D’ENTRECASTEAUX REPORT

Land Capability Survey of Tasmania

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Department of Primary Industries, Water and Environment
Newtown Offices
2001

D’Entrecasteaux Report
and accompanying 1:100 000 scale map

DEPARTMENT *of* PRIMARY INDUSTRIES, WATER *and* ENVIRONMENT
Tasmania

Natural Heritage Trust
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Contents

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SUMMARY

This map describes and classifies the land resources occurring on privately owned and leased Crown land within the area defined by the limits of the D'Entrecasteaux 1:100 000 scale topographic map (Sheet No: 8311) and eastern quarter of the Huon 1:100 000 scale topographic map (Sheet No: 8211). The survey area extends over 195 388ha of land, of which almost half or 92 656ha is mapped as exclusion area.

The area lies in southern Tasmania and includes the towns of Huonville and Blackmans Bay, together with smaller centres of Margate, Cygnet, Geeveston, and Dover. The survey area extends along the D'Entrecasteaux Channel from Blackmans Bay in the north to 7km below Southport in the south. It includes Bruny Island and the lower reaches of the Huon River from just northwest of Glen Huon to its confluence with the D'Entrecasteaux Channel northeast of Dover. The Snug Tiers and associated peaks rising to 831m above sea level form the dominant topographic feature in the survey area.

The land is described and assigned land capability classes according to the system defined in the Tasmanian Land Capability Handbook (Noble 1992a, Grose *in press*). The land capability assessment categorises land units according to their ability to produce agricultural goods without impairment to their long term, sustainable, productive potential. Each land unit is assigned one of seven capability classes, from Class 1 to Class 7 with increasing degree of limitation to agricultural production and decreasing range of potential agricultural uses. Classes 1 to 4 land are suitable for cropping activities. Class 3 or better land represents prime agricultural land and is restricted to the better soil types under more favourable site and climatic conditions. Classes 5 and 6 land are suitable for pastoral activities only, while Class 7 land is unsuitable for agricultural use.

In interpreting information contained within this report the reader needs to be aware of the following important points relevant to the land capability classification system:

- Land capability assessment in Tasmania is based on rainfed agriculture and does **not** consider the potential for irrigated agriculture.
- Land capability is assessed for broad acre cropping and grazing activities. Horticultural activities, notably orcharding and viticulture are not considered in the evaluation.
- Climate is an important factor in determining land capability. Cold, wet winter and spring months coupled with dry summer months, can produce limited opportunity for broad acre cropping.
- The 1:100 000 scale of survey restricts the minimum area of contiguous land that can be reasonably mapped to about 64ha. Smaller areas of land are occasionally mapped where they are considered significant and easily identified.
- Map units are not pure, and may contain up to 40% of another class, although in most cases the area of inclusions will be much smaller than this.

The land capability survey was achieved through a combination of fieldwork, aerial photo interpretation and computer modelling. The major limitations to agriculture were identified as poor soil properties (poor drainage, low natural fertility, high stone content, soil salinity and shallow rooting depth), water and wind erosion potential and unsuitable climate. The range of agricultural activities and their distribution across the survey area largely reflect the limitations identified.

Table 1 indicates the amount of each land capability class identified. Few areas of prime agricultural land (Class 1, 2 and 3 land) were mapped within the survey area. Small areas of Class 3 land were mapped on basalt and alluvial soils between Margate and Kingston where rainfall was considered adequate to support a range of cropping activities.

Throughout much of the remainder of the survey area, broad acre cropping is generally not undertaken due to a combination of poor soil conditions and an unsuitable climate of cold and wet winter and spring months. This greatly restricts soil trafficability and the establishment of arable crops. Historically, arable crops have been restricted to small areas of potatoes and wheat in some coastal localities where free draining soils are found (Atlas of Tasmania, 1965). Inland, cold temperatures produce a very short growing season. In general this area only supports short rotation cropping varieties suited to a cool temperate climate. Furthermore, summers are often dry and irrigation is normally required to offset risks associated with crop failure at this time of the year. Hence, most land is restricted to Class 5 or above, and current land use is predominantly grazing or perennial horticulture.

