MEANDER REPORT

Land Capability Survey of Tasmania

K E NOBLE
1993

Meander Report
and accompanying 1:100 000 scale map

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Authors Note: The Department of Primary Industry referred to in this document is now titled the Department of Primary Industry and Fisheries.

Contents

1. Introduction

The Department of Primary Industry in 1989 commenced a Land Capability Survey of Tasmania at a scale of 1:100 000. The primary aim of the survey is to identify and map the location and extent of different classes of agricultural land, in order to provide an effective base for land use planning decisions. In addition, the aim is to ensure that the long-term productivity of the land is maintained, through the promotion of compatible land uses and management practices. A land capability classification system has been developed specifically for Tasmania comprising seven classes, and is based on the capability of the land to support a range of agricultural uses on a long-term sustainable basis.

The basis of soil conservation is the proper use and management of the land - that is, using and managing land within its capability. The conservation and correct management of Tasmania's most important agricultural asset, the soil, is vital for sustained productivity. However, much of the land in Tasmania has limitations that restrict the land for agricultural use. The system of land capability recognises these limitations, and classifies the land accordingly.

This report and associated map describes and depicts the land capability of the Meander map (1:100 000 scale Tasmap series). It is one in a series of land capability maps and reports for Tasmania. All 1:100 000 maps of the Tasmap series that contain privately owned land will be mapped. Only Private Freehold and Leased Crown Land will be mapped at 1:100 000 scale, with some selected high priority areas remapped at larger scales.

2. Summary

This map and report describes and classifies the land capability of all privately owned land and leased Crown land on the Meander map. The map covers the area from Bengeo to west of Carrick in the north, to Little Pine Lagoon and Arthurs Lake in the south. Major towns in the area include Deloraine, Westbury and Bracknell.

The land capability system is based on the capability of the land to produce agricultural goods without impairing the long-term, sustainable productive potential of the land. A land capability classification system has been developed specifically for Tasmania, and categorises the land into seven land capability classes.

The land capability data and boundaries have been determined by a combination of field work and aerial photo-interpretation.

The major constraints which have determined the land capability classes are: slope, erosion hazard, inferior soils (poor soil structure, low fertility soils), and rockiness.

A summary of the areas of the land capability classes mapped on the Meander map is shown in Table 1.

Class	Area (ha)	% of land area on Meander map
1	0	0
2	127	0.1
3	12 250	5.9
3+4	840	0.4
4	47 582	22.9
4+3	213	0.1
4+5	6 170	3.0
5	17 035	8.2
5+6	788	0.4
6	15 108	7.3
6+7	235	0.1
7	6 308	3.0
Exclusion areas	101 218	48.6
TOTAL	207 874	100

Table 1: Summary of areas on Meander map.

3. Acknowledgments

Acknowledgment is given to the following people who assisted with this publication:

Mr Greg Pinkard, Deputy Chief, Land Management and Chemistry Branch, Department of Primary Industry (DPI), Mt Pleasant, for editorial comment and field checking of the map.

Mr Richard Doyle for assistance with soils identification in the field.

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Mr Romic Pajak and Mr Rob Moreton for art work.

Mrs Jackie Crosswell for typing.

This project has been funded by the National Soil Conservation Program through the Department of Primary Industry, Tasmania.

4. How to use this Map and Report

It is important that the land capability maps be used in conjunction with the accompanying report. Special attention needs to be given to reading and understanding the principles of the land capability classification system, outlined in Sections 6 and 7 of this report. By referring to the map, and locating the area of interest, the land capability class assigned to that area can be determined. This is given by a number (1 to 7) which corresponds to the land capability class. Descriptions of the land capability classes are given on the side legend of the map, and detailed in Section 8. Further detail about each of the land capability classes occurring on the Meander map is given in Sections 9 and 10, including explanatory diagrams showing the sequence of land capability classes on different rock types.

4.1 Limitations of Scale

Special attention needs to be given to the limitations imposed by the scale of mapping.

It is important that the map be used at the scale at which it is published. DO NOT ENLARGE THE MAP.

Errors in interpretation will occur if the map is enlarged and there will be a reduction in credibility of the information, as small areas would be delineated separately at a larger mapping scale. If more detail is required, the area of interest should be mapped at a larger scale rather than enlarge the smaller scale map.

Regardless of the mapping scale used, there are always some areas which are too small to delineate accurately.

At the map scale used in this survey, 1:100 000, the minimum area which can be adequately depicted on the map represents approximately 64 ha on the ground. Minimum widths of map units are approximately 300 m at this scale of mapping. However in some instances where it was felt important to highlight areas of higher land capability classes, or in areas where the lack of existing detail allowed separating out smaller areas, map units much smaller in size than 64 ha have been delineated.

The areas of land capability classes shown on the maps are rarely made up entirely of the land capability class indicated. They almost invariably contain areas of other land capability classes, too small to depict at the scale of the map. In complex areas, it is not possible to delineate these smaller areas of other land capability classes. In such circumstances the land is assigned to the dominant class, but up to 30% of land of other classes may be included. In the majority of cases, the land capability classes are estimated to be at least 80% pure, with more uniform areas having inclusions of other classes limited to about 10%.

In some areas, two land capability classes may be mapped as a complex, where it has been impossible at the scale of mapping to separate them, and they both occupy between 40 and 60% of the area. In this case both land capability class numbers are included on the map (e.g. 4 + 5).

The accuracy of the land capability boundaries depends on a number of factors including the complexity of the terrain and geology. In some cases the class boundaries may be well defined, such as with abrupt changes in geology or topography. Alternatively, changes may be gradual and more difficult to assess such as with a change in soil depth, soil type, slope, or extent of rockiness. In these cases the boundary is transitional and therefore is less precisely plotted.

4.2 Interpretation of the Land Capability Information

The scope and range of applications of the land capability information depends on the scale at which the surveys are carried out. A scale of 1:5 000 or 1:10 000 is suitable for whole farm planning purposes, to plan farm layouts and to identify appropriate land uses, soil conservation and land management practices. A scale of 1:25 000 is suitable for catchment planning, and 1:50 000 or 1:100 000 scales for district and regional planning.

One of the major uses of this map series at 1:100 000 scale will be for local government, regional and State land use planning decisions. The information at this scale is not intended to be used to make planning decisions at catchment or farm levels, although the information collected will form a useful base for more detailed studies.

Examples of other potential uses of land capability information are:

- Rational planning of urban and rural subdivisions
- Identifying areas for new crops, enterprises or major developments
- Identifying areas for expansion of particular land uses
- Identifying areas of prime agricultural land (Classes 1 to 3) for retention for agricultural use
- Planning for new routes for highways, railways, transmission lines, etc.
- Identifying areas of land degradation, flooding or areas that may require special conservation treatment
- Identifying areas of potential erosion hazard
- Resolving major land use conflicts

Land capability information combined with other resource data, will be analysed, stored, and disseminated with the aid of a GIS (Geographic Information System). This will greatly enhance the accessibility, interpretation and use of this information.

The applications of the land capability information do not depend solely on the maps themselves, but also on the implementation framework - legislation and administration, which are responsible for putting land use policies into practice. The land capability maps and reports do not purport to have legal standing as documents in their own right, nor should they attempt to stand alone in planning decisions without being supported by other relevant land resource, economic, social or conservation considerations.

4.3 Copyright

5. Methodology

5.1 Mapping Technique

The land capability maps are produced from a combination of both field work and aerial photo-interpretation. Extensive field work along major roads has been carried out over the survey area to check soil types, soil depths, geological boundaries etc, and to assess the land capability classes. Slopes were measured in the field with an inclinometer to determine critical slopes for different soil types. Soil profiles were examined by augering or by examination of exposures along road cuttings and banks to determine depth of soil horizons and their properties. Exposures were also used to examine the underlying geology. Local agricultural advisory officers were taken in the field to assist with cropping and agricultural information. Land capability class boundaries were transferred onto aerial photographs where possible in the field, using the technique of stereoscopic interpretation (see Photo 1). In areas where access was not possible land capability boundaries were drawn after interpretation of aerial photos and other relevant available information (e.g. geology, soils and land systems maps). The land capability boundaries were then transferred onto the relevant topographic base map. Extensive field checking of the area has been carried out to check the accuracy of boundaries and the land capability assessment assigned to each area.

5.2 Aerial Photography

Aerial photos used for this map have been 1982 Tamar, 1988 Central North and 1990 Meander-South Esk surveys, at 1:42 000 scale.

5.3 Exclusion Areas

Only Private Freehold and Leased Crown Land has been mapped (as shown on the Tasmap 1:100 000 Series). All other areas such as State Forests, State Reserves, Conservation Areas, Crown Land, and urban areas etc., have been excluded from the mapping program. These excluded areas are indicated on the map by the letter E.

Photo 1: Checking land class boundaries in the field.

6. Land Capability Classification

Land capability classification is an internationally recognised means of land classification, used to evaluate the capability of land to support a range of land uses, on a long-term sustainable basis.

For the Tasmanian classification, agricultural land uses only are covered, and are defined as broadscale grazing and cropping uses. Land capability ratings for specific land uses are not evaluated, nor is the capability of land for forestry use incorporated into the classification system.

Land capability may be defined as a rating of the ability of land to sustain a range of land uses without degradation of the land resource. It is an interpretive and somewhat subjective assessment based on the physical limitations and hazards of the land, potential cropping and pastoral productivity, and the versatility of the land to produce a range of agricultural goods (refer to Figure 1).

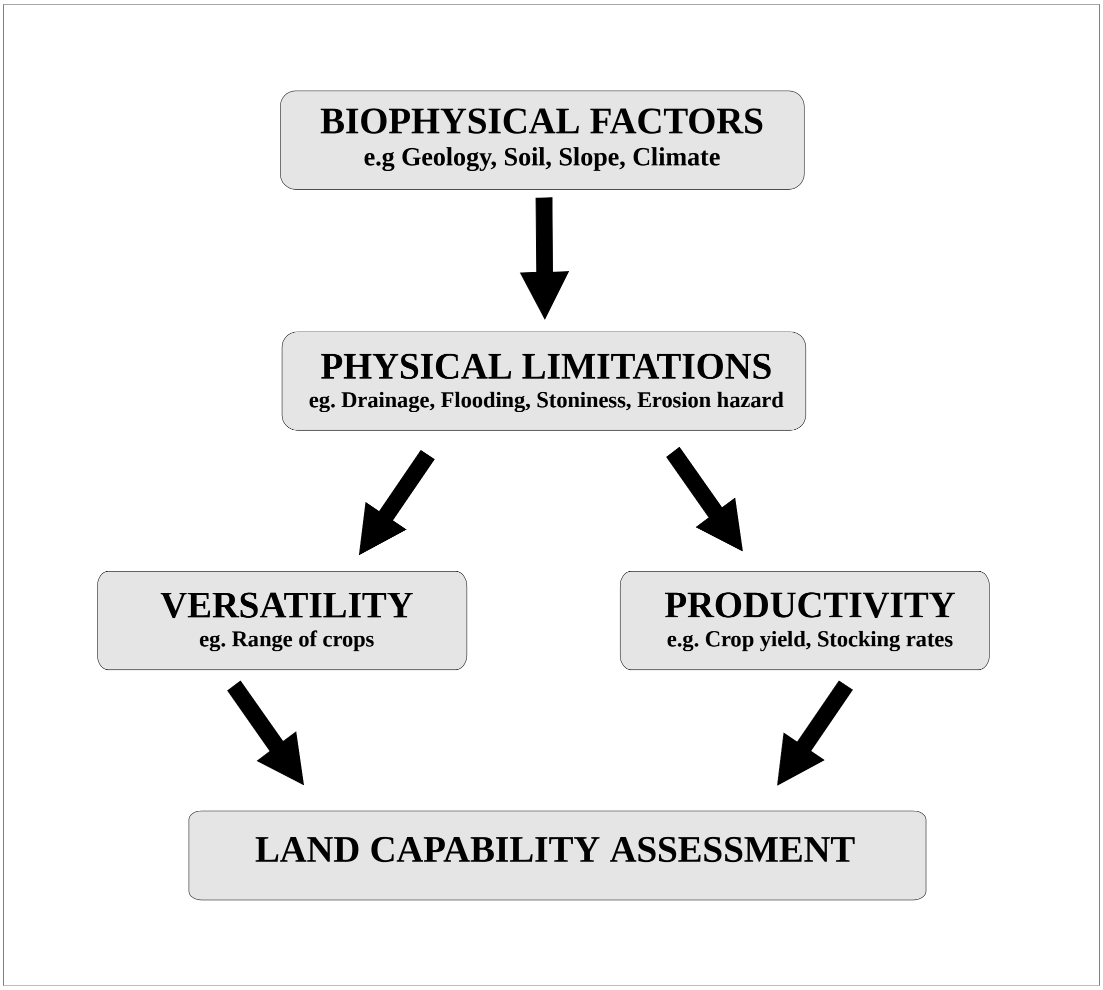

Figure 1: Factors in land capability assessment.

Land capability assessment takes into account the physical nature of the land (e.g. geology, soils, slope) plus other factors (e.g. climate, erosion hazard, land management practices) which determine how that land can be used without destroying its long-term potential for sustainable agricultural production. It also takes into account limitations that might affect agricultural use, e.g. stoniness, drainage, salinity or flooding. Land capability assessment is therefore based on the permanent biophysical features of the land (including climate), and does not take into account the economics of agricultural production, distance from markets, or social or political factors.

