LANDS OF THE DAWSON–FITZROY AREA, QUEENSLAND

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Lands of the Dawson–Fitzroy Area, Queensland

Comprising papers by N. H. Speck, R. L. Wright, F. C. Sweeney,
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PART I. INTRODUCTION TO THE DAWSON–FITZROY AREA

By I. B. Wilson*

I. General

The survey reported is one of a series of scientific resources surveys undertaken in Australia and New Guinea by the Division of Land Research.

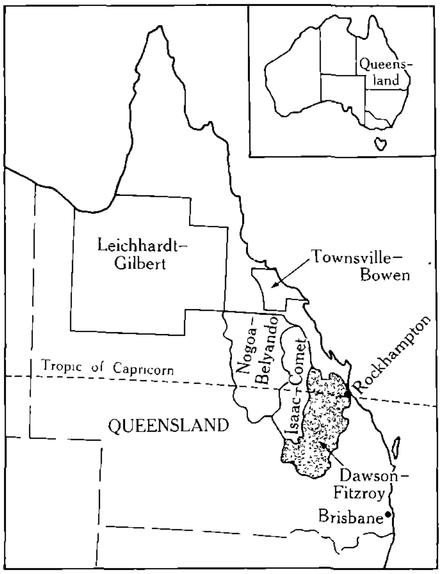

Fig. 1.—Location of the Dawson–Fitzroy area in relation to other survey areas in Queensland.

The surveys are conducted by a team of scientists (in this case, a geomorphologist, pedologist,† and botanist) who work together in the field and laboratory. The concepts and techniques have been described by Christian and Stewart.‡ A basic feature is that the areas are described in terms of land systems, which are defined as "an area or group of areas throughout which there is a recurring pattern of topography, soils, and vegetation".

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† Seconded from Queensland Department of Primary Industries.

‡ Christian, C. S., and Stewart, G. A. (1953).—General report on survey of Katherine-Darwin region, 1946. CSIRO Aust. Land Res. Ser. No. 1.

The technique of surveying large areas in limited time is based on the interpretation of aerial photographs, and a basic assumption is that the patterns distinguishable on aerial photographs are a reflection of land characteristics and

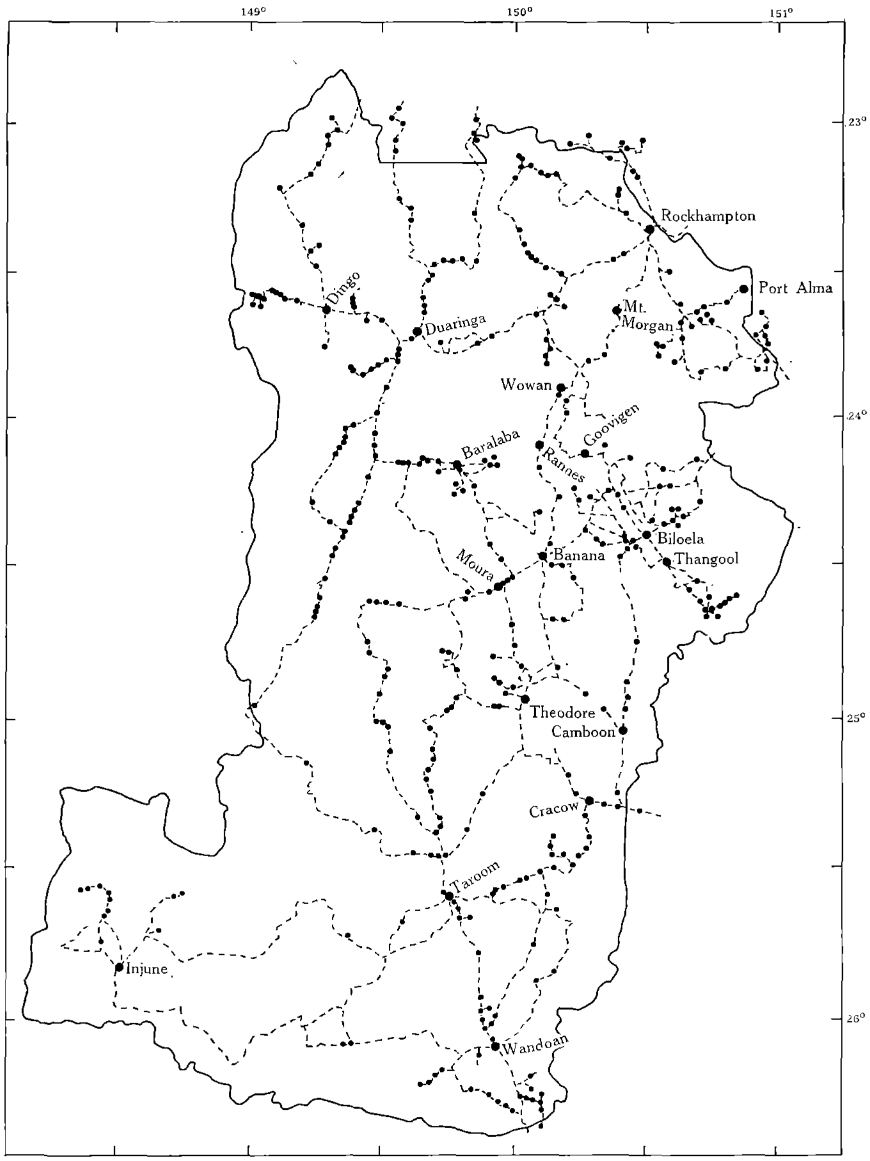

Fig. 2.—Traverse routes and query areas.

vice versa. A complete cover of aerial photographs is necessary. Most of this area was covered by photos at a scale of approx. 1 : 80,000, with a small area in the south at a scale of approx. 1 : 25,000, all taken in 1961 and 1962.

II. Location and Survey Statistics

The Dawson–Fitzroy area comprises 25,000 sq miles in east-central Queensland, between long. 148°15′E. and 151°E. and lat. 22°53′S. and 26°25′S. It embraces the entire Dawson River drainage basin and includes areas bordering the lower Mackenzie and the Fitzroy Rivers.

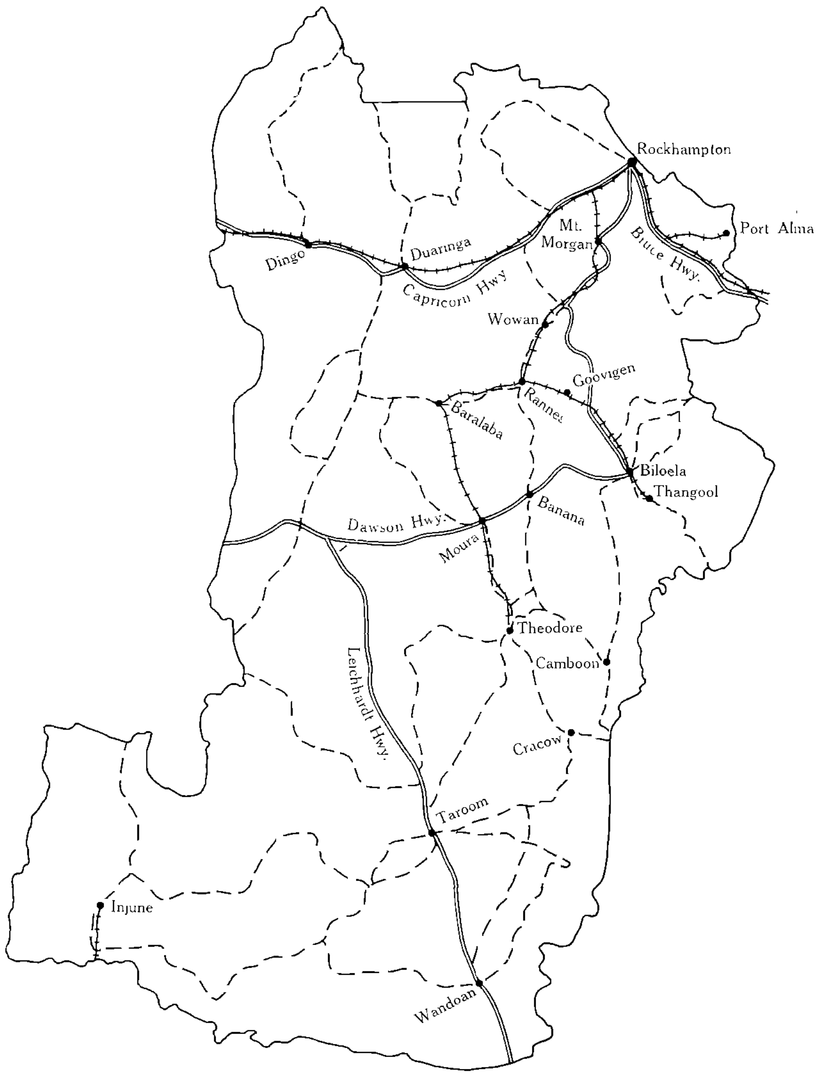

Fig. 3.—Railways and more important roads.

The area is one of three contiguous areas surveyed in the Fitzroy region of Queensland. Its location in relation to other areas surveyed in Queensland is shown in Figure 1.

Altogether, four months were spent in the field by the team—three periods from June to November 1963 and during the period April–May 1964. Recordings were made of 360 query areas, each comprising several site observations and entailing nearly 5000 miles of land traverses (Fig. 2). Approximately eight months were spent in the laboratory on interpretation of aerial photographs.

III. Towns and Communications

The city of Rockhampton, with a population exceeding 50,000, is situated near the mouth of the Fitzroy River, where it is the focus of road and rail communications. The population in the rest of the area is 24,000. To the west, the small towns of Dingo and Duaringa are served by both rail and sealed highway which link Rockhampton with Emerald and centres beyond (Fig. 3). To the south, the important mining town of Mount Morgan is the first of a number of towns on a railway system that bifurcates beyond Wowan to serve the mining and rural industries in the parallel Callide and Dawson valleys. The western branch serves Baralaba, Moura, and Theodore, while the eastern branch serves Goovigen, Biloela, and Thangool.

A railway line currently under construction will provide a direct link between the open-cut coal mine at Moura and the port of Gladstone.

Communications in the southern part of the survey area reflect a close association with the western Dawson and Maranoa regions further to the south. Taroom is linked by sealed highway to Wandoan, which is linked by both road and rail to Miles, on the western railway line that provides a direct link to Brisbane. Injune, in the extreme south-west of the Dawson valley, is similarly linked by road and rail to Roma, on the western railway line. Road construction throughout the whole area has been accelerated through mining and rural development.

Regular commercial airline flights serve Rockhampton, Biloela, Taroom, and Theodore.

IV. Acknowledgments

The Queensland Department of Primary Industries seconded Mr. F. C. Sweeney for the duration of the survey, and botanists of the Department assisted with plant identifications. The Commonwealth Bureau of Meteorology supplied climatic data and the Division of National Mapping, Department of National Development, compiled the base map. The Bureau of Mineral Resources, Geology and Geophysics, and the Queensland Department of Mines supplied geological information.

PART II. GENERAL DESCRIPTION OF THE DAWSON–FITZROY AREA

By R. A. Perry*

I. Major Features of the Environment

(a) *Climate*

The climate of the area has strong affinities to that of south-eastern Queensland and north-eastern New South Wales and is characterized by a warm wet summer and a warm dry winter. Some important features are:

(i) winter rainfall, although low, is not negligible and has an important influence on land use;

(ii) frosts occur on winter nights particularly in inland localities;

(iii) in all seasons the risk of rainfall being well below average is high.

The mean annual rainfall varies from 23 in. in the south-west to about 40 in. in the extreme north-east. On the average, about 75% of the total rain falls in the six months from November through April, with February being the wettest month. The average annual evaporation is about 65 in. throughout the area. It is highest (*c.* 8 in.) in December and lowest (*c.* 3 in.) in June or July.

Throughout the area mean maximum temperatures vary from about 70°F in mid winter to 90°F in mid summer. Summer mean minimum temperatures are also fairly uniformly 65–70°F throughout the area but winter mean minimum temperatures range from about 40°F at inland localities to 50°F on the coast.

(b) *Geology*

The oldest rocks occur in the north-east of the area, where interbedded sediments and volcanics were laid down in lower Palaeozoic (possibly Precambrian) times and metamorphosed to mainly schist and quartzite by mid Devonian. From middle Devonian through to middle Carboniferous times sediments and volcanics were laid down in the Yarrol basin adjacent to the older rocks.

After a terrestrial period during upper Carboniferous and lower Permian times the sediments and volcanics of the Bowen Basin were deposited over most of the area during Permian times. Marine and non-marine sequences are represented.

During Mesozoic times the northern part of the area was subject to erosion but in the south and centre thick terrestrial deposits (mainly shale and sandstone) were laid down during the Triassic.

Subsequently a period of orogeny occurred during which the Bowen Basin rocks were folded, faulted, and intruded to varying degrees throughout the area.

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After the orogeny the whole area except the Surat Basin in the south was exposed to erosion during Jurassic and Cretaceous times. In the Surat Basin non-marine sandstones, siltstones, and shales were deposited in the Jurassic and early Cretaceous. Later in the Cretaceous, marine sandstones and claystones were deposited. From late Cretaceous, erosion characterized the area.

(*c*) *Geomorphology*

The main elements of the present drainage pattern came into being in early Tertiary times. They incised themselves up to about 500 ft into the uplifted Mesozoic plains and etched out the present high country. Later in the early Tertiary the lowlands throughout the area were masked by terrestrial fan and lake deposits and basalt flows. Subsequently, deep weathering formed extensive lateritic plains.

During upper Tertiary the deeply weathered plains were dissected and extensive gently rolling plains were formed below them. The dissection was followed by widespread deposition—colluvial fans and aprons at the foot of ranges, thin gravelly sheet deposits on low interfluves, and flood-plains along the main rivers.

There then followed several alternations of drainage rejuvenation and flood-plain extension.

(*d*) *Soils*

The soils have been described in seven main groups, only four of which cover more than 5% of the area.

The commonest (36% of total area) are the texture-contrast soils which are characterized by marked textural contrast between the topsoil and subsoil. They are sands or loams over clays.

Cracking clay soils, some of which are strongly gilgaied, occupy 20% of the area, shallow soils and rock outcrops 19%, and dark brown and grey-brown soils 11%.

The remaining areas have alluvial soils, red and yellow earths, or uniform coarse-textured soils.

(*e*) *Vegetation*

Sixty per cent of the area is occupied by vegetation dominated by eucalypts, half in the form of grassy woodlands, the rest being either shrub woodland, sandstone forest, or high forest. The eucalypt country has a grass ground layer 3–5 ft high, dense in the grassy woodlands and sparse in the forests.

Acacia forests (locally called scrubs) occupy 23% of the area, brigalow (21%) being by far the most prominent. Various softwood scrubs—dense communities 15–40 ft high and characteristically containing many rain-forest species—occupy 13% of the area. Both the *Acacia* and softwood scrubs are characterized by a sparse, short, largely annual grass layer.

The remainder of the area carries various minor communities, 2% being treeless.

II. Major Types of Country

The area has been subdivided into 63 land systems. On the map the land systems have been grouped into 13 broad types of country on the basis of topography, soils, and vegetation. These broad types are described below.

(a) Mountains

These mountainous land systems (Plate 1, Fig. 1) have a local relief of 500–1000 ft and have in common a large proportion of steep slopes with shallow soils. They occupy 8% of the area. Gelobera and Hillmore land systems occur in the north-east on steeply dipping volcanics with interbedded sediments. Gelobera carries wet sclerophyll forest and Hillmore shrub woodland. Carborough land system consists of rugged sandstone country in the west of the area.

(b) Deeply Dissected Tablelands

This type of country comprises Nathan and Doonkuna land systems, both of which are deeply dissected sandstone tablelands with a high proportion of shallow and rocky soils. Together they account for 8% of the area and are restricted to the south.

(c) Hills with Eucalypt Forests

This type of country (Plate 1, Fig. 2) comprises three land systems (2% of area) with local relief ranging from 100 to 300 ft and with a considerable proportion of steep slopes with shallow rocky soils. Range land system is restricted to the Dawson Range and is developed on gently dipping sandstones and siltstones and the Tertiary weathered surface. Both Yebna and Surprise land systems occur in the south-west and are formed in flat-lying Mesozoic rocks, Yebna largely below the Tertiary weathered surface and Surprise containing remnants of it.

(d) Hills with Woodlands and Eastern Mid-height Grass

This type (Plate 2, Fig. 1) comprises hilly country, with a local relief up to 500 ft in the north-east of the area. It covers 3% of the area. The slopes are generally less steep and the topography less rugged than the mountain land systems. Boomer land system is developed on steeply dipping sedimentary rocks, and Irving on granitic and volcanic rocks.

(e) Hills with Softwood Scrub

Eight land systems (9% of the area), with a local relief of mainly about 100 ft but in some cases up to 500 ft, comprise this group (Plate 2, Fig. 2). It is extensive in the south and occurs as a number of isolated small areas in the north-east. All the land systems have in common a considerable proportion of clay loam to light clay soils carrying softwood scrub. They are differentiated on the rocks on which they are formed and on the associated soils and vegetation. Womblebank, Narran, Mundell, Oakleigh, and Redrange land systems occur on flat-lying Mesozoic sediments and differ mainly in the proportions of associated soils and vegetation. Lawgi land system is on Tertiary basalt, Toonda on steeply dipping Palaeozoic volcanics, and Malakoff on steeply dipping Palaeozoic sediments and volcanics.

(f) Tablelands and Plains

This group (Plate 3, Fig. 1) of three land systems (4% of the area) has been formed by the shallow dissection of the Tertiary land surface and has a local relief of less than 100 ft. It is commonest in the north-west, with small areas in the south and centre. Red and yellow earth soils form a considerable proportion of the soil cover. Duaringa and Kaiuroo land systems are both formed on flat-lying Tertiary sediments and differ in the proportion of undissected Tertiary land surface. They both carry predominantly shrub woodland. Narowie land system is formed on deeply weathered Tertiary basalt and has high forest vegetation.

(*g*) *Undulating Plains with High Forest*

These undulating plains (Plate 3, Fig. 2) have a local relief mainly less than 50 ft and are restricted to the west and south (7% of the area). They have been formed by dissection of the weathered Tertiary land surface and have predominantly texture-contrast soils and high forest. The six land systems differ in underlying rocks and associated land units. Conloi, Doughboy, and Glenhaughton land systems are formed from weathered flat-lying Mesozoic sediments (largely sandstones), Wooroonah and Redcliffe land systems from weathered Tertiary sediments and Tertiary–Quaternary colluvium and alluvium, and Auburn land system from weathered granitic rocks.

(*h*) *Undulating Plains with Woodlands and Texture-contrast Soils*

These undulating to strongly undulating plains (Plate 4, Fig. 1) (local relief mainly less than 100 ft but up to 200 in some land systems, and up to 500 ft in Ohio land system) with mainly texture-contrast soils carrying eucalypt woodlands over eastern mid-height grass are widespread and cover 17% of the area. Melbadale and Perch land systems are developed on dissected Tertiary land surface and contain remnants of the surface with red and yellow earths. Rosewood, Bannockburn, and Mourangie land systems are strongly undulating plains developed on relatively unweathered Palaeozoic argillaceous sediments. They have shallow rocky soils and outcrops as well as texture-contrast soils. They differ mainly in vegetation cover and the relative proportions of the associated land units. Ohio and Torsdale land systems are also strongly undulating, especially the former, but are developed on steeply dipping Palaeozoic volcanics, Torsdale land system having more extensive erosional lower slopes with cracking clay soils than Ohio. Bouldercombe land system is a complex, strongly undulating plain developed on granitic and volcanic rocks. Montana, Langmorn, Woleebee, and Palmtree are relatively gently undulating (local relief mainly less than 50 ft) valley plains, all developed on colluvial–alluvial materials but with varying amounts and kinds of erosional slopes. In Montana, Woleebee, and Palmtree land systems the erosional slopes are developed on Mesozoic sediments. Montana land system is distinguished by its relatively extensive erosional slopes, and Palmtree by its broad, flooded, drainage floors. In Langmorn land system the erosional slopes are on Palaeozoic volcanic rocks.

(*i*) *Undulating Plains with Woodlands and Cracking Clay Soils*

These undulating plains (Plate 4, Fig. 2) occupy a relatively small proportion (2%) of the area, mainly in the east-central part but with small isolated areas throughout.

The local relief is normally less than 50 ft but rises to 200 ft in some places. The four land systems are all developed on relatively unweathered volcanic rocks, Westwood and Grevillea land systems on Tertiary basalt flows and Orana and Barfield on steeply dipping Palaeozoic volcanics. The predominant soils are cracking clays and the common vegetation is silver-leaved ironbark woodland with eastern mid-height grass.

(*j*) *Undulating Plains with Woodlands and Red Earths*

This type of country is represented only by Mimosa land system which comprises two small areas ($<1\%$ of total area) in the north-western quarter. It is developed on old alluvium in broad valleys and has a local relief of less than 30 ft. Red earths are the predominant soils and shrub woodland with three-awn grass is the common vegetation.

(*k*) *Undulating Plains with Brigalow Scrub*

These undulating to nearly flat plains (Plate 5, Fig. 1) are very extensive (22% of area) throughout the area except in the north-east. They are typified by a large proportion of cracking clay soils carrying brigalow scrub, and are thus important because of their agricultural and pastoral potential. In all eight land systems the local relief is mainly less than 50 ft. The major part of all the land systems is developed on Tertiary–Quaternary colluvium–alluvium. The land systems are mainly distinguished by the nature and proportion of the associated erosional slopes, and to some extent by the nature and proportion of associated soils and vegetation.

(*l*) *Undulating Plains with Softwood Scrub*

These undulating plains (Plate 5, Fig. 2) are widespread and occur upslope from the previous type. They occupy 8% of the area and have a local relief mainly between 25 and 75 ft. They are characterized by clay soils (commonly lighter, shallower, and less cracking than those in the previous type) and by softwood scrub vegetation grading downslope into brigalow scrub. Like the previous type they are important because of their agricultural and pastoral potential.

The three land systems are formed from weathered rocks below the Tertiary weathered land surface, Eurombah land system mainly on Mesozoic shales and Banana and Ramsay land systems on Palaeozoic argillaceous rocks.

(*m*) *Alluvial Plains*

These alluvial plains (Plate 6, Fig. 1) occupy 8% of the area and are associated with main streamlines. Coreen land system consists of stable old flood-plains with cracking clay soils carrying brigalow scrub. The other six land systems all have grassy woodland or tall grassy woodland vegetation. Dingo, Juandah, Kroombit, and Raglan land systems are all stable alluvial plains with mainly texture-contrast soils. In Dingo land system the alluvium is derived from the weathered Tertiary land surface but in Juandah, Kroombit, and Raglan the alluvium is derived from less weathered rocks. Kroombit land system is characterized by broad levees, and

Raglan by saline flats on its lower margins. Gavial and Coolibah land systems comprise unstable flood-plains of the main rivers, broken in Gavial land system by a dense pattern of distributary channels.

(*n*) *Coastal Plains*

This type of country (Plate 6, Fig. 2) is represented only by Carpentaria land system which covers 1% of the area and consists largely of saline mud flats.

Fig. 1.—Mountain country with a local relief of 500–1000 ft covers 8% of the area. It is characterized by steep rocky slopes with various eucalypt forests but Gelobera land system (pictured above) carries rain forest.

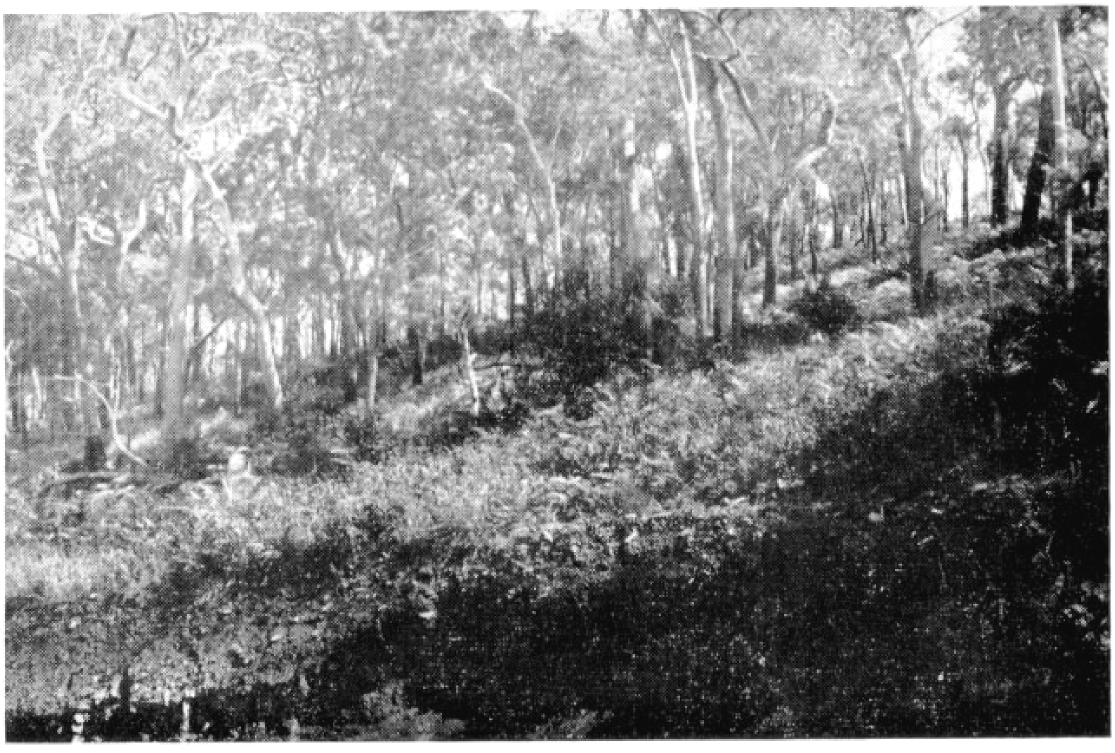

Fig. 2.—Hills with eucalypt forests have a local relief of 100–300 ft and cover 2% of the area, mainly in the south-west. Shallow rocky soils are characteristic.

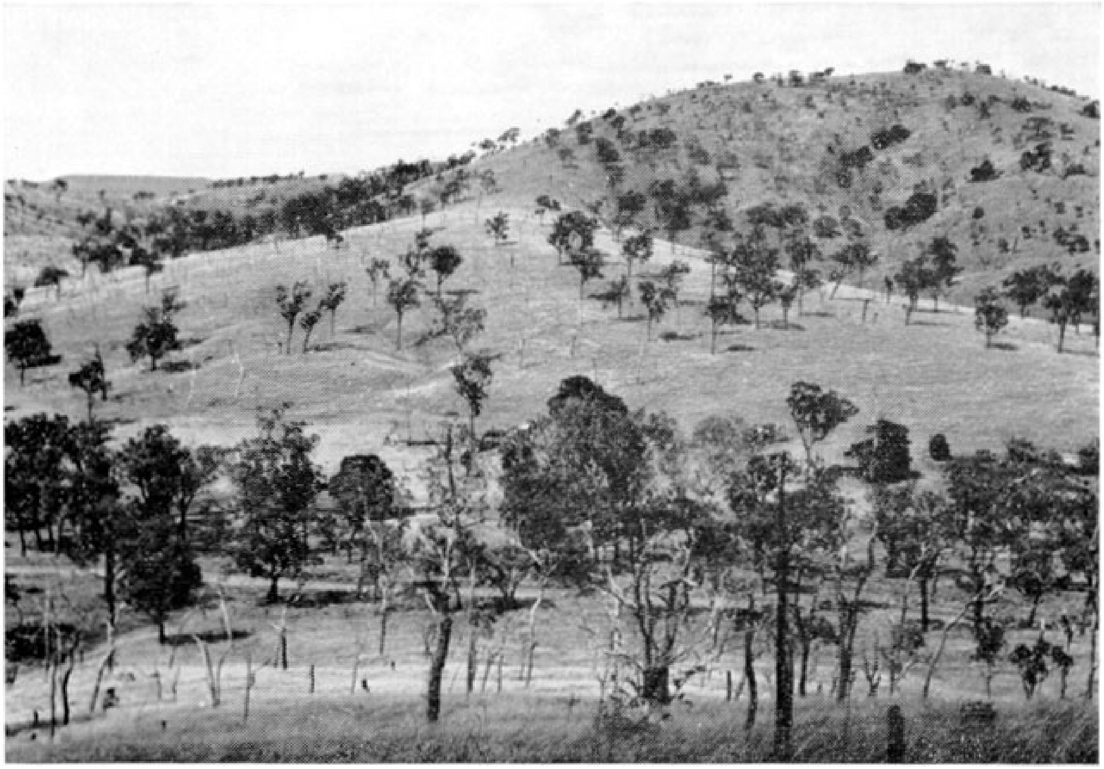

Fig. 1.—Hills with woodlands and eastern mid-height grass have a local relief up to 500 ft. They cover 3% of the area, mainly in the north-east. Shallow soils predominate.

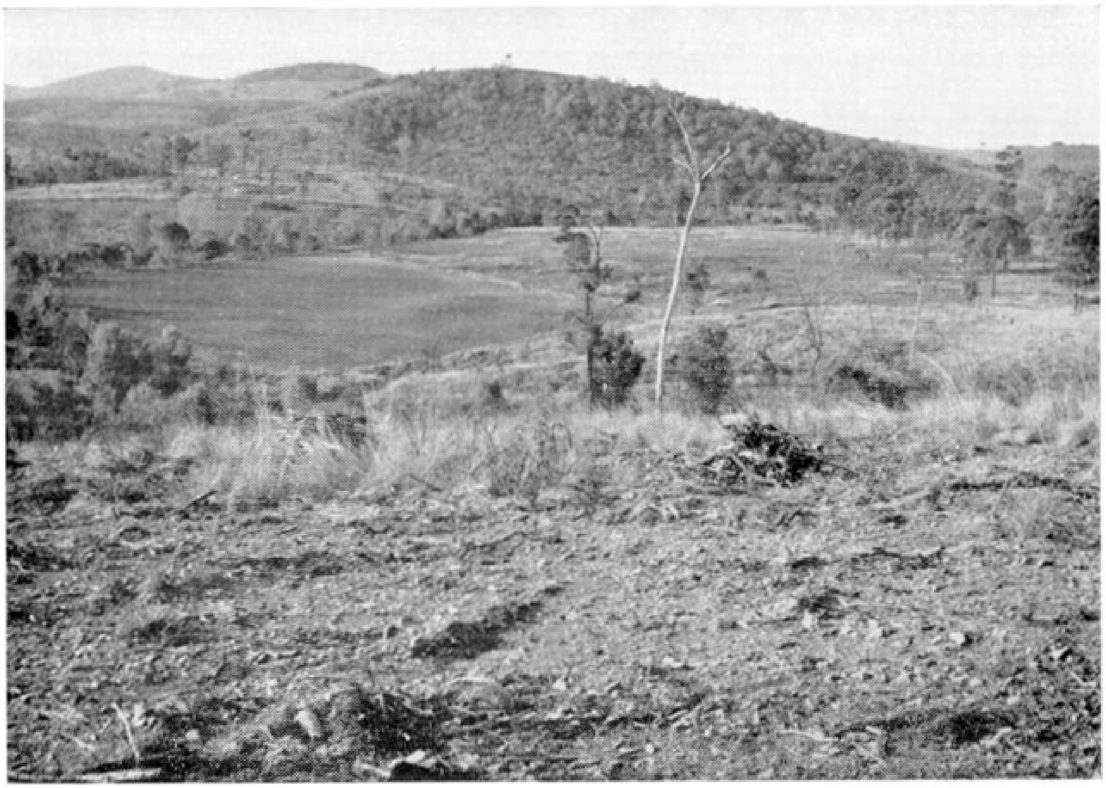

Fig. 2.—Hills with softwood scrub have a local relief mainly about 100 ft but up to 500 ft in places. They are extensive in the south and cover 9% of the area. The common soils are clay loams to light clays of varying depth.

Fig. 1.—Tablelands and plains with a local relief less than 100 ft and with largely red and yellow earth soils cover 4% of the area, mainly in the north-east. The vegetation is sandstone woodland or high forest.

Fig. 2.—Undulating plains with high forest have a local relief less than 50 ft. They cover 7% of the area and are restricted to the west and south. Texture-contrast soils are common.

Fig. 1.—Undulating plains with woodlands and texture-contrast soils have a local relief mainly less than 100 ft. They are widespread and cover 17% of the area.

Fig. 2.—Undulating plains with woodlands and cracking clay soils cover only 2% of the area, mainly in the east-central part. They are developed mainly on volcanic rocks and have a local relief less than 50 ft.

Fig. 1.—Undulating plains with brigalow scrub are very extensive, except in the north-east, and cover 22% of the area. Local relief is mainly less than 50 ft and the common soils are cracking clays.

Fig. 2.—Undulating plains with softwood scrub occur upslope from the brigalow country and cover 8% of the area. Clay loam to light clay soils predominate and local relief is from 25 to 75 ft.

Fig. 1.—Alluvial plains, associated with the main streams, cover 8% of the area. Texture-contrast soils and grassy woodlands predominate.

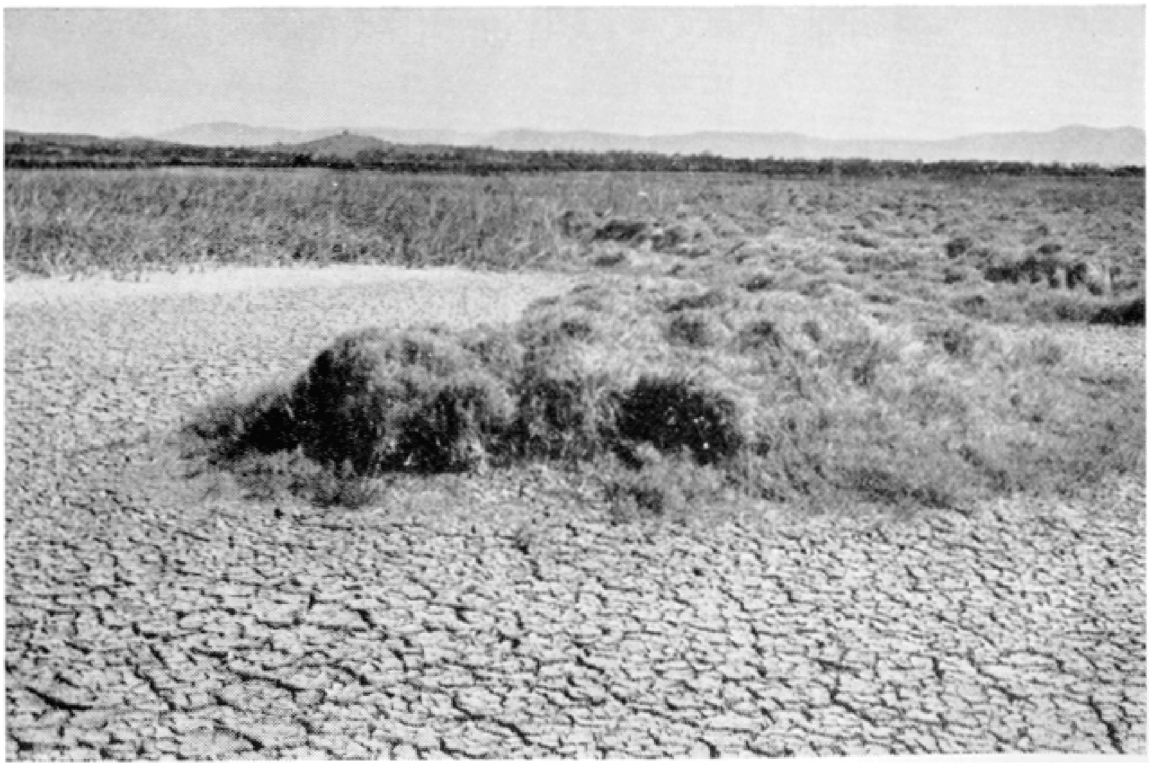

Fig. 2.—Coastal plains with saline mud flats cover only 1% of the area.

PART III. LAND SYSTEMS OF THE DAWSON–FITZROY AREA

By N. H. Speck,* R. L. Wright,† F. C. Sweeney,‡ H. A. Nix,* and R. A. Perry*

I. General

The lands of the area have been mapped into 63 land systems which are areas of country with similar patterns of land forms, soils, and vegetation (Christian and Stewart 1953). Each land system is described in tabular form in terms of its component units which are parts of the landscape and are relatively homogeneous in land form, soils, and vegetation. The relationships of the units in each land system are shown by a block diagram. In the land system descriptions the units are arranged according to their elevation, from highest to lowest, except for the alluvial land systems, where the order is from channel outwards.

Table 1

Similar land systems in the Nogoa–Belyando, Isaac–Comet, and Dawson–Fitzroy areas

Nogoa–Belyando	Isaac–Comet	Dawson–Fitzroy
Wharton	Arcadia	—
—	Barwon	Barwon
Kareela	Bedourie	Womblebank
Blackwater	Blackwater	Wandoan
Carborough	Carborough	Carborough
Comet	Comet	Coreen
Alpha	Connors	Dingo
Hope	Cotherstone	—
Durrandella	Durrandella	—
Funnel	Funnel	Coolibah
Hillalong	Hillalong	—
Humboldt	Humboldt	Thomby
Lennox (in part)	Junee	Kaiuroo
Monteagle	Monteagle	—
Oxford	Oxford	—
Percy	Percy	—
—	Planet	Nathan (in part)
—	Racecourse	Eurombah
Somerby	Somerby	Highworth
Waterford	Waterford	—
Skye	—	Woleebee

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The areas of the land systems were determined with a dot grid (25 dots/sq in.) on a 1 : 506,880 (8 miles/in.) map. The proportions of each unit in the land systems were estimated from photo interpretation and field experience. The symbols in the column headed "land class" refer to land capability classes described in Appendix I. The symbols following the soil family names refer to principal profile forms (Northcote 1965).

Some of the land systems are similar enough to land systems of the Isaac–Comet (Story *et al.* 1967) and Nogoa–Belyando (Gunn *et al.* 1967) areas to bear the same name. These, and others that are somewhat similar but different enough to have different names, are listed in Table 1.

On the land system map the land systems are arranged in groups defined according to physiography, soils, and vegetation. The land system descriptions in the report are arranged in the same order. The smaller maps (soils, vegetation, and pasture lands) have been compiled by grouping land systems according to their dominant characteristics.

II. Softwood Scrub–Brigalow Scrub Abstract Land System

An important feature of the Dawson–Fitzroy area is the wide occurrence of lands of low relief carrying various types of softwood scrub and brigalow scrub. These lands have been subdivided into about 20 land systems throughout which a limited number of land units recur, in varying proportions. In order to demonstrate better the affinities of the land systems and the distribution of the land units, the approach of Brink *et al.* (1966) has been adopted. The whole softwood scrub–brigalow scrub landscape is designated as an abstract land system composed of 17 abstract land facets that recur in a typical topographic sequence. Each of the 20 local form land systems is comprised of combinations of some of the land facets with, in some cases, additional land units that do not regularly occur throughout the abstract land system. Some of the land facets of the abstract land system also occur as land units in land systems not considered part of the softwood scrub–brigalow scrub abstract land system.

Other abstract land systems could be defined in the area, but would contribute less to the understanding of the relationships between various land units and land systems than the softwood scrub–brigalow scrub abstract land system.

Overall, the softwood scrub–brigalow scrub landscape is undulating, the topographic sequence, from highest to lowest, being low hills, erosional crests and steeper upper slopes, erosional or colluvial lower slopes, alluvial drainage floors, and channels. The soils in the upper part of the sequence are clays with a general increase in depth and degree of cracking downslope. Clays or texture-contrast soils are characteristic of the lower part of the catena. The vegetation sequence is from microphyll vine woodland on the hills, through softwood scrub, softwood scrub with brigalow, softwood scrub with brigalow and bauhinia, softwood scrub with blackbutt, softwood scrub with belah, brigalow scrub with blackbutt, brigalow scrub with belah, brigalow scrub with bauhinia, brigalow scrub with wilga and sandalwood, silver-leaved box grassy woodland, brigalow scrub with poplar box, poplar box with sandalwood, poplar box grassy woodland, blue gum–Moreton Bay ash tall woodland, to fringing communities along the channels.

The 17 land facets of the abstract land system do not all occur in any one location. In various parts of the area, combinations, varying in both kind and proportions, of the land facets (in most cases including some additional land facets) have been recognized as different land systems. For example Eurombah land system

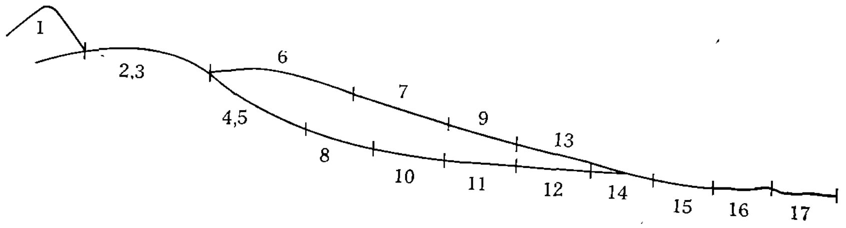

Fig. 4.—Land facets of the softwood scrub–brigalow abstract land system.

1 Hill slopes; shallow clay loams to clays; microphyll vine woodland.
2 Crests and gentle upper slopes on sedimentary rocks; moderately deep to deep cracking clays; softwood scrub.
3 Crests and gentle upper slopes mainly on basalt; moderately deep to deep cracking clays; softwood scrub.
4 Steeper upper slopes on sedimentary rocks; shallow to moderately deep clay loams and light to medium clays; softwood scrub with brigalow.
5 Steeper upper slopes on basalt; shallow clay loams and light to medium clays; softwood scrub with brigalow.
6 Gentler mid slopes and lower crests; moderately deep light to medium clays; softwood scrub with brigalow and bauhinia.
7 Steeper mid slopes and lower crests; very shallow sandy clay loams and clays; softwood scrub with blackbutt.
8 Upper colluvial slopes; moderately deep to deep clay loams to clays; softwood scrub with belah.
9 Erosional mid slopes; shallow to moderately deep texture-contrast soils; brigalow scrub with blackbutt.
10 Lower colluvial slopes; moderately deep to deep cracking clays with a stony or gravelly surface; brigalow scrub with bauhinia.
11 Upper colluvial–alluvial slopes; deep to very deep cracking clays; brigalow scrub, wilga, and sandalwood.
12 Lower colluvial–alluvial slopes; strongly gilgaied deep clay soils; brigalow scrub.
13 Erosional lower slopes; shallow to deep texture-contrast soils; silver-leaved ironbark woodland.
14 Tributary drainage floors and lower slopes; deep to very deep texture-contrast soils; brigalow scrub with poplar box.
15 Colluvial slopes in lowest sectors; moderately deep to deep texture-contrast soils; poplar box woodland with sandalwood.
16 Main drainage floors; deep texture-contrast soils; poplar box woodland.
17 Alluvial flats; deep layered alluvial soils; blue gum–Moreton Bay ash tall woodland.

contains 12 of the 17 land facets of the general catena with the upper softwood scrub part making up about 50% of its area, the lower brigalow scrub part about 40%, and the eucalypt woodlands accounting for only a small proportion. In Wandoan land system about 20–25% of the area is softwood scrub land facets and 65–70% is brigalow scrub.

The softwood scrub–brigalow scrub abstract land system is illustrated diagrammatically in Figure 4 and its component abstract land facets are described in detail below. The occurrence of these land facets in all the land systems of the area is shown in Table 2.

Table 2

LAND UNITS OF THE VARIOUS LAND SYSTEMS IN RELATION TO LAND FACETS OF THE SOFTWOOD SCRUB–BRIGALOW SCRUB ABSTRACT LAND SYSTEM

The figures in the body of the table are land unit numbers for each land system

Land System	Land Facets of Softwood Scrub–Brigalow Scrub Abstract Land System																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Mountains																	
Gelobera													4				
Hillmore	2												3		4		6
Carborough	4												5		7	9	
Deeply dissected tablelands																	
Nathan																	8
Doonkuna	5										8		6		7	9	
Hills with eucalypt forests																	
Range																	
Yebna													4, 6		5		
Surprise											7		4		6	9	
Hills with woodlands																	
Boomer													3				6
Irving	3												5		7		8
Hills with softwood scrub																	
Malakoff	1								4				5				
Womblebank	1			1				7	4		6		5			8	
Toonda	1										4		5				
Narran		1		2					4		7		6		8	9	
Mundell	3			1					2		4, 5		7			8	
Lawgi			1		2	4					5						
Oakleigh				3			4				5		7		6	8	
Redrange		1		2		3	4				5		8		6		
Tablelands and plains																	
Duaringa																8	
Kaiuroo																6	
Narowie																	

Undulating plains with high forest																	
Conloi													4		5		
Doughboy													6		9	10	
Glenhaughton													4		7	8	
Wooroonah																8	7
Redcliffe																	
Auburn																	
Undulating plains with woodlands on texture-contrast soils																	
Melbadale																8	
Perch													4		5	9	8
Rosewood												4				5	
Bannockburn													3				
Mourangie													3				7
Ohio													1		4	5	
Torsdale	1										6	6	2		5		
Bouldercombe															9		
Montana													1, 2		4	7	
Langmorn													1		4		5
Woleebee													1		3	5	
Palmtree													1, 2		4	7	
Undulating plains with woodlands on cracking clay soils																	
Westwood											6				5		
Grevillea			1		1												
Orana													1				
Barfield																	
Undulating plains with woodlands on red earths																	
Mimosa																	
Undulating plains with brigalow scrub																	
Kariboe			2	1	3, 4						5, 6			7			9
Wandoan		1		2		4		6	5	8	7, 10		9	11		12	
Barwon												3	2	4			
Kiddell		1		2		3			4	5	5, 7		9		8		
Highworth		1							2		3	6	5	8		9	
Thomby		2							3		5	7	6	9		10	
Hinchley										1	2, 4		3			5	
Dakenba				1					2	4	3, 5	6		7		9	

TABLE 2 (*Continued*)

Land System	Land Facets of Softwood Scrub–Brigalow Scrub Abstract Land System																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Undulating plains with softwood scrub																	
Eurombah		1	3	2	4	5		7, 9	6		8, 10			11		12	
Banana			1								6		4			9	
Ramsay									1		7, 8	7					
Alluvial plains																	
Coreen											7	5					
Dingo												6				4	
Juandah													7		6	2	
Kroombit																	
Raglan															4		
Gavial																	
Coolibah																	
Coastal plains																	
Carpentaria																	

Land Facet 1.—Hills on sedimentary or volcanic rocks with slopes up to ½ mile long and varying mainly from 5 to 15% (locally exceeding 40%), and with cobble-strewn outcrop surfaces. Soils shallow (locally moderately deep) clay loams or light to medium clays with or without grit and gravel (Ingelara, Rugby, Kinnoul, Cheshire, and Carraba). Vegetation microphyll vine woodland (a more or less continuous canopy of slender densely packed trees 20–40 ft high with a discontinuous emergent layer of evergreen or semi-evergreen trees, lianes common, dense shrub layer, sparse scrub grass).

Land Facet 2.—Gentle upper slopes and crests on sedimentary rocks, slopes up to 2% and 1 mile long. Sealed, cracking surfaces with moderately deep to deep cracking clay soils (Teviot). Vegetation softwood scrub (an uneven canopy 15–30 ft high of slender, densely packed trees with a discontinuous emergent layer 30–60 ft high of mixed evergreen, semi-evergreen, and deciduous trees characterized by *Brachychiton rupestre*, moderately dense to dense shrub layer, sparse scrub grass).

Land Facet 3.—Gentle upper slopes and crests on basalt, slopes mainly less than 2% (locally up to 5%) and up to 1 mile long, with cobble patches. Soils moderately deep light to medium clays (Cheshire), in some parts shallower (Kinnoul). Vegetation softwood scrub (an uneven canopy 15–30 ft high of slender, densely packed trees with a discontinuous emergent layer 30–60 ft high of mixed evergreen, semi-evergreen, and deciduous trees characterized by *Brachychiton rupestre*, moderately dense to dense shrub layer, sparse scrub grass).

Land Facet 4.—Steeper upper slopes and crests on sedimentary rocks, slopes mainly less than 5% (locally up to 30%) and up to ½ mile long, with cobble-strewn surfaces with minor rock outcrop. Soils shallow to moderately deep clay loams and light to medium clays overlying gravel layers and weathering rock (Kinnoul). Vegetation softwood scrub (an uneven canopy 15–30 ft high of slender, densely packed trees with a discontinuous emergent layer 30–60 ft high of mixed evergreen, semi-evergreen, and deciduous trees characterized by *Brachychiton rupestre* and *Acacia harpophylla*, moderately dense to dense shrub layer, sparse scrub grass).

Land Facet 5.—Steeper upper slopes and crests on basalt, slopes mainly less than 10% (locally up to 25%) and less than ¼ mile long, cobble-strewn surfaces with minor rock outcrops. Soils shallow clay loams and light to medium clays (Kinnoul, locally Rugby). Vegetation softwood scrub (an uneven canopy 15–30 ft high of slender, densely packed trees with a discontinuous emergent layer 30–60 ft high of mixed evergreen, semi-evergreen, and deciduous trees characterized by *Brachychiton rupestre* and *Acacia harpophylla*, moderately dense to dense shrub layer, sparse scrub grass).

Land Facet 6.—Gentle mid slopes and lower crests on sedimentary rocks, slopes mainly less than 5% and less than ½ mile long, sealed surfaces with cobble patches. Soils moderately deep light to medium clays (Cheshire), locally shallower (Kinnoul). Vegetation softwood scrub (an uneven canopy 15–20 ft high of slender, densely packed trees with a discontinuous emergent layer 30–60 ft high of mixed evergreen, semi-evergreen, and deciduous trees characterized by *Brachychiton rupestre*, *Acacia harpophylla*, and *Bauhinia carronii*, moderately dense to dense shrub layer, sparse scrub grasses).

Land Facet 7.—Steeper mid slopes and lower crests on sedimentary rocks, slopes mainly less than 15% and less than ¼ mile long with minor rock outcrops. Soils very shallow sandy clay loams and clays (Rugby). Vegetation softwood scrub (an uneven canopy 15–30 ft high of slender, densely packed trees with a discontinuous emergent layer 30–60 ft high of mixed evergreen, semi-evergreen, and deciduous trees characterized by *Brachychiton rupestre* and *Eucalyptus cambageana*, moderately dense to dense shrub layer, sparse scrub grasses).

Land Facet 8.—Upper colluvial slopes mainly less than 3% (locally up to 5%) and less than ½ mile long. Soils moderately deep to deep clay loams to clays (Cheshire) or moderately deep cracking clays (Teviot), locally deep cracking clays (Downfall); vegetation softwood scrub (an uneven canopy 15–30 ft high of slender, densely packed trees, with a discontinuous emergent layer 30–60 ft high of mixed evergreen, semi-evergreen, and deciduous trees characterized by *Brachychiton rupestre* and *Casuarina cristata*, moderately dense to dense shrub layer, sparse scrub grasses).

Land Facet 9.—Erosional mid slopes mainly less than 5% (locally up to 15%) and less than ¼ mile long; soils a complex of very shallow sandy clay loams and clays (Rugby), with shallow to moderately deep texture-contrast soils (Southernwood, Medway, Retro, and Taurus), locally deeper (Wyseby); vegetation brigalow forest with a tree layer 30–60 ft high of *Acacia harpophylla* and *Eucalyptus cambageana*, a moderately dense tall shrub–small tree layer 10–30 ft high of *Geijera parviflora* and *Eremophila mitchellii*, a moderately dense lower shrub layer of *Carissa ovata*, *Heterodendrum* sp., and *Capparis* spp., and sparse scrub grasses.

Land Facet 10.—Lower colluvial slopes, concave, mainly less than 5% and up to ¼ mile long, locally dissected up to 20 ft into gently rounded spurs; soils moderately deep to deep cracking clays with a stony and gravelly surface (Teviot); vegetation brigalow forest with a tree layer 30–60 ft high characterized by *Acacia harpophylla* and *Bauhinia carronii*, sparse to moderately dense lower trees, tall shrubs, and low shrubs, and sparse scrub grasses.

Land Facet 11.—Upper colluvial–alluvial slopes mainly less than 3% and less than ½ mile long; soils deep or very deep cracking clays (Rolleston or Downfall), locally deep gravelly clay loams to light clays (Cheshire); vegetation brigalow forest with a tree layer 30–60 ft high of *Acacia harpophylla*, in parts with *Casuarina cristata*, a moderately dense tall shrub–small tree layer 10–30 ft high of *Geijera parviflora* and *Eremophila mitchellii*, a moderately dense lower shrub layer of *Carissa ovata*, *Heterodendrum* sp., and *Capparis* spp., and sparse brigalow scrub grasses.

Land Facet 12.—Lower colluvial–alluvial slopes mostly less than 1%, but up to 2% locally, and up to 1 mile long; strongly gilgaied complex of deep cracking clays (Pegunny) in the depressions and texture-contrast soils (Wyseby or Retro) on the puffs; vegetation brigalow forest with a tree layer 30–60 ft high characterized by *Acacia harpophylla* locally, with *Casuarina cristata*, *Eucalyptus thozetiana*, or *E. cambageana*, a moderately dense tall shrub–low tree layer 10–30 ft high of *Geijera parviflora* and *Eremophila mitchellii*, a moderately dense to dense low shrub layer of *Carissa ovata*, *Heterodendrum* sp., and *Capparis* spp., and sparse brigalow scrub grasses.

Land Facet 13.—Erosional lower slopes, mainly less than 5% (locally up to 15%) and up to ½ mile long, locally dissected up to 30 ft into narrow spurs with flank slopes up to 10%; mainly shallow to deep texture-contrast soils (Southernwood and Medway, locally Luxor, Retro, Springwood, Taurus, or Wyseby); vegetation grassy woodland with a tree layer 30–40 ft high characterized by *Eucalyptus melanophloia*, locally in association with *E. dichromophloia*, sparse to moderately dense shrub layer, eastern mid-height grass.

Land Facet 14.—Tributary drainage floors up to ¼ mile wide and with gradients up to 1 in 50; deep to very deep texture-contrast soils (mainly Retro, locally Taurus or Wyseby), locally deep cracking clays; vegetation brigalow forest with a tree layer 30–60 ft high characterized by *Acacia harpophylla* and *Eucalyptus populnea*, a moderately dense tall shrub–low tree layer 10–30 ft high of *Geijera parviflora* and *Eremophila mitchellii*, a moderately dense low shrub layer of *Carissa ovata*, *Heterodendrum* sp., and *Capparis* spp., and sparse scrub grasses.

Land Facet 15.—Colluvial slopes, concave, up to about 5% but mainly 2–3%, and up to ½ mile long; moderately deep to deep texture-contrast soils (mainly Retro, locally Taurus or Broadmeadow); vegetation grassy woodland with a tree layer 30–40 ft high characterized by *Eucalyptus populnea*, sparse to moderately dense shrub layer of mainly *Eremophila mitchellii*, eastern mid-height grass.

Land Facet 16.—Main drainage floors mostly up to ½ mile wide (locally to 2 miles) with gradients below 1 in 100 and with transverse slopes up to 2% locally; deep texture-contrast soils (mainly Retro, locally Taurus or Wyseby); vegetation grassy woodland with a tree layer 30–40 ft high characterized by *Eucalyptus populnea*, shrub layer sparse or absent, eastern mid-height grass.

Land Facet 17.—Alluvial flats, mainly less than ¼ mile wide but up to 2 miles, with gradients mainly less than 1 in 100; mainly deep layered alluvial soils (Moolayember, Clematis) or deep texture-contrast soils (Wyseby); vegetation tall grassy woodland with a tree layer 60–100 ft high characterized by *Eucalyptus tereticornis* and *E. tessellaris*, shrub layer sparse or absent, frontage grasses.

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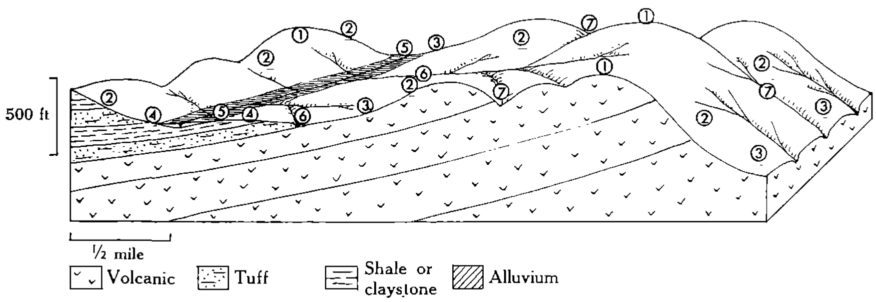
(1) Gelobera Land System (340 sq miles)

Volcanic hills and mountains with eucalypt forests, in the north-east.

Geology.—Relatively unweathered or deeply weathered, steeply dipping rhyolitic and andesitic volcanics with marine beds of Devonian to Carboniferous age, and locally Permian.

Geomorphology.—Standing above, or formed by deep dissection of, the Tertiary weathered surface—mountains and hills: strike belts up to 10 miles wide, mainly comprising steep hill slopes with subordinate but moderately extensive crest and hill-foot slopes; dense dendritic or rectangular pattern of incised valleys, with restricted alluvial drainage floors in lowest sectors; local relief typically up to 500 ft but attaining 1000 ft.



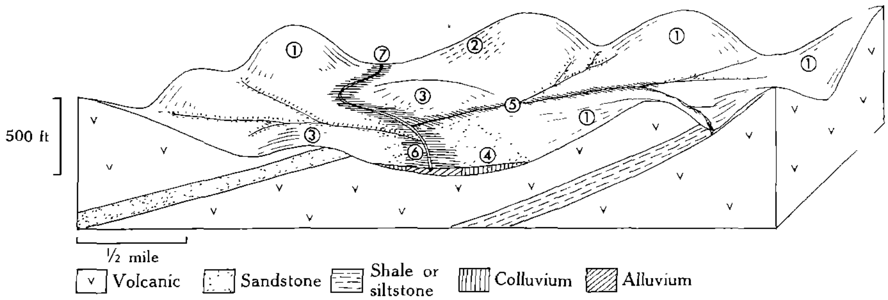
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	15	Crest slopes: mainly less than 5% and ¼ mile in extent; firmed loamy surfaces with cobble patches and rock outcrops locally	Very shallow gritty loam, Rugby (Um1.41)	Wet sclerophyll forest (11). Closely spaced trees (60–80 ft) (*E. tenuipes*, *E. crebra*); understorey of low palms, cycads, *Xanthorrhoea* sp., and ferns; ground cover mainly forbs and sparse forest grass (77)	VId_5, r_{4-5}
2	55	Hill slopes: commonly up to about 60%, but attaining 70–80% locally, and up to ½ mile long; boulder-strewn outcrop slopes with minor benches	Rock outcrops with patches of very shallow to shallow loams, Rugby and Kinnoul (Um1.41)	High-rainfall parts: wet sclerophyll forest (11) grading to dry sclerophyll forest; various combinations of *E. crebra*, *E. citriodora*, *Tristania conferta*, and *E. tenuipes*; understorey mainly cycads, *Xanthorrhoea* sp., and locally low palms; ground cover mainly ferns and forbs with sparse forest grass (77). Sheltered high-rainfall parts: microphyll vine woodland (1). Lower-rainfall parts: shrub woodland (48) and grassy woodland (64); trees (50–70 ft), mainly *E. crebra*; moderate to dense shrubs; modified in many places to grassy woodlands; sparse to moderate eastern mid-height grass (80)	$VII–VIIIt_{7-8}$, r_5
3	20	Hill-foot slopes: mainly less than 10% and ¼ mile long, dissected up to 50 ft into rounded spurs with flank slopes up to 25%; firmed loamy surfaces with pebble-cobble patches and rock outcrops locally	Shallow texture-contrast soils, Southernwood (Dr3.41)	High forest (13). Closely spaced trees (60–100 ft) (*E. crebra*, *E. maculata*); moderate shrub layer, forest grass (77)	VIt_6, r_{4-5}
4	<5	Land facet 13: erosional lower slopes	Shallow to moderately deep gritty texture-contrast soils, Medway and Retro (Dr2.13, Dy2.23)	Silver-leaved ironbark grassy woodland	IVp_{3-4}, d_{3-4}, e_{3-4}
5	<5	Drainage floors: less than ¼ mile wide, gradients up to about 1 in 70; firmed loamy surfaces	Deep texture-contrast soils with a fine sandy clay loam surface over a medium clay, Retro (Dd3.13)	Tall grassy woodland (54). Moderately open tree layer (60–100 ft) (*E. tereticornis*, *E. crebra*); moderate shrubs; frontage grass (82)	$III–IVp_{3-4}$, w_{3-4}
6	<5	Channels—lower sectors: up to 50 ft wide and 10 ft deep	Bed loads range from silt to boulders	Fringing vegetation	
7	<5	Channels—upper sectors: mainly less than 20 ft wide and about 5 ft deep, gradients up to 1 in 10	Bed loads mainly cobbles and boulders	Fringing vegetation	

(2) Hillmore Land System (1060 sq miles)

Hilly volcanic country with eucalypt woodlands, in the north-eastern quarter.

Geology.—Relatively unweathered or deeply weathered, moderately to steeply dipping extrusive and pyroclastic volcanics, commonly andesitic but with a range of rock types including trachytic, dacitic, and basaltic types, and with interbedded sediments largely of andesitic provenance; mainly of Lower Permian to Upper Carboniferous age, but locally Devonian or Mesozoic.

Geomorphology.—Standing above, or formed by deep dissection of, the Tertiary weathered surface—mountains and hills: strike belts up to 15 miles wide, dominated by steep hill slopes but with restricted erosional or colluvial lower slopes; dense dendritic or rectangular pattern of incised valleys with minor alluvial drainage floors; local relief up to 500 ft or more.



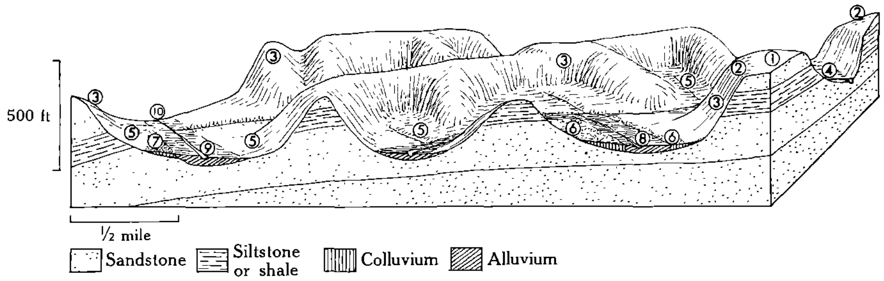
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	75	Hill slopes: concavo–convex, up to about 60% or more, but mainly 10–20%, and up to 1 mile long; cobble-strewn outcrop surfaces with minor rock ledges and boulder patches	Very shallow to shallow loams, Rugby (Um1.41)	Shrub woodland (48). Closely spaced woodland, mainly *E. crebra* grading into forest in places; moderate shrub layer cycads and *Xanthorrhoea* locally; eastern mid-height grass, *Themeda australis*, common where unmodified (80)	VI–VIIt$_{6-7}$
2	<5	Land facet 1: hill slopes	Shallow clay loams to clays, Rugby and Kinnoul (Uf6.31)	Microphyll vine woodland	VI–VIIt$_{6-8}$
3	10	Land facet 13: erosional lower slopes	Shallow to deep texture-contrast soils, Medway and Retro (Dy2.13, 2.23)	Silver-leaved ironbark grassy woodland	IVe$_{3-4}$, p$_{3-4}$
4	5	Land facet 15: colluvial slopes	Moderately deep to deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland with sandalwood	IVp$_{3-4}$
5	<5	Tributary drainage floors: less than ¼ mile wide, gradients up to 1 in 30; sealed, cracking surfaces with grit patches and scattered pebbles	Deep cracking clay, Vermont (Ug5.34)	Grassy woodland (55). Openly spaced *E. melanophloia*; shrubs mainly sparse; eastern mid-height grass (80)	IIIw$_3$
6	<5	Land facet 17: main drainage floors	Deep layered alluvial soils, Moolayember (Gn3.94)	Blue gum–Moreton Bay ash tall grassy woodland	IVw$_{3-4}$
7	<5	Channels: up to 100 ft wide and 15 ft deep	Bed loads silt to boulders	Fringing vegetation	

(3) Carborough Land System* (670 sq miles)

Rugged sandstone country with eucalypt forests, Expedition Range and west of Cracow.

Geology.—Relatively unweathered or deeply weathered, flat-bedded or gently dipping sandstone with minor siltstone, shale, and claystone of Triassic or Jurassic age.

Geomorphology.—Standing above, or formed by deep dissection of, the Tertiary weathered surface—mountains and hills: strike belts up to 10 miles wide, consisting mainly of steep hill slopes but with restricted crest slopes and a complex of more extensive erosional or depositional lower slopes; dense rectangular pattern of incised valleys; local relief up to 500 ft.



Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	5	Gentler crest slopes: mainly less than 3% and ½ mile in extent; loose to firmed sandy to loamy surfaces	Shallow texture-contrast soils with a thin sandy or loamy surface on light–medium clay, Springwood (Dr3.32, 2.31, Dy2.12)	Tall forest (16). Moderately dense to open (50–70 ft), mainly *E. crebra*, *E. drepanophylla*, and *Callitris columellaris*. Some *Casuarina luehmannii* locally; dense to moderately dense shrub layer; sparse to moderate forest grass (77)	IVd_4, p_{3-4}
2	5	Steeper crest slopes: up to about 10% and ½ mile in extent; cobble-strewn surfaces with rock outcrops	Very shallow sands, Shotover (Uc1.21)	Sandstone forest (27). Moderately dense *E. crebra*, *E. tenuipes*, and *E. cloeziana*; moderate shrub layer; sparse forest grass with spinifex (78)	VIr_{4-5}, d_5, e_{3-4}
3	55	Hill slopes: up to about 60% and ½ mile long, with vertical upper faces locally; benched, boulder-strewn outcrop surfaces	Rock outcrops	Sandstone forest (25). Moderately dense *E. watsoniana*, *E. cloeziana*, *E. crebra*, *E. polycarpa*, and *Angophora costata*; rich shrub layer; sparse forest grass (77) and forest grass with spinifex (78)	$VII\text{–}VIIIt_{7-8}$
4	5	Land facet 1: steep erosional lower slopes in upper sectors	Shallow to moderately deep light clays, Kinnoul and Cheshire (Uf6.32)	Microphyll vine woodland	VIt_6, e_4
5	10	Land facet 13: erosional lower slopes in lower sectors	Shallow texture-contrast soils, Springwood (Dr2.12)	Silver-leaved ironbark grassy woodland	VIt_6, d_4, e_4
6	10	Slopes in coarser-textured colluvium: concave, mainly 2–5% and up to ¼ mile long; loose sandy surfaces	Deep medium sand, Highmount (Uc1.21)	Sandstone forest (26). Open forest (*Angophora costata*, *E. watsoniana*, *Callitris columellaris*); moderately dense rich shrub layer; sparse forest grass (77) locally with spinifex (78)	IVn_{3-4}, m_3
7	<5	Land facet 15: slopes in finer-textured colluvium	Moderately deep texture-contrast soils, Retro (Dy3.43)	Poplar box grassy woodland with sandalwood	IVp_{3-4}, e_{2-3}
8	<5	Drainage floors in coarser-textured alluvium: less than ¼ mile wide, gradients up to about 1 in 50, and with transverse slopes up to 1% locally; firmed sandy surfaces	Deep coarse sand, Highmount (Uc5.11)	Tall forest (23). Closely spaced tall trees (60–100 ft) (*E. tereticornis*, *Angophora costata*, *E. crebra*, *Tristania suaveolens*, *E. drepanophylla*, *E. maculata*); sparse shrubs and tall frontage grass (82)	IVn_{3-4}, m_3, w_3
9	<5	Land facet 16: drainage floors in finer-textured alluvium	Deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland	IVp_{3-4}, w_{3-4}
10	<5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt to cobbles with much sand	Fringing vegetation	

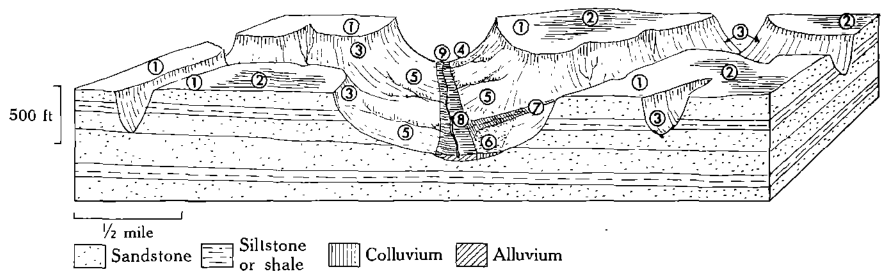
* Similar to Carborough land system of the Isaac–Comet and Nogoa–Belyando areas.

(4) Nathan Land System* (1320 sq miles)

Rugged sandstone country with eucalypt forests, mainly in the south.

Geology.—Deeply weathered or little-weathered, subhorizontal or gently dipping sandstone with minor siltstone or shale, of Jurassic or Triassic age.

Geomorphology.—Standing above, or formed by deep dissection of, the Tertiary weathered surface—high tablelands and hills: strike belts up to 20 miles wide, with fragmented rocky or soil-covered crests delimited by steep hill slopes, and with restricted erosional or depositional lower slopes; moderately dense to dense rectangular pattern of incised valleys with narrow alluvial drainage floors; local relief up to 500 ft or more.



Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	30	Rocky crests: less than 1 mile in extent and up to 5%, attaining 10–20% on marginal slopes; cobble-strewn outcrop surfaces with scattered boulders	Very shallow sands, Shotover (Uc1.21)	Sandstone forest (25). Moderately dense forest trees; rich shrub layer; sparse forest grass (77) with local spinifex, *Triodia mitchellii* (78)	VIt$_6$, d$_5$
2	20	Soil-covered crests: up to 1½ miles in extent and mainly less than 3%, but locally with stony slopes up to 10%; firmed sandy to loamy surfaces with pebble-cobble patches	Shallow texture-contrast soils with a thin sandy or sandy clay loam surface on a light–medium clay, Southernwood and Medway (Dr3.32, 2.33, Dy2.33)	High forest (16). Moderately dense to open forests (50–70 ft), mainly *E. crebra*, *E. drepanophylla*, *Callitris columellaris*, with *Casuarina luehmannii* in places; sparse forest grass (77)	IVd$_1$, p$_{3-4}$, e$_4$
3	25	Hill slopes: up to 80%, with vertical upper faces, and less than ½ mile long; benched, boulder-strewn outcrop surfaces	Rock outcrop	Sandstone forest (25). As unit 1, but with local lancewood forest (32)	VII–VIIIt$_{7-8}$
4	<5	Scree slopes: concave bouldery slopes mainly 10–20% and less than ¼ mile long; dissected up to 30 ft at head and 10 ft distally	Rock outcrop and boulder rubble with pockets of soil	High forest (14). Moderately dense tall trees (*E. citriodora*, *E. crebra*) with patches of lancewood; forest grass (77)	VIIt$_6$, r$_5$
5	10	Erosional lower slopes: up to ¼ mile long and mainly less than 10%, dissected up to 20 ft into narrow, rounded spurs with flank slopes up to 20%; rock outcrops locally	Moderately deep to deep gravelly sands, Petrona and Highmount (Uc1.21)	High forest (13). Closely spaced tall trees (60–100 ft) (*E. maculata*, *E. crebra*); moderate shrub layer; sparse forest grass (77)	VIt$_6$, e$_{3-4}$
6	<5	Colluvial slopes: concave, mainly 2–5%, and less than ½ mile long; sandy surfaces with grit patches and gravel exposures locally in upper parts	Moderately deep coarse sand over gravels, Petrona (Uc1.22)	Forest (26). Moderately dense trees (60–80 ft) (*Angophora costata*, *E. watsoniana*, *E. tenuipes*, *Callitris columellaris*); rich shrub layer; sparse forest grass with spinifex (78)	IVn$_{3-4}$, m$_3$, d$_3$
7	<5	Tributary drainage floors: less than 200 yd across, gradients up to about 1 in 50; sandy surfaces	Deep alluvial coarse sand, Davy (Uc1.21)	High forest (22). Closely spaced tall trees (60–100 ft) (*E. tereticornis*, *Angophora costata*, *E. crebra*, *Tristania suaveolens*, *E. drepanophylla*, *E. maculata*); sparse shrubs; tall frontage grass (82)	IVn$_{3-4}$, m$_3$
8	<5	Land facet 17: main drainage floors	Deep layered alluvial soils, Davy and Clematis	Blue gum tall grassy woodland	IVw$_{3-4}$
9	<5	Channels: up to 300 ft wide and 20 ft deep	Bed loads silt to boulders, much sand	Fringing vegetation	

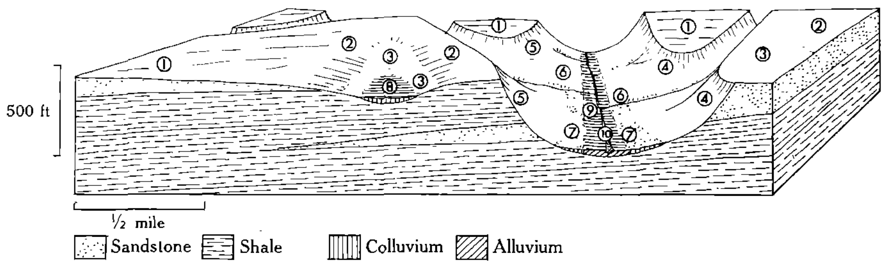
* Similar to Planet land system of the Isaac–Comet area.

(5) Doonkuna Land System (540 sq miles)

Plateaux and slopes, mainly shallow soils, eucalypt forests and woodlands, in the south.

Geology.—Deeply weathered or little-weathered, flat-lying or gently dipping Jurassic sandstone and shale.

Geomorphology.—Standing above, or formed by deep dissection of, the Tertiary weathered surface—high tablelands and hills: tracts up to 25 miles in extent, comprising extensive rocky or soil-covered crests with relatively restricted hill slopes; open to moderately dense rectangular pattern of incised valleys; local relief up to 500 ft.



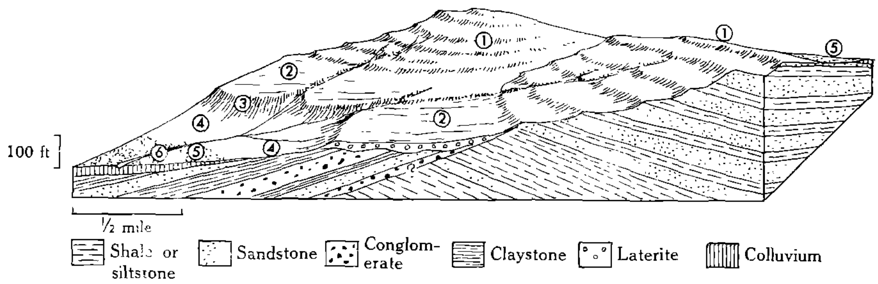
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	40	Rocky crests: mainly less than 1 mile in extent and up to 5%, with marginal slopes 10–20%; cobble-strewn outcrop surfaces with scattered boulders	Outcrop and very shallow sands, Shotover (Uc1.21)	Sandstone forest (25). Moderately dense tree layer (*E. watsoniana, E. cloeziana, E. crebra, Angophora costata, E. polycarpa, E. maculata*); moderate shrub layer; forest grass (77), locally with spinifex (78)	VI–VIIt$_6$, d$_5$
2	15	Soil-covered crests: up to 2 miles in extent and mainly less than 3%; firmed sandy to loamy surfaces with pebble-cobble patches	Deep texture-contrast soils with a thick very fine sand surface over massive clay, Luxor (Dy5.83)	High forest (17). Open to moderately dense tree layer (*E. fibrosa, E. polycarpa,* and scattered *Casuarina luehmannii* and *Callitris columellaris*); moderate shrubs; forest grass (77)	IVp$_{3-4}$, e$_{2-3}$
3	15	Marginal slopes of unit 2: mainly 3–5%, but up to 10% locally, and less than ½ mile long; cobble patches with minor rock outcrops	Deep texture-contrast soils with a thin gravelly fine sandy clay loam surface over clay, Wyseby (Dr2.31)	High forest (16). Mainly open forest (*E. crebra, E. drepanophylla, Callitris columellaris*); shrubs sparse to moderate; forest grass (77)	IVp$_{3-4}$, e$_{3-4}$
4	10	Hill slopes mainly in sandstone: up to 80%, with vertical upper faces, and less than ½ mile long; boulder-strewn outcrop surfaces	Rock outcrop, cobbles, and gravel	Sandstone forest (25). Moderately dense tree layer (*E. watsoniana, E. cloeziana, E. crebra, Angophora costata, E. polycarpa, E. maculata*); moderate shrub layer; forest grass (77), locally with spinifex (78)	VII–VIIIt$_{7-8}$
5	5	Land facet 1: hill slopes mainly in siltstone	Moderately deep sandy clay loams to clays, Carraba (Gn3.11)	Microphyll vine woodland	VII–VIIIt$_{7-8}$
6	5	Land facet 13: erosional lower slopes	Shallow texture-contrast soils, Springwood (Dr2.22)	Silver-leaved ironbark grassy woodland	IV–VIt$_6$, d$_4$, e$_{3-4}$
7	<5	Land facet 15: gentle colluvial slopes	Moderately deep texture-contrast soils, Retro (Dy3.43)	Poplar box grassy woodland with sandalwood	IVp$_{3-4}$, e$_{2-3}$
8	<5	Land facet 11: gentle colluvial slopes	Very deep cracking clays, Rolleston (Ug5.38)	Brigalow scrub with wilga and sandalwood	II–IIIk$_{2-3}$, e$_2$
9	<5	Land facet 16: drainage floors	Deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland	IVp$_{3-4}$
10	<5	Channels: up to 200 ft wide and 15 ft deep	Bed loads silt to boulders	Fringing vegetation	

(6) Range Land System (65 sq miles)

Hilly country with eucalypt woodlands, restricted to the Dawson Range.

Geology.—Lateritized, gently dipping Tertiary sandstone, conglomerate, claystone, and shale; deeply weathered or little-weathered, gently dipping sandstone, siltstone, and shale of Triassic age.

Geomorphology.—Formed by shallow dissection of the Tertiary weathered surface—low tablelands and hills: strike tracts up to about 2 miles wide, with narrow hill belts 200–500 ft above the level of lateritic remnants with erosional or colluvial lower slopes; moderately dense dendritic pattern of incised drainage; local relief mainly up to about 100 ft.



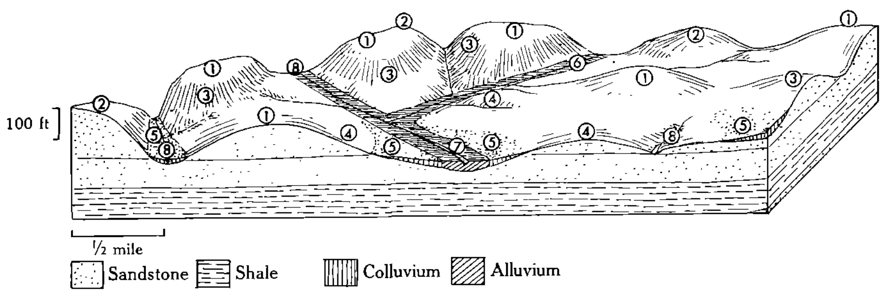
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	35	Hill slopes: up to about 60% with vertical upper faces locally, and ½ mile long; benched, boulder-strewn outcrop surfaces	Mainly outcrop	Sandstone forest (25). *E. cloeziana*, *E. polycarpa*, and other species (not as rich as in Nathan and Carborough land systems); forest grass (77)	VII–VIIIt$_{7-8}$
2	30	Stable remnants: mainly less than 2%, but attaining 5%, and up to 1 mile in extent; sandy to loamy surfaces with cobble patches and local exposures of ironstone or deeply weathered rock	Deep sandy or loamy red earths, Annandale and Dunrobin (Gn2.18)	Shrub woodland (46). *E. crebra*, *E. polycarpa*, and *E. exserta*; moderate shrub layer *Petalostigma pubescens*, *Lysicarpus angustifolius*, and *Alphitonia excelsa*; sparse three-awn grass (79)	IVn$_{3-4}$, m$_3$, e$_{2-3}$
3	10	Marginal slopes of unit 2: mainly 5–25% and less than ¼ mile long; cobble-strewn sandy slopes with rock outcrops	Shallow to moderately deep sands and pisolitic gravel, Shotover and Petrona (Uc1.21)	Lancewood forest (31) and rosewood forest (28). Dense forests of slender trees characterized by *A. shirleyi* and *A. rhodoxylon*; sparse three-awn grass (79)	VIIt$_7$, d$_5$, r$_5$
4	10	Erosional lower slopes: concave, mainly 3–5% and up to about ¼ mile long; sandy surfaces with pebble-cobble patches and minor rock outcrops	Moderately deep texture-contrast soil with a thick deep sand over a light red clay, Luxor (Dr5.41)	Shrub woodland (45). Moderately spaced *E. crebra* and *E. polycarpa*; moderate shrub layer; three-awn grass (79)	IVp$_{3-4}$, e$_{2-3}$
5	10	Colluvial slopes: mainly less than 2% and up to ½ mile long; firmed sandy to loamy surfaces with grit patches	Deep texture-contrast soils with a thin sandy surface, Wyseby (Dy3.41)	High forest (14). Closely spaced tall trees (60–100 ft) (*E. citriodora*, *E. crebra*); moderate shrub layer; sparse forest grass (77)	IVp$_{3-4}$
6	<5	Channels: up to 50 ft wide and 10 ft deep	Deep sand bed loads	Fringing vegetation	

(7) Yebna Land System (230 sq miles)

Hilly country with eucalypt forests and woodlands, in the south.

Geology.—Weathered, gently dipping to subhorizontal sandstone, conglomerate, and shale of Jurassic or ?Cretaceous age.

Geomorphology.—Formed from weathered coarser-textured rocks, below the Tertiary weathered surface—undulating plains: tracts up to about 5 miles wide and extending up to 35 miles along the strike, comprising a range of upper slopes and restricted erosional or depositional lower slopes, and with intervening hill slopes; moderately dense rectangular pattern of incised valleys; local relief up to 200 ft.



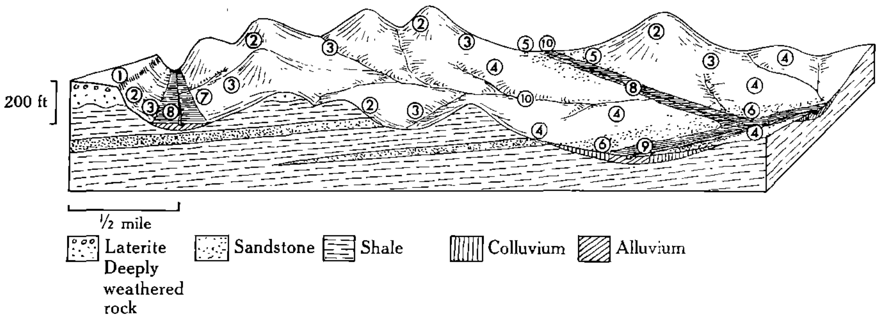
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	15	Gentler upper slopes: mainly less than 3% and up to 1½ miles long; firmed sandy to loamy surfaces with pebble patches	Moderately deep texture-contrast soil with a thin sandy surface over columnar-structured clay, Taurus (Dy3.43, Dr3.43)	High forest (12). Moderately dense tree layer (*E. fibrosa*, *E. maculata*, *Callitris columellaris*); moderate shrub layer; sparse forest grass (77) (*Cymbopogon refractus*, *Bothriochloa decipiens*, *Aristida* spp.)	IVp_{3-4}
2	10	Steeper upper slopes: up to about 10% and ½ mile long; pebble-strewn sandy to loamy surfaces with cobble patches	Shallow texture-contrast soils with a thin sandy and gravelly surface, Medway (Dy3.43)	High forest (18). Moderately dense tree layer (*E. melanophloia*, *E. drepanophylla*, *Callitris columellaris*); shrubs moderate; sparse forest grass (77)	VIe_{3-4}, p_{3-4}, d_4
3	45	Hill slopes: up to 60% or more and ¼ mile long, with vertical upper faces locally; benched, boulder-strewn outcrop surfaces	Rock outcrop with very shallow loamy sands amid gravels and boulders, Shotover (Uc2.12, 1.21)	High forest (12, 15). Dense tall trees (80–100 ft) (*E. crebra*, *E. fibrosa*, *E. maculata*, *E. drepanophylla*), scattered to moderately dense *Callitris columellaris*; shrubs sparse to moderate; sparse forest grass (77), locally with sandstone forest (25)	$VII–VIIIt_{7-8}$
4	10	Land facet 13: erosional lower slopes	Moderately deep to deep texture-contrast soils, Taurus (Dy2.33)	Silver-leaved ironbark grassy woodland with local poplar box	IVp_{3-4}, e_{3-4}
5	5	Land facet 15: colluvial slopes	Moderately deep texture-contrast soils, Retro and Taurus (Dy2.43)	Poplar box grassy woodland with sandalwood	IVp_{3-4}, e_{2-3}
6	5	Land facet 13: tributary drainage floors	Deep texture-contrast soils, Springwood and Taurus (Dy1.12)	Silver-leaved ironbark grassy woodland, with *E. orgadophila* and *E. dichromophloia*	IVp_{3-4}
7	<5	Main drainage floors: up to ¼ mile wide, gradients below 1 in 100; firmed to lightly sealed surfaces	Deep layered alluvial soils, Davy (Uc1.21). Soils showing gradational development, Moolayember (Gn3.44)	Tall grassy woodland (53). Openly spaced trees (80–100 ft) (*E. tereticornis*, *Angophora floribunda*, *Tristania suaveolens*); sparse shrubs; frontage grass (82)	IVw_{3-4}
8	<5	Channels: up to 100 ft wide and 10 ft deep	Deep sand bed loads	Fringing vegetation	

(8) Surprise Land System (290 sq miles)

Hills with eucalypt forests and woodlands, in the west.

Geology.—Deeply weathered or little-weathered, flat-lying or gently dipping Jurassic shale and sandstone.

Geomorphology.—Standing above, or formed by deep dissection of, the Tertiary weathered surface—hills: tracts up to 15 miles across, consisting of hills with a variety of moderately extensive erosional and depositional lower slopes; moderately dense to dense dendritic pattern of incised valleys; local relief typically up to 300 ft but locally more.



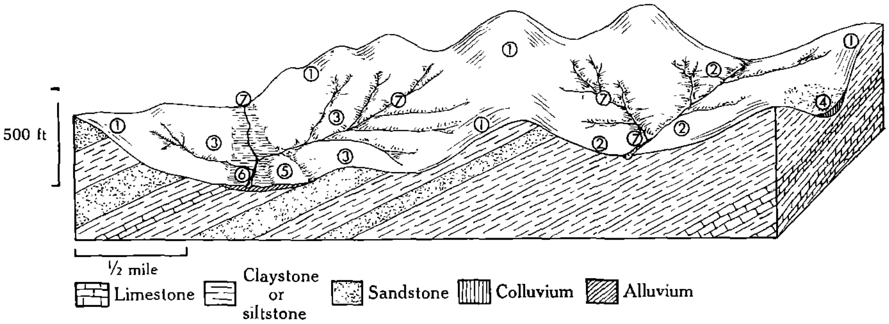
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	5	Summit remnants: less than ½ mile in extent, with slopes mainly less than 5% but attaining 10% at margins; delimiting breakaways up to 20 ft high; firmed loamy surfaces with cobble patches and exposure of ironstone or mottled-zone rock locally	Deep gravelly red earth, Dunrobin (Gn2.11)	Sandstone forest (27). Closely spaced trees (40–80 ft) (*E. crebra*, *E. tenuipes*, *E. polycarpa*, *E. cloeziana*, *E. maculata*, *Angophora costata*, and scattered *Callitris* sp.); moderate tall shrub–small tree layer (*Casuarina inophloia*, *Lysicarpus angustifolius*, *Acacia* sp.); rich low shrub layer (*Hibbertia stricta*, *Hovea longifolia*, *Dodonaea* spp., *Euphorbia* spp., *Acacia* spp.); sparse forest grass (77), local spinifex (78)	IVn_{3-4}, m_3
2	25	Hill slopes: up to about 60% and ¼ mile long; boulder-strewn slopes with rock ledges	Mostly outcrop	High forest (13). Closely spaced trees (60–100 ft) (*E. crebra*, *E. maculata*); moderate shrubs; sparse forest grass (77)	VI–VIIIt_{7-8}
3	25	Hill-foot slopes: mainly less than 10% and ¼ mile long, dissected up to 30 ft into narrow rounded spurs with flank slopes up to 20%; rock outcrops locally	Shallow stony texture-contrast soil with thin loamy surface over light clay, Southernwood (Dr2.12)		VIt_6, d_4, e_{3-4}
4	25	Land facet 13: erosional lower slopes	Shallow to deep texture-contrast soils, Southernwood and Springwood (Dr2.22)	Silver-leaved ironbark grassy woodland	IV–VIt_6, p_{3-4}, e_{3-4}
5	5	Colluvial slopes in upper sectors: up to 5%, but mainly about 3%, and less than ¼ mile long; firmed sandy to loamy surfaces with grit-pebble patches	Moderately deep to deep texture-contrast soils with sandy and gravelly surface horizon, Taurus (Dy2.43)	Tall woodland (49). Closely spaced *E. moluccana*; sparse shrubs; eastern mid-height grass (80)	IVp_{3-4}, e_{2-3}
6	5	Land facet 15: colluvial slopes in lower sectors	Moderately deep texture-contrast soils, Retro (Dy3.43)	Poplar box grassy woodland with sandalwood	IVp_{3-4}
7	<5	Land facet 11: slopes of older colluvium–alluvium	Deep cracking clays, Rolleston (Ug5.15)	Brigalow scrub with wilga and sandalwood	IIIk_{2-3}
8	<5	Tributary drainage floors: less than ¼ mile wide, gradients up to about 1 in 30	Very deep alluvial clays with very stony surface, Clematis (Uf6.41)	Ecotone high forest (13) and grassy woodland (55)	IVw_{3-4}
9	<5	Land facet 16: main drainage floors	Deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland	IVp_{3-4}, w_{3-4}
10	<5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt and sand	Fringing vegetation	

(9) Boomer Land System (460 sq miles)

Rocky hills with eucalypt woodlands, in the north.

Geology.—Relatively unweathered or deeply weathered, moderately to steeply dipping siltstone, claystone, shale, sandstone, and limestone, with greywacke and subgreywacke in some areas; of Permian age, and locally Carboniferous.

Geomorphology.—Standing above, or formed by deep dissection of, the Tertiary weathered surface—mountains and hills: tracts up to 30 miles in extent, dominated by steep hill slopes but with moderately extensive erosional lower slopes; dense dendritic pattern of incised valleys with strike-controlled trunk drainage; local relief up to 500 ft.



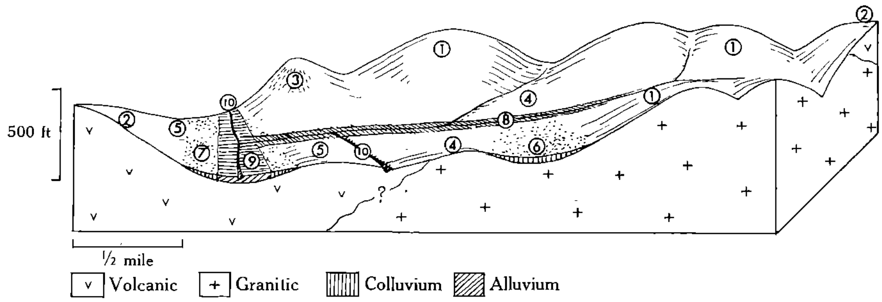
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	55	Hill slopes: mainly up to about 60%, but with extensive slopes 10–15% in lower parts, and ½ mile long; cobble-strewn, benched, outcrop surfaces	Very shallow loamy sand pockets in outcrop, Shotover (Uc1.21)	Mainly grassy woodland (64). *E. crebra* but with local slopes of rosewood forest (30); characterized by *A. rhodoxylon* and *E. crebra*; shrubs moderate to sparse; eastern mid-height grass (80)	VI–VIIt$_{6-7}$
2	15	Erosional lower slopes in upper sectors: concave, up to 10% and ¼ mile long; grit-strewn surfaces with cobble patches and rock outcrops	Shallow to moderately deep texture-contrast soils, Medway and Taurus (Dy2.23)	Rosewood forest (30). Moderately dense woodlands of *A. rhodoxylon* and *E. crebra*; shrubs sparse; mainly eastern mid-height grass (80)	IVp$_{3-4}$, e$_{3-4}$
3	20	Land facet 13: erosional lower slopes in lower sectors	Shallow texture-contrast soils, Medway (Db1.43)	Silver-leaved ironbark grassy woodland	IVp$_{3-4}$, e$_{2-3}$
4	<5	Colluvial slopes: less than 5% and ¼ mile long; firmed to sealed loamy surfaces	Shallow sandy clay loams grading with depth to sandy clays, Ingelara (Uf6.31)	Microphyll vine woodland (1). A more or less continuous canopy of slender densely packed trees (20–40 ft), upper layer comprises discontinuous evergreen or semi-evergreen emergents; lianes common; shrub layer dense; sparse softwood grass (75)	IVd$_4$, e$_{2-3}$
5	<5	Slopes of older alluvium: mainly less than 1% and ¼ mile in extent; sealed loamy surfaces	Deep texture-contrast soils on old alluvium. Thin clay loam surface on medium clay over layered clays, Retro (Dy2.23)	Tall woodland (49). Closely spaced *E. moluccana* (50–70 ft); shrubs commonly sparse; eastern mid-height grass (80)	IVp$_{3-4}$
6	<5	Land facet 17: drainage floors	Deep layered alluvial soils, Moolayember (Gn2.42)	Blue gum–Moreton Bay ash tall woodland	III–IVw$_{3-4}$
7	<5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt to boulders	Fringing vegetation	

(10) Irving Land System (340 sq miles)

Hilly granite and volcanic country with eucalypt woodlands, in the north and east.

Geology.—Relatively unweathered or deeply weathered. ?Triassic granite and granodiorite intruded in, and partly faulted against, dipping andesitic volcanics of Lower Permian to Upper Carboniferous age.

Geomorphology.—Standing above, or formed by deep dissection of, the Tertiary weathered surface—mountains and hills: tracts up to 20 miles across, with a range of hill slopes and erosional lower slopes on granitic or volcanic lithologies, and with restricted colluvial slopes derived from both rock types; dense dendritic pattern of incised tributary valleys with rectangular system of trunk streams; local relief up to 500 ft or more.



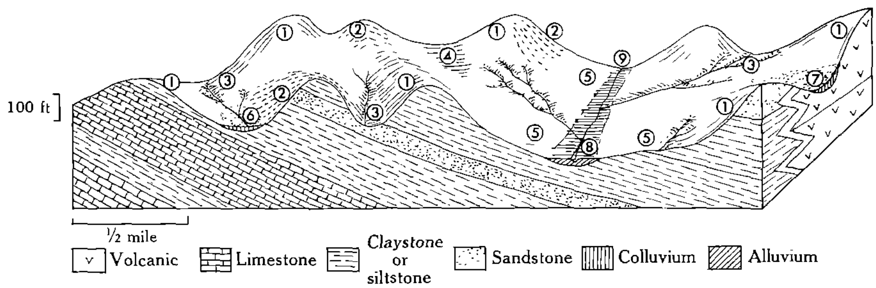
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	45	Hill slopes on granitic rocks: boulder-strewn outcrop slopes up to about 60% and 1 mile long, locally with basal scree slopes up to 25%	Shallow texture-contrast soils: gritty loams on gritty clays, Southernwood (Dy3.62, Dr2.12)	Grassy woodland (64). Closely spaced *E. crebra*, and *E. dichromophloia*; moderate to sparse shrubs; eastern mid-height grass (80)	VI–VIIt$_{6-7}$
2	15	Hill slopes on volcanic rocks: up to about 60% or more, but mainly 10–20%, and up to 1 mile long; cobble-strewn outcrop surfaces with minor benches and scattered boulders	Very shallow to shallow loams, Rugby (Um1.41)	Shrub woodland (48) (now modified in part to grassy woodland). Closely spaced *E. crebra*; moderate shrub layer cycads and *Xanthorrhoea* sp. in places; eastern mid-height grass (80) (*Themeda australis*) common where unmodified	VII–VIIIt$_{7-8}$
3	<5	Land facet 1: hill slopes on volcanic rocks	Very shallow to shallow loams and light clays, Rugby and Kinnoul (Uf6.31)	Microphyll vine woodland	VI–VIIIt$_{6-8}$
4	10	Erosional lower slopes on granitic rocks: mainly less than 5% and up to ½ mile long; loose to firmed sandy to loamy surfaces with grit-pebble patches	Moderately deep texture-contrast soils with a thick gritty sand surface horizon on a gritty clay, Luxor (Dy4.51)	Grassy woodland (55, 56). Openly spaced *E. melanophloia* and *E. dichromophloia*; sparse shrub layer; eastern mid-height grass (80)	IVp$_{3-4}$
5	10	Land facet 13: erosional lower slopes on volcanic rocks	Shallow texture-contrast soils, Southernwood (Dy3.12, 2.12)	Silver-leaved ironbark grassy woodland, locally with *E. dichromophloia*	IVd$_4$, p$_{3-4}$
6	5	Slopes of granitic colluvium: up to 5% and less than ½ mile long; firmed sandy to loamy surfaces with grit-pebble patches	Deep texture-contrast soils, Retro (Dy3.43)	Tall woodland (49). Closely spaced *E. moluccana*; sparse shrubs; sparse to moderate eastern mid-height grass (80)	IVp$_{3-4}$, e$_{2-3}$
7	5	Land facet 15: slopes of volcanic colluvium	Moderately deep to deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland with sandalwood	IVp$_{3-4}$
8	<5	Land facet 17: drainage floors of coarser-textured alluvium	Deep layered alluvial soils	Blue gum–Moreton Bay ash tall grassy woodland	IVw$_{3-4}$
9	<5	Drainage floors of finer-textured alluvium: up to ¼ mile wide, gradients mainly below 1 in 100; sealed, locally cracking surfaces	Deep alluvial cracking clays, slightly gilgaied locally, Vermont (Ug5.15)	Tall grassy woodland (54). Moderately spaced *E. tereticornis* with scattered *E. crebra* and *E. tessellaris*; sparse shrubs; moderate eastern mid-height grass (80)	IIIw$_3$, k$_{2-3}$
10	<5	Channels: up to 100 ft wide and 10 ft deep; fringing vegetation	Bed loads silt to boulders with much sand		

(11) MALAKOFF LAND SYSTEM (370 SQ MILES)

Hills with shallow soils, softwood scrub, rosewood, and eucalypt woodland, in the centre and north.

Geology.—Weathered, moderately to steeply dipping siltstone, claystone, shale, sandstone, and limestone, or andesitic volcanic rocks, mainly of Permian age but locally Devonian–Carboniferous.

Geomorphology.—Formed from weathered finer-textured rocks below the Tertiary weathered surface—hills: strike belts up to 5 miles wide, comprising rounded hills with a diversity of erosional lower slopes, and with minor colluvial lower slopes; moderately dense rectangular drainage pattern with alluvial drainage floors in lower sectors; local relief mainly 100–300 ft but attaining 500 ft.



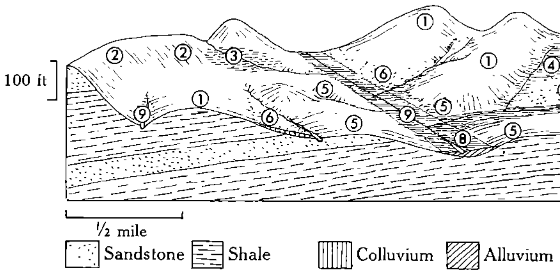
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	40	Land facet 1: hill slopes	Very shallow to shallow clay loams to clays, Rugby and Ingelara (Um5.41, Uf6.32)	Microphyll vine woodland	VIt_6
2	10	Hill slopes: mainly up to about 60%, but extensively less than 20% in lower parts, and ½ mile long; cobble-strewn outcrop surfaces with minor rock ledges	Very shallow loamy sand pockets in outcrop, Shotover (Uc1.21)	Rosewood forest (30). Mixed *A. rhodoxylon*, *E. crebra*, and *E. moluccana* (30–60 ft); moderate shrub layer; sparse forest grass (77)	$VII–VIIIt_{7–8}$
3	15	Stony erosional lower slopes in upper sectors: concave, up to 10% and ¼ mile long; cobble-strewn surfaces with rock outcrops	Shallow to moderately deep texture-contrast soils, Medway and Taurus (Dy2.23)	Rosewood forest (30). Mixed *A. rhodoxylon* and *E. crebra* with moderate to dense softwood scrub understorey; very sparse forest grass (77)	$VIr_{4–5}$, d_4, e_4
4	10	Land facet 9: erosional lower slopes in upper sectors	Shallow to moderately deep texture-contrast soils, Retro, Medway, and Taurus (Db1.13, Dd1.43, and Dy4.43)	Brigalow scrub with blackbutt	IVd_4, $p_{3–4}$, $e_{2–3}$
5	15	Land facet 13: erosional lower slopes in lower sectors	Shallow texture-contrast soils, Medway (Db1.43)	Silver-leaved ironbark grassy woodland	IVd_4, $p_{3–4}$, $e_{2–3}$
6	<5	Slopes of coarser-textured colluvium up to 5% and ¼ mile long; firmed sandy to loamy, grit-strewn surfaces with pebble patches	Moderately deep to deep gritty texture-contrast soil, with a thin fine sandy clay loam over medium clay, Wyseby (Dy3.42)	Tall woodland (49). Closely spaced *E. moluccana*; sparse shrubs; eastern mid-height grass (80)	$IVp_{3–4}$, $e_{2–3}$
7	<5	Slopes of finer-textured colluvium: less than 5% and up to ¼ mile long; firmed to sealed loamy surfaces	Shallow sandy clay loams grading with depth to sandy clays, Ingelara (Gn3.12)	Microphyll vine woodland (1). More or less continuous canopy of slender densely packed trees (20–40 ft), upper layer comprises discontinuous evergreen or semi-evergreen emergents; lianes common; shrub layer dense; sparse softwood grass (75)	IVd_4, $e_{2–3}$
8	<5	Drainage floors: up to ¼ mile wide, gradients mainly below 1 in 100; sealed loamy surfaces	Deep texture-contrast soil with thin clay loam surface on medium clay over buried soils, Retro (Dy2.23)	Tall woodland (49). Closely spaced *E. moluccana*; sparse shrubs; eastern mid-height grass (80)	$IVp_{3–4}$
9	<5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt to boulders	Fringing vegetation	

(12) Womblebank Land System* (150 sq miles)

Hilly country with softwood scrub and brigalow, in the south-western quarter.

Geology.—Weathered, gently dipping shale and sandstone of Triassic or Jurassic age.

Geomorphology.—Formed from weathered finer-textured rocks below the Tertiary weathered surface—hills: strike belts up to 5 miles across, with rounded hills and moderately extensive erosional or depositional lower slopes; moderately dense pattern of branching drainage with subparallel trunk streams; local relief mainly 100–300 ft but attaining 500 ft.



Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	35	Land facets 1 and 4: upper slopes	Shallow to moderately deep clay loams and light to medium clays, Kinnoul and Cheshire (Uf6.33, 6.31, 6.21, 6.11)	Softwood scrub with brigalow merging with microphyll vine woodland	IV–VIIt$_{6-7}$, e$_{3-4}$
2	10	Upper slopes: mainly less than 10% but locally steepening to 50% or more; firmed surfaces with cobble patches and minor rock ledges on steeper slopes	Moderately deep texture-contrast soil with a thin loamy surface over a light clay, Wyseby (Dr2.11)	Shrub woodland (48). Moderately spaced tree layer (40–60 ft) of *E. crebra*; moderate shrub layer; eastern mid-height grass (80)	IVp$_{3-4}$
3	10	Stony erosional lower slopes in upper sectors: mainly less than 10% and ¼ mile long, dissected up to 30 ft into narrow spurs with flank slopes up to 20%; cobble-strewn loamy surfaces with rock outcrops	Shallow texture-contrast soil with a thin loamy surface over a light clay, Southernwood (Dr2.11)	Tall forest (13). Moderately spaced tall trees (80–100 ft); moderate shrub layer; sparse to moderate forest grass (80)	VIt$_6$, d$_4$, e$_4$
4	15	Land facet 9: erosional lower slopes in upper sectors	Very shallow sandy clay loams and clays, Rugby (Um1.43, Uf6.31)	Brigalow scrub with blackbutt	VId$_5$, r$_5$
5	5	Land facet 13: erosional lower slopes in lower sectors	Shallow to moderately deep texture-contrast soils, Southernwood (Dy2.12) and Luxor (Dy3.42)	Silver-leaved ironbark grassy woodland	IVp$_{3-4}$, e$_{3-4}$
6	15	Land facet 11: colluvial slopes	Moderately deep to deep cracking clays, Rolleston (Ug5.22)	Brigalow scrub with wilga and sandalwood	IIIe$_{2-3}$, k$_{2-3}$
7	5	Land facet 8: drainage floors in upper sectors	Very deep clay loams to clays, Cheshire (Gn3.93)	Softwood scrub with belah	IIe$_2$, k$_2$
8	<5	Land facet 16: drainage floors in lower sectors	Deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland	IVp$_{3-4}$, w$_{3-4}$
9	<5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt to boulders	Fringing vegetation	

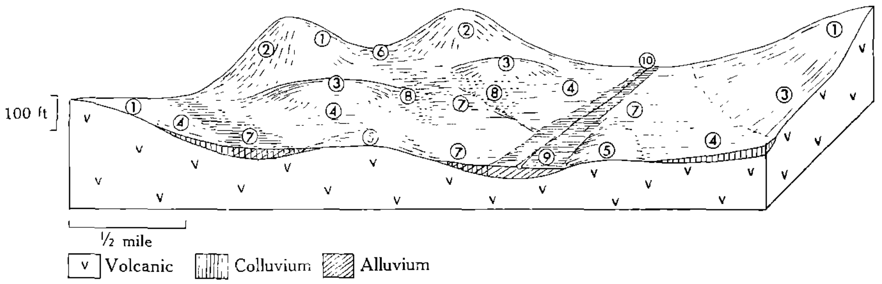
* Similar to Bedourie land system of the Isaac–Comet area and Kareela land system of the Nogoa–Belyando area.

(13) Toonda Land System (250 sq miles)

Volcanic hills and slopes with softwood scrub, mainly in the north-east.

Geology.—Weathered, moderately to steeply dipping andesitic volcanics of Lower Permian to Devonian age.

Geomorphology.—Formed from weathered finer-textured rocks below the Tertiary weathered surface—hills: tracts up to 15 miles across, comprising scattered hills and moderately extensive mid and lower slopes, the latter masked with colluvium in many parts; moderately dense to sparse branching pattern of drainage; local relief mainly 100–300 ft but up to 500 ft.



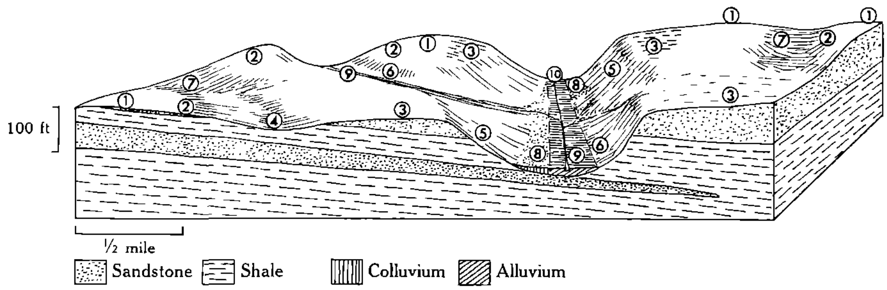
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	15	Land facet 1: hill slopes	Shallow gravelly clay loams, Ingelara	Microphyll vine woodland	VI–VIIt$_{6-7}$, r$_{4-5}$, d$_4$
2	15	Hill slopes: up to about 60% and $\frac{1}{2}$ mile long; cobble-strewn outcrop surfaces with minor rock ledges	Shallow gritty clay loams, Rugby and Ingelara (Um1.41), and shallow to moderately deep texture-contrast soils, Medway (Dd1.13) and Wyseby (Dr3.12)	Shrub woodland (48). Mainly *E. crebra* but with *Tristania conferta* in higher-rainfall parts; moderate shrub layer; very sparse eastern mid-height grass (80)	VII–VIIIt$_{7-8}$, r$_{4-5}$, d$_{4-5}$
3	20	Mid slopes: up to 5%, but mainly 2–3%, and 1 mile in extent; firmed to lightly sealed surfaces with grit patches	Deep friable clay loams and light to medium clays, Cheshire and Carraba (Uf6.32)	Semi-evergreen vine thicket (9). Uneven canopy (15–30 ft) of slender, densely packed trees with mixed evergreen, semi-evergreen, and deciduous emergents (30–60 ft) characterized by *Brachychiton rupestre*, *A. harpophylla*, *E. tereticornis*, *E. crebra*, and *E. polycarpa*; shrubs dense; sparse softwood scrub grass or bare ground (75)	IIIe$_{2-3}$
4	25	Land facet 11: colluvial slopes	Deep gritty clay loams and clays, Cheshire (Gn3.23)	Brigalow scrub with wilga and sandalwood grading into bottle tree scrub with brigalow	IIIe$_{2-3}$
5	5	Land facet 13: erosional lower slopes	Shallow to moderately deep texture-contrast soils, Southernwood and Wyseby (Dy2.12)	Silver-leaved ironbark grassy woodland	IV–VIt$_6$, p$_{3-4}$, e$_{3-4}$
6	5	Colluvial–alluvial slopes in upper sectors: mainly 1–2% and up to $\frac{1}{4}$ mile long; sealed surfaces with scattered pebbles	Moderately deep texture-contrast soils, loams to fine sandy clay loams over medium clays, often gritty and gravelly, Retro (Dy4.33, 4.13)	Semi-evergreen vine thicket (9). *E. moluccana* prominent among emergents; softwood scrub grass (75)	IVp$_{3-4}$
7	10	Colluvial–alluvial slopes in lower sector: mainly 1–2% and up to $\frac{1}{2}$ mile long; sealed, cracking surfaces with microrelief	Deeply gilgaied (18–24 in.) cracking clays, Pegunny (Ug5.29)	Semi-evergreen vine thicket (5). Emergent layer characterized by *A. harpophylla* and *Bauhinia carronii*; softwood scrub grass (75)	IVg$_{3-4}$, k$_{3-4}$
8	<5	Gravelly colluvial–alluvial slopes: less than 2% and $\frac{1}{4}$ mile long; grit-strewn sandy to loamy surfaces with gravels at shallow depth in many areas	Deep texture-contrast soil with a gravelly A_2 horizon, fine sandy loam over clay, Retro (Dy2.43)	Tall woodland (49). Closely spaced *E. moluccana*; sparse shrubs; eastern mid-height grass (80)	IVp$_{3-4}$
9	<5	Drainage floors: less than $\frac{1}{4}$ mile wide, gradients below 1 in 100; sealed, cracking surfaces with microrelief locally	Deep alluvial cracking clays, slight gilgai locally, Vermont (Ug5.24)	Tall grassy woodland (52). Openly spaced *E. tereticornis*, *E. tessellaris*, and *Tristania suaveolens*; sparse shrubs; frontage grass (82)	IVw$_{3-4}$
10	<5	Channels: up to 30 ft wide and 5 ft deep	Bed loads silt to boulders	Fringing vegetation	

(14) Narran Land System (610 sq miles)

Tablelands and slopes, with eucalypt woodlands, softwood scrub, and brigalow, in the south.

Geology.—Weathered, gently dipping Jurassic shale and sandstone.

Geomorphology.—Formed from weathered finer-textured rocks below the Tertiary weathered surface—tablelands: strike belts up to 15 miles wide, with irregular crests including moderately extensive slopes on sandstone, and with colluvial sites in upper sectors; erosional and depositional lower slopes occur in narrowly entrenched valleys; moderately dense branching drainage pattern; local relief mainly less than 50 ft but up to 200 ft.



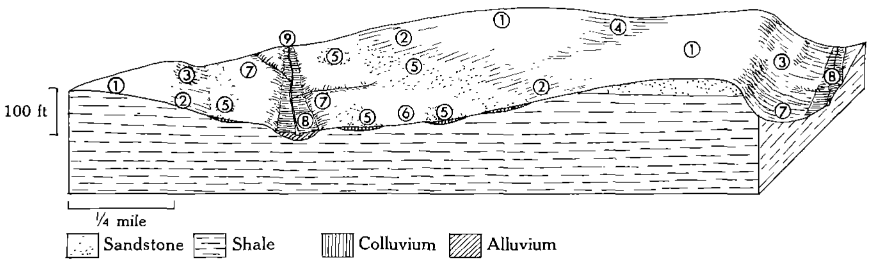
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	15	Land facet 2: gentler crest slopes on weathered rock	Moderately deep to deep cracking clays, Teviot (Ug5.33)	Softwood scrub	II–IIIk$_{2-3}$, e$_2$
2	10	Land facet 4: steeper crest slopes on weathered rock	Shallow texture-contrast soils, Southernwood (Dy4.22)	Softwood scrub with brigalow	VIt$_6$, p$_{3-4}$, d$_4$
3	35	Crest slopes on sandstone: up to about 10%, but mainly less than 5%, and 1 mile in extent; sandy surfaces with pebble-cobble patches and rock outcrops locally	Shallow to moderately deep texture-contrast soil with a fine sandy surface over sandy or silty clay, Southernwood (Dy4.22) and Taurus (Dd3.43)	Tall forest (16). Moderately dense *E. crebra*, *E. drepanophylla*, with variable amounts of *Callitris columellaris*; moderate shrubs (*Alphitonia excelsa*, *Petalostigma pubescens*, *Acacia* spp.); moderately dense forest grass (78)	IVp$_{3-4}$, e$_{3-4}$
4	5	Land facet 9: stony mid slopes	Very shallow sandy clay loams and clays, Rugby (Um1.43, Uf6.31)	Brigalow scrub with blackbutt	VIt$_6$, r$_{4-5}$
5	5	Hill slopes: up to 80% and less than ¼ mile long, with vertical faces locally; boulder-covered outcrop surfaces	Outcrop with pockets of shallow sand, Shotover (Uc1.21)	Semi-evergreen vine thicket (9). Emergents *Brachychiton rupestre*, *E. crebra*, and *E. orgadophila*	VII–VIIIt$_{7-8}$
6	5	Land facet 13: erosional lower slopes	Shallow to moderately deep texture-contrast soils, Southernwood (Dy2.12) and Luxor (Dy3.42)	Silver-leaved ironbark grassy woodland	IV–VIt$_6$, d$_4$, p$_{3-4}$
7	15	Land facet 11: colluvial slopes in upper sectors	Deep to very deep cracking clays, Rolleston (Ug5.16, 5.13, 5.22, 5.29)	Brigalow scrub with wilga, sandalwood, and locally belah	IIIk$_{2-3}$, e$_{2-3}$
8	5	Land facet 15: colluvial slopes in lower sectors	Deep texture-contrast soils, Retro (Dd1.13, Db2.33)	Poplar box grassy woodland with sandalwood	IVp$_{3-4}$, e$_{2-3}$
9	<5	Land facet 16: drainage floors	Deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland	IVp$_{3-4}$, w$_{3-4}$
10	<5	Channels: mainly up to 50 ft wide and 10 ft deep	Bed loads silt and sand	Fringing vegetation	

(15) MUNDELL LAND SYSTEM (130 SQ MILES)

Tablelands and slopes, with softwood scrub and brigalow, in the south.

Geology.—Weathered, gently dipping Jurassic shale and sandstone.

Geomorphology.—Formed from weathered finer-textured rocks below the Tertiary weathered surface—tablelands: tracts up to 15 miles in extent, comprising broad crests with colluvial slopes in upper sectors, and delimited by stony mid slopes or steeper, rocky hill slopes with minor erosional or depositional sites downslope; open, branching drainage pattern; local relief mainly less than 50 ft but up to 200 ft.



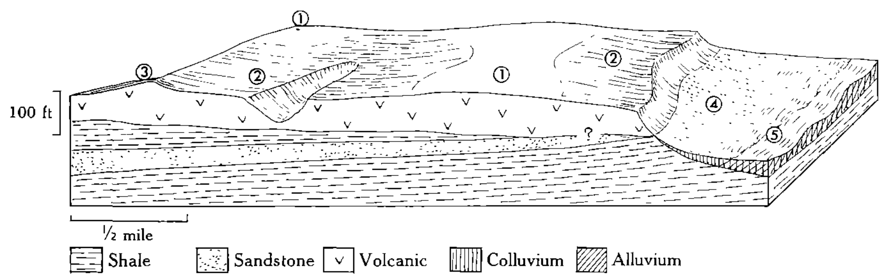
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	40	Land facet 4: crests and steeper upper slopes	Shallow clay loams and light to medium clays, Kinnoul (Uf6.31, 6.21, 6.11)	Softwood scrub with brigalow, and locally bauhinia	IVd_4, e_{3-4}
2	10	Land facet 9: mid slopes	Very shallow sandy clay loams and clays, Rugby (Um1.43, Uf6.31)	Brigalow scrub with blackbutt	VIt_6, d_5
3	10	Land facet 1: hill slopes	Shallow to moderately deep clay loams to clays, Kinnoul and Cheshire (Uf6.33, 6.31, 6.21, 6.11)	Microphyll vine woodland	VIt_6, e_{3-4}
4	10	Land facet 11: gentler colluvial slopes	Deep to very deep cracking clays (slight gilgai), Downfall (Ug5.16, 5.22)	Brigalow scrub with wilga, sandalwood, and belah	II–IIIe_{2-3}, k_{2-3}
5	10	Land facet 11: steeper colluvial slopes	Moderately deep to deep cracking clays, Rolleston (Ug5.22)	Brigalow scrub with wilga and sandalwood	IIIe_{2-3}, k_{2-3}
6	<5	Gentler erosional lower slopes: mainly 1–3% and up to ½ mile long; sealed surfaces with scattered pebble-cobbles	Moderately deep to deep cracking clays, Teviot (Ug5.22, 5.26)	Treeless community (72); blue grass grassland (81)	II–IIIk_{2-3}, e_2
7	10	Land facet 13: steeper erosional lower slopes	Shallow texture-contrast soils, Southernwood (Dy3.22)	Silver-leaved ironbark grassy woodland	IVp_{3-4}, d_4
8	5	Land facet 16: drainage floors	Deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland	IVp_{3-4}, w_{3-4}
9	<5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt to cobbles	Fringing vegetation	

(16) LAWGI LAND SYSTEM (150 SQ MILES)

Basalt tablelands with softwood scrub and minor brigalow, south and east of Biloela.

Geology.—Weathered Tertiary basalt flows.

Geomorphology.—Formed from weathered finer-textured rocks below the Tertiary weathered surface—tablelands: up to 15 miles across, with extensive crests, and mainly depositional slopes in entrenched valleys; sparse pattern of branching drainage; local relief mainly less than 50 ft but up to 200 ft.



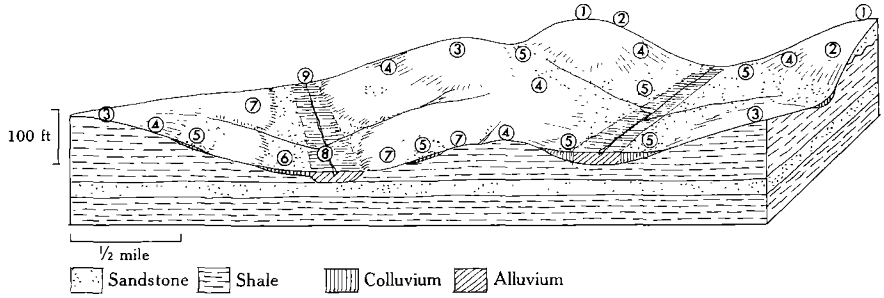
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	25	Land facet 3: gentler crest slopes	Moderately deep to deep light clays, Cheshire (Uf5.22)	Softwood scrub	IIIe$_{2-3}$, k$_{2-3}$
2	40	Land facet 5: steeper crest slopes	Shallow clay loams and light to medium clays, Rugby, minor Kinnoul (Uf6.31)	Softwood scrub with brigalow	VIt$_6$, d$_4$, e$_4$
3	5	Rocky crest slopes, boulder-strewn outcrop slopes up to 60% or more and less than ¼ mile long	Very shallow clay loams and light clays in basalt rubble and outcrops, Rugby (Um1.43)	Grassy woodland (56). Openly spaced *E. melanophloia* and *E. dichromophloia*; sparse shrubs; eastern mid-height grass	VII–VIIIt$_{7-8}$
4	20	Land facet 6: colluvial slopes	Moderately deep light clays, Cheshire (Uf6.32)	Softwood scrub with brigalow and bauhinia	II–IIIe$_{2-3}$, k$_{2-3}$
5	10	Land facet 11: colluvial–alluvial slopes	Deep cracking clays, Rolleston (Uf5.16)	Brigalow scrub with wilga and sandalwood	IIIk$_{2-3}$, e$_2$

(17) Oakleigh Land System (380 sq miles)

Undulating and hilly country with eucalypt woodland, softwood scrub, and brigalow, in extreme south.

Geology.—Weathered, subhorizontal or gently dipping Jurassic shale and sandstone; weathered flat-lying ?Cretaceous sandstone and shale.

Geomorphology.—Formed from weathered finer-textured rocks below the Tertiary weathered surface—undulating plains: up to 40 miles in extent, with upper slopes on sandstone or shale, and with stony mid slopes on shale grading down into extensive colluvial slopes interspersed with restricted erosional sites in lower parts; dense dendritic pattern of drainage with alluvial drainage floors in lower sectors; local relief mainly less than 100 ft but up to 200 ft.



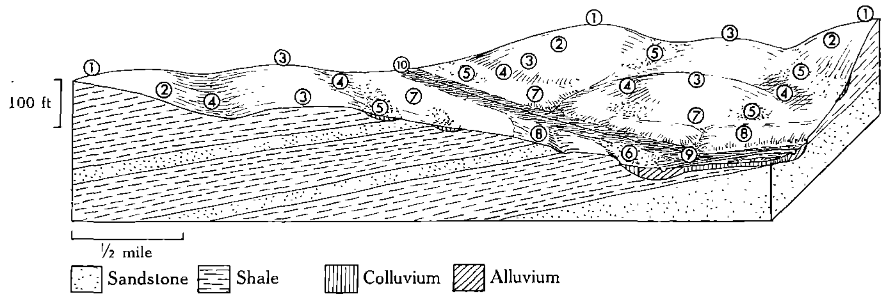
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	10	Gentler upper slopes on sandstone: mainly less than 2% and ½ mile in extent; firmed sandy to loamy surfaces with pebble patches	Moderately deep texture-contrast soil with a thin sandy surface over columnar clay, Taurus (Dy3.43, Dr3.43)	High forest (16). Moderately dense tree layer (50–70 ft) (*E. crebra*, *E. drepanophylla*, *Callitris columellaris*); moderate shrubs; sparse to moderate forest grass (77) (*Cymbopogon refractus*, *Bothriochloa decipiens*, *Aristida* spp.)	IVp_{3-4}
2	10	Steeper upper slopes on sandstone: up to about 15% and ¼ mile long; sandy to loamy surfaces with pebble-cobble patches	Shallow texture-contrast soils with a thin sandy and gravelly surface, Medway (Dy3.43)	High forest (15). Moderately dense tall tree layer (60–80 ft) (*E. crebra*, *E. maculata*, *E. drepanophylla*, *Callitris columellaris*); moderate shrubs; sparse to moderate forest grass (77)	VIt_6, d_4, e_4
3	20	Land facet 4: upper slopes mainly on shale	Shallow clay loams and light to medium clays, Kinnoul (Uf6.31, 6.21, 6.11)	Softwood scrub with brigalow	IVd_4, e_{3-4}
4	20	Land facet 7: mid slopes	Very shallow sandy clay loams and clays, Rugby (Um1.43, Uf6.31)	Softwood scrub with blackbutt	VIt_6, r_5, d_5
5	20	Land facet 11: colluvial slopes in mid and upper sectors	Very deep cracking clays, Rolleston (Ug5.16, 5.13, 5.29)	Brigalow scrub with wilga, sandalwood, and belah	$IIIk_{2-3}$
6	5	Land facet 15: colluvial slopes in lower sectors	Deep texture-contrast soils, Broadmeadow and Taurus (Dy5.83)	Poplar box grassy woodland with sandalwood	IVp_{3-4}
7	10	Land facet 13: erosional lower slopes	Shallow to moderately deep texture-contrast soils, Southernwood (Dy2.12) and Luxor (Dy3.42)	Silver-leaved ironbark grassy woodland	IVp_{3-4}, e_{3-4}, d_4
8	5	Land facet 16: drainage floors	Deep texture-contrast soils, Taurus and Retro (Dd1.43, Dy3.43)	Poplar box grassy woodland	IVp_{3-4}
9	<5	Channels: up to 100 ft wide and 10 ft deep	Bed loads silt and sand	Fringing vegetation	

(18) Redrange Land System (150 sq miles)

Hilly softwood scrub country, east of Taroom.

Geology.—Weathered, subhorizontal to gently dipping Jurassic shale and sandstone.

Geomorphology.—Formed from weathered finer-textured rocks below the Tertiary weathered surface—undulating plains: up to 20 miles in extent, with erosional upper and mid slopes, and erosional or depositional lower slopes; moderately dense branching drainage pattern with minor alluvial floors; local relief mainly less than 100 ft but up to 200 ft.



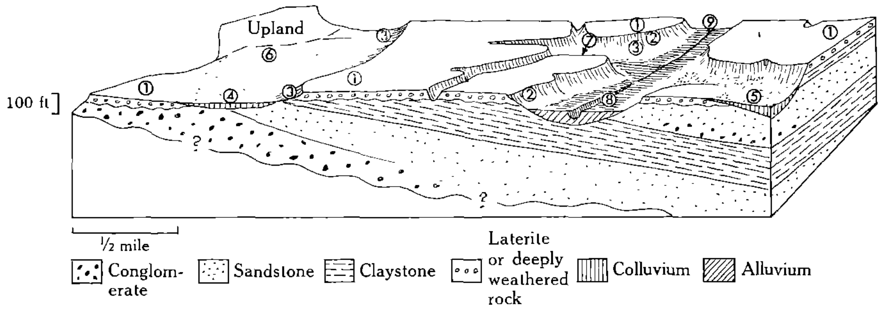
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	10	Land facet 2: gentler upper slopes	Moderately deep to deep cracking clays, Teviot (Ug5.33)	Softwood scrub	II–IIIk$_{2-3}$, e$_2$
2	15	Land facet 4: steeper upper slopes	Shallow clay loams and light to medium clays, Kinnoul (Uf6.31, 6.21, 6.11)	Softwood scrub with brigalow	IVd$_4$, e$_{3-4}$
3	20	Land facet 6: gentler mid slopes	Moderately deep incipient cracking clays, Cheshire (Uf6.21)	Softwood scrub with brigalow and bauhinia	IIIe$_{2-3}$, d$_3$
4	15	Land facet 7: steeper mid slopes	Very shallow sandy clay loams and clays, Rugby (Um1.43, Uf6.31)	Softwood scrub with blackbutt	VIt$_6$, d$_5$
5	10	Land facet 11: colluvial slopes in mid and upper sectors	Deep cracking clays, Rolleston and Downfall (Ug5.16, 5.22)	Brigalow scrub with wilga and sandalwood	IIIk$_{2-3}$
6	5	Land facet 15: colluvial slopes in lower sectors	Moderately deep texture-contrast soils, Retro (Dd1.43)	Poplar box grassy woodland with sandalwood	IVp$_{3-4}$, e$_{2-3}$
7	10	Gentler erosional lower slopes: mainly 1–3% and up to ½ mile long; sealed surfaces with pebble-cobble patches	Moderately deep to deep cracking clays, Teviot (Ug5.22, 5.26)	Treeless communities (72). Grasslands, moderately dense blue grass (81)	IIIk$_{2-3}$, e$_{2-3}$
8	10	Land facet 13: steeper erosional lower slopes	Shallow texture-contrast soils, Southernwood (Dy3.32)	Silver-leaved ironbark grassy woodland	VIt$_6$, e$_{3-4}$, d$_4$
9	<5	Drainage floors: up to ¼ mile wide, gradients mainly below 1 in 100; sealed surfaces	Deep cracking clays, Vermont (Ug5.16); locally with sandy wash on surface, Wyseby (Dy2.41)	Grassy woodland (52). Closely spaced *E. populnea*; sparse shrubs; eastern mid-height grass	IVw$_{3-4}$
10	<5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt to cobbles	Fringing vegetation	

(19) Duaringa Land System (820 sq miles)

Low lateritic tablelands with red and yellow earth soils and eucalypt woodlands.

Geology.—Lateritized, gently dipping to flat-lying Tertiary sandstone, conglomerate, claystone, and shale.

Geomorphology.—Formed by shallow dissection of the Tertiary weathered surface—low tablelands: tracts up to 20 miles in extent, comprising crests and delimiting hill slopes with restricted erosional and depositional sites downslope; branching pattern of incised drainage; local relief up to 100 ft or more.



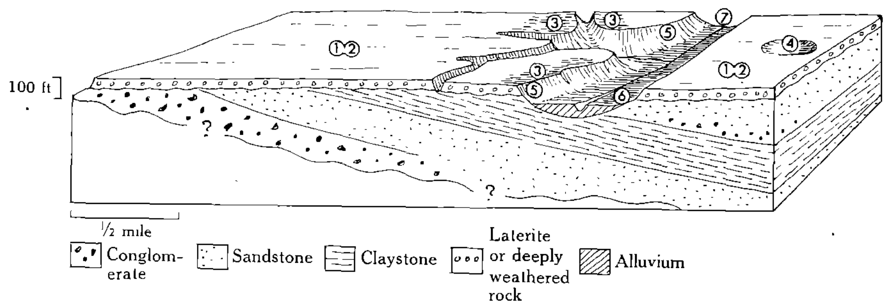
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	40	Interfluve crests: up to about 2 miles in extent but mainly less than 1 mile; sandy to loamy slopes mainly up to 2% but attaining 3–5% locally	Deep, sandy or loamy red earths, Annandale and Dunrobin (Gn2.12)	Shrub woodland (45–47 and locally 13). Moderately dense trees (*E. crebra, E. polycarpa*); moderate to dense shrub layer (*Petalostigma pubescens, Alphitonia excelsa, Lysicarpus angustifolius, Acacia* spp.); moderate three-awn grass (79)	IVn_{3-4}, m_3, e_{2-3}
2	10	Hill slopes: mainly up to about 40%, but attaining 80% locally, and less than ¼ mile long, with extensive lower slopes about 10%; boulder-strewn outcrop surfaces with upper breakaways in many areas, mainly less than 10 ft high but up to 25 ft	Outcrop with shallow sands and grits, Petrona (Uc1.21); moderately deep texture-contrast soils on lower slopes, Luxor (Dy2.42)	Lancewood and rosewood forests (28, 30, 31). *A. shirleyi* and *A. rhodoxylon* form a complex of dense forest very similar in structure; shrubs sparse; sparse three-awn grass (79)	VII–VIIIt_{7-8}
3	5	Hill-foot slopes: concave, up to 10% and less than ½ mile long, rapidly decreasing to about 5% or less; sandy to loamy surfaces with pebble-cobble patches	Deep, loamy coarse sand grading to loamy fine sand at depth, Highmount (Uc1.22); deep texture-contrast soils with a thin sandy surface, Springwood (Dr3.41)	Tall forest (14). Closely spaced forest of *E. citriodora, E. crebra*, and scattered *E. polycarpa*; moderate shrubs (*Petalostigma pubescens, Alphitonia excelsa*); sparse three-awn grass (79)	IVe_{3-4}, p_{3-4}
4	10	Colluvial slopes in upper sectors: sandy to loamy concave slopes up to 5%, but mainly less than 3%, and ½ mile long	Deep sandy red earth, Forrester (Gn1.12, 2.22)	Shrub woodland (46). Moderately dense trees (*E. crebra, E. polycarpa, E. exserta*); moderate to dense shrub layer; sparse to moderate three-awn grass (79)	IVn_{3-4}, m_3
5	15	Colluvial slopes in lower sectors: up to about 3%, but mainly less than 2%, and ½ mile long; with local depressions	Deep texture-contrast soils with a thin fine sandy surface over a medium clay, Taurus (Dy5.83)	Shrub woodland (45). As unit 1. *E. crebra, E. polycarpa*, and *E. tessellaris* in the depressions	IVp_{3-4}
6	10	Alluvial aprons: up to 2 miles long, gradients mainly 1 in 50 to 1 in 100; dissected up to 40 ft in lower parts	Shallow to moderately deep loamy sands, Petrona and Highmount (Uc5.11); locally, Springwood (Dy4.51)	Shrub woodland (46). Moderately dense trees (*E. crebra, E. polycarpa, E. exserta*); moderate to dense shrub layer; sparse to moderate three-awn grass (79)	IVd_{3-4}, n_{3-4}, m_3
7	<5	Tributary drainage floors: less than ¼ mile wide, gradients up to 1 in 50	Deep texture-contrast soils with a thin sandy or loamy surface, Taurus and Retro (Dy3.43)	Tall woodland (49, 50). Closely spaced *E. moluccana*; shrubs commonly sparse; eastern mid-height grass (80)	IVp_{3-4}
8	<5	Land facet 16: main drainage floors	Deep texture-contrast soils, Taurus (Dy2.43)	Poplar box grassy woodland	IVp_{3-4}
9	<5	Channels: up to 50 ft wide and 5 ft deep	Deep sand bed loads	Fringing vegetation	

(20) KAIUROO LAND SYSTEM* (230 SQ MILES)

Low lateritic tablelands with red and yellow earth soils and eucalypt woodlands, in the north-west.

Geology.—Lateritized, gently dipping to flat-lying Tertiary sandstone, conglomerate, claystone, and shale.

Geomorphology.—Formed by shallow dissection of the Tertiary weathered surface—low tablelands: up to 5 miles in extent, with broad crests diversified by distinctive marginal slopes and clayey depressions; sparse, branching pattern of incised drainage; local relief up to about 100 ft.



Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	40	Interfluve crests: up to about 5 miles in extent; sandy to loamy slopes mainly up to 2% but attaining 3–5% locally	Deep sandy or loamy red earths, Annandale and Dunrobin (Gn2.12)	Shrub woodland (45–47). Moderately dense trees (*E. crebra*, *E. polycarpa*); moderate to dense shrub layer (*Petalostigma pubescens*, *Alphitonia excelsa*, *Lysicarpus angustifolius*, *Acacia* spp.); sparse to moderate three-awn grass (79)	IVn$_{3-4}$, m$_{2-3}$
2	20			Bendee forest (41). Dense, almost pure stands of *A. catenulata*; shrub layer sparse; very sparse grass layer mainly *Aristida caput-medusae*	
3	15	Crest margins: sandy to loamy slopes mainly less than 1% but with 2–5% in dissected margins; locally scalded surfaces with grit patches and scattered pisoliths	Very shallow to shallow sandy or loamy red earths. Locally, as unit 5	Shrub woodland as unit 1, but with some *A. rhodoxylon* (30); open to moderate shrub layer; sparse to moderate three-awn grass (79), some bare scalded areas	VId$_{4-5}$, n$_4$, m$_3$
4	<5	Clayey depressions: up to about 1 mile across and 10 ft deep; sealed cracking and hummocky surfaces, commonly with 2–5 ft relief and with pebble patches	Deep gilgaied soil. Complex of cracking clay in the depressions, Pegunny (Ug5.28); and texture-contrast soil on the puff, Wyseby (Dy4.31)	Semi-evergreen vine thicket (8). Uneven canopy (15–30 ft) of slender, densely packed trees with mixed evergreen, semi-evergreen, and deciduous emergents (30–60 ft) characterized by *Casuarina cristata* and other softwood elements; moderate to dense shrubs; sparse softwood scrub grass (75)	IVp$_{3-4}$, g$_{3-4}$
5	15	Hill slopes: mainly up to about 40%, but attaining 80% locally, and less than ¼ mile long, with extensive lower slopes about 10%; boulder-strewn outcrop surfaces with upper breakaways in many areas, mainly less than 10 ft high but up to 25 ft	Outcrop with shallow sands and grits, Petrona (Uc1.21); and moderately deep texture-contrast soils, Luxor (Dy2.42)	Lancewood and rosewood forests (28, 31). Trees dense; shrubs sparse; sparse three-awn grass (79)	VII–VIIIt$_{7-8}$
6	<5	Land facet 16: main drainage floors	Deep texture-contrast soils, Taurus (Dy2.43)	Poplar box grassy woodland	IVp$_{3-4}$
7	<5	Channels: up to 50 ft wide and 5 ft deep	Deep sand bed loads	Fringing vegetation	

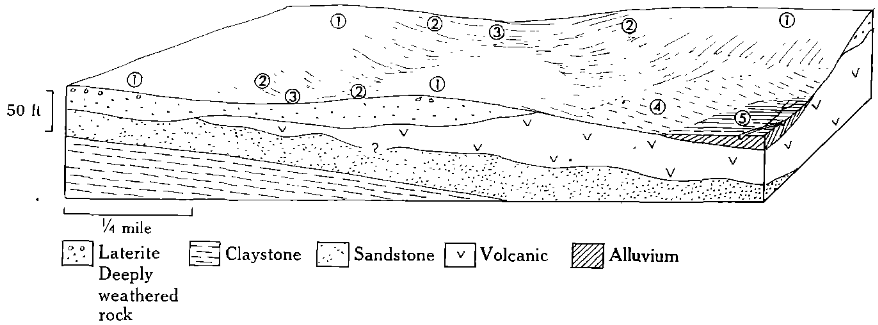
* Similar to Junee land system of the Isaac–Comet area and Lennox land system of the Nogoa–Belyando area.

(21) Narowie Land System (40 sq miles)

Undulating plains with deep red earth soils and eucalypt forest, in the south centre.

Geology.—Lateritized Tertiary basalt with interbedded sandstone and claystone.

Geomorphology.—Formed by shallow dissection of the Tertiary weathered surface—undulating plains: secondary divides up to 10 miles in extent, dominated by relatively unbroken upper slopes with restricted mid and lower slopes; sparse to moderately dense dendritic pattern of shallowly incised drainage; local relief mainly 25–50 ft.



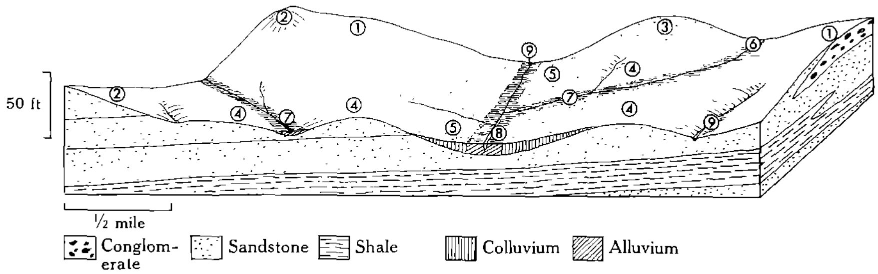
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	65	Upper slopes: up to 5%, but mainly less than 3%, and 1 mile in extent; firmed loamy surfaces with grit-pebble patches	Deep loamy red earth, locally with pisoliths, Dunrobin (Gn2.11)	High forest (13). Tall, moderately spaced trees (80–100 ft) (*E. maculata*, *E. crebra*); moderate shrubs; moderately dense forest grass (77)	IVn_{3-4}, m_{2-3}
2	15	Mid slopes: sandy slopes about 5% and up to ½ mile long	Deep sandy yellow earth, Forrester (Gn2.61)	High forest (20). Moderately spaced trees, mainly *Angophora costata*, *E. dealbata*, with some *E. crebra* and *E. polycarpa*; moderately dense shrubs (*A. glaucocarpa*, *A. cunninghamii*, *Alphitonia excelsa*, *Petalostigma pubescens*); moderately dense forest grass (*Cymbopogon refractus*, *Heteropogon contortus*, and *Aristida* spp.) (77)	IVn_{3-4}, m_3
3	5	Lower slopes in upper sectors: concave, up to about 3% and 200 yd long; firmed sandy to loamy surfaces, locally with scattered pebble-cobbles	Deep texture-contrast soils with a thick sandy surface, Luxor (Dg4.41)	High forest (20). Mainly *E. dealbata*, *E. polycarpa*, and *Tristania suaveolens*	IVp_{3-4}
4	10	Lower slopes in lower sectors: concave, mainly 1–2% and less than ¼ mile long; sealed, cracking surfaces with pebble-cobble patches	Deep cracking clays, May Downs (Ug5.5)	Grassy woodland (55). Openly spaced *E. melanophloia*; sparse shrubs; eastern mid-height grass (80)	$II–IIIk_{2-3}$, e_2
5	5	Drainage floors: up to about 200 yd wide, gradients mainly below 1 in 100, with transverse slopes up to about 2% locally; sealed, cracking surfaces, mainly unchannelled but with multiple shallow runnels or gullies up to 30 ft wide and 3 ft deep in degraded areas, and with small channels locally in lower sectors	Very deep alluvial cracking clays, Vermont (Ug5.34)	Tall grassy woodland (54). Widely spaced *E. tereticornis*, *E. crebra*, and *E. tessellaris*, 60–100 ft; sparse shrubs; frontage grass (82)	IVw_{3-4}, k_{2-3}

(22) Conloi Land System (60 sq miles)

Undulating and hilly country with eucalypt forests and woodlands, in extreme south.

