- Flooding risk*

Table 2.6 Land capability assessment for secondary roads

Areas capable of being used for the construction of earthen roads for light vehicles without sealed surfaces or concrete drainage and kerbing.

PARAMETERS INFLUENCING SECONDARY ROADS	LAND CAPABILITY RATINGS				
	Class 1	Class 2	Class 3	Class 4	Class 5
Slope (%)	0 - 1	2 - 5	6 - 10	11 - 30	> 30
Drainage *	Rapidly	Well	Moderately	Imperfectly	Poorly
Depth of seasonal watertable (m)	> 5	5 - 2	2 - 1	1 - 0.5	< 0.5
Proportion of stones and boulders (v/v %) *	0	1 - 10	11 - 20	21 - 50	> 50
Depth to hard rock (m)	> 1.5	1.5 - 0.75	0.75 - 0.51	0.5 - 0.25	< 0.25
Susceptibility to slope failure *	Very low	Low	Moderate	High	Very high
Linear shrinkage (%) *	< 6	7 - 12	13 - 17	18 - 22	> 22
Bearing capacity (kPa) *	> 50	-	< 50	-	-
Flooding risk*	Nil	Low	Moderate	High	Very high
Dispersibility of subsoil Emerson (> 4% slope) *	E6	E4, E5	E3	E2	E1
Unified Soil Group	GW, GC, SC	SM, SW, GM	SP, CL, CH,MH, GP	ML	Pt, OH, OL

* See Appendix 1

Table 2.7 Land capability assessment for scenic value

Natural landscape features are assessed on the basis of the scenic quality* of the landform, vegetation or waterform, the public sensitivity level* and the distance* of the feature from public access routes. The study area occurs in the Eastern Highlands Landscape Character Type (Williamson and Calder 1979).

		Public Sensitivity Level (PSL)*								
		High			Moderate			Low		
	Distance zone*	fg	mg	bg	fg	mg	bg	fg	mg	bg
Scenic Quality Class*	High	1	1	2	1	2	2	2	3	3
	Moderate	2	2	2	3	3	3	3	4	5
	Low	3	3	4	4	4	5	4	5	5

* See Appendix 1 for definitions