Land capability assessment should not be confused with land suitability assessment which, in addition to the biophysical features, may take into account economic, social and/or political factors in evaluating the 'best' use of a particular type of land. Land capability classification gives a grading of land for broadscale agricultural uses, whereas land suitability is applied to more specific, clearly defined land uses, such as land 'suitable' for carrots.

The land capability classification system for Tasmania gives an indication of the inherent capability of the land for general agricultural production and does not attempt to portray specific land uses, or rank the value of any particular agricultural land use above another. Neither does it attempt to give an indication of land values.

The system of land capability classifies land into a number of classes according to the land's capability to produce agricultural goods (based on broadscale grazing and cropping uses). The system for Tasmania is based on the USDA (United States Department of Agriculture) approach to land capability.

There are generally three levels to the land capability classification:

- The land capability <u>class</u> - which gives an indication of the general degree of limitation to use

- <u>subclass</u> - which identifies the dominant kind of limitation

- and the <u>unit</u> - which groups land with similar management and conservation requirements, potential productivity, etc.

The land capability system can be used and applied at various scales by mapping to the class, subclass and unit levels. The level at which the mapping is undertaken and presented depends on the purpose and scale of the survey. The levels of the land capability classification system are shown in Figure 2.

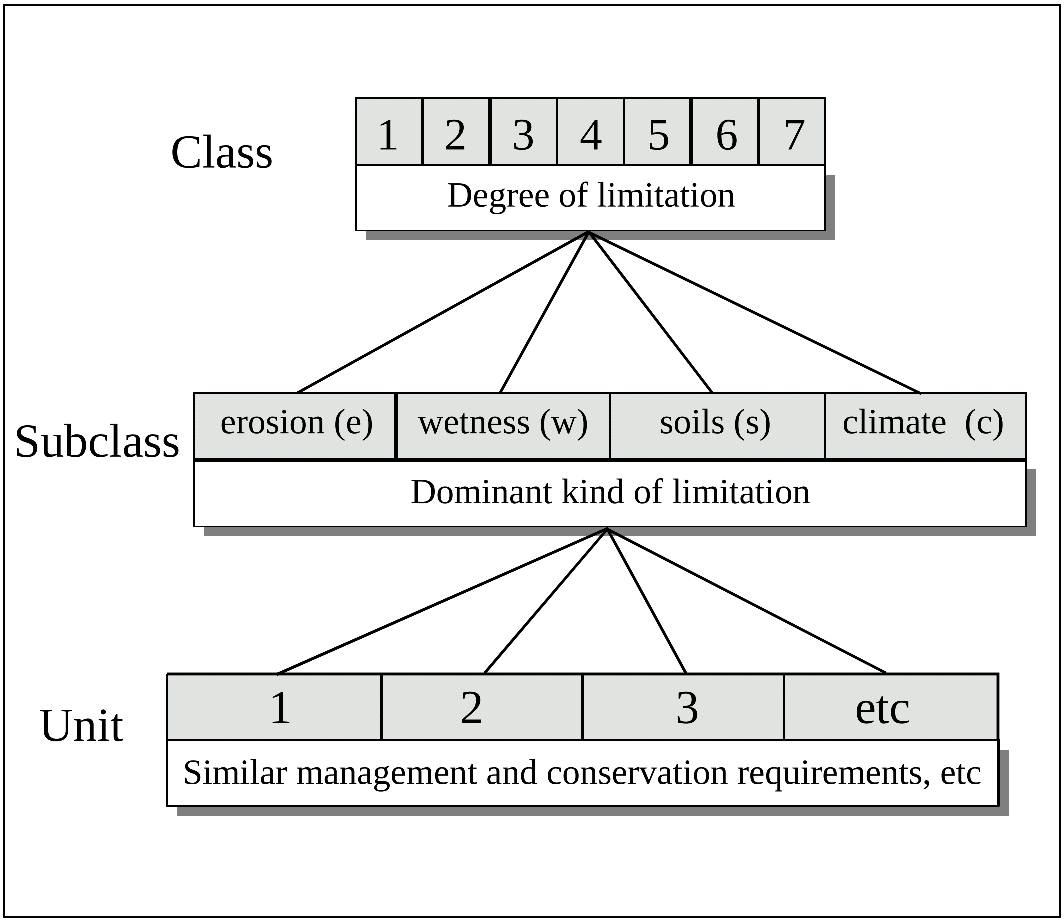

Figure 2: Levels of the land capability classification system.
(Adapted from: National Water and Soil Conservation Organisation, 1979, Our Land Resources. (NWASCO), Wellington, New Zealand.)

References for Further Reading:

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7. Features of the Tasmanian Land Capability Classification System

7.1 The classification is based primarily upon three permanent biophysical features of the landscape - soil, slope and climate, and their interactions. These three factors have a major influence in determining the capability of the land to produce agricultural goods. Other factors which must be taken into account are rock type, erosion hazard, range of crops that can be grown, management practices, soil conservation treatment, risk of flooding and past land use history.

7.2 The classification comprises seven classes ranked in order of increasing degree of limitations to use, and in decreasing order of versatility of use.

7.3 This survey only subdivides land to the class level. Further subdivision of land below the class level would be possible at more detailed scales of mapping, and would group together similar types of land requiring the same kind of management, the same kind and intensity of conservation treatments, and which occur on soils which are adapted to the same kinds of crops, with similar potential yields.

7.4 The system is hierarchical. Class 1 land can produce a wider variety of crops and pastures at higher levels of production with lower costs, or with less risk of damage to the land, than any of the other classes of land. Class 2 land is similarly superior to Classes 3 to 7, and so on.

7.5 The system assesses the versatility of the land to produce a range of agricultural goods that are considered typical for Tasmania, and not just those that are specific or suited to localised areas. For example, the range of crops that can be grown on Classes 1 and 2 land would be wider than the range of crops grown on Classes 3 and 4 land; and would include vegetable and allied crops, orchards as well as cereals, essential oils and forage crops.

7.6 The classification takes into account physical limitations the land may have. Limitations may be defined as physical factors or constraints which affect the versatility of the land and determine its capability for long-term sustainable agricultural production. The capability class takes into account the kind and degree of limitations present.

Examples of different kinds of limitations are: erosion hazard, slope, climate, flooding, stoniness, rock outcrops, salinity, poor soil structure, poor internal drainage, low fertility and low soil moisture holding capacity. There may be one or a number of limitations present at any one site, but it is the overall degree of limitation present that determines the capability class.

Physical limitations can be classified as either permanent, or able to be removed or modified. Permanent limitations include slope and most climatic influences. Removable or modifiable limitations include flooding, poor drainage, and the presence of stones. In addition, some climatic effects such as wind and low rainfall can be modified by the installation of shelterbelts and irrigation. The feasibility of the removal of a limitation depends largely on the severity of the limitation, and also on economics. Guidelines are therefore necessary to differentiate between limitations that can be reasonably removed and those that cannot.

Although economics do not feature in land capability assessments, they are a significant consideration when the removal of limitations is contemplated. The following key words: reasonable, feasible, and economic, are considered when deciding if limitations could be modified or removed. Limitations that are assumed to be removable using existing technology on an individual farm basis include poor drainage, stoniness, and low fertility. Where the necessary technology is not a practical proposition, or beyond the capabilities of an individual farmer and requires a catchment or community scheme, the land is classified according to the nature of its present limitations. If in time such schemes become operative, the land can be reclassified (if appropriate) into a higher land capability class.

Many areas have the potential to attain an improved land capability ranking through the application of irrigation. The extent of the beneficial effects of irrigation on land capability will vary considerably, depending upon such factors as available water and economics, which require individual assessment on a property basis. However it is not possible to provide a uniform system of classification of land capability based on irrigation potential on an on-farm basis, so this has not been included in the assessment of capability. In addition, areas within regional irrigation schemes (such as Cressy/Longford, Winnaleah and Coal River) may have a higher land capability ranking than that shown on the map. However because the effect of an irrigation scheme on land capability depends on a number of factors including economics, availability of water and type of irrigation used, the fact that an area falls within the boundary of a designated irrigation scheme has not influenced its capability in this study. Therefore land capability has been assessed assuming no irrigation potential.

With drainage, the land capability is considered assuming that drainage techniques that are currently available within the scope of an 'average' farmer to install, have been installed. These would include maintenance of existing drainage lines on individual properties, and installation of basic drainage measures to remove excess surface water. The installation of a large scale drainage scheme or extensive underground drainage, is not considered to be within the scope of individual farmers.

The land capability of areas that fall within Drainage Trust Schemes (e.g. Dairy Plains, King Island, Flinders Island, Mowbray Swamp and Circular Head) has been assessed according to the present condition of the land. In other words, the fact that an area of land falls within the boundary of a Drainage Trust Scheme has not influenced the land capability ranking. This is mainly because not all areas of land within Drainage Trusts are capable of the same increased land capability ranking, and not all areas within the Trust boundaries have been effectively drained to date.

Maps of both Irrigation Scheme areas and Drainage Trust areas will be incorporated into the relevant reports.

Climate is one of the major permanent limitations that restrict the versatility of the land (particularly for cropping), and together with soil and slope, has a major influence in determining the land capability class.

For a land capability survey at this scale (1:100 000) only generalised statements and boundaries relating to climate can be made. At more detailed scales of mapping, climatic boundaries (as they affect land capability) can be more clearly defined. These would be based on more localised effects of topography (including aspect), reliability of rainfall, availability of irrigation water, and more detailed records of rainfall, frosts, wind, etc.

Some of the major climatic constraints to agricultural use in Tasmania are:

- Uneven rainfall distribution (associated with topography, altitude and time of year);
- Unreliable rainfall in certain areas;
- Increasing frost hazard, lower mean temperatures and shorter growing seasons in areas away from the coastal maritime influence;
- Occurence of out of season frosts;
- Effect of wind in exposed areas;
- Extremes of both summer and winter temperatures affecting evaporation and length of growing season.

Section 9 deals more fully with the available relevant climatic information pertinent to each map sheet.

7.7 The system is based on agricultural production (cropping and pastoral productivity) and does not take into account forestry productivity. It is based on cultivation of the land for cropping purposes and not other land use systems which can sustain 'crops' on steeper land with longer rotations, and less risk of erosion (e.g. perennial horticulture, tree crops, minimum tillage crops). Indicators of stocking rates are incorporated where possible to support the grazing potential of the land.

7.8 The system considers degradation of the soil resource and does not take into account the possible effects of agricultural land use on water quality, aesthetics, wildlife, etc.

7.9 The basic principle of land capability brings together both facets of conservation - protection of the land, and its potential production. In other words, the balance between use of the land and the risk of degradation.

7.10 The classification, in particular at the unit level, takes into account the management strategies and soil conservation requirements the land may need in order to maintain a level of production without long-term degradation.

7.11 As with most land classification systems certain assumptions are necessary. These are:

(a) The land capability classification is an interpretive classification based on the permanent biophysical characteristics of the land.

(b) A moderately high level of management is being applied to the land.

(c) Appropriate soil conservation measures have been applied.

(d) Where it is reasonable and feasible for an individual farmer to remove or modify physical limitations (e.g. high water tables, stoniness, low fertility) the land is assessed assuming the improvements have been made.

(e) Land capability assessments of an area can be changed by major schemes that permanently change the nature and extent of the limitations (e.g. drainage or flood control schemes).

(f) The land capability classification is not a productivity rating for specific crops, although the ratio of inputs to outputs may help to determine the land capability class.

(g) Land capability does not take into account economic, social or political factors and is not influenced by such factors as location, distance from markets, land ownership, or skill of individual farmers.

(h) Present and past uses of the land (or similar land elsewhere) are guides to potential, in that they can indicate the limits of the capability of the land. Present land use and vegetation cover are not always good indicators of land capability class. The system of land capability is aimed at assessing the potential sustainable productivity of land rather than current productivity.

(i) Assessments are based on the capability of the land for sustained agricultural productivity, since use of the land beyond its capability can lead to land degradation and permanent damage.

7.12 The system is <u>consistent</u> across the State.

8. Land Capability Classes

The land capability class is the broadest grouping of the land capability classification and gives an indication of the general degree of limitation to use.

There are seven classes, arranged from Class 1 to Class 7 in order of increasing degree of limitations or hazards to use, and decreasing degree of versatility (refer to Tables 2 and 3).

Increasing Limitations to Use ↓

<table>
<tr><th>CLASS</th><th>CROPPING SUITABILITY</th><th>PASTORAL SUITABILITY</th></tr>
<tr><td>1</td><td rowspan="2">High</td><td rowspan="4">High</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td><td>Medium</td></tr>
<tr><td>4</td><td>Low</td></tr>
<tr><td>5</td><td rowspan="3">Unsuitable</td><td>Medium</td></tr>
<tr><td>6</td><td>Low</td></tr>
<tr><td>7</td><td>Unsuitable</td></tr>
</table>

Decreasing Versatility ↓

Table 2: Suitability of different land uses for land capability classes.
(Adapted from: National Water and Soil Conservation Organisation, 1979, Our Land Resources. (NWASCO), Wellington, New Zealand.)

CLASS		LIMITATIONS	CHOICE OF CROPS	CONSERVATION PRACTICES
1	Under cultivation	Very minor	any	Very minor
2		Slight	Slightly reduced	Minor
3		Medium	Reduced	Major
4		Severe	Restricted	Major + careful management
5	Under pastoral use	Slight to moderate	Grazing	
6		Severe	Grazing	
7		Very severe to extreme	No, or very minor agricultural value	

Table 3: Features of land capability classes.