Geology.—Weathered, gently dipping to subhorizontal sandstone, conglomerate, and shale of ?Cretaceous age.

Geomorphology.—Formed from weathered coarser-textured rocks below the Tertiary weathered surface—undulating plains: valley plains up to 10 miles in extent, consisting of a range of upper slopes forming rounded crests, and with moderately extensive erosional or colluvial lower slopes; dense rectangular pattern of shallowly incised drainage; local relief mainly less than 50 ft.



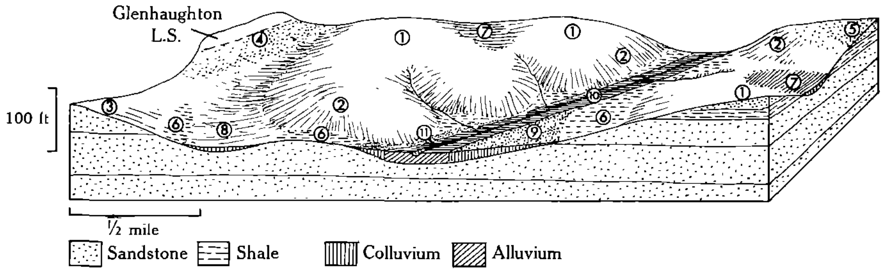
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	25	Gentler upper slopes: mainly less than 2% and up to 1 mile long; firmed sandy to loamy surfaces with pebble patches	Moderately deep texture-contrast soils with a thin sandy surface over columnar clay, Taurus (Dy3.43, Dr3.43)	High forest (16). Moderately dense tree layer (50–70 ft) (*E. crebra, E. drepanophylla, Callitris columellaris*); moderate shrubs; sparse to moderately dense forest grass (77) (*Cymbopogon refractus, Bothriochloa decipiens, Aristida* spp.)	IVp_{3-4}
2	25	Steeper upper slopes: up to about 10% and ¼ mile long; pebble-strewn sandy to loamy surfaces with scattered cobbles	Shallow texture-contrast soils with a thin sandy and gravelly surface, Medway (Dy3.43) and Southernwood (Dy3.42)	High forest (18). Moderately dense tree layer (40–60 ft) (*E. melanophloia, E. drepanophylla, Callitris columellaris*); moderate shrubs; sparse to moderately dense forest grass (77)	IVd_4, p_{3-4}
3	5	Gravelly upper slopes: mainly up to about 3%, but with marginal slopes attaining 10%, and up to ½ mile long; gravels at or near the surface, ranging from grit to boulders	Very shallow loamy sands amid gravels and boulders, Shotover (Uc2.12)	High forest (15). Moderately dense tall tree layer (60–80 ft) (*E. crebra, E. maculata, E. drepanophylla, Callitris columellaris*); moderate shrubs; sparse to moderately dense forest grass (77) (*Cymbopogon refractus, Aristida* spp.)	VId_5, r_{4-5}, e_{3-4}
4	25	Land facet 13: erosional lower slopes	Moderately deep texture-contrast soils, Taurus (Dd1.33, Dy2.33)	Silver-leaved ironbark grassy woodland, with *E. orgadophila* and *E. dichromophloia*	IVp_{3-4}, e_{3-4}
5	10	Land facet 15: colluvial slopes	Moderately deep to deep texture-contrast soils, Retro and Taurus (Dy2.43)	Poplar box grassy woodland with sandalwood	IVp_{3-4}
6	<5	Tributary drainage floors in upper sectors: up to about 200 yd wide, gradients up to 1 in 30, with transverse slopes up to 2% locally	Deep texture-contrast soils with a thin sandy loam over a medium clay, Springwood (Dd1.12)	Fringing community (69). Very open discontinuous *E. tereticornis* and *E. drepanophylla*, also scattered *Casuarina cunninghamiana* and *Melaleuca* spp.; frontage grass (82)	IVp_{3-4}
7	<5	Tributary drainage floors in lower sectors: less than ¼ mile wide, gradients mainly below 1 in 50; firmed surfaces	Deep texture-contrast soils with a thin sandy loam over a medium clay, Taurus (Dy2.33)	Grassy woodland (59). Closely spaced trees (*E. melanophloia, E. orgadophila, E. dichromophloia*); sparse shrubs; eastern mid-height grass (80)	IVp_{3-4}
8	<5	Main drainage floors: up to ¼ mile wide, gradients mainly below 1 in 200	Deep layered alluvial soils; sands and loamy sands, Davy (Uc1.21)	Tall grassy woodland (53). Widely spaced *E. tereticornis* and *Angophora floribunda*; sparse shrubs; frontage grass (82)	IVn_{3-4}, m_3
9	<5	Channels: up to 200 ft wide and 10 ft deep	Bed loads deep sand	Fringing vegetation	

(23) DOUGHBOY LAND SYSTEM (160 SQ MILES)

Undulating plains with sandy soils, eucalypt and bull-oak forests, near Injune.

Geology.—Weathered, gently dipping to subhorizontal Jurassic sandstone and shale.

Geomorphology.—Formed from weathered coarser-textured rocks below the Tertiary weathered surface—undulating plains: tracts up to 20 miles in extent, with diverse upper slopes and with less extensive lower slopes dominated by colluvial types; moderately dense branching pattern of incised valleys; local relief up to 100 ft.



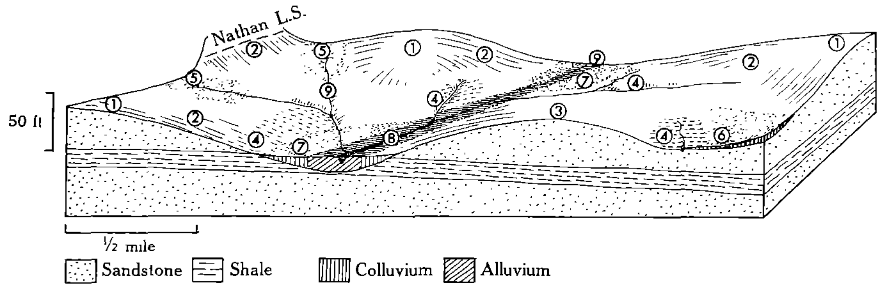
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	40	Gentler upper slopes: mainly less than 2% and up to ½ mile long; sandy to loamy surfaces with grit patches	Deep texture-contrast soils with a thick fine sand over a sandy clay loam, Luxor (Dy4.41, 5.81)	High forest (20). Moderately dense *Angophora costata*, *E. dealbata*, *Callitris columellaris*, and *Casuarina luehmannii*; moderate shrub layer; three-awn grass (79)	IVp_{3-4}
2	10	Steeper upper slopes: mainly up to about 10% and ¼ mile long, but dissected up to 50 ft into narrow spurs with flank slopes attaining 20% or more; scattered rock outcrops and minor structural benches	Moderately deep texture-contrast soil with a thin loamy surface over gritty clay, Springwood (Dy2.12)	High forest (19). Moderately dense tree layer (*E. melanophloia*, *Callitris columellaris*, *Casuarina luehmannii*); moderate shrubs; sparse to moderate three-awn grass (79)	$IV–VIt_6$, e_4, d_4
3	5	Gravelly upper slopes: up to 5%, but mainly less than 3%, and ¼ mile long; sandy to loamy surfaces with gravel exposures	Deep texture-contrast soil with a thick fine sandy surface over sandy clay loam, Luxor (Dg4.41)	High forest (19). Moderately dense tree layer (*E. melanophloia*, *Callitris columellaris*, *Casuarina luehmannii*); moderate shrubs, sparse three-awn grass (79)	IVp_{3-4}, e_3
4	10	Sandy upper slopes in headwater areas: up to about 5% and mainly less than ½ mile long	Very deep sands, Highmount (Uc1.21)	Tall forest (20). Moderately dense *Angophora costata*, *E. dealbata*, *E. polycarpa*, and *E. tessellaris*; moderate shrub layer; three-awn grass (79)	IVn_4, m_3
5	5	Loamy upper slopes in headwater areas: up to 3%, but mainly less than 1%, and ½ mile long; firmed surfaces	Deep texture-contrast soil with a thin sandy loam surface over columnar clay, Taurus (Dd1.43)	Grassy woodland (59). Open tree layer of *E. orgadophila*, *E. melanophloia*, *E. dichromophloia*; shrubs moderate to sparse; eastern mid-height grass (80)	IVp_{3-4}
6	5	Land facet 13: erosional lower slopes	Shallow texture-contrast soils, Southernwood (Dy2.12)	Silver-leaved ironbark grassy woodland	$IV–VIp_{3-4}$, d_4, e_{3-4}
7	15	Colluvial slopes in upper sectors: sandy slopes up to about 3% and ½ mile long	Deep texture-contrast soils with a thick sand or loamy sand over a sandy clay loam or sandy clay, Luxor (Dy4.41, 5.41, 4.61)	*Casuarina* forest (42) and *Callitris* forest (43). Shrubs sparse or absent; sparse three-awn grass (79)	IVp_{3-4}
8	<5	Sandy colluvial slopes in lower sectors: concave, up to 5% and less than ¼ mile long	Deep fine sand to loamy sand, Highmount (Uc5.11)	Grassy woodland (66). *E. dealbata*; shrubs commonly sparse; three-awn grass (79)	IVn_4, m_3
9	<5	Land facet 15: loamy colluvial slopes in lower sectors	Deep texture-contrast soils, Retro (Dy3.43)	Poplar box grassy woodland with sandalwood	IVp_{3-4}
10	<5	Land facet 16: drainage floors	Deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland	IVp_{3-4}
11	<5	Channels: up to 200 ft wide and 15 ft deep	Deep sand bed loads	Fringing vegetation	

(24) Glenhaughton Land System (670 sq miles)

Undulating plains with sandy soils, eucalypt woodlands, and bull-oak forest, in the south.

Geology.—Weathered, gently dipping to subhorizontal Jurassic sandstone and shale.

Geomorphology.—Formed from weathered coarser-textured rocks below the Tertiary weathered surface—undulating plains: up to 30 miles in extent, with extensive upper slopes and restricted, mainly colluvial lower slopes: moderately dense branching drainage pattern with large through-going trunk streams; local relief mainly less than 50 ft.



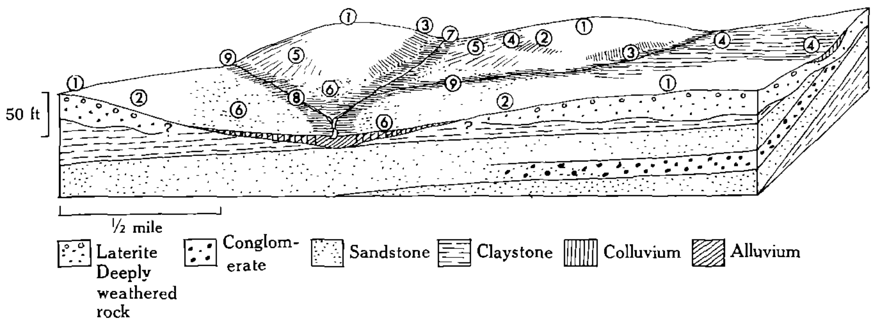
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	40	Gentler upper slopes: mainly less than 2% and up to ½ mile long; sandy to loamy surfaces with grit patches	Deep texture-contrast soils with a thick fine sand over a sandy clay loam, Luxor (Dy5.81)	High forest (20). Moderately dense *Angophora costata*, *E. dealbata*, and *Casuarina luehmannii*; moderate shrub layer; sparse three-awn grass (79)	IVp_{3-4}
2	15	Steeper upper slopes: up to 10%, but mainly 2–5%, and ½ mile long; sandy surfaces with rock outcrops locally	Shallow sands, Petrona (Uc2.12)		VIe_4, d_4, n_{3-4}
3	10	Gravelly upper slopes: up to about 5% and ¼ mile long; sandy surfaces with gravel exposures	Very shallow sands, Shotover (Uc1.21)	*Casuarina* forest (42). Dense stands of *Casuarina luehmannii*, with scattered eucalypts; sparse shrub layer; sparse three-awn grass (79)	VId_5, r_{4-5}, n_4
4	5	Land facet 13: erosional lower slopes	Shallow texture-contrast soils, Southernwood (Dy2.12)	Silver-leaved ironbark grassy woodland	VIt_6, d_4, e_{3-4}
5	15	Colluvial slopes in upper sectors: sandy slopes up to about 3% and ½ mile long	Deep texture-contrast soils with a thick sand or loamy sand over a sandy clay loam or sandy clay, Luxor (Dy4.41, 5.41, 4.61)	*Casuarina* or *Callitris* forest (42, 43). Dense stands of *Casuarina luehmannii* or *Callitris columellaris*, with scattered eucalypts; sparse shrubs; sparse three-awn grass (79)	IVp_{3-4}
6	5	Sandy colluvial slopes in lower sectors: concave, up to 5% and less than ¼ mile long	Deep fine sand to loamy sand, Highmount (Uc5.11)	Grassy woodland (66). Openly to moderately spaced *E. dealbata*; sparse shrubs; sparse three-awn grass; moderate eastern mid-height grass (80)	IVn_{3-4}, m_3
7	5	Land facet 15: loamy colluvial slopes in lower sectors	Deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland with sandalwood	IVp_{3-4}
8	<5	Land facet 16: drainage floors	Deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland with sandalwood	IVp_{3-4}
9	<5	Channels: up to 100 ft wide and 10 ft deep	Deep sand bed loads	Fringing vegetation	

(25) Wooroonah Land System (750 sq miles)

Undulating plains with eucalypt woodlands and forests and bull-oak and cypress pine forests, in the central west.

Geology.—Quaternary–late Tertiary colluvium–alluvium; lateritized Tertiary sandstone, conglomerate, claystone, and shale.

Geomorphology.—Formed by shallow dissection of the Tertiary weathered surface—undulating plains: tracts up to 30 miles across, comprising extensive and varied lower slopes in mainly coarser-textured deposits, with scattered lateritic crests and delimiting mid slopes; open, branching drainage pattern with through-going trunk streams; local relief mainly less than 50 ft but attaining 100 ft.



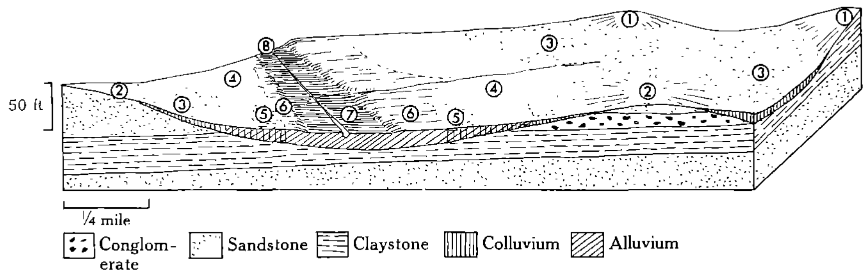
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	15	Crests: up to 5%, but mainly less than 3%, and ½ mile across; sandy surfaces with scattered pebbles and ironstone exposures locally	Shallow loamy sands and sandy loams over a layer of pisoliths, Petrona (Uc1.21)	Shrub woodlands (47). Moderately spaced trees (*E. tenuipes*, *E. crebra*, *E. polycarpa*); well-developed shrub layer (*Petalostigma pubescens*, *Alphitonia excelsa*, *Lysicarpus angustifolius*); sparse three-awn grass (71)	VId_4, n_{3-4}, m_3, e_{2-3}
2	15	Gentler mid slopes: mainly less than 3% and ¼ mile long; sandy surfaces with pebble patches and minor rock outcrops	Deep texture-contrast soil with a thick loamy sand layer over a massive mottled clay, with a layer of pisoliths in the A_2 horizon, Luxor (Dy5.81)	*Casuarina* forest (42). Dense stands of *Casuarina luehmannii*, with scattered eucalypts; shrubs sparse; very sparse three-awn grass (79)	IVp_{3-4}
3	<5	Steeper mid slopes: predominantly 5–15% and up to 200 yd long; cobble-strewn sandy surfaces with scattered rock outcrops	Deep texture-contrast soil with a thin ironstone layer between the loamy sand surface soil and the massive mottled clay subsoil, Luxor (Dy5.84)	Lancewood forest (31). Dense stands of *A. shirleyi*, with scattered eucalypts; sparse shrubs; very sparse three-awn grass (79)	VIt_6, p_{3-4}, r_{4-6}
4	25	Colluvial slopes—upper parts: up to about 3% and ¼ mile long; sandy surfaces with grit patches	Very deep medium sands to loamy sands, Highmount (Uc5.11). Locally, deep texture-contrast soils with a thick loamy sand surface over a mottled sandy clay, Luxor (Dy4.61)	Tall forest (24). Moderately spaced tall trees (80–100 ft) (*E. acmenioides*, *Angophora costata*); moderate shrub layer; sparse three-awn grass	IVp_{3-4}, n_{3-4}, m_3
5	15	Colluvial slopes—lower parts: sandy slopes mainly less than 2% and up to ½ mile long	Deep texture-contrast soils with a thick sand or loamy sand over a sandy clay loam or sandy clay, Luxor (Dy4.41, 4.61, 5.41)	As unit 2, or *Callitris* forest (43). Dense stands of *Callitris columellaris*, with scattered eucalypts; moderate shrub layer; sparse three-awn grass (79)	IVp_{3-4}
6	20	Colluvial–alluvial slopes: mainly less than 1%, but up to 2% locally, and ½ mile long; firmed sandy to loamy surfaces	Deep texture-contrast soils with a thick sand or loamy sand over a mottled clay, Luxor (Dy3.41)	Tall forest (21). Moderately spaced trees (60–80 ft), mainly *E. tereticornis* and *Casuarina luehmannii* but with scattered other eucalypts and *Angophora costata*; shrubs scattered; sparse forest grass (77)	IVp_{3-4}
7	<5	Land facet 17: tributary drainage floors	Deep layered alluvial soils, Davy and Moolayember	Blue gum–Moreton Bay ash tall grassy woodland	IVw_{3-4}
8	<5	Land facet 16: main drainage floors	Deep texture-contrast soils, Retro (Dy3.43)	Poplar box grassy woodland	IVp_{3-4}, w_{3-4}
9	<5	Channels: up to 50 ft wide and 5 ft deep	Bed loads sand and silt	Fringing vegetation	

(26) Redcliffe Land System (130 sq miles)

Plains with sandy soils, eucalypt woodland and bull-oak and cypress pine forests, in the central west.

Geology.—Quaternary–late Tertiary colluvium–alluvium; weathered Tertiary sandstone, conglomerate, claystone, and shale.

Geomorphology.—Formed from weathered coarser-textured rocks below the Tertiary weathered surface—nearly flat plains: valley plains up to 15 miles across, with extensive colluvial or colluvial–alluvial slopes diversified by scattered erosional crests; moderately dense branching drainage pattern with broad alluvial floors; local relief mainly less than 50 ft.



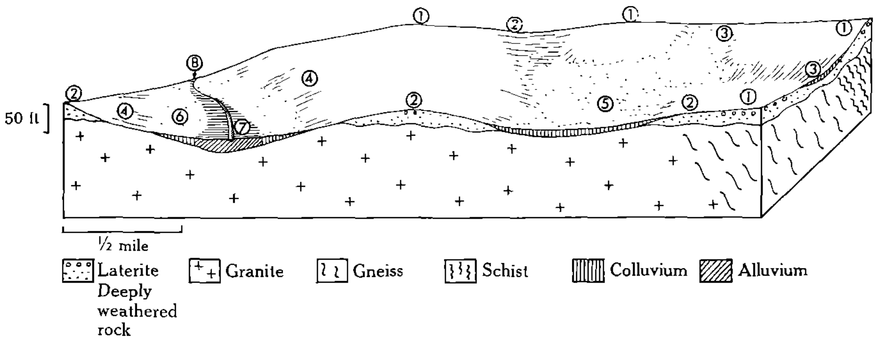
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	10	Crests in upper sectors: up to 3%, but mainly less than 2%, and about ¼ mile across; firmed loamy surfaces	Very deep yellow earth with clay loam surface, Struan (Gn2.22)	Shrub woodland (47). Closely spaced *E. crebra*, *E. polycarpa*, and *E. exserta*; moderate shrub layer (*Petalostigma pubescens*, *Alphitonia excelsa*, *Lysicarpus angustifolius*); sparse three-awn grass (79)	IVn_{3-4}, e_{2-3}
2	10	Crests in lower sectors: mainly less than 1%, but locally attaining 3%, and up to ½ mile in extent; firmed loamy surfaces	Deep texture-contrast soil with a thick loam to sandy clay loam surface over medium clay, Retro (Dy2.43)	Grassy woodland (64). Mainly *E. crebra*; sparse to moderate shrub layer; forest grass (77)	IVp_{3-4}, e_{2-3}
3	35	Colluvial slopes: concave, up to 3% and 1 mile long; sandy to loamy surfaces with grit patches	Deep texture-contrast soils with a thick sandy surface over a columnar-structured clay, Broadmeadow (Dy3.43)	*Casuarina* or *Callitris* forest (42, 43). Dense stands of *Casuarina luehmannii* or *Callitris columellaris* with scattered eucalypts; sparse shrubs; three-awn grass (79) or forest grass (77)	IVp_{3-4}, e_{2-3}
4	20	Colluvial–alluvial slopes: up to about 2% and ½ mile long; firmed sandy to loamy surfaces	Deep texture-contrast soils with a thin sandy surface over a columnar-structured clay, Taurus (Dy3.43)	High forest (21). Mainly *E. tereticornis* and *Casuarina luehmannii*; sparse to moderate shrubs; forest grass (77)	IVp_{3-4}
5	5	Lower parts of unit 4: less than 1% and ¼ mile long	Deep sandy yellow earth, Forrester (Gn2.22)	High forest (19). *E. melanophloia*, *Callitris columellaris*, and *Casuarina luehmannii*; shrubs sparse to moderate; sparse forest grass (77)	IVn_{3-4}, m_3
6	10	Margins of main drainage floors: sandy slopes mainly less than 1% and ¼ mile across; up to about 10 ft above the level of unit 7, with short transitional slopes about 3%	Deep sands and loamy sands, Davy (Uc5.21)	Shrub woodlands (44). Moderately spaced *E. melanophloia*; moderate shrub layer; three-awn grass (79)	IVn_{3-4}, m_3
7	5	Central parts of main drainage floors: up to ½ mile wide, gradients below 1 in 100; firmed sandy surfaces	Deep sands, Davy (Uc5.11, 5.22)	Tall grassy woodland (53). Widely spaced *E. tessellaris* and *Angophora floribunda*; moderate shrub layer; frontage grass (82)	IVn_{3-4}, m_3
8	<5	Channels: up to 100 ft wide and 10 ft deep	Deep sand bed loads	Fringing vegetation	

(27) Auburn Land System (70 sq miles)

Undulating plains with eucalypt forests, east of Cracow.

Geology.—Lateritized granite and granodiorite of ?Triassic age.

Geomorphology.—Formed by shallow dissection of the Tertiary weathered surface—undulating plains: main divides up to 25 miles across, with lateritic upper slopes merging into colluvial mid slopes and with less extensive erosional and depositional sites in the lower parts; moderately dense dendritic pattern of shallowly incised drainage; local relief mainly 25–50 ft.



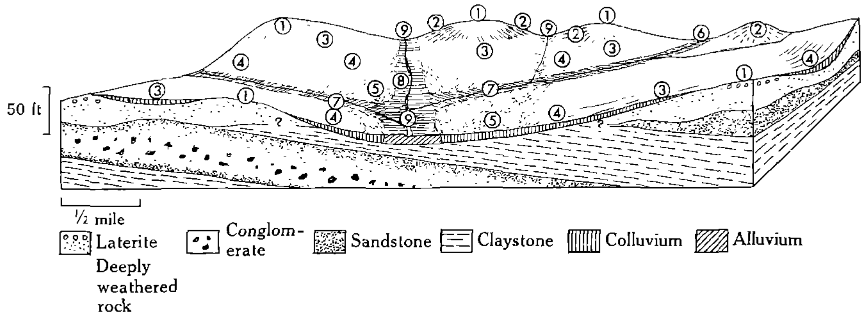
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	20	Gentler upper slopes: less than 2% and up to ½ mile long; firmed sandy to loamy surfaces with pebble-cobble patches	Deep texture-contrast soils with a thin sandy and gravelly surface over light to medium clay, Springwood (Dr4.11)	High forest (12). *E. fibrosa* and *E. maculata* with scattered *E. exserta*; moderate shrub layer; three-awn grass (79) (*Aristida* spp., *Themeda australis*)	IVp_{3-4}
2	20	Steeper upper slopes: up to about 5% and ½ mile long; cobble-strewn sandy surfaces with minor rock outcrops	Very shallow gritty sand or loam, Rugby (Um5.41) and Shotover (Uc1.21)	High forest (13). *E. crebra* and *E. maculata*; moderate shrub layer; three-awn grass (79) (*Aristida* spp., *Cymbopogon refractus*)	VIr_5, d_5
3	20	Colluvial mid slopes: mainly 2–3% and less than ½ mile long; sandy to loamy surfaces with grit patches	Deep texture-contrast soils with a thin loamy surface over a gritty light clay, Wyseby (Dy3.81, Db3.31, 3.41)		IVp_{3-4}
4	10	Erosional lower slopes: up to about 5%, locally more, and ½ mile long; sandy surfaces with bouldery rock outcrops commonly up to 10 ft high	Outcrops with pockets of shallow gritty sand or loamy sand, Shotover (Uc1.21)	High forest (13). Mainly *E. crebra*, with scattered *E. polycarpa* and *E. tessellaris*; moderate shrub layer; three-awn grass (79), mainly *Aristida* spp.	VIr_5, d_5
5	10	Lower slopes of coarser-textured colluvium: up to about 3% and ½ mile long; firmed sandy to loamy surfaces	Deep texture-contrast soils with a thin sandy or loamy surface, Springwood or Wyseby (Dy3.42)	Tall woodland (49, 50). *E. moluccana* and *E. crebra*; sparse shrub layer; eastern mid-height grass (80)	IVp_{3-4}
6	5	Lower slopes of finer-textured colluvium: mainly less than 1%, but attaining 3% locally, and up to ½ mile long	Very deep cracking clays with slight gilgai, Downfall (Ug5.34)	Brigalow forest (36). *A. harpophylla* and *Casuarina cristata*; moderate to dense shrub layer; very sparse scrub grass (76)	$IIIk_{2-3}$, e_{2-3}
7	10	Drainage floors: up to ½ mile wide, gradients mainly below 1 in 100; with transverse slopes up to 2% locally; mainly sandy surfaces	Deep alluvial sands and sandy loams, Davy (Uc2.12); shallower on margins, Shotover (Uc1.21)	High forest (23). *Angophora costata*, *E. tereticornis*, and *E. crebra*, with scattered *E. polycarpa* and *Casuarina luehmannii*; moderate shrub layer; three-awn grass (79) (*Aristida* spp., *Themeda australis*)	$IV–VId_5$, n_{3-4}, m_3
8	5	Channels: up to 50 ft wide and 5 ft deep	Deep sand bed loads	Fringing vegetation	

(28) Melbadale Land System (420 sq miles)

Undulating plains with eucalypt woodlands, south of Dingo.

Geology.—Quaternary–late Tertiary colluvium–alluvium; lateritized Tertiary sandstone, conglomerate, claystone, and shale.

Geomorphology.—Formed by shallow dissection of the Tertiary weathered surface—undulating plains: tracts up to 30 miles in extent, dominated by complex depositional mid and lower slopes in coarser- and finer-textured materials, and with minor lateritic upper slopes; moderately dense branching drainage pattern with subparallel, through-going trunk streams; local relief mainly less than 50 ft.



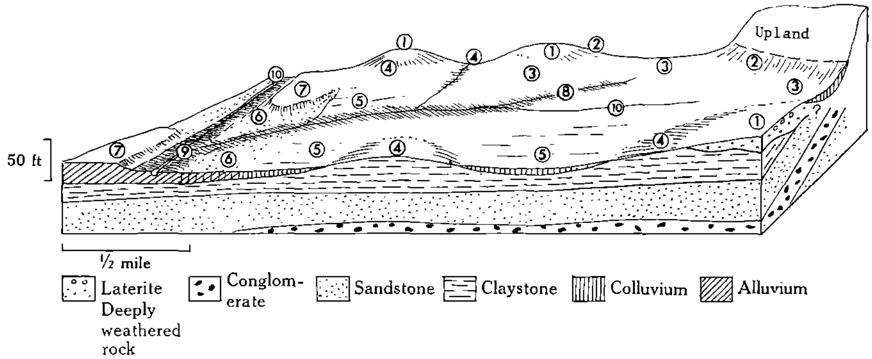
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	15	Gentler upper slopes: up to 2% and ½ mile in extent; firmed sandy to loamy surfaces	Deep loamy and sandy red earths, Annandale (Gn2.12, 2.21) and Dunrobin (Gn2.11). Minor loamy yellow earths, Struan (Gn2.21)	Shrub woodland (46). Moderately dense *E. crebra*, *E. polycarpa*, and *E. exserta*; moderate to dense shrubs; sparse to moderate three-awn grass	IVn_{3-4}, m_3
2	5	Steeper upper slopes: up to about 20% and less than ¼ mile long; cobble-strewn sandy to loamy surfaces with rock outcrops	Very shallow fine sandy loams and fine sandy clay loams, Rugby (Um1.43) and Shotover (Uc1.21). Locally, shallow texture-contrast soils, Southernwood (Dy3.41)	Lancewood forest (31). Dense *A. shirleyi*, with scattered *E. crebra* and *E. polycarpa*; sparse to moderate shrubs; sparse three-awn grass	VIt_6
3	20	Colluvial mid slopes: mainly less than 1% and ½ mile long; firmed sandy to loamy surfaces with grit-pebble patches	Deep texture-contrast soils with loamy surface soil over mottled clay with gravel layer in A_2 horizon, Wyseby (Dy3.42)	Tall woodland (50). Closely spaced *E. moluccana* and *E. crebra*; sparse shrub layer; eastern mid-height grass	IVp_{3-4}
4	35	Lower slopes in coarser-textured colluvium: 1–3% mainly and up to ½ mile long; firmed sandy to loamy surfaces	Moderately deep to deep texture-contrast soils. Loamy sand or sandy loam on mottled, massive, sandy clay, Springwood (Dy5.61) and Luxor (Dy3.81, 3.41)	Grassy woodland (64). Open-spaced *E. crebra*, with *E. polycarpa* in places; shrubs sparse to moderate. Grades into shrub woodland (42). Local patches of *Casuarina* forest (43*a*); three-awn grass	IVp_{3-4}, n_{3-4}
5	15	Lower slopes in finer-textured colluvium: up to 1% and 1 mile in extent; sealed surfaces with grit patches	Deep light to medium clays, Carraba (Uf5.41)	Tall forest (14). *E. citriodora* and *E. crebra*, locally *E. polycarpa*, *E. tenuipes*, and *A. shirleyi*; moderate shrub layer; three-awn grass	$IIIk_{2-3}$
6	<5	Tributary drainage floors in upper sectors: less than 200 yd wide, gradients up to about 1 in 50; firmed to sealed sandy to loamy surfaces	Deep texture-contrast soils with a thin loamy surface on a medium clay, Wyseby (Db1.32)	Tall woodland (49). Closely spaced *E. moluccana*; sparse shrubs; eastern mid-height grass	IVp_{3-4}
7	<5	Tributary drainage floors in lower sectors: up to ¼ mile wide, gradients mainly below 1 in 100; firmed sandy surfaces mainly	Stratified loams, clays, and grits overlying clay at depth, Consuelo. Some exhibit weak gradational development	Tall grassy woodland (52). Openly spaced *E. tereticornis* and *E. tessellaris*, scattered *E. polycarpa* (60–80 ft); sparse to moderate shrubs; frontage grass	IVw_{3-4}
8	<5	Land facet 16: main drainage floors	Deep texture-contrast soils, Taurus (Dy3.43)	Poplar box grassy woodland	IVp_{3-4}, w_{3-4}
9	<5	Channels: up to 50 ft wide and 5 ft deep	Bed loads sand and silt	Fringing vegetation	

(29) Perch Land System (250 sq miles)

Undulating plains with eucalypt woodlands, mainly in the north-western quarter.

Geology.—Quaternary–late Tertiary colluvium–alluvium; lateritized or little-weathered Tertiary sandstone, conglomerate, claystone, and shale.

Geomorphology.—Formed by shallow dissection of the Tertiary weathered surface—undulating plains: valley plains up to 8 miles across, consisting of extensive colluvial and alluvial slopes with minor lateritic crests and erosional lower slopes; moderately dense branching drainage with large through-going streams; local relief mainly less than 50 ft.



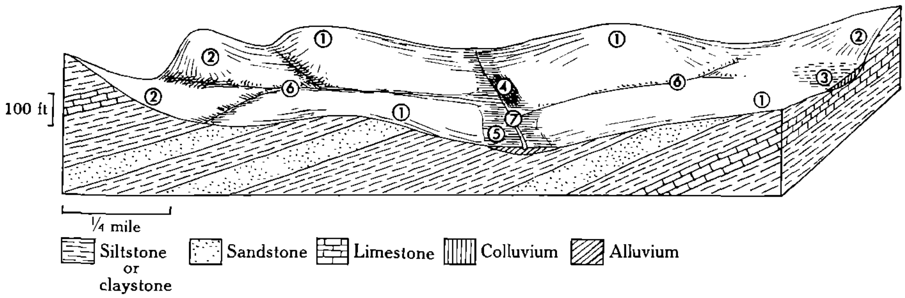
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	10	Upper slopes: mainly 1–2%, but up to 5% locally and up to ½ mile long; sandy to loamy surfaces with grit patches	Deep loamy red earths, Dunrobin (Gn2.12)	Shrub woodland (46). Moderately spaced *E. crebra* and *E. polycarpa*; shrubs sparse to moderate; three-awn grass	IVn$_{3-4}$, m$_3$, e$_{2-3}$
2	10	Steeper colluvial slopes in upper sectors: 3–6% mainly and less than ¼ mile long; sandy surfaces with gravel exposures locally	Moderately deep coarse sands overlying gravel, Petrona (Uc1.22)	Tall grassy woodland (54). Closely spaced *E. tessellaris* and *E. polycarpa*; sparse shrubs; three-awn grass	IVn$_{3-4}$, m$_3$
3	15	Gentler colluvial slopes in upper sectors: concave, up to 3% and ½ mile long; sandy to loamy surfaces with grit patches	Moderately deep texture-contrast soil with a thick loamy sand surface over a mottled light clay on rock, Luxor (Dy3.41). Layer of pisoliths in A_2 horizon	Tall grassy woodland (54). Closely spaced *E. crebra, E. tessellaris*, and *E. polycarpa*; sparse to moderate shrubs; three-awn grass	IVp$_{3-4}$
4	10	Land facet 13: erosional lower slopes	Shallow to moderately deep texture-contrast soils, Southernwood and Wyseby (Dy3.42)	Silver-leaved ironbark grassy woodland, occasional *E. papuana*	IVp$_{3-4}$
5	15	Land facet 15: colluvial slopes in lower sectors	Moderately deep texture-contrast soils, Retro (Dy3.43)	Poplar box grassy woodland with sandalwood	IVp$_{3-4}$
6	10	Colluvial–alluvial slopes: mainly less than 1% and up to 1 mile long; sealed, locally cracking, and hummocky surfaces	Deep uniform cracking clays with slight gilgai, Vermont (Ug5.26); non-cracking, Carraba (Uf6.31)	Tall woodland (49). Closely spaced *E. moluccana*; sparse shrubs; eastern mid-height grass	IIIk$_{2-3}$
7	20	Slopes of older alluvium: sandy to loamy slopes mainly less than 1% but up to 2%, and ¼ mile in extent	Deep loamy and sandy red earths on old alluvium, Wilpeena (Gn2.12)	Shrub woodlands (44). Moderately spaced *E. melanophloia*; moderate shrubs (*Petalostigma pubescens, Alphitonia excelsa, Lysicarpus angustifolius*); three-awn grass	IVn$_{3-4}$, m$_3$
8	5	Land facet 17: tributary drainage floors	Very deep texture-contrast soils, Wyseby (Dy3.41)	Blue gum–narrow-leaved ironbark tall grassy woodland	IVp$_{3-4}$
9	<5	Land facet 16: main drainage floors	Very deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland	IVp$_{3-4}$, w$_{3-4}$
10	<5	Channels: up to 50 ft wide and 5 ft deep	Bed loads silt and sand	Fringing vegetation	

(30) Rosewood Land System (95 sq miles)

Strongly undulating plains with shallow stony soils and rosewood forest, in the north.

Geology.—Moderately to steeply dipping Permian siltstone, claystone, shale, sandstone, and limestone.

Geomorphology.—Eroded in relatively unweathered rocks—strongly undulating plains: up to 15 miles in extent, mainly consisting of gentler or steeper upper slopes forming low hills, but with minor depositional lower slopes; moderately dense dendritic or rectangular pattern of incised valleys with through-going alluvial drainage floors; local relief 50–200 ft.



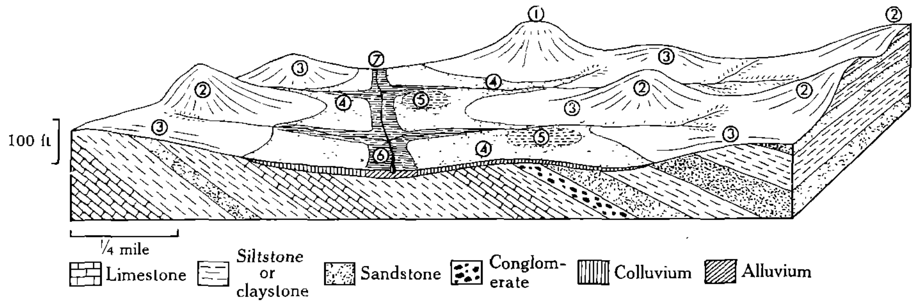
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	55	Gentler upper slopes: mainly less than 5%, but up to about 10% locally, and up to ½ mile long; firmed loamy surfaces with cobble patches and minor rock outcrops	Shallow to moderately deep, texture-contrast soils with a thin loam to clay loam surface over alkaline to highly alkaline clay, Medway and Retro (Dy2.43, Dd1.23)	Rosewood forest and grassy woodland (29, 30). Moderately dense *A. rhodoxylon*, *E. melanophloia*, and *E. crebra*; sparse shrubs; eastern mid-height grass and forest grass	IVp$_{3-4}$, d$_4$, e$_{3-4}$
2	30	Steeper upper slopes: concave–convex, up to about 50% but mainly less than 20%, and less than ½ mile long; cobble-strewn outcrop slopes with minor benches	Outcrop and very shallow gritty sand or sandy loam, Shotover (Uc1.21)		VII–VIIIt$_{7-8}$
3	<5	Colluvial slopes: mainly less than 5% and up to ¼ mile long; firmed to sealed loamy surfaces with grit-pebble patches	No observations, probably Ingelara (Gn3.12)	Microphyll vine woodland (1). A continuous canopy of slender, densely packed trees 20–40 ft; upper layer comprises discontinuous evergreen and semi-evergreen emergents (30–60 ft); lianes common; shrub layer dense; sparse softwood scrub grass	—
4	<5	Land facet 12: slopes of older alluvium	Very deep cracking clays (incipient gilgai), Downfall and Retro (Ug5.28, Dy1.43)	Brigalow scrub with wilga and sandalwood	IVp$_{3-4}$, k$_{2-3}$
5	5	Land facet 16: drainage floors	Deep gritty texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland	IVp$_{3-4}$
6	<5	Tributary channels: gradients mainly 1 in 30 to 1 in 100; up to 30 ft wide and 5 ft deep, incised up to 10 ft into bed-rock; locally with marginal sandy flats less than 100 ft across	Very shallow to shallow sandy loam to loam, Petrona (Uc5.21) and Rugby (Um1.41)	Fringing community (70). Fringe formed by adjoining community (*E. crebra*, *A. rhodoxylon*)	—
7	<5	Main channels: up to 50 ft wide and 10 ft deep	Bed loads silt to boulders	Fringing vegetation	

(31) Bannockburn Land System (130 sq miles)

Undulating and low hilly country with shallow soils and eucalypt woodland, in the north.

Geology.—Moderately to steeply dipping Carboniferous siltstone, claystone, limestone, sandstone, and conglomerate.

Geomorphology.—Eroded in relatively unweathered rocks—strongly undulating plains: tracts up to 15 miles across, with extensive erosional upper and lower slopes and fairly extensive colluvial lower slopes; moderately dense branching drainage pattern, comprising alluvial drainage floors with incised tributary channels; local relief mainly 50–100 ft but up to 200 ft.



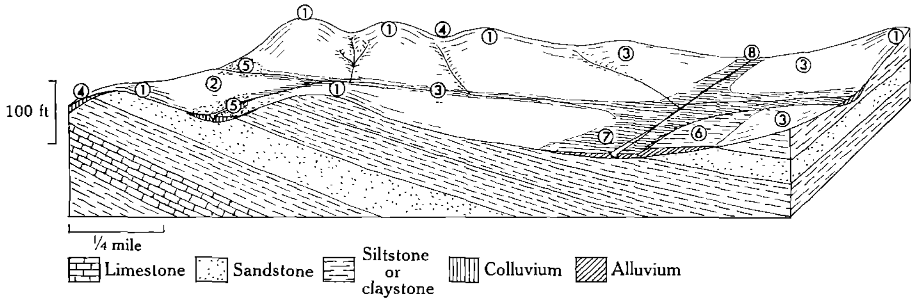
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	5	Upper slopes on weathered rock: up to 40%, locally more, and ¼ mile in extent; cobble-boulder mantles and rock outcrops	Mostly outcrop	Grassy woodland (64). In places grades into shrub woodland (48). *E. crebra* forms open to moderately dense tree layer; moderate to sparse shrubs; mainly eastern mid-height grass	VII–VIIIt_{7-8}, r_5
2	30	Upper slopes on relatively unweathered rock: mainly up to about 25% and ½ mile long; cobble-strewn outcrop surfaces	Outcrop and shallow pockets of loam, Rugby (Um1.41)	Grassy woodland (58). *E. crebra*, *E. melanophloia*, and *E. dichromophloia* open tree layer; moderate to sparse shrubs; eastern mid-height grass	VII–VIIIt_{7-8}, r_5
3	25	Land facet 13: erosional lower slopes	Very shallow loams and shallow texture-contrast soils	Silver-leaved ironbark grassy woodland	VId_4, e_{3-4}, r_{3-4}
4	25	Colluvial slopes: mainly 2–3% and up to ½ mile long; firmed loamy surfaces with pebble patches	Moderately deep to deep texture-contrast soils, Retro (Dy2.23)	Grassy woodland (55). Open tree layer of *E. melanophloia*; sparse shrubs; moderately dense eastern mid-height grass	IVp_{3-4}
5	<5	Slopes of older colluvium–alluvium: less than 2% and ¼ mile long; sealed surfaces with grit-pebble patches	Deep texture-contrast soil with thin silt loam surface horizon, Retro (Dy2.43)	Brigalow forest (38). Local thickets of *A. harpophylla* with moderate tall shrub layer (*Geijera parviflora*, *Eremophila mitchellii*); moderate low shrubs; brigalow scrub grass	III–IVp_{3-4}, k_{2-3}
6	10	Drainage floors: up to ¼ mile wide, gradients mainly below 1 in 200; firmed to sealed loamy surfaces		Grassy woodland (63). Commonly closely spaced *E. populnea* and *E. crebra*; shrubs mostly sparse; eastern mid-height grass	IVp_{3-4}
7	<5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt to cobbles	Fringing vegetation	

(32) Mourangie Land System (160 sq miles)

Undulating and low hilly country with mostly shallow soils with eucalypt woodland and rosewood forest, in scattered small areas north of Moura.

Geology.—Moderately to steeply dipping Permian siltstone, claystone, shale, sandstone, and limestone.

Geomorphology.—Eroded in relatively unweathered rocks—strongly undulating plains: strike tracts up to 5 miles across, comprising erosional upper and lower slopes with moderately extensive colluvial lower slopes and more restricted alluvial types; moderately dense to dense rectangular or dendritic pattern of incised valleys with through-going alluvial drainage floors; local relief mainly up to 100 ft but attaining 200 ft.



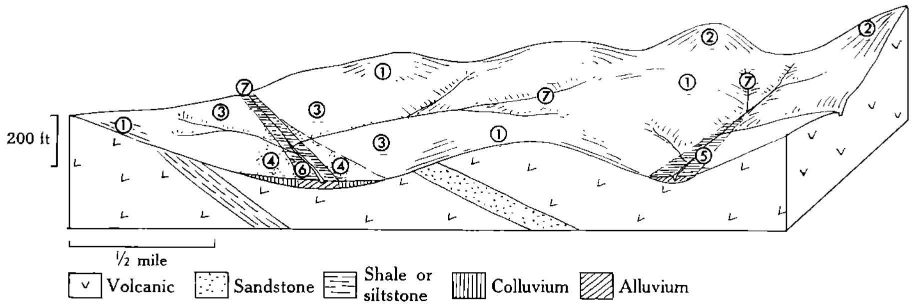
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	35	Upper slopes: up to about 20%, but extensively less than 5%, and about ½ mile long; pebble-cobble-strewn outcrop surfaces	Very shallow loamy sand pockets in outcrop, Shotover (Uc1.21)	Complex of rosewood forest (30). *A. rhodoxylon* and *E. crebra* shrub woodland (46); eastern mid-height grass	VIt_6, r_{4-5}, d_5
2	5	Erosional lower slopes in upper sectors: concave, up to about 10% and ½ mile long; grit-strewn surfaces with pebble-cobble patches and minor rock outcrops	Shallow to moderately deep texture-contrast soils, Medway and Taurus (Dy2.23)	Rosewood forest (30). Moderately dense *A. rhodoxylon* and *E. crebra*; shrubs sparse to moderate; sparse forest grass	IVp_{3-4}, d_4
3	30	Land facet 13: erosional lower slopes in lower sectors	Shallow texture-contrast soils, Medway (Db1.43)	Silver-leaved ironbark grassy woodland	IVp_{3-4}, d_4
4	10	Slopes of coarser-textured colluvium: up to 5% and ¼ mile long; firmed sandy to loamy, grit-strewn surfaces with pebble patches	Moderately deep to deep gravelly texture-contrast soils, Wyseby (Dy3.42)	Tall woodland (49). Closely spaced *E. moluccana*; shrubs sparse to moderate; sparse eastern mid-height grass	IVp_{3-4}
5	5	Slopes of finer-textured colluvium: less than 5% and up to ¼ mile long; firmed to sealed loamy surfaces	Shallow sandy clay loams grading with depth to sandy clays, Ingelara (Gn3.12)	Microphyll vine woodland (1). A more or less continuous canopy of slender densely packed trees (20–40 ft), upper layer comprises discontinuous evergreen or semi-evergreen emergents; lianes common; shrub layer dense; sparse softwood grass	IVd_4, e_{2-3}
6	5	Slopes of older alluvium: mainly less than 1% and up to ½ mile in extent, with marginal bluffs up to 10 ft high; sealed loamy surfaces	Deep texture-contrast soils with thin clay loam surface on medium clay over layered clays, Retro (Dy2.23)	Tall woodland (49). Closely spaced *E. moluccana*; shrubs sparse to moderate; sparse eastern mid-height grass	IVp_{3-4}
7	5	Land facet 17: drainage floors	Deep layered alluvial soils, Moolayember (Gn2.42)	Blue gum–Moreton Bay ash tall grassy woodland	IVw_{3-4}
8	5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt to cobbles	Fringing vegetation	

(33) Ohio Land System (470 sq miles)

Strongly undulating volcanic country, mainly with silver-leaved ironbark, in the east and north-east.

Geology.—Mainly moderately to steeply dipping andesitic volcanics with agglomerate, siltstone, tuffaceous sandstone, tuff, and limestone, of Lower Permian to Upper Carboniferous age.

Geomorphology.—Eroded in relatively unweathered rocks—strongly undulating plains: up to 15 miles across, with extensive upper slopes and minor erosional or depositional lower slopes; moderately dense dendritic pattern of incised valleys with through-going alluvial drainage floors; local relief mainly up to 300 ft but attaining 500 ft.



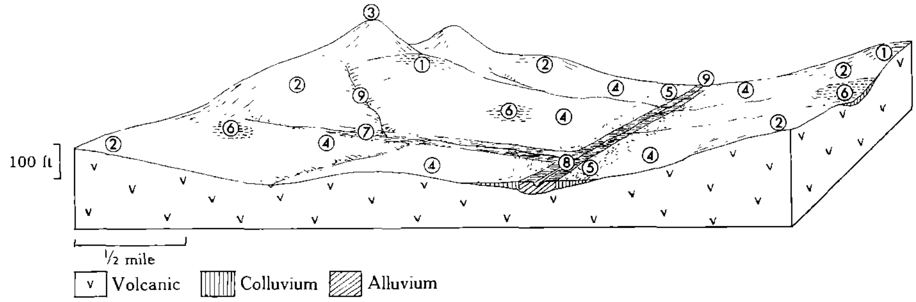
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	65	Land facet 13: gentler upper slopes	Shallow to moderately deep gritty texture-contrast soils, Medway, minor Retro (Dr2.12, Dy2.23)	Silver-leaved ironbark grassy woodland, occasional *E. crebra* or *E. papuana*	IV–VIt$_6$, p$_{3-4}$, e$_{3-4}$
2	5	Steeper upper slopes: concavo-convex, mainly 10–20% but up to about 60%, and mainly less than ½ mile long; cobble-strewn surfaces with scattered rock outcrops	Very shallow gritty clay soils, Rugby (Uf6.32)	Shrub woodland (48). Mainly closely spaced *E. crebra*; moderate shrubs; eastern mid-height grass. This community in many places modified to grassy woodland	VII–VIIIt$_{7-8}$, r$_5$
3	10	Erosional lower slopes: concave, up to 3% but mainly less than 2%, and up to ½ mile long; sealed, cracking surfaces with pebble-cobble patches	Moderately deep to deep cracking clay, May Downs; locally shallower, Bruce (Ug5.15, 5.16, 5.13)	Grassy woodland (56). Openly spaced *E. melanophloia* and *E. dichromophloia*; sparse shrubs; eastern mid-height grass	IIIe$_{2-3}$, k$_{2-3}$
4	10	Land facet 15: colluvial slopes	Moderately deep to deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland with sandalwood	IVp$_{3-4}$
5	<5	Land facet 16: tributary drainage floors	Deep texture-contrast soils, Retro (Dd1.43)	Poplar box–narrow-leaved ironbark grassy woodland	IVp$_{3-4}$
6	5	Main drainage floors: up to ½ mile wide, gradients below 1 in 100; sealed, locally cracking surfaces	Deep alluvial cracking clay soils, Vermont (Ug5.15); non-cracking, Clematis (Uf6.11)	Grassy woodland (62). Closely spaced *E. populnea*; sparse shrubs; eastern mid-height grass	IVw$_{3-4}$
7	5	Channels: up to 100 ft wide and 10 ft deep	Bed loads silt to cobbles	Fringing vegetation	

(34) Torsdale Land System (570 sq miles)

Strongly undulating volcanic plains with mostly shallow soils and eucalypt woodland, in the central east.

Geology.—Mainly moderately to steeply dipping andesitic volcanics with agglomerate, siltstone, tuffaceous sandstone, tuff, and limestone, of Lower Permian to Upper Carboniferous age.

Geomorphology.—Eroded in relatively unweathered rocks—strongly undulating plains: strike belts up to 10 miles wide with extensive upper slopes, moderately extensive lower slopes, and minor colluvial slopes; moderately dense dendritic pattern of incised valleys; local relief mainly 50–200 ft.



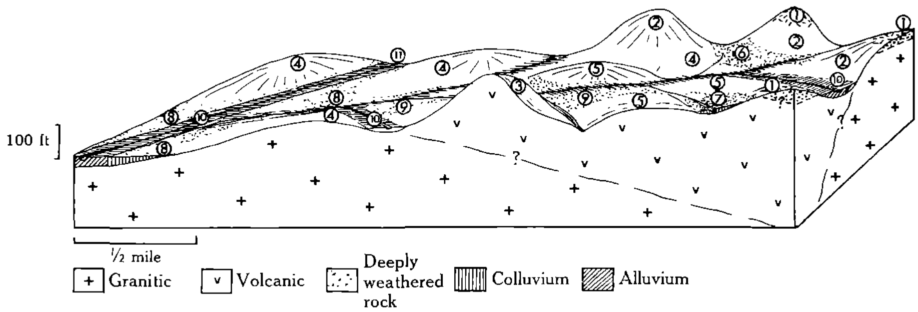
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	5	Land facet 1: upper slopes on weathered rock	Shallow clay loams to clays, Ingelara and Carraba (Um6.21, Uf6.32)	Microphyll vine woodland	VIt$_6$, d$_4$, e$_{3-4}$
2	45	Land facet 13: gentler upper slopes on relatively unweathered rock	Shallow texture-contrast soils, Southernwood (Dr2.12), locally shallow clays, Kinnoul (Uf6.32)	Silver-leaved ironbark grassy woodland	IVe$_{3-4}$, d$_{3-4}$
3	5	Steeper upper slopes on relatively unweathered rock; concavo–convex, mainly 10–20% but up to about 60%, and mainly less than ½ mile long; cobble-strewn surfaces with scattered rock outcrops	Very shallow gritty clay soils, Rugby (Uf6.32)	Shrub woodland (48). Moderately spaced *E. crebra*; moderate shrub layer; eastern mid-height grass. In many places modified to grassy woodland	VI–VIIIt$_{6-8}$
4	25	Erosional lower slopes: concave, up to 3% but mainly less than 2%, and up to ½ mile long; sealed, cracking surfaces with pebble-cobble patches	Moderately deep to deep cracking clays, May Downs (Ug5.13)	Grassy woodland (55). Openly spaced *E. melanophloia*; sparse shrubs; eastern mid-height grass	IIIe$_{2-3}$, k$_{2-3}$
5	5	Land facet 15: colluvial slopes	Moderately deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland with sandalwood	IVp$_{3-4}$
6	5	Land facets 11 and 12: colluvial slopes	Moderately deep to deep cracking clays, Rolleston (Ug5.16), commonly moderately to strongly gilgaied, Pegunny (Ug5.16)	Brigalow scrub with wilga and sandalwood	III–IVg$_{3-4}$, k$_{2-3}$, e$_{2-3}$
7	<5	Tributary drainage floors: up to ¼ mile wide, gradients up to 1 in 50; sealed loamy surfaces with gravel patches	Deep texture-contrast soils. Thin silty loam or fine sandy loam surface over medium to heavy clay, Retro (Dd1.43)	Grassy woodland (58). Openly spaced *E. crebra*, *E. melanophloia*, and *E. papuana*; sparse shrubs; eastern mid-height grass	IVp$_{3-4}$
8	5	Main drainage floors: up to ½ mile wide, gradients below 1 in 100; sealed, locally cracking surfaces	Deep alluvial cracking clay soils, Vermont (Ug5.15); non-cracking, Clematis (Uf6.11)	Grassy woodland (62). Closely spaced *E. populnea*; sparse shrubs; eastern mid-height grass	IVw$_{3-4}$
9	<5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt to cobbles	Fringing vegetation	

(35) Bouldercombe Land System (570 sq miles)

Undulating granite country with mostly shallow soils and eucalypt woodland, mainly near Camboon but small areas near Rockhampton.

Geology.—?Triassic granite and granodiorite; andesitic volcanics of Lower Permian to Upper Carboniferous age.

Geomorphology.—Eroded in relatively unweathered rocks—strongly undulating plains: up to 30 miles in extent, mainly comprising gently rounded erosional lower slopes with scattered hills on granitic or volcanic rocks, and with a range of colluvial slopes; moderately dense dendritic or rectangular pattern of incised valleys, with alluvial drainage floors in lower sectors; local relief mainly 50–100 ft, attaining 200 ft.



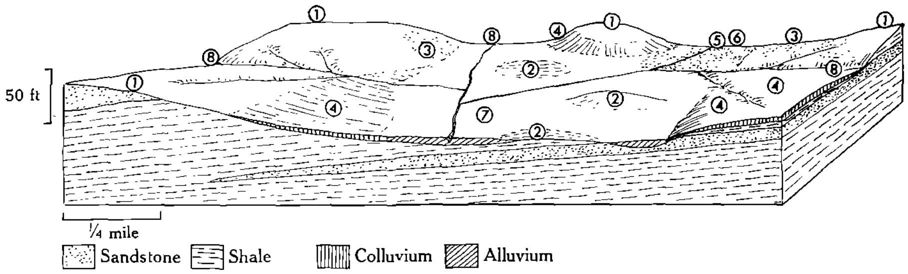
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	5	Upper slopes on weathered rocks: commonly up to 25% and less than ¼ mile long	Rock outcrops with pockets of very shallow sands and grits, Shotover and Petrona (Uc1.21). Deeper loams and light clays on volcanics, Carraba (Gn3.11)	Softwood scrub	VI–VIIt$_{6-7}$
2	10	Granitic hill slopes: boulder-strewn outcrop slopes up to about 60% and ½ mile long	Rock outcrops with shallow gritty soil, Petrona (Uc1.21)	Grassy woodland (64). *E. crebra*, *E. dichromophloia*, locally *E. melanophloia*; moderate to sparse shrubs; eastern mid-height grass	VII–VIIIt$_{7-8}$, r$_5$
3	5	Volcanic hill slopes: up to 60% but mainly 10–20%, less than ½ mile long	Very shallow to shallow texture-contrast soils, Southernwood (Dy3.62, Dr2.12)	Grassy woodland (64). *E. crebra*; moderate shrubs; eastern mid-height grass	VI–VIIt$_{6-7}$
4	25	Granitic lower slopes: mainly less than 5% and ½ mile long	Moderately deep texture-contrast soil, Luxor (Dy4.51)	Grassy woodland (55). *E. melanophloia*, locally *E. dichromophloia*; sparse shrubs; eastern mid-height grass	IVp$_{3-4}$
5	20	Volcanic lower slopes: mainly less than 5% and ½ mile long	Shallow texture-contrast soils, Medway (Dy3.12, 2.12)	Grassy woodland (56). *E. melanophloia* and *E. dichromophloia*; sparse shrubs; eastern mid-height grass	IVp$_{3-4}$
6	5	Colluvial slopes in upper granitic sectors: mainly 3–5% and ¼ mile long	Moderately deep to deep texture-contrast soils, Retro (Dy3.43)	Tall woodlands (49). *E. moluccana*; moderate to sparse shrubs; eastern mid-height grass	IVp$_{3-4}$, e$_{2-3}$
7	<5	Colluvial slopes in upper volcanic sectors: mainly less than 3% and ¼ mile long	Moderately deep texture-contrast soils, Wyseby (Dy3.41)	Brigalow forest (38). *A. harpophylla*; dense softwood shrub layer; scrub grass	IVp$_{3-4}$, e$_{2-3}$
8	10	Colluvial slopes in lower granitic sectors: concave, up to 5% and 1 mile long, locally dissected into narrow spurs	Moderately deep to deep gritty sands, Highmount (Uc6.12) and Petrona (Uc2.21); locally, Wyseby (Db3.12)	Tall grassy woodland (54). *E. tereticornis*, *E. tessellaris*, and *E. crebra*; sparse shrubs; eastern mid-height grass	IV–VIt$_6$, e$_{3-4}$, p$_{3-4}$
9	5	Land facet 15: colluvial slopes in lower volcanic sectors	Moderately deep to deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland with sandalwood	IVp$_{3-4}$
10	<5	Drainage floors: up to ¼ mile wide, gradients up to 1 in 30	Coarser-textured, Moolayember; finer-textured, Vermont (Ug5.15)	Tall grassy woodland (52, 54). *E. tereticornis*, *E. tessellaris*, locally *E. crebra*; sparse shrubs; eastern mid-height grass	IIIw$_3$
11	<5	Channels: up to 100 ft wide and 10 ft deep	Bed loads mainly deep sand	Fringing vegetation	

(36) MONTANA LAND SYSTEM (850 SQ MILES)

Plains with eucalypt woodland, mainly in the south.

Geology.—Quaternary colluvium–alluvium; subhorizontal to gently dipping shale and sandstone of Jurassic or Triassic age.

Geomorphology.—Fluvial plains—tributary plains: valley plains up to 6 miles wide, consisting of a branching system of drainage floors in finer- or coarser-textured alluvium, with low interfluves comprising erosional upper slopes grading into lower slopes of finer- or coarser-textured colluvium; erosional lower slopes have restricted occurrences within the main drainage floors; local relief mainly less than 50 ft.



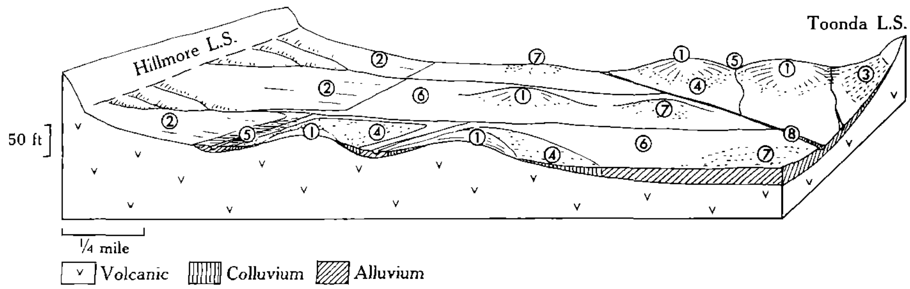
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	40	Land facet 13: upper slopes	Shallow texture-contrast soils, Southernwood (Dr2.22)	Silver-leaved ironbark grassy woodland	VIt$_6$, e$_{3-4}$, d$_4$
2	10	Land facet 13: erosional lower slopes	Deep texture-contrast soils, Luxor (Dy3.22)	Silver-leaved ironbark grassy woodland with *E. dichromophloia*	IVp$_{3-4}$
3	10	Slopes in coarser-textured colluvium: sandy concave slopes up to 5%, but mainly 2–3%, and less than ¼ mile long	Deep fine sand to loamy sand, Highmount (Uc5.11)	Grassy woodland (66). Open to moderately dense *E. dealbata*; sparse to moderate shrubs; three-awn grass. (This unit not present in all areas)	IVn$_{3-4}$, m$_3$
4	15	Land facet 15: slopes in finer-textured colluvium	Moderately deep texture-contrast soils, Retro (Dy3.43)	Poplar box grassy woodland with sandalwood	IVp$_{3-4}$, e$_3$
5	5	Drainage floors in coarser-textured alluvium: up to about ½ mile wide, gradients below 1 in 100, and with transverse slopes up to 1% locally; firmed sandy surfaces	Layered alluvial soil showing weak gradational development (clayey sand—light sandy clay loam—sandy clay loam) on coarse sand at 30 in., Warrinilla	Tall grassy woodland (53). Openly to moderately spaced *E. tereticornis* and *Angophora floribunda*; sparse shrubs; frontage grass	IVw$_{3-4}$
6	<5	Depressions in unit 5: linear, up to about 3 ft deep and 200 yd wide; firmed sandy surfaces		Tall grassy woodland (51). Widely spaced *E. tereticornis*; sparse shrubs; frontage grass	
7	15	Land facet 16: drainage floors in finer-textured alluvium	Deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland	IVw$_{3-4}$, p$_{3-4}$
8	<5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt and sand	Fringing vegetation	

(37) LANGMORN LAND SYSTEM (140 SQ MILES)

Alluvial plains with eucalypt woodland, south-east of Rockhampton.

Geology.—Quaternary colluvium–alluvium; steeply dipping rhyolitic and andesitic volcanics with minor marine beds of Devonian to Carboniferous age.

Geomorphology.—Fluvial plains—tributary plains: alluvial aprons extending up to 10 miles downslope, comprising subparallel main drainage floors with a branching pattern of tributary floors, and with erosional and colluvial slopes forming scattered "rises"; moderately extensive hill-foot slopes at the headward margins; local relief mainly less than 50 ft, but attaining 75 ft in upper sectors.



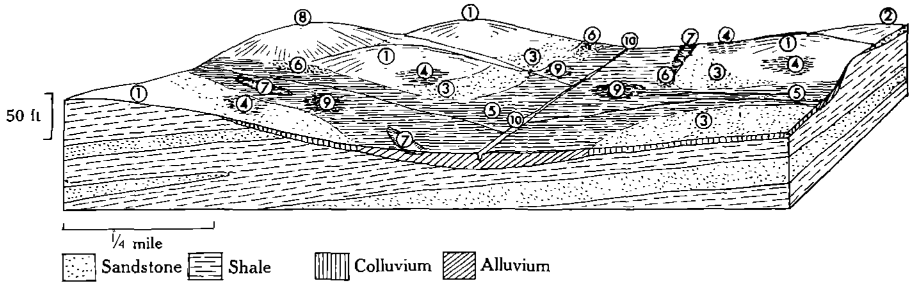
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	10	Land facet 13: upper slopes	Shallow texture-contrast soils, Southernwood (Dy4.32)	Silver-leaved ironbark grassy woodland	IVd_4, e_{2-3}
2	25	Hill-foot slopes: concave, up to about 10% but mainly 2–5%, and 1 mile long; locally dissected up to 50 ft into spurs up to ¼ mile wide, flank slopes up to 20%; firmed loamy surfaces with cobble patches and minor rock outcrops	Outcrop and shallow loams, Rugby (Um1.41); shallow texture-contrast soils, Medway (Dy2.43)	Tall grassy woodland (54). Mainly *E. tereticornis* and *E. crebra* but also *E. polycarpa*, *E. papuana*, and *E. tessellaris* in places; sparse shrubs; eastern mid-height grass	VIt_6, d_4, e_{3-4}
3	10	Slopes in coarser-textured colluvium: mainly 1–2% and up to ½ mile long; grit-strewn, firmed sandy to loamy surfaces with pebble patches	Deep texture-contrast soils with thin sandy and gravelly surface, Springwood (Dy2.41)	Tall woodland (49). Closely spaced tall *E. moluccana* (40–70 ft); shrubs sparse; eastern mid-height grass	IVp_{3-4}
4	10	Land facet 15: slopes in finer-textured colluvium	Deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland with sandalwood	IVp_{3-4}
5	15	Land facet 17: tributary drainage floors	Deep texture-contrast soils, Wyseby (Dy4.42)	Blue gum–Moreton Bay ash tall grassy woodland	IVp_{3-4}
6	10	Lower parts of main drainage floors: up to about 1 mile across, gradients below 1 in 300; sealed, cracking surfaces with microrelief	Deep alluvial cracking clay, slightly gilgaied, Vermont (Ug5.16, 5.28)	Tall grassy woodland (51). Openly spaced *E. tereticornis* (60–100 ft) with occasional *E. tessellaris* or *E. polycarpa*; sparse shrubs; frontage grass	$II–IIIk_{2-3}$
7	15	Rises in main drainage floors: up to about 5 ft high and 1 mile across, with slopes mainly less than 1% but attaining 2% locally; sealed loamy surfaces	Deep texture-contrast soils with a thin fine sandy clay loam surface, Retro (Dy3.33)	Tall grassy woodland (54). Mainly *E. tereticornis* and *E. crebra* but also *E. polycarpa*, *E. papuana*, and *E. tessellaris* in places; sparse shrubs; eastern mid-height grass	IVp_{3-4}
8	5	Channels: up to 300 ft wide and 15 ft deep	Bed loads silt to cobbles	Fringing vegetation	

(38) Woleebee Land System* (390 sq miles)

Plains with eucalypt woodlands and minor brigalow confined to the south and west.

Geology.—Quaternary colluvium–alluvium; subhorizontal to gently dipping shale and sandstone of Jurassic or Triassic age.

Geomorphology.—Fluvial plains—tributary plains: valley plains up to 5 miles wide, with through-going main drainage floors and a branching pattern of tributary floors; scattered rises comprise erosional upper slopes with shallow or deeper soils, slopes of older alluvium, and diverse colluvial slopes; local relief mainly less than 50 ft but up to 100 ft.



Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	20	Land facet 13: upper slopes	Shallow texture-contrast soils, Southernwood (Dy3.42)	Silver-leaved ironbark grassy woodland	IVe$_{3-4}$, p$_{3-4}$, d$_4$
2	10	Upper slopes with deeper soils: up to about 5%, but mainly less than 3%, and ½ mile long; firmed sandy to loamy surfaces	Deep texture-contrast soils with thick sandy surface horizons, Luxor (Dg4.81)	Grassy woodland (66). Openly or moderately spaced *E. dealbata*; shrubs sparse; three-awn grass	IVp$_{3-4}$, e$_{2-3}$
3	15	Land facet 15: colluvial slopes with coarser-textured surface horizons	Very deep texture-contrast soils, Broadmeadow and Taurus (Dy5.83)	Poplar box grassy woodland with sandalwood	IVp$_{3-4}$, e$_{2-3}$
4	10	Slopes in finer-textured colluvium: up to 5%, but typically less than 2%, and mainly less than 200 yd long; firmed to sealed loamy surfaces	Deep texture-contrast soils with thin sandy or thin loamy surfaces, Taurus (Dy4.43) and Retro (Dd3.33)	Brigalow forest (38). Dense layer of slender trees (*A. harpophylla*); moderately tall shrub layer (*Geijera parviflora, Eremophila mitchellii*); numerous smaller shrubs (*Carissa ovata, Heterodendrum* sp., *Capparis* spp.); sparse brigalow scrub grass	IVp$_{3-4}$
5	30	Land facet 16: drainage floors	Deep texture-contrast soils, Taurus (Dy2.43, 3.43)	Poplar box grassy woodland, scattered *E. orgadophila* and *Callitris columellaris*	IVp$_{3-4}$
6	<5	Marginal slopes of unit 5: less than 1% and up to 200 yd long; firmed to sealed surfaces	Deep layered sands, Davy (Uc1.21)	Grassy woodland (67). Moderately spaced trees (*Angophora floribunda*); sparse shrubs; three-awn grass	IVn$_{3-4}$, m$_3$
7	<5	Depressions in unit 5: linear, up to 200 yd across but mainly less than 100 yd, and up to 10 ft deep; marginal slopes up to 10%	Deep alluvial clays, non-cracking, Clematis (Uf6.32)	Tall grassy woodland (51). Openly spaced tall trees (60–100 ft) (*E. tereticornis*); sparse shrubs; frontage grass	IVw$_{3-4}$
8	5	Sandy slopes of older alluvium: less than 1% and up to ½ mile long, dissected up to 20 ft with marginal slopes up to about 5%	Deep sandy red earth, Wilpeena (Gn1.11)	Shrub woodland (44). Moderately spaced tree layer, mainly *E. melanophloia*; moderate shrub layer (*Petalostigma pubescens, Alphitonia excelsa, Acacia* spp.); three-awn grass	IVn$_{3-4}$, m$_3$
9	<5	Clayey slopes of older alluvium: less than 1% and 200 yd across; sealed, locally cracking surfaces	Deep texture-contrast soils with thin loamy surfaces over medium clays, Retro (Dy2.43, Dd1.43)	Brigalow forest (38). Dense layer of slender trees of *A. harpophylla*; moderate tall shrub layer (*Geijera parviflora, Eremophila mitchellii*); numerous smaller shrubs (*Carissa ovata, Heterodendrum* sp.)	IVp$_{3-4}$, g$_{3-4}$
10	<5	Channels: up to 50 ft wide and 10 ft deep	Deep sand bed loads	Fringing vegetation	

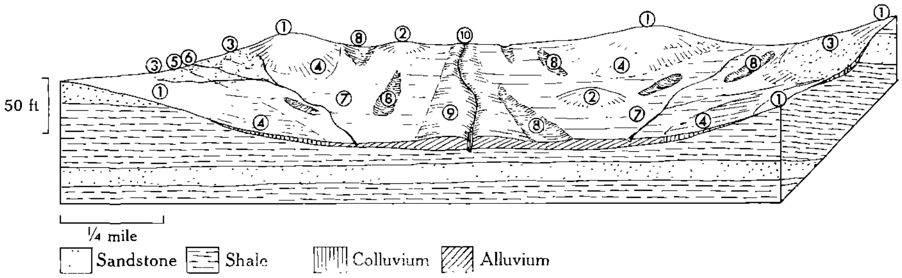
* Similar to Skye land system of the Nogoa–Belyando area.

