2 LAND SYSTEMS

Background

The collection of data on the nature of the land to support land management and land use planning programs has proceeded for much of the last fifty years in Victoria. Soil surveys, based on technology, and experience gained overseas, were the dominant form of land description. However, by the late 1960s, it had become apparent to some soil scientists that soil surveys, while very useful in promoting production aspects of agriculture, did not provide the full suite of information required for the development and implementation of land management programs. In particular, soil surveys have not generally incorporated information on landform and associated land-forming processes - essential information for the management of land degradation.

The concept of land systems is credited to C.S. Christian, working within a group of CSIRO soil scientists. Christian and Stewart (1946) first formally described the principles and practice of land system mapping. Subsequently, the concept was further developed for Victorian conditions by Rowan and Downes (1963) and by Gibbons and Downes (1964). These principles and practice have now been applied to the description of more than half of the land in the state of Victoria, as well as significant areas of the rest of Australia.

The land system approach

The land systems approach to the mapping and description of land involves an ecological approach, integrating environmental features often mapped separately - geology, landform, climate, soils and native vegetation. It traditionally incorporated information at three levels - land zone, land system, and land component.

The distribution of these elements in the landscape is not random, with patterns resulting from the interactions of geology, landform and climate over time influencing the distribution of soils and vegetation across the landscape. These patterns can be identified and mapped by a combination of remote sensing (airphoto images, satellite imagery and airborne radiometrics/magnetics) and by field inspection.

A **land zone** consists of land systems that are related in terms of one or more of the less dependent land features - landform, geological material and climate. Soils and native vegetation are listed in broad terms but differences in these dependent features are not diagnostic. This grouping of land systems is accomplished by describing geomorphic units rather than land zones in this report. A **land system** is distinguished by its range of geological material, landform, soil and native vegetation in which the variation, although usually substantial, can be expressed as a repetitive sequence of particular land components. A **land component** is distinguished by its narrow range of geological material, landform, soil and native vegetation. These features are considered to be essentially uniform at the scale of mapping employed.

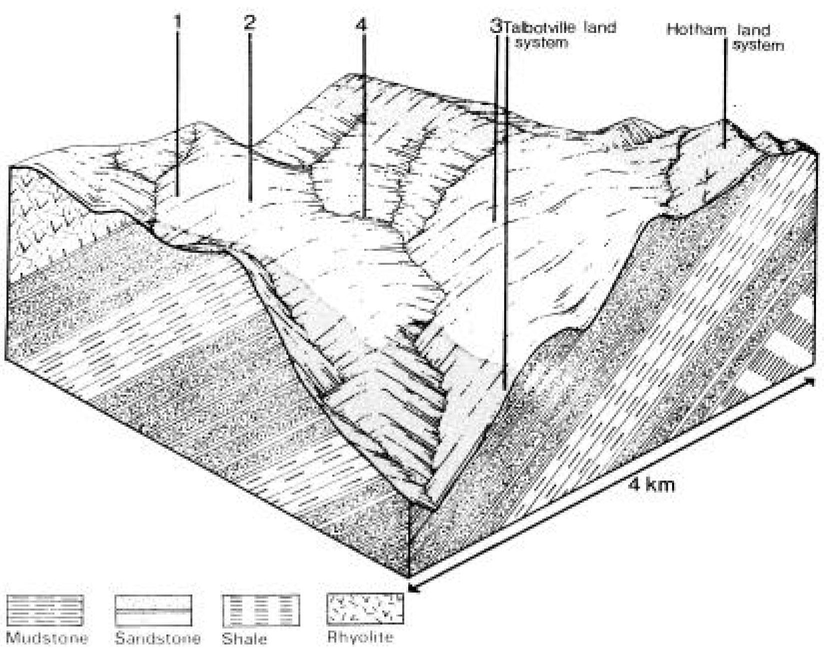
A land system is a complex mapping unit which contains a pattern of land components, each of which has limited variation in climate, lithology (rock type), landform, soil and native vegetation. These components occur in predictable and repeated patterns to form a land system, although not all identified components may appear in any one occurrence of the land system. Land systems are usually labelled with a local name from the area where the Land System is known to occur to assist with local recognition of the land system. The land component is often regarded as the basic unit of management for broad-scale land uses such as dryland farming or forestry.