The criteria used to define the classes are based on observation and experience only, and not on experimental work. Where necessary, soil physical and chemical criteria have been tested in a laboratory situation.

In time, it may be necessary to refine or modify the criteria for the different classes to incorporate changes in technology and increased understanding about the interactions between soils, farming practices and the natural environment. It is anticipated that the guidelines to the classes will be revised, where relevant, to incorporate this new information.

8.1 Class Definitions

CLASS 1

Multiple use land with virtually no limitations to intensive cropping and grazing. It occurs on flat land with deep, well drained soils, and in a climate that favours a wide variety of crops. It is capable of being cropped eight to nine years out of ten in a rotation with pasture or equivalent.

CLASS 2

Land suitable for intensive cropping and grazing. Limitations to use are slight, and these can be readily overcome by management and minor conservation practices. Limitations reduce the length of the cropping phase to five to eight years out of ten in a rotation with pasture or equivalent.

CLASS 3

Land suitable for cropping and intensive grazing. Cultivation for cropping should be limited to two to five successive crops in a rotation with pasture or equivalent. Soil conservation practices and sound management are needed to overcome the moderate limitations to cropping use. The range of crops able to be grown is generally more restricted than on Class 1 or 2 land.

CLASS 4

Land marginally suitable for cropping because of limitations which restrict the range of crops that can be grown, and/or make major conservation treatment and careful management necessary. Cropping rotations should be restricted to one to two years out of ten in a rotation with pasture or equivalent. This land is well suited to intensive grazing.

CLASS 5

Land with slight to moderate limitations to pastoral use. This land is unsuitable for cropping, although some areas on easier slopes may be cultivated for pasture establishment or renewal. The effects of limitations on the grazing potential may be reduced by applying appropriate soil conservation measures and land management practices.

CLASS 6

Land marginally suitable for grazing because of severe limitations. This land has low levels of production, high risk of erosion, low natural fertility or other limitations that severely restrict agricultural use.

CLASS 7
Land with very severe to extreme limitations which make it unsuitable for agricultural use.

8.2 Guides for Identifying the Land Capability Classes

Class 1 land has most or all of the following features :

- land is level or very gently sloping with slopes less than 5%,
- soils are deep, freely drained and have high water holding capacity,
- surface drainage is adequate,
- productivity is high for a wide range of crops,
- erosion hazard is nil to slight,
- soils have a high capacity to withstand frequent cultivation and irrigation without serious damage under sound, average management,
- soil physical and chemical deficiencies can be readily corrected,
- climate does not seriously affect productivity,
- soils do not have excessively high sand or clay contents.

Class 2 land has most or all of the following features:

- slopes may range up to 12%,
- soils are deep and freely drained, and have moderate to high water holding capacities,
- soils have a moderate to high capacity to withstand frequent cultivation and irrigation without serious damage under sound, average management,
- minor conservation measures may be required,
- productivity is high to moderately high for a range of crops,
- adverse soil characteristics can be easily improved,
- the risk of flooding is low.

Class 3 land has most or all of the following features:

- slopes may range up to 18%,
- high to moderately high levels of productivity under improved pasture species and crops,
- the range of crops is generally more restricted than on Class 1 or 2 land,
- soil depth and drainage can be variable,
- conservation measures are necessary under cropping,

- soil physical features and/or slope restrict the amount of cultivation the land will tolerate between pasture phases.

In addition they may have a range of limitations from among the following:

- slope,
- erosion hazard,
- adverse soil characteristics (e.g. stoniness, internal drainage, soil structure, nutrient deficiencies),
- salinity hazard,
- periodic flooding,
- climate.

<u>Class 4 land</u> has a similar set of limitations to those described above for Class 3 but the limitations are more severe so that only occasional cropping is possible, and/or the range of crops able to be grown is severely restricted. Slopes may range up to 30%. Major soil conservation practices may be necessary under cropping.

<u>Class 5 land</u> has many of the following features:

- slopes can range up to around 40%,
- land may be broken by gullies and surface irregularities,
- the degree of stoniness, wetness or other physical limitations prevents the cultivation of the soil for cropping,
- erosion hazard may be moderate to severe,
- nutrient deficiency, acidity or salinity may depress but not prevent plant growth.

<u>Class 6 land</u> is often very steep, rocky or wetlands.

The land may have either a single very severe limitation or a combination of several severe limitations from among the following:

- slope,
- stoniness or rockiness,
- erosion hazard,
- soil physical limitations,
- salinity,

- surface water, flooding,
- nutrient deficiency,
- climate, altitude.

These limitations make this class of land unsuitable to be cleared for grazing and steeper areas should be left under a vegetative cover, because of the potential erosion hazard and low productivity. Conservation measures including revegetation or retention of existing vegetation cover should be adopted.

Class 7 land has a similar set of limitations to those described for Class 6 but the limitations are very severe to extreme, making this land unsuitable for agricultural use.

Note:

1. Slope ranges given are the maximum slopes for the most stable soils in Tasmania (ie. soils on basalt). Other less stable soils will have slope ranges lower than these for each capability class (see Section 10).

2. The frequency of crop rotations will vary according to the soil type and slope of the land. The cropping rotations indicated are a guide to ensure that soil structure is maintained or improved, thereby preventing degradation of the soil resource under cropping regimes. This applies particularly to sloping land that has the potential to be cultivated for cropping.

3. Slope conversions:

Slope in percentage (%)	Slope in degrees (°)
5	3
12	7
18	10
30	17
40	22

9. Description of Area Mapped

9.1 Topography

The topography and associated geomorphology of the Meander map falls into four distinct categories outlined below. The topography of these areas is determined by the underlying geological formations which influence and control the landscape and landform features, and determine their resistance to erosion. Photo 2 shows an example of landscape and topography on the Meander map.

a) <u>Flat plains and dissected terraces</u>

The flat plains and terrace country occur in the north west and north east to south east areas of the map, on recent alluvial sediments, and on older, higher terraces formed on clays and gravels. Elevation of these areas is between 160 and 280 m.

b) <u>Low rolling country with steeper hill slopes; hill slopes and foothills of the Great Western Tiers</u>

The low rolling country occurs principally in the Bengeo-Deloraine-Exton area, and is formed on basalt, with elevation around 300 m.

Steeper hill slopes divide the low country and plains (e.g. Gardners Ridge, Needles Ridge, Long Ridge, Native Hop Hill, Black Jack Hill, Cluan Tiers, McRaes Hills); and also occur along the foothills of the Great Western Tiers (e.g. Western Creek-Meander-Golden Valley-Liffey-Blackwood Creek-Poatina areas).

Elevation of these areas range between 300 and 800 m. A large portion of these steeper areas occur in unmapped areas of Forestry Commission land and Forest Reserves. These steeper areas are comprised of rocks that are resistant to erosion, typically quartzites, slates and dolerite, or areas of sandstone and mudstone that outcrop below a protective capping of more resistant dolerite, and therefore have been somewhat protected from extensive erosion.

c) <u>Very steep and precipitous slopes of the Great Western Tiers escarpment</u>

The very steep and precipitous slopes of the Great Western Tiers escarpment are formed from dolerite and dolerite talus. Altitude ranges from 800 to 1100 m along the northern part of the Tiers (Mother Cummings Peak-Projection Bluff); rising to 1300 m along the eastern part (Drys Bluff-Billop Bluff). The escarpment of the Great Western Tiers is in unmapped areas of Forestry Commission land, Forest Reserve and Hydro Electric Commission land.

d) <u>Undulating to rolling and steep slopes on the Central Plateau</u>

Extending inland from the Great Western Tiers escarpment, at elevations ranging from 1100 m to 1400 m, lies the Central Plateau, a broad subalpine plateau modified by glacial processes. The part of the plateau which occurs on the Meander map is comprised of dolerite and basalt. Many lakes occur on the Central Plateau, the principal ones on the Meander map being Great Lake, Arthurs Lake and Lake Augusta. A large portion of the Central Plateau occurs in unmapped areas of the Central Plateau Protected Area, Hydro Electric Commission land and Forestry Commission land.

The major rivers on the Meander map are the Meander and Liffey Rivers which drain north and north east of the Great Western Tiers, and the Ouse River which drains south off the Central Plateau.

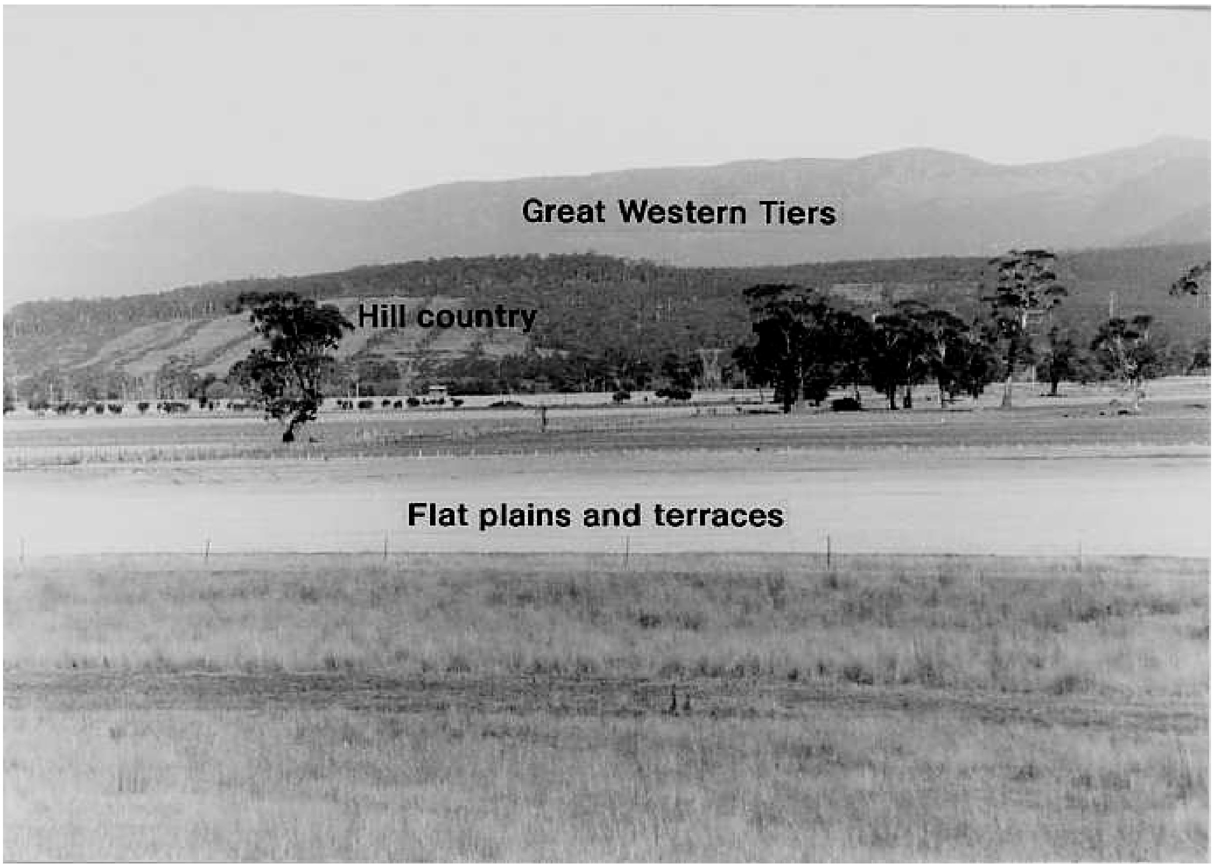

Photo 2: Landscape showing different topographic regions. Meander map 909 907*, Cluan Road.

* Grid references based on the 1:100 000 Tasmap Series.

9.2 Climate

The area experiences a wide range of climatic conditions directly related to the steep rise in elevation across the map from north to south.

The lowland areas in the northern half of the map experience a mild to cool climate which is favourable for agricultural production. The Great Western Tiers and the elevated Central Plateau have a marked influence on the climate of the southern half of the map, resulting in severe climatic limitations to agricultural use.

Average annual rainfall increases from 700 mm in the north eastern corner of the map (Hagley, Bishopsbourne), to 2200 mm along the Great Western Tiers scarp (north of Breona). Rainfall is winter dominant, although thunderstorms are more common during summer.

The topographic effect of the Great Western Tiers, combined with the prevailing westerly weather flows, result in a sharp rise in rainfall along the Tiers escarpment, which drops off significantly in the associated rain shadow area to the south and east. Flooding can be common on the lowland areas during winter and spring, in particular along the Meander and Liffey Rivers. Refer to Figure 3 and Table 4 for rainfall information.

On the Central Plateau prevailing winds are from the north west, west and south west sectors. Elsewhere, prevailing winds are generally from the west and north west sectors, although variations do occur depending on the time of year, and localised orographic features. Figure 4 shows windrose information for Deloraine, Palmerston and Liawenee.

Summers are generally mild to warm, and winters cool to cold. Seasonal variations in temperatures are more marked towards the Great Western Tiers, and on the Central Plateau. Frosts are a limiting factor for cropping in most areas, particularly inland, and at higher altitudes. Cressy, Deloraine and Palmerston receive an average of more than 100 frosts per year, while Miena and Shannon receive more than 200 frosts per year. Figure 5 shows the average dates of first and last occurrences of air frosts in Tasmania.