The area has traditionally been used for apple, berry fruits, stone fruits, and hops, although in recent years the area planted in orchards has decreased (Class 4 and 5 land). There is a trend towards more non-traditional farming enterprises such as the establishment of viticulture, hazelnut and olive orchards, albeit on a small scale, where suitable soil types and microclimates exist. Elsewhere, gently to moderate sloping land is used primarily for beef and sheep production (Class 5 land). Occasional cultivation is undertaken during summer and autumn months for pasture renewal and the occasional fodder crops of lucerne or oats (Photo 1). Grazing enterprises also dominate in coastal areas where extensive Quaternary sand sheets are found (Class 5 and 6 land). The lower slopes and benches of rises and hills provide grazing on productive native and improved pastures (Class 5 and 6 land). These areas are often underlain by siliceous Permian and Triassic rocks which produce nutrient poor, erodible soils. Jurassic dolerite commonly occurs further upslope and along ridges and, while producing more fertile soils, these are often stony and shallow. Extensive areas of steep hill country support native forest and woodland on steeper slopes (Class 6 land). Rocky mountain lands at higher elevation, together with very steep slopes, coastal cliffs, sand dunes, coastal and inland swamps in high rainfall areas are unsuitable for any form of agriculture (Class 7).

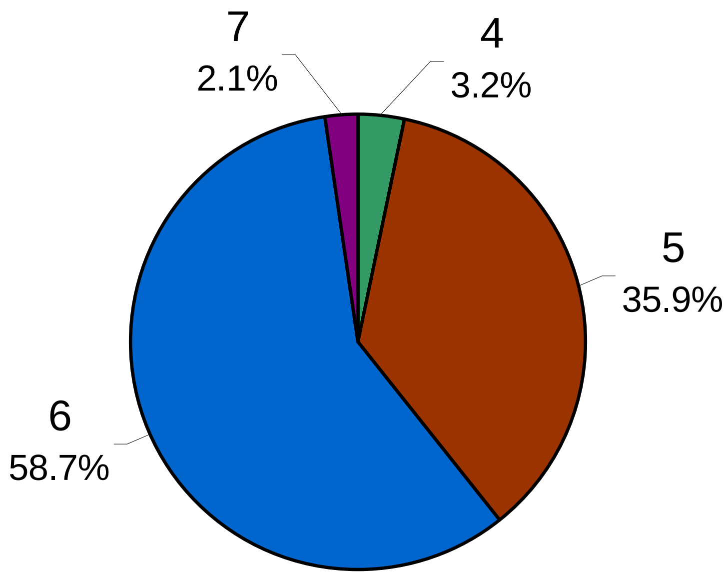


Figure 1. Relative proportion of Land Capability Classes on privately owned and leased Crown land within the D'Entrecasteaux map. Class 3 land only makes up 0.09% of the surveyed area and is too small to be shown on this chart relative to other classes.

Figure 1 above indicates the extent of the identified land capability classes within the survey area. These include complex units in which two land classes have been identified but cannot be usefully separated at the scale of mapping. Within each complex the first land class identified is dominant, occupying 50-60% of the unit, while the second class occupies only 40-50%. Complexes occupy only a small percentage of mapped units.

Table 1. Extent of Land Classes and Land Class Complexes on the D'Entrecasteaux map.

Capability Class	**Area (ha)**	**% of map area**
4+3	229	0.1
4	2502	1.3
4+5	972	0.5
5	35265	18.0
5+6	1718	0.9
6	59030	30.2
6+5	575	0.3
6+7	394	0.2
7	1961	1.0
7+6	86	<0.1
E	92656	47.4
TOTAL	195388	100.00

1. INTRODUCTION

This report describes the land capability of the agricultural land within the D'Entrecasteaux and part of the Huon 1:100 000 topographic map sheets (Sheet numbers 8311 and 8211, respectively). Throughout this report both areas are described collectively as the D'Entrecasteaux region. The distribution of the land capability classes identified is depicted in the accompanying map.

This report continues the series published by the Department of Primary Industries, Water and Environment as part of a 1:100 000 scale land capability survey of Tasmanian agricultural land which first started in 1989. This report and map describe and depict the land capability of private freehold and leased or unallocated crown land only. Other areas are considered non-agricultural and are mapped as exclusion areas.