(39) Palmtree Land System (150 sq miles)

Alluvial plains with eucalypt woodland, associated with Palmtree and Robinson Creeks north of Taroom.

Geology.—Quaternary colluvium–alluvium; subhorizontal to gently dipping shale and sandstone of Jurassic or Triassic age.

Geomorphology.—Fluvial plains—tributary plains: valley plains up to 8 miles across traversed by large through-going streams subject to heavy seasonal flooding; broad drainage floors mainly in finer-textured alluvium, with extensive back plains diversified by major depressions and minor erosional lower slopes, and with restricted levee zones; erosional upper slopes and colluvial slopes form low "rises"; local relief mainly less than 50 ft.



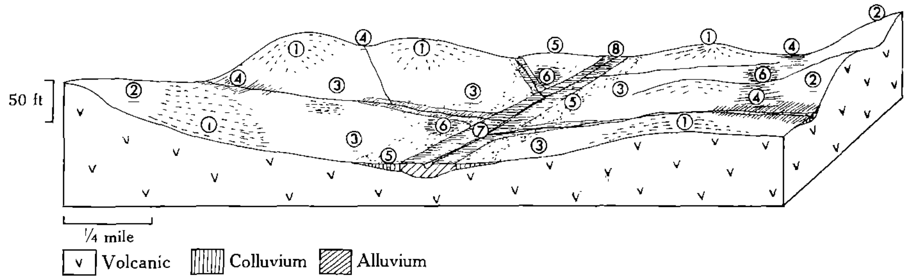
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	20	Land facet 13: upper slopes	Shallow texture-contrast soils, Southernwood (Dr2.22)	Silver-leaved ironbark grassy woodland, locally with *E. dichromophloia*	VIt$_6$, d$_4$
2	5	Land facet 13: erosional lower slopes	Deep texture-contrast soils, Luxor (Dy3.22)	Silver-leaved ironbark grassy woodland	IVp$_{3-4}$
3	10	Slopes in coarser-textured colluvium: sandy concave slopes up to 5%, but mainly 2–3%, and less than ½ mile long	Deep fine sand to loamy sand, Highmount (Uc5.11)	Grassy woodland (66). Open to moderately spaced *E. dealbata*; sparse shrubs; moderate three-awn grass	IVn$_{3-4}$, m$_3$, e$_{2-3}$
4	20	Land facet 15: slopes in finer-textured colluvium	Moderately deep texture-contrast soils, Retro (Dy3.43)	Poplar box grassy woodland with sandalwood	IVp$_{3-4}$, e$_{2-3}$
5	10	Drainage floors in coarser-textured alluvium: up to about ½ mile wide, gradients below 1 in 100, and with transverse slopes up to 1% locally; firmed sandy surfaces	Layered alluvial soil showing weak gradational development (clayey sand—light sandy clay loam—sandy clay loam) on coarse sand at 30 in., Warrinilla	Tall grassy woodland (53). Openly spaced *E. tereticornis* and *Angophora floribunda*; moderate shrubs; frontage grass	IVw$_{3-4}$
6	<5	Depressions in unit 5: linear, up to about 3 ft deep and 200 yd across; firmed sandy surfaces		Tall grassy woodland (51). Openly spaced *E. tereticornis* (60–100 ft); dense palms in some places; sparse tall frontage grass	
7	15	Land facet 16: drainage floors in finer-textured alluvium	Deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland, locally brigalow	IVp$_{3-4}$, w$_{3-4}$
8	10	Depressions in unit 7: mainly linear, up to 1 mile long, ¼ mile wide, and 5 ft deep, locally more; transverse slopes about 1% with discontinuous marginal bluffs in larger depressions; seasonally flooded and with perennial pools in the larger depressions	Deep alluvial cracking clays, slightly gilgaied, Vermont (Ug5.14)	Seasonal meadow; mostly annuals and sedges (when not flooded)	Vw$_{4-5}$
9	5	Drainage floors in finer-textured alluvium—levees: up to 5 ft high with back slopes up to 1%, locally attaining 5%, and 250 yd long; sealed surfaces	Deep alluvial clays, Clematis (Uf6.32)	Tall grassy woodland (51). Openly spaced *E. tereticornis*; shrubs sparse; frontage grass	Vw$_{4-5}$
10	<5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt and sand	Fringing vegetation	

(40) Westwood Land System (170 sq miles)

Undulating volcanic plains with fine-textured soils and eucalypt woodland, scattered throughout all but the south.

Geology.—Tertiary basalt flows.

Geomorphology.—Eroded in relatively unweathered rocks—undulating plains: valley plains up to 4 miles wide, with gentler and steeper upper slopes, and a complex of erosional and colluvial lower slopes; moderately dense branching pattern of incised tributary valleys with through-going alluvial drainage floors; local relief mainly up to 50 ft but attaining 100 ft.



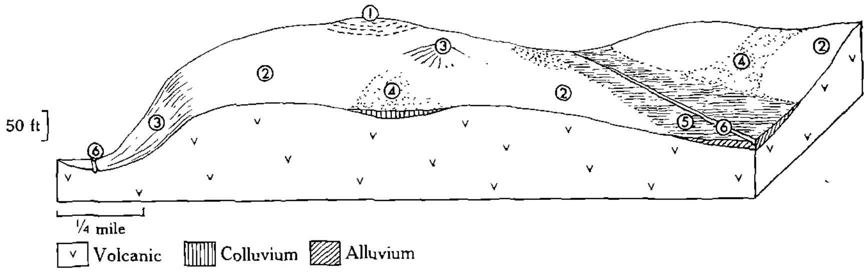
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	40	Gentler upper slopes: mainly 2–3%, locally more, and up to 1 mile long; lightly sealed surfaces with pebble-cobble patches	Shallow gritty clay soils, Kinnoul (Uf6.32, 6.11)	Grassy woodland (56). Openly spaced *E. melanophloia* and *E. dichromophloia*; sparse shrubs; eastern mid-height grass	IVd_4, e_{2-3}
2	20	Steeper upper slopes: up to 35%, but mainly 5–10%, and ½ mile long; cobble-strewn surfaces with rock outcrops	Very shallow to shallow loams and clays, Rugby and Kinnoul (Uf6.31, Um1.41)		VIt_6, d_{4-5}
3	15	Erosional lower slopes: concave up to 3% and ½ mile long; sealed, cracking surfaces with pebble-cobble patches and minor rock outcrops	Moderately deep to deep cracking clays, May Downs; locally shallow, Bruce (Ug5.15, 5.16, 5.13)	Grassy woodland (57). Openly spaced *E. melanophloia* and *E. tessellaris*; sparse shrubs; eastern mid-height grass	$II–IIIe_{2-3}$, k_{2-3}
4	10	Colluvial slopes in upper sectors: concave, typically less than 3%, and up to ½ mile long; sealed, cracking surfaces with grit patches and scattered pebbles	Deep cracking clays, May Downs (Ug5.15)	Grassy woodland (56). Openly spaced *E. melanophloia* and *E. dichromophloia*; sparse shrubs; eastern mid-height grass	$II–IIIe_{2-3}$, k_{2-3}
5	5	Land facet 15: colluvial slopes in lower sectors	Deep texture-contrast soils, Broadmeadow (Dy3.43, 5.83), locally Taurus (Dy3.43)	Poplar box grassy woodland with sandalwood	IVp_{3-4}, e_{2-3}
6	<5	Land facet 11: clayey colluvial slopes in lower sectors	Deep to very deep cracking clays, Rolleston (Ug5.16)	Brigalow scrub with wilga and sandalwood	$IIIk_{2-3}$
7	5	Drainage floors: up to ½ mile wide, gradients below 1 in 100; sealed, locally cracking surfaces	Deep alluvial cracking clay soils, Vermont (Ug5.5); non-cracking, Clematis (Uf6.11)	Grassy woodland (62). Moderately spaced *E. populnea*; sparse shrubs; eastern mid-height grass	IVw_{3-4}, k_{2-3}
8	<5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt and sand	Fringing vegetation	

(41) Grevillea Land System (130 sq miles)

Undulating basalt plains with fine-textured soils and eucalypt woodland, mainly south of Biloela with small areas in the west and south-west.

Geology.—Tertiary basalt flows.

Geomorphology.—Eroded in relatively unweathered rocks—undulating plains: up to 15 miles across with extensive upper slopes and more restricted erosional or colluvial lower slopes; open, branching drainage pattern; local relief mainly up to 50 ft but attaining 100–200 ft in dissected margins.



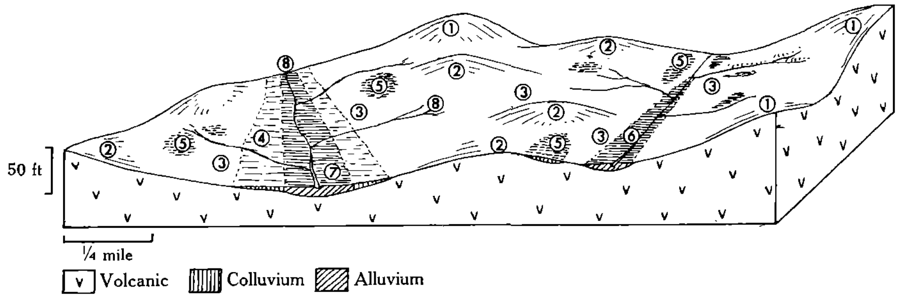
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	<5	Land facets 3 and 5: crest slopes on weathered rock	Shallow to moderately deep clay loams and light to medium clays, mainly Cheshire, minor Kinnoul (Uf5.22)	Softwood scrub, locally with brigalow	IVd_{3-4}, e_{3-4}
2	60	Crest slopes on relatively unweathered rock: up to 5% or more, but mainly less than 3%, and up to 1 mile long; sealed, cracking surfaces with pebble-cobble patches and rock outcrops locally	Shallow cracking clays, Bruce (Ug5.12, 5.13, 5.27)	Grassy woodland (56). Openly spaced *E. melanophloia* and scattered *E. dichromophloia*	IVd_4
3	10	Hill slopes: commonly up to 35%, locally up to 80%, and ½ mile long; boulder-strewn surfaces with minor rock ledges	Very shallow pockets of clay loams and light clays in basalt rubble and outcrop, Rugby		$VII\text{–}VIIIt_{7-8}$
4	15	Colluvial slopes: mainly up to about 2% and ¼ mile long; sealed, cracking surfaces with pebble patches	Moderately deep to deep cracking clay soils, May Downs (Ug5.12)	Treeless community (72). Trees and shrubs generally absent; moderately dense blue grass ground cover	$II\text{–}IIIk_{2-3}$, e_2
5	10	Drainage floors: less than ½ mile wide, gradients mainly below 1 in 100; sealed, cracking surfaces	Deep alluvial cracking clay soils, Vermont (Ug5.15)	Tall grassy woodland (52). Widely spaced tall trees (60–100 ft) (*E. tereticornis, E. tessellaris*). Frontage grass (82)	IVw_{3-4}
6	<5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt to boulders	Fringing vegetation	

(42) Orana Land System (130 sq miles)

Undulating plains with shallow fine-textured soils and eucalypt woodland with minor brigalow, between Theodore and Banana.

Geology.—Moderately dipping andesite and andesitic tuff of Lower Permian to Upper Carboniferous age.

Geomorphology.—Eroded in relatively unweathered rocks—undulating plains: tracts up to 25 miles in extent, comprising erosional upper, mid, and lower slopes, with colluvial slopes in lower sectors and scattered remnants of older colluvium–alluvium; moderately dense branching pattern of shallowly incised tributary valleys with through-going trunk drainage floors; local relief mainly up to 50 ft but attaining 100 ft.



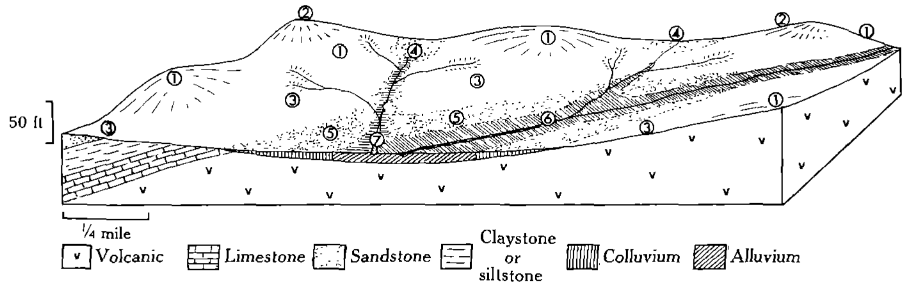
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	20	Land facet 13: upper slopes	Shallow texture-contrast soils, Southernwood (Dy3.12, 2.12)	Silver-leaved ironbark grassy woodland with *E. dichromophloia*	IV–VIe$_{3-4}$, d$_4$, r$_{4-5}$
2	30	Mid slopes: mainly 3–7% and less than ½ mile long; lightly sealed surfaces with pebble-cobble patches	Very shallow light clays on weathering rock, Rugby (Uf6.33)	Grassy woodland (55). Openly spaced *E. melanophloia*; sparse shrub layer; moderate eastern mid-height grass	VId$_5$, r$_5$
3	25	Erosional lower slopes: mainly 2–3% and up to ½ mile long; sealed surfaces with pebble patches	Shallow cracking clay soils on weathering rock, Bruce (Ug5.22)	Grassy woodland (55). Openly spaced *E. melanophloia*; sparse shrub layer; moderate eastern mid-height grass	IVd$_4$, e$_{2-3}$
4	10	Colluvial slopes: mainly about 1% and up to ½ mile long; sealed, locally cracking surfaces	Moderately deep to deep clay soils, incipient cracking, May Downs (Ug5.4)	Grassy woodland (62). Closely spaced *E. populnea*; sparse shrubs (*Eremophila mitchellii*); moderate eastern mid-height grass	II–IIIk$_{2-3}$
5	5	Slopes of older colluvium–alluvium: mainly less than 2% and 200 yd long; firmed sandy to loamy surfaces	Deep texture-contrast soils with a thin sandy or thin loamy surface, Taurus and Retro (Dd3.33)	Brigalow forest (38). Dense layer of slender trees (*A. harpophylla*); moderately dense tall shrub layer (*Geijera parviflora*, *Eremophila mitchellii*); moderate lower shrubs (*Carissa ovata*, *Heterodendrum* sp., *Capparis* spp.); sparse brigalow scrub grass	IVp$_{3-4}$
6	5	Tributary drainage floors: up to ¼ mile wide, gradients up to 1 in 50; sealed, cracking surfaces	Deep cracking clay soils, Vermont (Ug5.12)	Grassy woodland (56). Openly spaced *E. melanophloia* and *E. dichromophloia*; sparse shrub layer; eastern mid-height grass	II–IIIk$_{2-3}$, e$_2$
7	<5	Main drainage floors: up to 1 mile across, gradients mainly less than 1 in 200; sealed, cracking surfaces	Deep alluvial cracking clay, Vermont (Ug5.15)	Tall grassy woodland (51). Mainly widely spaced *E. tereticornis*; sparse shrubs; moderate frontage grass	Vw$_{4-5}$
8	<5	Channels: up to 100 ft wide and 10 ft deep	Bed loads silt to boulders	Fringing vegetation	

(43) Barfield Land System (130 sq miles)

Undulating plains with fine-textured soils and eucalypt woodland, between Theodore and Banana.

Geology.—Moderately dipping andesite and andesitic tuff of Lower Permian to Upper Carboniferous age; Permian siltstone, claystone, sandstone, and limestone.

Geomorphology.—Eroded in relatively unweathered rocks—undulating plains: strike belts up to 8 miles wide, with mainly gentle erosional upper and lower slopes, grading into colluvial lower slopes; open, branching drainage pattern with broad alluvial floors; local relief mainly less than 50 ft.



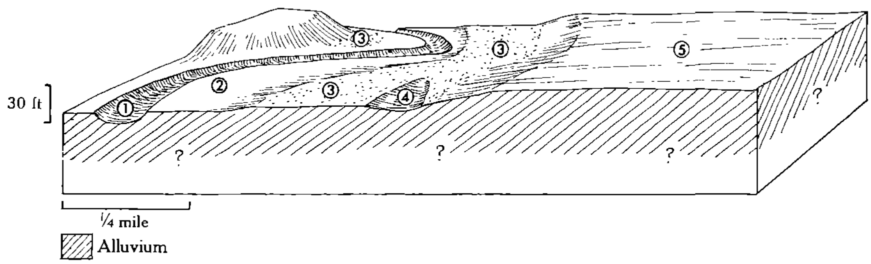
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	20	Gentler upper slopes: mainly 2–3% and up to ½ mile long; sealed, locally cracking surfaces	Shallow cracking clay soils, Bruce (Ug5.22)	Grassy woodland (55, 56). Widely spaced *E. melanophloia*, locally with *E. dichromophloia*; eastern mid-height grass	IVd$_4$
2	10	Steeper upper slopes: mainly 3–7% and less than ¼ mile long; lightly sealed surfaces with pebble patches	Very shallow light clays, Rugby (Uf6.33)		VId$_5$, r$_{4-5}$, e$_{2-3}$
3	40	Erosional lower slopes: up to about 3% and ½ mile long; sealed, locally cracking surfaces	Shallow cracking clay soils, Bruce (Ug5.12)		IVd$_4$
4	5	Colluvial slopes in upper sectors: up to about 3% and ¼ mile long; sealed, locally cracking surfaces	Moderate to deep cracking clay soils, May Downs (Ug5.12)		II–IIIk$_{2-3}$, e$_2$
5	10	Colluvial slopes in lower sectors: up to about 1% and ½ mile long; sealed, locally cracking surfaces	Moderate to deep cracking clay soils, May Downs (Ug5.4)	Grassy woodland (62). Commonly closely spaced *E. populnea*; shrubs sparse to moderate (*Eremophila mitchellii* common in places); eastern mid-height grass	II–IIIk$_{2-3}$
6	10	Drainage floors: up to 1 mile across, gradients mainly less than 1 in 200; sealed, cracking surfaces	Deep alluvial cracking clay, Vermont (Ug5.15)	Tall grassy woodland (51). Tall trees (60–100 ft) (*E. tereticornis* widely spaced); well-developed grassy layer, eastern mid-height grass	IIIw$_3$, k$_{2-3}$
7	5	Channels: up to 100 ft wide and 10 ft deep	Bed loads silt to boulders	Fringing vegetation	

(44) MIMOSA LAND SYSTEM (80 SQ MILES)

Old alluvial plains with red earth soils and eucalypt woodland, in the central west.

Geology.—Quaternary–late Tertiary alluvium.

Geomorphology.—Formed from weathered coarser-textured rocks below the Tertiary weathered surface—nearly flat plains: valley floors up to about 2 miles wide, comprising broad terraces with shallowly entrenched drainage floors traversed by through-going meandering streams; local relief less than 30 ft.



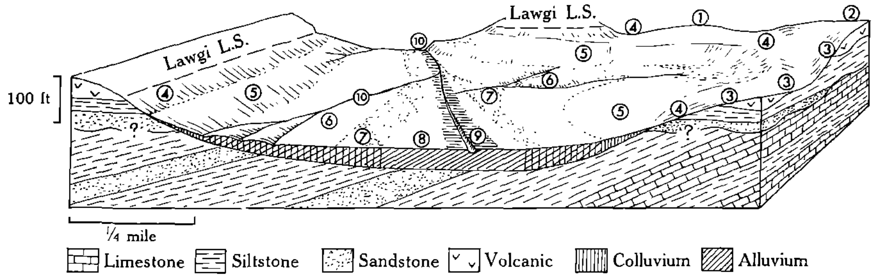
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	<5	Channels: up to 300 ft wide and 15 ft deep	Bed loads sand and gravel	Fringing vegetation	
2	15	Central parts of drainage floors: up to ½ mile across, gradients below 1 in 200; firmed to lightly sealed surfaces	Layered alluvial soils, Consuelo	Tall grassy woodland (52). Openly spaced *E. tereticornis* and *E. tessellaris*; sparse shrubs; frontage grass	IVw_{3-4}
3	25	Margins of drainage floors: loamy slopes less than 1% and ¼ mile long; lower parts up to about 3 ft above the level of unit 2	Very deep sandy and loamy red and yellow earths on alluvium, Wilpeena (Gn2.11, 2.21)	Shrub woodland (44). Moderately spaced *E. melanophloia*, locally *E. crebra*; moderate shrub layer; three-awn grass	IVn_{3-4}, m_3
4	5	Depressions in unit 3: linear, up to about 3 ft deep and 150 yd across; lightly sealed surfaces	Very deep loamy yellow earth on alluvium, Wilpeena (Gn2.34)	Tall grassy woodland (52). Openly spaced *E. tereticornis* and *E. tessellaris*; sparse shrubs; frontage grass	IVn_{3-4}, w_{3-4}
5	50	Terraces: mainly less than 1%, but with marginal slopes of about 5%, and up to 1 mile across: firmed loamy to sandy surfaces	Very deep texture-contrast soils on the steeper marginal slopes. Thick sandy loams over an alkaline sandy clay, Luxor (Dr4.53). Loamy red earths on terrace crests, Wilpeena (Gn2.13)	Shrub woodland (44). Mainly moderately spaced *E. melanophloia*, locally *E. crebra*; moderate shrub layer (*Petalostigma pubescens*, *Alphitonia excelsa*, *Lysicarpus angustifolius*); three-awn grass	IVp_{3-4}, n_{3-4}

(45) Kariboe Land System (80 sq miles)

Brigalow plains with steeper softwood scrub slopes, mainly east of Biloela.

Geology.—Quaternary–late Tertiary colluvium–alluvium; weathered Tertiary basalt with sandstone and claystone interbeds, or weathered Permian siltstone, claystone, shale, sandstone, and limestone.

Geomorphology.—Formed from weathered finer-textured rocks below the Tertiary weathered surface—undulating to nearly flat plains: valley plains up to 4 miles across, comprising extensive and varied colluvial or colluvial–alluvial lower slopes, with erosional mid and upper slopes on basalt or sedimentary rocks; moderately dense branching pattern of tributary drainage with through-going alluvial floors; local relief mainly up to 50 ft but attaining 100 ft.



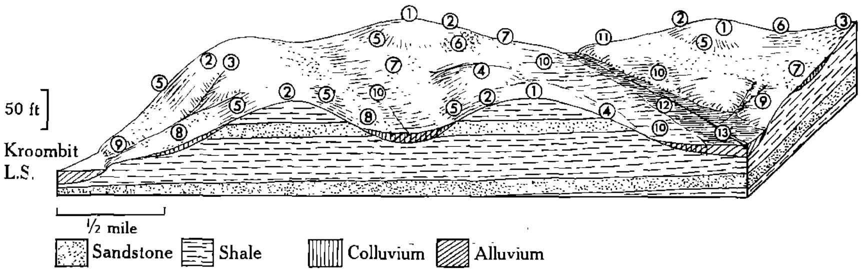
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	<5	Land facet 4: upper slopes on sedimentary rocks	Moderately shallow light clays, Kinnoul (Uf6.31, 6.21)	Softwood scrub with brigalow	IVd_{3-4}, e_{3-4}
2	10	Land facet 3: gentler upper slopes on basalt	Shallow to moderately deep light clays, Kinnoul and Cheshire (Uf6.31)	Softwood scrub, locally with brigalow	IVd_{3-4}
3	15	Land facet 5: steeper upper slopes on basalt	Very shallow light clays, Rugby	Softwood scrub with brigalow	VId_5, e_{3-4}
4	15	Land facet 5: mid slopes	Shallow light clays, Kinnoul (Uf6.21)		IVd_{3-4}, e_3
5	30	Land facet 11: colluvial slopes	Deep cracking clays, Rolleston (Ug5.16), or incipient cracking clays, Cheshire (Uf6.32)	Brigalow scrub with wilga, sandalwood, and locally belah	II–$IIIe_{2-3}$, k_{2-3}
6	15	Land facet 11: upper parts of colluvial–alluvial slopes	Deep cracking clays, Rolleston (Ug5.16)	Brigalow scrub with wilga and sandalwood	II–$IIIk_{2-3}$, e_{2-3}
7	<5	Land facet 14: lower parts of colluvial–alluvial slopes		Brigalow scrub with poplar box	II–$IIIk_{2-3}$, e_2
8	5	Margins of drainage floors: transverse slopes less than 1% and up to 300 yd long; firmed loamy surface	Deep texture-contrast soils, Wyseby (Db1.42)	Tall grassy woodland (51). *E. tereticornis*; locally grassy woodland (62), *E. populnea*; shrubs sparse; frontage grass (82)	IVp_{3-4}
9	<5	Land facet 17: central parts of drainage floors	Deep layered alluvial soil, Moolayember	Blue gum–Moreton Bay ash tall grassy woodland	IVw_{3-4}
10	<5	Channels: up to 100 ft wide and 10 ft deep	Bed loads silt to boulders	Fringing vegetation	

(46) Wandoan Land System* (1520 sq miles)

Undulating brigalow plains, scattered throughout the area but mainly near Wandoan.

Geology.—Quaternary–late Tertiary colluvium–alluvium; weathered, subhorizontal to gently dipping Jurassic shale and sandstone.

Geomorphology.—Formed from weathered finer-textured rocks below the Tertiary weathered surface—undulating to nearly flat plains: tracts up to about 30 miles in extent, consisting of a mosaic of depositional sites with minor erosional lower slopes, and with a variety of erosional mid and upper slopes forming low "rises"; sparse to moderately dense branching pattern of unchannelled tributary drainage floors, with shallowly entrenched and channelled main floors; local relief mainly up to 50 ft and attaining 100 ft.



Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	5	Land facet 2: gentler upper slopes	Moderately deep to deep cracking clays, Teviot (Ug5.33)	Softwood scrub	II–IIIk$_{2-3}$, e$_2$
2	5	Land facet 4: steeper upper slopes	Shallow gravelly clay loams and light to medium clays, Kinnoul (Uf6.31, 6.21, 6.11)	Softwood scrub with brigalow	IVd$_4$, e$_{2-3}$
3	5	Gravelly upper slopes: cobble-strewn slopes mainly less than 3% and ½ mile in extent; dissected up to 30 ft into rounded spurs less than ¼ mile wide with flank slopes attaining 25%	Moderately deep gravelly loams and clay loams, Carraba (Um2.12, Gn3.4); locally shallower, Ingelara (Um2.12)	Semi-evergreen vine thicket (2). Emergent *Brachychiton rupestre*	IV–VIt$_6$, r$_{3-4}$, e$_{3-4}$
4	5	Land facet 6: gentler mid slopes	Shallow to moderately deep light to medium clays, Kinnoul and Cheshire (Uf6.32)	Softwood scrub with brigalow and bauhinia	IVd$_{3-4}$, e$_{2-3}$
5	15	Land facet 9: steeper mid slopes	Shallow to moderately deep texture-contrast soils, Medway and Retro (Db1.13, Dd3.43) and Taurus (Dd3.43, Dy3.43)	Brigalow scrub with blackbutt	IVp$_{3-4}$, e$_{3-4}$, d$_4$
6	<5	Land facet 8: colluvial slopes in upper sectors	Moderately deep cracking clays, Teviot (Ug5.14), locally clay loams to clays, Cheshire (Uf6.31) and Carraba (Gn3.41)	Softwood scrub with belah	IIIe$_{2-3}$, k$_{2-3}$
7	15	Land facet 11: colluvial slopes in lower sectors	Very deep incipient cracking clays, Cheshire (Uf6.31), locally cracking, Rolleston (Ug5.24, 5.22)	Brigalow scrub with wilga, sandalwood, and locally belah	II–IIIk$_{2-3}$, e$_{2-3}$
8	10	Land facet 10: stony colluvial slopes	Moderately deep to deep cracking clays, locally linear gilgais, Teviot (Ug5.22)	Brigalow scrub with bauhinia	IIIk$_{2-3}$, e$_{2-3}$, r$_3$
9	5	Land facet 13: erosional lower slopes	Shallow to moderately deep texture-contrast soils, Southernwood (Dy2.12)	Silver-leaved ironbark grassy woodland	IVp$_{3-4}$, d$_4$
10	20	Land facet 11: colluvial–alluvial slopes	Very deep cracking clays, Downfall (Ug5.24, 5.15), locally deep clay loams to light clays, Cheshire (Um6.22) and Carraba (Gn3.91)	Brigalow scrub with wilga, sandalwood, and belah	II–IIIe$_{2-3}$, k$_{2-3}$
11	<5	Land facet 14: slopes marginal to drainage floors	Deep texture-contrast soils, Retro and Taurus (Dy2.43)	Brigalow scrub with poplar box	IVp$_{3-4}$
12	<5	Land facet 16: drainage floors	Deep texture-contrast soils, Retro and Taurus (Dy2.43)	Poplar box grassy woodland	IVp$_{3-4}$, w$_{3-4}$
13	<5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt and sand	Fringing vegetation	

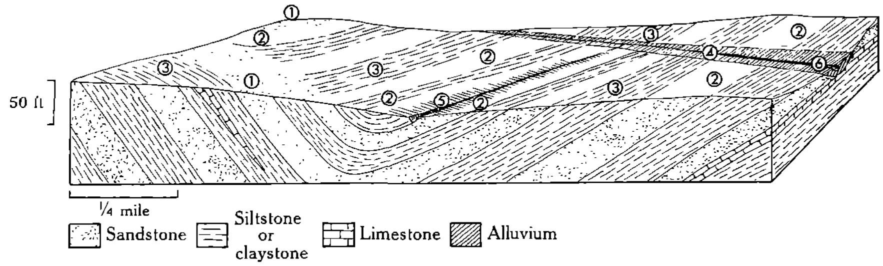
* Similar to Blackwater land system of the Isaac–Comet and Nogoa–Belyando areas.

(47) Barwon Land System* (260 sq miles)

Plains with brigalow and silver-leaved ironbark in a strike pattern, in the north-west.

Geology.—Weathered or little-weathered, steeply dipping Permian siltstone, claystone, sandstone, and limestone; Quaternary–late Tertiary colluvium–alluvium.

Geomorphology.—Formed from weathered finer-textured rocks below the Tertiary weathered surface—undulating to nearly flat plains: stripped plains up to 30 miles in extent, mainly consisting of a narrowly banded pattern of strike-controlled slopes with deeper, residual or derived soils, interspersed with erosional slopes in weathered or relatively unweathered rock; open, rectangular or branching pattern of ill-defined drainage floors; local relief mainly up to 50 ft.



Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	15	Slopes on weathered rock: up to 5%, locally more, and mainly less than 200 yd long; lightly sealed loamy surfaces with cobble patches	Moderately deep texture-contrast soils with a fine sandy clay loam on a friable medium clay, Retro (Dy4.13)	Brigalow forest (33). *A. harpophylla* and *E. cambageana*; moderate to dense shrub layer; sparse brigalow scrub grass (76)	IVp_{3-4}, e_{2-3}
2	25	Land facet 13: slopes on relatively unweathered rock	Shallow to deep texture-contrast soils, Medway (Dy2.13, Dr3.13)	Silver-leaved ironbark grassy woodland (occasional *E. papuana*)	IVp_{3-4}, e_{2-3}
3	50	Land facet 12: slopes with deeper soils	Strongly gilgaied deep clay soils, Pegunny (Ug5.28) and Retro (Dy4.13)	Brigalow scrub	IVg_{3-4}, p_{3-4}
4	5	Land facet 14: drainage floors	Deep texture-contrast soils, Retro (Dy2.43)	Brigalow scrub with poplar box	IVp_{3-4}
5	<5	Tributary channels: mainly less than 30 ft wide and 5 ft deep, gradients up to about 1 in 30; incised up to 10 ft into bed-rock	—	Fringing community (70). Formed largely from the adjoining brigalow community; some *Melaleuca* spp.	—
6	<5	Main channels: up to 50 ft wide and 10 ft deep	Bed loads silt to boulders	Fringing vegetation	

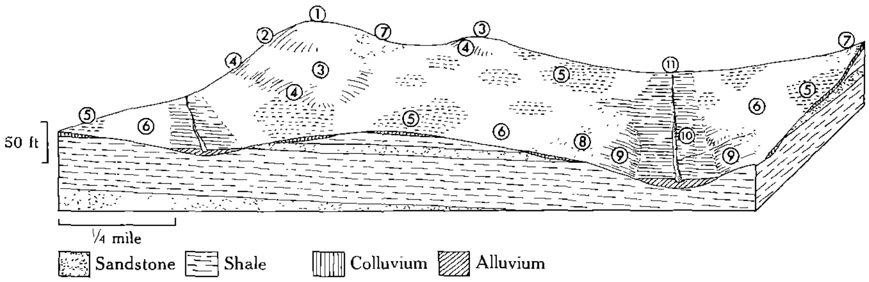
* Similar to Barwon land system of the Isaac–Comet area, but with more brigalow and deeper soils.

(48) Kiddell Land System (670 sq miles)

Grassland and brigalow plains, in the southern half.

Geology.—Quaternary–late Tertiary colluvium–alluvium; weathered, subhorizontal to gently dipping shale and sandstone of Triassic or Jurassic age.

Geomorphology.—Formed from weathered finer-textured rocks below the Tertiary weathered surface—undulating to nearly flat plains: valley plains up to 3 miles wide, comprising erosional upper and mid slopes forming scattered "rises" above the level of extensive and varied colluvial slopes, and more restricted erosional lower slopes with a patchy distribution; sparse branching drainage pattern; local relief mainly up to 50 ft.



Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	5	Land facet 2: gentle upper slopes	Moderately deep to deep cracking clays, Teviot and May Downs (Ug5.33, 5.12)	Softwood scrub	II–IIIk$_{2-3}$, e$_2$
2	5	Land facet 4: steeper upper slopes	Shallow clay loams and light to medium clays, Kinnoul (Uf6.31, 6.21, 6.11)	Softwood scrub with brigalow	IVe$_{3-4}$, r$_{3-4}$
3	5	Land facet 6: gentler mid slopes	Moderately deep light to medium clays, Cheshire (Uf6.21)	Softwood scrub with brigalow and bauhinia	IIIe$_3$, d$_3$
4	10	Land facet 9: steeper mid slopes	Very shallow sandy clay loams and clays, Rugby (Um1.43, Uf6.31)	Brigalow scrub with blackbutt	VIt$_6$, d$_4$
5	20	Land facets 10 and 11: gentler colluvial slopes	Moderately deep to deep cracking clays with a stony or gravelly surface, Rolleston and Teviot	Mosaic of brigalow scrub with bauhinia and treeless community (72)	II–IIIk$_{2-3}$, e$_2$
6	15	Gentler erosional lower slopes: mainly 1–3% and up to ½ mile long; sealed surfaces with scattered pebble-cobbles	Moderately deep to deep cracking clays, commonly with linear gilgais, Teviot (Ug5.22, 5.26)	Treeless community (72). Moderately dense blue grass; clumps of brigalow (38 or 35). Patchy plain pattern	II–IIIk$_{2-3}$ e$_2$
7	15	Land facet 11: steeper colluvial slopes	Moderately deep to deep incipient cracking clays, Cheshire (Uf6.31)	Brigalow scrub with wilga and sandalwood	II–IIIe$_{2-3}$, k$_{2-3}$
8	5	Land facet 15: colluvial slopes in lower sectors	Moderately deep texture-contrast soils (Dd1.43)	Poplar box grassy woodland with sandalwood	IVp$_{3-4}$
9	5	Land facet 13: steeper erosional lower slopes	Shallow texture-contrast soils, Southernwood (Dy3.32)	Silver-leaved ironbark grassy woodland	IVd$_4$, e$_{3-4}$
10*	10	Drainage floors: commonly ¼ mile wide, locally up to 1 mile, gradients mainly below 1 in 200; sealed, cracking surfaces with microrelief	Deep cracking clay soils, Vermont (Ug5.16); locally with loamy wash on surface, Wyseby (Dy2.41)	Treeless community (72). Well-developed blue grass	III–IVp$_{3-4}$, k$_{2-3}$
11	5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt to cobbles	Fringing vegetation	

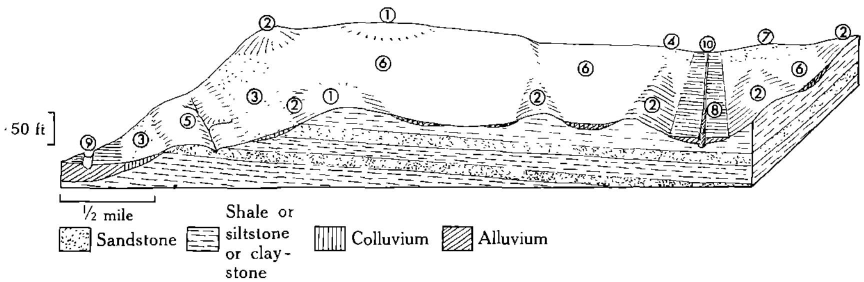
* Unit 10 is much reduced or absent in most southern parts.

(49) Highworth Land System* (1190 sq miles)

Brigalow plains, commonly gilgaied, in the centre and north.

Geology.—Quaternary–late Tertiary colluvium–alluvium; weathered, gently dipping shale, siltstone, claystone, and sandstone, mainly of Permian or Triassic age.

Geomorphology.—Formed from weathered finer-textured rocks below the Tertiary weathered surface—undulating to nearly flat plains: strike belts up to 15 miles wide, with broad colluvial–alluvial slopes, scattered erosional upper slopes, and minor erosional lower slopes; open, rectangular or branching drainage pattern, mainly unchannelled in upper sectors; local relief up to 50 ft.



Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	5	Land facet 2: crests and gentle upper slopes on sedimentary rocks	Moderately deep to deep cracking clays, Teviot (Ug5.32)	Softwood scrub	II–IIId$_{2-3}$, e$_2$
2	25	Land facet 9: erosional mid slopes	Deep texture-contrast soils, Retro (Db1.33, 1.43, Dd3.13, Dy3.33)	Brigalow scrub with blackbutt	IVp$_{3-4}$, e$_{2-3}$
3	10	Land facet 11: colluvial slopes	Deep cracking clays, Rolleston (Ug5.24, 5.22)	Brigalow scrub with wilga, sandalwood, and locally belah	II–IIIk$_{2-3}$
4	<5	Gentler erosional lower slopes: mainly 1–3% and up to ½ mile long; sealed surfaces with scattered pebble-cobbles	Moderately deep to deep cracking clays, Teviot (Ug5.22)	Treeless community (72). Grassland (patchy plain) characterized by blue grass	II–IIIk$_{2-3}$, e$_{2-3}$
5	<5	Land facet 13: steeper erosional lower slopes	Shallow texture-contrast soils, Medway (Dy2.13, Dr2.13) and Southernwood (Dy2.12)	Silver-leaved ironbark grassy woodland	VIt$_6$, d$_4$, r$_{3-4}$
6	45	Land facet 12: colluvial–alluvial slopes	Strongly gilgaied deep clay soils, Pegunny (Ug5.24) and Wyseby (Dy2.41)	Brigalow scrub with yapunyah or belah	IVg$_4$, p$_{3-4}$
7	<5	Slopes of older alluvium: loamy to sandy slopes mainly less than 2% and up to ½ mile in extent	Deep texture-contrast soils with a deep (15–36 in.) sandy loam or sandy surface over sandy clay, Luxor (Dy4.42)	Semi-evergreen vine thicket (2). Emergents *Brachychiton rupestre*	IVp$_{3-4}$
8	<5	Land facet 14: tributary drainage floors	Deep texture-contrast soils, Retro (Db3.23, Dy2.23)	Brigalow scrub with poplar box	
9	<5	Land facet 16: main drainage floors	Deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland	
10	<5	Channels: up to 100 ft wide and 10 ft deep	Bed loads silt and sand	Fringing vegetation	

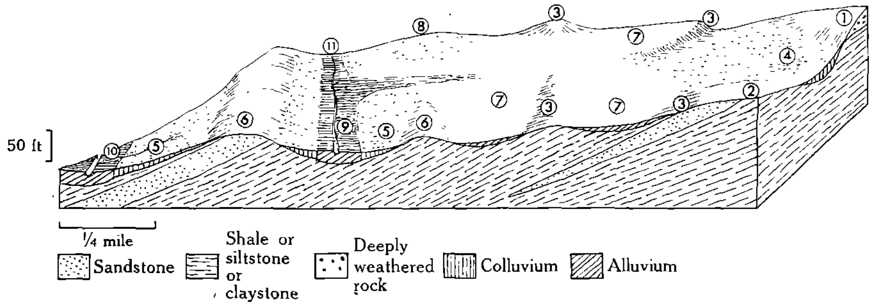
* Similar to Somerby land system of the Isaac–Comet and Nogoa–Belyando areas.

(50) Thomby Land System* (1380 sq miles)

Gently undulating plains, with brigalow and minor softwood scrub and silver-leaved ironbark, in the centre and north.

Geology.—Quaternary–late Tertiary colluvium–alluvium; weathered, dipping Triassic shale, siltstone, and sandstone; lateritized Tertiary sandstone and claystone locally.

Geomorphology.—Formed from weathered finer-textured rocks below the Tertiary weathered surface—undulating to nearly flat plains: tracts up to 15 miles in extent, comprising broad colluvial–alluvial slopes with erosional upper slopes and minor lateritic crests, and with mainly strike-aligned erosional lower slopes; open rectangular or branching drainage pattern; local relief up to 50 ft.



Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	5	Higher crests: up to 3% and ½ mile across; firmed to lightly sealed sandy to loamy surfaces	Moderately deep to deep loamy red and yellow earths over a pisolitic layer, Dunrobin and Struan (Gn1.12, 2.21). Locally, texture-contrast soils with a deep loamy sand over a mottled clay, with a thick layer of pisoliths in the bleached A_2 horizon, Luxor (Dy3.41)	Shrub woodlands (44–46). Moderately spaced *E. crebra*, *E. polycarpa*, and *E. melanophloia* (in various combinations); well-developed tall shrub layer (*Petalostigma pubescens*, *Alphitonia excelsa*, *Lysicarpus angustifolius*); moderate smaller shrubs; sparse to moderate three-awn grass	IVn$_{3-4}$, p$_{3-4}$, m$_3$
2	5	Land facet 2: gentler upper slopes	Moderately deep to deep cracking clays, Teviot (Ug5.33)	Softwood scrub	IIIk$_{2-3}$, e$_2$
3	15	Land facet 9: steeper upper slopes	Moderately deep to deep texture-contrast soils, Wyseby (Db3.22)	Brigalow scrub with blackbutt	IVp$_{3-4}$, e$_{3-4}$
4	10	Colluvial slopes in upper sectors: concave, up to 5% and less than ½ mile long; firmed to sealed loamy surfaces with cobble patches	Moderately deep sandy clay loam over a light to medium clay, Wyseby (Db1.11), Carraba (Gn3.21)	Semi-evergreen vine thicket (4). Emergent layer *Brachychiton rupestre* and *A. harpophylla*	IIIe$_{2-3}$
5	15	Land facet 11: colluvial slopes in lower sectors	Very deep incipient cracking to cracking clays, Cheshire (Uf6.31) and Rolleston (Ug5.24)	Brigalow scrub with wilga and sandalwood	IIIe$_{2-3}$, k$_{2-3}$
6	10	Land facet 13: erosional lower slopes	Shallow texture-contrast soils, Medway (Dy2.13) and Southernwood (Dr2.12, Dy2.12)	Silver-leaved ironbark grassy woodland	VIt$_6$, d$_4$
7	20	Land facet 12: colluvial–alluvial slopes	Strongly gilgaied deep clay soils, Pegunny and Wyseby (Ug5.24, Dy2.41)	Brigalow scrub, with yapunyah or belah	IVg$_{3-4}$, p$_{3-4}$
8	5	Slopes of older alluvium: sandy to loamy slopes less than 2% and ½ mile long, locally dissected up to 30 ft	Deep texture-contrast soils with a thick loamy sand or sandy loam on a sandy clay, Luxor (Dy4.42, 4.82); locally, deep sands overlying water-worn gravels, Highmount (Uc1.21)	Semi-evergreen vine thicket (2). Emergents *Brachychiton rupestre*	IVp$_{3-4}$
9	5	Land facet 14: tributary drainage floors	Deep texture-contrast soils, Retro (Db1.13, 3.23)	Brigalow scrub with poplar box	IVp$_{3-4}$, e$_2$
10	<5	Land facet 16: main drainage floors	Deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland	IVp$_{3-4}$, w$_{3-4}$
11	<5	Channels: up to 100 ft wide and 10 ft deep	Bed loads silt and sand	Fringing vegetation	

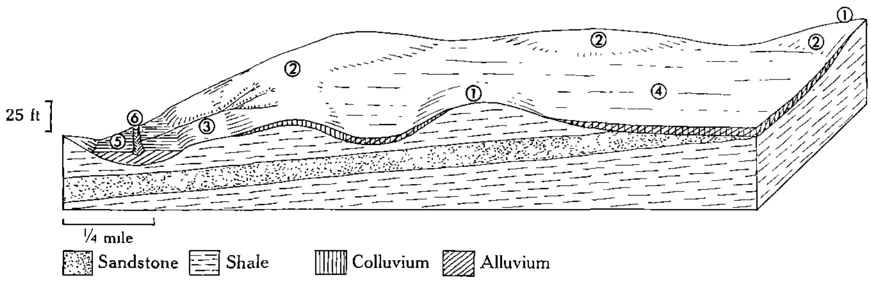
* Similar to Humboldt land system of the Isaac–Comet and Nogoa–Belyando areas.

(51) Hinchley Land System (110 sq miles)

Brigalow plains, scattered small areas in the south.

Geology.—Quaternary–late Tertiary colluvium–alluvium; weathered, subhorizontal to gently dipping Jurassic shale and sandstone.

Geomorphology.—Formed from weathered finer-textured rocks below the Tertiary weathered surface—undulating to nearly flat plains: up to 10 miles across, with extensive colluvial or colluvial–alluvial slopes, and minor erosional upper and lower slopes; sparse branching pattern of mainly unchannelled, ill-defined drainage floors; local relief mainly up to 25 ft.



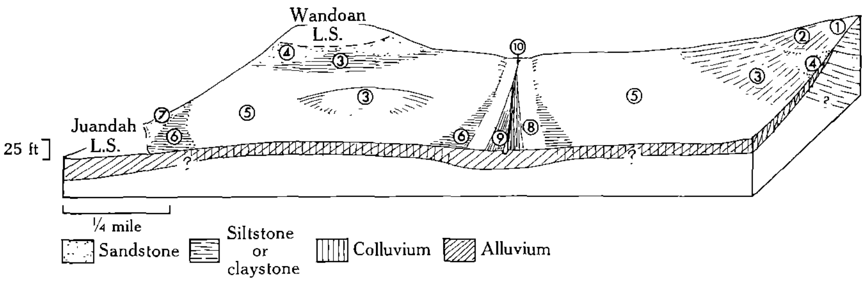
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	10	Land facet 10: upper slopes	Moderately deep to deep cracking clays with stony or gravelly surfaces, Teviot (Ug5.14)	Brigalow scrub with bauhinia, wilga, and sandalwood	$IIIe_{2-3}$, k_{2-3}
2	35	Land facet 11: colluvial slopes	Moderately deep to deep cracking clays with or without linear gilgais, Teviot (Ug5.14) and Downfall (Ug5.27)	Brigalow scrub with wilga, sandalwood, and locally belah	II–$IIIe_{2-3}$, k_{2-3}
3	5	Land facet 13: erosional lower slopes	Shallow to moderately deep texture-contrast soils, Southernwood (Dy2.12) and Luxor (Dy3.42)	Silver-leaved ironbark grassy woodland	IVp_{3-4}, e_{3-4}
4	40	Land facet 11: colluvial–alluvial slopes	Very deep cracking clays, Downfall (Ug5.24)	Brigalow scrub with wilga, sandalwood, and belah	II–$IIIk_{2-3}$, e_2
5	5	Land facet 16: drainage floors	Deep texture-contrast soils, Taurus (Dy2.43)	Poplar box grassy woodland	IVp_{3-4}
6	<5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt and sand	Fringing vegetation	

(52) Dakenba Land System (270 sq miles)

Brigalow country on alluvium, mainly associated with the Dawson River.

Geology.—Quaternary–late Tertiary colluvium–alluvium; weathered, mainly argillaceous rocks ranging in age from Permian to Tertiary.

Geomorphology.—Formed from weathered finer-textured rocks below the Tertiary weathered surface—undulating to nearly flat plains: colluvial–alluvial plains up to about 5 miles across, periodically flooded in the lower parts, and with erosional mid and upper slopes forming low "rises"; minor through-going drainage floors with little integrated tributary drainage; local relief mainly less than 25 ft but up to 50 ft.



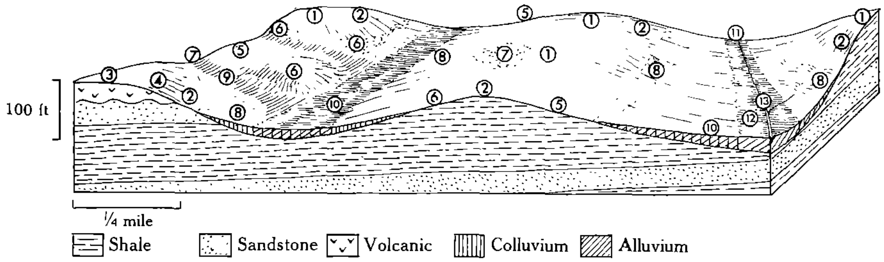
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	5	Land facet 4: upper slopes	Shallow clay loams and light to medium clays, Kinnoul (Uf6.31, 6.21, 6.11)	Softwood scrub with brigalow	IVd_{3-4}, e_{2-3}
2	10	Land facet 9: mid slopes	Very shallow sandy clay loams and clays, Rugby (Um1.43, Uf6.31)	Brigalow scrub with blackbutt	VIt_6, d_5
3	20	Land facet 11: gentler colluvial slopes	Deep cracking clays, Rolleston (Ug5.34)	Brigalow scrub with wilga and sandalwood, locally with belah	IIIk_{2-3}
4	10	Land facet 10: steeper colluvial slopes	Moderately deep to deep cracking clays, Teviot (Ug5.27)	Brigalow scrub with bauhinia	III–IVe_{3-4}, k_{2-3}
5	30	Land facet 11: colluvial–alluvial slopes	Very deep cracking clays, Rolleston (Ug5.28)	Brigalow scrub with wilga and sandalwood	IIIk_{2-3}
6	10	Land facet 12: occasionally flooded slopes in fine-textured alluvium	Strongly gilgaied deep clay soils, Pegunny (Ug5.15, 5.35)	Brigalow scrub	IVg_4, w_{3-4}
7	5	Land facet 14: occasionally flooded slopes with loamy surface	Very deep texture-contrast soils, Wyseby (Db1.12)	Brigalow scrub with poplar box	IVp_{3-4}, w_{3-4}
8	<5	Frequently flooded slopes: less than 0·5% and up to ½ mile across; sealed, cracking surfaces	Deep alluvial cracking clays, slightly gilgaied, Vermont (Ug5.24)	Brigalow forest (39). Where undisturbed, tall mature *A. harpophylla*; no shrubs. Where disturbed, brigalow stands not pure. Numerous *E. microtheca* seedlings in places	Vw_{4-5}, k_{2-3}
9	5	Land facet 16: drainage floors	Deep texture-contrast soils, Retro (Dy2.43, Dd1.43)	Poplar box grassy woodland	IVp_{3-4}, w_{3-4}
10	<5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt and sand	Fringing vegetation	

(53) Eurombah Land System* (1570 sq miles)

Undulating plains with softwood scrub on crests and brigalow on slopes, scattered throughout but mostly in the south.

Geology.—Weathered, subhorizontal to gently dipping shale and sandstone of Jurassic or Triassic age; weathered Tertiary basalt with thin interbeds of sandstone and claystone.

Geomorphology.—Formed from weathered finer-textured rocks below the Tertiary weathered surface—undulating plains: secondary divides up to 6 miles across, comprising diverse erosional upper and mid slopes, with a range of mainly colluvial sites downslope; open branching pattern of drainage floors, unchannelled in upper sectors; local relief mainly 25–75 ft but up to 100 ft.



Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	15	Land facet 2: gentle upper slopes on sedimentary rocks	Moderately deep to deep cracking clays, Teviot (Ug5.33)	Softwood scrub	II–IIIk$_{2-3}$
2	20	Land facet 4: steeper upper slopes on sedimentary rocks	Shallow clay loams and light to medium clays, Kinnoul (Uf6.31, 6.21, 6.11)	Softwood scrub with brigalow	IVd$_{3-4}$, e$_{3-4}$
3	<5	Land facet 3: gentler upper slopes on basalt	Moderately deep light to medium clays, Cheshire (Uf6.21)	Softwood scrub	IIId$_3$, e$_{2-3}$
4	<5	Land facet 5: steeper upper slopes on basalt	Shallow clay loams and light to medium clays, Rugby and Kinnoul (Uf6.21)	Softwood scrub with brigalow	VId$_4$, e$_4$, r$_4$
5	10	Land facet 6: gentler mid slopes	Moderately deep incipient cracking clays, Cheshire (Uf6.21)	Softwood scrub with brigalow and bauhinia	IIIe$_3$, d$_3$
6	10	Land facet 9: steeper mid slopes	Very shallow sandy clay loams and clays, Rugby (Um1.43, Uf6.31)	Brigalow scrub with blackbutt	VIt$_6$, d$_5$, r$_4$
7	<5	Land facet 8: colluvial slopes in upper sectors	Deep cracking clays, Downfall (Ug5.16)	Softwood scrub with belah	IIIg$_3$, k$_{2-3}$
8	15	Land facet 11: colluvial slopes in lower sectors	Deep cracking clays, Rolleston (Ug5.16, 5.13, 5.29)	Brigalow scrub with wilga and sandalwood, locally with belah	IIIk$_{2-3}$
9	5	Land facet 8: colluvial–alluvial slopes in upper sectors	Very deep clay loams to clays, Cheshire (Gn3.93)	Softwood scrub with belah	IIe$_2$, k$_2$
10	10	Land facet 11: colluvial–alluvial slopes in lower sectors	Very deep cracking clays, Rolleston (Ug5.15, 5.24)	Brigalow scrub with wilga and sandalwood, locally with belah	IIIk$_{2-3}$
11	<5	Land facet 14: drainage floors in upper sectors	Deep to very deep texture-contrast soils	Brigalow scrub with poplar box	IVp$_{3-4}$
12	<5	Land facet 16: drainage floors in lower sectors	Deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland	
13	<5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt to boulders	Fringing vegetation	

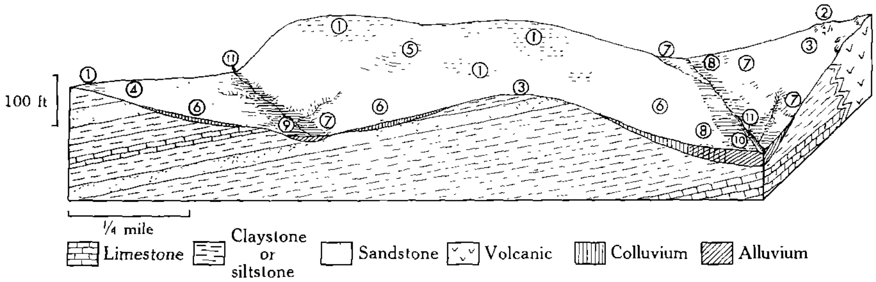
* Similar to Racecourse land system of the Isaac–Comet area.

(54) Banana Land System (460 sq miles)

Undulating plains with softwood scrub, brigalow, and eucalypt woodland, mainly in the north-eastern quarter.

Geology.—Weathered, moderately to steeply dipping Permian siltstone, claystone, shale, sandstone, and limestone; locally with volcanic rocks of Permian or Tertiary age.

Geomorphology.—Formed from weathered finer-textured rocks below the Tertiary weathered surface—undulating plains: strike tracts up to 10 miles across, consisting of soil-covered or stony erosional upper and mid slopes, with moderately extensive depositional and erosional sites downslope; moderately dense branching drainage pattern with through-going trunk streams; local relief mainly 25–75 ft but up to 100 ft.



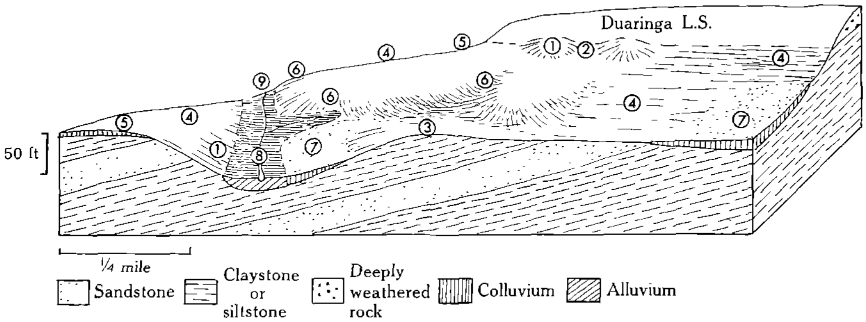
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	15	Land facet 3: upper slopes	Shallow to moderately deep light to medium clays, Kinnoul and Cheshire (Uf6.22)	Softwood scrub	$IIIk_{2-3}$
2	5	Rocky upper slopes: boulder-covered slopes up to about 5% and mainly less than 200 yd in extent	Very shallow pockets of loam or clay loam between boulders, Rugby (Um1.43)	Semi-evergreen vine thicket (10). Shrubby tree canopy (8–10 ft) with scattered emergents	$VIIr_5$, d_5
3	15	Mid slopes: up to 5%, locally more, and mainly less than 200 yd long; sealed surfaces with cobble patches	Very shallow to shallow light to medium clays, Rugby (Uf6.22); locally cracking, Bruce (Ug5.12)	Grassy woodland (56). Open *E. melanophloia* and *E. dichromophloia* with local semi-evergreen vine thickets (9); sparse shrubs; eastern mid-height grass (80)	VId_{4-5}, e_{2-3}
4	5	Land facet 13: mid slopes	Shallow to moderately deep texture-contrast soils, Medway, minor Retro (Dy2.13)	Silver-leaved ironbark grassy woodland	IVp_{3-4}, d_{3-4}
5	15	Colluvial slopes in upper sectors: mainly less than 2% and 300 yd long; sealed, cracking surfaces with microrelief and pebble patches	Deep cracking clays, moderately gilgaied, Downfall (Ug5.18)	Semi-evergreen vine thicket (4). Emergents *Brachychiton rupestre* and *Acacia harpophylla*	$IIIk_{2-3}$
6	20	Land facet 11: colluvial slopes in lower sectors	Deep cracking clays, Rolleston (Ug5.15, 5.34)	Brigalow scrub with wilga and sandalwood	$IIIk_{2-3}$, e_{2-3}
7	15	Erosional lower slopes: up to 5% and less than ¼ mile long, locally dissected up to 30 ft into narrow spurs with flank slopes up to 10%	Shallow to moderately deep cracking clays, Bruce (Ug5.12); locally non-cracking, Kinnoul (Uf6.22)	Grassy woodland (55). Open *E. melanophloia*; moderate to sparse shrub layer; eastern mid-height grass (80)	IVd_{3-4}, e_{2-3}
8	<5	Colluvial–alluvial slopes: concave, mainly 1–2%, and up to 250 yd long; firmed to lightly sealed loamy surfaces	Deep cracking clays, Vermont (Ug5.15); locally non-cracking, Clematis (Uf6.22)	Tall grassy woodland (52). Tall trees (60–100 ft) (*E. tereticornis*, *E. tessellaris*) widely spaced; shrubs sparse; well-developed grassy floor (frontage grass)	$II–IIIk_{2-3}$
9	<5	Land facet 16: tributary drainage floors	Deep texture-contrast soils, Retro (Dd1.43)	Poplar box grassy woodland	IVp_{3-4}, w_3
10	<5	Main drainage floors: up to ½ mile wide, gradients below 1 in 200; levees up to 3 ft high with back slopes up to 2% and 200 yd long, and restricted back plains locally with linear depressions up to 100 ft wide and 5 ft deep	Deep cracking clays in drainage floors, Vermont (Ug5.15). Sandy clay loams over medium clays on levees, Moolayember (Gn3.43)	Tall grassy woodland (51). Tall trees (60–100 ft), *E. tereticornis* in pure stands or in association with *E. tessellaris* (52); frontage grass (82)	$III–IVw_{3-4}$
11	<5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt to cobbles	Fringing vegetation (locally includes *E. raveretiana*)	

(55) Ramsay Land System (100 sq miles)

Undulating plains with softwood scrub and some brigalow, in the centre.

Geology.—Quaternary–late Tertiary colluvium–alluvium; weathered Permian andesitic volcanics or Permian siltstone, claystone, shale, sandstone, and limestone.

Geomorphology.—Formed from weathered finer-textured rocks below the Tertiary weathered surface—undulating to nearly flat plains: aprons extending up to 3 miles downslope from Duaringa land system, with extensive colluvial and alluvial slopes and minor erosional or stony colluvial upper slopes; sparse branching pattern of mainly unchannelled drainage floors.



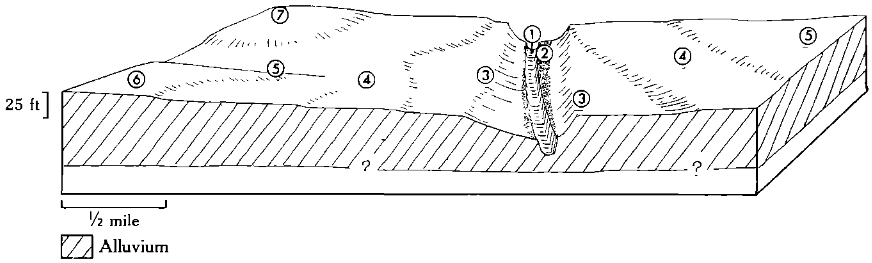
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	10	Land facet 9: steeper upper slopes	Shallow texture-contrast soils, Southernwood (Dy3.32)	Brigalow scrub with blackbutt	VIt_6, d_4
2	5	Gentler upper slopes: mainly less than 10% and 200 yd long; clayey surfaces with cobble patches	Shallow light to medium clays over weathering rock to depths of 36 in., Ingelara (Uf6.31)	Semi-evergreen vine thicket (3). Uneven canopy (15–30 ft) of slender, densely packed trees with mixed evergreen, semi-evergreen, and deciduous emergents (30–60 ft) characterized by *Brachychiton rupestre* and *Cadellia pentastylis*; moderate to dense shrubs; sparse softwood scrub grass	IVd_4, e_{3-4}
3	5	Gravelly upper slopes: mainly less than 2%, but up to 5% locally, and less than ¼ mile in extent; gravels at or near the surface	Moderately deep to deep light to medium clays over gravels, Carraba (Uf6.31)		$II–IIIe_{2-3}$, k_{2-3}, r_3
4	35	Colluvial slopes in upper sectors: loamy slopes mainly 2–4% and up to ½ mile long	Deep loams and sandy loams grading through clay loams to light clays at depth, Carraba (Gn3.11, 3.22) and Cheshire (Gn3.13)		$II–IIIe_{2-3}$, k_{2-3}
5	5	Upper margins of unit 4: up to about 5% and less than 250 yd long; loamy surfaces with grit-pebble patches	Deep sandy clay loams grading to light clays at depth, Carraba (Gn3.12)	Semi-evergreen vine thicket (6). Emergents *A. harpophylla*, *A. rhodoxylon*, and *Brachychiton rupestre*	$II–IIIe_{2-3}$, k_{2-3}
6	5	Lower margins of unit 4: loamy slopes up to 4% and 200 yd long, locally dissected up to 20 ft into narrow rounded spurs with flank slopes up to 10%	Deep loamy red earth, Dunrobin (Gn2.12)	Shrub woodlands (44). Moderately spaced *E. melanophloia* and *E. crebra*; moderate shrub layer; sparse three-awn grass	IVn_{3-4}, m_3
7	20	Land facets 11 and 12: colluvial slopes in lower sectors	Moderately deep to deep cracking clays, Rolleston (Ug5.38), locally deeply gilgaied, Pegunny (Ug5.33) and Wyseby (Db1.12)	Brigalow scrub with wilga and sandalwood	IVg_{3-4}, p_{3-4}
8	15	Land facet 11: drainage floors	Very deep alluvial clays, Carraba (Gn3.75)	Brigalow scrub with wilga and sandalwood	IVw_{3-4}
9	<5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt and sand	Fringing vegetation	

(56) Coreen Land System* (260 sq miles)

Flooded brigalow country, mainly associated with the Mackenzie and Fitzroy Rivers.

Geology.—Quaternary–late Tertiary alluvium.

Geomorphology.—Fluvial plains—mainly stable trunk plains: shallowly dissected tracts of older alluvium up to 5 miles wide, frequently flooded in the lower parts and mainly occasionally flooded elsewhere; local relief mainly less than 25 ft.



Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	<5	Channels: up to 50 ft wide and 10 ft deep	Bed loads silt and sand	Fringing vegetation	
2	5	Flats marginal to unit 1: up to about 200 yd across; firmed sandy to loamy surfaces	Deep alluvial sands, Davy (Uc1.21)	Tall grassy woodland (51). Openly spaced *E. tereticornis* and *E. microtheca*; shrubs sparse; frontage grass (82)	IVw_{3-4}, n_{3-4}, m_3
3	30	Frequently flooded slopes—lower parts: mainly less than 1% and ¼ mile long, with marginal bluffs up to 40 ft high; sealed, cracking surfaces	Deep alluvial cracking clays, slightly gilgaied (2 in.), Vermont (Ug5.24)	Brigalow forest (39). In undisturbed state, tall stands of mature *Acacia harpophylla*; shrubs and grass mostly absent	Vw_{4-5}
4	20	Frequently flooded slopes—upper parts: less than 0·5% and up to 2 miles across; sealed, cracking surfaces with microrelief locally	Deep cracking clays, moderate gilgais locally, Vermont (Ug5.16, 5.24)	Brigalow forest (39). *A. harpophylla*; where disturbed, *Terminalia oblongata* and other small trees more numerous; abundant young *E. microtheca* saplings in places; sparse brigalow grass (78)	IV–Vw_{4-5}
5	20	Land facet 12: occasionally flooded slopes—lower parts	Strongly gilgaied deep clay soils, Pegunny (Ug5.15, 5.35)	Brigalow scrub	IVg_{3-4}, w_{3-4}
6	15	Occasionally flooded slopes—upper parts: less than 0·5% and up to 1 mile in extent; sealed, cracking surfaces	Deep cracking clays, Rolleston (Ug5.16)	As unit 4	III–IVw_{3-4}, k_{2-3}
7	10	Land facet 11: rarely flooded slopes	Very deep cracking clays, Rolleston (Ug5.28)	Brigalow scrub with wilga and sandalwood	IIIw_3, k_{2-3}

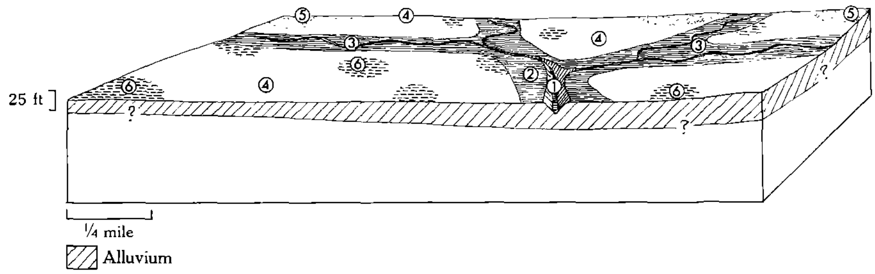
* Similar to part of Comet land system of the Isaac–Comet and Nogoa–Belyando areas.

(57) DINGO LAND SYSTEM* (120 SQ MILES)

Alluvial plains with poplar box, near Dingo.

Geology.—Quaternary alluvium.

Geomorphology.—Fluvial plains—mainly stable trunk plains: prior-weathered deposits forming stable plains with slopes of coarser- or finer-textured alluvium, and with a branching pattern of drainage floors traversed by shallowly incised channels.



Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	<5	Channels: up to 100 ft wide and 10 ft deep		Fringing vegetation	
2	<5	Main drainage floors: up to ½ mile wide, gradients mainly below 1 in 300; firmed to sealed surfaces	Deep texture-contrast soils with a thick sandy loam to loam over a mottled clay, Broadmeadow and Retro (Dy5.43)	Tall grassy woodland (54). Openly spaced *E. tereticornis* and *E. crebra*; shrubs sparse; moderate frontage grass	IVp_{3-4}
3	10	Tributary drainage floors: up to about ¼ mile wide, gradients mainly 1 in 200 to 1 in 300; sealed, locally cracking and hummocky surfaces	Deep texture-contrast soils with a thin clay loam surface over a medium clay, Wyseby (Db1.11); locally, cracking clays with large gilgais, Pegunny (Ug5.25, 5.28)	Tall woodland (49). Closely spaced *E. moluccana*; moderate to sparse shrubs; eastern mid-height grass	IVp_{3-4}, g_{3-4}
4	60	Land facet 16: plains up to 2 miles wide	Deep texture-contrast soils, Taurus and Retro (Dy2.43)	Poplar box grassy woodland	IVp_{3-4}
5	10	Slopes of coarser-textured alluvium: less than 1% and up to ½ mile across; loose to firmed sandy to loamy surfaces	Deep layered soils on alluvium. Fine sandy clay loams to clay loams over sandy loams and coarser material above 40 in., Warrinilla	Tall grassy woodland (54). Moderately spaced *E. tereticornis* and *E. crebra*, with scattered *E. polycarpa* and *E. papuana* in places; shrubs sparse; moderate eastern mid-height grass	II–IIIp_{2-3}
6	15	Land facet 12: slopes of finer-textured alluvium	Strongly gilgaied very deep clay soils, Pegunny (Ug5.28) and Retro (Dy2.13)	Brigalow scrub	IVg_{3-4}

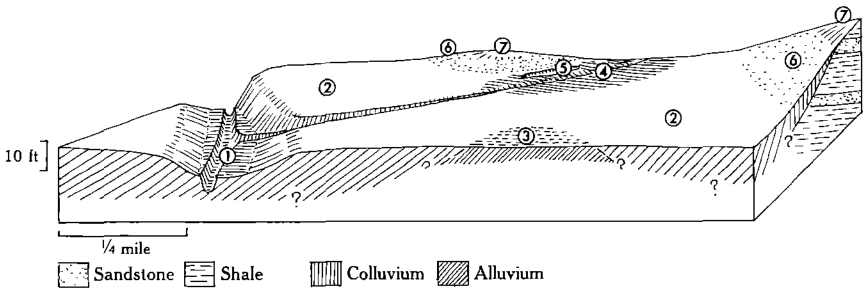
* Similar to Connors land system of the Isaac–Comet area and Alpha land system of the Nogoa–Belyando area.