The Central Plateau area experiences a harsh climate, particularly in the winter months, with snow and ice common. Snowfalls can occur at any time of year, but are most frequent from July to September. Three to four major snowfalls each winter are common, with depths of up to 1 m, although in places snow drifts can be up to 6 m deep.

Along the edge of the Tiers and on the Central Plateau much of the precipitation is from mist, low cloud and drizzle. The lowland areas can be subject to occasional light winter snowfalls, but snowfalls are more common above 600 m.

The lowland areas have a more favourable climate although cropping versatility and yields are affected by frosts and shorter growing seasons in comparison with areas further north, and nearer the coast. Summer droughts also occur in some years which can affect crop and pasture yields, particularly in areas where irrigation water is not available.

Average monthly maximum and minimum temperatures for selected stations in the region are shown in Table 5. Frost information for selected stations is shown in Table 6.

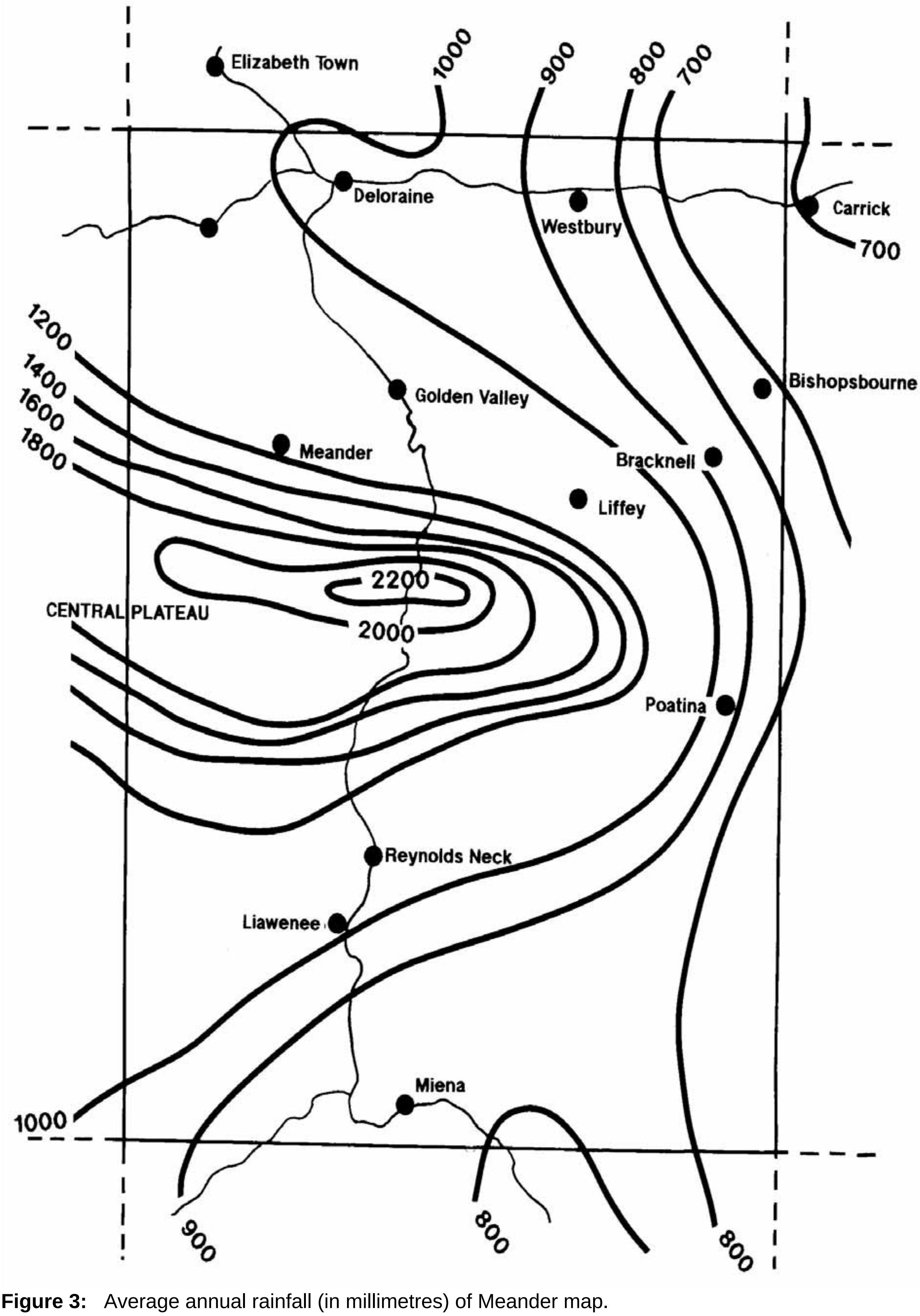

Figure 3: Average annual rainfall (in millimetres) of Meander map.
(Source: Hydro Electric Commission, 1986, Average Annual Rainfall Map of Tasmania (1:500 000 scale map, unpublished). Hobart, Tasmania.)

Station	Period of record	No of full years of record	Average Annual Rainfall (in)	(mm)
Arthur Lake (Upper) [4]	1917 - 1951	32	31.0	787
Ashley Home [2]	1884 - 1958	72	38.3	973
*Billopp [4]	1949 - 1962	14	27.6	701
Blackwood Creek [2]	1956 - 1957	2	47.2	1199
Breona [2]	1921 - 1956	21	75.0	1905
Breona [4]	1903 - 1965	24	71.3	1812
*Carrick [2]	1907 - 1957	49	29.1	739
*Carrick [3]	1907 - 1973	67	28.0	711
*Cressy Research [1]	1939 -	47	25.3	643
*Cressy Res. Farm [2]	1941 - 1957	17	26.3	668
*Cressy Research St. [3]	1939 - 1973	33	25.5	647
*Cressy Res. Farm [4]	1941 - 1954	15	25.3	643
*Cressy P.O. [2]	1899 - 1929	31	23.8	604
Deloraine [3]	1884 - 1973	77	38.1	968
Deloraine East [1]	1970 - 1980	10	42.8	1087
Golden Valley [2]	1917 - 1958	42	40.9	1039
Golden Valley [3]	1916 - 1973	56	40.8	1037
Liawenee [2]	1920 - 1958	11	41.2	1046
Liawenee [4]	1920 - 1966	18	39.4	1000
Liffey [2]	1916 - 1932	17	47.0	1194
Liffey [2]	1933 - 1957	16	40.6	1031
Liffey [3]	1915 - 1973	38	43.4	1102
Meander [2]	1930 - 1958	28	42.2	1072
Meander [3]	1930 - 1973	44	42.5	1078
Miena [2]	1890 - 1947	54	32.4	823
Miena [4]	1890 - 1942	49	32.3	820
Palmerston [1]	1962 -	24	31.0	787
Palmerston [3]	1963 - 1973	11	32.8	832
*Shannon [4]	1928 - 1966	39	33.3	845
*Shannon HEC [1]	1927 - 1985	58	33.6	854
Upper Arthur Lakes [2]	1917 - 1950	31	31.1	790
Westbury [2]	1901 - 1957	56	33.0	838
*Wihareja [2]	1913 - 1952	40	31.0	787
*Wihareja [4]	1913 - 1952	39	31.0	787
*Wood's Den [4]	1912 - 1952	32	28.7	729

* Outside Meander map area.

Table 4: Average yearly rainfall for selected stations.
(Source 1. Australia, Bureau of Meteorology, 1988, Climatic Averages Australia. Australian Government Publishing Service, Canberra.
2. Nicholls, K.D. & Aves, S.M., 1961, Average Yearly Rainfall in Tasmania. Commonwealth Bureau of Meteorology, Melbourne.
3. Australia, Bureau of Meteorology, 1980, Climatic Survey, Tasmania. Region 3, Northern. Australian Government Publishing Service, Canberra.)
4. Australia, Bureau of Meteorology, 1972, Climatic Survey, Midland Region 4, Tasmania. Australian Government Publishing Service, Canberra.)

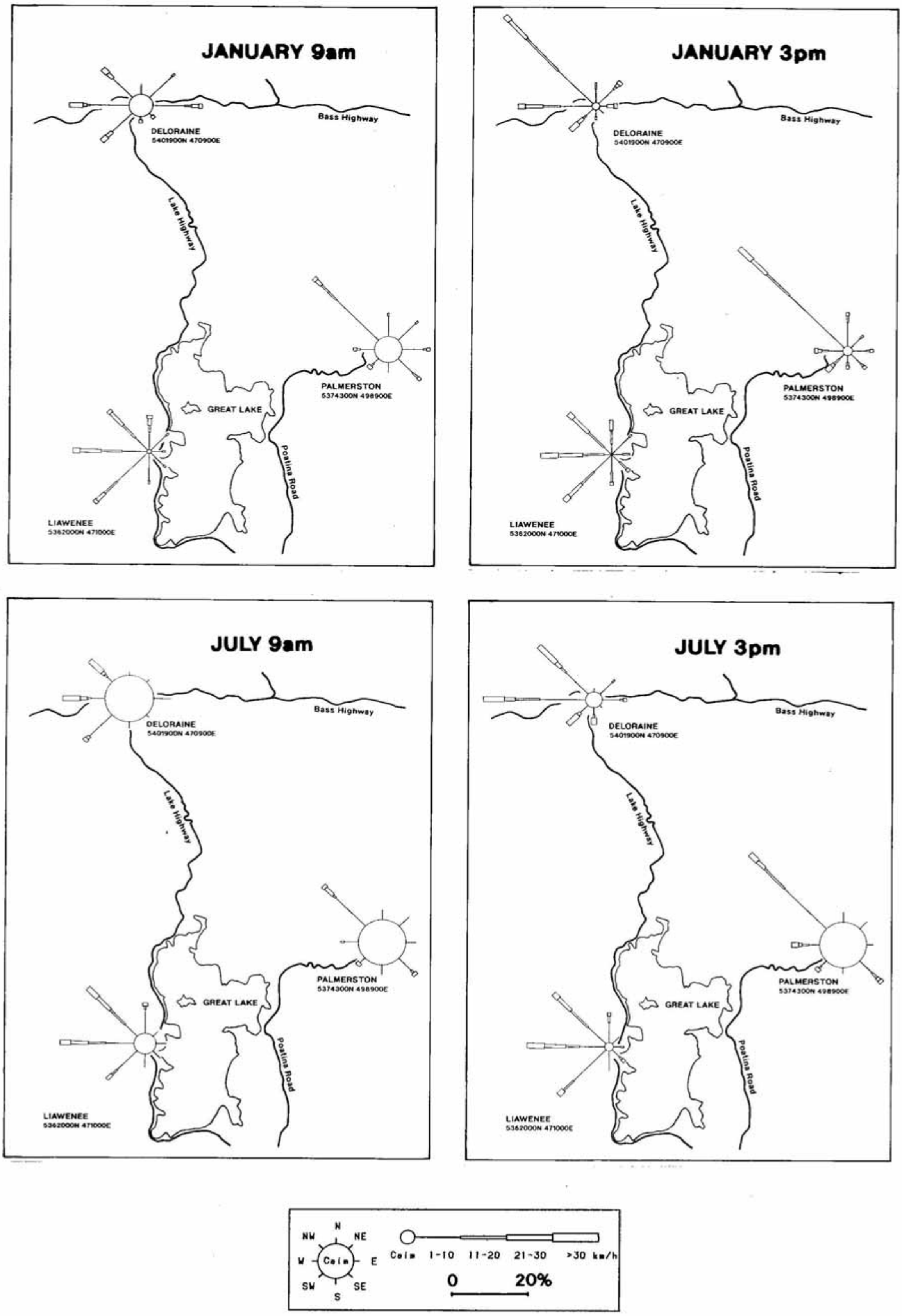

Figure 4: Windrose information showing direction of recorded winds for Deloraine, Palmerston and Liawenee.
(Source: Bureau of Meteorology, Climate and Consultative Services Section, Hobart, 1993.)