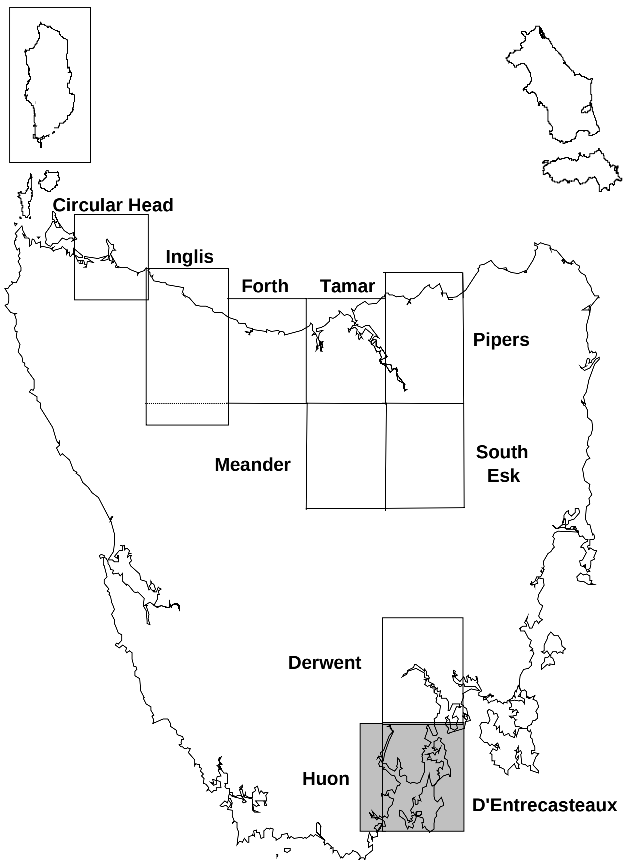


Figure 2. D'Entrecasteaux survey location and previous land capability surveys in Tasmania

The land capability survey aims to: a) identify and map the extent of different classes of agricultural land in order to provide an effective base for land use planning decisions; and b) ensure that the long term productivity of the land is maintained at a sustainable level through the promotion of compatible land uses and management practices. It undertakes to achieve these aims through a program of mapping activities and associated extension and awareness programs such as Farmwi$e and Best Farm Practice.

The land capability classification system for Tasmania comprises a seven class classification which ranks the capability of land to support a range of agricultural uses on a long term sustainable basis (Noble 1992a). The classification system ranks the capability of land to support sustained agricultural production and does not consider suitability for individual crops, silviculture, horticulture, viticulture or other non-agricultural uses. The information printed here and in the accompanying map is intended for use at a regional planning level and is inappropriate for farm scale planning. However, the system and the methodology can be applied at any level.

Ever increasing demands are placed on our agricultural land to produce greater yields with a corresponding greater risk of land degradation. For Tasmania to continue to support a productive agricultural industry into the future, landholders must employ appropriate soil conservation measures. Much of Tasmania's agricultural land has limitations that restrict the variety of crops that can be grown both productively and on a sustainable basis. The land capability classification system provides the framework to determine these limitations, and the classification that results from this process allows land managers to make informed decisions to ensure productive and sustainable use of the land. In other words, the use of land within it's capability.

In addition to it's use as an agricultural land management tool, land capability information is required by regional planners to make informed, objective land use planning decisions. High quality agricultural land is irreplaceable and needs to be protected from loss to urban development and rural subdivision. Land capability information contained within this report provides valuable information to help identify areas of significant agriculture value, and to ensure that land is used within its capability.

Chapter 3 of this report explains land capability classification in detail and provides explicit definitions of land capability classes and subclasses. Chapter 4 of this report explains the survey method and the guidelines that were used in assessing land within the survey area. A detailed description of the survey area appears in Chapter 5. A detailed account of land capability classes occurring within the survey area is presented in Chapter 6, wherein the land capability information is arranged hierarchically, firstly by class and secondly by the geology unit on which the class occurs.

2. HOW TO USE THIS MAP AND REPORT

This publication comprises a report and map. It is important that the land capability map be used in conjunction with the accompanying report.

Land capability classes are briefly defined in the map legend, and more detailed definitions may be found in Chapter 3 of this report. Further information regarding limitations for each of the land capability classes may be found in Chapter 6.

2.1 Limitations of Scale

Special attention must be paid to the limitations of the map imposed by the scale at which it was surveyed.

It is important that the map is used at the scale at which it is published (1:100 000). **The map should not be reproduced at a larger scale (eg. 1:25 000)**. The land capability boundaries found on this map are accurate only at the published scale of 1:100 000. Errors in interpretation will occur if the map is enlarged. If more detail is required, the area of interest should be remapped at a more suitable scale for the end use.