(58) Juandah Land System (390 sq miles)

Alluvial plains with poplar box, associated with the Dawson River and its tributaries.

Geology.—Quaternary alluvium and colluvium.

Geomorphology.—Fluvial plains—mainly stable trunk plains: broad plains with through-going, shallowly entrenched large streams, and with minor "rises" comprising erosional and colluvial slopes.



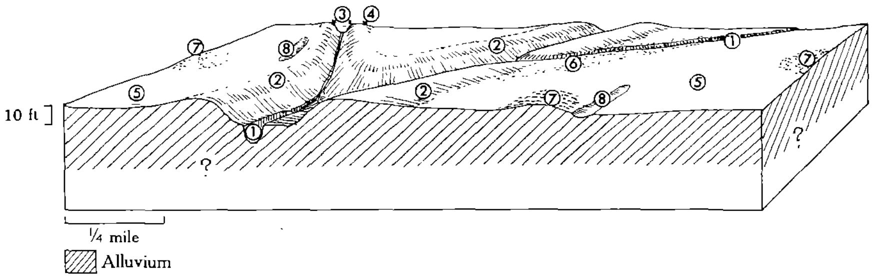
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	<5	Channels: up to 100 ft wide and 10 ft deep		Fringing vegetation	
2	65	Land facet 16: plains up to 2 miles across	Deep texture-contrast soils, Taurus and Retro (Dy2.43, 3.43)	Poplar box grassy woodland	IVp_{3-4}
3	5	Slopes of older alluvium: mainly less than 1% and ¼ mile in extent; sealed, cracking surfaces with microrelief	Very deep slightly gilgaied cracking clays, Vermont (Ug5.25)	Brigalow forest (38, locally 33). Dense tree layer (*A. harpophylla*, locally also *E. cambageana*); moderate tall shrub–small tree layer; moderate shrub layer; sparse scrub grass	$II–IIIk_{2-3}$
4	10	Sandy tributary drainage floors: up to ½ mile wide, with transverse slopes up to 1%	Layered alluvial soil showing weak gradational development (clayey sand—light sandy clay loam—sandy clay loam) on coarse sand at 30 in., Warrinilla	Tall grassy woodland (53). Tall, moderately spaced trees (*E. tereticornis*, *Angophora floribunda*); sparse shrubs; frontage grass	IVw_{3-4}
5	<5	Depressions in unit 4: linear, up to about 3 ft deep and 200 yd wide; firmed surfaces		Tall grassy woodland (51). Tall widely spaced *E. tereticornis* (60–100 ft); shrubs sparse; frontage grass	
6	10	Land facet 15: colluvial slopes	Moderately deep to deep texture-contrast soils, Retro (Dy3.43)	Poplar box grassy woodland	IVp_{3-4}, e_{2-3}
7	5	Land facet 13: erosional slopes	Shallow texture-contrast soils, Southernwood (Dy2.22)	Silver-leaved ironbark grassy woodland	IVp_{3-4}, e_{2-3} d_4

(59) KROOMBIT LAND SYSTEM (310 SQ MILES)

Alluvial plains, originally with eucalypt woodland, mainly in the Callide valley.

Geology.—Quaternary alluvium.

Geomorphology.—Fluvial plains—mainly stable trunk plains: extensive back plains with scattered loamy or clayey "rises", and with shallow depressions; moderately extensive levee zones in coarser- or finer-textured alluvium flanking shallowly entrenched channels.



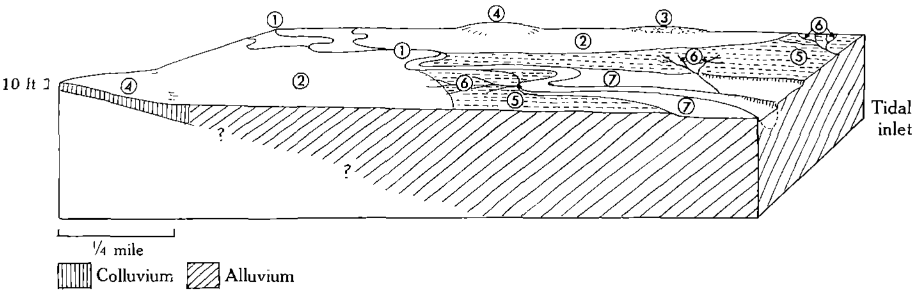
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	<5	Main channels: up to 100 ft wide and 20 ft deep, locally more		Fringing vegetation	
2	15	Flats and levees marginal to unit 1: up to about 100 yd across; firmed sandy to loamy surfaces	Layered alluvial soils, Consuelo and Clematis (Uf6.32)	Tall grassy woodland (52). Tall widely spaced *E. tereticornis* and *E. tessellaris*; sparse shrubs; frontage grass	IVw_{3-4}
3	5	Crests of levees in coarser-textured alluvium: up to 10 ft high and ¼ mile wide, slopes locally up to 2%; firmed to sealed sandy to loamy surfaces	Layered alluvial soils. Weakly developed gradational profiles of medium to fine textures over sand, Warrinilla (Gn3.22, 3.92)	Grassy woodland (55). Locally occurring patches of open woodland (*E. melanophloia*); sparse shrubs; frontage grass	$IIIw_3$
4	10	Back slopes of levees in coarser-textured alluvium: mainly less than 1% and ½ mile long; sealed loamy surfaces		Tall grassy woodland (51, 52). Tall trees (60–100 ft), widely spaced *E. tereticornis* with occasional *E. polycarpa*; sparse shrubs; frontage grass	
5	35	Back plains: up to 2 miles wide, gradients below 1 in 500, locally with transverse slopes about 1% and less than ¼ mile long; sealed surfaces	Deep texture-contrast soils, with a thin fine sandy clay loam surface over a medium to heavy clay, Retro (Dd1.33, 1.43)	Tall grassy woodland (51). Tall trees (60–100 ft), widely spaced *E. tereticornis*; sparse shrubs; frontage grass	IVp_{3-4}, w_{3-4}
6	10	Lower margins of unit 5: slopes mainly 1–3%, but attaining 5% locally, and less than ½ mile long; sealed surfaces	Deep texture-contrast soils, with a thin fine sandy or fine sandy loam surface over a medium to heavy clay, Retro and Taurus (Dy2.43 and Dd1.43); locally, deep cracking clay, Vermont (Ug5.16)	Tall grassy woodland (68). Tall trees (60–80 ft), widely spaced *E. microtheca*; shrubs sparse; frontage grass	IVp_{3-4}, w_{3-4}
7	15	Upper margins of, and rises in, unit 5; slopes up to about 1% and ¼ mile in extent	Deep texture-contrast soils with a thin fine sandy clay loam surface over medium to heavy clay, Retro (Dd1.33)	Grassy woodland (62). Moderately spaced (40–50 ft) *E. populnea*; sparse to moderate shrubs; frontage grass	IVp_{3-4}
8	5	Depression in unit 5: mainly 1–3 ft deep, but attaining 5 ft, and up to 100 yd across; sealed, cracking surfaces with microrelief locally	Deep alluvial cracking clay, slightly gilgaied, Vermont (Ug5.16)	Tall grassy woodland (51). Tall (60–100 ft) widely spaced *E. tereticornis* with scattered *E. populnea*; sparse shrubs; frontage grass	IVw_{3-4}

(60) Raglan Land System (80 sq miles)

Fine-textured alluvial plains, saline in lower parts, south-east of Rockhampton.

Geology.—Quaternary alluvium.

Geomorphology.—Fluvial plains—mainly unstable trunk plains: alluvial aprons comprising non-saline plains in upper sectors with minor colluvial slopes, and saline estuarine plains in lower sectors flanking tidal inlets.



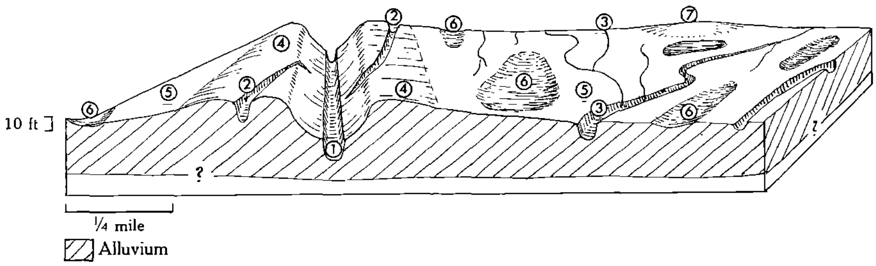
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	5	Channels: up to 100 ft wide, locally 300 ft, and 15 ft deep		Fringing vegetation	
2	65	Alluvial plains in upper sectors: up to about 3 miles across, gradients mainly below 1 in 500, but up to about 1 in 300; sealed, locally cracking and hummocky surfaces	Deep alluvial cracking clays, Vermont (Ug5.16); non-cracking, Clematis (Uf6.23)	Tall grassy woodlands (51). Openly spaced *E. tereticornis*; sparse shrubs; moderately dense frontage grass	Vw_{4-5}
3	5	Rises in unit 2: up to about 5 ft high and ½ mile across; sealed surfaces	Deep texture-contrast soils, Retro (Dy3.33)	Tall grassy woodland (54). Mainly *E. tereticornis* and *E. crebra* but also, in places, *E. polycarpa* and *E. papuana*; sparse shrubs; frontage grass	IVp_{3-4}, w_{3-4}
4	10	Land facet 15: colluvial slopes	Moderately deep to deep texture-contrast soils, Retro (Dy2.43)	Poplar box grassy woodland with sandalwood	IVp_{3-4}, e_2
5	10	Estuarine alluvial plains—upper parts: up to 2 miles across, gradients mainly below 1 in 1000, with transverse slopes up to about 0·5%; sealed, cracking, and locally scalded surfaces	Very deep saline cracking clays, slightly gilgaied, Vermont (Ug5.28)	Treeless community (73). Grasslands characterized by *Sporobolus virginicus* with many introduced or invading species	VIs_{4-6}, w_{3-4}
6	<5	Drainage zones in unit 5: up to 100 ft wide and 3 ft deep; sealed, cracking, and hummocky surfaces		Treeless community (73). Grasslands characterized by *Sporobolus virginicus* with many coarse tussocky grasses and sedges	
7	<5	Estuarine alluvial plains—lower parts: slopes less than 0·1% and ¼ mile in extent; heavily sealed and cracking surfaces	Saline clays, Alma	Bare	$VIIs_{4-7}$, w_5

(61) Gavial Land System (140 sq miles)

Flooded fine-textured alluvial plains with eucalypt woodlands, near Rockhampton *and* Wowan.

Geology.—Quaternary alluvium.

Geomorphology.—Fluvial plains—mainly unstable trunk plains: extensive back plains with numerous linear depressions and low "rises", traversed by a dense system of distributary channels; minor levee zones flanking through-going main channels.



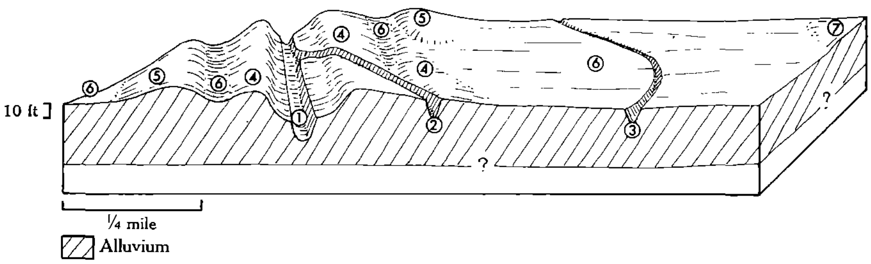
Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	<5	Main channels: to about 200 ft wide and 25 ft deep		Fringing vegetation	
2	<5	Distributary channels in levee zones; up to 100 ft wide and 20 ft deep			
3	10	Distributary channels in back plains: mainly less than 100 ft wide and 10 ft deep, with marginal slopes up to about 15%	Deep cracking clays, Vermont (Ug5.16)	Tall grassy woodland (51). Widely spaced *E. tereticornis* (60–100 ft); shrubs absent; grasses mostly annuals or coarse frontage grass	Vw_{4-5}
4	<5	Levees: commonly about 5 ft high and up to ¼ mile wide, with back slopes up to 2%; firmed to sealed surfaces	Alluvial soils showing gradational development. Coarse to medium textures grading to fine textures	Tall grassy woodland (52). Widely spaced tall trees (60–100 ft) (*E. tereticornis, E. tessellaris*); shrubs sparse; dense frontage grass	III–IVw_{3-4}
5	50	Back plains: up to 2 miles wide, gradients below 1 in 500, with transverse slopes up to 1% locally; sealed surfaces	Deep alluvial clays—cracking, Vermont (Ug5.16); non-cracking, Clematis (Uf6.23)	Tall grassy woodland (51). Widely spaced tall trees (60–100 ft) (*E. tereticornis, E. tessellaris*, with local patches of *E. melanophloia*); shrubs sparse; dense frontage grass	
6	25	Depressions in unit 5: attaining ½ mile in extent, with linear billabong up to 10 ft deep and mainly less than 100 yd wide; sealed, cracking, and locally hummocky surfaces	Deep cracking clays, Vermont (Ug5.16)	Grassy woodland (69). Openly spaced *E. microtheca*; sparse shrubs; frontage grass. *Tristania suaveolens* fringe (70) to billabongs	Vw_{4-5}
7	5	"Rises" in unit 5: mainly less than 5 ft high and ¼ mile across, with slopes less than 1%; sealed surfaces	Deep texture-contrast soils with a thin fine sandy clay loam surface soil on a medium or heavy clay, Retro (Dy3.33)	Tall grassy woodland (54). Close woodlands of *E. tereticornis* and/or *E. crebra*, with scattered *E. tessellaris* and *E. populnea*; shrubs sparse; moderately dense frontage grass	IVp_{3-4}

(62) Coolibah Land System* (620 sq miles)

Flooded alluvial country with coolibah, associated with the Dawson, Mackenzie, and Fitzroy Rivers.

Geology.—Quaternary alluvium.

Geomorphology.—Fluvial plains—mainly unstable trunk plains: broad back plains with moderately extensive levee zones, comprising inner levees and slightly higher outer levees, flanking meandering and anastomosing main channels.



Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	5	Main channels: mainly 20–30 ft deep, less in upper parts, and up to 300 ft wide, but attaining ¼ mile in lower sectors		Fringing vegetation	
2	<5	Distributary channels in levee zone: up to 20 ft deep and mainly less than 250 ft wide			
3	<5	Distributary channels in back plains: up to 10 ft deep and 200 ft wide, with marginal slopes up to about 15%	Deep cracking clays; slightly gilgaied locally, Vermont (Ug5.16)	Tall grassy woodland (51). Widely spaced tall trees (60–100 ft) (*E. tereticornis*); shrubs absent; grasses mostly annuals or coarse frontage grasses	Vw_{4-5}
4	15	Inner levees: up to 10 ft high with back slopes attaining 2–3%, mainly less than ¼ mile long but up to ½ mile; locally traversed by numerous subparallel linear depressions 5 ft or more in depth and up to 200 ft across	Alluvial soils showing gradational development, Moolayember (Gn3.22, 3.42, 3.92)	Tall grassy woodland (52). Widely spaced tall trees (60–100 ft) (*E. tereticornis, E. tessellaris*); shrubs sparse; dense frontage grass	$III–IVw_{3-4}$
5	5	Outer levees: up to 5 ft high, with back slopes mainly less than 1% and ¼ mile long	Deep medium- to fine-textured alluvial soils, Clematis (Um6.42, 6.22, Uf6.23)	Tall grassy woodland (51). Widely spaced tall trees (60–100 ft) (*E. tereticornis, E. tessellaris*), local patches of *E. melanophloia*; shrubs sparse; dense frontage grass	$IIIw_3$
6	65	Back plains and major depressions: plains up to 1 mile or more wide, with linear billabongs up to 10 ft deep and mainly less than 100 yd wide, and depressions up to 10 ft deep and ¼ mile across; slopes mainly less than 0·5%	Deep cracking clays, mainly Vermont (Ug5.15, 5.25); non-cracking, Clematis (Uf6.23, 6.61)	Grassy woodland (68). Widely spaced trees (50–70 ft) (*E. microtheca* with scattered *E. tessellaris* and *E. polycarpa*, and locally *E. tereticornis*); shrubs moderate; frontage grass	Vw_{4-5}
7	5	Back-plain "rises"; up to 5 ft high and ¼ mile across, slopes less than 1%; sealed surfaces, locally cracking and hummocky	Deep texture-contrast soils on alluvium, with a thin fine sandy clay loam surface on a medium or heavy clay, Retro (Dy3.33)	Tall grassy woodland (54). Close woodland of *E. tereticornis, E. crebra,* and *E. polycarpa* with scattered *E. tessellaris* and *E. populnea*; shrubs sparse; frontage grass	IVp_{3-4}

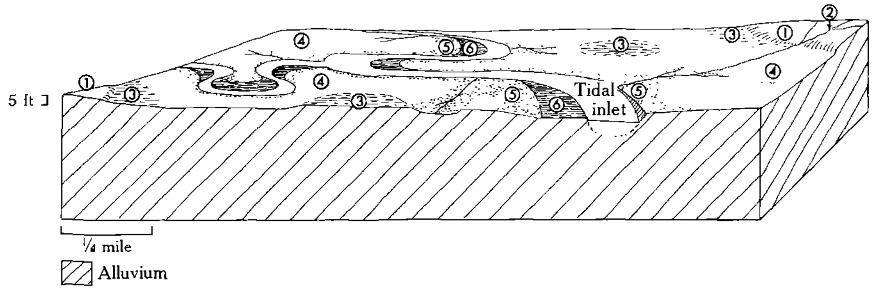
* Similar to Funnel land system of the Isaac–Comet and Nogoa–Belyando areas.

(63) Carpentaria Land System (170 sq miles)

Saline coastal plains.

Geology.—Quaternary estuarine alluvium.

Geomorphology.—Littoral plains: vegetated upper slopes and intermediate slopes mainly above high tides, and more extensive, bare, tidal lower slopes with outer flats flanking a dense, intricately branching pattern of tidal inlets.



Unit	Area (%)	Land Form	Soils	Vegetation	Land Class
1	10	Upper slopes: mainly less than 0·5%, but attaining 1% locally, and up to about 1 mile in extent; margins up to about 1 ft above unit 3 and 3 ft or more above unit 4; sealed, cracking surfaces, locally scalded	Very deep cracking clays, slightly gilgaied, Vermont (Ug5.28, 5.26)	Treeless communities (73). Mainly *Sporobolus virginicus* with numerous taller grasses	IV–VIIs$_{4-7}$, w$_{4-5}$
2	<5	Drainage zones in unit 1: up to 100 ft wide and 3 ft deep; sealed, cracking, and hummocky surfaces		Treeless communities (73). *Sporobolus virginicus* with many large tussocks of cyperaceous plants	
3	15	Intermediate slopes: mainly less than 0·5% and up to ½ mile long; margins up to about 6 in. above unit 4 and 1 ft above unit 5; sealed, cracking, and hummocky surfaces		Treeless communities (73, 80). A complex of dense *Sporobolus virginicus* grassland with numerous patches of samphire meadow (*Arthrocnemum leiostachyum*, *Suaeda australis*, *Arthrocnemum* sp., and *Sesuvium portulacastrum*)	VI–VIIs$_{4-7}$,w$_5$
4	60	Lower slopes: less than 0·1% and up to 2 miles across; heavily sealed and cracking surfaces	1–6 in. cracking clay over saline clay and mud, Alma	Bare	VIIIs$_8$, w$_5$
5	<5	Seaward margins of unit 4: mainly less than 0·5%, but locally attaining 3% flanking major tidal inlets, and less than ¼ mile across; hummocky surfaces	Saline mud, Alma	Fringing communities (71). Open mangrove community (*Aegiceras corniculatum*, *Avicennia marina*, *Osbornia octodonta*); considerable bare mud with numerous small patches of samphire and salt-water couch	VIIIs$_8$
6	10	Outer flats: mainly less than ½ mile wide; in shallow water or exposed only at low tide		Fringing community (71). Dense tall mangrove fringe (*Rhizophora stylosa*, *Aegiceras corniculatum*, *Avicennia marina*, *Osbornia octodonta*)	

PART IV. CLIMATE OF THE DAWSON–FITZROY AREA

By E. A. Fitzpatrick*

I. Introduction

(a) Principal Climatic Features

In accordance with prevailing levels of mean temperature and average rainfall, the area experiences a climate that may be described broadly as mesothermal subhumid (Köppen 1931; Thornthwaite 1931). As is characteristic over the whole of tropical Australia, average rainfall is higher in summer than in winter. However, several notable features of the climate are distinctive when the area is compared with regions to the north and north-west. Probably most important of these are the comparatively low minimum temperatures during winter, and the fact that the winter season, although having considerably less rainfall on the average than summer, does receive more than negligible amounts. These features give the climate of this area strong affinities with those of south-eastern Queensland and northern New South Wales (Isbell 1962).

Throughout the area average daily maximum temperatures remain high over the entire year. However, because of the moderating influences of maritime controls eastward from the area, the average maximum temperatures in summer are from 5 to 10 degrees lower than is characteristic of the pre-wet season period over inland northern Australia. The prevailing daily temperature range is between 20 and 30 degF, depending to a large degree on local conditions affecting night-time radiative cooling and air drainage as well as the degree of moderation of day-time temperatures by sea breezes.

(b) Principal Climatic Controls

Owing to latitudinal situation the climate is strongly controlled by south-easterly winds, and the prevailing weather is closely linked with the circulation patterns developing along the northern flanks of the progression of subtropical anticyclones, the centres of which move typically from west to east across the central (in winter) or southern (in summer) portions of Australia. The seasonal pattern of prevailing winds in the southern portion of the area is shown by the sequence of monthly wind roses for Taroom (Fig. 5). The percentage frequencies shown here are based solely upon 3 p.m. observations, and it must be emphasized that the daily pattern of surface winds at a particular site is closely related to local terrain and to the degree to which sea breezes are developed. Being considerably closer to the sea and less sheltered by intervening ranges, the northern extremity of the area is subject to sea breezes much more than is the southern inland. Because of its southerly situation and the orientation of nearby ranges, Taroom experiences a tendency for south-westerlies during the

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winter months not evident in the vicinity of Rockhampton. Apart from this, however, the pattern shown in Figure 5 may be taken as generally representative for the area.

From May to August, when the anticyclonic centres are furthest to the north and when the intertropical convergence zone is well beyond the northern extremities of the continent, prevailing winds are south-easterly to south-westerly. Over this

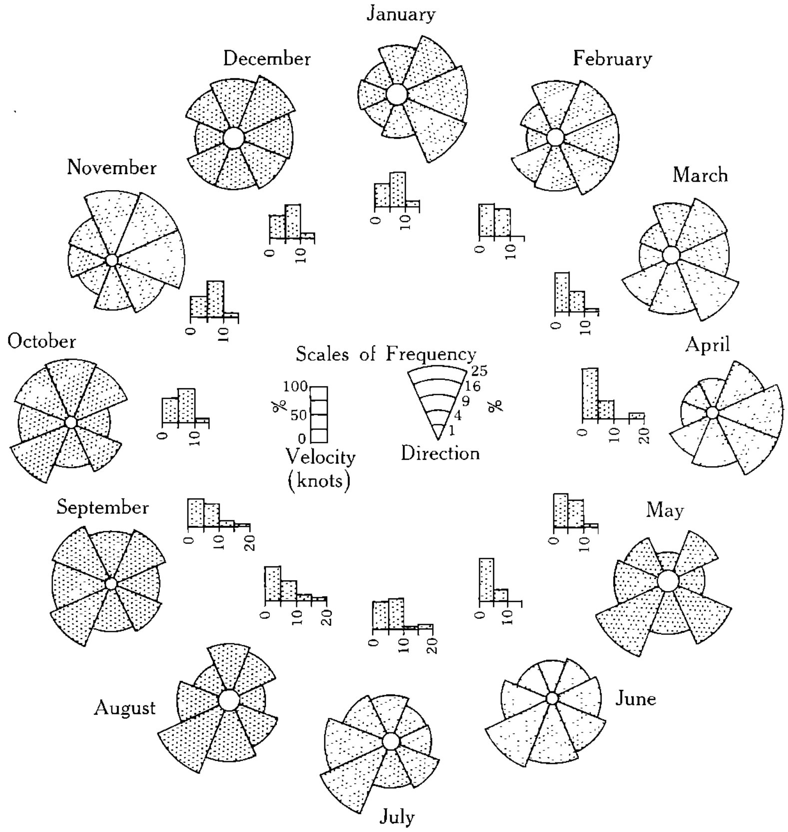

Fig. 5.—Wind direction and speed at Taroom. Prepared from data from 3 p.m. observations supplied by Department of National Development from records of Bureau of Meteorology. Areas enclosed within the eight sectors of the wind roses are proportional to the percentage frequency of winds from directions within those compass intervals, and the area of the central circle is proportional to the percentage frequency of calms. Histograms show percentage frequency of winds with velocities within specified intervals.

period the usual weather is that of fine sunny days with cool nights, minimum temperatures at times falling below freezing at low-lying inland localities. Normally, southerly depressions that follow in succession in an easterly direction south of the Australian mainland at this time do not have any significant influence upon the daily weather pattern. Occasionally, however, the area experiences the passage of fairly well-developed troughs that cause a shift from the prevailing winds to winds of easterly or north-westerly direction ahead of the trough, thus causing an influx of air that has had a longer passage over warmer waters. This situation may produce brief spells of unsettled weather in winter, with light to moderate falls of rain. The area is thus situated approximately at the northern limit of significant winter rainfall over eastern Australia (Fitzpatrick 1964). Following the passage of particularly well-developed troughs, air masses that have had a long trajectory from higher latitudes may enter the area. The greatest frost risks occur under clear calm conditions following closely these northerly penetrations of cooler air masses from the south.

The transitional period, September–October, shows a weakening in the dominance of winds having a southerly component and an increasing tendency toward winds from the north and north-east. By November, with greatly increased solar radiation intensities and longer days, day-time heating is rapid over the inland. Day-time temperatures are moderated by the effects of sea breezes along the Queensland coast, but generally, maximum temperatures in the 80s and lower 90s are observed inland at this time. Normally, monotonously fine dry weather prevails, but as the season advances rain becomes more frequent, much of it from thunderstorms with squally winds and intense falls of short duration. The average number of thunder days per year over the area ranges between somewhat more than 20 in the north to about 40 in the vicinity of Injune (Bureau of Meteorology 1960*a*). They are most frequent in late spring and early summer.

During the summer months, December to March, with the southward displacement of the anticyclonic centres, the prevailing winds are between south-east and north-east and air masses reaching the area have had long passages over warm seas. This is normally the period of most frequent and heaviest rainfall. However, the variability of summer rainfall is high by comparison with areas of comparable rainfall in northern Australia that are close to centres of frequent development of tropical low-pressure systems and where there is normally greater convergence of wind streams.

Tropical cyclones reach the central Queensland coast in 50% of all seasons. These storms normally arrive from the north or north-east and are on occasions highly destructive of property and crops along the coast. Although winds normally slacken quickly if the centres of tropical cyclones cross the coast and move inland, they not uncommonly persist for some time over adjacent inland areas in the form of extensive rain depressions. These often cause very high rainfall over several consecutive days and severe flooding (Fitzpatrick 1960). Although tropical cyclones have occurred along the Queensland coast at all times of the year, there is a marked concentration in the middle and late summer months. Their erratic incidence is a contributing factor to high variability of rainfall within the area (Dick 1958).

II. General Climatic Characteristics

(*a*) *Rainfall*

Mean annual rainfall within the area ranges generally between 23 and 38 in. The isohyetal map in Figure 6 is based upon mean annual rainfall for all stations having records over the 35-year period, 1926–60. Rainfall gradients are weak over the whole of the area with the exception of the northern slopes of the Mount Alma

Range and the western (lee) slopes of the Calliope Range where the highest mean rainfalls occur. Over the northern portion of the area the isohyets have a north–south trend, the mean annual rainfall decreasing inland from about 37 in. at Rockhampton to about 24 in. at Blackwater. Over the southern half of the area the isohyets trend in a west-north-west to east-south-east direction, with a general decrease from approximately 30 in. at Coorada to somewhat less than 23 in. at Mooga Hills.

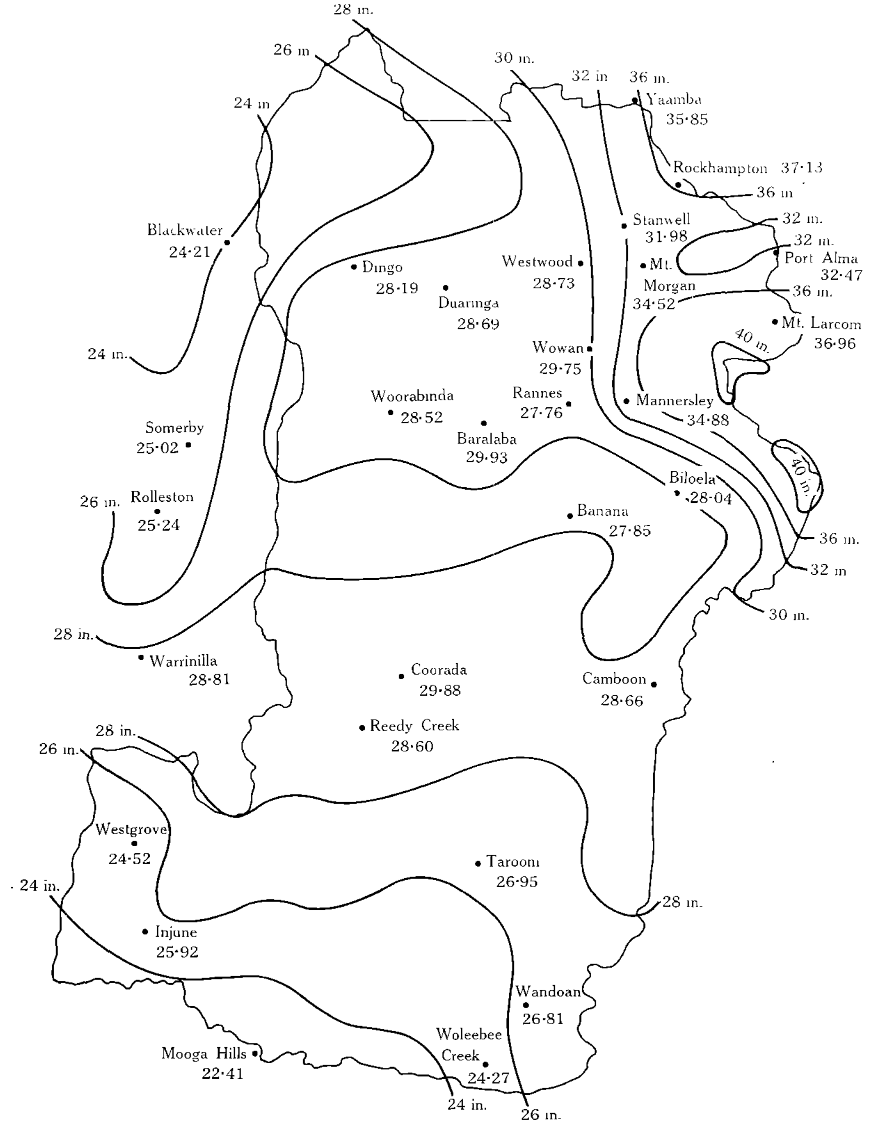

Fig. 6.—Mean annual isohyetal map.

Mean seasonal (6-monthly) and annual rainfall with standard deviations, coefficients of variation, and the percentages of the mean annual rainfall occurring during the six summer months are given in Table 3. Only minor differences occur

TABLE 3

MEAN ANNUAL AND SEASONAL RAINFALL WITH STANDARD DEVIATIONS AND COEFFICIENTS OF VARIATION*

Station	Annual			Summer (Nov.–Apr.)			Winter (May–Oct.)			Mean Summer Rainfall as Percentage of Mean Annual
	Mean	S.D.	C.V.	Mean	S.D.	C.V.	Mean	S.D.	C.V.	
Banana	27·85	± 8·89	32	19·63	± 5·52	28	8·22	± 4·33	53	70
Baralaba	29·93	±10·35	35	21·96	± 7·57	34	7·97	± 3·99	50	73
Biloela	28·04	± 6·77	24	19·82	± 4·85	24	8·22	± 3·21	39	71
Blackwater	24·22	± 7·59	31	17·47	± 6·33	36	6·75	± 3·50	52	72
Camboon	28·66	± 8·26	29	19·41	± 5·21	27	9·25	± 3·93	42	68
Coorada	29·88	± 9·80	33	21·16	± 7·33	35	8·72	± 4·41	51	71
Dingo	28·19	±10·09	36	20·59	± 7·83	38	7·60	± 4·35	57	73
Duaringa	28·69	± 8·00	28	21·29	± 6·93	33	7·40	± 4·14	56	74
Injune	25·92	± 8·73	34	18·34	± 6·05	33	7·58	± 3·58	47	71
Mannersley	34·88	±11·47	33	24·98	± 8·28	33	9·90	± 4·25	43	72
Mooga Hills	22·41	± 6·89	31	16·92	± 9·65	57	5·47	± 3·68	67	76
Mt. Larcom	36·96	±13·75	37	27·90	±11·24	40	9·06	± 4·74	52	75
Mt. Morgan	34·52	±11·26	33	25·28	±11·46	45	9·24	± 4·63	50	73
Port Alma	32·47	±12·10	37	23·31	± 9·31	40	9·16	± 6·24	68	72
Rannes	27·76	± 6·24	22	20·10	± 5·78	29	7·66	± 3·99	52	72
Reedy Creek	28·60	± 9·70	34	20·57	± 6·92	34	8·03	± 3·66	46	72
Rockhampton	37·13	±13·48	36	28·01	±11·07	40	9·12	± 5·18	57	75
Stanwell	31·98	±10·49	33	23·72	± 9·75	41	8·26	± 4·54	55	74
Taroom	26·95	± 8·03	30	20·07	± 8·97	45	6·88	± 4·27	62	74
Wandoan	26·81	± 8·14	30	18·09	± 4·70	26	8·72	± 4·27	49	67
Westgrove	24·56	± 9·48	39	17·40	± 6·59	38	7·16	± 3·68	51	71
Westwood	28·73	± 8·25	29	21·02	± 6·70	32	7·71	± 3·58	46	73
Woleebee Creek	24·27	± 7·95	33	15·43	± 5·72	37	8·84	± 4·34	49	64
Woorabinda	28·52	±11·42	40	21·14	±10·13	48	7·37	± 4·19	57	74
Wowan	29·75	± 8·41	28	22·73	± 8·17	36	7·02	± 3·67	52	76
Yaamba	35·85	±12·36	34	28·02	±10·50	37	7·83	± 4·72	60	78

* From records over the period 1926–60 inclusive supplied by Bureau of Meteorology.

Table 4

MEAN MONTHLY RAINFALL (IN.) *

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Banana	4·14	4·83	3·03	1·61	1·50	1·61	1·23	0·69	0·83	2·15	2·48	3·74
Baralaba	4·04	5·39	3·17	2·14	1·53	1·55	1·23	0·63	0·80	2·08	2·93	3·57
Biloela	4·17	4·90	2·76	1·63	1·65	1·55	1·26	0·70	0·78	2·16	2·83	3·65
Blackwater	3·50	4·53	2·51	1·18	1·30	1·21	1·06	0·46	0·80	1·92	2·54	3·21
Camboon	3·63	4·75	2·43	1·73	1·73	1·64	1·43	0·81	1·16	2·41	3·06	3·87
Coorada	3·82	5·48	2·94	2·27	1·87	1·52	1·36	0·61	1·04	2·44	2·77	3·76
Dingo	4·40	5·28	2·86	1·76	1·50	1·53	1·29	0·53	0·81	2·09	2·30	3·85
Duaringa	4·35	5·62	2·82	1·90	1·53	1·54	1·15	1·44	0·95	1·88	2·78	3·59
Injune	3·50	3·81	2·67	1·82	1·31	1·20	1·33	0·81	1·00	1·93	3·07	3·47
Mannersley	6·22	6·19	4·11	1·52	1·85	2·21	1·62	0·83	0·82	2·15	2·57	4·22
Mooga Hills	2·62	3·76	2·12	1·58	1·41	1·22	1·29	0·67	1·00	1·81	2·29	2·64
Mt. Larcom	5·87	8·48	4·22	2·09	1·79	2·10	1·73	0·68	0·96	1·90	2·65	4·48
Mt. Morgan	5·47	7·23	4·16	2·44	1·73	1·84	1·89	0·67	0·81	2·09	2·67	3·51
Port Alma	4·92	7·25	3·96	1·96	1·64	1·96	1·60	0·61	0·83	1·88	2·58	3·27
Rannes	4·55	4·54	2·92	1·56	1·59	1·39	1·43	0·79	0·77	2·12	2·79	3·60
Reedy Creek	4·01	5·30	2·83	2·30	1·48	1·43	1·32	0·73	0·95	2·11	2·73	3·41
Rockhampton	6·56	8·16	4·40	2·50	1·66	2·14	1·82	0·71	0·87	1·88	2·54	3·88
Stanwell	5·11	7·04	3·47	2·46	1·54	1·75	1·55	0·56	0·68	2·00	2·71	3·10
Taroom	3·78	4·31	2·08	1·58	1·62	1·24	1·38	0·75	1·08	2·38	2·95	3·80
Wandoan	3·51	3·76	2·58	1·52	1·57	1·40	1·36	0·88	1·08	2·50	3·09	3·58
Westgrove	3·24	3·64	2·67	1·52	1·28	1·11	1·22	0·70	0·83	2·02	2·66	3·67
Westwood	4·88	5·48	2·88	1·97	1·45	1·61	1·42	0·61	0·88	1·79	2·35	3·40
Woleebee Creek	3·23	3·24	2·21	1·31	1·69	1·42	1·39	0·92	0·97	2·10	2·67	3·12
Woorabinda	4·16	5·51	3·02	2·07	1·61	1·42	1·19	0·54	0·88	1·82	2·70	3·45
Wowan	4·74	5·55	2·98	1·95	1·52	1·68	1·43	0·67	0·72	2·00	2·62	3·88
Yaamba	6·70	7·88	4·55	2·27	1·46	1·95	1·70	0·59	0·84	1·67	2·42	3·81

* From records over the period 1926–60 inclusive supplied by Bureau of Meteorology.

within the area in the proportion of the mean annual rainfall during the 6-month interval November through April, this being generally of the order of 70 to 75% and without any clearly recognizable regional trends. Similarly, the variability of annual and seasonal rainfall is not related in any obvious way to broad geographic controls. Both summer and winter rainfalls are highly variable by comparison with areas of comparable rainfall in the northern and southern parts of the continent (Loewe 1948). High variability in rainfall is largely a reflection of geographical remoteness from centres of either summer or winter concentration of rainfall in the northern and southern parts of Australia respectively and also of the intrinsic erratic incidence of high-rainfall-producing tropical cyclones.

Mean monthly rainfalls are summarized in Table 4. Throughout the area February is the wettest month; however, concentration of rainfall at this time is much less marked at inland stations than at stations in the vicinity of Rockhampton. For the north-eastern coastal area, representative averages for the months December through March are 3·8, 6·5, 8·0, and 4·4 in. respectively, whereas inland localities generally have averages over these months of the order of 3·5, 4·0, 5·0, and 3·0 in. throughout the north and 3·5, 3·5, 3·8, and 2·6 throughout the south. Mean rainfalls for April are everywhere considerably lower than those for March, this being typical over all of northern Australia. From May to July monthly averages are between 1·0 and 2·0 in. with a general tendency for June to be the wettest of these three months, particularly in the north-eastern coastal area. August has the lowest mean monthly rainfall, less than 1·0 in. at all stations. Between September and November the monthly averages increase generally to somewhat less than 3·0 in. During these months inland stations have higher averages than do those closer to the coast, this feature reflecting the widespread occurrence of convectional thunderstorms throughout the inland area.

Largely owing to the occasional very high falls associated with tropical cyclones, the annual and monthly averages give an exaggerated impression of the "normal" rain expectancy. This is clearly shown by a comparison of mean and median rainfall for Rockhampton, Banana, and Taroom in Table 5. Also shown are the levels of rainfall exceeded in 10% and 90% of all years. Mean rainfalls are almost without exception higher than the rainfall exceeded on 50% of all occasions (i.e. the median), and in some cases as much as 100% higher. Of particular interest in relation to agricultural and pastoral land use is the high risk of rain being well below the average at any time during the year. Table 5 shows that even during the wettest month, February, there is a 10% chance that the monthly total will be less than 1·5 in. at Rockhampton and less than 0·5 and 0·4 in. at Banana and Taroom respectively. It is notable that in terms of minimal risk of extremely low monthly totals, December and January are more favourable than February at Banana and Taroom; this is presumably so for all inland stations where there is a high incidence of thunderstorms. The prevailing high levels of monthly rainfall exceeded in 10% of all years show that no part of the year is so dry as to preclude the possibility of useful rain. In general, inland localities experience monthly totals greater than 7·0 in. in 1 year in 10 in January or February, and falls greater than 3·0 in. can be expected with at least this frequency in any month between April and September except August. A high degree of variability

TABLE 5

MONTHLY AND ANNUAL RAINFALLS EXCEEDED IN 10, 50, AND 90% OF ALL YEARS*

Criterion	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Banana (85 yr of records)													
10%	7·00	7·60	6·10	3·20	3·40	3·10	3·10	2·40	3·20	4·00	4·70	6·80	37·30
50%	3·60	3·40	2·30	0·80	0·90	0·70	0·90	0·60	0·90	1·80	2·20	3·30	27·50
Mean†	4·14	4·83	3·03	1·61	1·50	1·61	1·23	0·69	0·83	2·15	2·48	3·74	28·84
90%	1·20	0·50	0·30	nil	nil	nil	nil	nil	nil	0·30	0·60	1·00	17·50
Rockhampton (83 yr of records)													
10%	17·00	20·00	9·40	4·80	3·60	6·00	4·00	2·30	2·70	4·30	4·70	8·50	56·30
50%	4·40	4·30	3·20	1·40	1·10	1·30	0·80	0·90	0·90	1·40	2·40	3·60	34·30
Mean†	6·56	8·16	4·40	2·50	1·66	2·14	1·82	0·71	0·87	1·88	2·54	3·88	37·12
90%	1·30	1·50	0·50	0·20	0·20	0·20	nil	nil	0·20	0·30	0·40	1·30	22·80
Taroom (81 yr of records)													
10%	8·00	8·00	5·30	3·80	4·40	3·20	3·00	2·80	3·10	4·00	5·60	5·90	38·30
50%	3·70	2·50	2·00	1·00	0·80	1·20	0·90	0·60	1·10	1·40	2·60	2·80	26·70
Mean†	3·78	4·31	2·08	1·58	1·62	1·24	1·38	0·75	1·08	2·38	2·95	3·80	26·95
90%	1·30	0·40	0·50	0·10	0·10	0·10	0·10	0·10	0·10	0·30	0·50	0·60	17·80

* Data supplied by Department of National Development from records of Bureau of Meteorology.

† Mean 1926–60.

in rainfall throughout the year is evident from Table 5; this feature, more than any other aspect of climate, imposes an element of uncertainty in agricultural and pastoral pursuits.

Table 6 shows the frequency patterns of daily rainfalls at Rockhampton and Banana. The mean number of rain days (⩾0·01 in.) follows closely the annual regime of mean rainfall at both stations, these being approximately twice as many in mid summer as in mid winter. For all months at Rockhampton, over 55% of the rain days have falls within the range 0·01–0·24 in., and during May, July, August, and September the percentage within this range exceeds 70. Between December and March, falls exceeding 4·0 in. account for up to 3% of the total number of rain days

TABLE 6

MEAN NUMBER OF RAIN DAYS* WITH FALLS WITHIN SPECIFIED LIMITS FOR BANANA AND ROCKHAMPTON

Range (in.)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
					Banana							
0·01–0·24	43	41	51	55	56	52	52	59	54	51	47	38
0·25–0·99	38	41	35	33	32	34	40	34	37	41	42	47
1·00–1·99	15	13	10	10	11	11	6	5	7	8	9	11
2·00–3·99	4	6	4	2	1	4	2	2	3	1	2	3
4·00–5·99	—	—	—	—	—	—	—	—	—	—	—	—
⩾6·00	—	—	—	—	—	—	—	—	—	—	—	—
Mean no. of rain days	7·4	6·4	5·7	3·3	3·1	3·4	3·1	2·5	2·9	4·5	5·4	6·7
					Rockhampton							
0·01–0·24	55	56	66	67	73	64	71	79	73	59	64	58
0·25–0·99	26	27	23	24	21	23	21	16	22	32	26	26
1·00–1·99	11	10	7	5	4	8	6	5	4	6	8	11
2·00–3·99	5	4	2	3	1	4	2	—	1	3	2	4
4·00–5·99	2	1	1	—	—	—	—	—	—	—	—	1
⩾6·00	1	2	1	—	—	—	—	—	—	—	—	—
Mean no. of rain days	10·6	11·3	10·0	5·9	5·2	5·8	5·2	3·7	4·0	5·2	7·2	8·5

* Rain day defined as a day with 0·01 in. or more of rain.

at Rockhampton, and the distinctly larger proportion of daily falls with over 1·0 in. during June as compared with the preceding or subsequent months is clearly evident. Although the mean number of rain days at Banana is considerably less than at Rockhampton, the percentages of rain days within the range 1·0–4·0 in. are roughly the same for both stations throughout the year. By comparison with Rockhampton, the most conspicuous features in the data from Banana are the absence of daily falls greater than 4·0 in. and the higher proportion of falls between 0·25 and 1·0 in., especially during the period of frequent thunderstorms in late spring and early summer.

(*b*) *Temperature*

Temperature data are available for Biloela, Mount Morgan, Rockhampton, Taroom, and Westwood. Although these are inadequate for preparing detailed

TABLE 7

AVERAGE MEAN MAXIMUM, MEAN, AND MEAN MINIMUM TEMPERATURES FOR FIVE STATIONS *

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
						Biloela							
Maximum (°F)	92·5	89·4	87·9	83·1	77·5	71·2	70·9	75·4	80·7	85·6	89·4	91·4	82·9
Mean (°F)	80·0	77·9	75·3	68·7	62·9	57·3	55·8	58·0	63·5	70·1	75·1	78·0	68·5
Minimum (°F)	67·5	66·3	62·6	54·3	48·3	43·4	39·8	40·6	46·4	54·7	60·8	64·6	54·1
						Mt. Morgan							
Maximum (°F)	88·5	86·7	85·3	82·0	76·8	71·1	70·7	73·9	78·9	84·3	87·1	88·6	81·2
Mean (°F)	78·8	77·7	75·8	71·1	65·3	60·1	58·9	61·4	67·2	72·5	76·1	78·1	70·2
Minimum (°F)	69·1	68·8	66·3	60·1	53·8	49·1	47·2	48·9	55·5	60·8	65·0	67·7	59·4
						Rockhampton							
Maximum (°F)	90·0	88·7	87·2	84·2	79·3	74·4	73·3	76·7	81·7	85·9	88·5	90·0	83·3
Mean (°F)	81·1	80·3	78·5	74·5	68·8	64·2	62·5	64·8	70·0	74·8	78·2	80·5	73·2
Minimum (°F)	72·3	72·1	69·8	64·8	58·3	54·0	51·2	52·9	58·3	63·8	68·0	70·9	63·0
						Taroom							
Maximum (°F)	89·3	89·0	86·6	83·3	73·5	70·6	68·8	72·0	79·1	86·1	88·9	91·9	81·6
Mean (°F)	78·1	78·3	74·9	70·2	59·5	55·9	54·5	55·9	63·8	72·0	76·3	79·5	68·2
Minimum (°F)	67·0	67·6	63·2	57·1	45·6	41·3	40·2	39·9	48·5	57·9	63·7	67·0	54·9
						Westwood							
Maximum (°F)	90·5	87·7	86·5	83·0	78·0	72·3	71·3	75·8	80·4	85·2	88·1	90·1	82·4
Mean (°F)	79·4	77·7	75·5	70·1	64·1	59·4	57·9	60·5	66·1	71·7	75·7	78·1	69·7
Minimum (°F)	68·3	67·7	64·4	57·2	50·3	46·5	43·9	45·2	51·8	58·2	63·2	66·2	56·9

* Data of Bureau of Meteorology (1962).

TABLE 8

MEAN NUMBER OF DAYS WITH TEMPERATURES ABOVE AND BELOW SELECTED THRESHOLDS*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Biloela													
Maximum ≥90°F	20·6	13·2	10·2	2·1	—	—	—	—	1·7	4·9	13·1	19·1	84·9
Maximum ≥100°F	2·0	0·6	0·2	—	—	—	—	—	0·1	—	0·5	1·0	4·4
Minimum ≤36°F	—	—	—	0·3	2·3	8·8	11·7	10·5	2·9	0·3	—	—	36·8
Minimum ≤32°F	—	—	—	—	0·6	4·6	6·8	5·7	0·6	0·1	—	—	18·4
Mt. Morgan													
Maximum ≥90°F	12·7	6·1	4·3	0·7	—	—	—	—	0·2	4·5	10·5	15·3	54·2
Maximum ≥100°F	0·6	0·1	—	—	—	—	—	—	0·1	0·2	0·2	0·2	1·4
Minimum ≤36°F	—	—	—	—	—	1·2	1·1	0·9	—	—	—	—	3·2
Minimum ≤32°F	—	—	—	—	—	0·1	0·1	—	—	—	—	—	0·2
Rockhampton													
Maximum ≥90°F	19·9	11·4	9·4	3·0	—	—	—	—	1·7	6·1	13·1	17·5	82·1
Maximum ≥100°F	1·1	0·4	0·1	—	—	—	—	—	—	—	0·8	1·2	3·6
Minimum ≤36°F						No frosts most years							
Minimum ≤32°F						No frosts most years							
Taroom													
Maximum ≥90°F	17·0	14·0	10·0	4·0	—	—	—	—	1·0	9·0	16·0	22·0	93·0
Maximum ≥100°F	2·0	1·0	—	—	—	—	—	—	—	—	1·0	3·0	7·0
Minimum ≤36°F	—	—	—	—	3·0	10·0	16·0	14·0	2·0	—	—	—	45·0
Minimum ≤32°F	—	—	—	—	—	3·0	6·0	5·0	—	—	—	—	14·0
Westwood													
Maximum ≥90°F	18·4	7·9	7·0	1·0	—	—	—	—	0·9	4·5	12·3	17·0	69·0
Maximum ≥100°F	2·9	—	—	—	—	—	—	—	0·1	—	0·7	0·7	4·4
Minimum ≤36°F	—	—	—	0·3	0·4	2·5	2·8	3·9	0·6	—	—	—	10·5
Minimum ≤32°F	—	—	—	—	0·2	1·2	1·8	1·1	—	—	—	—	4·3

* Data of Bureau of Meteorology (1960*b*).

isothermal maps, the broad temperature characteristics over the area can be described. In general, the area is not one with marked spatial differences in temperature. In Table 7 monthly average maximum, minimum, and mean temperatures are given. The mean numbers of days with temperatures above and below selected thresholds are given in Table 8.

Mean maximum temperature ranges from approximately 70°F in mid winter to 90°F or slightly higher in mid summer. Although temperatures over 100°F are not common, runs of up to three consecutive days with temperatures over 100° may occur at inland localities between December and February. The greatest risk of such heat-waves occurs in January. Skerman (1958) reports five occurrences of five or more consecutive days with temperatures over 100°F at Biloela, and Table 8 shows that over the whole of the area there are on the average up to three such days during either December or January, the lowest averages occurring naturally at stations closest to the coast. The incidence of very high temperatures is markedly reduced during February, mainly due to the increased cloudiness of that month.

Mean minimum temperatures during the winter months are spatially very variable within the area, distance from the coast and local terrain being the principal determinants. The data for Biloela and Taroom in Table 7 may be taken as broadly representative for inland areas, but doubtless considerable very localized variation occurs as a result of the favourability or otherwise of specific sites for the accumulation of cold air within surface depressions. At these two stations mean minimum temperatures during July and August are about 40°F, giving a mean daily range of temperature of about 30 degF or more. In the north-eastern portion of the area mean minimum temperatures in winter are about 10 degF higher. During summer mean minimum temperatures show a higher degree of uniformity throughout the area, these being of the order of 65 to 70°F.

Throughout all except the extreme north-eastern part of the area, where maritime influences are strongest and where nocturnal radiational losses are reduced owing to greater cloudiness and higher water vapour contents in the atmosphere, there is an appreciable frost risk throughout the winter months. The occurrence of screen temperatures of 36°F or less may be taken as a rough approximation of the occurrence of temperatures at or below freezing at the surface (Foley 1945). Table 8 shows that at Biloela these conditions have occurred as early as April and as late as October. However, such low temperatures are rare during the transitional months April, May, September, and October by comparison with June, July, and August when, in general, inland localities have monthly averages of ten or more days with minimum screen temperatures below 36°F, and about half of these result from occurrences of minimum temperatures of 32°F or lower. Under the latter conditions severe frosts are likely to be widespread over all but a narrow zone close to the coast. Temperature data for Rockhampton show that along the lower reaches of the Fitzroy River even mild frosts are rare. As seen from the data for Westwood (Table 8), frost incidence increases markedly within a distance of 30 miles inland from Rockhampton.

(c) *Humidity*

Data included in Table 9 depict the mean monthly humidity conditions at Rockhampton and Biloela, the only two stations for which long-term observations of wet- and dry-bulb temperature are available.

The mean monthly 9 a.m. vapour pressure data are of interest as an indication of seasonal trends in actual atmospheric water vapour content. The annual regime of this element follows closely that of mean rainfall, the highest levels occurring during January and February and the lowest during July or August. As might be expected from a consideration of relative distances from the coast, vapour pressures are distinctly lower at Biloela than at Rockhampton throughout the year. Reference to data for stations further inland shows that this trend continues westward and southward over the area.

At Rockhampton the mean index of relative humidity ranges narrowly between 63% in October and 69% in February and March. Mean relative humidity at 3 p.m. at this station is about 15% lower in summer and about 20% lower in winter. The mean index at Biloela is similar to that at Rockhampton over the summer months, but is distinctly higher between May and September.

Although data for 3 p.m. are not available for any inland station within the area, it may be safely assumed that mean relative humidities at this hour are generally lower than the levels observed at Rockhampton, owing to a combination of higher day-time temperature and lower vapour pressures at inland localities.

The mean monthly saturation deficits shown in Table 9 give a general indication of the seasonal trends in the drying power of the air. High saturation deficits occur during November and December, after which a steady decline occurs until the lowest levels are reached in June and July.

(d) *Cloudiness, Sunshine, and Radiation*

Cloudiness decreases generally from north-east to south-west. During the December–March period, mean cloudiness at Rockhampton ranges between about four- and five-tenths, whereas between July and September it is less than three-tenths. A basically similar seasonal pattern occurs at Biloela but the values are lower throughout the year.

As shown on maps published by the Bureau of Meteorology (1954), average duration of sunshine at Rockhampton reaches a maximum of approximately 9 hr/day during October and November. February and June have the least sunshine, each of these months having averages of about 7 hr/day. Corresponding values for Injune are approximately 10 hr/day in October–November, 8 hr/day in February, and 7 hr/day in June.

Estimated mean total radiation at Rockhampton ranges from 575 cal/cm^2/day in December to 312 cal/cm^2/day in June. Corresponding values for Injune are 625 cal/cm^2/day in December and 300 cal/cm^2/day in June (Bureau of Meteorology 1964).

TABLE 9

MEAN MONTHLY DATA* FOR ELEMENTS OTHER THAN RAINFALL AND TEMPERATURE AT BILOELA AND ROCKHAMPTON

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
						Rockhampton							
9 a.m. vapour pressure (inHg)	0·728	0·719	0·678	0·576	0·475	0·411	0·371	0·396	0·473	0·547	0·623	0·692	0·557
Average index of mean relative humidity (%)	68	69	69	67	67	68	65	64	64	63	64	66	66
3 p.m. relative humidity (%)	55	55	54	50	49	50	45	42	42	44	46	49	48
Saturation deficit (inHg)	0·326	0·304	0·267	0·250	0·204	0·154	0·155	0·192	0·263	0·358	0·391	0·383	0·271
9 a.m. cloudiness (tenths)	4·9	4·6	3·9	3·0	2·6	3·2	2·4	2·1	2·6	3·4	4·1	4·4	3·4
3 p.m. cloudiness (tenths)	4·4	4·5	4·3	3·7	3·4	3·6	2·7	2·6	2·6	2·8	3·2	3·7	3·4
Evaporation (in./month)	6·98	5·40	5·65	4·82	4·10	3·56	3·24	4·25	5·42	6·75	7·43	8·22	65·82
						Biloela							
9 a.m. vapour pressure (inHg)	0·671	0·664	0·610	0·488	0·422	0·346	0·317	0·345	0·395	0·467	0·551	0·600	0·490
Average index of mean relative humidity (%)	65	69	69	69	73	73	72	71	67	63	63	62	68
9 a.m. saturation deficit (inHg)	0·342	0·291	0·279	0·220	0·164	0·104	0·116	0·158	0·251	0·328	0·359	0·381	0·249
9 a.m. cloudiness (tenths)	4·0	4·0	3·3	2·4	2·4	3·0	2·2	1·6	1·8	2·7	3·4	3·5	2·9
Evaporation (in./month)	7·39	5·27	5·16	4·50	3·45	2·91	3·22	4·04	5·12	6·32	7·26	7·85	62·49

* Evaporation at Rockhampton observed from standard Australian tank; at Biloela estimated by method of Fitzpatrick (1963) from mean maximum temperature, vapour pressure, and day length. Other data extracted or derived from data published by Bureau of Meteorology (1960*b*, 1962).

(*e*) *Evaporation–Rainfall Relationships*

Data for evaporation as observed from the standard Australian tank are available for Rockhampton (Table 9) and Taroom. The annual average at both of these stations is approximately 65 in., and at each the highest rate occurs in December (approximately 8·0 in./month). The minimum rate at Rockhampton (3·24 in./month) occurs in July, whereas at Taroom it occurs in June (2·29 in./month). Although evaporation rates at Taroom are as much as 1·0 in./month lower than those at Rockhampton during June, July, and August, the reverse is true during January, February, and March. Thus, apart from controls upon evapotranspiration such as may result from restriction of available soil moisture or may relate to plant factors, it would appear that in terms of water economics the north-eastern portion of the area is favoured in summer even apart from the higher rainfalls occurring in this portion of the area. In winter, potential evapotranspiration is probably slightly lower in the extreme southern portion of the area, but this advantage is offset by lower rainfall than in the north-east.

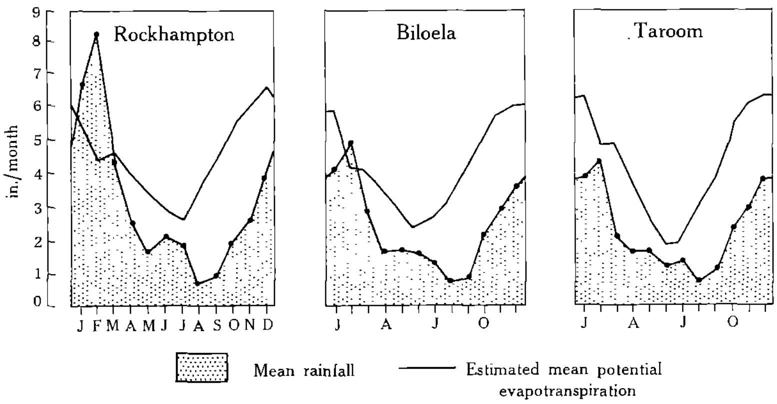

Fig. 7.—Mean monthly rainfall and estimated potential evapotranspiration at Rockhampton, Biloela, and Taroom.

Figure 7 shows the relationship between mean monthly rainfall and an assumed continuing monthly potential evapotranspiration equal to 0·8 times the observed or estimated (Fitzpatrick 1963) mean tank evaporation at Rockhampton, Biloela, and Taroom. The more favourable water balance toward the north-east in summer is clearly evident. It must be emphasized, however, that generalized diagrams of this type may be misleading, not only because they are based solely on monthly averages but also because they do not take into account soil and plant factors or special cultural practices that may critically affect the efficiency of water use. Such diagrams cannot, for example, be directly interpreted with any reliability in terms of expected pasture or crop growth since it cannot be assumed that growth is precluded when rainfall fails to satisfy potential evapotranspiration. Much useful growth normally continues over some considerable range of available soil moisture.

In winter, growth rates of native pasture species are greatly reduced through low temperatures quite apart from moisture status. Miles (1949) has shown, for example, that with the onset of lower temperatures growth rates of bunch spear grass (*Heteropogon contortus*) decline rapidly, and the occurrence of substantial winter rain has no immediate effect. In this context, Figure 7 is of interest mainly inasmuch as it demonstrates that large differences between mean rainfall and potential evaporation are confined mainly to the interval August to December. With application of special agronomic practice directed toward increasing infiltration and reducing evaporation (e.g. fallowing), it is clear that on soils having suitable moisture storage qualities the growth potential throughout the area is considerable, in spite of rainfall generally well below the potential rate of evapotranspiration.

III. Agroclimatology

An analysis of the climate of the whole of the Fitzroy region of Queensland, using a water-use model and weekly rainfalls over a standard 35-year period, has been published separately (Fitzpatrick 1965). The most important aspects affecting pasture and crop growth are summarized in Parts IX and X.

IV. Acknowledgments

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PART V. GEOLOGY OF THE DAWSON–FITZROY AREA

By R. L. WRIGHT*

I. INTRODUCTION

Reference to structure and lithology in this report is based largely on information included in a geological summary of Queensland (Hill and Denmead 1960), on the work of Malone *et al.* (unpublished data),† Olgers *et al.* (unpublished data),‡ and Malone (1964), and on unpublished maps made available by the Bureau of Mineral Resources, Geology and Geophysics, and the Geological Survey of Queensland.

This Part generally follows the "traditional" stratigraphic nomenclature of the area, but it should be pointed out that much of the terminology is in a state of flux as new names are being proposed for many of the stratigraphic units.

Geologically the survey area is complex, including parts of several of the major structural elements of the Tasman Geosynclinal Zone together with, in the south, the margins of the Surat Basin, an extensive unit within the Great Artesian Basin (Fig. 8). Those elements within the Tasman Geosynclinal Zone are as follows: in the extreme north-east, the Marlborough Block (a component of the South Coastal High) and the Yarrol Basin; and in the centre and north-west, the complex Bowen Basin here comprising the Mimosa Syncline, the Nebo Synclinorium (including the Folded Zone), the Connors Arch, the Auburn Arch, the Strathmuir Syncline, and the Gogango Overfolded Zone. In addition, immediately to the west and also within the Bowen Basin, the Comet Ridge and the Denison Trough have influenced the geological development of the region.

Underlying most of the area, the rocks of the Bowen Basin consist of a thick sequence of folded and faulted volcanics and sediments of Permian to Triassic age. Volcanics and sediments also characterize the Devonian–Lower Permian Yarrol Basin succession, with older metamorphic and igneous rocks in the Marlborough Block. To the south, overlapping unconformably onto the rocks of the Bowen Basin, the flat-lying or gently dipping beds of the Surat Basin are mainly of Jurassic and Cretaceous age. Lastly, Tertiary sediments and volcanics, and younger surficial deposits, mask the older rocks in many areas. The stratigraphic succession is summarized in Table 10.

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TABLE 10

STRATIGRAPHIC SUCCESSION IN THE DAWSON–FITZROY AREA

Age	Rock Unit	Lithology	Thickness (ft)	Structure
Tertiary	Duaringa Formation and equivalents	Sandstone, siltstone, claystone, and conglomerate. Some interbedded basalt flows	200–400 (locally more)	Gentle depositional dips
	Volcanics	Mainly basalt	100–?300	Flows and minor plugs
		Unconformity		
Cretaceous	Volcanics	Mainly trachyte and basalt	Unknown	Flows
	Blythesdale Formation	Sandstone and shale with minor coal seams	1000+	Gentle dips, mainly depositional
		Unconformity		
Middle Jurassic	Injune Creek Beds	Shale and lithic sandstone with thin coal seams	1000+	Horizontal or very gentle dips
————	Hutton Sandstone	Coarse-grained to conglomeratic sandstone with some shale	400–1000	Horizontal or very gentle dips
Lower Jurassic	Evergreen Formation	Shale, siltstone, and micaceous sandstone	200–500	Horizontal or very gentle dips
	Boxvale Sandstone Member	Quartz sandstone and micaceous quartz sandstone	+100	Horizontal or very gentle dips
	Precipice Sandstone	Quartz sandstone with some feldspathic sandstone and conglomerate	200–500	Horizontal or very gentle dips
		Unconformity		
Middle to Upper Triassic	Moolayember Formation	Shale, siltstone, greywacke, and conglomerate	5500+	Mainly gentle to moderate dips with shallow folds
	Clematis Sandstone	Mainly quartz sandstone with some siltstone	Up to 1000	Mainly gentle to moderate dips with shallow folds; locally steep dips associated with narrow fault zones
		Disconformity		
Lower Triassic	Rewan Formation	Shale, mudstone, siltstone, and lithic sandstone.	About 1500	Mainly moderate dips with shallow folds, locally tightly folded and faulted

TABLE 10 (*Continued*)

Age	Rock Unit	Lithology	Thickness (ft)	Structure
Carboniferous to Triassic	Auburn Complex	Mainly granite and granodiorite	Unknown	Intrusive
Upper Permian	Upper Bowen Coal Measures	Siltstone, sandstone, shale, and coal, with limestone lenses locally	Up to about 5000	Shallow folds in west, tightly folded in east and north
	Unit C, Middle Bowen Beds	Mainly quartz sandstone and micaceous siltstone in west; lithic sandstone, limestone, and calcilutite in east	Up to about 5000	Shallow folds in west, tightly folded in east and north
Lower Permian	Unit B, Middle Bowen Beds	Mainly lithic quartz sandstone and siltstone in north; not present in east	Up to about 1500	Mainly moderately to tightly folded
	Disconformity			
	Unit A, Middle Bowen Beds	Shelly limestone	?About 600	Mainly moderately to tightly folded
Lower Permian to Upper Carboniferous	Lower Bowen Volcanics and equivalents	Mainly andesitic volcanics with agglomerate, siltstone, tuffaceous sandstone, tuff, and limestone; also trachytic, dacitic, and basaltic flows and pyroclasts	10,000–?20,000	Mainly shallowly to moderately folded
	Dinner Creek Beds	Conglomerate, sandstone, siltstone, chert, and claystone, with andesitic sills locally	4000	Steeply dipping
Middle Carboniferous	Neerkol Formation	Shale, siltstone, quartz greywacke, and claystone, with a basal conglomerate (Turner Creek Conglomerate)	About 2000	Moderately to tightly folded
Disconformity				
Lower Carboniferous	Neils Creek Clastics	Subgreywacke, greywacke, chert, and limestone	2000	Moderately to tightly folded
	Pond Argillite	Feldspathic siltstone and quartzose argillites	1000+	Moderately to tightly folded
Upper Devonian	Boulder Creek Grit	Andesitic tuff and tuffaceous claystone	1000	Moderately to tightly folded
	Thomson Clastics	Mainly tuff and shale	500	Moderately to tightly folded

TABLE 10 (*Continued*)

Age	Rock Unit	Lithology	Thickness (ft)	Structure
Middle Devonian	Dee Volcanics	Mainly andesitic tuff, agglomerate, and lavas, with some limestone	About 2500	Moderately to tightly folded
		Unconformity		
Silurian to Devonian		Fossiliferous limestone, marble, phyllite, tuffaceous sandstone, and agglomerate	Unknown	Unknown
Lower Palaeozoic?	Ultrabasics of Marlborough Block	Mainly serpentinite	Unknown	Intrusive
	Metamorphics of Marlborough Block	Mainly schist and quartzite	Unknown	Mainly steeply dipping

II. Geological History

The evolution of the area begins in lower Palaeozoic and possibly Precambrian times, with the deposition along its north-eastern border of interbedded sediments and volcanics in the Marlborough Block and adjoining parts of the South Coastal High. Probably no later than the Middle Devonian, these rocks were regionally metamorphosed—to form mainly schist and quartzite—by a complex of ultrabasic intrusives. Subsequently, both metamorphics and ultrabasics were folded and intruded by basic to acid rocks including gabbro, granite, and diorite, the youngest of which are probably post-Permian.

On the margins of the Marlborough Block, to the south-west, deposition continued in Silurian to Devonian times when limestone was laid down in a shallow marine environment of unknown extent. Limestone and other sediments also accumulated to the south-east of the Marlborough Block, probably in the Lower to Middle Devonian, together with interbedded rhyolitic and andesitic volcanics.

After its emergence from the Lower Palaeozoic seas, the South Coastal High appears to have begun to collapse along its axial region so that the Yarrol Basin formed. The sea then invaded this trough in Middle Devonian times and deposition took place through to the Middle Carboniferous, vigorously until the Upper Devonian but more slowly afterwards. Initially deposition was accompanied by intensive volcanic activity during which the Dee Volcanics—including andesitic tuff, agglomerate, and lava, with limestone lenses—were laid down to a thickness of about 2500 ft. Less intensive vulcanicity continued during the Upper Devonian when tuff interbedded with shale or mudstone accumulated. Then followed the deposition of several thousand feet of Lower and Middle Carboniferous sediments—dominantly siltstone overlain by alternating greywacke, chert, and limestone, and succeeded mainly by shale in the central and eastern parts of the Basin but including coarser deposits in the west.

Marine regression then occurred in the Upper Carboniferous, and the final phase in the Yarrol Basin sedimentary sequence was one of continental deposition during which conglomerate, sandstone, and shale were laid down. Terrestrial conditions persisted into the Lower Permian when deposition finally ceased.