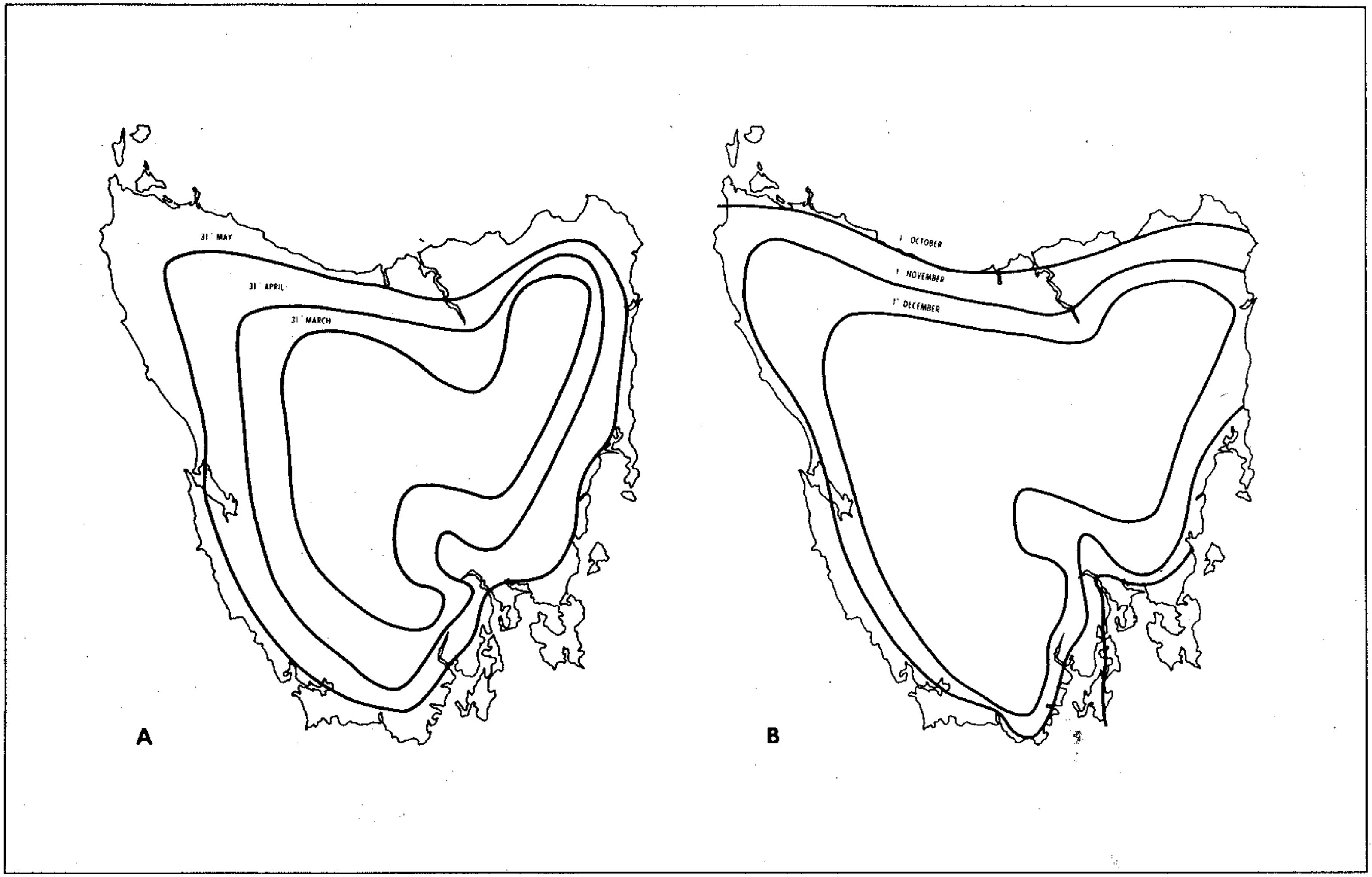

Figure 5: Average dates for (A) first occurrences and (B) last occurrences of air frosts in Tasmania.
(Source: Langford, J., 1965, Weather and Climate, in Atlas of Tasmania. Land and Surveys Department, Hobart.)

Station	Altitude (m)	Temp (°C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Cressy Research [2] 1940 - 73	150	Max Min	23.6 8.9	23.5 9.3	21.4 7.6	17.4 5.1	13.9 3.0	11.5 1.3	10.9 0.9	12.1 1.9	14.2 3.2	16.5 4.5	18.8 6.2	21.6 7.7	17.1 5.0
Cressy [3] 1940 - 86	150	Max Min	23.6 9.1	23.6 9.3	21.4 8.0	17.5 5.3	14.1 3.3	11.5 1.4	10.9 0.9	12.2 2.0	14.3 3.4	16.6 4.7	18.9 6.5	21.5 7.9	17.2 5.2
Deloraine [3] 1916 - 32	230	Max Min	21.3 7.7	22.5 8.7	19.6 6.3	16.5 4.5	13.2 2.7	10.9 1.0	10.4 0.9	11.4 1.2	13.3 3.1	15.5 4.4	17.7 5.4	20.1 7.2	16.0 4.4
Miena [1] 1916 - 42	1040	Max Min	15.1 4.7	16.1 5.7	13.7 4.0	10.8 2.2	8.1 0.7	5.4 -0.9	4.4 -1.7	5.3 -1.6	7.3 -0.5	9.5 1.0	12.1 2.5	14.8 4.2	10.3 1.7
Palmerston [2] 1965 - 73	180	Max Min	23.8 8.4	24.7 9.1	21.6 7.3	17.8 4.7	14.0 2.6	11.2 0.6	11.0 0.3	12.1 1.8	14.1 3.0	17.0 3.9	18.7 5.8	21.3 7.7	17.3 4.6
Palmerston [3] 1965 - 89	180	Max Min	23.7 8.8	24.6 9.1	21.7 8.0	17.9 5.2	14.3 3.2	11.5 1.1	11.1 0.7	12.4 2.1	14.4 3.5	16.9 4.6	19.3 6.6	21.6 7.8	17.5 5.1
Shannon [1] 1944 - 65	939	Max Min	17.7 6.0	16.9 5.8	14.8 4.8	11.2 2.7	8.1 1.1	6.0 -0.3	5.1 -0.9	5.8 -0.8	8.8 0.2	10.5 1.8	12.5 2.9	15.4 4.9	11.1 2.4
Shannon [3] (Wihareja) 1944 - 85	939	Max Min	17.7 5.8	17.6 6.0	15.2 4.8	11.6 2.8	8.4 1.3	6.2 -0.4	5.3 -1.1	6.2 -0.8	8.6 0.2	11.1 1.7	13.1 3.0	15.4 4.7	11.4 2.3

Table 5: Average maximum and minimum temperatures for selected stations (°C).
(Source: 1 Australia, Bureau of Meteorology, 1972, Climatic Survey, Tasmania. Region 4, Midlands. Australian Government Publishing Service, Canberra.
2. Australia, Bureau of Meteorology, 1980, Climatic Survey, Tasmania. Region 3, Northern. Australian Government Publishing Service, Canberra.
3. Australia, Bureau of Meteorology, 1990, Average and Extreme Maximum and Minimum Temperatures, Selected Tasmanian Stations. Commonwealth Bureau of Meteorology, Hobart, (Unpublished).

Station		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
*Cressy Research [1] 1948-69	a b c	22 1.9 0.3	22 1.1 0.2	22 3.3 1.1	22 8.2 4.0	22 13.2 7.5	22 17.9 12.1	21 19.8 13.8	21 17.1 10.0	21 11.5 5.7	21 7.4 2.6	21 4.1 1.0	21 2.6 0.5	 108.1 58.8
Deloraine [1] 1962-72	a b c	11 1.5 0.2	11 1.5 0.6	11 3.5 1.2	11 7.5 3.9	11 14.9 8.9	11 17.5 12.2	11 19.3 12.8	11 16.5 10.0	11 12.1 6.3	11 9.6 3.6	11 4.4 1.0	11 1.8 0.2	 110.1 60.9
Miena [2] 1916 - 42	b c	7.3 2.0	5.1 1.6	10.1 4.1	15.6 8.6	21.2 12.7	25.6 19.2	29.6 21.9	30.1 23.6	25.7 17.3	22.1 11.5	14.8 7.0	8.3 2.8	214.8 132.3
Palmerston [1] 1965-72	a b c	8 2.0 0.3	8 1.7 0.1	8 4.3 1.7	8 9.1 3.6	8 15.1 9.5	8 20.7 14.0	8 22.7 16.9	8 16.9 10.4	8 14.3 7.6	8 13.0 5.3	8 6.3 2.1	8 3.5 0.6	 129.6 72.1
Shannon [2] 1950-65	b c	5.6 1.6	4.7 1.2	8.1 2.5	15.4 7.3	20.8 13.2	24.4 16.8	28.7 21.1	27.9 20.3	23.9 16.1	18.6 10.9	15.3 6.7	8.9 2.7	202.3 120.4

*Outside the Meander map area.

(a) Number of months of records

(b) Air temperature equal to or less than 2^{o}C (light frost).

(c) Air temperature equal to or less that 0^{o}C (heavy frost).

Table 6: Average frequency of frost (days per month).
(Source: 1. Australia, Bureau of Meteorology, 1980, Climatic Survey, Tasmania. Region 3, Northern. Australian Government Publishing Service, Canberra.
2. Australia, Bureau of Meteorology, 1972, Climatic Survey, Tasmania. Region 4, Midlands. Australian Government Publishing Service, Canberra.

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9.3 Land Use

The major land uses within the Meander map are grazing, dairying, cropping and forestry. Sheep grazing predominates over beef cattle, with grazing occurring on improved pastures, native pastures, partially cleared areas, steeper country and stony land.

Dairying is concentrated in the Meander-Montana area, Dairy Plains-Western Creek area, and around Deloraine. Other scattered areas of dairying occur around Exton, and in the Glenore, Whitemore and Bracknell areas. Supplementary irrigation is used during summer months to boost pasture production for dairying.

The major areas of intensive cropping occur throughout the lowlands in the northern half of the map, in particular in the Bishopsbourne, Whitemore, Glenore, Hagley, Westbury, Exton, Deloraine and Bengeo areas. More intensive cropping occurs on the red basaltic soils (krasnozems) and on the Cressy association soils.

The major crops grown are peas, potatoes, poppies, beans, carrots and cereals, particularly wheat and barley. Triticale, buckwheat and lucerne are also grown. Forage and green fodder crops are grown throughout for stock feed (oats, turnips etc). A range of vegetables is grown for seed at Hagley.

The cropping areas can be affected by summer droughts which occur in some years.

A small area on the eastern boundary of the Meander map falls within the Cressy-Longford Irrigation Scheme area. The availability of irrigation water in this area is variable, but when available boosts the production of crops grown. Figure 6 shows the area covered by the Cressy-Longford Irrigation Scheme.

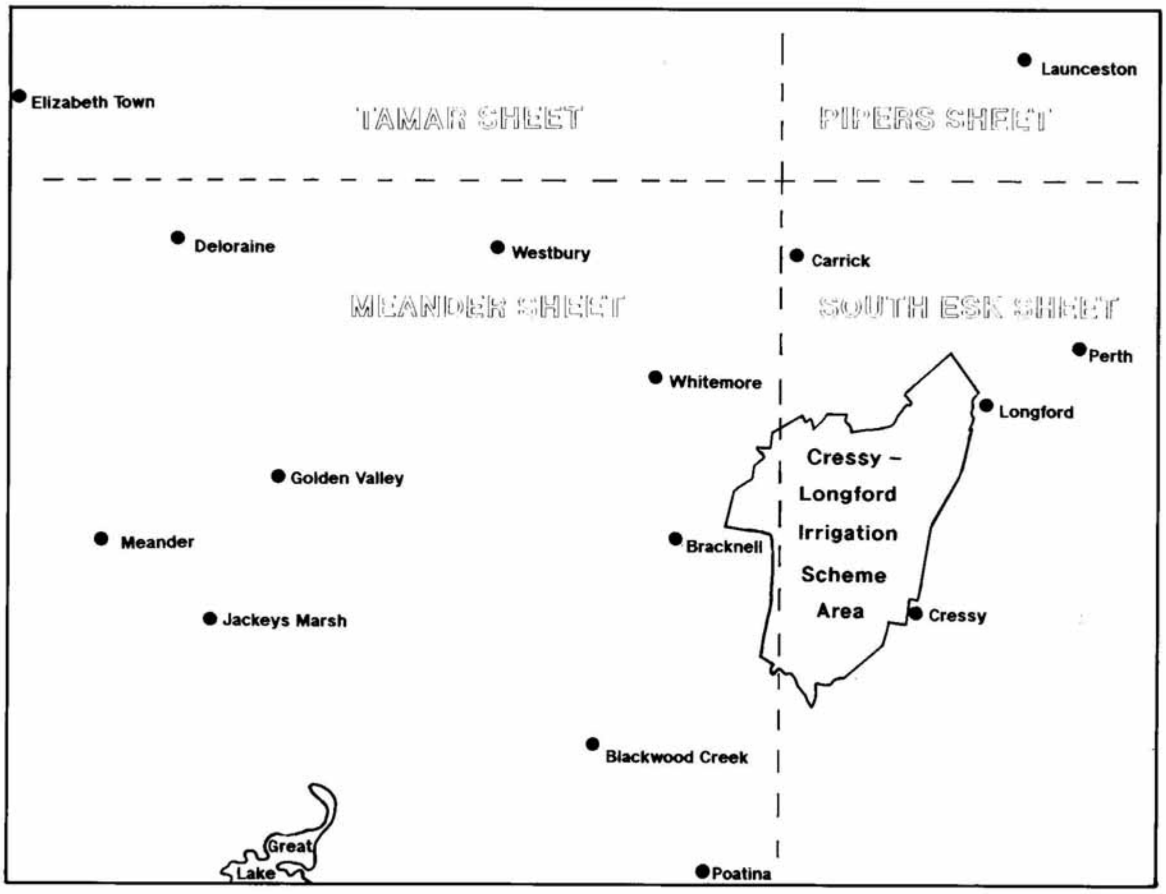

Figure 6: Area covered by the Cressy-Longford Irrigation Scheme on the Meander and South Esk map sheets.

In recent years there has been a proposal for an irrigation scheme which would include the northern and north western areas of the Meander map. The availability of irrigation water would encourage cropping in the area, although soil management practices must ensure that soil structural decline, salinity and drainage problems are not exacerbated. This would apply particularly to the areas south, east and south east of Exton, where soil types may be prone to these types of problems.

Forestry is also a major land use, with private and commercial forests providing wood for both pulp and sawlogs. Forestry occurs mainly on the dolerite, sandstones and mudstones, slate and quartzite hill country, with the majority occurring in unmapped exclusion areas of State Forests.

The majority of the Central Plateau area is reserved as protected areas and as Hydro Electric Commission Reserves. The area to the south and south west of Great Lake, and a small area east of Arthurs Lake is privately owned and used for summer grazing and forestry.