Gunn *et al* (1988) state that, at a scale of 1:100 000, the standard minimum area for a map unit which can be adequately depicted on the map is approximately 64ha. There appears to be little consistency however, as Landon (1991) suggests that a wide range of minimum areas are currently in use. For the purposes of this work, unit areas of less than 64ha have been mapped only where they are identifiable on the basis of clearly visible boundaries (usually topographic), or where they appear at the margins of the map or adjacent to exclusion zones. Impurities in map units will occur where land class changes are a result of less obvious changes in land characteristics.

In any mapping exercise there are always areas which are physically too small to delineate accurately at a given map scale. Surrounding units usually absorb these areas. The map units shown on this map will therefore often contain more than the one land capability class or sub-class. The map units are assigned the dominant land capability class within them, but it must be recognised that some map units may contain up to 40% of another class.

COMPLEX map units (eg. 4+5) have been mapped in some areas where two land classes are identified that cannot be delineated separately at this scale of mapping. These complex units represent areas where each class occupies between 40% and 60% of the unit area and are shown as striped units on the map. The first digit of the map unit label and the slightly wider of the two coloured stripes represent the dominant land capability class. Further discussion of this issue and the method of labelling units are found in Chapter 3.

The accuracy of the land capability class boundaries depends on a number of factors including the complexity of the terrain, soils and geology. Class boundaries are accurately mapped where topography, or other visible features important in boundary detection, change abruptly. Alternatively, where landscape changes are gradual, such as is often the case with changes in soil depth or slope, the class boundary may be gradual and therefore less accurately mapped.

2.2 Interpretation of the Land Capability Information

The scope and range of applications of land capability information depend upon the scale of the mapping program. This map has been surveyed at a 1:100 000 scale and is targeted for use at the district or regional planning level. Therefore, best use can be made of this map and report by local government, as well as regional and State land use planning authorities.

The information at this scale is **not** suitable for use in planning at the farm level. It does however, provide a general indication of land capability which makes it a useful starting point for more detailed studies. Larger scale maps (1:5 000 or 1:10 000) are suitable for farm planning purposes. For example, they are a useful information source for planning farm layouts, and identifying appropriate soil conservation and land management practices. The methodology applies to all scales of mapping and can be utilised equally well by local landowners, and local, regional or State planning authorities. A detailed discussion of the methodology may be found in Chapter 4.

Some examples of suitable uses of land capability information at 1:100 000 scale are:

- **Identifying broad areas of prime agricultural land to be protected for agricultural use**
- **Enabling rational planning of urban and rural subdivisions**
- **Identifying areas for new crops, enterprises or major developments**
- **Identifying areas for expansion of particular land uses**
- **Planning of 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**
- **Establishing integrated catchment management (depending on catchment size)**

Describing land capability information through this report and accompanying map is insufficient to ensure the adoption of sustainable land use practices. The move towards more sustainable practices can only occur through increased social awareness and education (a recognition that change is needed) together with the development of an appropriate implementation framework. This includes the legislative and administrative support 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. Indeed, the interpretation of land capability information can be greatly enhanced when viewed in concert with other resource information. The information is intended as a guide to planning development. More detailed plans, for example route alignments or farm plans, require further fieldwork at a more appropriate scale.

2.3 Copyright

2.4 Availability of Other Reports and Maps in this Series

Land Capability Publications (based on the TASMAP 1:100 000 Series) currently available:

Derwent Report and Accompanying Map

Circular Head Report and Accompanying Map

Inglis Report and Accompanying Map

Forth Report and Accompanying Map

Pipers Report and Accompanying Map

Tamar Report and Accompanying Map

Meander Report and Accompanying Map

South Esk Report and Accompanying Map

Land Capability Handbook (Second Edition)

Land Capability Classification in Tasmania, Information Leaflet

Maps, reports and the handbook are available for purchase by contacting Service Tasmania or direct from:

Department of Primary Industries, Water and Environment
Resource Management and Conservation Division
Land and Water Assessment Branch
GPO Box 46
KINGS MEADOWS, TAS 7249.

3. LAND CAPABILITY CLASSIFICATION

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

For the Tasmanian classification system, only agricultural land uses are considered. These are defined as broad scale grazing and cropping uses. Land capability ratings for specific land uses are not evaluated, nor is the capability of land for silvicultural, viticultural, or horticultural 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 in producing a range of agricultural goods.