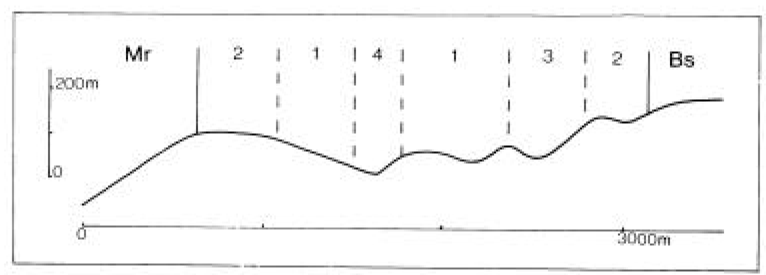
Since the pioneering work of CSIRO in developing the concept of land systems, there has been steady progress in development of processes for classifying land features and in the understanding of their dynamics. In particular, studies of landform/soil history have substantially improved our predictive capability on the nature, distribution and behaviour of soils - the study of soils in the field being largely an extension of the science of geomorphology. There have also been significant developments in botany, agronomy and meteorology, and the studies of various land degradation processes, that have improved the mapping and description of land systems.

Current land systems coverage (original studies)

Land system surveys, involving preliminary delineation of land systems and definition of components, detailed field work to verify and describe the land systems and components, and laboratory analyses for both physical and chemical characteristics of the various soils, have covered over half of the land of Victoria (refer Figure 3.2). Much of the remainder of Victoria has been subject to land studies of lesser detail and/or reliability. While there has been some overlap between certain studies, Figure 3.2 identifies the most reliable study for any given area. The land systems have been mapped at scale ranging from 1:250 000 to 1:100 000, reflecting both the degree of dissection of the landscape, the availability of base maps and mapping equipment, as well as the time and resources available for a perceived level of detail. (Details of the various studies are provided in Chapter 3.) Figure 2.1 indicates the level of detail now achieved (Aldrick *et al.* 1995; Wellington land system).

CLIMATE	
Rainfall, mean (mm)	Annual 900 – 1600; lowest January or February (50 – 90), highest August or September (120 – 180)
Temperature, mean (°C)	Annual 8 – 12; lowest July (3 – 7), highest February (16 – 20)
Seasonal growth limitations	Temperature <10°C (av.): April – October Rainfall < potential evapotranspiration: February; frequent winter snow
GEOLOGY	
Age, lithology	Variable; mainly Ordovician undifferentiated sandstones, mudstones and shales, often metamorphosed; Devonian rhyolites and rhyodacites
PHYSIOGRAPHY	
Landscape	Partially dissected hilly to undulating prior landscape residuals
Elevation range (m)	560 – 1460
Relative relief (m)	100 – 500
Drainage pattern	Dendritic
Drainage density (km/km²)	0.9
PRESENT LAND USE	Uncleared: hardwood forestry (mostly ash timber with some timber for general construction); bush grazing of cattle; apiculture





Wellington (Wn)

Figure 2.1 Details of a land system description (continued).