The Central Plateau area is a very fragile environment where inappropriate land uses can, and in some places have led to serious land degradation problems. The harsh climatic environment, slow vegetation growth rates and fragile alpine peat soils, make this area vulnerable to erosion. Photo 3 shows an example of land degradation on the Central Plateau.

Major environmental hazards associated with the Great Western Tiers and the Central Plateau are: the control and management of grazing marsupials and rabbits, overgrazing by stock, fire damage, fluvial erosion, forestry operations, landslide hazard and trampling of fragile vegetation and soils by humans, stock, horses and vehicles. Other land use concerns relate to recreational uses, wilderness conservation and tourism.

A major hydro electric power station is sited at Poatina, which harnesses water energy from the Great Lake. The water from this power scheme is diverted into channels which feed into the Cressy-Longford Irrigation Scheme.

Photo 3: Active fluvial erosion on shallow dolerite soils, Central Plateau. Note collapse of fence line in active fluvial channel. Meander map 708 538, Stone Hut Road.

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9.4 Geology

A wide range of rock types and soil parent materials occur across the Meander map area. They include Quaternary alluvium; Tertiary sand, clay, gravel and basalt; Jurassic dolerite; Triassic and Permian sandstone, siltstone and mudstone; Ordovician limestone and conglomerate; and Cambrian and Precambrian slate, sandstone, quartzite, schist, phyllite and conglomerate.

The geology and geological history of the area has a major influence on the present day topography and landforms. For example, dolerite generally forms rugged, steep and stony landforms because it is highly resistant to erosion, whereas mudstones and sandstones are less resistant, forming lower subdued landforms. Rock type strongly influences the erosion types, drainage characteristics and soil types, and therefore is a major factor influencing land capability.

The Meander map covers part of three physiographic regions of Tasmania: The Tamar Graben, Western Ranges, and the Central Plateau (refer to Figure 7).

The southern half of the Tamar Graben incorporates the Launceston Tertiary Basin. The western edge of this basin covers the lowland terrace country from Poatina to Carrick, and west to Westbury. Photo 4 shows the sequence of river terraces in the Launceston Tertiary Basin.

The Western ranges comprise the very steep slopes of the Great Western Tiers, Quamby Bluff, the Cluan Tiers and the steeper hill country extending from Golden Valley - Native Hop Hill - Long Ridge - Needles Ridge - Gardeners Ridge - Magog areas.

The Central Plateau consists of an elevated, undulating, dissected plateau which has been uplifted several times during geological history. The surface of the plateau dips toward the south, and is covered by a large number of variously sized lakes. The Great Lake is the largest of the lakes on the Central Plateau (due to artificial damming at Miena).

The Central Plateau has undergone extensive glaciation in the past and the western parts were the site of a small ice cap during the glacial periods. The effects of the glacial action have resulted in the numerous small lakes on the plateau surface, another glacial features which are more evident to the west of the Meander map sheet. Larger lakes such as the Great Lake, Arthurs Lake and Woods Lake, occur in the eastern parts, and are thought to have formed by northward tilting of the plateau surface. Mantling the plateau escarpment, are areas of solifluction deposits, the results of later periglacial action.

The oldest rocks on the Meander map are the schists, phyllites, conglomerates, slates and quartzites of Cambrian and Precambrian age. These rocks are highly resistant to erosion, and where they outcrop at the surface, form steep rugged ridges. They occur in a north westerly trending band, from Quamby Brook - Golden Valley to Pumicestone Ridge - Native Hop Hill, Beefeater Hill - Long Ridge, Needles Ridge and Magog.

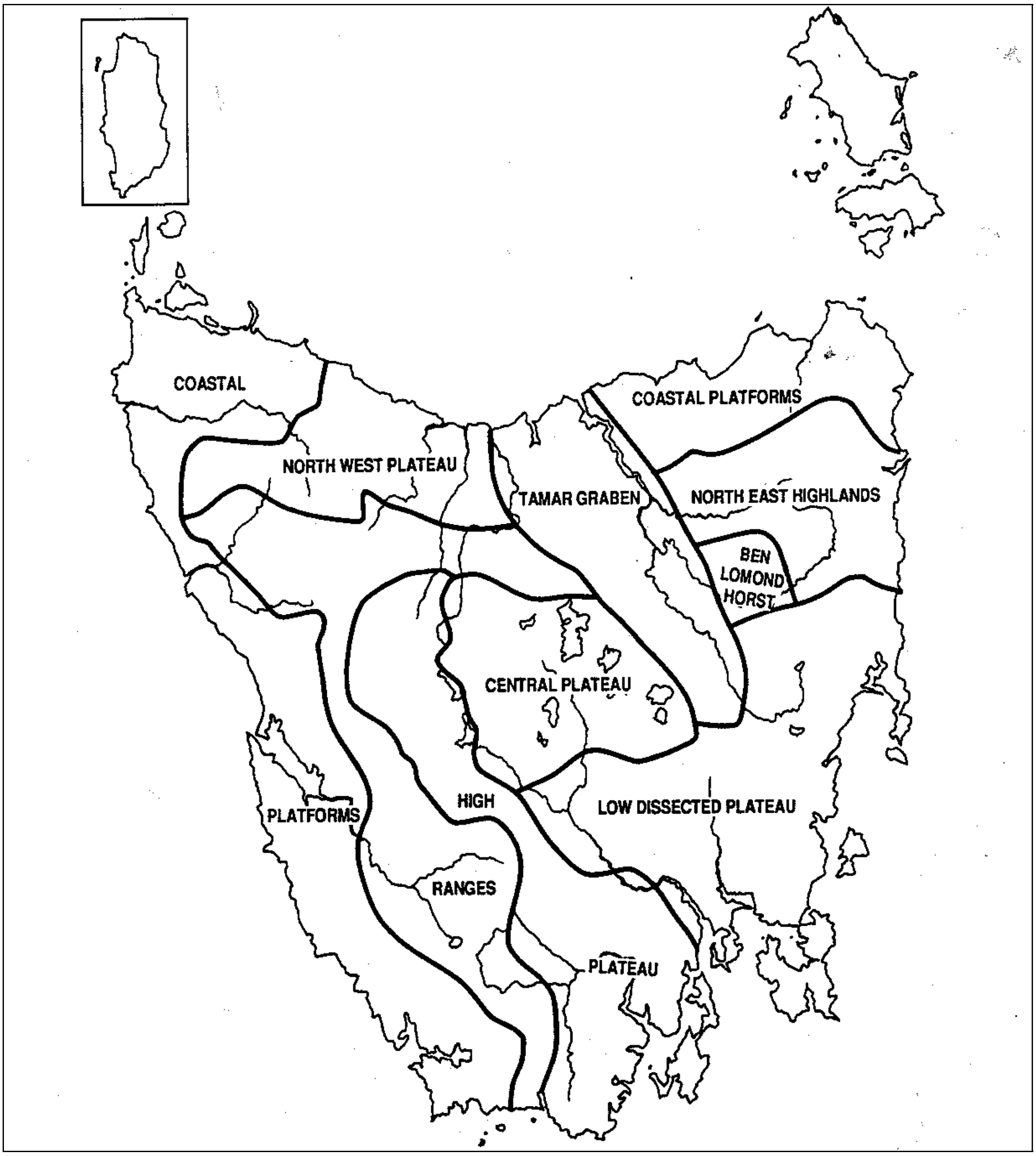

Figure 7: Physiographic regions of Tasmania.
(Source: Australian Bureau of Statistics, 1988, Tasmanian Year Book, Page 32).

Younger sediments of Permian and Triassic age were deposited sequentially above the Cambrian and Precambrian rocks. However these sedimentary rocks, principally sandstones, siltstones and mudstones, are more erodible, and are now only exposed at the surface where they have been protected by more resistant caps of dolerite. The Permian and Triassic rocks outcrop almost continuously along the scarp edge of the Great Western Tiers and around the margins of Archers and Warners Sugarloafs, Quamby Bluff, Cluan Tiers and McRaes Hills. Refer to Photo 5.

On the Tiers escarpment these Permian and Triassic deposits form steep slopes where they have been more protected by the presence of the dolerite. However away from the dolerite they have been exposed to erosion and the landscapes are more subdued, with lower relief. In lowland areas such as the Launceston Tertiary Basin, they have been covered by younger sediments. Some of the sandstone beds within the sequence are more cemented and therefore more resistant to erosion, and form distinctive cliffs and benches along the Western Tiers escarpment, and in the Liffey Valley. Below the steeper escarpments of Triassic sandstone, areas of Quaternary age sandstone talus are found.

During the Jurassic period, large intrusions of dolerite occurred into the Triassic rocks. The dolerite was deposited as very thick sills into the sub horizontal Triassic strata, however with uplift and subsequent erosion, the overlying sediments have been stripped away, exposing the dolerite.

Dolerite therefore occurs on the higher points of the landscape throughout the Meander map i.e. the majority of the Central Plateau, the Great Western Tiers escarpment (including Mother Cummings Peak, Bastion Bluff, Projection Bluff, Liffey Bluff and Drys Bluff), Archers Sugarloaf, Warners Sugarloaf, Quamby Bluff, Black Jack Hill and Cluan Tiers. All these areas, with the exception of a small area of dolerite mapped on the Central Plateau, occur in exclusion zones of the Central Plateau Protected Area, Hydro Electric Commission land or Forestry Commission land.

Other areas of lower relief dolerite mapped throughout the lowlands include McRaes Hills, Tea Hills, Dawson Hill, and areas south of Montana, west of Osmaston, north of Exton, southwest of Carrick and north of Cluan.

Areas of dolerite talus, scree and solifluction deposits occur around the margins of the dolerite bodies and often overlie the older basement rocks through which the dolerite has intruded (e.g. Great Western Tiers escarpment, Archers and Warners Sugarloafs, Quamby Bluff and Cluan Tiers). Although much of these talus deposits are concentrated at the base of the dolerite cliffs, in some areas large tongues of talus extend from these scree fields to the plains below (e.g. Quamby Bluff).

Tertiary age deposits of sands, clays and gravels occur in the north eastern corner of the map, extending from Bracknell, north to the Meander River, and north of Westbury and Hagley. These deposits are part of the Launceston Tertiary Basin, and have a sequence of cut river terraces and associated soil types (Refer to Figure 8 and Photo 4).

Also of Tertiary age are areas of basalt which occur in the north and eastern parts of the map, and on the Central Plateau. Localities are south west of Needles, Red Hills - Bengeo - Deloraine area, north of Montana, between Deloraine and Westbury, Black Hills area, north of Hagley, east and south of Whitemore, and on the Central Plateau at Ellis Plains, Liawenee Moor and extending west to McDowall Hill and Pine Hills, Skittleball Plains, north of First and Second Lagoons, and Reynolds Island.

The basalt has been extruded as volcanic eruptions and has either flowed along existing valleys or has flowed over the top of other rock types, giving them a protective capping. Quaternary age basalt talus occurs around the margins of the basalt north of Montana. On the Central Plateau the basalts disrupted the existing drainage patterns, and were subject to glacial and fluvial erosion as the stream systems redeveloped preferentially on

Photo 4: View across Launceston Tertiary Basin with sequence of river terraces. Meander map 950 908, Bracknell Road.

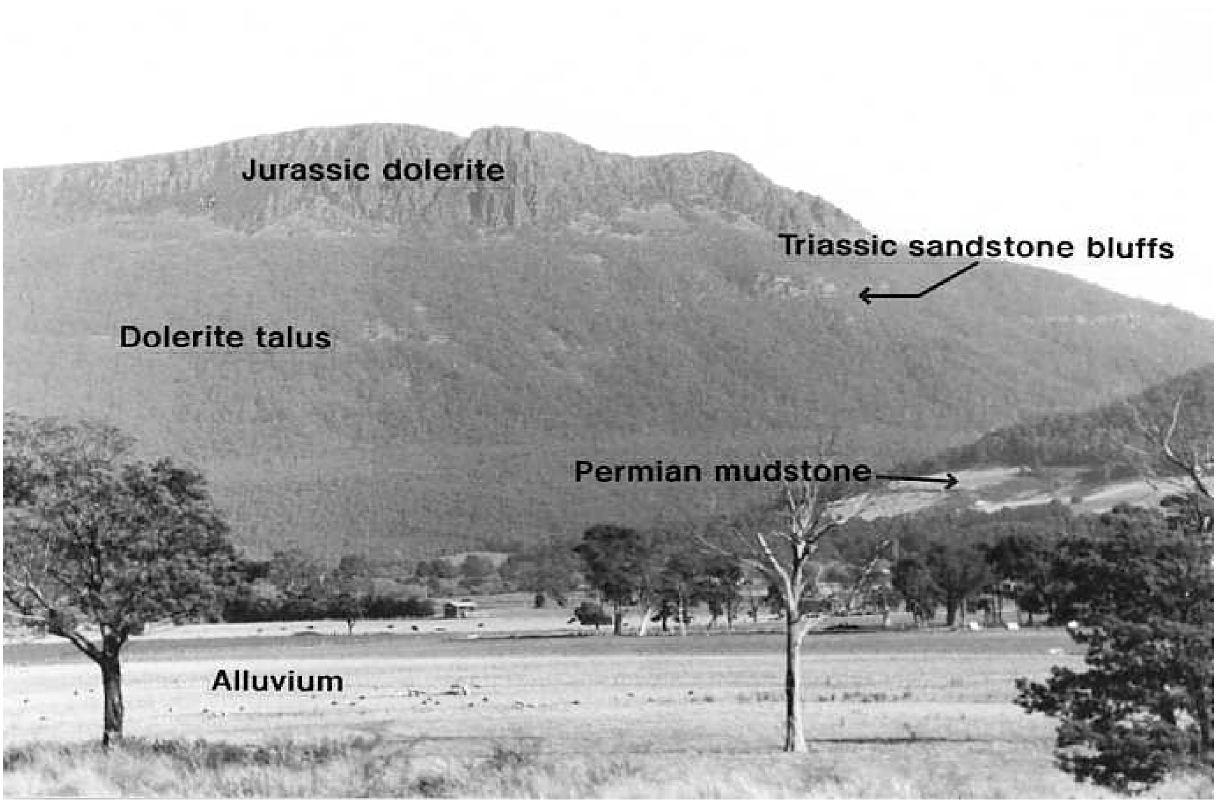

Photo 5: View to Drys Bluff with different rock types and deposits indicated. Meander map 928 888, Bracknell Road.

the basalt areas, rather than on the more resistant dolerite, resulting in more subdued landscapes.