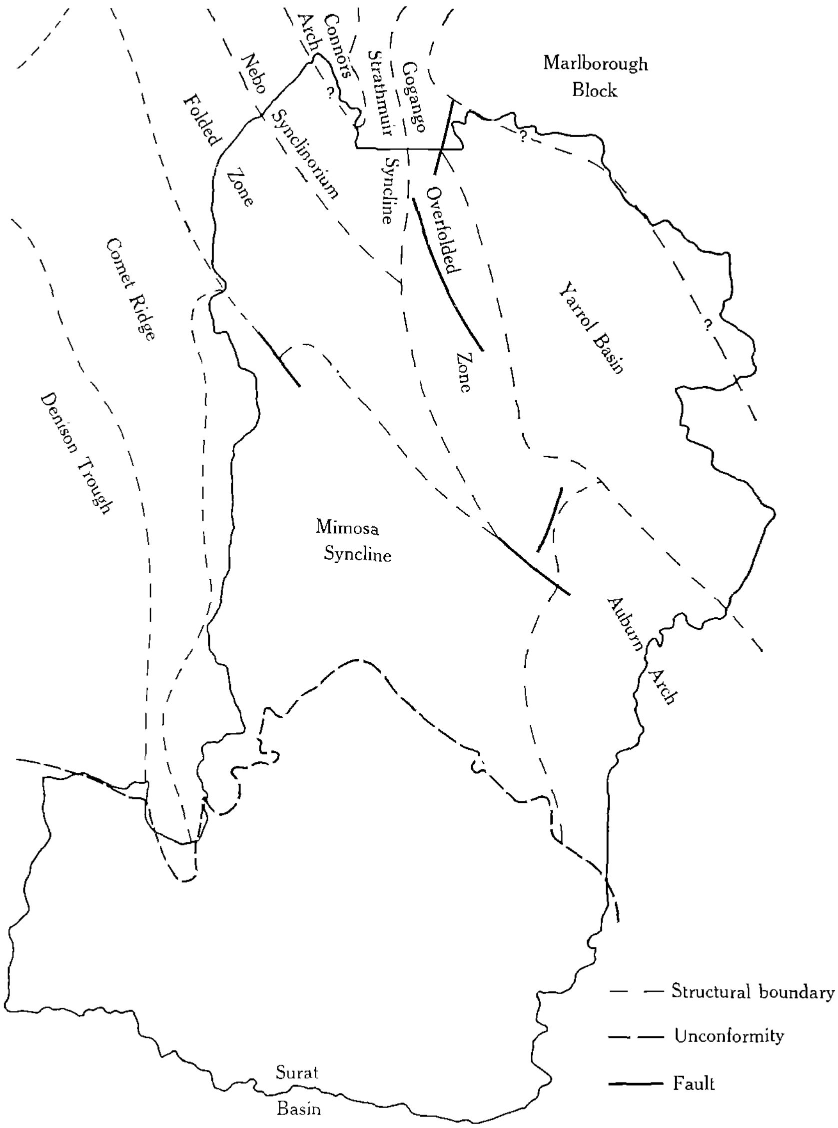

Fig. 8.—Structural elements of the Dawson–Fitzroy area and its borders (mainly after Malone 1964).

The period of final deposition in the Yarrol Basin also marked the beginning of a most important episode in the evolution of the remainder of the area—the development of the Bowen Basin. Initially, deposition in the Bowen Basin took place in an elongate trough on the eastern margin—upon which the Connors Arch and the Auburn Arch are now superimposed—and in a smaller depression in the south-west, the earliest expression of the Denison Trough. Separating the two downwarps was the Comet Ridge, a zone of only thin sedimentation through to the Triassic. The eastern trough received the Lower Bowen Volcanics and equivalents—12,000 ft or more of dominantly andesitic volcanics and sediments derived from volcanics, together with some spilitic lavas—which transgressed the Carboniferous rocks of the Yarrol Basin in the area of the Gogango Overfolded Zone. In contrast, a mainly freshwater sequence accumulated in the smaller downwarp.

A general subsidence of most of the basin occurred later in the Lower Permian, accompanied by a change from non-marine sedimentation to the deposition of the marine Middle Bowen Beds. Unit A at the base of the marine sequence was laid down extensively, but with particular concentrations in the Denison Trough, which continued to subside, and also in the Nebo Synclinorium along the western margin of the Lower Bowen Volcanics downwarp. Subsequently, deposition of Unit B was more restricted, apparently being mainly confined to these two troughs. Finally, general subsidence in the Upper Permian was accompanied by widespread deposition of Unit C, the youngest beds of this marine sequence, again with particularly thick sedimentation in the Nebo Synclinorium. Later in the Upper Permian, and possibly associated with uplift along the axis of the Lower Bowen Volcanics trough, there was a gradual reversal to dominantly freshwater deposition and the Upper Bowen Coal Measures were laid down. At this time, part at least of the Gogango Overfolded Zone probably formed a barrier between the Yarrol Basin and the Bowen Basin.

Much of the area was subject to erosion during the Triassic but terrestrial deposition continued, particularly in the Mimosa Syncline where more than 10,000 ft of sediments accumulated. Here the shale of the Rewan Formation, with thin beds of sandstone and siltstone, was laid down during the Lower Triassic, followed in the Middle to Upper Triassic by the deposition first of the Clematis Sandstone and then of the thick, shaly Moolayember Formation. Deposition also took place further east, along the western margins of the Yarrol Basin, where beds mainly of sandstone—but including the thin coal seams of the Callide area—were laid down.

The main orogenic phase of the Bowen Basin may have commenced after or towards the end of the deposition of the Moolayember Formation. It was most marked in the east where Yarrol Basin and Bowen Basin rocks were folded, faulted, and intruded. Broad folds trending north–south developed in the Yarrol Basin, including the Craigilee Anticline with steeply inclined flanks locally overturned on the west. Tight folding aligned north-north-west, parallel to the major trends of the Bowen Basin, occurred in the Gogango Overfolded Zone and adjacent parts of the Strathmuir Syncline, with steep easterly dips reflecting overturning of the western limbs. However, within this eastern area of severe compression, folding was characteristically broader in the Lower Bowen Volcanics than in the overlying, less competent Middle Bowen Beds.

By comparison, rocks to the west were protected from intense deformation by the competent blocks of the Connors Arch and Auburn Arch, which began to rise in Upper Permian times. Thus, gentle to only moderate folding occurred in the eastern parts of the Nebo Synclinorium, with tighter folding further west in a zone transitional to the gentle structures of the Comet Ridge and the Mimosa Syncline (possibly separated from the contorted rocks to the north-east by an eastward-dipping thrust zone, the northern continuation of a major fault near Banana).

Igneous activity accompanied the movements—first with the intrusion of basaltic and andesitic material, and subsequently with the intrusion mainly of granite and diorite associated with extensive faulting, commonly aligned north-north-west and north-east. At this time the granite of the Auburn Arch was emplaced, and the Mount Morgan granite intruded the axial region of a low anticlinal structure.

Following the orogenic phase, extensive erosion occurred throughout the Jurassic except in the Surat Basin to the south where deposition was renewed, mainly in a shallow non-marine environment but with minor marine incursions. Overlapping unconformably onto the Triassic and Permian rocks, first the Precipice Sandstone was laid down, followed by the siltstone and shale of the Evergreen Formation and including the Boxvale Sandstone Member. Then the more lithic Hutton Sandstone was deposited, and lastly the Injune Creek Beds—over 1000 ft of shale and lithic sandstone with thin coal seams.

Erosion continued throughout most of the area in the Cretaceous, but freshwater sedimentation persisted in the Surat Basin, and the sandstone, shale, and thin coal seams forming much of the Blythesdale Formation were laid down there. However, the sea gradually flooded the basin later in the Lower Cretaceous and the topmost beds of Blythesdale Formation were marine-deposited. Subsequently, more than 2000 ft of marine claystone with interbeds of sandstone and sandy shale accumulated, mainly to the south of the area. In addition, marine sandstones of unknown extent were laid down to the north in the Yarrol Basin where some trachyte and basalt also may have been extruded at this time.

Following regression later in the Cretaceous, erosion was characteristic throughout the area, but associated terrestrial deposits gradually spread over the lowlands during the Tertiary. In and to the south, fluvial and lacustrine sandstone, shale, and claystone extensively buried truncated Cretaceous beds. In the east, clay shale with interbedded sandstone choked the broad valley of Callide Creek. Over much of the west and north, sandstone, conglomerate, and claystone were laid down as fans and lake deposits masking bevelled Permian rocks between the main ranges. Little is known of the actual thickness of these sediments in most parts, but they attain between 200 and 600 ft in the north-west. Interbedded with them, or transgressing older rocks, basalt flows formed valley fills or more continuous sheets of variable thickness but generally less than 100 ft. These were particularly widespread in the east near Biloela, in the north near Rockhampton, in the Mimosa Syncline and extending south into the margins of the Surat Basin, and also in the extreme south-west near Injune.

III. General Distribution

The distribution of the main rock types is shown in Figure 9 in which, where possible, the strata of each geological period are broadly subdivided according to dominant lithology. The oldest rocks that crop out in the area, however, cannot be represented at the scale of this map. These are Silurian–Devonian limestone, siltstone, phyllite, and volcanics exposed in the north in only two very restricted localities. The oldest rocks mapped in Figure 9 are those of the Devonian–Carboniferous Yarrol Basin sequence forming a belt of irregular width extending north-west to south-east

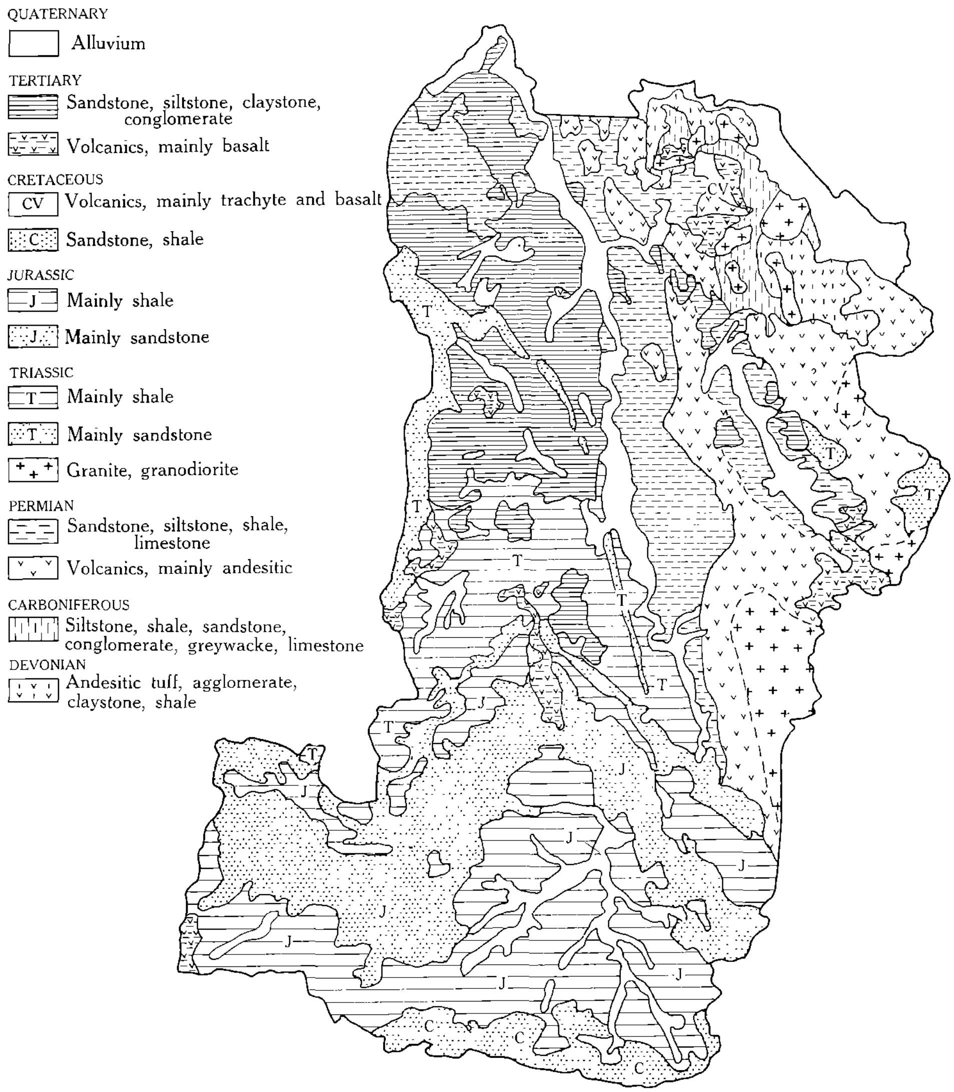

Fig. 9.—Generalized geology.

along the north-eastern margin of the area. Devonian volcanics interbedded with shale or mudstone crop out at the extremities of this belt—in and around the Dee Range in the south, and north-west of Rockhampton in the north—with mainly argillaceous Carboniferous rocks in the central parts and along the south-western border. Outcrops of Triassic granite and granodiorite intrusions have a scattered distribution within this belt, being particularly extensive in the south. In addition, there are three large occurrences of these intrusive rocks further south along the eastern boundary of the area—in the Mount Alma and Calliope Ranges, the Dawes Range, and the Auburn Range.

The Permian rocks of the Bowen Basin crop out extensively between the Devonian–Carboniferous belt and the alluvium of the Dawson River to the west, and also across the river in the north-west. Lower Bowen Volcanics and equivalents are widespread in the eastern parts of this area, with Middle and Upper Bowen sedimentary rocks mainly exposed in the west but also underlying much of the Callide valley in the east. Numerous remnants of Tertiary deposits and basalt mask the Permian strata, particularly along and north-west of the Callide valley. But the main mass of these younger rocks lies further west where they transgress and extensively conceal both the Permian rocks in the north-west and the Triassic beds of the Mimosa Syncline to the south. However, forming an upstanding rim to the syncline, the Clematis Sandstone rises from the Tertiary mantle in the Expedition Range on the west and the Dawson Range on the east. These ranges extend south beyond the main area of Tertiary rocks where the shales of the Moolayember and Rewan Formations are exposed in the centre of the syncline and on the eastern margin respectively.

Further south the Triassic rocks are overlapped by the Jurassic succession which, except for Cretaceous beds in the extreme south and local remnants of Tertiary basalt, underlies the remainder of the area. Within this large tract of Jurassic rocks dipping gently southwards, the older, predominantly sandstone beds form a northern selvage—in which the Evergreen Formation crops out in a discontinuous strike belt of irregular width—with the overlying shaly Injune Creek Beds occurring extensively in the south.

The main areas of Quaternary alluvium, considered in more detail below, are along the Dawson River and its larger southern tributaries, in the west along Mimosa Creek and the upper parts of Zamia Creek, in the east in the Callide valley, and flanking the Mackenzie and Fitzroy Rivers in the north.

IV. Geology and Land Systems

In Table 11 the land systems are classified into seven groups on the basis of dominant surface materials, in order to illustrate a major aspect of the relationships between land systems and geology.

Underlying structure and lithology find their maximum surface expression in those erosional land systems where relatively unweathered rock occurs at or near the surface. Twenty-one land systems, forming one-third of the survey area, are of this type. In a further 12 land systems, forming two groups that constitute 19% of the area, original parent materials are partially concealed by mainly deep *in situ* soils, or weathered rock, or both. In the remaining 30 land systems, covering just under half of the total area and classified into four groups, the nature and conformation of underlying rocks are masked by surficial deposits or, in five land systems, by the products of deep lateritic weathering.

The group of land systems underlain by relatively unweathered rock is subdivided according to lithology and, though each subgroup has certain distinctive features overall, there are no simple correlations between land systems and parent materials. In general, geological characteristics are of particular importance in determining landscape features on two contrasted scales—on the broad scale and in

TABLE 11

GEOLOGY AND LAND SYSTEMS

Dominant Surface Materials and Percentage of Total Area	Geological Parent Materials	Land Systems
Relatively unweathered rock at or near the surface (33%)	Dipping Upper Palaeozoic volcanics	Barfield, Gelobera, Hillmore, Ohio, Orana, Toonda, Torsdale
	Dipping Upper Palaeozoic sedimentary rocks	Bannockburn, Boomer, Malakoff, Mourangie, Rosewood
	?Triassic granite and granodiorite intrusions with Upper Palaeozoic volcanics	Bouldercombe, Irving
	Flat-lying to gently dipping Mesozoic sedimentary rocks	Doonkuna, Carborough, Nathan, Surprise, Womblebank
	Tertiary basalt flows	Grevillea, Westwood
Coarser-textured soils and/or weathered rock (4%)	Mainly flat-lying to gently dipping Mesozoic sandstone	Conloi, Doughboy, Glenhaughton, Yebna
Finer-textured soils and/or weathered rock (15%)	Mainly flat-lying to gently dipping Mesozoic shale, or Tertiary basalt, or dipping Upper Palaeozoic sedimentary rocks	Banana, Barwon, Eurombah, Lawgi, Mundell, Narran, Oakleigh, Redrange
Deeply weathered rock at or near the surface (4%)	Flat-lying to gently dipping sedimentary rocks of Tertiary or Mesozoic age, or Tertiary basalt, or ?Triassic igneous intrusions	Auburn, Duaringa, Kaiuroo, Narowie, Range
Coarser-textured colluvium–alluvium (7%)	Mainly deeply weathered Tertiary, and locally Mesozoic, sedimentary rocks	Melbadale, Perch, Redcliffe, Wooroonah
Finer-textured colluvium–alluvium (22%)	Mesozoic shale, or Upper Palaeozoic sedimentary rocks, or Tertiary basalt	Dakenba, Highworth, Hinchley, Kariboe, Kiddell, Ramsay, Thomby, Wandoan
Alluvium (15%)	Mainly deeply weathered Tertiary sedimentary rocks	Dingo, Mimosa
	Mesozoic interbedded sandstone and shale	Montana, Palmtree, Woleebee
	Upper Palaeozoic volcanic and sedimentary rocks, and Mesozoic shale	Carpentaria, Coolibah, Coreen Gavial, Juandah, Kroombit, Langmorn, Raglan

detail—with factors of geomorphological history of comparable or greater importance at intermediate levels, including that of the land system as mapped in this survey. Thus, there is a broad-scale contrast between the dominantly tableland forms developed on subhorizontal Mesozoic beds in the south of the area, the strongly accidented hill and plain lands underlain by structurally complex and lithologically varied Palaeozoic sedimentary rocks in the north, and the comparatively unbroken eastern mountain and hill ranges on Palaeozoic volcanics. Within these broad tracts of country, however, at the land system level there occur important differences in terrain, often on closely similar lithologies, which mainly reflect differences of geomorphological evolution. For example, main divides may differ markedly in terms of form, amount of relief, soils, and other important characteristics, from areas where erosion has proceeded further flanking major drainage lines. Hence, within the area of Mesozoic rocks, the widespread tableland surfaces such as Nathan land system are mapped from more dissected terrain, including the hill lands of Carborough land system—on identical rocks to Nathan land system in many areas. Similarly, in the belt of Palaeozoic volcanic rocks, the extensive mountain and hill ranges of, for example, Hillmore land system are mapped from the more restricted but very distinctive undulating terrain of Ohio land system and the plains of Barfield land system, though all three of these strikingly different land systems are underlain by the same complex of volcanic rocks—again reflecting the importance of generic differences. Moreover, not only do land systems formed on similar rocks commonly differ markedly in this way but, conversely, each may have close similarities of land forms, major soil types, and dominant vegetation with land systems on different rocks but sharing a common geomorphological history. For this reason, as described in Part VI, the land systems are most meaningfully classified on a geomorphological basis. Nevertheless, on a more detailed scale within any group of land systems classified in this way on the basis of similar overall characteristics, geological differences, particularly of detailed lithology, are most important in producing many of the distinguishing features of individual land systems. Thus, Nathan and Doonkuna land systems, both of the same tablelands class and both underlain by interbedded sandstone and shale, have differences mainly expressive of differences in the relative proportions of these rock types. Such lithological contrasts may be more pronounced, as, for example, between Hillmore and Boomer land systems—both members of the same group of mountain and hill lands dominated by steep, outcrop slopes and patches of shallow soils, but differing in detail primarily because one is underlain mainly by Palaeozoic volcanics and the other by Palaeozoic sedimentary rocks.

In the 12 land systems characterized by extensive *in situ* soils and associated mantles of weathered rock, geological influences are consistently reflected in surface features only in terms of the resultant weathering products (and these commonly subdue or even mask some lithological differences) rather than, say, in land forms. Thus, for example, although the flat-lying Mesozoic beds build tablelands in Mundel and Marran land systems, in many areas these same rocks underlie the undulating plains land systems of Eurombah and Redrange; nevertheless, all four land systems are characterized by similar weathering products. In this regard, two groups of land systems of this category are shown in Table 11—those with coarser-textured soils derived mainly from weathered Mesozoic sandstones and those dominated by finer-textured soils on weathered argillaceous rocks of Palaeozoic or Mesozoic age. Beyond this, as described in Part VI, major differences between land systems are again due to contrasts in geomorphological history, though, as stressed previously, the distinctive features of land systems of common origin are generally expressive of differences in detailed lithology. For example, Barwon land system is largely distinguished from other members of the same class of undulating plains by the narrowly belted pattern of its component land units, reflecting the control of underlying, dipping, thinly bedded strata.

Mantles of deeply weathered rock mask structure and lithology almost completely in five land systems covering 4% of the total area. The resultant pronounced general similarity of these land systems reflects a unity of geomorphological history, but the distinguishing features of each of them are partly expressive of geological differences. Thus, dipping beds of Clematis Sandstone build prominent ridges that distinguish Range from Duaringa land system; and Auburn and Narowie land systems are partly differentiated from each other, and from the other two, by erosional lower slopes in contrasted, relatively fresh rocks—granitic in Auburn land system and volcanic in Narowie.

Because of widespread surficial deposits, bed-rock lithology has exercised only broad control in the 25 land systems that make up the remaining 44% of the area. In 12 of these land systems the deposits are locally derived colluvium–alluvium in which there is a general contrast between coarser-textured detritus mainly eroded from deeply weathered Tertiary beds and finer-textured materials principally derived from Mesozoic and Palaeozoic shaly rocks. Similarly, though differences between the 13 alluvial land systems are mainly attributable to differences in geomorphological processes both in the past and at present, they are also a function of source materials. In this context there are major contrasts between the varied but predominantly medium- to coarse-textured prior-weathered alluvia of Dingo and Mimosa land systems, the complex of fine and coarse deposits of Montana, Palmtree, and Woleebee land systems, furnished by Mesozoic interbedded sandstone and shale, and the typical silt and clay deposits of the main fluvial plains, chiefly derived from the Palaeozoic and finer-grained Mesozoic rocks.

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PART VI. GEOMORPHOLOGY OF THE DAWSON–FITZROY AREA

By R. L. WRIGHT*

I. INTRODUCTION

The catchment of the northward-flowing Dawson River constitutes the greater part of the survey area, and its watershed forms the eastern, southern, and western boundaries in most parts. However, in the north where the Dawson and Mackenzie Rivers unite to form the Fitzroy River which winds eastwards to the sea, the area includes tracts drained by the other two rivers, and their flood-plains form the northern border throughout much of its length.

Viewed broadly, the area comprises extensive plains traversed by the Dawson River and its main tributaries, with tablelands on flat-lying Mesozoic sandstones rising above them in the south and with mountain ranges on deformed older rocks in the east and north. However, though the plain lands in particular appear deceptively simple, they, as well as the more obviously diverse landscapes of greater relief, comprise an intricate mosaic of erosional and depositional sites of widely different ages and attributes, expressive of the long and complex geomorphological history that has shaped them from the varied rocks described in Part V. The land systems are the constituent site assemblages within this mosaic, each comprising recurring groups of sites bound together by common history and parent material, and consequently having a limited range of characteristics.

This Part aims to provide an understanding of the geomorphology of the land systems. It begins with a description of the larger regions of which the area is composed followed by an outline geomorphological history, thus providing a framework for the description and classification of the land systems in the concluding section.

II. GEOMORPHOLOGICAL REGIONS

The area takes in part of two of the major physiographic divisions of the continent—the Eastern Highlands and the Great Artesian Basin. These are made up of provinces with a unity of major relief based on a unity of geological structure. In turn, the provinces are built of smaller regions which, although formed in a diversity of rock types, have a unity of relief mainly expressive of a unity of geomorphological history (Fig. 10).

(a) *Eastern Highlands*

This division comprises the complex structures of the Tasman Geosynclinal Zone, etched by deeply entrenched rivers into mountain and hill ranges, typically at

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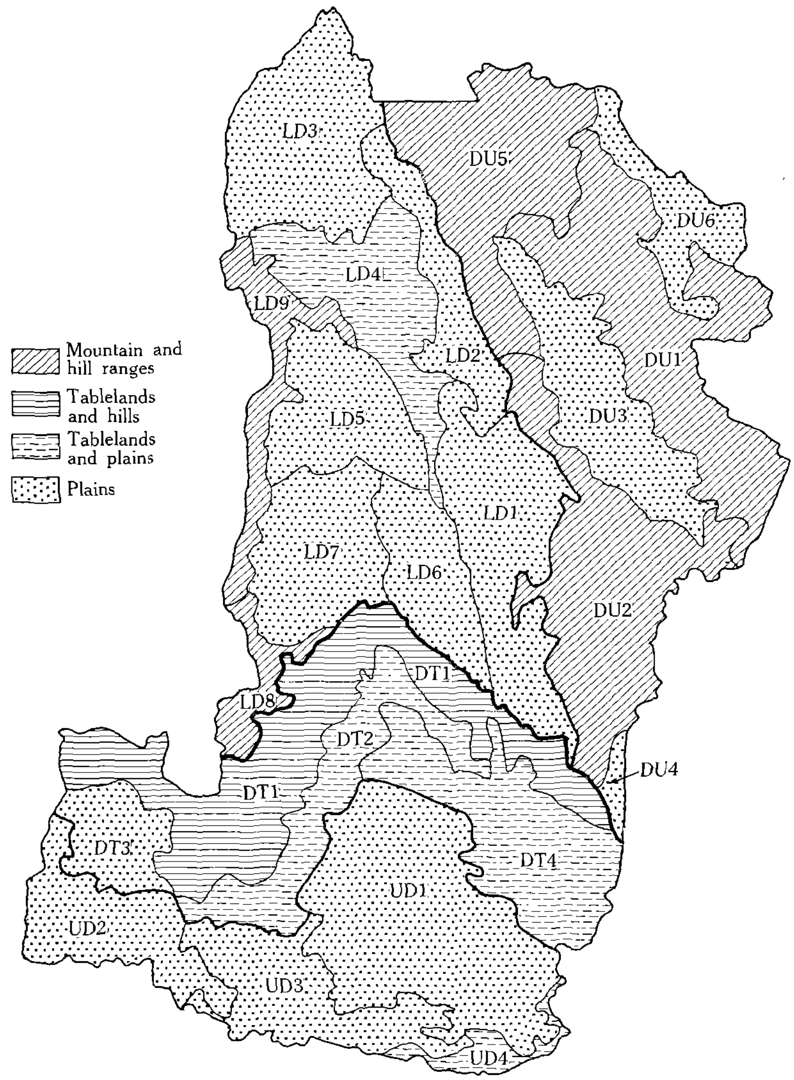

Fig. 10.—Geomorphological regions.

Eastern Highlands

UD Dawson uplands province
1 Eastern ranges
2 Southern ranges
3 Callide plains
4 Auburn upland plains
5 Northern ranges
6 Rockhampton plains

LD Lower Dawson plains province
1 Southern river plains
2 Northern river plains
3 North-western plains
4 Duaringa plains & tablelands
5 Mimosa plains
6 Roundstone plains
7 Zamia plains
8 Southern hill lands
9 Western ranges

Great Artesian Basin

DT Dawson tablelands province
1 Northern tablelands & hills
2 Southern tablelands & plains
3 Western upland plains
4 Eastern tablelands & plains

UD Upper Dawson plains province
1 Taroom plains
2 Injune plains
3 Southern plains
4 Southern plains & tablelands

an elevation of 1000–2500 ft in this part of Queensland, and with broad valley plains flanking the main drainage lines at a much lower level. Two of its component provinces lie within the area.

(i) *Dawson Uplands Province*.—This province is underlain by the comparatively strongly folded and faulted Palaeozoic strata of the Yarrol Basin and the adjoining eastern parts of the Bowen Basin, consisting chiefly of andesitic volcanics and varied sedimentary rocks of andesitic provenance, with granitic intrusions in the east and south. It includes large areas standing well above 1000 ft where numerous major streams rise, flowing west across the province to join the Dawson River beyond its western boundary.

Within the survey area this province contains six regions, with mountain and hill ranges dominant in the three largest—the eastern ranges, the southern ranges, and the northern ranges—forming main divides between drainage west to the Dawson River, north to the Fitzroy, and east to the sea. Culminating altitudes are 2000–2700 ft in the eastern ranges, but generally 500–1000 ft lower in the other two mountainous regions, with main valleys narrowly entrenched to depths of up to 500 ft and characteristically with steep rocky slopes. These three regions differ considerably, however, in detail. The eastern ranges are composed almost entirely of mountains and hills, forming the most rugged terrain in the survey area. But though similar terrain constitutes the backbone of the southern ranges, undulating plains and hill lands occur on the flanks with local relief of no more than 100–300 ft in many parts. Similarly, downslope from the main divides in the more complex northern ranges region, stony or soil-covered foothills merge into lower colluvial–alluvial plains, which in turn grade into the alluvial plains of the Fitzroy River at about 100 ft above sea level in the north.

The remaining, less extensive, three regions of the Dawson uplands province consist of plain lands, each of markedly different character. The Callide plains region, lying between the eastern and southern ranges and more than 1000 ft below their crests, is a broad valley plain with local relief of less than 50 ft in most parts and drained throughout much of its length by Callide Creek and its tributary Grevillea Creek. Alluvial deposits are widespread in lower sectors, with colluvial mantles or residual soils on intervening low secondary divides. In contrast, the Auburn upland plains region to the south comprises gently rolling lateritic plains more than 1200 ft above sea level and forming the southern part of the main eastern divide. Finally, the Rockhampton plains region is the coastal tract at the foot of the eastern ranges, mainly consisting of the near-flat terminal flood-plains of the Fitzroy River and contiguous littoral plains bordering its estuary.

(ii) *Lower Dawson Plains Province*.—This province, to the west of the structurally complex Dawson uplands, is underlain by the less deformed strata of the central and southern parts of the Bowen Basin. These are mainly moderately folded Permian siltstone and sandstone in the north and east, with the gentle structures of the Mimosa Syncline in Triassic sandstone and shale to the south and west; both sets are masked by deeply weathered Tertiary deposits in the central parts. In contrast with the Dawson uplands, this province is dominated by gently undulating plains, mainly considerably less than 1000 ft above sea level and with a sparse drainage pattern providing few large tributaries to the Dawson River which flows along its eastern margin. It comprises nine regions within the survey area.

Flanking the Dawson River along the eastern border are the narrowly elongated southern river plains and northern river plains regions, the former declining down-valley from about 600 ft in the south to roughly 300 ft above sea level in the north, and the latter mainly below 300 ft. Both regions are characterized by gently sloping plains of fine-textured surficial deposits or residual soils, with central flood-plains of irregular width. However, slightly higher erosional terrain forms secondary divides in the southern river plains but does not occur in the northern region, which is further distinguished by minor occurrences of low lateritic tablelands.

Broadly similar soil-covered plains also dominate three other regions in this province, but at different elevations, in association with different types of terrain and in contrasting settings. The first of these, the north-western plains region, is probably mainly between 300 and 400 ft above sea level with distinctive stripped plains and moderately extensive, slightly higher lateritic tablelands in the central parts. It forms part of a broader lowland extending west into the Mackenzie catchment and north into the catchment of the Isaac River. Secondly, the Roundstone plains region is at an altitude mainly between 500 and 600 ft within the Mimosa Syncline to the south. It includes the narrow Dawson range along the eastern border together with scattered low lateritic tablelands. Thirdly, and also in the Mimosa Syncline but overlooked by neighbouring uplands that feed a comparatively dense drainage system, the Zamia plains rise up-valley along Zamia Creek and its tributaries from about 600 ft in the north-east to about 1000 ft in marginal foothills in the south and west. The region includes in the lower sectors valley plains similar to the Roundstone plains, but is distinguished from this latter region by broadly rounded secondary divides with soils of shallow or only moderate depth, and in upper sectors by complex undulating terrain including both eroding and depositing streams.

The central parts of the lower Dawson plains province comprise two regions of quite different character from those on all sides, the Duaringa plains and tablelands, and the Mimosa plains. The former chiefly consist of sandy to loamy undulating plains downslope from lateritic tablelands, but include part of the Dawson range rising to more than 1000 ft above sea level. The plains stand at about 800–900 ft in the extreme west, gradually declining eastwards to below 300 ft, the associated and slightly higher tablelands being particularly extensive in the east and south and typically dissected to depths of up to 100 ft. The adjoining Mimosa plains are dominated by similar undulating plains, at comparable elevations, but without lateritic tablelands and with distinctive colluvial–alluvial plains along main drainage lines, spreading out in lower sectors in the south-east.

Finally, forming an upstanding border to this province are two regions of mountains and hills, the southern hill lands and the western ranges. The first of these largely consists of closely spaced rocky hills with local relief of 200–500 ft, though undulating plains with restricted alluvial plains occur in lower sectors. Higher summits are over 2000 ft above sea level but typical elevations probably range several hundred feet lower. To the north the more extensive and less broken western ranges form most of the sandstone rim of the Mimosa Syncline, overlooking the Mimosa, Zamia, and Roundstone plains in the central parts. They comprise deeply dissected mountain and hill ranges with restricted high tablelands, and constitute the main divide between Dawson drainage and that which flows west to the Comet River. Summits are typically at an elevation of 1500–2000 ft, locally attaining 2000–2500 ft especially in the extreme north. Steep rocky slopes are characteristic and include delimiting escarpments about 1000 ft high in places, particularly on the western flank.

(*b*) *Great Artesian Basin*

In the south the Dawson catchment extends into the margins of the Great Artesian Basin, a relatively stable sedimentary structure of vast dimensions, mainly of gently dipping Mesozoic rocks and comprising a number of large sub-basins—of which the Surat Basin underlies this part of Queensland. The basin is characterized by comparatively unbroken plains with scattered low tablelands, mostly less than 1000 ft above sea level and with extensive tracts below 500 ft. However, elevations are mainly above 1000 ft along the eastern margin, including that part of the Surat Basin within the survey area. Two provinces are mapped in Figure 10.

(i) *Dawson Tablelands Province*.—This includes the highest and most dissected terrain, almost entirely between 1000 and 2000 ft and locally higher along the northern margin. It consists chiefly of tablelands on flat-lying to gently dipping Lower Jurassic sandstone with some shale. The Dawson River and most of its larger southern tributaries rise here, flowing in deep trenches eastwards or south-eastwards before turning north into the lower Dawson plains.

The province contains four regions, the largest being the broad and distinctively rugged northern tablelands and hills. Here a dense drainage network is narrowly entrenched to depths of up to 500 ft, with shallow soils typical on tableland crests and in valley floors and with much rock outcrop on the steep linking slopes. Summit altitudes are 2000 ft or more in the west and north of this region, declining gradually by about 300–500 ft in the south and east. To the south in the adjoining southern tablelands and plains region, the tablelands are lower, less deeply dissected, and occur in association with sandy to loamy upland plains, probably mainly at an altitude of 1400–1500 ft. Similar plains at about the same elevation dominate the relatively small western upland plains region.

Terrain is more varied, however, in the lowest parts of this province in the eastern tablelands and plains. This region consists of broad soil-covered tablelands, or undulating and locally hilly interfluves, at an elevation of about 1000 ft or slightly less and rising 100–200 ft above the margins of gently rolling plains. The plains carry deep mantles of fine-textured colluvium in upper sectors but grade into distinctive valley tracts with a complex of erosional and depositional slopes. In addition, restricted sandstone or lateritic tablelands occur in western, higher sectors.

(ii) *Upper Dawson Plains Province*.—At the head of the Dawson catchment but overlooked by the Dawson tablelands to the north, this province largely consists of plains of fine-textured surficial deposits and residual soils derived from underlying Middle Jurassic shales. Compared with the lower Dawson plains it has a denser drainage network, with the Dawson River as its trunk, but with a few exceptions the larger streams are fed by headwaters in the adjoining tablelands. Of the four regions described here, one, the southern plains and tablelands, represents a small inclusion of another province in the extreme south-east. However, it is described with the upper Dawson plains because of insufficient information concerning terrain to the south.

Only the margins of the southern plains and tablelands region extend into the survey area, where it consists of gently sloping, deeply weathered sandy crests, probably at an altitude of 1300–1400 ft, partially dissected into restricted tablelands with local relief up to about 100 ft and with minor sandy valley plains. Downslope and extending northwards, the Taroom plains form the most low-lying, largest, but least diverse region in this province, mainly comprising colluvial–alluvial plains with local relief of less than 50 ft and declining down-valley from about 900–1000 ft to roughly 700 ft above sea level in the north. The Injune plains in the west of the province, however, are considerably more diverse though much less extensive. Probably mainly between 1200 and 1400 ft above sea level, they include colluvial–alluvial plains typical of the Taroom region, but with a fragmented distribution, complex undulating terrain with closely interspersed erosional and depositional sites along main drainage lines, and upstanding hill ranges on the western border. Lying between the Taroom and Injune regions, the remainder of this province, the southern plains, largely consists of slightly higher erosional plains with local relief of up to 100 ft, including scattered hills, but with mainly gentle soil-covered slopes.

III. History of the Physical Landscape

The record provided by the stratigraphical succession described in Part V is terminated by the Triassic orogeny in much of the area; evidence of subsequent events is largely geomorphological. The first major episode for which there is abundant testimony is the development of a Tertiary, deeply weathered surface—a composite feature of planation and deposition. The former extent of this surface, the long interval of time that its development encompasses, and its significance in influencing later achievements of landscape formation, make it convenient to subdivide the geomorphological history outlined below into three main periods: Mesozoic denudation, the formation of the Tertiary weathered surface, and subsequent evolutionary stages. Each of these periods is clearly expressed in the present landscape.

(a) *Mesozoic Denudation*

During Jurassic and much of Cretaceous times, the folded and uplifted structures of the Bowen and Yarrol Basins in the centre and north of the area were planed down. Contemporaneously, deposition occurred in the Surat Basin to the south—mainly of freshwater sediments, but in a marine environment for much of the Lower Cretaceous. Following gradual regression the newly emerged Cretaceous sea floor was also denuded, but only shallowly because of low erosive potential on this comparatively undisturbed depositional surface of gentle slopes and low available relief. Thus, by the Upper Cretaceous the area was probably almost entirely one of broadly undulating plains cut indifferently across varied and deformed Palaeozoic and Triassic rocks in the centre and north, and transgressing gently dipping Jurassic and Cretaceous beds in the south.

Degraded remnants of these Mesozoic plains survive as bevelled and accordant summits of main divides on a number of geological formations in the Dawson uplands province. They have largely been destroyed, however, on the predominantly shaly rocks to the west and south, though much reduced relics are locally preserved as planed ridge and tableland summits on the Triassic sandstone rim of the Mimosa Syncline and on Jurassic sandstone in northern parts of the Dawson tablelands. In the areas referred to, this old planation surface is probably chiefly between 2000 and 2500 ft on marginal divides, though apparently only slightly above 1000 ft in the Dawson range 30 miles nearer the central parts of the catchment.

Deep lateritic weathering, typically to a depth of over 100 ft, is associated with the Mesozoic planation surface. At most, however, only truncated mottled and pallid zones are preserved, the overlying ferruginous zone having been stripped off. Rock rotting appears to have been most intense on the mainly feldspathic Palaeozoic sedimentary and volcanic rocks, and probably also on shaly strata of the Triassic Moolayember Formation and Middle Jurassic Injune Creek Beds. By comparison, weathering was shallower and more selective on the Triassic Clematis Sandstone and on the Lower Jurassic sandstone-dominated strata.

(*b*) *Formation of the Tertiary Deeply Weathered Surface*

Subsequent dissection of the Mesozoic plains is likely to have been caused by uplift, possibly part of widespread epeirogenic movements commencing in the late Cretaceous–early Tertiary. The main elements of the present drainage pattern already existed or came into being at this time and incised themselves up to 500 ft and more into the uplifted planation surface. Eastern tributaries of the Dawson River cut a dense network of deep trenches in the Dawson uplands province, with limited planation on granitic rocks in the Auburn upland plains and in lower sectors of main valleys, particularly in the Callide plains region. Flanking the Dawson River and its western tributaries, more extensive plains were eroded 500 ft or more below the level of main divides in the lower Dawson plains province. Here, on all but the resistant sandstone edges of the Mimosa Syncline, widespread planation was facilitated by the stripping of the Mesozoic weathering mantle and underlying, easily erodable shaly rocks.

Uplift also created a potential for vigorous erosion that had not previously existed in the margins of the Great Artesian Basin, and major lithological contrasts were etched out within these former lowlands. Extensive lower plains were cut in comparatively easily erodable Middle Jurassic shales—the earliest expression of the upper Dawson plains province. To the north of these plains, deep dissection left a broad upstanding divide—the Dawson tablelands province—in the Lower Jurassic sandstone sequence, with a high delimiting escarpment overlooking the shaly plains of the Mimosa Syncline further north and with a composite "dip slope" inclined gently southwards and diversified by minor escarpments. This dissection was accompanied mainly by summit lowering rather than by valley planation in headwater areas along the northern margin of the Dawson tablelands, but in the southern parts of this province the lower planation surface of the upper Dawson plains was extended up the "dip slope".

Later in the Lower Tertiary, the newly created lowlands in all parts of the area were masked by terrestrial deposits and basalt flows. The former included fans and aprons of conglomerate, sandstone, and claystone at the foot of the main ranges, with boulder screes locally. Downslope, extensive sheets of mainly fine-textured fluvial and lacustrine sediments were laid down to a thickness of over 200 ft in some lower sectors, with a very much thinner veneer of ill-sorted sheet-flood deposits on slightly higher ground and in tributary headwater areas. These deposits were interbedded with or buried by basalt flows in many parts, particularly in the lower Dawson plains province and in the Callide plains to the east.

Deep weathering continued and lateritic profiles developed on the Tertiary plains, extending into the underlying rocks where the depositional cover was thin. The depth of weathering varied considerably, apparently being particularly pronounced at the foot of the main ranges where profiles up to about 100 ft thick are preserved; elsewhere, weathering of about 50 ft seems to have been more usual. Typical profiles consist of 5–15 ft of ironstone, which is partly detrital, overlying 10–30 ft of mottled zone and 20–50 ft of pallid zone. Much shallower profiles, 10 ft or less, formed on some basalt flows.

Remnants of these formerly very extensive, deeply weathered Tertiary plains are mainly preserved in the Duaringa plains and tablelands as dissected aprons more than 1000 ft above sea level downslope from the western ranges, and extending south at rather lower elevations on the flanks of the Dawson range. Further remnants flanking the Dawson River 30 miles to the east, however, are at an altitude of only 300–500 ft. Scattered residuals show a progressive increase in altitude up-valley to the south, attaining 1000 ft in the upper Dawson plains and rising 400–500 ft higher in the Dawson tablelands. Similarly, remnants rise appreciably up-valley to the east, where a more extensive area of the Tertiary plains is preserved in the Auburn upland plains region, probably mainly at 1200–1300 ft.

(c) *Upper Tertiary–Quaternary Events*

The subsequent geomorphological record is complex, comprising successive phases of erosion and deposition of which four main stages, of differing duration, are recognized here.

(i) *Dissection of the Tertiary Weathered Surface and Ensuing Deposition.*— Following regional rejuvenation of drainage the Tertiary deeply weathered surface was dissected, and gently rolling plains were formed extensively below its level and separated from it by low discontinuous escarpments or dissected undulating terrain. The formation of these younger plains was everywhere facilitated by the stripping of the Tertiary weathering profile and they were cut near its base in many localities, particularly in the north of the lower Dawson plains. However, only partial stripping was achieved in tributary headwater areas in the west of this province and in the Auburn upland plains to the east, where dissection was confined to irregular but generally slight lowering of the Tertiary surface.

In contrast, erosion advanced below the level of the weathering mantle up-valley to the south, where it was underlain by easily erodable argillaceous rocks: for example, in the southern river plains and Callide plains underlain by Middle Bowen Beds, in the Zamia and Roundstone plains on the Moolayember Formation, and in the upper Dawson plains on the Injune Creek Beds. Where the Tertiary weathered plains were underlain by comparatively resistant sandstones in these areas, mainly in the south of the Dawson tablelands province, dissection was chiefly limited to vertical incision to depths of 100–200 ft, though limited planation occurred flanking major drainage lines in the western upland plains and in the eastern tablelands and plains. In northern parts of the Dawson tablelands and in the Dawson uplands province, down-cutting was intensified in the entrenched valleys of uplands standing above the level of the duricrusted Tertiary plains.

Widespread deposition then occurred. Alluvial fans and aprons again formed at the foot of the main ranges, incorporating both prior-weathered and relatively unweathered materials, with thinner, gravelly sheet-flood deposits downslope on low interfluves and deeper deposits in intervening drainage floors. Many tributary valleys, particularly in the south and west, were choked with colluvium and alluvium and flood-plains spread down-valley along the main rivers.

The younger plains were weathered during the following deposition, but to a lesser degree in both depth and intensity of weathering than were older surfaces. Where the effects of this younger weathering are clearly distinguishable from inherited older weathering products—in restricted sites cut well below the level of the Tertiary weathered surface and with only thin, locally derived deposits—surface materials and subjacent rocks are partially decomposed to depths of 10–20 ft at most, with only incipient development of laterite.

(ii) *Dissection and Reworking of Deposits.*—Subsequently, drainage again became entrenched throughout the region—the main rivers to depths of 100 ft or more—and the earlier deposits were dissected and reworked in many areas and stripped away completely in others. However, before the newly formed plains below the level of the Tertiary weathered surface could be extensively destroyed, streams became unable to carry away the eroded detritus and younger depositional mantles were laid down in many areas, masking and subduing the dissected lowland topography of the earlier Quaternary landscape. The deposits of this second stage, chiefly derived from those of the preceding stage and from weathered rock, mainly comprise gravelly colluvium in the higher parts passing downslope into deep colluvial–alluvial fills characteristically of fine-textured material but with much inherited gravel. Deep soils formed both on the younger deposits and on truncated older materials up-slope indicate slope stability later in this stage.

(iii) *Drainage Rejuvenation and Flood-plain Development.*—Further rejuvenation and entrenchment of drainage throughout the area initiated another stage of landscape development. In mid sectors the Dawson River incised itself within its valley to depths of over 50 ft in the southern river plains region, and incision of at least this amount occurred downstream along the lower Dawson, Mackenzie, and Fitzroy Rivers but is partially masked by later deposition there. In tributary areas, western streams in the lower Dawson plains became entrenched to depths of up to 30 ft, as did eastern streams in the Callide plains; but at least 50 ft of incision—through alluvium and deep into bed-rock—was more typical up-valley in the ranges of the Dawson uplands and in headwater areas of the upper Dawson plains.

Later, as in the previous stage, the entrenched valleys became partially infilled with deposits. First, alluvial flood-plains formed along the main rivers, mainly below the level of the remains of older deposits but locally overlapping their dissected margins. This deposition extended into headwater areas to the south in the Dawson tablelands and upper Dawson plains provinces, but tributary streams to the east in the Dawson uplands generally remained adequate to remove the products of their erosion, though trunk streams in the Callide plains also built wide flood-plains at this time.

(iv) *Drainage Rejuvenation and Further Flood-plain Development.*—Finally, downcutting was resumed during the most recent stage and the older flood-plains were shallowly dissected. This incision continues to the present day in tributary headwater areas, but younger inner flood-plains are forming along main rivers, particularly in the northern and southern river plains, the Rockhampton plains, the Callide plains, and also up-valley in those northern sections of the Taroom plains fed by heavy floods from the Dawson tablelands.

IV. Geomorphology of the Land Systems

The land systems are grouped into seven classes according to the characteristics of their dominant site assemblages, differences between which are mainly related to different geomorphological history and, in some classes, lithology. The first class comprises land systems mainly above the level of the Tertiary weathered surface or produced by deep dissection of it; the next class has formed by shallow dissection of this surface; then follow two classes of younger weathered terrain—and here the expression in surface materials of major contrasts in parent rocks is of particular classificatory significance, with one class on coarser-textured rocks and one on mainly finer-textured rocks; lastly, there are three classes of the youngest erosional or depositional terrain, the former in a variety of little-weathered rocks. Several classes contain groups mainly differentiated in terms of major land forms and local relief.

(*a*) *Land Systems Standing Above, or Formed by Deep Dissection of, the Tertiary Weathered Surface*

These land systems comprise mountain and hill ranges largely above the level of the Tertiary lateritic plains, together with high tablelands and hills partly formed by deep dissection of these plains but also including upstanding old divides. They are characterized by steep rocky slopes, typically up to 60% or more, but in association with a range of contrasting sites.

(i) *Mountains and Hills.*—This first group forms main divides on diverse rock types and is particularly extensive in the Dawson uplands province. Local relief is commonly about 500 ft, attaining 1000 ft.

Gelobera land system is mainly cut in Upper Palaeozoic volcanic rocks, and includes hill slopes in weathered materials or in fresh rock, with gentler crest and hill foot slopes of moderate extent.

Hillmore land system is also eroded in Upper Palaeozoic volcanics but is less complex, chiefly consisting of steep rocky hill slopes in relatively fresh rock.

Irving land system comprises a variety of hill slopes, with subordinate erosional and depositional lower slopes, underlain by a complex of granitic and volcanic rocks.

Boomer land system, built of varied and contorted Palaeozoic sedimentary rocks, is distinguished by fairly extensive erosional lower slopes.

Carborough land system is formed on flat-lying or gently dipping Mesozoic sandstone with some shale and has extensive and varied lower slopes.

(ii) *High Tablelands and Hills*.—In this group extensive slopes typically less than 5%, with shallow soils, co-dominate with the steep rocky hill slopes; the gentle slopes occur mainly in the higher parts of the landscape with the rocky slopes in narrowly entrenched valleys up to 500 ft deep. These land systems form much of the Dawson tablelands province and are underlain by flat-lying Mesozoic sandstone and shale.

Nathan land system has a relatively close pattern of dissection, with extensive rocky hill slopes. It is the most widespread member of this class and one of the largest land systems in the area.

Doonkuna land system has a more open pattern of dissection with a proportionately greater area of summit slopes.

Surprise land system differs in that the gentle slopes mainly occur in the lower parts, rocky slopes forming hills up to about 300 ft high.

(b) Land Systems Formed by Shallow Dissection of the Tertiary Weathered Surface

These land systems chiefly consist of low tablelands or plains comprising shallowly dissected and lightly stripped residuals of the Tertiary weathered surface, mainly preserved in the lower Dawson plains. Features in common are gently sloping lateritic crests and sandy to loamy colluvial–alluvial lower slopes, which occur together in widely varying proportions. The deeply weathered parent rocks are Tertiary sandstone, claystone, and conglomerate in the majority of the land systems. Two groups with different form, local relief, and subordinate sites are recognized.

(i) *Low Tablelands and Hills*.—This group of two land systems is dominated by lateritic tableland surfaces with slopes of 1–3% and with soils of variable depth. Valleys are entrenched up to 100 ft or more and depositional lower slopes are comparatively restricted.

Range land system is distinguished by steep ridges of Triassic sandstone rising 200–500 ft above the level of closely dissected aprons of lateritized Tertiary deposits. It occurs in the Duaringa tablelands and plains region and in the Roundstone plains.

Duaringa land system comprises dissected low tablelands. Characteristic features include fragmented lateritic crests delimited by erosional slopes with shallow soils on mottled-zone or pallid-zone rock in many areas, and a variety of depositional sites downslope. It is the most extensive of this class and has scattered occurrences in most of the lower Dawson plains region and in the Callide plains, and also occurs locally in the upper Dawson plains.

Kaiuroo land system consists of partially dissected low tablelands with extensive crests diversified by distinctive marginal slopes and clayey depressions. It is confined to the north-western plains region.

(ii) *Undulating Plains*.—There are five land systems in this group of plains, with local relief attaining 100 ft but mainly less than 50 ft. In most of them the materials eroded from the lateritic crests have accumulated only a short distance downslope from the surviving remnants, filling the shallowly entrenched valleys, hence the area of depositional lower slopes is proportionately greater than in the previous group.

Auburn land system is underlain by deeply weathered granitic rocks and principally consists of gently rounded, low lateritic crests with moderately extensive depositional sites downslope. It constitutes all of that part of the Auburn upland plains within the survey area.

Narowie land system is mainly formed on deeply weathered volcanics but is distinguished by erosional lower slopes on relatively fresh rock. The least extensive member of this class, it occurs locally in the southern tablelands and plains.

Wooroonah land system, and the remainder of this group, contain a greater proportion of depositional slopes than of degraded lateritic remnants. It constitutes large parts of the Mimosa plains.

Melbadale land system has distinctive finer-textured colluvial deposits in addition to the typically coarser-textured materials. It occurs extensively downslope from the tablelands of Duaringa land system in the Duaringa tablelands and plains region.

Perch land system, in which lateritic crests are of least extent, is characterized by a diversity of younger sites mainly of colluvial origin but with alluvial types of moderate extent. Occupying a smaller total area than Wooroonah and Melbadale land systems, it occurs in association with them in the Mimosa plains and in the Duaringa tablelands and plains.

(*c*) *Land Systems Formed from Weathered Coarser-textured Rocks below the Tertiary Weathered Surface*

This and the succeeding classes of land system are formed below the level of the Tertiary weathered surface. They comprise groups differing mainly in relation to the relative proportions and characteristics of their constituent sites. The first class consists of strongly undulating to nearly flat plains mainly underlain by weathered sandstone—chiefly of Mesozoic age but locally Tertiary—and characterized by gentle slopes with coarser-textured soils of variable depth. It comprises two groups differing in amount of local relief and in the relative importance of erosional and depositional sites.

(i) *Undulating Plains*.—These land systems have local relief typically up to about 50 ft, but attaining 100–200 ft, with slopes mainly below 5% and extensively less than 3%. Erosional sites are dominant and include complex upper slopes of varied inclination and surface materials. The land systems differ from one another primarily in the nature of their lower slopes.

Yebna land system contains those areas of greatest relief with relatively extensive gravelly sites and with minor but recurring steep rocky slopes. It mainly occurs in the southern tablelands and plains region.

Doughboy land system chiefly differs from Yebna land system in that colluvial lower slopes are more extensive, gravelly slopes are only minor, and rocky hill slopes are absent. It occurs in the western upland plains of the Dawson tablelands province.

Conloi land system has moderately extensive erosional lower slopes with mainly shallow soils. It covers a small area with a dense pattern of branching drainage at the head of Juandah Creek in the south of the upper Dawson plains province.

Glenhaughton land system is distinguished in the lower parts by colluvium with only minor erosional sites, and by an associated sparser drainage pattern. It forms much of the western upland plains and the southern tablelands and plains regions.

(ii) *Nearly Flat Plains*.—The two land systems in this group are plains with local relief of mainly less than 30 ft. They are dominated by slopes of about 1% or less with deep colluvium and alluvium, chiefly sandy or loamy at the surface but becoming finer with depth.

Redcliffe land system largely consists of gentle colluvial slopes rising locally to low lateritic crests. It is confined to the Mimosa plains region.

Mimosa land system comprises dissected colluvial–alluvial plains flanking Mimosa Creek, and traversing Redcliffe land system. There are also minor occurrences in the southern river plains.

(*d*) *Land Systems Formed from Weathered Finer-textured Rocks below the Tertiary Weathered Surface*

These land systems comprise hill lands, tablelands, and plains cut mainly in weathered argillaceous rocks, and in the lower parts with a blanket of surficial deposits derived from these rocks. There are four groups.

(i) *Hills*.—Land systems in this group are hill lands dominated by moderately steep slopes—attaining about 60% but extensively less than 20%—and with a discontinuous soil cover of shallow to moderate depth. Less extensive gentler lower slopes of varied character, with residual soils or surficial deposits, provide the principal distinguishing features of individual land systems. Local relief is typically 100–300 ft, and up to 500 ft locally.

Malakoff land system is cut in a variety of dipping sedimentary or volcanic rocks of Upper Palaeozoic age, and is notable for the extent of its erosional lower slopes. It has numerous scattered occurrences mainly in western parts of the northern and southern ranges of the Dawson uplands province.

Womblebank land system is underlain by subhorizontal Mesozoic shale with some sandstone and has erosional and depositional sites in roughly equal proportions in the lower parts. One of the least extensive members of this class, it occurs locally in the Injune plains, Roundstone plains, and southern hill lands.

Toonda land system is mainly formed in Upper Palaeozoic volcanics that have weathered to provide comparatively extensive sheets of colluvium and alluvium in the lower parts. It has a fragmented distribution in the northern, southern, and eastern ranges of the Dawson uplands province.

(ii) *Tablelands.*—These land systems, in contrast with those of the preceding group, are dominated by slopes less than 10%, and mainly 1–5%, occurring as tableland surfaces with local relief of mainly less than 50 ft, and delimited by the steep rocky slopes of valleys entrenched up to 200 ft. There is also a more continuous soil cover, though of variable depth, than in the hill lands.

Narran land system, built of flat-lying Jurassic shale with important sandstone interbeds, is distinguished by crest slopes on the coarser-textured rocks and by a comparatively dense pattern of incising drainage.

Mundell land system differs in that sites eroded in sandstone beds are of only minor extent. In addition, crest surfaces are less broken because of the relatively open pattern of dissection.

Narran and Mundell land systems occur together in the eastern tablelands and plains region, but Narran also occurs in the southern plains.

Lawgi land system, in contrast, is mainly formed on relatively homogeneous Tertiary basalt flows and is less dissected and more uniform than either Narran or Mundell land systems. It occurs at the head of the Callide plains and in adjoining parts of the southern ranges.

(iii) *Undulating Plains.*—This group comprises undulating plains with local relief of mainly less than 100 ft, but in some cases with scattered hills 100–200 ft high, chiefly underlain by subhorizontal Mesozoic shale with some sandstone. They have gentle, mainly soil-covered, erosional upper and mid slopes, with a diversity of depositional and generally more restricted erosional sites in the lower parts.

Oakleigh land system includes distinctive upper slopes on ?Cretaceous sandstone, with mainly depositional lower slopes. It covers a large part of the southern plains region in the upper Dawson plains.

Redrange land system has erosional and depositional lower slopes of comparable extent. It occurs chiefly in the eastern tablelands and plains of the Dawson tablelands province.

Eurombah land system includes upper slopes on Tertiary basalt and has extensive colluvial lower slopes. The most extensive land system of this class, and one of the largest in the area, it has a wide distribution in the upper Dawson plains and down-valley in the Zamia plains.

Banana land system is mainly underlain by more varied but chiefly argillaceous rocks of Upper Palaeozoic age. Due to closer dissection, upper slopes cover less of the total area, lower slopes include distinctive erosional types, and the land system is more stony overall. It occurs in the southern river plains, the northern ranges, and locally in the Callide plains.

(iv) *Undulating to Nearly Flat Plains.*—This group consists of plains with local relief ranging from about 50 ft to less than 30 ft, with sheets of colluvium and alluvium furnished by subjacent, weathered Palaeozoic and Mesozoic argillaceous rocks, but including erosional slopes in varying proportions. The deposits are mainly locally derived, and in parts of some land systems the distinction is not always clear between these predominantly fine-textured and weathered materials and the physically similar deep residual soils with which they are interspersed.

Ramsay land system is unique in having plains of colluvium–alluvium incorporating finer-textured deposits derived from weathered Upper Palaeozoic argillaceous rocks which underlie most of the land system, and coarser-textured materials from lateritized Tertiary beds upslope. It is largely confined to the Callide plains region.

Kariboe land system is distinguished by erosional upper slopes either on Tertiary basalt or on shaly rocks of Upper Palaeozoic or Mesozoic age, and by comparatively steep and locally stony colluvial slopes, grading down into gentler colluvial–alluvial sites in through-going drainage floors. It is of limited extent in the Callide plains and in the west of the upper Dawson plains.

Wandoan land system, mainly underlain by gently dipping Jurassic or Permian shale, has a characteristic fragmentary pattern of erosional sites in the upper parts and depositional sites downslope—including extensive colluvial–alluvial floors. The largest land system in this class, it covers most of the Taroom plains, has a scattered distribution elsewhere in the upper Dawson plains province, and also occurs down-valley in the southern river plains and in the Callide plains.

Barwon land system is formed on dipping, interbedded argillaceous and arenaceous Permian rocks in the north-western plains region. It is distinctive by virtue of extensive younger erosional slopes in the lower parts, with a pronounced strike-controlled banded pattern of shallow and deeper soils; the latter include degraded residual types and stripped relics of earlier colluvial sheets.

Kiddell land system also has extensive younger erosional sites but, cut in subhorizontal Mesozoic shale and hence without the strike orientation occurring in Barwon land system, these have a patchy distribution flanking shallowly entrenched drainage lines. In further contrast, Kiddell land system has a range of minor, but recurring, erosional sites on low crests rising above the dominant depositional slopes. It is small but has a widely scattered distribution in the upper Dawson plains province and in the Zamia, Roundstone, and southern river plains down-valley.

Highworth land system is dominated by extensive comparatively uniform colluvial–alluvial slopes that mask underlying Permian or Triassic or Tertiary shaly beds.

Thomby land system, mainly underlain by Triassic shale, is distinguished by degraded lateritic remnants on low crests and by relatively extensive younger erosional sites.

Highworth and Thomby land systems cover large parts of the lower Dawson plains, particularly in the Roundstone and Zamia regions. They also occur to the east throughout the Callide plains and locally in the northern ranges.

Hinchley land system has only minor erosional sites along shallowly entrenched drainage lines. It is confined to the headwater margins of the Taroom plains and is the smallest member of this group.

Dakenba land system is similar to Hinchley land system in upper sectors but has distinctive slopes of older alluvium in the lower parts which are flooded periodically. It has a wider distribution down-valley, flanking, but mainly above the level of, major flood-plains in the northern and southern river plains, in the northern ranges, and in the Rockhampton plains.

(e) *Land Systems Eroded in Relatively Unweathered Rocks below the Tertiary Weathered Surface*

Land systems of this class comprise younger plains cut in a range of little-weathered rock types below the level of the Tertiary weathered surface. Recent and continuing erosion is reflected in mainly shallow soils or stony surfaces with associated relatively dense patterns of incising drainage. Two groups are differentiated on the basis of amount of local relief and characteristic slopes.

(i) *Strongly Undulating Plains.*—These mainly have local relief of 50–200 ft, with up to 300 ft in minor hill tracts. Slopes attaining 5–10% and shallow soils interspersed with rock outcrops are typical, with some steeper rocky slopes in most land systems.

Ohio land system includes the strongest relief of this group, with Upper Palaeozoic volcanics near or at the surface on all but restricted gentler lower slopes. It has a scattered distribution throughout the Dawson uplands province, occupying a considerable total area.

Torsdale land system, of even greater extent in the Dawson uplands province and on similar rocks to Ohio land system, is distinguished by a greater proportion of gentler lower slopes with soils of moderate depth, and by minor but recurring patches of deep soils on clayey colluvium.

Rosewood land system is eroded in dipping Permian beds of varied but predominantly argillaceous lithology, which are reflected in the banded pattern of soils and vegetation in most parts. Rosewood land system is of restricted extent in the northern ranges.

Mourangie land system is underlain by similar rocks, but differs in that these are masked by surficial deposits in about one-third of the total area. Furthermore, where bed-rock does occur near the surface it exerts a less pronounced control over the distribution of soils and vegetation. This land system is also confined to the northern ranges.

Bouldercombe land system, formed in a complex of granitic and volcanic rocks, has a related mosaic of lithologically determined soils and vegetation on erosional slopes, together with comparatively extensive depositional lower slopes. It is the largest land system of this class, occurring in the northern, eastern, and southern ranges, and particularly in the last-named region.

Bannockburn land system is chiefly cut in varied Carboniferous sedimentary rocks, but these are masked by moderately extensive colluvial deposits in the lower parts and by truncated weathering mantles on isolated hill crests. It occurs in the northern ranges and adjoining parts of the eastern ranges.

(ii) *Undulating Plains.*—Local relief is mainly 50 ft or less in this group but attains 100 ft locally. Dominant slopes are below 5% with a more continuous soil cover than in the preceding group, though typically of only shallow to moderate depth.

Westwood land system has a particularly fragmented pattern of sites—including comparatively steep upper slopes—related to a closely branching pattern of drainage incised into underlying Tertiary basalt. It has restricted occurrences in the Dawson tablelands province and in the Zamia and Mimosa plains regions.

Grevillea land system is underlain by Tertiary basalt sheets that are less closely dissected than in Westwood land system, and it is consequently less diverse. It occurs in the southern ranges and locally in the adjoining part of the eastern ranges.

Orana land system, on Upper Palaeozoic volcanics, is notable for relatively steep erosional upper slopes and for depositional lower slopes that include patches of older materials. It chiefly occurs on the western flank of the southern ranges, with minor outliers in the adjoining southern river plains.

Barfield land system, mainly contiguous with Orana land system and on similar rocks, is distinctive in that local relief is less and slopes are gentler and more uniform overall, with greater areas of surficial deposits.

(*f*) *Fluvial Plains*

These land systems constitute the plains traversed by the Dawson, Mackenzie, and Fitzroy Rivers and their larger tributaries. Tributary plains, in which depositional and erosional sites are interspersed, are differentiated from the unbroken depositional surfaces down-valley in which comparatively stable plains mainly of older deposits, flooded on occasions but where deposition is now generally inactive, are distinguished from unstable plains of active deposition characterized by more frequent and heavier floods. Local relief is mainly less than 25 ft but attains 50 ft in tributary plains.

(i) *Tributary Plains*.—These consist of headwater drainage plains dominated by very gently sloping sites in younger alluvium and colluvium, but with scattered erosional sites like those characteristic of the preceding class of land systems, mainly on flat-bedded Mesozoic shale and sandstone.

Montana land system includes extensive erosional slopes forming narrow "rises" between alluvial drainage floors. The most widespread of this class, it occurs along mid and upper sectors of larger tributary streams in several regions of the upper Dawson plains and Dawson tablelands provinces and in the adjoining southern hill lands.

Langmorn land system, on the southern margin of the Rockhampton plains, includes restricted foot slopes of adjacent uplands on Upper Palaeozoic volcanics with a complex pattern of depositional sites downslope.

Woleebee land system, occurring in association with Montana land system, contrasts with it in having less extensive erosional slopes and even more complex colluvial–alluvial sites, including deposits of different ages.

Palmtree land system is notable for broader drainage floors distinguished by heavy floods and numerous large depressions containing semi-permanent pools. It occurs where Palmtree Creek and Robinson Creek, fed by vigorous headwaters in the tablelands to the west, debouch onto adjoining lowlands in the eastern tablelands and plains, and in the Taroom plains.

(ii) *Mainly Stable Trunk Plains*.—These occur in upper sectors of main drainage-ways or form outer zones flanking active inner flood-plains in lower sectors. The deposits range from sand to clay with fine-textured materials dominant, but with a thin loamy surface veneer in many areas. From limited observations longitudinal gradients apparently range from about 1 in 200 to below 1 in 500. Transverse slopes are mainly less than 1%.

Dingo land system is distinguished by a complex of deposits of different textures and ages, principally derived from the dissected Tertiary weathered surface in the Duaringa tablelands and plains region.

Coreen land system consists of fine-textured deposits furnished by weathered rocks below the level of the Tertiary weathered plains. It occurs in the northern and southern river plains, the north-western plains, and the northern ranges.

Juandah land system comprises deposits mainly derived from less weathered materials below the level of the Tertiary plains. Minor colluvial or erosional sites form low "rises". It occurs chiefly in the Taroom plains in the south and in the Zamia plains in the west, and also down-valley particularly in the southern river plains.

Kroombit land system occurs in similar geomorphological situations to Juandah land system but has gentler gradients or is generally more low-lying and is notable for broad levees. It is most extensive in the Callide plains and southern river plains.

(iii) *Mainly Unstable Trunk Plains*.—These land systems comprise the frequently flooded lower sectors of the main river plains, extending headwards as active inner zones flanked by and mainly below the level of older deposits in the land systems of the previous group. Typical gradients are less than 1 in 500 and probably mainly below 1 in 1000, and the deposits are uniformly fine-textured in most parts.

Gavial land system constitutes the lowest, "flood-out" sectors of the Fitzroy River and of other channels in the Callide plains. It is distinguished by extensive back plains traversed by a dense network of distributary channels and discontinuous linear depressions.

Coolibah land system comprises the active inner flood-plains of the Dawson, Mackenzie, and Fitzroy Rivers throughout most of their length. Though of limited width it covers the greatest area in this class. In common with Gavial land system it has extensive back plains, but differs in that these are less broken by drainage lines and levees are of considerable extent.

Raglan land system has only limited occurrences along the southern margins of the Rockhampton plains where it comprises aprons at the foot of adjacent uplands and flanking the Fitzroy estuary. It is distinguished by broad, relatively uniform depositional surfaces with scattered "rises" masked by colluvium in upper sectors and with saline tidal flats in the lowest parts.

(*g*) *Littoral Plains*

Carpentaria land system, consisting of the nearly flat saline plains of the Fitzroy estuary, is the only member of this class. It comprises extensive bare tidal mud flats diversified by slightly higher vegetated areas with, at their lower margin, an intricate branching pattern of tidal inlets flanked by mangrove flats.

PART VII. SOILS OF THE DAWSON–FITZROY AREA

By F. C. Sweeney*

I. Introduction

As described in Part VI, most of the area was at one time covered by a mantle of Tertiary sediments in which deep weathering lateritic profiles developed. These profiles consisted of a cover of red and yellow earths underlain by ferruginous, mottled, and pallid zones. Subsequent dissection and stripping of the mantle left remnants of the earths on uplands and exposed the underlying weathered zones on intermediate and lower slopes. Solodic and related soils with abrupt textural contrasts and cracking clays commonly with gilgai microrelief formed in these situations. Over wide areas the Tertiary mantle was completely removed by erosion and relatively unweathered rocks of varying lithologies were exposed to form soil parent materials. Uniform fine-textured soils, some of which crack seasonally, were formed on shales and volcanic rocks and texture-contrast or uniform sandy soils formed on more quartzose materials. Extensive areas of alluvial soils developed on plains adjacent to the major rivers and creeks and shallow undifferentiated soils predominate in hilly and mountainous terrain.

Some of the more important soils of this area have been mapped previously by Hubble (unpublished data) and Isbell (1954, 1957*a*, 1957*b*). Those soils in the area carrying brigalow vegetation have been mapped more recently in four groups by Isbell (1962), and analytical data for some soils are available from reports of Reeve, Isbell, and Hubble (1963) and Oertel and Giles (1964).

II. Classification

The soils were described and classified in the field using the key and criteria of Northcote (1965). Other criteria used are those of the United States Department of Agriculture (1951), except with regard to gilgai development. The term soil family has been used in the context given by the United States Soil Conservation Service (1960).

Gilgai development has been divided into two classes. Firstly, those in which the vertical interval between the mound and the bottom of the depression is greater than 12 in. have been classed as strongly gilgaied, and cause physical and mechanical problems when cultivated. Secondly, those with an interval of less than 12 in. have been classified as slightly to moderately gilgaied.