LAND COMPONENT	1	2	3	4
Percentage of land system	40	40	15	5
Diagnostic features	Moderate slopes with deeper soils; sedimentary or igneous rocks	Gentle slopes with deeper soils; sedimentary or igneous rocks	Slopes of any gradient with shallow rocky soils; mainly Ordovician sediments	Drainage depressions, often with minor swamps
PHYSIOGRAPHY				
Slope %, typical and (range)	20 – 30, (15 – 50)	5 – 10, (2 – 15)	20 – 30, (15 – 50)	Variable, (10 – 40)
Slope shape	Straight to concave	Mainly concave	Straight to convex	Straight, some concave
SOIL				
Parent material	Variable: mostly rhyolite, rhyodacite, and siltstone; minor granodiorite		Sandstone, mudstone and shale	Colluvium and alluvium
Description	Mainly dark brown sandy clay loam grading into yellowish brown to reddish brown sandy clay loam to light clay with fine structure, commonly stony; topsoil often deep		Mainly shallow brown stony sandy loam to sandy clay loam	Limited observations — probably dark, undifferentiated with much organic matter and variable texture
Classification	Red and Brown Earths; Krasnozems Gn4.11, Gn4.31, Gn3.11, Gn2.11, Gn4.81, Um4.21, Um6.11, Um6.12, Um6.23, Um7.11		Lithosols, Brown Earths Um-, Um6.23, Uc1.44	Humic Gleys Uc1.24
Surface texture	Sandy clay loam, sometimes loam or clay loam		Sandy loam to sandy clay loam	-
Surface consistence	Soft when dry, friable when moist		Friable when moist	-
Depth (m)	Generally 1.0 – 2.0		<0.8	-
Nutrient status	Low to moderate		Low	Probably low
Available soil water capacity	Moderate		Low	Probably moderate
Perviousness to water	Rapid		Slow to moderate	Probably rapid
Drainage	Good		Good	Very poor to poor on alluvium; better on colluvium
Exposed stone (%)	Often 0, but 5 – 30 not uncommon		Probably >10	Probably 0
Sampled profile number	32	-	-	-
NATIVE VEGETATION				
Structure of vegetation and characteristic species of dominant stratum (+ Predominant species)	Mostly open forest II, III, often shrubby or layered:		Open forest I or II:	Limited observations — probably open forest I of *Leptospermum grandifolium*
	Mixed or pure stands with composition dependent on elevation and aspect; species including — Higher elevations — *E. delegatensis, E. dives, E. pauciflora, E. radiata, E. rubida* and occasionally *E. nitens* Lower elevations — *E. cypellocarpa, E. dives, E. obliqua, E. regnans, E. viminalis*			

Figure 2.1 Details of a land system description (continued).

Disturbance	Affected process and trend	Primary resultant deterioration			Causal activities	Primary off-site process
		Form	Susceptibility of components	Incidence within components		
Alteration of vegetation: **— reduction in leaf area, rooting depth and/or perenniality**	Reduced transpiration, resulting in: a) increased deep percolation	Not determined	Not determined	Not determined	Removal of trees	Increased movement of water to groundwater; increased base-flow of streams
	b) increased regolith wetness	Soil creep	1; moderate	Uncommon: observed occasionally on steep slopes as a natural process	Usually after the removal of trees from steeper land	Inceased sediment load
— reduction in density of tree roots	Decreased root-binding	Soil creep	1; moderate	Uncommon: observed occasionally on steep slopes as a natural process	Accelerated by major disturbance to the native vegetation	Increased sediment load
Increased exposure of surface soil	Increased overland flow and soil detachment	Sheet and rill erosion	1,3; moderate 2; low – moderate	Uncommon: locally severe	Clearing, logging, burning, overgrazing, road building and other earth-moving activities, trafficking by stock.	Increased flash flows and sediment load.
Increased physical pressure on soil	Increased compaction with	Structure decline	1,2; moderate 3; low 4; moderate – high	Uncommon	Increased trafficking, export of organic matter	-
	reduced infiltration	Sheet and rill erosion	1,3; moderate 2; low – moderate	Uncommon: locally severe	As for sheet and rill erosion above	Increased flash flows
Increased soil disruption	Increased soil break-up	Gully erosion	1,2,3,4; moderate	Uncommon	As for sheet and rill erosion above	Increased sediment load.

Comments: –

Figure 2.1 Details of a land system description (continued).