The youngest deposits consist of Quaternary age alluvium, gravels, swamp deposits and windblown sands. The alluvial deposits occur along river flats and terraces, and range from confined valleys to broad flood plains. Areas of alluvium are found along the Ouse and Pine Rivers, Blackwood Creek area, Liffey River, Whitemore Creek, Swamp Gum Rivulet, Quamby Brook, Meander River, Rubicon River, and in the Dairy Plains - Stockers Plains area (Stockers Creek, Meander River, Leiths Creek, Western Creek and Dale Brook). Swamp and marsh deposits occur in depressions and along drainage lines on the Central Plateau.

In the Blackwood Creek area deposits of dolerite boulders occur. These may have formed by alluvial fan processes or sheet flood activity, and are comprised of reworked dolerite talus derived from the slopes of the Great Western Tiers.

Small areas of windblown sands of Quaternary age occur in small pockets along the Meander River and Cluan Valley, and blanket some of the lower terraces (Brumby surface). These deposits have been blown from the river valleys during arid cycles associated with the last glaciation (Nicolls, 1960).

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9.5 Soils

The northern half of the Meander sheet is covered by soil survey information, however the southern half has no soil survey coverage.

The reconnaissance soil map of Tasmania, Sheet 46, Quamby, covers the whole northern half of the map sheet extending onto the Central Plateau south of Pine Lake, and on the eastern lowlands, south of Blackwood Creek. This reconnaissance map was published at a scale of 1 inch to 1 mile (1:63,360), and is accompanied by a report detailing the major soil types found in the area (Nicolls, 1959). A summary of the soil information from the Quamby soil map is shown in Table 7.

An unpublished soil map covers the area to the east of the Liffey River as far south as Lawsons Corner and extends onto the adjoining South Esk map (Hubble, 1944). The soil map is at a scale of approximately 1 inch to 20 chains (1:15,840). This map is an extension of the published soil map of the Parishes of Longford, Cressy and Lawrence, County of Westmorland (Stephens *et al*, 1942). Relevant soil information and descriptions are found in the report which accompanies this published map.

In the following section, the soils of the Meander map are described under each of the four topographic regions that occur on the map. Soil descriptions are from Pemberton, 1986, Land Systems Region 5 - Central Plateau; and Nicolls, 1959, Quamby Reconnaissance soil map and report.

1. Soils of the Central Plateau

The majority of soils on the Central Plateau are either gradational or organic soils. These soils are not suitable for cropping because of climatic limitations, and erosion hazard. Some grazing may be undertaken, but careful management is essential to prevent further degradation of these sensitive soils in alpine areas. An area of duplex soils consisting of loam over light medium clay occurs on basalt flats and slopes on Ellis Plains.

The organic soils occur in areas of poor or restricted drainage, along drainage lines, flats or in depressions. Organic matter which accumulates in these areas is slow to break down because of the low temperatures and waterlogged conditions. Organic matter content in these soils is generally over 50%, and they are strongly acid with pH <5, (Nicolls, 1959).

These soils occur in valleys, watercourses and swamps underlain by both dolerite and basalt. Soil depths can vary between 0.3 and >0.8m in these areas. Typical soil profiles consist of a black or brown peat topsoil overlying black, brown or yellowish brown clay in the B horizon.

Some areas of these organic soils have been eroded by fluvial processes and wind, due to the effects of fire and overgrazing.

These soils have been mapped as 'high moor peats' on the Quamby soil map (Nicolls, 1959). Gradational soils are widespread on the remainder of the Central Plateau area which occurs on the Meander sheet. They occur on dolerite, basalt, periglacial deposits and alluvium.
The dolerite soils normally contain many rock fragments or boulders. Most soils contain a matrix of soil material with rock of various sizes occurring throughout the profiles. Some areas of dolerite talus and boulder fields consist of rocks or boulders only.

A typical profile may have a clay loam or loam topsoil overlying a light clay to clay loam B horizon. Soil colours can range from yellowish brown to brown and yellowish red.

These soils on dolerite equate to the 'yellow-brown soils on solifluction deposits (derived wholly or partly from dolerite)' mapped and described on the Quamby soil map (Nicolls, 1959).

Gradational soils on basalt occur in the southern part of the map to the west and south of Great Lake. These soils usually have a loam topsoil overlying a clay loam or sandy clay B horizon. Soil colours range from yellowish brown to strong brown and reddish brown. Soil depths are generally over 0.5m. These soils are significantly less stony than the dolerite soils, although some areas of rock outcrops do occur, particularly on crests or ridges. Gradational soils are also found on alluvial flats within the basalt areas, and consist of a loam topsoil over a very dark greyish brown fine sandy loam subsoil (Pemberton, 1986).

2. Soils of the Great Western Tiers

The soils of this area are gradational soils, and occur on dolerite and sandstone, and associated solifluction material deposited as a result of periglacial action. The major limitation to use of these soils is the steep topography and erosion hazard. On lower slopes, some areas may be suitable for grazing.

Soils on dolerite and solifluction material from dolerite are the most extensive, and occur along the Tiers escarpment, Warner and Archers Sugarloafs, Quamby Bluff and Cluan Tier. These soils are mapped as 'yellow brown soils on solifluction deposits - derived wholly or partly from dolerite', on the Quamby soil map (Nicolls, 1959), and are described under the section on Soils of the Central Plateau, above.

The solifluction debris and rock screes extend downslope from the steep bluffs of the Great Western Tiers, and mantle some of the underlying Triassic or Permian strata. Clay loams overlie sandy clay loams, or light medium clays. Soil colours vary with drainage - better drained soils tend to have reddish or bright yellow-brown colours, while poorly drained areas have yellow-grey colours (Nicolls, 1959). The size and number of dolerite boulders varies in some profiles, while other areas are predominantly rock scree with no soil matrix.

On lower slopes, 'yellow brown soils on solifluction deposits - derived wholly or mainly from sandstone without dolerite', have been mapped on the Quamby soil map (Nicolls, 1959). These soils are also gradational and occur on areas where sandstone boulders and solifluction material from the Triassic sandstones occur. These soils have a dark brownish grey sandy loam or loamy sand surface, overlying a greyish or yellowish brown sandy loam or clay loam (Nicolls, 1959). Boulders of sandstone of varying size may be present throughout the profile. In some areas the presence of dolerite from higher upslope may influence the profile. These soils are generally well drained, but are prone to fluvial erosion because of the weak soil structure (usually single grained).

3. Soils of the Hill Country

This group of soils covers those areas that comprise the foothills of the Great Western Tiers, Quamby Bluff and Cluan Tiers, steeper hill slopes (e.g. Needles Ridge, Native Hop Hill, McRaes Hills) and low rolling country in the north and north west of the map sheet. Soils in these areas are either gradational or duplex, and are found on a range of rock types including dolerite, sandstone, mudstone, basalt, conglomerates and quartzites.

On areas of Permian siltstones and mudstones which outcrop along the foothills of the Great Western Tiers and Cluan Tiers, gradational soils are found. These soils have a dark brownish grey loam or clay loam topsoil, over a yellowish or brownish fine sandy loam or fine sandy clay loam subsoil, passing into yellowish brown clay, containing weathered mudstone (Nicolls, 1959). These soils have been mapped as 'yellow podzolic soils on mudstones' on the Quamby soil map (Nicolls, 1959). They are relatively infertile and prone to waterlogging. Lower slopes which are not too steep may be used for occasional cropping.

Duplex soils occur on areas of Triassic and Permian sandstones which also outcrop along the foothills of the Great Western Tiers and Cluan Tiers. These soils have a grey to dark grey loamy sand, sandy loam or sandy clay loam topsoil over a light grey or bleached sub surface layer, over yellowish brown to dark grey medium clay or sandy clay subsoils. These soils equate to the 'podzolic soils on Permian and Triassic sandstones' mapped on the Quamby soil map (Nicolls, 1959). Erosion hazard, low fertility, poor soil structure and slope, limit cropping on these soils.

Duplex soils also occur on dolerite under lower rainfalls (generally < 1000 mm). These soils have been mapped as 'podzolic soils on dolerite' (Eastfield association) on the Quamby soil map (Nicolls, 1959). Typical soil profiles have a grey-brown loam or fine sandy loam topsoil, (A_1 horizon), over a light grey fine sand to sandy loam A_2 horizon. This horizon often contains fine rounded ironstone gravel. Below this is a mottled yellow-brown, grey-brown and yellow-grey clay (Nicolls, 1959). Dolerite stones and boulders can occur throughout the profile.

These podzolic soils on dolerite occur around Montana, Cluan Tiers, north of Westbury, Cluan, Tea Hills, and McRaes Hills. In the area south of Bracknell, areas of brown soils on dolerite are found, and these soils have brown to red-brown clay subsoils, with no bleached A_2 horizon.

Soils on dolerite are variable in terms of soil depth and the amount of stones and boulders present throughout the profile. Most of the dolerite soils are imperfectly drained with slow permeability . The major limitation to cropping of the soils on dolerite is the amount of rock outcrop, the presence of surface and subsurface stones and shallow soil depths. The dolerite soils are moderately acid with topsoil pH generally between 5.0 and 6.0 (CSIRO data base).

Also on dolerite are areas of kraznozem soils which occur north east of Deloraine, Osmaston, south east of Meander, Montana and Gibsons Sugarloaf. These are gradational soils, with reddish friable loam, clay loam or gravelly clay loam topsoils over red-brown clay (Nicolls, 1959). Stones and boulders of basalt are common throughout the profile. These soils are friable and well drained. They have been mapped as 'krasnozems on dolerite' on the Quamby reconnaissance soil map, and where areas of laterite occur, as 'lateritic krasnozems on dolerite' (Nicolls, 1959).

On the steep hill country comprised of the Cambrian and Precambrian rocks which occur north west of Golden Valley, 'red and yellow podzolic soils and podzols on various metamorphic rocks' have been mapped on the Quamby reconnaissance soil map (Nicolls, 1959).

Podzolic profiles are characterised by a sandy, leached A_2 horizon with clay accumulation in the B horizon; whereas podzol profiles usually have a dark peaty topsoil overlying a strongly leached light grey sand (A_2 horizon), and a brownish black organic-iron layer which may form a cemented pan. Iron and organic matter has been leached, from the A_2 horizon and deposited in the B horizon. The difference between the podzolics and podzols therefore depends on the degree of development of the organic B horizon - where it is well developed, soils are classified as podzols; and where it is not strongly developed, but organic coatings may occur, the soil is classified as podzolic. Podzols are more commonly developed on sandy or siliceous parent materials, where clay, iron and organic matter are more easily transported and redeposited down the profile.

The red podzolic soils are gradational soils. They could be mistaken for kraszonem soils on basalt, however they have much sandier textures and are not as well structured. Typical profiles have a dark grey to greyish brown sandy loam surface which overlies a reddish brown to red-brown sandy loam, sandy clay loam or friable clay (Nicolls, 1959). Angular siliceous gravel and stones can occur throughout the profile, and on the surface.

The yellow podzolic soils are mostly duplex soils. They have a grey to grey-brown fine sandy loam surface over a light grey fine sandy loam subsurface, which overlies friable yellow-brown light clay or sandy clay (Nicolls, 1959). Siliceous gravel and stones occur on the surface and throughout the profile.

In some places podzol soils occur on the Precambrian quartzites. These soils have a dark grey fine sandy A_1 horizon and a light grey sandy A_2 horizon, with rock fragments, over a humus-iron pan. These soils are very infertile and strongly leached. They require high fertilizer inputs and are prone to fluvial erosion.

The soils formed on basalt are predominantly krasnozem soils, although some areas of brown and dark coloured soils occur on lower slopes or in areas with poor drainage. The krasnozem soils occur south west of Needles, north of Montana, west and south of Whitemore, north west of Hagley, north and west of Westbury and north and west of Deloraine.

The krasnozems on basalt are gradational soils and have deep, freely drained, friable clay profiles. They can withstand regular cropping because of excellent soil structure, although they have low to moderate chemical fertility. Basaltic boulders and stones can occur throughout the profile and may be a limitation to cultivation in some areas. A typical profile has a brown to reddish brown friable clay loam surface, over a reddish brown to red brown friable clay. These soils have been mapped as 'krasnozems and other soils on basalt' on the Quamby reconnaissance soil map (Nicolls, 1959).