The soils have been arranged in seven major groups consisting of 34 families differentiated according to variations in texture, horizonation, reaction, effective

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TABLE 12

SOIL GROUPS AND FAMILIES IN THE DAWSON–FITZROY AREA

Major Group	Family	Brief Description	Appropriate or Approximate Equivalent Names	Principal Profile Form (Northcote 1965)
Alluvial soils	Davy	Uniform coarse textures		Uc2.12, 5.11, 5.22
	Clematis	Uniform medium to fine textures		Uf6.23, Um6.42
	Alma	Uniform fine textures, saline	Alluvial soils (Stephens 1962)	
	Warrinilla	Medium to fine textures on coarse-textured substrata		
	Moolayember	Coarse to medium textures on fine-textured substrata		Gn3.22, 3.42, 2.42
	Consuelo	Stratified soils with coarse- to fine-textured layers		Uf6.32
Cracking clay soils	Bruce	Shallow soils (< 24 in.) on various rocks		Ug5.12, 5.27
	May Downs	Dark grey-brown to black, self-mulching soils on basalt or other volcanic rocks (> 36 in.)	Black earths	Ug5.12, 5.13
	Teviot	Dark grey to very dark grey-brown self-mulching soils on various sedimentary rocks (> 36 in.)		Ug5.33, 5.14, 5.27
	Pegunny	Gilgaied, very deep, mainly dark grey-brown soils on Tertiary weathered zone materials		Ug5.28, 5.24, 5.15
	Downfall	Slightly gilgaied, deep, dark grey to grey-brown soils on Tertiary weathered zone materials	Grey and brown soils of heavy texture (Stephens 1962)	Ug5.27, 5.24
	Rolleston	Non-gilgaied, deep, dark grey-brown to black soils on Tertiary weathered zone materials		Ug5.28, 5.34
	Vermont	Dark grey to grey-brown soils on alluvial materials (> 60 in.)		Ug5.16, 5.24
Texture-contrast soils	Shallow soils (< 24 in.)			
	Southernwood	Sandy or loamy surface soils, acid to mildly alkaline subsoils	Solod (Stephens 1962)	Dr2.12, Dy3.62, 3.41
	Medway	Sandy or loamy surface soils, moderately to strongly alkaline subsoils	Solodic and solodized solonetz (Stephens 1962)	Dy2.43, 2.23
	Moderately deep to deep soils (> 24 in.)			
	Thin sandy surface soils (< 15 in.)			
	Springwood	Acid to mildly alkaline subsoils	Solod	Dy3.42, 2.12
	Taurus	Moderately to strongly alkaline subsoils	Solodic and solodized solonetz	Dd1.43, Dy2.33, 2.43

	Thick sandy surface soils			
	Luxor	Acid to mildly alkaline subsoils	Sandy solod (Isbell 1957*a*)	Dy3.41, 5.81, 4.61
	Broadmeadow	Moderately to strongly alkaline subsoils	Sandy solodic and solodized solonetz (Isbell 1957*a*)	Dy5.83, 3.43
	Thin loamy surface soils (< 15 in.)			
	Wyseby	Acid to mildly alkaline surface soils	Solod	Dy3.81, 3.41, 3.42
	Retro	Moderately to strongly alkaline subsoils	Solodic and solodized solonetz	Dy2.43, Dd1.33, 1.43
Dark brown and grey-brown soils	Kinnoul	Shallow uniform medium- to fine-textured soils, alkaline subsoils		Uf6.31, 6.21
	Ingelara	Shallow uniform medium- to fine-textured soils, moderately to strongly acid throughout		Um5.41, Uf6.32
	Cheshire	Deep, uniform or gradational, medium- to fine-textured soils, moderately to strongly alkaline subsoils		Uf6.32, 6.21, Gn3.93, 3.13
	Carraba	Deep, uniform or gradational, medium- to fine-textured soils, strongly acid subsoils		Uf5.41, 6.32, Gn3.12
Red and yellow earths	Dunrobin	Loamy red earths	Lateritic red earths (Stephens 1962)	Gn2.12, 2.11
	Struan	Loamy yellow earths	Yellow earths (Stephens 1962; Stewart 1954)	Gn2.22
	Annandale	Sandy red earths	Lateritic red earths	Gn2.12, 1.12
	Forrester	Sandy yellow earths	Yellow earths	Gn2.22
	Wilpeena	Red and yellow earths on alluvial materials		Gn2.12, 2.11, 2.22
Uniform coarse-textured soils	Petrona	Shallow to moderately deep sands to sandy loams (< 36 in.)		Uc1.21, 2.12
	Highmount	Deep sandy soils (> 36 in.)		Uc5.11, 1.21
Shallow rocky soils	Rugby	Very shallow, uniform medium- to fine-textured soils	Skeletal soils (Stephens 1962)	Uf6.33, Um1.43
	Shotover	Very shallow, uniform coarse-textured soils		Uc1.21

depth, and parent materials. In order to correlate the soils of the area with those of adjacent survey areas (Story *et al.* 1967; Gunn *et al.* 1967) the classification follows that of Gunn (1967*a*, 1967*b*). The soil groups and families are shown in Table 12.

The broad distribution of the dominant soils in the area is shown in the small-scale soil map and in relation to land systems in Tables 13–15.

III. Descriptions of the Soils

(*a*) *Alluvial Soils*

These are young, largely undifferentiated soils, on alluvial materials, that occur in the lower units of most land systems and are most extensive along the major rivers and creeks. They have been divided into six families on the basis of their textural characteristics.

They are generally deep soils, ranging in texture from Davy coarse sands on levees to Clematis loams and clays in back plains and merging into Vermont cracking clays in depressions and flats. On the older, more mature levees, clay illuviation has begun and weak gradational characteristics may be evident as in Moolayember family.

In small valleys, particularly in the land systems on denuded Tertiary weathered zones, several of the soil families of this group may occur in close association. In such cases only the major soil family or that family covering an estimated area greater than 1% of the land system is shown in the land system descriptions. Generally, in the erosional terrain formed by dissection of the Tertiary surface and weathered zone, the coarse-textured, strongly weathered materials have been stripped and redeposited on the marginal flats of drainage lines and are classified as Davy and Consuelo families, whereas in the alluvial–colluvial land systems transported finer-textured material occurs as Clematis and Warrinilla families. On the more mature levees and back-plain rises Moolayember family is typical. Alma family of saline clays and muds has a restricted occurrence as estuarine alluvium in the coastal Carpentaria land system.

The soils of all families except Moolayember are liable to flooding at irregular intervals although this has not prevented their extensive development along the Dawson and Callide valleys for agriculture and grazing. Their nearness to water and better than average fertility, especially where derived from basic rocks, suggest that they are very suitable for crops such as lucerne, fruit, and vegetables, provided flooding is not a serious problem.

The alluvial soils are often very variable and extremes within the group may occur over less than a quarter of a mile. Consequently crop yield variability can be expected. Detailed mapping of these soils would be necessary for development planning, particularly where irrigation is contemplated.

Davy.—These are very deep, uniform coarse-textured soils which occur on levees, alluvial flats, and some drainage floors. Textures range from sand to loamy sand and some profiles contain ironstone concretions and water-worn gravel. Colours of the humic-stained surface soils range from greyish brown to reddish brown and subsoils are yellowish brown or yellowish red. They are structureless and dry consistency is soft and loose. The soils are well drained and reaction is moderately acid to neutral throughout. The typical vegetation is grassy tall woodland or forest of carbeen, grey bloodwood, silver-leaved ironbark, and apple gum. These soils correspond with the coarse-textured alluvial soil association of Isbell (1957*b*). They have low water-retaining capacities and fertility but are considered suitable for specialized horticultural crops under irrigation.

Clematis.—These soils have uniform medium to fine textures sometimes underlain by sand or gravel lenses at depths exceeding 60 in. They occur on levees, back slopes, and low rises in main drainage floors under grassy tall woodland of blue gum, coolibah, carbeen, or poplar box. Two phases occur, one with loam, silty loam, or fine sandy clay loam textures and the other ranging from sandy or silty clay to light or medium clay occasionally grading to heavy clay at depth. The soils have good to imperfect drainage depending on texture but they are subject to frequent flooding in some areas. Colours are very dark grey to very dark greyish brown often becoming lighter and sometimes mottled at depth. Surface structure is commonly fine granular but may be platy or coarse blocky with fine cracks where the silt content is high. Subsoil structure is massive to weak subangular blocky. Soil reaction at the surface is slightly acid to neutral becoming moderately to strongly alkaline at depth where soft carbonate accumulations are common. In places the soils are slightly acid throughout. Although they have good water-retaining capacities and moderate fertility, frequent flooding generally limits their use to permanent pasture.

Alma.—This family comprises uniform medium to heavy clays and muds on estuarine alluvia adjacent to streams near the coast. They are moderately to strongly affected by salt and are either barren or have a cover of samphire, salt-water couch, or mangroves in permanently moist sites. Salt deposits are common in drier areas where the surface cracks form coarse angular blocks. Colours are dark grey to very dark greyish brown at the surface and grade to mottled olive-yellow, pale brown, bluish grey, or strong brown. The very salty soils are soft and "puffy" at the surface when dry and are very sticky in the wet state. Soil reaction at the surface is neutral to slightly alkaline and becomes strongly acid at depth. The soils have very poor internal drainage and are flooded regularly with tidal or brackish water. The grazing of natural pastures is likely to be the main form of land use on these soils, but where tide control and the leaching of salt are feasible, the establishment of pasture species such as para grass (*Brachiaria mutica*) may be practicable.

Warrinilla.—This family comprises medium- to fine-textured soils over coarse-textured substrata. They occur mainly on back-plain slopes and recent levees under woodlands of blue gum and silver-leaved ironbark or, less commonly, grey bloodwood, carbeen, or palms. The clay loam, fine sandy clay loam, or sandy clay surface layers are generally 24–30 in. thick and the underlying sands, clayey sands, or gravel extend to depths of 60 in. or more. Colours at the surface are very dark greyish brown to dark brown and grade to lighter colours at depth over yellowish brown or mottled dark greyish brown sandy materials. Structure varies from very weak subangular blocky to massive. Most of the soils set hard and form fine cracks on drying but occasionally surface soils are loose and friable. Reaction at the surface is moderately to slightly acid and generally strongly acid to neutral in the subsoils,

TABLE 13

OCCURRENCE OF SOIL FAMILIES IN LAND SYSTEMS FORMED ABOVE OR BY THE DISSECTION OF THE TERTIARY WEATHERED SURFACE

Percentage area of land system with major soil

Major Group and Family	Above or Deep Dissection of Tertiary Weathered Surface								Shallow Dissection of Tertiary Weathered Surface							
	Boomer	Carborough	Gelobera	Hillmore	Irving	Doonkuna	Nathan	Surprise	Duaringa	Kaiuroo	Range	Auburn	Melbadale	Narowie	Perch	Wooroonah
Alluvial soils																
Davy							5					10	< 5			
Clematis							< 5	< 5								
Alma																
Warrinilla																
Moolayember	< 5				< 5											
Consuelo													< 5			
Cracking clay soils																
Bruce																
May Downs														10		
Teviot																
Pegunny										< 5						
Downfall												5				
Rolleston						< 5		< 5								
Vermont				< 5	< 5									5	5	
Texture-contrast soils																
Southernwood		15	20		35		10	40							5	
Medway	20		< 5	5			10									
Springwood						5		10	5			25	20			
Taurus	15							5	25	< 5			< 5			

Luxor					10	15			<5	5	10		15	5	15	55
Broadmeadow																
Wyseby						15				<5	10	25	20		10	
Retro	<5	5	5	10	10	5		5	<5						15	<5
Dark brown and grey-brown soils																
Kinnoul		<5	15	<5	<5											
Ingelara	<5															
Cheshire		<5														
Carraba						5							15		5	
Red and yellow earths																
Dunrobin								5	20	35	15		5	65	10	
Struan													<5			
Annandale									20	35	15		5			
Forrester									10					15		
Wilpeena															20	
Uniform coarse-textured soils																
Petrona							5		5	10	5				10	15
Highmount		10					5		5							20
Shallow rocky soils																
Rugby		<5	55	75	15	<5		5				10				
Shotover	10	5				30	30				5	25				
Outcrop	45	55			20	20	30	25	5	5	35					

occasionally mildly to moderately alkaline. Frequent flooding restricts their use to the grazing of natural pastures.

Moolayember.—These soils most commonly have fine sandy clay loam to clay loam textures that grade to light or medium, occasionally heavy, clay between 6 and 30 in. Surface soil textures of loamy sands or sandy loams are less common. Gravel lenses may occur at depths below 40 in. They occur on crests and back slopes of older levees or low rises in back plains and are most extensive in Coolibah and Ramsay land systems. Typical vegetation is grassy tall woodland of blue gum, carbeen, silver-leaved ironbark, or, less commonly, coolibah. They correspond with Isbell's (1957*b*) unit 2, medium-textured alluvial soil association. Colours range from dark brown to black and are generally uniform but subsurface colours are sometimes lighter than at the surface. Structure at the surface is granular and grades to weak, fine to medium subangular blocky in the subsoils. Smooth-faced peds are most common but rough-faced peds also occur. Surface soils are friable when dry. Soil reaction is slightly acid to neutral at the surface and grades to moderately or strongly alkaline at depth, where soft carbonate accumulations may occur. The soils generally have medium to good, occasionally imperfect, drainage. In the Callide valley they are cultivated extensively and are less prone to flooding than other alluvial soils.

Consuelo.—These are very deep, stratified alluvial soils, generally coarse loamy sands at the surface but finer-textured in places, and are underlain by layers ranging from sand to clay. Gravel lenses and pisolitic layers are present in some profiles. They occur in broad channels and alluvial flats near present stream courses. Grassy woodlands of blue gum, poplar box, apple gum, carbeen, or rarely ironbark are typical. Colours of surface soils range from yellowish red to grey or very dark greyish brown and vary considerably in the underlying layers. The soils are structureless and generally have a loose, soft consistence at the surface. Soil reaction of coarse-textured layers is generally slightly to moderately acid while clayey layers tend to be alkaline. Internal drainage is medium to imperfect but frequent flooding by overflow occurs and the use of these soils is restricted mainly to grazing of permanent pastures.

(*b*) *Cracking Clay Soils*

These are uniform light to heavy clay soils with pronounced swelling and shrinking properties that may cause heaving and gilgai development (Hallsworth, Robertson, and Gibbons 1955; Isbell 1957*a*; Hubble and Isbell 1958). They occur generally on gentle slopes on a range of materials derived from alluvium, basalt, Permian volcanics and sediments, and reworked deeply weathered materials. They have also formed on colluvial–alluvial materials derived from these rocks. They have been divided into seven families according to differences in depth, parent materials, and microrelief. Depths range from shallow in Bruce family, formed mainly on basalt, to the very deep heavy clays of Pegunny family on Tertiary weathered zone materials.

Frequently, where the surface soils are friable and have granular structure they are correlated with softwood scrub vegetation and an organic clay loam surface texture.

They have poor to imperfect internal drainage although cracking assists water penetration following the dry season. On freshly weathered materials they are normally fertile, but soils formed from deeply weathered materials frequently have gilgai microrelief and are very strongly acid, low in available phosphate, and high in chlorides.

Agricultural development has taken place on the deeper, more fertile cracking clays, particularly May Downs, Teviot, Downfall, and Rolleston families. Less development has occurred on Pegunny soils which are largely derived from infertile, deeply weathered materials and cover an area of approximately 400,000 acres in the centre of the survey area, including part of the Queensland Department of Primary Industries Brigalow Research Station near Theodore.

This group is the second largest in extent and covers an estimated 20% of the area.

Bruce.—The soils of this family are all shallow (less than 24 in.) light to heavy clays that have formed *in situ* in materials derived mainly from basalt or Permian volcanics and sediments. They occur mainly on crests and erosional slopes, generally 2–3% but up to 5%, under grassy woodlands of silver-leaved ironbark, bloodwood, or mountain coolibah. They are similar to the black earth association, shallow phase, of Isbell (1957*b*). Colours are very dark grey or greyish brown at the surface and usually lighter below. Surface soils when dry have a friable, self-mulching, granular structure and are medium to coarse angular blocky and hard beneath. Reaction is moderately acid to neutral at the surface and mildly to moderately alkaline in the lower profiles where carbonate concretions are commonly present. They have medium to good drainage and are generally too shallow for cropping.

May Downs.—This family comprises moderately deep to deep (36–72 in.), sedentary, medium to heavy clay soils derived from basalt or other volcanic rocks. They occur on lower slopes in gently undulating terrain under grassland or open grassy woodlands of silver-leaved ironbark or bloodwood. Linear gilgais are often present and a surface strew of stones sometimes occurs. These soils correspond with the black earth association, deep phase, of Isbell (1957*b*). Surface colours range from very dark greyish brown to black grading to lighter colours in the subsoils which commonly have yellow or red mottles. In the dry state a very thin, granular, friable, self-mulching layer forms at the surface, below which structure is medium to coarse angular blocky and consistence is hard.

Reaction at the surface is slightly acid and at depth becomes mildly to moderately alkaline where soft carbonate accumulations generally occur. The soils have medium to good surface drainage but internal drainage is poor to very poor. They are arable soils with good moisture storage capacities and moderate to high fertility but erosion control measures are necessary for regular cropping.

Teviot.—These soils are moderately to very deep uniform sandy to heavy clays formed mainly in materials derived from Permian mudstones, shales, and calcareous sandstones, some of which have been affected by deep weathering. They occur on upper and middle slopes, generally less than 2% but up to 5%, in gently undulating terrain under grassy woodland and brigalow or softwood scrubs. Very slight linear gilgais sometimes occur and a sparse surface strew of cobbles and rounded billy stones is a common feature. These soils are equivalent to the brown clay association of

TABLE 14

OCCURRENCE OF SOIL FAMILIES IN LAND SYSTEMS FORMED ON WEATHERED ROCKS BELOW THE TERTIARY WEATHERED SURFACE

Percentage area of land system with major soil

Major Group and Family	Coarse-textured Rocks						Fine-textured Rocks																		
							Hills and Tablelands						Undulating to Nearly Level Plains												
	Conloi	Doughboy	Glenhaughton	Mimosa	Redcliffe	Yebna	Lawgi	Malakoff	Mundell	Narran	Toonda	Womblebank	Banana	Barwon	Dakenba	Eurombah	Highworth	Hinchley	Kariboe	Kiddell	Oakleigh	Ramsay	Redrange	Thomby	Wandoan
Alluvial soils																									
Davy	< 5				15	< 5																			
Clematis													< 5												
Alma																									
Warrinilla																									
Moolayember						< 5							< 5					< 5	< 5						
Consuelo				15										< 5						< 5					< 5
Cracking clay soils																									
Bruce													15												
May Downs																				< 5					
Teviot									< 5	15				5		15	10	30		25			20	5	15
Pegunny											10			25	10		30							10	
Downfall									10				15		10	< 5		55		5			< 5	5	15
Rolleston							10		10	15		15	20		50	25	5		20	15	20	15	10	5	5
Vermont	5										< 5		5		< 5					10					
Texture-contrast soils																									
Southernwood	10	5	5						10	30		10					< 5	< 5		5	5	10	10	5	< 5
Medway	15					10		15			5		5	25			< 5				10			5	5
Springwood	< 5	10																							

Taurus	60	5			20	45		15		15								5			10				5
Luxor		60	60	25						< 5		< 5					< 5	< 5			5			5	< 5
Broadmeadow					35																< 5				
Wyseby								< 5			5	10			5		10		5	< 5		< 5	< 5	20	
Retro	5	5	5		10	5		10	5	5	5	< 5	5	45	5		25			5	< 5		5	10	5
Dark brown and grey-brown soils																									
Kinnoul							5		40			20	10		5	25			30	5	20		15		10
Ingelara								10			15											5			< 5
Cheshire							45		5		35	20	5			15			30	15		15	20	10	20
Carraba											10											40		10	5
Red and yellow earths																									
Dunrobin																						5		< 5	
Struan					10																			< 5	
Annandale																									
Forrester				55	5																				
Wilpeena																									
Uniform coarse-textured soils																									
Petrona			15																						
Highmount		15	5																					< 5	
Shallow rocky soils																									
Rugby							35	25	10	5	5	10	15		10	10			10	10	20		15		
Shotover	< 5		10			20		5		< 5															
Outcrop	< 5					10	5	15	5	10	5	10	< 5		< 5	< 5	5		< 5	< 5	< 5		< 5	< 5	< 5

Isbell (1957*b*). Colours range from dark to very dark grey or greyish brown at the surface, gradually becoming lighter at depth. Structure is commonly coarse, granular, and friable at the surface when dry, occasionally platy and firm, merging into coarse angular blocky to massive and hard at depth.

Reaction ranges from strongly acid to strongly alkaline but most commonly is neutral to moderately alkaline throughout the profiles. Surface drainage is medium to good and internal drainage imperfect to poor. Analysis results on samples collected during the survey conform with those of Isbell (1957*b*) with regard to available phosphate which is variable but often low. These soils are suitable for cropping but erosion control measures are required on steep and long slopes.

Pegunny.—The soils of this family are characterized by their uniform medium to heavy clay textures, great depth, and strongly developed gilgai microrelief. Fine water-worn gravel is often present throughout the profiles. They have formed from deeply weathered parent materials and occur in level to very gently undulating areas (slopes less than 0·5 to 2%) frequently in a complex association with texture-contrast soils (Wyseby or Retro families) on the mounds of very large gilgais. Brigalow scrub with varying amounts of belah, blackbutt, or yapunyah is the characteristic vegetation. The gilgais are elongate to semicircular with microrelief of 1–4 ft, occasionally 5 ft or more, and often appear to follow contour lines. These soils correspond with the gilgaied clay association and deep gilgaied soils of Isbell (1957*a*, 1962).

Surface soil colours are very dark grey, greyish brown, reddish brown, or brown generally with darker tones in the depressions than on the mounds. Colours gradually become lighter at depth where prominent yellowish brown, brownish yellow, or grey mottles are common. On the mounds there is a thin crust or platy layer while in the depressions the surface structure is granular. Below the surface horizons in both situations the structure is strong, medium to coarse angular blocky grading to massive at depth. Consistencies are very hard when dry and plastic and sticky when wet. Soil reaction varies from alkaline to acid. Generally the upper profiles are strongly alkaline and may contain soft carbonate accumulations and the lower profiles are very strongly acid with moderate to high contents of soluble salts. The soils are very poorly drained and gilgai depressions may retain water for several months after rain. Owing to generally low nutrient status, particularly with regard to available phosphate (0·1–0·2%), moderate to high contents of soluble salts, poor drainage, and difficult microrelief, these soils are not very suitable for cultivation. With the possible accumulation of nitrogen under brigalow they appear to be best suited to the establishment of improved pastures, but regeneration problems after clearing are often serious and phosphate applications are necessary.

Downfall.—These soils are very similar to those of Pegunny family but gilgai development is only slight to moderate (less than 12 in. vertical interval between mound and depression). Parent materials have apparently been derived from reworked weathered zones and sometimes have an overlay derived from less weathered basic rocks and Permian sediments. They occur generally on very gentle slopes of less than 2% but up to 5% in places, under brigalow and softwood scrubs. These soils are suitable for cultivation and are commonly used for this purpose in the south of the area. Fertility is probably variable depending on the thickness and origin of less weathered materials.

Rolleston.—These soils are similar to those of Downfall family but gilgai microrelief is absent and they are somewhat shallower with rock occasionally at depths between 3 and 5 ft. They occur on gentle colluvial slopes of up to 5% but generally 2–3%, under brigalow scrub or a mosaic of scrub and grassland. They correspond with the brown and dark grey clay catenary association of Isbell (1957*a*). Surface texture is commonly light to medium clay but ranges from clay loam to heavy clay. Gravel may be present throughout the profiles and a surface strew of stones or cobbles generally occurs. Colours at the surface are very dark greyish brown to black grading to greyish brown or yellowish brown at depth with prominent red, yellow, or grey mottles. In the dry state there is a friable, granular to platy, self-mulching layer 2–3 in. thick underlain by strong, coarse angular blocky structure becoming massive at depth. Soil reaction is generally alkaline at or near the surface, gradually becoming acid at depth. Less commonly the soils are alkaline throughout and contain carbonate concretions, or they are slightly acid at the surface and become moderately alkaline at depth. Drainage is medium to imperfect. The soils are considered suitable for crop production.

Vermont.—The soils of this family are very deep, uniform, light to medium cracking clays formed on alluvial materials in nearly level drainage floors and back plains. The typical vegetation is grassy woodland of blue gum or coolibah or, less commonly, silver-leaved ironbark, poplar box, or brigalow scrub. They correspond with the dark grey clay association of Isbell (1957*a*). Colours at the surface are dark grey to very dark greyish brown, occasionally black, and gradually change to lighter colours at depth, commonly with grey, yellow, or reddish brown mottles. A granular self-mulching layer forms at the surface when dry and this is underlain by fine to medium blocky structure that grades to coarse blocky and becomes massive at depth. Dry consistence at the surface is firm to friable and hard to very hard in subsoils. Soil reaction ranges from medium acid to neutral at the surface and gradually becomes strongly alkaline at depth where soft carbonate nodules are commonly present. Some profiles are neutral to mildly alkaline throughout. Both surface and internal drainage are imperfect to poor and the soils are generally subject to flooding by overflow. These soils have moderate to high fertility and high available moisture storage capacities, and they occur in nearly level areas often in close proximity to sources of irrigation water. They are potentially the most productive soils in the area provided that drainage and flood control are feasible.

(*c*) *Texture-contrast Soils*

This group of soils is characterized by abrupt textural contrasts between surface and subsoil horizons. The surface horizons in many of these soils are apparently unrelated to the underlying clayey subsoils and are believed to be polygenetic in origin. Some soils occur on colluvial and/or alluvial slopes of denuded weathering profiles; the surface horizons consist of coarse materials, gravels, and pisoliths derived from the stripping of the Tertiary land surface and the clayey subsoils are truncated or reworked weathered-zone materials. In other members of the group

TABLE 15

OCCURRENCE OF SOIL FAMILIES IN LAND SYSTEMS FORMED ON UNWEATHERED ROCKS BELOW THE TERTIARY WEATHERED SURFACE OR ON ALLUVIA

Percentage area of land system with major soil

Major Group and Family	Unweathered Rocks										Alluvia											
	Bannockburn	Barfield	Bouldercombe	Grevillea	Mourangie	Ohio	Orana	Rosewood	Torsdale	Westwood	Carpentaria	Coolibah	Coreen	Dingo	Gavial	Juandah	Kroombit	Langmorn	Montana	Palmtree	Raglan	Woleebee
Alluvial soils																						
Davy													5									< 5
Clematis						< 5			< 5	< 5		20			20		20			5	35	< 5
Alma											75										< 5	
Warrinilla												< 5		10	< 5	10	5		5	10		
Moolayember			< 5	< 5	< 5					< 5		10			< 5	< 5			< 5			
Consuelo												5			< 5		5					
Cracking clay soils																						
Bruce		60		50		5	25			5												
May Downs		15		15		5	10		25	20												
Teviot																						
Pegunny									< 5				20	5								
Downfall								< 5	< 5				< 5	5								
Rolleston									< 5				20									
Vermont		10	< 5	10		< 5	5		< 5	< 5	25	55	50		65	5	10	10		10	45	
Texture-contrast soils																						
Southernwood			5				20		35							5		10	30			20
Medway	10		20		30	50		40										10				
Springwood																		10				
Taurus					< 5		< 5			< 5				30		35	5					30

Luxor			25															10	20		10
Broadmeadow										5				<5		10						10
Wyseby			5		10									10				15				
Retro	35		10		5	30	<5	20	5			5		35	5	30	50	25	30	35	15	15
Dark brown and grey-brown soils																						
Kinnoul				<5					5	50												
Ingelara					5				<5													
Cheshire				<5																		
Carraba			<5						<5													
Red and yellow earths																						
Dunrobin																						
Struan																						
Annandale																						
Forrester																						
Wilpeena																						5
Uniform coarse-textured soils																						
Petrona			15					<5														
Highmount			5																10	10		
Shallow rocky soils																						
Rugby	25	10		10		5	30	<5	5	10						<5		15	5	5		
Shotover			<5		15			20														
Outcrop	25		<5	10	25	<5		15	5	5								<5	5	<5		

the soils have developed *in situ* from various igneous and sedimentary rocks and probably are more fertile than those formed on strongly weathered materials. Clay illuviation has occurred in some of the soils of this group and typical solodized solonetz with columnar structure have developed, particularly in gum-top box and some poplar box–sandalwood sites of land facets 14–16 (Part III). These soils all have the duplex (D) primary profile forms of Northcote (1965).

From a land use point of view the depth of the surface soil and physical characteristics of the subsoil are of particular importance. Some thin-surfaced texture-contrast soils, for example Retro family, appear to be Rolleston or Downfall cracking clays with a thin loamy overlay, and sometimes incipient gilgai effects show as slight microrelief. Where the subsoil has a moderate to strongly developed blocky structure, roots are able to penetrate deeply. With columnar structure, root penetration may be restricted to the larger cracks. In some dense massive clay subsoils roots are practically absent.

In general, these soils have little agricultural value at present, but because of their widespread occurrence should receive some investigation priority. They are the most extensive and widespread soils and cover an estimated 36% of the area.

Southernwood.—These are shallow soils (24 in. or less to bed-rock) with slightly acid, sand to sandy clay loam surface horizons over acid to mildly alkaline, light to medium clay subsoils. They occur in undulating areas with average slopes of about 5%, but up to 10%, under woodlands of silver-leaved or narrow-leaved ironbarks or softwood scrub. Parent materials are derived mainly from Permian sediments and acid volcanic rocks. Surface soils range from 6 to 15 in. in thickness and are greyish brown to dark greyish brown in colour. Conspicuously or sporadically bleached subsurface horizons 1–3 in. thick generally occur. Subsoils are brownish yellow, greyish brown, or reddish brown in colour and are commonly mottled. The surface soils are structureless and subsoils have coarse subangular blocky structure. Drainage is imperfect. These soils are generally too shallow or steeply sloping for other than grazing use.

Medway.—The soils of this family are similar to those of Southernwood but subsoil reaction is moderately to strongly alkaline and colours are dark to very dark greyish brown, occasionally reddish brown, grey, or black. Stone or gravel strews on the surface sometimes occur and rock outcrops are common. Woodlands of silver-leaved ironbark and bloodwood are typical.

Springwood.—These are deep soils with thin sandy surface horizons over light, medium, or sandy clay subsoils that are acid to mildly alkaline in reaction. They occur on upper slopes in undulating areas and hill foot slopes (generally 5–10% but up to 20%), mainly on sandstones and acid volcanic rocks. Forest or woodlands of narrow-leaved and silver-leaved ironbarks, spotted gum, lemon-scented gum, carbeen, grey bloodwood, and other species occur.

Surface horizons are generally 10–12 in. thick but range from 6 to 15 in., and textures are sands to sandy loams. Colours are brown to dark reddish brown and thin bleached subsurface horizons are sometimes present. They are structureless and reaction is slightly to moderately acid.

Subsoils are red or light grey to yellowish grey, and are often mottled at depth. They generally have subangular blocky structure but sometimes are massive. Iron–manganese concretions are present in some profiles and reaction is commonly slightly acid but ranges from strongly acid to mildly alkaline. The soils have good surface drainage but internal drainage is imperfect.

Steep slopes, poor drainage, and probable low fertility limit the present use to the grazing of native pastures.

Taurus.—These soils are similar to those of Springwood family but have moderately to strongly acid reaction in the subsoils. They occur on crests and upper slopes of gently undulating terrain (slopes generally 2–3%, but up to 10%) under woodlands of narrow-leaved and silver-leaved ironbarks, poplar box, cypress pine, and brigalow scrub. They have formed in parent materials derived from sandstones and denuded weathered zones of laterite profiles. Surface soil textures range from sand to sandy loam and thickness from 2 to 14 in. Structure is generally massive, sometimes weakly granular. Colours are very dark greyish brown to grey or brown, and a conspicuously bleached subsurface horizon is commonly present. Subsoils are sandy to medium clays and are greyish brown to very dark grey in colour. Carbonate concretions are commonly present and structure is coarse angular blocky, occasionally columnar.

Luxor.—The soils of this family are deep to very deep and have thick sandy surface horizons (15–40 in.) over acid to mildly alkaline clayey subsoils. They have formed in parent materials derived from sedimentary and igneous rocks and on the lower zones of denuded laterite profiles. They occur on crests and slopes, generally 3–5% but up to 10%, in gently undulating areas under forests or woodlands of silver-leaved or narrow-leaved ironbarks, grey bloodwood, cypress pine, or, less commonly, softwood scrub. A bleached subsurface horizon occurs which commonly contains gravel and ironstone concretions. The surface soils are structureless and subsoils have weak blocky structure, occasionally columnar or massive. Internal drainage is imperfect and lateral subsurface seepage may cause waterlogging in low-lying areas. In view of their unfavourable physical properties and probably low fertility, they are considered to be better suited to pasture improvement or forestry than to crop production.

Broadmeadow.—These soils are very similar to those of Luxor family but have moderately to strongly alkaline subsoils. They occur in gently undulating areas, generally with slopes of less than 5% but locally 10% or more, under woodlands of narrow-leaved or silver-leaved ironbarks, poplar box, cypress pine, or grey bloodwood. Parent materials are derived mainly from sandstones. Surface soils have brown, grey-brown, or dark greyish brown colours, and a bleached subsurface horizon occurs. Subsoils are brown, olive-brown, or yellowish brown, commonly with prominent mottles. Surface soils are generally massive and subsoils have medium angular blocky, occasionally columnar, structure. Land use capability is similar to that of Luxor soils.

Wyseby.—This family has deep soils (more than 36 in.) with thin loamy surface soils and acid to mildly alkaline subsoils. They occur in gently undulating areas with slopes generally less than 2%, under woodlands of narrow-leaved ironbark, gum-top box, spotted gum, grey bloodwood, and blue gum, as well as blackbutt–brigalow scrub. Parent materials are derived from sedimentary rocks, alluvium, and denuded Tertiary weathered zones.

Surface soils are 6–9 in. thick and textures range from loam to fine sandy clay loam. A surface strew of gravel and cobbles is common. Colours vary from dark brown to black, mainly dark brown or greyish brown, and structure is generally massive. Subsurface horizons are generally bleached and reaction is slightly to strongly acid.

Subsoil textures range from sandy to heavy clay and structure is medium to coarse angular blocky, sometimes columnar. They are brown to dark greyish brown, occasionally red, in colour and brown, yellow, or red mottles are common. Reaction is very strongly acid to neutral. Drainage is imperfect.

Some of the soils of this family, particularly those with blocky friable subsoils with slightly acid reaction, may be suitable for cultivation but in common with other soils of the group as a whole they are regarded as being more suited to improved pastures.

Retro.—These soils are similar to those of Wyseby family but have strongly alkaline reaction in the subsoils. They occur usually in very gently undulating to nearly level terrain on a wide range of parent materials including those derived from alluvium, sedimentary and igneous rocks, and the lower zones of denuded weathering profiles. They support brigalow and softwood scrubs and woodlands of poplar box and silver-leaved ironbark.

Surface soils are generally 4–6 in. thick but range from 3 to 12 in. and textures vary from sandy loam to clay loam, more commonly the latter. They are very dark grey to greyish brown in colour and a thin, bleached subsurface horizon sometimes occurs. Structure is massive to weak granular and gravel and stones on the surface are common. Reaction at the surface ranges from strongly acid to neutral.

Subsoils are sandy to heavy clays and colours range from light or dark greyish brown and yellowish brown to red. They have angular to subangular blocky, occasionally columnar, structure and are moderately to very strongly alkaline in reaction. Carbonate concretions and sometimes gypsum occur at depths of 2–3 ft or more. Drainage is medium to imperfect.

The members of this family which have blocky friable subsoils are considered suitable for cultivation, and the mixing of surface and subsoil horizons by ploughing may improve water and root penetration.

(*d*) *Dark Brown and Grey-brown Soils*

The soils of this group have uniform or gradational, medium to fine textures and have formed on materials derived from basalt, Permian volcanic rocks, shales, and mudstones, which have been affected only slightly or indirectly by deep weathering. They cover about 11% of the area and occur mainly on crests and upper slopes of undulating to hilly terrain under softwood and/or brigalow scrub.

In undisturbed scrubs these soils have a granular, highly organic, surface mulch that has subplastic properties as defined by Northcote (1965). They have strong, medium to coarse angular blocky structure in the subsoils but the friable surface soils are liable to erode severely after land clearing. The soils have limited swelling and shrinking properties and only fine cracks develop when dry. The deeper soils of this group are highly productive under cultivation but erosion control measures and careful management are required. The shallow soils also have moderate to high fertility and are being used widely and successfully for the establishment of exotic pasture grasses.

Kinnoul.—The soils of this family are shallow (12–24 in.), uniform clay loams or light to medium clays formed on materials derived from basalt or Permian volcanic and sedimentary rocks. They occur on upper and mid slopes of 2–5%, but occasionally 10% or more, under softwood scrub. Colours are brown to very dark greyish brown, less frequently reddish brown, throughout. Stones or gravel on the surface are common and are sometimes present in the profiles. Reaction is moderately alkaline throughout or slightly acid at the surface, becoming alkaline beneath where carbonate concentrations may be present. The soils are moderately well drained, but are generally too shallow for cultivation. They are used extensively for improved pastures, which are established by burning the pulled scrub and sowing in the ashes.

Ingelara.—These soils are very similar to those of Kinnoul family but are moderately to strongly acid throughout. They occur in hilly terrain on upper slopes of 5–15% on materials derived from acid volcanic and sedimentary rocks, under softwood scrub or microphyll vine woodland. Areas of these soils are generally best suited to light grazing or forestry.

Cheshire.—These soils are moderately deep to deep (>36 in.) and have either uniform light to medium clay textures throughout or grade from loam or clay loam at the surface to light or medium clays within 12–24 in. They occur on crests and upper slopes of 2–3%, but 5% or more in places, under softwood scrub. Parent materials are derived from basic volcanic rocks, shales, mudstones, or colluvium. Surface colours are generally dark to very dark brown, occasionally grey or brown, and gradually change to yellowish or reddish brown in the subsoils. Surface soils have granular structure grading to subangular blocky in subsoils, which sometimes become massive at depth. Reaction is neutral to moderately acid at the surface and grades to moderately or strongly alkaline in the subsoils where soft carbonate concretions are common. The soils have moderate to imperfect drainage, moderate to high fertility, and good structure.

Carraba.—These soils are similar to those of Cheshire family but have strongly to very strongly acid reaction in the subsoils. They occur on upper slopes of 2–5%, but up to 15% in hilly areas, under softwood scrub, microphyll vine woodland, and, less commonly, woodlands of silver-leaved ironbark, gum-top box, and lemon-scented gum. Parent materials are derived from strongly weathered colluvium or acid volcanic rocks. Colours are dark grey-brown or red throughout or they change gradually to reddish or yellowish brown at depth. Surface texture ranges from sandy loam to clay loam and grades to light or medium clays. Reaction is neutral to strongly acid at the surface and strongly to very strongly acid at depth. In Ramsay land system the soils are usually neutral to slightly acid throughout. They are moderately to well drained.

(*e*) *Red and Yellow Earths*

The soils of this group occur on more or less intact residuals of the Tertiary land surface or in erosional–depositional sites on materials derived from the stripping of the old surface. They have also formed on coarse- to medium-textured alluvia in well-drained situations. They occur mainly in the north-west in Narowie, Kaiuroo, Mimosa, and Duaringa land systems and cover less than 4% of the area. The soils are characterized by their red or yellow colours, massive structure, and gradational, occasionally uniform, texture profiles. They have formed mainly on Tertiary sediments, but also on other rocks that were subjected to intense weathering and leaching, and consequently they have low fertility. The group is subdivided into five families according to differences in colour, texture, and parent material.

Dunrobin.—These are deep, dark brown to reddish brown sandy loams or sandy clay loams which grade to red or dark red, sandy clay loam or clay loam at depths of less than 24 in. and generally grade to light clay at depth. Occasionally they have uniform medium textures throughout. They occur on nearly level to gently sloping terrain under forest or woodland of narrow-leaved or silver-leaved ironbarks, grey bloodwood, spotted gum, rosewood, or yellowjack, commonly with an understorey of wattle and quinine. Structure is usually massive and subsoils have an earthy porous fabric. Small to moderate amounts of concretionary ironstone occur in some profiles. Soil reaction is generally slightly acid to neutral throughout but some soils become moderately to strongly acid at depth. The soils are well drained.

Struan.—These soils are similar to those of Dunrobin family but they have brown or yellowish brown subsoils and they generally occur on gentle slopes below areas of red earths in slightly less well-drained situations. Concretionary ironstone commonly occurs in the subsoils.

Annandale.—These soils have sand to sandy loam textures to depths of 2 ft or more, and the clay content commonly increases to sandy clay loam or clay loam at depth. They occur on crests and upper slopes in gently undulating areas under woodlands of narrow-leaved ironbark, grey bloodwood, or, less frequently, stringybark and Moreton Bay ash. Depths exceed 40 in. The surface soils are about 6 in. thick and are dark brown or reddish brown grading to red in the subsoils. They are structureless and have soft loose consistency at the surface. Soil reaction is slightly acid to neutral throughout but some profiles become strongly acid at depth. They are well drained.

Forrester.—These are deep sandy yellow earths similar to those of Annandale family but they have brownish yellow to yellowish brown subsoils that are sometimes mottled. They occur in similar situations under woodlands of narrow-leaved ironbark or grey bloodwood. Concretionary ironstone commonly occurs in the subsoils. Soil reaction is generally moderately acid at depth.

Wilpeena.—The red and yellow earths of this family have developed on coarse- to medium-textured alluvial materials. They occupy extensive areas in Mimosa land system under woodlands of silver-leaved ironbark, grey bloodwood, and carbeen. Profiles are more than 40 in. deep. Textures in surface horizons are commonly sandy loams or loamy sands that grade to sandy clay loam or light clay at depth. A little concretionary ironstone sometimes occurs. Colour at the surface is dark brown to dark reddish brown and grades to red or yellowish brown at depth where mottling is uncommon. Structure is massive throughout and the soils are well drained.

(*f*) *Uniform Coarse-textured Soils*

The soils of this group are uniform sands to sandy loams generally with little profile development apart from slight organic accumulation at the surface. They occur on materials derived from quartz sandstone, granite, and denuded weathering profiles on colluvial slopes. They are well drained but have low fertility and poor water-retaining capacities and are not very suitable for crop production. They cover about 4% of the area. Two families are distinguished according to differences in depth.

Petrona.—These are uniform, structureless sands to sandy loams less than 36 in. deep. They occur on crests and upper slopes under woodlands of narrow-leaved ironbark, lancewood, yellowjack, cypress pine, and apple gum. Surface soils are dark grey or brown to grey or brown and grade to light or very pale brown or yellow at depth. Reaction is neutral to moderately acid at the surface and slightly to strongly acid in the lower profiles.

Highmount.—These soils are very similar to those of Petrona family but are more than 36 in. deep, and reaction ranges from moderately acid to mildly alkaline.

(*g*) *Shallow Rocky Soils*

These are very shallow soils less than 12 in. deep with little or no profile development and they occur in hilly or mountainous terrain on slopes exceeding 5%. They occupy about 11% of the area. Two families are recognized on the basis of texture and parent material differences.

Rugby.—These soils have medium to fine textures and occur on basalt, volcanic, and sedimentary rocks. They are generally gravelly or stony and rock outcrops are frequent. They are brown or dark brown loams to light clays and are usually massive. Vegetation is microphyll vine woodland, softwood or brigalow scrubs, or shrub woodland. The soils have slightly acid to neutral reaction and are well drained.

Shotover.—The soils of this family are sands to coarse sandy loams on sandstone and granite materials. They occur on crests and steep upper slopes under sandstone or high forest, or lancewood and rosewood scrubs. They are structureless, moderately to strongly acid, and excessively drained.

IV. Acknowledgment

Analyses of the soil samples collected during the survey were carried out in the laboratories of the Queensland Department of Primary Industries, Brisbane, under the direction of F. Chippendale.

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PART VIII. VEGETATION OF THE DAWSON–FITZROY AREA

By N. H. Speck*

I. Introduction

The common vegetation of the area on coarse- to medium-textured soils is some form of eucalypt grassy woodland or forest. Closed woody communities ("softwood scrub" and brigalow "scrub") occur on large areas of fine-textured soils. Small areas of treeless grassland also occur on fine-textured soils but not to the extent that they do in lower-rainfall areas (Pedley 1967; Story 1967). Very small areas of wet sclerophyll forest and low rain forest (microphyll vine woodland) are restricted to the north-east where mean annual rainfall exceeds 40 in.

Many of the communities have a tall shrub–low tree layer, some of these layers being associated with particular habitats, e.g. various combinations of *Petalostigma pubescens*, *Lysicarpus angustifolius*, *Alphitonia excelsa*, and *Acacia cunninghamii* are indicative of the old weathered land surface and *Eremophila mitchellii* occurs with some brigalow forests and some eucalypt woodlands (particularly *Eucalyptus populnea*).

In this area each grass layer community is associated with a particular range of tree layer communities, which obviates the need for a synusial treatment like that used in the Leichhardt–Gilbert (Perry and Lazarides 1964) and Nogoa–Belyando areas (Pedley 1967). The reason for the closer association here between tree and grass communities is not clear but it seems to be a feature of higher-rainfall areas throughout northern Australia, whereas a marked lack of association is a feature of lower-rainfall areas.

The vegetation has been classified into 74 floristic communities within four structural forms (subtropical rain forest, forest, woodlands, and grassland). Classification follows Webb (1959) for subtropical rain forest and Beadle and Costin (1952) for other structural forms. The distribution of the communities can be obtained from the land system descriptions (community numbers in the following text are used in the land system descriptions) and in a more generalized way from the vegetation map.

II. Description of the Vegetation

(a) Subtropical Rain Forest

Highly developed rain forests do not occur within the survey area. Those reduced forms that do occur have been classified by Webb (1959) as woodland, thicket, and scrub.

(i) *Microphyll Vine Woodland*

(1) Microphyll vine woodland has two tree layers. The lower consists of slender, densely packed trees forming a continuous canopy 20–40 ft high. The upper layer is

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TABLE 16

COMPOSITE FLORISTIC LIST FOR SEMI-EVERGREEN VINE THICKET

Occurrence	Emergents (30–60 ft)	Canopy Layer (15–20 ft)	Shrub Layer (4–8 ft)	Ground Layer	Lianes
Common	*Brachychiton rupestre*	*Flindersia australis*	*Exocarpos latifolius*	*Ancistrachne uncinulatum*	*Cissus opaca*
		Bauhinia carronii	*Carissa ovata*	*Chloris unispicea*	*C. oblongata*
		Macropteranthes leichhardtii	*Acalypha eremorum*	*Cyperus gracilis*	*Jasminum racemosum*
					Passiflora sp.
					Marsdenia sp.
					Sarcostemma australe
					Tylophora sp.
					Malaisia scandens
Local	*Flindersia australis*	*Owenia* sp.	*Hovea longipes*	*Aporuellia australis*	
	Cadellia pentastylis	*Mallotus claoxyloides*	*Canthium* spp.	*Abutilon oxycarpum*	
	Casuarina cristata	*Tieghemopanax elegans*	*Heterodendrum diversifolium*	*Cheilanthes distans*	
	Acacia harpophylla	*Alphitonia excelsa*	*Citriobatus spinescens*	*Aristida* sp.	
	Bauhinia carronii	*Elattostachys bidwillii*			
	Homalium alnifolium	*Bridelia leichhardtii*			
	Backhousia sciadophora	*Alectryon connatus*			
		Murraya ovatifoliolata			
		Maba geminata			
		Elaeodendron melanocarpum			
		Croton insularis			
		Denhamia obscura			
		Strychnos arborea			
		Geijera parviflora			

formed by discontinuous, mostly evergreen or semi-evergreen emergents. Coniferous or deciduous emergents are rare or absent. Robust lianes are common. The shrub understorey is commonly dense and the ground layer is sparse with abundant litter.

Except for some difference of proportion of species in the emergent layer, in particular the reduction or absence of *Brachychiton rupestre*, the species are very similar to those in the semi-evergreen vine thicket (Table 16).

There is considerable variation in quality of microphyll vine woodland throughout the area. It is only in the more favourable environments that it maintains its typical form. In many places it grades into semi-evergreen vine thicket or it is reduced to depauperate forms.

Because of the scale of the survey and the relative economic unimportance and restricted distribution of the form, it has not been subdivided.

It is typically restricted to the steeper, upper slopes of brigalow–softwood country in the higher-rainfall environments. Commonly it grades downslope into semi-evergreen vine thicket. Although the soils are fertile they are shallow and rocky and the slopes are too steep for agricultural development, and the community is rarely cleared.

(ii) *Semi-evergreen Vine Thicket.*—This rain-forest form is related to microphyll vine woodland, is considered to be a reduced form of it, and is commonly known as softwood scrub. The canopy level is lower (15–20 ft), uneven, and is formed of more slender trees closely packed, with mixed evergreen, semi-evergreen, and deciduous emergents (30–60 ft). Conspicuous among these are the swollen stems of the bottle trees (*Brachychiton rupestre*). Lianes are fewer but still common. The shrub understorey is generally dense but the ground layer is sparse. Litter is abundant. The most common species are listed in Table 16.

Typically, these semi-evergreen vine thickets occur on gently rounded crests or grade into microphyll vine woodland when it occurs on slopes above them. Downslope they commonly grade into and form associations with *Acacia harpophylla* (brigalow), *Casuarina cristata* (belah), and *Eucalyptus* spp. Although the boundaries between these "associations" are not sharply demarcated, the communities tend to characterize particular slope environments. The most important communities are described below.

(2) Softwood scrub is the typical form of the semi-evergreen vine thicket. It occurs on gently rounded crests of many land systems and is the most important of the softwood scrub communities. It is being extensively cleared for cultivation or improved pastures.

(3) Softwood scrub with *Cadellia* differs mainly in that *Cadellia* is prominent as an emergent. In many places *Acacia harpophylla* is also present.

(4) Softwood scrub with brigalow is a semi-evergreen vine thicket with all of the elements of (2), but *Acacia harpophylla* occurs as scattered emergents near the crests and in increasing numbers downslope, grading more or less sharply into other brigalow communities. It is widespread and important in a number of land systems.

(5) Softwood scrub with brigalow and *Bauhinia* differs from (4) mainly in that *Bauhinia carronii* is conspicuous both in the canopy and as an emergent. This makes

for less distinction between the two layers, and commonly there are gaps in the canopy. The community occurs mainly on the gentle mid slopes.

(6) Softwood scrub with brigalow and rosewood is a semi-evergreen vine thicket in which *Acacia harpophylla*, *A. rhodoxylon*, and *Brachychiton rupestre* occur as emergents above a dense canopy dominated by *Croton* spp., but also with many of the usual softwood elements. Scattered *Eucalyptus exserta* and *E. crebra* occur.

(7) Softwood scrub with *Eucalyptus cambageana* has all the usual elements of semi-evergreen vine thicket but also has *E. cambageana* in the emergent layer. In many places this community grades into others so that in places *Acacia harpophylla* or *Casuarina cristata* also are represented among the emergents. In some places it grades downslope into the brigalow–*Eucalyptus cambageana* community.

(8) Softwood scrub with *Casuarina* is a semi-evergreen vine thicket in which *Casuarina cristata* dominates the emergent layer. *Brachychiton rupestre* is rare or absent. In places it forms an ecotone area between softwood scrub and brigalow.

(9) Sundry softwood scrubs include several types of semi-evergreen vine thickets of limited distribution and importance.

(*a*) In the higher-rainfall parts of Toonda land system remnants of vegetation suggest that there had been dense softwood canopy with *Brachychiton rupestre*, *Eucalyptus tereticornis*, *E. crebra*, and *E. polycarpa* as emergents.

(*b*) Softwood scrub with *E. moluccana* was recorded only as a minor community in Toonda land system.

(*c*) Softwood scrub with *E. orgadophila* was recorded on several land systems only in the southern part of the area.

(*d*) Softwood scrub with *E. melanophloia* has a limited distribution in Banana and Bouldercombe land systems. It grades in places into depauperate semi-evergreen vine thicket (10).

(10) Depauperate semi-evergreen vine thicket is very variable. It characteristically comprises dense shrubby trees (6–8 ft) forming a discontinuous canopy with occasional emergents (15–20 ft), mainly *Brachychiton rupestre* and/or *B. australe*. Scattered eucalypts also occur as emergents in places.

(*b*) *Forest*

(i) *Wet Sclerophyll Forests*.—These are restricted to Gelobera land system and to those parts of the land system that occur in the higher-rainfall parts. Only one community has been described although several other communities grade into wet sclerophyll forest locally.

(11) *Eucalyptus tenuipes–E. crebra* form a community of closely spaced trees with interlacing canopy 60–80 ft high. A well-developed but discontinuous shrub layer of palms, cycads, *Xanthorrhoea*, and ferns occurs. The herbaceous layer is mostly non-gramineous. The community grades into dry sclerophyll forest.

(ii) *High Forest*.—These dry sclerophyll forests are generally characterized by tall trees (60–100 ft) with usually interlacing crowns, a well-developed discontinuous layer of shrubs, and commonly a sparse to moderate discontinuous herbaceous stratum.

(12) *Eucalyptus fibrosa–E. maculata* community is tall forest (80–100 ft) with a moderately spaced dominant layer with scarcely interlacing crowns. *E. exserta* occurs in places as a smaller tree. A fairly open shrub layer is formed by *Exocarpos* sp. and *Acacia* spp. Three-awn grass (79) (*Aristida* spp., *Themeda australis*) forms a very sparse ground layer. In Yebna land system *Callitris columellaris* also occurs and is sparse to moderately abundant.

(13) *Eucalyptus crebra–E. maculata* community is tall forest of high quality. Tall straight trees (80–100 ft) with a usually interlacing canopy characterize the dominant layer. A tall shrub layer (*Acacia glaucocarpa, A. cunninghamii, Alphitonia excelsa, Petalostigma pubescens,* and *Eremophila* sp.) is well developed. The grass layer (forest grass) is rather patchy and includes *Cymbopogon refractus, Aristida caput-medusae, A. ramosa, Arundinella* sp., *Eragrostis* sp., *Gahnia* sp., and *Cyperus* sp.

(14) *Eucalyptus citriodora–E. crebra* community is also tall forest of high quality, resembling (13) in structure. It has a well-developed shrub layer (*Lysicarpus angustifolius, Alphitonia excelsa, Petalostigma pubescens, Acacia* sp., *Persoonia falcata,* and *Xanthorrhoea* sp.). The ground layer (forest grass) is mainly *Cymbopogon refractus, Themeda australis, Heteropogon contortus, Arundinella* sp., *Aristida* sp., and *Eragrostis* sp.

(15) *Eucalyptus crebra–E. maculata–E. drepanophylla* community is composed of tall trees (80–100 ft). The density is increased by a smaller tree, *Callitris columellaris.* The shrub layer (*Acacia* sp., *Petalostigma pubescens*) is sparse. Forest grass (*Cymbopogon refractus, Eragrostis* sp., and *Aristida* spp.) characterizes the sparse ground layer.

(16) *Eucalyptus crebra–E. drepanophylla–Callitris* community has a very dense tree layer (60 ft), moderate to sparse shrubs (*Alphitonia excelsa, Geijera parviflora, Acacia* sp., and *Carissa ovata*), and sparse forest grass (*Cymbopogon refractus* and *Paspalidium* sp.) as the ground layer.

(17) *Eucalyptus fibrosa–E. polycarpa–Casuarina–Callitris* community is moderately open forest (some clearing effect suspected) characterized by the above eucalypts with scattered *Casuarina* sp. and *Callitris columellaris.* Shrubs (*Alphitonia excelsa* and *Acacia* sp.) are sparse and the ground layer is forest grass.

(18) *Eucalyptus melanophloia–E. drepanophylla–Callitris columellaris* community is forest which, except for different eucalypts, closely resembles (16).

(19) *Eucalyptus melanophloia–Callitris columellaris–Casuarina luehmannii* community is moderately dense forest but seldom exceeds 50 ft in height. Shrubs (*Eremophila mitchellii* and *Acacia* sp.) are sparse. The ground layer is forest grass (*Cymbopogon refractus, Stipa* sp., *Bothriochloa* sp., *Aristida* spp., and *Heteropogon contortus*).

(20) *Angophora costata–Eucalyptus dealbata–E. polycarpa–E. crebra* community is moderately dense forest (50–60 ft) with abundant tall shrubs (*Acacia glaucocarpa, A. cunninghamii, Alphitonia excelsa, Petalostigma pubescens, Dodonaea* sp., and *Exocarpos* sp.). Forest grass (*Cymbopogon refractus, Aristida* sp., *Heteropogon contortus, Arundinella* sp., and *Chloris* sp.) forms a sparse to moderate ground storey.

(21) *Eucalyptus tereticornis–Casuarina luehmannii* with scattered *E. tessellaris* form the moderately open tree layer (60–70 ft) of forests which are important in Redcliffe and Wooroonah land systems. Shrubs (*Grevillea striata* and *Petalostigma pubescens*) are scattered and the ground layer is sparse to moderate forest grass.

(22) *Eucalyptus tereticornis–Angophora floribunda* and an assortment of other eucalypts (*E. polycarpa, E. crebra, E. drepanophylla, E. maculata,* and *E. tessellaris*) form close stands of tall trees (80–100 ft) on some tributary drainage floors. Shrubs (*Acacia* spp., *Petalostigma pubescens*) are sparse. The ground layer is tall, moderately dense frontage grass (*Arundinella* sp., *Heteropogon contortus, Aristida* sp., and *Dichanthium sericeum*).

(23) *Angophora costata–Eucalyptus tereticornis–E. crebra* and scattered *E. polycarpa, E. moluccana,* and *Casuarina luehmannii* characterize the tree layer (60–70 ft) of forests which occur on drainage floors. Shrubs (mostly *Acacia* spp.) are sparse. The ground layer is three-awn grass community (*Aristida* spp., *Themeda australis,* and numerous small sedges).

(24) *Eucalyptus acmenioides–Angophora costata* with scattered *E. polycarpa* characterize the tree layer (80–100 ft) of tall open forests that occur on upper colluvial slopes. Shrubs (*Lysicarpus angustifolius, Petalostigma pubescens*) are sparse. Sparse three-awn grass (mostly *Aristida* spp.) constitutes the ground layer.

(iii) *Sandstone Forest*.—These forests are floristically rich in both the tree and shrub layers, but vary from place to place. Three main habitat types were recognized.

(25) Sandstone forest of the rocky plateaux and steep slopes is characterized by *Eucalyptus watsoniana* and a rich assortment of other trees (*Angophora costata, Eucalyptus crebra, E. cloeziana, E. polycarpa, E. peltata, E.* sp. nov.). Although many of the trees are tall (60–90 ft) and straight, many, particularly the bloodwoods, are gnarled and twisted. The forest is moderately dense and there is considerable interlacing in the canopy. There are several smaller trees (*Casuarina inophloia* and *Lysicarpus angustifolius*), a very rich shrub layer (*Petalostigma glabrescens, Grevillea longistyla, Acacia excelsa, A. complanata, A. flavescens, A. juncifolia, A. jucunda, Alphitonia excelsa, Leptospermum attenuatum, Notelaea longifolia, Astrotricha pterocarpa, Boronia rosmarinifolia, B. glabra, B. bipinnata, Pultenaea cunninghamii, Dodonaea vestita*), and numerous forbs (*Cryptandra amara, Helichrysum apiculatum* sens. lat., *Mirbelia pungens, Macarthuria ephedroides*). Forest grass with spinifex (*Triodia mitchellii, Cymbopogon refractus, Arundinella* sp., *Chloris* sp.) is the common ground storey.

(26) Sandstone forest of the sandy lower slopes is characterized by *Angophora costata, Eucalyptus tenuipes, E. watsoniana, Callitris columellaris,* and several other scattered eucalypts. The shrub layer is more open and not as rich as in (25) and includes *Lysicarpus angustifolius, Acacia* sp., *A. juncifolia, Hibbertia stricta, Hovea longifolia, Dodonaea filifolia,* and *Euphorbia* sp. Forest grass with spinifex (*Triodia mitchellii, Cymbopogon refractus,* and *Aristida* sp.) provides a sparse ground layer. Forbs (*Dianella* sp., *Lomandra* sp., and several composites) are numerous.

(27) Sandstone forest of the crest divides is characterized by *Eucalyptus crebra, E. tenuipes, E. polycarpa, E. cloeziana,* and scattered *Angophora costata, Callitris*

columellaris, and *E. maculata* in the tree layer. The moderate shrub and grass layers are similar to (26).

(iv) *Rosewood Forest*.—This group of forest communities is characterized by *Acacia rhodoxylon* (rosewood) either as a dominant or co-dominant with *Eucalyptus* spp. Three communities are recognized.

(28) *Acacia rhodoxylon* (rosewood) forms dense stands of slender trees with interlacing crowns (40–45 ft) with scattered eucalypts (*E. exserta* and *E. polycarpa*). Several smaller trees (*Flindersia australis* and *Acacia* sp.) have a scattered distribution. Tall shrubs (*Alphitonia excelsa* and *Alstonia* sp.) and lower shrubs (*Croton* sp., *Hovea* sp., *Erythroxylum* sp.) are sparse. Scant three-awn grass (*Aristida caput-medusae, Paspalidium gracile, Chloris* sp., *Leptochloa* sp., *Eriochloa* sp., and *Eragrostis* sp.) forms the ground layer.

(29) *Acacia rhodoxylon–Eucalyptus melanophloia* with scattered *E. crebra* form dense forests and woodlands which characterize Rosewood land system. Shrubs (*Alphitonia excelsa, Grewia retusa,* and *Carissa ovata*) are sparse. Forest grass (*Cymbopogon refractus, Leptochloa decipiens, Bothriochloa decipiens, Heteropogon contortus, Aristida* sp., *Chloris pectinata, Eriochloa pseudo-acrotricha*) forms a moderate grass layer. In most places this community has been very much modified by selective cutting.

(30) *Acacia rhodoxylon–Eucalyptus crebra* with *E. moluccana* in places characterize a taller (30–60 ft) forest that locally grades to woodland. The shrub layer (*Alphitonia excelsa, Grevillea striata, Hakea lorea, Acacia cunninghamii, Acacia* sp., *Cassia brewsteri, Petalostigma pubescens, Alstonia constricta,* and *Heterodendrum diversifolium*) is well developed. Forest grass (*Cymbopogon refractus, Bothriochloa decipiens, Aristida* sp., *Leptochloa* sp., *Paspalidium* sp., *Chloris unispicea*) forms a moderate ground storey. In many places this community has been modified by selective cutting or clearing, in which cases the ground storey more closely resembles eastern mid-height grass.

(v) *Lancewood Forest*.—These forests closely resemble rosewood forests both in structure and in general habitat requirements, and in places there is some mingling of the two communities. They comprise dense stands of slender trees (30–50 ft), in some places with scattered eucalypts or other trees but more typically forming a monospecific layer. Both shrubs and grasses are generally sparse. Two types have been described.

(31) *Acacia shirleyi* (lancewood) as monospecific forest, or with occasional eucalypts (*E. citriodora, E. crebra, E. exserta, E. cloeziana,* or *E. polycarpa*), is restricted to steep hill slopes and breakaways. Scattered *Alphitonia excelsa, Petalostigma pubescens, Eriostemon difformis, Erythroxylum* sp., and *Heterodendrum* sp. form a very sparse shrub layer. Sparse three-awn grass (*Aristida* sp., *Eragrostis* sp., *Eriachne* sp., and *Cymbopogon refractus*) forms the very open ground layer.

(32) *Acacia shirleyi–Callitris columellaris–Eucalyptus crebra* form a related community of different appearance because of the presence of cypress pine (*Callitris columellaris*). Shrubs and three-awn grasses are both sparse. The community occurs as local patches on stony hill slopes.

TABLE 17

COMPOSITE FLORISTIC LIST FOR BRIGALOW FOREST

Tree Layer	Tall Shrub Layer	Low Shrub Layer	Ground Layer	Lianes
Acacia harpophylla	*Geijera parviflora*	*Carissa ovata*	*Paspalidium caespitosum*	*Cissus opaca*
Eucalyptus cambageana	*Terminalia oblongata*	*Heterodendrum diversifolium*	*P. constrictum*	*Capparis lasiantha*
E. thozetiana	*Eremophila mitchellii*	*Denhamia obscura*	*P. gracile*	*Jasminum lineare*
E. populnea	*Opuntia tomentosa*	*Erythroxylum australe*	*Chloris unispicea*	
E. melanophloia	*Atalaya hemiglauca*	*Apophyllum anomalum*	*C. acicularis*	
E. moluccana	*Bauhinia carronii*	*Indigofera australis*	*Leptochloa debilis*	
Casuarina cristata	*Croton phebaloides*	*Canthium vacciniifolium*	*L. digitata*	
Terminalia oblongata	*C. insularis*	*Spartothamnella juncea*	*Sporobolus caroli*	
Bauhinia carronii	*Ehretia membranifolia*	*Citriobatus spinescens*	*S. elongatus*	
Brachychiton rupestre	*Canthium odoratum*	*Capparis lasiantha*	*Panicum juncei*	
	Capparis mitchellii	*Atriplex muelleri*	*Aristida* spp.	
	C. loranthifolia	*Chenopodium* sp.	*Cheilanthes distans*	
	Eremocitrus glauca	*Enchylaena tomentosa*		
	Flindersia australis	*Kochia* sp.		
	Alectryon connatus	*Rhagodia hastata*		
		Salsola kali		
		Bassia tetracuspis		

(vi) *Brigalow Forest*.—Brigalow is the common name of *Acacia harpophylla* and communities dominated by it are locally known as brigalow scrub. Some variation within the species has been recognized (Johnson 1964). From a practical standpoint, growth form differences that are very marked in the field are of great importance and can generally be related to clearing, burning, or similar influences.

Tall or virgin brigalow are names used for communities of tall mature trees. The trees have straight erect trunks branching only near the top to form rounded, umbrella-shaped crowns which, although they form a more or less continuous canopy, exhibit very little interlacing. The tree layer usually averages 40–60 ft in height, down to 30 ft in the drier western limits and up to 80 ft in some scrubs in the higher-rainfall parts, with corresponding density from open forest to closed communities.

Sucker brigalow, usually less than 12 ft high, has a characteristic low branching habit. Brigalow of this growth form commonly results from an inefficient burn or incorrect management following clearing. Suckers (20–30 shoots from a single root) are produced from adventitious buds on lateral roots. Continual grazing of these young suckers tends to increase the number of shoots. With age the shoots become thinner and may develop into whipstick brigalow after about 30 years (Johnson 1964).

Whipstick brigalow is a growth form of brigalow comprising numerous slender erect stems (2000–9000 per acre) and is about 12–30 ft in height. The lower branches become self-pruned and branching is restricted to the upper parts. Some stands of whipstick brigalow are known to be 50 years old and it is not known what period of time must elapse before mature brigalow is formed (Johnson 1964). Because these growth forms are related to the history of the site and not to basic environmental factors an attempt has been made to recognize the original communities for each site and to describe them as mature communities.

A list of the main species commonly associated with the various layers of brigalow forest is given in Table 17.

A number of brigalow communities distinguished by associated trees are recognized. In all of them the ground layer is the brigalow scrub grass community (76).

(33) *Acacia harpophylla–Eucalyptus cambageana* community is a brigalow forest with moderately dense, tall slender brigalow and scattered, more spreading *E. cambageana*. A well-developed nearly continuous tall shrub–small tree layer (10–20 ft) is common and smaller shrubs are numerous.

The community characteristically occurs on the steeper mid slopes of the brigalow–softwood landscape.

(34) *Acacia harpophylla–Eucalyptus thozetiana* (yapunyah) is a brigalow forest community closely resembling (33). It typically occurs downslope from (33) but in places there is some mingling of the two communities.

(35) *Acacia harpophylla–Bauhinia carronii* is a brigalow forest community in which these two species characterize the tree layer. Small gaps in the canopy are common. It occurs on slopes in coarse-textured alluvium locally dissected into gently rounded spurs.

(36) *Acacia harpophylla–Casuarina cristata* (belah) brigalow forest is extensive and widespread on the gentle colluvial–alluvial slopes of most of the brigalow–

softwood country. Except where the belah is very dense, the shrub and ground layers resemble the other brigalow forests. All gradations from almost pure brigalow (38) to almost pure belah occur.

(37) *Acacia harpophylla–Terminalia oblongata* (yellowwood) is a brigalow forest restricted to the northern part of the area. Yellowwood occurs as a small tree or tall shrub and although other shrubs (*Geijera parviflora, Eremophila mitchellii, Ehretia membranifolia*, and *Eremocitrus* sp.) are present it tends to dominate the understoreys of the community. Yellowwood appears to increase with clearing or disturbance.

(38) *Acacia harpophylla–Geijera parviflora* (wilga)–*Eremophila mitchellii* (sandalwood) community is a brigalow forest characterized by dense, more or less pure stands of brigalow and a well-developed small tree–tall shrub layer dominated by *Geijera parviflora* and *Eremophila mitchellii*. It is a widespread community and occurs typically on the lower slopes of the brigalow–softwood landscapes.

(39) *Acacia harpophylla* without shrub layers or with very much reduced shrub layers occurs in places that are frequently flooded, as in Coreen and parts of Dakenba land system. In the northern parts of the area, *Terminalia oblongata* is common in the brigalow forest on these sites. In disturbed areas numerous *Eucalyptus microtheca* saplings occur.

(40) *Acacia harpophylla–Eucalyptus populnea* (poplar box) is an ecotone community between brigalow forest and poplar box grassy woodland. The subordinate layers resemble brigalow forest.

(vii) *Bendee Forest*.—Only one community is included in this group.

(41) *Acacia catenulata* (bendee) forms dense, almost pure forest on the gently rounded crest surfaces of Kaiuroo land system. Only limited observations were possible because of extensive clearing.

The tree layer comprised dense stands of *A. catenulata*, in general appearance very similar to brigalow forest but lacking the well-defined small tree–tall shrub layer so typical of brigalow forest. Only one shrub species (*Lysicarpus angustifolius*) was observed. Grasses were also very scarce and consisted mainly of *Aristida caput-medusae*. It is difficult to account for the distribution of these forests as the soils and site factors seem identical with those of the adjoining *Eucalyptus crebra–E. polycarpa* shrub woodlands.

The community occurs only in the extreme north-west of the area.

(viii) Casuarina *Forest*.—Although three *Casuarina* species form important constituents (locally dominants) of a number of communities, pure stands are rare. *Casuarina cristata* (belah) has been described as a co-dominant, locally forming almost pure stands with brigalow or softwood scrub. *C. cunninghamiana* is a frequent and conspicuous element of the fringing forests associated with the streams of the area. *C. luehmannii* is widely scattered in various proportions throughout the tall forests and sandstone forests and in places forms relatively pure stands.