Areas which have massive laterite outcrops have been mapped as 'lateritic krasnozems on basalt' on the Quamby reconnaissance soil map (Nicolls, 1959).

4. <u>Soils of the flat plains and dissected terraces.</u>

This group of soils occupy the low terrace country which extends from Poatina north to Carrick, and west to Deloraine, the Stockers Plains-Dairy Plains area, and in other small river valleys throughout the map.

The area in the east of the map sheet, extending west to Westbury, is part of the Launceston Tertiary Basin. The sediments which were deposited into this basin are of lacustrine and fluvial origin, mainly clays and gravels. These sediments were then dissected and incised producing a series of erosion surfaces and river terraces. More recent (Quaternary age) deposits of sands, gravels and clays occur along river valleys, and in the Stockers Plains - Dairy Plains area.

A view across part of the Launceston Tertiary Basin is shown in Photo 4, and a schematic cross section showing the relationship between the different terraces and associated soils is shown in Figure 8.

The highest and oldest terrace level is known as the Woodstock surface. Soils mapped on the Quamby soil map are 'lateritic podzolic soils' of the Woodstock association. These are highly weathered, leached, low fertility, acid duplex soils, with imperfect drainage. Typical profiles have a grey-brown loamy sand to sandy loam A_1 horizon, over a light brown or light grey A_2 horizon of loose sand to sandy loam with concentrations of ironstone gravel, over a mottled yellow-brown, red-brown and grey friable clay (Nicolls, 1959). Most of the Woodstock surface has been removed by erosion and now only discontinuous areas remain.

These soils require high fertiliser inputs, topsoils can be prone to water and wind erosion, and some areas are very rocky with boulders of cemented laterite. Woodstock soils occur north east and south west of Whitemore, south east of Bracknell and west and south west of Westbury.

Incised into the Woodstock surface, and the Brickendon terrace (described later), are areas of soils mapped as 'lateritic podzolic soils' of the Cressy association, on the Quamby reconnaissance soil map (Nicolls, 1959). These soils have a dark grey-brown to brown loam to clay loam surface, over a reddish brown to grey brown friable clay, over mottled yellow-brown, brown, grey and red friable clay (Nicolls, 1959). Ironstone gravel can occur throughout the profile. These soils are mainly gradational, although in some areas with sandy sub-surface horizons, duplex soils occur. The Cressy soils suffer from molybdenum and potassium deficiencies (Nicolls, 1959). They are moderately drained and are acid.

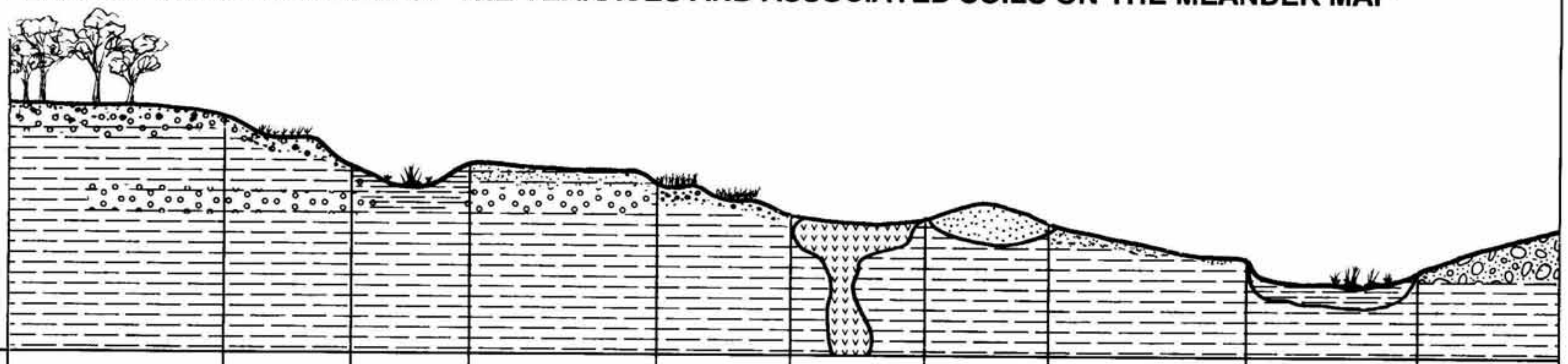
Along drainage lines and in depressions throughout the Cressy association, Kinburn soils are found. These are poorly drained, gradational, alluvial soils. Profiles have a dark grey friable clay loam or clay surface, over a yellow-grey or dark yellow-grey mottled clay (Nicolls, 1959). Ironstone gravel occurs throughout the profile. Cressy and Kinburn soils occur in the Westbury-Hagley area, around Oaks and south west of Bishopsbourne.

The Brickendon terrace occurs below the Woodstock surface, and 'lateritic podzolic soils' of the Brickendon association are mapped on the Quamby reconnaissance soil map. These soils are imperfectly drained acid to neutral soils. Typical profiles have a grey sandy A_1 horizon, over a light grey sand with quartz and ironstone gravels in the $A_{2,}$ over mottled yellow-brown, red-brown and grey friable clay subsoil (Nicolls, 1959). The presence of quartz gravels in the upper part of the profile is characteristic of the Brickendon association soils.

Brickendon soils occur around Westbury, Bracknell, north of Whitemore and west of Carrick. North and west of Westbury, some of the soils on the drop-off slopes of the Brickendon terrace, resemble Newham association soils that are mapped on the adjacent Longford soil map.

At approximately the same level as the Brickendon terrace, is a terrace cut across basalt. Soils on this terrace have dark clay and clay loam soils, and these are mapped as 'Alluvial soils, A_1 (soils of high terraces, other than Brickendon)', on the Quamby reconnaissance soil map (Nicolls, 1959). These soils occur north east of Hagley, and west of Westbury.

IDEALISED CROSS SECTION OF THE TERRACES AND ASSOCIATED SOILS ON THE MEANDER MAP



Landform	High level erosion surface (Woodstock surface)	Dissected erosion surface (Cressy surface)	Drainage lines	High river terrace (Brickendon surface)	Dissected erosion surface (Cressy surface)	High river terrace	Windblown sand dunes	Low river terrace (Brumby surface)	Recent flood plain	Alluvial and gravel fans
Geology	Tertiary clays	Tertiary clays	Quaternary alluvium	Tertiary clays with quartz gravel	Tertiary clays	Tertiary basalt	Quaternary windblown sand	Quaternary alluvium	Quaternary alluvium (silts and clays)	Quaternary alluvium and gravels
Soils	Woodstock association LPw*	Cressy association LPc*	Kinburn association A3*	Brickendon association LPb*	Cressy association LPc*	Soils of terraces cut across basalt A1*	Panshanger association P*	Brumby association A2*	Canola association A3*	Soils of stony alluvial fans A4*
Slope	Flat to undulating 0-10%	Flat to rolling 0-15%	Flat to gently undulating 0-3%	Flat to undulating 0-5%	Flat to rolling 0-15%	Flat to gently undulating 0-3%	Undulating to rolling 3-20%	Flat to gently undulating 0-3%	Flat to gently undulating 0-3%	Flat to undulating 0-10%
Limitations	- Low fertility acid soils - Heavy clay subsoil	- Imperfect internal drainage	- Poor internal drainage - Massive structure	- Quartz gravel - Imperfect drainage	- Imperfect internal drainage	- Variable profiles - Imperfect drainage	- Wind erosion - Summer dryness	- Winter wetness - Summer dryness - Heavy clay subsoils	- Flooding - Drainage problems	- Stoniness - Internal drainage problems
Land capability classes	4,5	3	4	4	3	4	4	4	4	4,5

*Soil association names and symbols from Quamby Reconnaissance Soil Map (Nicolls 1959)

Figure 8 Cross section showing terraces and associated soils on the Meander map.

Below the Brickendon terrace, lies the Brumby terrace, which is situated approximately 3 metres above the present day flood plains. The soils on this terrace have been mapped as Brumby association soils ('soils of the lower terraces, A_2', on the Quamby reconnaissance soil map). These soils are duplex soils, and are poorly drained. They have a grey or brownish grey sandy loam or loam A_1 horizon, over a light grey fine sand, fine sandy loam or loam A_2 horizon, over a dark grey-brown to dark yellow-grey clay, over yellow mottled clay or sandy clay (Nicolls, 1959). The A_2 horizon often has concentrations of rounded ironstone or quartz gravel, although these can occur throughout the profile.

The lowest river terrace comprises the present day flood plain, and at this level the Canola association soils are found (mapped as soils of the flood plains and other young alluvium, A_3, on the Quamby reconnaissance soil map, Nicolls, 1959). These soils are found along the major river systems (e.g. Liffey River, Meander River) and tributaries (e.g. Quamby Brook, Swamp Gum Rivulet, Western Creek), and in drained lagoons (Western Lagoon) and valley floors in the hill country (e.g. Jackeys Marsh).

The Canola association soils are poorly drained gradational and uniform soils. Typical profiles have dark grey to dark grey-brown humic clay loam or clay A_1 horizons, over a dark brownish grey or black clay, with rust coloured mottles. These black cracking clays are also associated with areas of basalt, and profiles can vary depending on the parent material of the clays, with some areas having browner, less organic profiles (Nicolls, 1959).

In a few areas on the Meander sheet, areas of windblown sands which have been derived from river valleys and lagoons occur. The soils on these areas have been mapped as 'windblown sands' of the Panshanger association. These soils are rapidly drained, uniform and gradational soils. Typical profiles have a loamy sand topsoil over sand or clayey sand (Nicolls, 1959). Soil colours can range from grey to yellow and brown.

Also found on the Meander sheet are areas of stony soils, mapped as soils of 'stony alluvial fans (A_4)' on the Quamby reconnaissance soil map (Nicolls, 1959). These soils are formed on fans and terraces made up of stony dolerite material which has been transported down onto the lowland areas, from slopes on the Great Western Tiers.

These soils are mainly brown or yellowish brown loams with stones and boulders throughout the profile. Stony alluvial soils occur along Western Creek and around Blackwood Creek.

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SOILS	SYMBOL	AREA (ha)	PARENT MATERIAL	CSIRO LABORATORY NUMBERS	SOIL SERIES (Related CSIRO Data)	SOIL GREAT GROUP
Soils of the Plateau Top						
Yellow brown soils and high moor peats						
On solifluction deposits derived wholly or mainly from dolerite and organic matter.	YBs & HMP	6 358	Jurassic dolerite and organic matter	H 110	Unnamed	Acid peat
Soils of the upper slopes of the Tiers escarpment						
Yellow brown soils						
On solifluction deposits derived wholly or partly from dolerite	YBs	21 039	Jurassic dolerite	H176	Unnamed	Krasnozem
On solifluction deposits derived wholly or mainly from sandstone without dolerite	YBss	1 163	Permian and Triassic sandstone	H 175	Unnamed	Brown podzolic
Soils of the lower slopes of the Tiers escarpment, and other low hills						
Podzolic soils						
On Permian mudstones, tillite, sandstones (Yellow podzolic soils)	YPm	13 108	Permian mudstones and sandstones	H177, 178, 179	Unnamed	Yellow podzolic
On Permian and Triassic sandstones	Pss	2 545	Permian and Triassic sandstones			
On dolerite (Eastfield association)	Pd	8 321	Jurassic dolerite	H130	Unnamed	Gleyed podzolic
On various metamorphic rocks: slates, quartzites, conglomerates, lavas, older than Permian (Red and yellow podzolic soils and podzols)	RYP	7 964	Ordovician, Cambrian and Precambrian slates, quartzites and conglomerates	H185	Unnamed	Red podzolic

Table 7: Soil information relating to the Quamby reconnaissance soil map.
(Source: Nicolls, K.D., 1959, Reconnaissance soil map of Tasmania. Sheet 46, Quamby. Div. Report, Div. Soils CSIRO, Aust. 9/58)

SOILS	SYMBOL	AREA (ha)	PARENT MATERIAL	CSIRO LABORATORY NUMBERS	SOIL SERIES (Related CSIRO Data)	SOIL GREAT GROUP
Krasnozems and other soils						
On basalt	Kb	9 350	Tertiary basalt	H91 H197	Unnamed Unnamed	Krasnozem Krasnozem
On dolerite	Kd	2 177	Jurassic dolerite			
Lateritic krasnozems						
On basalt	LKb	1 008	Tertiary basalt	H180	Unnamed	Krasnozem
On dolerite	LKd	13	Jurassic dolerite			
Soils of the basin sediments, river terraces and recent alluvium						
Lateritic Podzolic soils						
On the higher (older) erosion surfaces:						
Woodstock association	LPw	3 750	Tertiary gravels, sands, clays			
Cressy association	LPc	6 876	" "			
Brickendon association	LPb	3 739	" "	H198 H219 H246	Brickendon Unnamed Unnamed	Lateritic podzolic " " " "
Other soils of high terraces	A_1	1 535	Tertiary basalt			
Soils of lower terraces	A_2	14 247	Quaternary gravels and clays	H25	Brumby	Gleyed podzolic
Soils of flood plains and other young alluvium (except A_4)	A_3	8 469	Quaternary clays	H26	Canola	Humic gley
Soils of stony alluvial fans	A_4	3 671	Quaternary gravels			
Windblown sands (Panshanger association)	P	324	Quaternary sand			

Table 7 continued: Soil information relating to the Quamby reconnaissance soil map (Nicolls, 1959)