(42) *Casuarina luehmannii* forms quite dense local stands. Shrubs are sparse and the three-awn grass ground layer is discontinuous.

(ix) Callitris *Forest.*—*C. columellaris* is extremely widespread, commonly on coarse-textured soils. It occurs in many communities as a scattered tree but only in certain very sandy habitats is it a dominant.

(43) *Callitris columellaris* associated with scattered eucalypts (*E. crebra, E. polycarpa, E. tereticornis*) and *Angophora costata* is widespread in the southern part of the area. It is very closely related to communities (16)–(19). The shrub layer is sparse to moderate, mainly *Petalostigma pubescens, Acacia* sp., *Hakea lorea,* and *Lysicarpus angustifolius.* Forest grass (*Cymbopogon refractus, Heteropogon contortus, Aristida* sp., and *Eragrostis* sp.) forms a sparse grass layer.

(*c*) *Woodlands*

(i) *Shrub Woodland.*—This subform is characterized by a discontinuous dominant stratum in which the crowns of the dominants are separated by a distance greater than the diameter of the crown, a discontinuous but well-developed tall shrub stratum, a discontinuous smaller shrub stratum, and a continuous or discontinuous herbaceous stratum.

(44) *Eucalyptus melanophloia* (silver-leaved ironbark) with scattered *E. polycarpa* and locally *E. tessellaris* form an open tree layer (40–60 ft). Tall shrubs (*Petalostigma pubescens, Alphitonia excelsa, Lysicarpus angustifolius,* and *Eremophila mitchellii*) form a moderately dense shrub layer. Abundant smaller shrubs (*Cassia* sp., *Denhamia* sp., *Hakea lorea,* and *Acacia* sp.) are present. *Aristida latifolia, Heteropogon contortus, Themeda australis, Eremochloa* sp., and scattered blue grass form a sparse to moderate ground layer.

(45) *Eucalyptus crebra* (narrow-leaved ironbark)–*E. polycarpa* (bloodwood), with occasional *E. papuana* and *E. tessellaris,* form an open tree layer. A well-developed tall shrub layer (*Alphitonia excelsa, Petalostigma pubescens,* and *Lysicarpus angustifolius*) is common. Smaller shrubs (*Grewia retusa, Carissa ovata, Dodonaea* sp., and *Acacia* sp.) are abundant. The sparse ground layer is the three-awn grass community (*Aristida* sp., *Heteropogon contortus, Themeda australis,* and *Cymbopogon refractus*).

(46) *Eucalyptus crebra–E. polycarpa–E. exserta* shrub woodland closely resembles (45) but with *E. exserta* (stringybark) in the tree layer. The shrub and grass layers are very similar.

(47) *Eucalyptus crebra–E. polycarpa–E. tenuipes* shrub woodland is similar to (46) in general floristics and habitat requirements.

(48) *Eucalyptus crebra* (narrow-leaved ironbark) forms a moderately close tree layer (40–70 ft). The discontinuous shrub layer includes *Alphitonia excelsa, Petalostigma pubescens, Acacia* spp., and locally *Xanthorrhoea* sp. and cycads. Eastern mid-height grass (*Themeda australis, Bothriochloa decipiens, Heteropogon contortus, Eragrostis* sp., *Cymbopogon refractus*) forms a sparse to moderate ground layer. The community occurs on hills on volcanic rocks.

(ii) *Tall Woodland.*—Tall woodland is a closed woodland community characterized by a tall sparsely continuous dominant stratum in which the crown depth of the dominants equals, or only slightly exceeds, the length of the bole. Shrub and grass layers are poorly developed.

(49) *Eucalyptus moluccana* (gum-top box) in relatively pure stands forms a close tree layer (60–80 ft), locally with scattered *E. melanophloia* or *E. populnea*. The sparse to moderate shrub layer includes *Flindersia dissosperma*, *Eremophila mitchellii*, *Petalostigma pubescens*, and *Eremocitrus* sp. Patchy eastern mid-height grass (*Bothriochloa* spp., *Heteropogon contortus*, *Aristida* sp., *Themeda australis*, *Chrysopogon* sp., and *Arundinella* sp.) forms a sparse to moderate ground layer. It occurs on slopes with coarse-textured alluvium.

(50) *Eucalyptus moluccana–E. crebra* tall woodland is similar but the grass layer is better developed.

(iii) *Tall Grassy Woodland*.—The group of communities comprising this subform are all similar in structure and are related floristically. The tree layer (80–100 ft) is widely spaced giving a parkland appearance. Shrubs are sparse or absent. The herbaceous stratum is well developed and comprises the frontage grass community (*Bothriochloa intermedia*, *B. decipiens*, *Heteropogon contortus*, *Themeda australis*, *Aristida ramosa*, *Leptochloa* sp., *Arundinella* sp., *Chloris gayana*, *Thellungia advena*, *Stipa verticillata*, *Ophiuros exaltatus*, and many others). Tall grassy woodlands are characteristic of the levees, levee back slopes, and back plains associated with the main streams of the area.

(51) *Eucalyptus tereticornis* forms monospecific communities of widely spaced large trees (80–100 ft, occasionally to 120 ft) giving a parkland effect. Shrubs are mainly sparse and the ground layer of frontage grass is well developed. The community characterizes the back slopes of the levees and back plains.

(52) *Eucalyptus tereticornis–E. tessellaris* form a closely related community on the flats and levees adjacent to the main channels throughout the area. *E. polycarpa* occurs locally.

(53) *Eucalyptus tereticornis–Angophora floribunda* are associated in tall grassy woodlands resembling (52) on drainage floors in coarser-textured alluvium.

(54) *Eucalyptus tereticornis–E. crebra* together with *E. polycarpa*, *E. tessellaris*, *E. populnea*, and *E. papuana* form a very closely related group of communities ranging in places from stands of the two dominants alone through many combinations and proportions of the various species. The tree layer is commonly closely spaced, lower (60–80 ft), and in places approaches (before modification by clearing) the density of forest. The shrub layer is sparse to moderate and the grass layer (eastern mid-height grass and three-awn grass) moderately developed. It is associated with highs in the main drainage floors and with the adjacent gentle slopes.

(iv) *Grassy Woodland*.—This subform is widespread and extensive in the area. Grassy woodlands characteristically occur on the low hills and undulating terrain and on the lower slopes and terraces adjacent to the main drainage lines. Because of accessibility and other factors that encouraged development, very few areas of this country have not been selectively cleared or modified by grazing and burning, and therefore in many places it is difficult to discover the original structure and floristics of the various sites.

(55) *Eucalyptus melanophloia* (silver-leaved ironbark) is extensive and widespread, second only in this respect to the ubiquitous *E. crebra* (narrow-leaved ironbark). It not only dominates a large proportion of the grassy woodland but occurs in association with a number of other eucalypt species. Over extensive areas it forms a monospecific, very open to moderately open tree layer, usually 30–40 ft high but in places to 60 ft. Shrubs are mostly sparse and the grass layer (eastern mid-height grass) usually continuous and well developed. Scattered *E. dichromophloia*, *E. papuana*, and *E. crebra* are present in places.

It is characteristic of the low hills, undulating country, and erosional lower slopes, and locally occurs on low rises on levees in many parts of the area.

(56) *Eucalyptus melanophloia–E. dichromophloia* grassy woodland differs from (55) only in the presence of *E. dichromophloia*. It has a similar distribution but is not as widespread.

(57) *Eucalyptus melanophloia–E. tessellaris* occur as a variant of (55) on lower slopes with deep soils. The eastern mid-height grass community is also better developed.

(58) *Eucalyptus melanophloia–E. crebra–E. papuana–E. dichromophloia* grassy woodland is similar to (56).

(59) *Eucalyptus melanophloia–E. orgadophila–E. dichromophloia* grassy woodland is restricted to the southern part of the area. Shrubs are sparse and the ground stratum is the eastern mid-height grass community.

(60) *Eucalyptus melanophloia–E. orgadophila–E. populnea* grassy woodland is closely related to (59). It has a restricted distribution.

(61) *Eucalyptus crebra–E. papuana* grassy woodland contains scattered *E. melanophloia* and *E. dichromophloia* and is similar to (58). It has a restricted distribution.

(62) *Eucalyptus populnea* (poplar box) grassy woodland is extensive and widespread throughout the area. The trees are commonly more closely spaced than in the *E. melanophloia* grassy woodlands. The shrub layer is sparse to moderate, mainly *Eremophila mitchellii* on the gentle slopes and terraces, but is sparse or absent on the alluvial floors. The ground layer (eastern mid-height grass) is moderately well developed.

The community is characteristic of extensive plains, drainage floors, and adjacent alluvial or colluvial slopes.

(63) *Eucalyptus populnea–E. crebra* grassy woodland is similar to (62).

(64) *Eucalyptus crebra* (narrow-leaved ironbark) grassy woodland (with *E. dichromophloia* in places) is similar to (48) but has been modified to a grassy woodland by clearing, ring-barking, and grazing.

The tree density varies from open to moderately close and the trees are 40–60 ft high. Shrubs are sparse to moderate and the ground storey comprises thin eastern mid-height grass. It occurs on hill slopes.

(65) *Eucalyptus crebra–E. polycarpa–E. tessellaris* grassy woodland occurs on lower slopes in coarser-textured alluvium. The open tree layer is 40–80 ft high. The shrub layer is very sparse. The ground storey (eastern mid-height grass) is moderately well developed.

(66) *Eucalyptus dealbata* grassy woodland (locally with scattered *E. polycarpa*) has an open to moderately dense tree layer. Shrubs are sparse. The three-awn grass community forms a scanty ground layer. It is characteristic of slopes on coarser-textured colluvium.

(67) *Angophora floribunda* grassy woodland occurs along the margins of the main drainage floors of Woleebee land system. The tree layer is moderately dense, shrubs are sparse, and the ground storey comprises poorly developed frontage grass.

(68) *Eucalyptus microtheca* (coolibah) grassy woodlands are 40–60 ft high (locally 80 ft) and occur on fine-textured flood-plains. Shrubs are commonly sparse. The ground storey is characterized by frontage grass.

(v) *Fringing Communities*.—These communities are mainly forest but in many places are open and discontinuous. *Eucalyptus tereticornis* with occasional *E. tessellaris* form a continuous or discontinuous tall tree layer (80–100 ft) and *Casuarina cunninghamiana* is a fairly constant and conspicuous smaller tree. *Angophora costata* and *Tristania suaveolens* occur locally. In environments with finer-textured soil *E. microtheca* is common. The tall shrub–low tree layer, mostly at or near the water's edge, is commonly dense but patchy and discontinuous, and consists of *Melaleuca* spp., *Callistemon* sp., *Acacia* spp., and, in parts, a number of softwood species with vines and creepers. Frontage grass is patchy and discontinuous. The height and density of these fringing communities vary with the period in which the streams contain water. Perennial streams have tall dense fringing forests, ephemeral streams open and discontinuous communities.

(69) *Eucalyptus tereticornis–Casuarina cunninghamiana–Melaleuca* spp. fringing community occurs along most streams and may be open, continuous, or discontinuous.

(70) Sundry fringing communities occur on ephemeral streams. In these sites the channel fringes are commonly composed of similar species to those of adjoining communities.

(71) Mangrove fringes occur along the margins of the river estuaries, mainly in Carpentaria land system.

Rhizophora stylosa, Aegiceras corniculatum, Avicennia marina, and *Osbornia octodonta* form a dense single-layered forest 20–40 ft high. Access is difficult because of the density of the forest and the deep tidal mud in which it grows.

(*d*) *Grassland and other Treeless Communities*

Only a very small proportion of the vegetation of the area is not characterized by trees. These communities are summarized below, but for complete descriptions reference should be made to Section III.

(72) Patchy plain grassland community commonly occurs as a mosaic and comprises a matrix of grassland (blue grass) with scattered, small clumps of brigalow, *Bauhinia*, or poplar box trees. It characteristically occurs on gentler colluvial or erosional slopes with cracking clay soils.

(73) Salt-water couch (*Sporobolus virginicus*) grassland occurs on saline flats.

(74) Samphire meadow commonly occupies a zone between the bare saline mud flats and the salt-water couch grasslands, mainly in Carpentaria land system. There is

considerable mixing of the two communities. The main species occurring are *Arthrocnemum leiostachyum*, *Suaeda australis*, *Arthrocnemum* sp., and *Sesuvium portulacastrum*.

III. Description of the Native Pasture Communities

(75) Softwood scrub grass is the name applied to the very sparse grass layer found beneath the microphyll vine woodlands (1) and the semi-evergreen vine thickets (2)–(10).

The sparse grasses are mainly *Ancistrachne uncinulata* and *Chloris unispicea*. Scattered *Abutilon oxycarpum* var. *acutatum*, *Aporuellia australis*, and *Cheilanthes distans* occur as ground herbs. The community has little or no grazing value in its natural state but when cleared the land is highly regarded for cropping and improved pastures.

(76) Brigalow scrub grass is the pasture type occurring as ground layer in the brigalow forest communities (33)–(40). In virgin brigalow forest the layer is open and discontinuous and comprises mainly *Paspalidium caespitosum*, *P. constrictum*, *P. gracile*, *Chloris acicularis*, *C. divaricata*, *C. pectinata*, *C. ventricosa*, *Leptochloa debilis*, *L. digitata*, *Sporobolus caroli*, *S. scabridus*, *S. elongata*, *Brachiaria foliosa*, *Calyptochloa gracillima*, *Eragrostis cilianensis*, *E. megalosperma*, *Enneapogon pallidus*, *Setaria brownii*, and in depressions, *Leptochloa digitata* and *Panicum buncei*. The community grades into the adjoining one (75). When disturbed, changes in density and floristics occur. In its natural state the community has a low yield of nutritious grasses. The land is generally highly regarded for improved pastures or cropping after clearing. It is widespread.

(77) Forest grass is a widespread but relatively unimportant pasture type. It characterizes much of the hilly to mountainous land systems and occurs as a thin, discontinuous grass layer beneath the main forests of the area. There is considerable variation in quality and floristics, but the main species are *Cymbopogon refractus*, *Themeda australis*, *Aristida* spp., *Setaria* sp., *Stipa verticillata*, *Chloris* sp., *Eragrostis* sp., *Paspalidium* sp., *Leptochloa* sp., with patches of *Eulalia fulva*, and *Arundinella* sp. Forbs are common. The type is commonly associated with a discontinuous, sparse to moderately dense shrub layer. The type has a very low grazing value and is commonly on steep slopes.

(78) Forest grass with spinifex is closely related to (77) and differs mainly in having a discontinuous layer of *Triodia mitchellii*.

(79) Three-awn grass is a pasture type mainly associated with the old deeply weathered land surface or with particularly sandy environments. It occurs mostly as a sparse understorey to forests or shrub woodlands. The floristics are variable but commonly include *Aristida* spp., *Heteropogon contortus*, *Eremochloa* sp., *Chloris* sp., *Eriachne* sp., and *Cymbopogon refractus*. As a natural pasture the type has a low grazing value.

(80) Eastern mid-height grass is one of the most extensive and important grass communities in the survey area. It characterizes the open grassy woodlands.

The grass layer is normally dense and is composed of perennial drought-evading tussock grasses 2 ft high. The composition varies from place to place partly because of differences of grazing pressure and different treatment since development. It is thought that some species, e.g. *Themeda australis*, were originally more common and that other species such as *Heteropogon contortus* have increased. The most common species observed were *Bothriochloa ewartiana* (especially under *Eucalyptus populnea*), *Heteropogon contortus*, *Themeda australis*, *Chloris acicularis*, *Cymbopogon refractus*, *Bothriochloa decipiens*, *Dichanthium sericeum*, *Thellungia advena*, *Eragrostis* sp., *Enneapogon* sp., *Aristida ramosa*, *Rhynchelytrum repens*, and *Cymbopogon bombycinus*. Forbs are usually not abundant.

This extensive pasture type has a moderate grazing value and is important to the cattle industry, which in this region largely depends on it.

(81) Blue grass pasture occurs mainly on the dark cracking clays of the patchy plains that characterize Kiddell land system and occurs as smaller elements in several others. These grasslands are commonly broken by small clumps of brigalow, poplar box, or *Bauhinia* sp. There are also limited occurrences of blue grass pastures associated with *Eucalyptus melanophloia* and *E. populnea* on cracking clay soils.

The perennial drought-evading grasses of this community form a mid-height grass layer 3–4 ft high. It is floristically diverse and exhibits considerable variation from place to place. *Dichanthium sericeum* is probably the most constant species; other common species are *Thellungia advena*, *Cymbopogon refractus*, *Aristida latifolia*, *A. leptopoda*, *Eriochloa pseudo-acrotricha*, *E. procera*, *Sporobolus caroli*, *Eulalia fulva*, *Chloris divaricata*, and *Astrebla lappacea*. Forbs (*Ptilotus semilanatus*, *Pimelea haematostachya*, *Bassia quinquecuspis*, and a number of legumes) are abundant in season.

The community is capable of providing a large quantity of good forage and has a high carrying capacity.

(82) Frontage grass is associated with the frontage woodlands.

This mid-height grass community is variable in density and composition. The most common species are *Bothriochloa decipiens*, *B. ewartiana*, *Dichanthium*, *Heteropogon contortus*, *Chrysopogon* sp., *Arundinella nepalensis*, and *Themeda australis*. Forbs are locally abundant in the favourable season.

Forage production is generally moderate to high and because the forage is adjacent to water in the major streams, it is commonly well utilized.

(83) Salt-water couch pasture is restricted to the saline flats of Carpentaria and Raglan land systems. The main grass (*Sporobolus virginicus*) is a perennial and forms a moderately dense sward 1–2 ft high. Numerous other species (*Heteropogon contortus*, *Chloris* sp., *Chrysopogon* sp., and several blue grasses) appear to be invading, probably as a result of grazing. Large sedge tussocks are common, particularly in depressions.

The pasture is palatable and nutritious and has a high carrying capacity.

(84) Samphire community is closely associated with the salt-water couch pastures (83) but commonly occurs on the seaward side of them. It is open, with considerable bare saline mud surface or with scattered *Sporobolus virginicus*. The main samphire species are *Arthrocnemum leiostachyum*, *Suaeda australis*, *Arthrocnemum* sp., and *Sesuvium portulacastrum*.

IV. Distribution of the Vegetation

The distribution of the vegetation is shown generally on the vegetation and pasture lands maps. More detailed distribution can be obtained by using the land system descriptions and the land system map.

The salient features of the distribution of the communities are given below.

The commonest vegetation is grassy woodland, particularly communities characterized by *Eucalyptus melanophloia* on shallow soils (Rugby) and shallow texture-contrast soils (Southernwood and Medway) and *E. populnea* on deep texture-contrast soils (Retro and Taurus).

Softwood scrubs (microphyll vine woodland and semi-evergreen vine thickets) and brigalow forests occur mainly on various fine-textured soils, softwood scrub more commonly on non-cracking fine-textured soils, and brigalow particularly on Rolleston family.

Wet sclerophyll forest is restricted to the high-rainfall parts of Gelobera land system.

High forests are commonly associated with the Tertiary weathered surface or areas formed by shallow dissection of it. Shrub woodlands and sandstone forests account for most of the remainder of these surfaces.

Rosewood forests are prominent only in Rosewood land system, and occur on shallow and texture-contrast soils.

Tall grassy woodlands (*Eucalyptus tereticornis*, *E. tessellaris*, *E. crebra*) are mainly limited to fluvial plains (mostly alluvial soils).

Tall woodlands (*E. moluccana*) do not characterize any particular land system but occur on colluvial–alluvial slopes with texture-contrast soils.

Treeless communities are only a minor feature of the area. Blue grass grassland occurs on cracking clay soils in several land systems and salt-water couch grassland on Raglan and Carpentaria land systems. Most of the remainder of Carpentaria land system is either samphire meadow or bare mud.

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PART IX. PASTURE LANDS OF THE DAWSON–FITZROY AREA

By R. A. Perry*

I. Introduction

Rockhampton is the centre for the most important beef cattle region in Australia (Beattie 1956). The Dawson–Fitzroy area is a part of this region and has a stock population of 750,000 beef cattle, 85,000 dairy cattle, and 500,000 sheep. In the early years of settlement beef was raised on native pastures under extensive conditions, and the pastures of the open woodlands were more valuable than those of the brigalow and softwood scrub lands. During the early part of the century and extending until the early 1930s, much of the brigalow country was infested with prickly pear. Following its eradication, brigalow lands were slowly cleared and improved. In the last decade, with the development of new methods, the rate of clearing has increased rapidly.

Compared with other beef-raising areas of the world the region is relatively free of pests and diseases. Brooks (1962) lists the main pests as cattle tick, lice, sandfly, buffalo fly, and worms, and describes the control measures available. He also lists four poisonous plants (*Trema aspera, Terminalia oblongata, Eremophila maculata,* and *Myoporum deserti*) that can be troublesome in brigalow country but are of only minor significance.

II. Description of Pasture Lands

(*a*) *General*

The land systems of the area have been grouped into seven pasture lands on the basis of their prominent constituent native pasture communities, which have been described in Part VIII. Although the pasture lands are defined according to their native grass communities, the groups are significant in terms of improved pastures because the suitability of land for introduced pastures is related to the occurrence of native pastures. However, with improvement the relative value of the pasture lands changes, e.g. under natural pastures the scrub country is poorer than the eastern mid-height grass country, but under improved pastures the situation is reversed.

The areas of the native pasture communities in each of the pasture lands are shown in Table 18. The table shows the areal importance of the scrub grass (34% of total area) and eastern mid-height grass (29% of total area) communities and the relative insignificance of the other types.

(*b*) *Scrub Country*

The scrub country is gently undulating to low hilly, largely with clay soils ranging from relatively shallow clay loams and light clays to deep cracking clays.

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TABLE 18

AREA (SQ MILES) OF PASTURE TYPES IN PASTURE LANDS

Pasture Land	Area (sq *miles*)	Softwood Scrub Grass	Brigalow Scrub Grass	Forest Grass	Forest Grass with Spinifex	Three-awn Grass	Eastern Mid-height Grass	Blue Grass	Frontage Grass	Salt-water Couch	Bare
Scrub country	9960	2850	5140	400		70	1040	210	250		
Eastern mid-height grass (clay soils) country	560	5	10				490	20	30		
Eastern mid-height grass (not clay soils) country	5830	130	120	50		180	4950		400		
Forest grass–three-awn country	3980	20	10	450	10	2830	520		140		
Frontage country	1150						10		1130	10	
Non-range country	3070	80	10	1850	680	30	300		120		
Coastal country	170									50	120
Total	24,720	3085	5290	2750	690	3110	7310	230	2070	60	120
Percent total area	99·0	12·4	21·2	11·0	2·8	12·5	29·3	0·9	8·3	0·2	0·5

Table 19

LAND SYSTEMS OF SCRUB COUNTRY AND THEIR COMPONENT PASTURE TYPES (% OF LAND SYSTEM)

Land System	Area (sq miles)	Softwood Scrub Grass	Brigalow Scrub Grass	Forest Grass	Three-awn Grass	Eastern Mid-height Grass	Blue Grass	Frontage Grass
Malakoff	370	40	10	25		20		< 5
Womblebank	150	40	30	10		20		< 5
Toonda	250	65	10			20		5
Narran	610	30	20	35		10		< 5
Mundell	130	50	30			15	< 5	< 5
Lawgi	150	85	10			5		
Oakleigh	380	40	20	20		20		< 5
Redrange	150	60	10			15	10	< 5
Eurombah	1570	55	40			< 5		< 5
Banana	460	35	20			40		5
Ramsay	100	50	45		5			< 5
Kariboe	80	40	50			10		
Wandoan	1520	20	70			5		< 5
Barwon	260		70			25		5
Highworth	1190	5	85			5	< 5	< 5
Kiddell	670	15	45			10	25	5
Thomby	1380	20	60		5	15		< 5
Hinchley	110		85			10		< 5
Dakenba	270	5	85			5		< 5
Coreen	260		95					5
Total area (sq miles)	10,060	2850	5140	400	70	1040	210	250
Percent area of pasture land	100	28·3	51·1	4·0	0·7	10·3	2·1	2·5
Percent total area	40·3	11·4	20·6	1·6	0·3	4·2	0·8	1·0

The 20 land systems of the pasture land are listed in Table 19 together with the relative proportions of their component native pasture communities. The pasture land comprises 40% (10,060 sq miles) of the total area. Overall, 79% of the pasture land carries one or other of the two scrub grass communities, the only other constituent of importance being eastern mid-height grass (10%).

TABLE 20

LAND SYSTEMS OF EASTERN MID-HEIGHT GRASS (CLAY SOILS) COUNTRY AND THEIR COMPONENT PASTURE TYPES (% OF LAND SYSTEM)

Land System	Area (sq miles)	Softwood Scrub Grass	Brigalow Scrub Grass	Eastern Mid-height Grass	Blue Grass	Frontage Grass
Grevillea	130	<5		70	15	10
Orana	130		5	90		5
Barfield	130			95		5
Westwood	170		<5	95		<5
Total area (sq miles)	560	5	10	490	20	30
Percent area of pasture land	100	0·9	1·8	87·5	3·6	5·4
Percent total area	2·2	0	0	2·0	0·1	0·1

In its uncleared unimproved state the scrub country has only a low grazing value but under improved pastures it is the best grazing land in the area. Uncleared brigalow land has a carrying capacity of 1 beast to 25–60 acres, but by clearing and sowing to pasture with Rhodes grass as the major component its carrying capacity is raised to 1 beast to 6–8 acres (Sutherland 1962). *Sorghum almum* and various cultivars of *Panicum maximum* and *Cenchrus ciliaris* are also widely used.

(*c*) *Eastern Mid-height Grass (Clay Soils) Country*

This country is mostly undulating plains (some low hills) on volcanic rocks and mostly carries silver-leaved ironbark grassy woodland. It comprises four land systems (Table 20) but occupies only 560 sq miles (2% of total area). Overall, 88% of the pasture land carries eastern mid-height grass, the other main communities being blue grass and frontage grass. It appears to have a higher stock-carrying capacity than the eastern mid-height grass (not clay soils) country, possibly because of more fertile soils.

(*d*) *Eastern Mid-height Grass (not Clay Soils) Country*

Most of this pasture land consists of undulating plains, but some land systems are hilly. Texture-contrast soils predominate and the common vegetation consists of various eucalypt grassy woodlands. Dry matter and protein production from an area dominated by bunch spear grass have been studied by Shaw and Bisset (1955).

The pasture land includes 15 land systems (Table 21) that together cover 5900 sq miles (24% of total area), of which 84% carries eastern mid-height grass. The other main native pasture components are frontage grass (7%) and three-awn grass (3%).

(*e*) *Forest Grass–Three-awn Grass Country*

This pasture land comprises undulating, hilly, or tableland country with generally shallow sandy or red and yellow earth soils. The vegetation is mainly various forms of eucalypt woodlands or forests with sparse forest grass or three-awn grass native pasture communities.

TABLE 21

LAND SYSTEMS OF THE EASTERN MID-HEIGHT GRASS (NOT CLAY SOILS) COUNTRY AND THEIR COMPONENT PASTURE TYPES (% OF LAND SYSTEM)

Land System	Area (sq miles)	Softwood Scrub Grass	Brigalow Scrub Grass	Forest Grass	Three-awn Grass	Eastern Mid-height Grass	Frontage Grass
Hillmore	1060	< 5				90	5
Irving	340	< 5				90	5
Boomer	460	< 5				90	5
Ohio	470					95	< 5
Torsdale	570	5	5			90	< 5
Bouldercombe	570	10	< 5			85	< 5
Bannockburn	130		< 5			95	< 5
Mourangie	160	5		5		80	10
Rosewood	95		< 5	40		50	5
Montana	850				10	80	10
Langmorn	140					70	30
Woleebee	390		10		20	65	5
Palmtree	150				10	60	30
Dingo	120		15			80	< 5
Juandah	390		5			80	15
Total area (sq miles)	5900	130	120	50	180	4950	400
Percent area of pasture land	100	2·2	2·0	0·8	3·1	83·9	6·8
Percent total area	23·6	0·5	0·5	0·2	0·7	19·8	1·6

The 3980 sq miles (16% of total area) are made up of 13 land systems (Table 22). Overall, 84% of the pasture land is either three-awn grass or forest grass. The only other native grass community of importance is eastern mid-height grass, which comprises 13% of the pasture land and is relatively important (40% of area) in Perch, Surprise, and Conloi land systems.

The pasture land has a low stock-carrying capacity in its natural state and a low potential for improvement.

(*f*) *Frontage Grass Country*

This pasture land occurs in flat alluvial country with deep texture-contrast or clay soils and various eucalypt woodlands.

The four land systems (Table 23) cover 1150 sq miles (5% of total area) of which 98% carries frontage grass pastures.

TABLE 22

LAND SYSTEMS OF THE FOREST GRASS–THREE-AWN GRASS COUNTRY AND THEIR COMPONENT PASTURE TYPES (% OF LAND SYSTEM)

Land System	Area (sq miles)	Softwood Scrub Grass	Brigalow Scrub Grass	Forest Grass with Spinifex	Forest Grass	Three-awn Grass	Eastern Mid-height Grass	Frontage Grass
Kaiuroo	230	< 5				90	< 5	< 5
Duaringa	820	< 5				90	5	< 5
Auburn	70		5			85	10	
Mimosa	70					80		20
Wooroonah	750				20	75	< 5	5
Melbadale	420					70	25	5
Perch	250					55	40	5
Glenhaughton	670					90	10	< 5
Doughboy	160					80	15	< 5
Narowie	40				85		10	5
Surprise	310		< 5	< 5	55		40	< 5
Conloi	60				55		40	5
Redcliffe	130				55	40		5
Total area (sq miles)	3980	20	10	10	450	2840	510	140
Percent area of pasture land	100	0·5	0·2	0·2	11·4	71·7	12·9	3·5
Percent total area	15·9	0·1	0	0	1·8	11·4	2·0	0·6

(g) Saline Coastal Country

The only land system in this pasture land is Carpentaria, which has an area of 170 sq miles. It consists of alluvial plains with saline clays and muds and is treeless except for mangroves fringing creeks. The lower seaward parts are mostly bare but the higher inland parts (25%) carry salt-water couch grass which has a moderate carrying capacity where supplies of fresh water are available for stock.

TABLE 23

LAND SYSTEMS OF FRONTAGE GRASS COUNTRY AND THEIR COMPONENT PASTURE TYPES (% OF LAND SYSTEM)

Land System	Area (sq miles)	Eastern Mid-height Grass	Frontage Grass	Salt-water Couch	Bare
Kroombit	310		100		
Gavial	140		100		
Coolibah	620		100		
Raglan	80	10	75	10	<5
Total area (sq miles)	1150	10	1130	10	0
Percent area of pasture land	100	0·9	98·3	0·9	
Percent total area	4·6	0	4·5	0	0

(h) Non-range Country

This pasture land is composed of country too steep, rugged, or barren for grazing. It contains six land systems (Table 24) that together occupy 3165 sq miles (13% of total area).

Small parts of the pasture land, particularly the lower, more accessible parts of Yebna and Gelobera land systems, have a similar grazing capacity to the eastern mid-height grass country.

III. Development

(a) General

In the past the beef industry has been based on the grazing of natural pastures that are reasonably nutritious during their summer growing season but are dormant and of poor quality during the winter and spring. Shaw and Bisset (1955) studied the yield and chemical composition of a bunch spear grass pasture over a period of 4 years. They found that 60% of production occurred between January and April and that no growth occurred during the cooler winter months. The nutritive value was low for most of the year, the winter crude protein content being only 2–3%.

The result in terms of animal production is an annual cycle of alternating summer weight gains and winter weight losses. The seasonal nature of the growth curve has been documented by Chester (1952), Alexander and Chester (1956), Sutherland (1959), and Stubbs and Arbuckle (1962). Under these conditions cattle are at least 3 and commonly 4–4½ years old before they are marketable, resulting in

TABLE 24

LAND SYSTEMS OF NON-RANGE COUNTRY AND THEIR COMPONENT PASTURE TYPES (% OF LAND SYSTEM)

Land System	Area (sq miles)	Softwood Scrub Grass	Brigalow Scrub Grass	Forest Grass with Spinifex	Forest Grass	Three-awn Grass	Eastern Mid-height Grass	Frontage Grass
Nathan	1320			30	60			5
Carborough	670	5		30	45		15	<5
Yebna	230				75		20	5
Doonkuna	540	5	<5	15	65		10	<5
Range	65				45	50		5
Gelobera	340	5			60		30	5
Total area (sq miles)	3165	80	10	680	1850	30	300	120
Percent area of pasture land	100	2·5	0·3	21·5	58·5	0·9	9·5	3·8
Percent total area	12·7	0·3	0	2·7	7·4	0·1	1·2	0·5

a low turn-off, large animals with a relatively low value per 100 lb, and a strongly seasonal availability of marketable animals (Arbuckle 1962).

Shaw and Bisset (1955) conclude that there is little prospect of increasing beef production per acre by grazing management of native pastures, and further that as the drawbacks stem from the plant species rather than the climate, the logical approach is to replace native species with sown grasses and legumes. Sown pastures produce higher yields than native pastures, have a higher carrying capacity, and maintain quality (and animal weight gains) for most of the year (Young, Fox, and Burns 1959), but nutrition during the spring period remains critical. During this period gains can be maintained by crop grazing or supplementation with small areas of lucerne or with conserved fodder (Fox 1960, 1961; Mawson 1962). Most of the brigalow and softwood scrub soils are suitable for improved pastures (Davies 1959; Isbell 1962) and many parts are suitable for cropping, either for grazing or grain. Thus in the brigalow–softwood scrub lands a combination of sown pastures and crop-growing provides a higher carrying capacity, year-long gains with animals near marketable condition throughout their life, an earlier and therefore higher turn-off, a smaller, better-quality, more valuable (per 100 lb) product, and more flexible marketing (Alexander 1962*b*; Arbuckle 1962; Stubbs and Arbuckle 1962; Stubbs, Arbuckle, and Alexander 1964).

As well as the provision of adequate forage throughout the year, animal husbandry, performance, and quality are important. Alexander (1962*a*) (using results of studies reported by Alexander *et al.* 1960, Alexander, Beattie, and Sutherland 1964) points out that most Queensland herds produce only about 70% of calves and that milk production of dams is low, resulting in low initial weight gains of offspring. He highlights the need for selection for survival (less important with a satisfactory level of nutrition), reproduction, and growth, and advocates pregnancy testing and elimination of barren cows, selection of heifers on weaning weights which give an indication of the growing ability of the calf and the milk production of the dam, and the culling of bulls on the basis of their fertility. Thus the development of the brigalow lands requires a combination of good pasture and crop farming and efficient animal husbandry.

An analysis of the economics of developing brigalow lands (Bureau of Agricultural Economics 1962) shows that this country has an outstanding economic potential for increased beef production, even if the cost of developing roads is included. The inclusion of the development of forest land appears to reduce slightly the rate of return on capital but it is concluded that a certain amount of forest land development will occur with brigalow development due to the complex spatial distribution of the land types.

(*b*) *Climatic Considerations*

Climate is a major factor determining existing land use and potential agricultural and pastoral productivity in the area. The most important effect of climate is through its effect on the availability of soil moisture for plant growth. Fitzpatrick (1965), using a water-use model and weekly rainfalls over a standard 35-yr period, has estimated lengths of periods of useful pasture growth (stored soil moisture between 0 and 4 in.). Because of the effect of low temperatures on the growth of native pastures (Miles 1949) he has excluded the interval from May 14 to September 10. As might be expected, the mean period of useful pasture growth is longest in coastal areas (Rockhampton 25·4 weeks) and decreases inland (Banana 23·1 weeks, Taroom 22·4 weeks). Variability increases in the same direction. The periods of active pasture growth (stored soil moisture between 2·5 and 4·0 in.) are much shorter, the mean lengths being 11·2 weeks at Rockhampton, 8·0 weeks at Banana, and 6·8 weeks at Taroom. These figures indicate that the coastal areas are much more favourable for active pasture growth than inland areas. This is further exemplified by the percentage of years in which the period of active pastoral growth exceeds 10 weeks (Rockhampton 56%, Banana 24%, Taroom 12%).

An interesting feature of the analysis is the number of weeks with available stored moisture in the 17-week period excluded because of low temperatures. At Rockhampton 12·2 of these weeks have stored moisture available (Banana 12·2, Taroom 12·0). This suggests a considerable potential for plants less restricted in their growth by low temperatures than the native pastures.

(*c*) *Land Considerations*

From topographic and potential productivity considerations the most suitable lands for development in the area are the brigalow–softwood scrub lands which have cracking clay or clay loam to light clay soils. Their higher productivity under crops and pastures is probably related to the higher fertility and water-holding capacity compared with the predominantly texture-contrast soils of the eastern mid-height grass country.

Before the establishment of pastures or crops the scrub has to be cleared. The primary concern in clearing and subsequent operations is to ensure the prevention of regrowth or at least the suppression and control of root suckers. The actual path and timing of operations depends on the land type, growth form of the trees, the associated trees, and the proposed land use. These aspects have been described in detail by Johnson (1964) and summarized by Johnson (1962*a*, 1962*b*), Everist (1962), Mawson (1962), and Marriott and Wilson (1962*b*). Management methods for the various soils have been described by Hart (1962*a*). Kelsey (1962) highlights the dangers of erosion, especially on slopes greater than 5%, and advocates the use of conservation practices such as contour banks.

(*d*) *Pasture and Fodder Crop Species*

The main species available for sown pastures are discussed by Fox (1960), Marriott and Wilson (1962*a*), McDonald (1963), Sillar (1963), and Bisset (1964).

Sown pastures in the brigalow–softwood country have mostly incorporated Rhodes grass (*Chloris gayana*) as a major component. It is outstanding on brigalow soils where rainfall is greater than 25 in. Buffel grass (*Cenchrus ciliaris*) has a place in drier areas and on lighter soils (Grof 1957) and is commonly included in mixtures to insure against the decline of Rhodes in dry periods. Green panic (*Panicum maximum*) is more frost-tender and is not vigorous enough to suppress brigalow suckers, but initiates growth early in spring with suitable moisture. It is used in mixtures with Rhodes grass, particularly on softwood country. Columbus grass (*Sorghum almum*) declines in vigour in the first few years so it is best sown as a mixture with Rhodes grass. Both the CSIRO Division of Tropical Pastures (1963, 1964, 1965) and the

Queensland Department of Primary Industries have been searching for better species and strains (Davies and Edye 1959; Grof 1961; Wilson 1963; Bryan and Shaw 1964; Fletcher, Henzell, and Moore 1965; Cameron 1965).

The situation with pasture legumes is different in that those tried have given indifferent results. Until recently lucerne appeared to be the best but it requires cultivation for establishment and does not persist well. It is therefore largely restricted to pastures established in a rotation on crop land. In recent experiments (CSIRO Division of Tropical Pastures 1965) Siratro showed considerable promise over a wide range of soils and demonstrated its ability to survive and produce under drought conditions. On the coastal soils some success was obtained with centro and phasey bean (Fox 1960) under arable conditions but Townsville lucerne is the only legume to establish successfully in native pastures. Even under drought conditions Townsville lucerne had a marked effect on beef production from native pastures (CSIRO Division of Tropical Pastures 1965).

Various fodder and grain sorghums are the main summer fodder crops and oats are the main winter fodder crop, although barley and wheat are also used (Fox 1960; Hart 1962*b*; Graham 1963). Safflower is also used as a winter fodder crop. In production and quality it is similar to oats but performs better in the critical late winter–spring months (Brauns and Rudder 1963). Lucerne is the outstanding fodder crop legume. It performs well on silver-leaved ironbark as well as brigalow country but is less suited to poplar box country (Teakle 1957). Under rain-fed conditions it persists for only 3–4 years but it persists longer and yields well under irrigation.

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PART X. LAND USE IN THE DAWSON–FITZROY AREA

By R. H. Gunn*

I. Introduction

The grazing of natural pastures by beef cattle is at present the most important form of land use in the area, as it is also in the western parts of the Fitzroy basin. Soil and climatic conditions in a large part of the area, however, are suitable for more intensive use, and this is reflected in the areas at present under cultivation and improved pastures.

Area I and part of Area III of the Fitzroy Basin Land Development Scheme occur in the area, and the clearing of brigalow and softwood scrubs for pasture improvement and cultivation has increased significantly in recent years. Sutherland (1962) considers that carrying capacities of these lands are raised about sixfold by the establishment of improved pasture grasses. From aerial photographs taken during 1960–63 the total area of cultivated land is estimated at about 250,000 acres, and it is certain that further development of arable lands has taken place subsequently. Sorghum and wheat are the main dryland crops; cotton, lucerne, and other fodders are grown under irrigation. The soils in these areas are mainly cracking clays and non-cracking medium- to fine-textured soils described in Part VII.

In this Part the climate and soils of the area are discussed briefly and the lands are classified in terms of their potential use for cultivation, grazing, or other purposes. Capability classes in respect of land units and facets are given in the tabulated descriptions of the land systems in Part III, and the estimated proportions of the various land classes in each system are shown in Table 25. The capability classes are those defined by the United States Department of Agriculture (1958), and are given in Appendix I together with tentative definitions of subclasses. These interpretations based on the results of broad reconnaissance surveys are intended to be no more than guides to potential land use in the area.

II. Climate and Land Use

Broad transitions between areas of more reliable summer rainfall to the north and winter rainfall to the south and from the coast inland are characteristic of the area. Owing to its geographic position and the general absence of high ranges, it has more favourable climatic conditions in terms of plant growth than the western parts of the Fitzroy region. Nevertheless, the most important climatic factors that influence land use, although less extreme, are the same as those further west, namely, moisture deficits and extremes of temperature, both above and below the optimum for plant growth. The following brief discussion on the growth of crops in relation to these

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factors is based on data from Part IV and an assessment of climate and plant growth in the Fitzroy region by Fitzpatrick (1965). In the land capability classification given in the land system descriptions and Table 25, climate has been taken into account only indirectly.

The average annual rainfall in the area ranges from 38 to 23 in. but, as stated in Part IV, owing to occasional very high falls the average monthly and annual figures appear more advantageous for cropping than they really are. To provide a more meaningful assessment Fitzpatrick (1965) analysed the lengths of individual sequences or "runs" of weeks during which soil moisture is available without interruption, using rainfall data over a 35-yr period. A conservative upper limit of 4 in. of available soil storage was assumed, and no account was taken of special practices to conserve soil moisture such as fallowing.

During the period mid January to early April, the median lengths of growth sequences at Rockhampton and Banana are generally greater than 20 weeks over the 35 years of analysis. The percentage chance of there being a week without available soil moisture during this summer period does not exceed 11 at Rockhampton and 21 at Banana. Conditions for sustained growth at Taroom for the same period are distinctly less favourable. The median lengths of growth sequences are less than 10 weeks and there is about a 25% chance of there being a week without available soil moisture. These estimates indicate the climatic limitations in the south and west of the area to the production of summer crops requiring long periods of active growth.

With regard to winter cropping during the period May to August inclusive, the median lengths of growth sequences at Rockhampton and Banana are generally greater than 10 weeks. The percentage chance of there being a week without available moisture ranges from about 20 to 30. At Taroom the median lengths of sequences for this interval are greater than 13 weeks and there is a continuation of long sequences up to about the end of October. These analyses indicate the much more favourable conditions for winter cropping in the south-east of the area.

The occurrence of extreme temperatures and their effects on crops in the area are discussed by Fitzpatrick (1965), and in the central highlands region by Skerman (1953). Apart from the extreme north-east there is an appreciable risk of frosts in the area generally from May to August, particularly in the south in low-lying sites, and frost damage to wheat at time of flowering or to late planted summer crops is possible. The incidence of heat waves when temperatures exceeding 100°F occur on several consecutive days is a further hazard, especially to young crops during the period December to February.

These observations indicate the risks of there being inadequate moisture for both summer and winter cropping in the area, particularly in the south-west where rainfall is lower and more variable. The more favourable conditions for summer cropping in the northern half and winter cropping in the southern half are suggested. The risks can be reduced to some extent by careful selection of soils with adequate depth and water-holding capacity and by measures to conserve soil moisture, such as summer fallowing, contour cultivation, and thorough weed control.

TABLE 25

ESTIMATED OCCURRENCE AND AREA (SQ MILES) OF LAND CAPABILITY CLASSES II–VIII IN LAND SYSTEMS

Land System	Total Area	II–III	IV	V	VI	VII	VII–VIII
Mountains							
Gelobera	340		20		120		190
Hillmore	1060		210			850	
Carborough	670		135		135		370
Deeply dissected tablelands							
Nathan	1320		395		530		395
Doonkuna	540		215			215	80
Hills with eucalypt forests							
Range	65		30			10	20
Yebna	230		90		25		105
Surprise	290	15	60		145		70
Hills with woodlands							
Boomer	460		185			255	
Irving	340		120			205	
Hills with softwood scrub							
Malakoff	370		110		55	185	
Womblebank	150	30	50		35	20	
Toonda	250	110	50		10	35	35
Narran	610	185	245		120		30
Mundell	130	25	70		25		
Lawgi	150	80			60		5
Oakleigh	380	75	190		115		
Redrange	150	75	35		35		
Tablelands and plains							
Duaringa	820		740				80
Kaiuroo	230		105		80		35
Narowie	40	5	35				
Undulating plains with high forest							
Conloi	60		55		5		
Doughboy	160		130		25		
Glenhaughton	670		470		200		
Wooroonah	750		600		110		
Redcliffe	130		125				
Auburn	70	5	35		30		
Undulating plains with woodlands and texture-contrast soils							
Melbadale	420	65	335		20		
Perch	250	25	225				
Rosewood	95		60				30

TABLE 25 (*Continued*)

Land System	Total Area	II–III	IV	V	VI	VII	VII–VIII
Undulating plains with woodlands and texture-contrast soils (*continued*)							
Bannockburn	130		45		30		45
Mourangie	160		95		55		
Ohio	470	45	70		305		25
Torsdale	570	140	340		30	30	
Bouldercombe	570	30	340		55	30	85
Montana	850		510		340		
Langmorn	140	15	85		35		
Woleebee	390		390				
Palmtree	150		90	20	30		
Undulating plains with woodlands and cracking clay soils							
Westwood	170	40	85		35		
Barfield	130	30	80		15		
Grevillea	130	15	95				15
Orana	130	20	65	5	40		
Undulating plains with woodlands and red earths							
Mimosa	70		70				
Undulating plains with brigalow scrub							
Kariboe	80	35	30		10		
Wandoan	1520	840	530		75		
Barwon	260		245				
Kiddell	670	400	170		70		
Highworth	1190	180	950				
Thomby	1380	415	760		140		
Hinchley	110	95	10				
Dakenba	270	135	95		25		
Undulating plains with softwood scrub							
Eurombah	1570	865	470		155		
Banana	460	230	115		70	25	
Ramsay	100	45	45		10		
Alluvial plains							
Coreen	260	25	105	130			
Dingo	120	10	100				
Juandah	390	20	350				
Kroombit	310	45	240				
Raglan	80		10	50	10	5	
Gavial	140		85	50			
Coolibah	620	30	125	435			
Coastal plains							
Carpentaria	170	15				25	125

III. Soils and Land Use

In this section some of the more important properties affecting land use in the area are considered broadly. The kind and degree of limitations imposed by varying conditions of soils and relief are listed in Appendix I, which is intended to be no more than a guide to the placing of land in appropriate classes.

In the light of observations in the preceding section, lack of soil moisture is likely to be the most important single factor limiting agricultural and pastoral production. Apart from the possibilities of irrigation and moisture conservation by fallowing or other means, the selection of soils with high capacities for absorption and retention of available water is of great significance. Texture and effective depth are properties that greatly influence soil–moisture relationships and for this reason have been given emphasis in the classification and evaluation of the soils. These and other soil characteristics are considered in relation to the soil groups and families described in Part VII.

(a) *Cracking Clay Soils* (4990 *sq miles*)

This group comprises seven families which occur mainly in lowlands with very gentle slopes under softwood and brigalow scrub with wilga and belah or grassy woodlands. Moderate to high clay contents with a preponderance of montmorillonoid clay minerals are characteristic and capacities for retaining available water are high (Reeve, Isbell, and Hubble 1963). Fertility levels are also generally moderate to high. The main limitations for the group as a whole are the somewhat narrow optimal moisture ranges for tillage, susceptibility to erosion by high-intensity storms even on very gentle slopes, and imperfect to poor drainage.

Areas of May Downs, Teviot, Downfall, and Rolleston cracking clays which cover over 3000 sq miles have been placed in classes II and III, and they constitute some of the best arable land in the area. They are at present cultivated extensively in some parts. The soils of Bruce family are shallow (less than 2 ft) and consequently have lower capacities for moisture storage, and they occur usually in gently undulating areas with slopes up to 5%. For these reasons they are placed in class IV. Pegunny gilgaied clays, covering 690 sq miles, have strongly developed gilgai microrelief and are judged to be best suited to the establishment of improved pastures (class IV) provided regeneration problems can be overcome. In some areas where gilgais are widely spaced and do not have abrupt slopes they may be cultivated but, unless levelling is also undertaken, the growth of crops is likely to be very uneven, particularly in seasons of abnormally high rainfall when depressions are flooded. They are slightly to moderately affected by soluble salts in the deeper layers, and crops or grasses with moderate to high salt tolerance should be selected. Vermont cracking clays (930 sq miles) occur in alluvial flats that are subject to regular flooding of varying depth and duration. They are well suited to cultivation where drainage and flood control are possible or in elevated sites subject to only occasional flooding. They are tentatively placed in class V.

(b) *Texture-contrast Soils* (8880 *sq miles*)

The eight families that constitute this group are the most extensive in the area and they have very variable properties. The solodized solonetz and solodic soils often occur in a complex pattern with similar soils but without the unfavourable subsoil characteristics. Owing to variations in depth of profile, texture, and thickness of surface horizons, and in structure and consistency of subsoils, they have variable water-holding capacities and water and root penetration in the clayey subsoils are often severely restricted. Levels of fertility are generally low, and high proportions of sodium and magnesium are common in the exchange complex. On the other hand, some soils of Wyseby and Retro families under blackbutt–brigalow scrub have thin loamy surface soils over blocky-structured clays with similar properties to those of Rolleston family in the cracking clay group.

The shallow soils of Southernwood and Medway families, covering 2770 sq miles, occur generally in undulating landscapes with slopes up to 10% in moderately dissected areas, and they have been placed mainly in class VI. Areas covered by the other families of this group have been placed in class IV, mainly because of their unfavourable subsoil characteristics, susceptibility to erosion, and complex distribution. They are judged to be best suited to pasture improvement but may be suitable for cultivation in some areas, which should be selected by detailed survey.

(*c*) *Dark Brown and Grey-brown Soils* (2740 *sq miles*)

The four families in this group occur mainly on the crests and upper slopes of areas with gently undulating to hilly relief under softwood or brigalow scrub. The soils are judged to be fertile, especially where derived from basalt, and in view of their moderately high clay and surface organic contents, probably have high water-retaining capacities. Limitations to their use are high susceptibility to erosion, particularly where slopes exceed about 2%, and in two families of the group, shallow depth.

Areas of Kinnoul and Ingelara families that are less than 2 ft deep have been placed in classes IV or VI depending on slope and relief. Because of shallowness and erodability, the class IV areas are considered best suited to established pastures. The areas of deeper soils of Cheshire and Carraba families, which cover about 1500 sq miles in several land systems in lowlands, have been placed in classes II or III and are considered suitable for cultivation provided erosion control measures are implemented promptly after clearing.

(*d*) *Red and Yellow Earths* (905 *sq miles*)

The soils of this group occur on gentle slopes of tablelands and lowlands mainly in four land systems. They have formed on the deeply weathered Tertiary land surface or on materials derived from the stripped surface. The strong weathering and leaching to which they have been subjected are reflected in their kaolinitic clay minerals, high quartz content, and variable amounts of ferruginous gravel. The five families of this group are generally porous and have low water-retaining capacities, particularly the more sandy soils of Annandale and Forrester families. They are mildly to moderately acid and very low levels of fertility are characteristic. Exchangeable metal cations do not exceed 10 m-equiv./100 g soil and nitrogen and phosphorus contents are low. The soils of Wilpeena family on alluvial deposits may have somewhat higher fertility owing to mixing with less weathered materials. In view of these characteristics areas of these soils have been placed in class IV and are judged to be best suited to improved pasture establishment. Selected areas of the loamy soils of Dunrobin and Struan families are suitable for cultivation provided that conservation works are constructed and fertilizers are applied. These soils are liable to seal and set hard at the surface on drying and the growing of row crops on ridges would facilitate infiltration and seedling emergence and assist in the prevention of run-off.

(*e*) *Uniform Coarse-textured Soils* (1000 *sq miles*)

The soils of this group occur in areas of gently undulating to hilly relief in several land systems throughout the area. They have uniform coarse textures, low water-holding capacities, and probably low levels of fertility. They are considered generally as non-arable soils and have been placed in class IV or VI depending on the relief.

(*f*) *Very Shallow Undifferentiated Soils* (4730 *sq miles*)

These soils occur generally in areas of hilly to mountainous relief with extensive outcrops and steep slopes. They are very shallow and stony. These areas have been placed mainly in classes VII and VIII and are of little or no value for grazing or forestry.

(*g*) *Alluvial Soils* (1060 *sq miles*)

These soils occur throughout the area but are most extensive in the seven alluvial land systems near the major rivers and creeks. The soils of the five families in riverain areas are nearly all subject to periodic flooding of varying depth and duration, about which few data were collected during the survey. Most areas of these soils are tentatively placed in class IV because of the limitations of flooding. Some areas of medium- to fine-textured soils (Clematis, Warrinilla, Moolayember, and Consuelo families) where risk of flooding is considered to be slight have been placed in classes II and III.

The areas of saline muds and clays of Carpentaria land system on the coast are considered to be class VII or VIII land because of salinity and/or flooding.

IV. Water Resources and Irrigation

The average annual yield in the Fitzroy Basin, which has a total area of 55,000 sq miles, is 5·7 million ac ft of which not more than 100,000 ac ft are committed (Irrigation and Water Supply Commission, Queensland 1965). Owing to the variability of rainfall, stream flows are also variable and over much of the area cease altogether in the dry season. The provision of assured supplies for irrigation on a moderate or large scale therefore involves the construction of storage reservoirs.

Apart from small areas irrigated by pumping from unregulated flows or water-holes, the main areas under irrigation are near Theodore and Moura on the Dawson River, where water is supplied by pumping from storage reservoirs. Small areas are irrigated in the Callide valley near Biloela from ground-water supplies. About 3000 acres are under irrigation annually in the areas near Theodore where cotton, lucerne, and other fodders are grown.

In terms of water resources, the considerable scope for irrigation development in the area is indicated by the possible storage capacities of two sites investigated by the Irrigation and Water Supply Commission, Queensland (1965). A dam on the Dawson River at Nathan Gorge would impound about 2·5 million ac ft in a reservoir extending miles upstream. At The Gap on the Fitzroy River, 3·5 to 10·0 million ac ft of storage is possible depending on the height of the dam. The Dawson project is estimated to be capable of serving an irrigated area of about 170,000 acres.

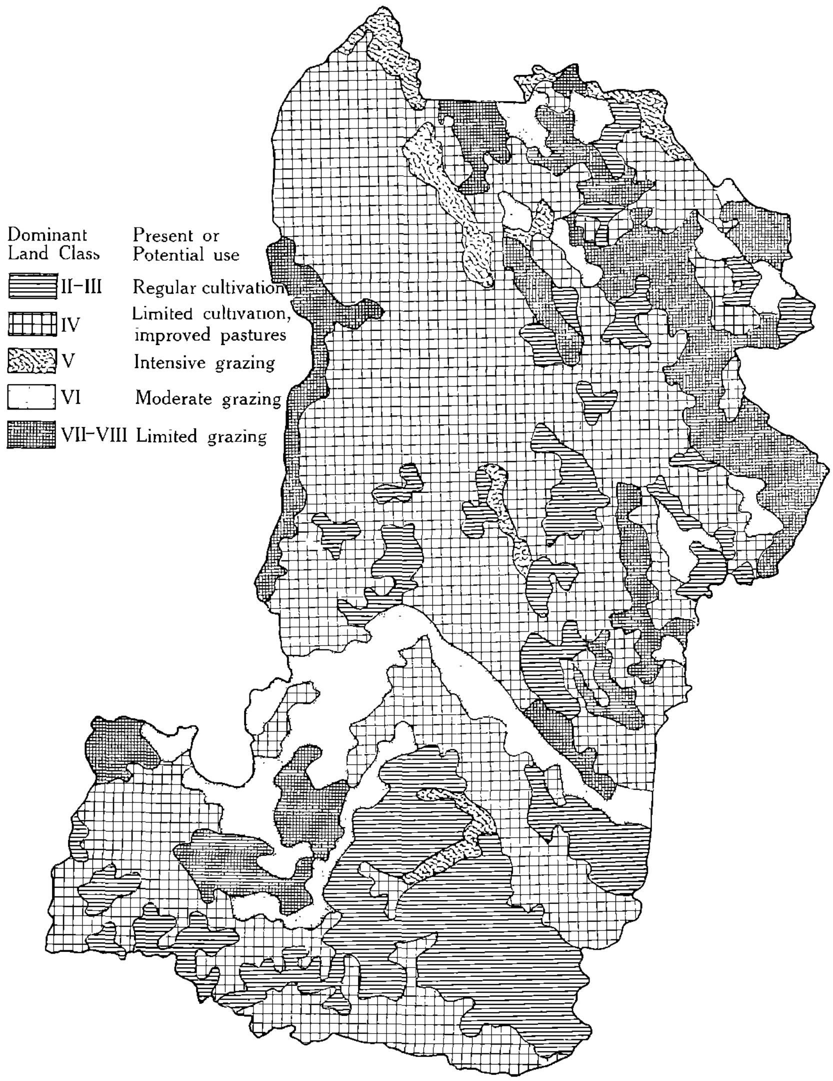

Fig. 11.—Distribution of land capability classes.

With regard to the suitability of the soils for irrigated crop production, detailed surveys in the Dawson and Callide valleys have been reported by Isbell (1954, 1957). In the Dawson valley 80,000 acres of medium-textured alluvial soils, some with unfavourable subsoil characteristics, and dark clay soils were considered suitable for a wide range of crops and, with certain reservations, a further 150,000 acres of fine-textured alluvial soils and black earths were considered suitable. In the Callide, Don, and Dee valleys large areas of alluvial and fine-textured soils supporting brigalow and softwood scrubs were considered suitable. In both these areas flooding in the alluvial sites was regarded as a hazard.

On the basis of this reconnaissance survey the medium- to fine-textured alluvial soils (Clematis, Warrinilla, and Consuelo families) are tentatively considered suitable for irrigation provided that flooding can be controlled or is accepted as a risk. The cracking clay soils of Vermont family also appear to be suitable but again flooding is likely to be a major hazard. These soils have very low permeability when moist and the growing of crops on ridges spaced as closely as practicable would facilitate water management. Where they occur in areas of suitable relief, the soils of May Downs, Teviot, Cheshire, Carraba, and some texture-contrast soils, particularly those with thin loamy surface soils and friable clayey subsoils, are considered suitable for irrigation but should be surveyed in detail before development.

V. Occurrence and Distribution of Land Classes

The estimated occurrences of the various classes of land in relation to the land systems of the area are given in Table 25 and are shown in Figure 11. Approximately 4400 sq miles or about 2·82 million acres of land have been placed in classes II–III, and are considered suitable for cultivation with slight to moderate limitations. Allowing for areas occupied by roads, headlands, and conservation works the net cultivable area is of the order of 2·3 million acres.

Class IV land is estimated to comprise about 12,000 sq miles or 7·68 million acres and is suitable mainly for the grazing of improved pastures but is also considered suitable for cultivation in limited areas. Class V land comprises 690 sq miles of land in alluvial situations where the main limitation is flooding by overflow from rivers and creeks. The total area of land placed in class VI is 3400 sq miles and is judged suitable for grazing or forestry with only moderate limitations. Land in classes VII and VIII covers about 3630 sq miles and in places is considered suitable for grazing, but a large proportion is inaccessible or is too steep, rocky, or barren even for this purpose.

VI. References

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APPENDIX I

Land Capability Classes and Subclasses

I. Classes

The capability classes shown in the tabulated land system descriptions indicate broadly the use to which the various kinds of land in the area are best suited. The classes defined below follow the pattern of the United States Department of Agriculture* (1958) and have been recommended for use in Queensland by the Soil Conservation Division, Department of Primary Industries.

(*a*) *Class I Land*

This is land with few or no limitations. With good management it is suitable for long-continued cropping without special practices. It is nearly level, has deep, easily worked soil, and erosion hazard is low. The soils are well drained but not droughty and are either well supplied with nutrients or highly responsive to fertilizer applications. The climate is favourable to a wide range of cultivated crops, pastures, or forest.

(*b*) *Class II Land*

This is land with slight limitations. It is arable land, limitations are few, and the practices easy to apply. It may require moderate conservation practices, which will depend on the limitations but will include such practices as strip cropping, stubble mulching, etc. where erosion is the major hazard.

(*c*) *Class III Land*

This is land with moderate limitations. It is arable land but limitations may restrict the choice of plants grown, or require special conservation practices, or both. A combination of intensive measures is necessary for permanent use of the land. Such measures as adequate mechanical protection will be necessary if erosion is the limiting factor and the land is cultivated.

(*d*) *Class IV Land*

This is land that is subject to severe limitations and is suitable for occasional but not regular cultivation. It is primarily grazing land. The choice of plants may be very limited or more intensive conservation practices may be necessary.

* United States Department of Agriculture (1958).—Land capability classification. Soils Memorandum SCS-22.

TABLE 26

CLASSES AND SUBCLASSES—KIND AND DEGREE OF LIMITATION

Limitation	Degree of Limitation	Class	Subclass
Susceptibility to water erosion	Slope $<1\%$, or up to 2% on short slopes up to 1000 ft long	I	
	Slope 1–3%	II*	e_2
	Slope 3–8%	III*	e_3
	Slope 8–12%	IV*	e_4
Topography	Slope 12–20%, or moderate gullying	VI	t_6
	Slope $>20\%$, or extreme gullying	VII–VIII	t_{7-8}
Microrelief affecting use of machinery, e.g. gilgais	Tillage interfered with but not impracticable	III	g_3
	Tillage difficult	IV	g_4
	All use of machinery impracticable	V	g_5
Stoniness	Tillage interfered with but not impracticable	III	r_3
	Tillage difficult	IV	r_4
	All use of machinery impracticable	V	r_5
Workability affecting use of machinery, e.g. high clay content, compaction	Slight restriction	II	k_2
	Moderate restriction	III	k_3
	Severe restriction	IV	k_4
Physical properties affecting plant growth, e.g. hard pan, surface crusting	Slight restriction	II	p_2
	Moderate restriction	III	p_3
	Severe restriction	IV	p_4
Wetness, frequency of flooding, or waterlogging	1 in 5 years	III	w_3
	>1 in 5 years	IV	w_4
	Seasonal	V	w_5
Salinity	Slightly affected	II	s_2
	Moderately affected	III	s_3
	Seriously affected	IV–VII	s_{4-7}
	Salt pan	VIII	s_8
Effective depth of soil	>48 in.	I	
	36–48 in.	II	d_2
	24–36 in.	III	d_3
	12–24 in.	IV	d_4
	<12 in.	V	d_5
Available water capacity (in./ft depth of soil)	2 in. or more—high	I	
	1–2 in.—moderate	II	m_2
	<1 in.—low	III	m_3
Soil nutrient status	Low	III	n_3
	Very low	IV	n_4

* The class may be downgraded according to the susceptibility of a particular soil to erosion, e.g. texture-contrast soil.

(*e*) *Class V Land*

This is nearly level land that has little or no erosion hazard even if cultivated, but it has other limitations which it is not practical to remove and which prevent the normal production of cultivated crops. This land may be used for pasture or forestry with few or no limitations. Special crops may be grown on it but only with the use of special practices.

(*f*) *Class VI Land*

This is land with such severe limitations that it is unsuitable for cultivation, but it is suitable for grazing or forestry subject only to moderate limitation in use. Limitations of soils or slopes are such that pasture improvement practices requiring the use of tractors and machinery are practicable.

(*g*) *Class VII Land*

This is land with very severe limitations that make it unsuitable for cultivation and restrict its use even for grazing or forestry. Limitations are such that pasture improvement practices requiring the use of tractors and machinery are impractical.

(*h*) *Class VIII Land*

This is land with such severe limitations that it is not suitable for cultivation, grazing, or commercial forestry. Its main value is for watershed protection and wildlife and recreation reserves.

II. Subclasses

The subclasses, together with the kind and degree of limitations in the various classes, are given in Table 26.

APPENDIX II

Plant Names and Their Common Equivalents

Abutilon oxycarpum var. *acutatum*	Flannel weed
Acacia catenulata	Bendee
A. excelsa	Ironwood
A. harpophylla	Brigalow
A. rhodoxylon	Rosewood
A. shirleyi	Lancewood
Aegiceras corniculatum	River mangrove
Alphitonia excelsa	Red ash, soap tree
Alstonia constricta	Bitter bark
Ancistrachne uncinulata	Hooky grass
Angophora costata	Sugar gum, cabbage gum, rusty gum
A. floribunda	Rough-barked apple
Apophyllum anomalum	Broom-bush
Aristida caput-medusae	Wire grass
A. latifolia	Feather-top wire grass
A. leptopoda	White spear grass
A. ramosa	Wire grass
Arthrocnemum leiostachyum	Samphire
Arundinella nepalensis	Reed grass
Astrebla lappacea	Curly Mitchell grass
Atalaya hemiglauca	White wood
Atriplex muelleri	Annual saltbush
Avicennia marina	Grey mangrove
Bassia quinquecuspis	Black roly-poly, prickly roly-poly
B. tetracuspis	Brigalow burr, dog burr
Bauhinia carronii	Bauhinia
Boronia bipinnata	Boronia
B. glabra	Boronia
B. rosmarinifolia	Boronia
Bothriochloa decipiens	Bitter or pitted blue grass
B. ewartiana	Desert blue grass
B. intermedia	Forest blue grass
Brachychiton australe	Broad-leaf bottletree
B. rupestre	Bottletree
Cadellia pentastylis	Ooline, solid-wood
Callitris columellaris	Cypress pine
Capparis lasiantha	Nipan, split-jack
C. loranthifolia	Wild pomegranate
C. mitchellii	Bumble tree
Carissa ovata	Currant-bush
Cassia brewsteri	Leichhardt bean
Casuarina cristata	Belah
C. cunninghamiana	River oak
C. inophloia	Thready-bark oak
C. luehmannii	Bull-oak
Cheilanthes distans	Rock fern
Chloris acicularis	Spider grass
C. divaricata	Small chloris
C. gayana	Rhodes grass
C. ventricosa	Tall chloris
Cissus opaca	Native grape, yam vine
Citriobatus spinescens	Wallaby berry
Cymbopogon refractus	Barb-wire grass
Cyperus gracilis	Whisker grass
Dichanthium sericeum	Queensland blue grass
Dodonaea filifolia	Hop-bush
D. vestita	Hop-bush
Ehretia membranifolia	Peach bush
Enchylaena tomentosa	Berry cotton-bush
Eragrostis cilianensis	Stink grass
Eremocitrus glauca	Lime-bush
Eremophila mitchellii	Budda, sandalwood
Eriochloa procera	Spring grass, early spring grass
E. pseudo-acrotricha	Spring grass, early spring grass
Eucalyptus acmenioides	White stringybark, white mahogany
E. cambageana	Dawson gum, blackbutt
E. citriodora	Lemon-scented gum
E. cloeziana	Gympie messmate
E. crebra	Narrow-leaved ironbark
E. dealbata	Tumble-down gum
E. dichromophloia	Red-barked bloodwood
E. drepanophylla	Grey ironbark
E. exserta	Queensland peppermint
E. fibrosa	Broad-leaved ironbark
E. maculata	Spotted gum
E. melanophloia	Silver-leaved ironbark
E. microtheca	Coolibah
E. moluccana	Gum-topped box
E. orgadophila	Mountain coolibah
E. papuana	Desert gum, ghost gum, carbeen
E. peltata	Yellowjack
E. polycarpa	Long-fruited bloodwood
E. populnea	Poplar box
E. tereticornis	Queensland blue gum, forest red gum
E. tessellaris	Moreton Bay ash, carbeen

E. thozetiana	Yapunyah, lapunyah
E. watsoniana	Yellowjack
Eulalia fulva	Brown-top grass
Flindersia australis	Crow's ash
F. dissosperma	Scrub leopard wood
Geijera parviflora	Wilga
Grevillea striata	Beefwood
Grewia retusa	Dysentery plant
Hakea lorea	Bootlace oak
Heterodendrum diversifolium	Scrub boonaree
Heteropogon contortus	Black spear grass, bunch spear grass
Hibbertia stricta	Guinea flower
Hovea longifolia	Purple bush pea, hovea
H. longipes	Purple bush pea, hovea
Indigofera australis	Australian indigo
Jasminum lineare	Native jasmine
J. racemosum	Native jasmine
Kochia sp.	Cotton-bush
Leptochloa digitata	Cane grass
Lysicarpus angustifolius	Budgeroo
Maba geminata	Native ebony
Macropteranthes leichhardtii	Bonewood
Malaisia scandens	Fire-vine
Mallotus claoxyloides	Stink bush
Notelaea longifolia	Native olive
Opuntia tomentosa	Velvety tree pear
Paspalidium caespitosum	Brigalow grass
P. constrictum	Belah grass
Petalostigma pubescens	Quinine berry, quinine bush
Pimelea haematostachya	Pimelea poppy
Ptilotus semilanatus	Prince of Wales feathers, fox bush
Rhagodia hastata	Berry saltbush
Rhizophora stylosa	Red mangrove
Rhynchelytrum repens	Red Natal grass
Salsola kali	Soft roly-poly
Sarcostemma australe	Caustic vine
Sporobolus caroli	Fairy grass
S. elongatus	Rat's-tail grass
S. virginicus	Marine couch, sand couch
Stipa verticillata	Bamboo spear grass
Terminalia oblongata	Yellowwood
Thellungia advena	Coolibah grass
Themeda australis	Kangaroo grass
Tieghemopanax elegans	Celery-top
Triodia mitchellii	Spinifex
Tristania suaveolens	Swamp box, swamp mahogany

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LAND RESEARCH SERIES

1. General Report on Survey of Katherine–Darwin Region, 1946
2. Survey of the Townsville–Bowen Region, North Queensland, 1950
3. Survey of the Barkly Region, Northern Territory and Queensland, 1947–48
4. The Lands and Pastoral Resources of the North Kimberley Area, W.A.
5. Pasture Lands of the Northern Territory, Australia
6. General Report on Lands of the Alice Springs Area, Northern Territory, 1956–57
7. General Report on Lands of the Wiluna–Meekatharra Area, Western Australia, 1958
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