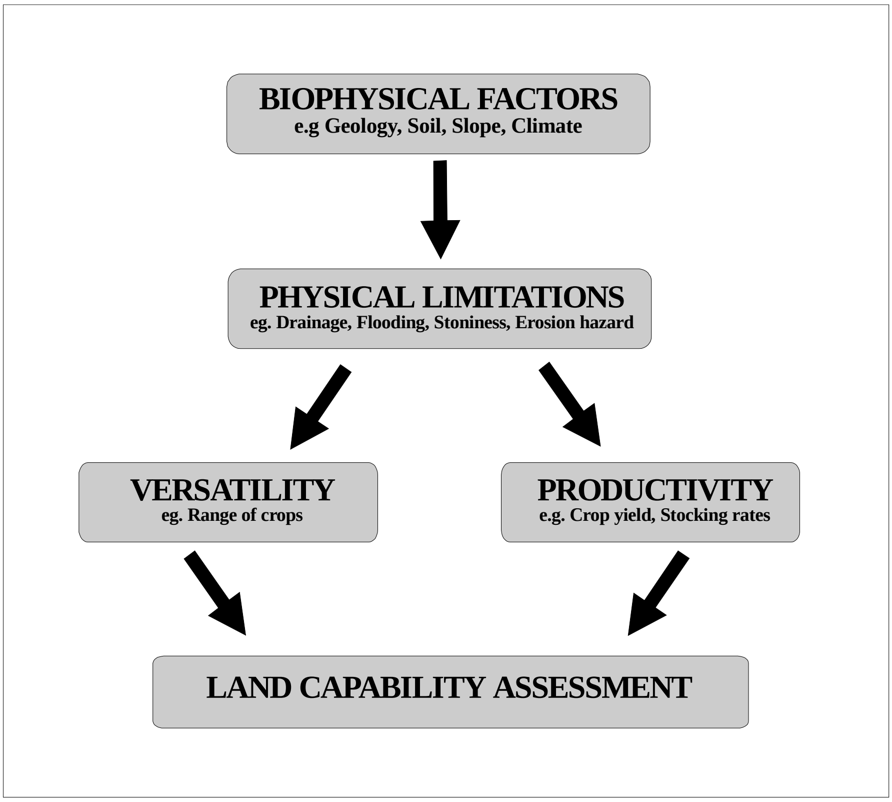


Figure 3. Factors in land capability assessment.

Land capability assessment takes into account the physical nature of the land (e.g geology, soils, slope) plus other factors (eg. 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, such as 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 sociopolitical factors.

Land capability assessment should not be confused with land suitability assessment which, in addition to the biophysical features, may assess economic, social and/or political factors to determine the best use of a particular type of land. Land capability classification gives a grading of land for broad scale agricultural uses, whereas land suitability classification is applied to more specific, clearly defined land uses, such as classifying land 'suitable' for growing carrots. In addition, land suitability usually defines specific management systems.

3.1 Features of the Tasmanian Land Capability Classification System

The Tasmanian system of land capability classifies land into seven classes according to its' capability to produce agricultural goods. The system is modelled on the United States Department of Agriculture approach to land capability (Klingbiel and Montgomery 1961) and is described in full by Noble (1992a) and Grose (in prep). A summary of the system is presented here to assist in the interpretation of the report and accompanying map. The classification does not attempt to portray specific land uses, nor rank the value of any particular agricultural land use above another. Neither does it attempt to give an indication of land values.

The classification relates primarily to three permanent biophysical features of the landscape - soil, slope and climate - and their interactions, such as soil erodibility, flood risk, soil moisture holding capacity, etc. These three factors have a major influence in determining the capability of the land to produce agricultural goods. Past land use history and present management practices, such as the range of crops grown and soil conservation treatment required, are used as a guide in land capability assessments.

Three levels are defined within the Tasmanian land capability classification:

- The land capability **Class** - which gives an indication of the general degree of limitation to use
- **Subclass** - which identifies the dominant kind of limitation
- and the **Unit** - 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 4.

The classification system comprises seven classes ranked in order of increasing degree of limitation, and in decreasing order of versatility, for agricultural use. 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 other of the land classes. Class 2 land is more productive than Class 3, and so on.

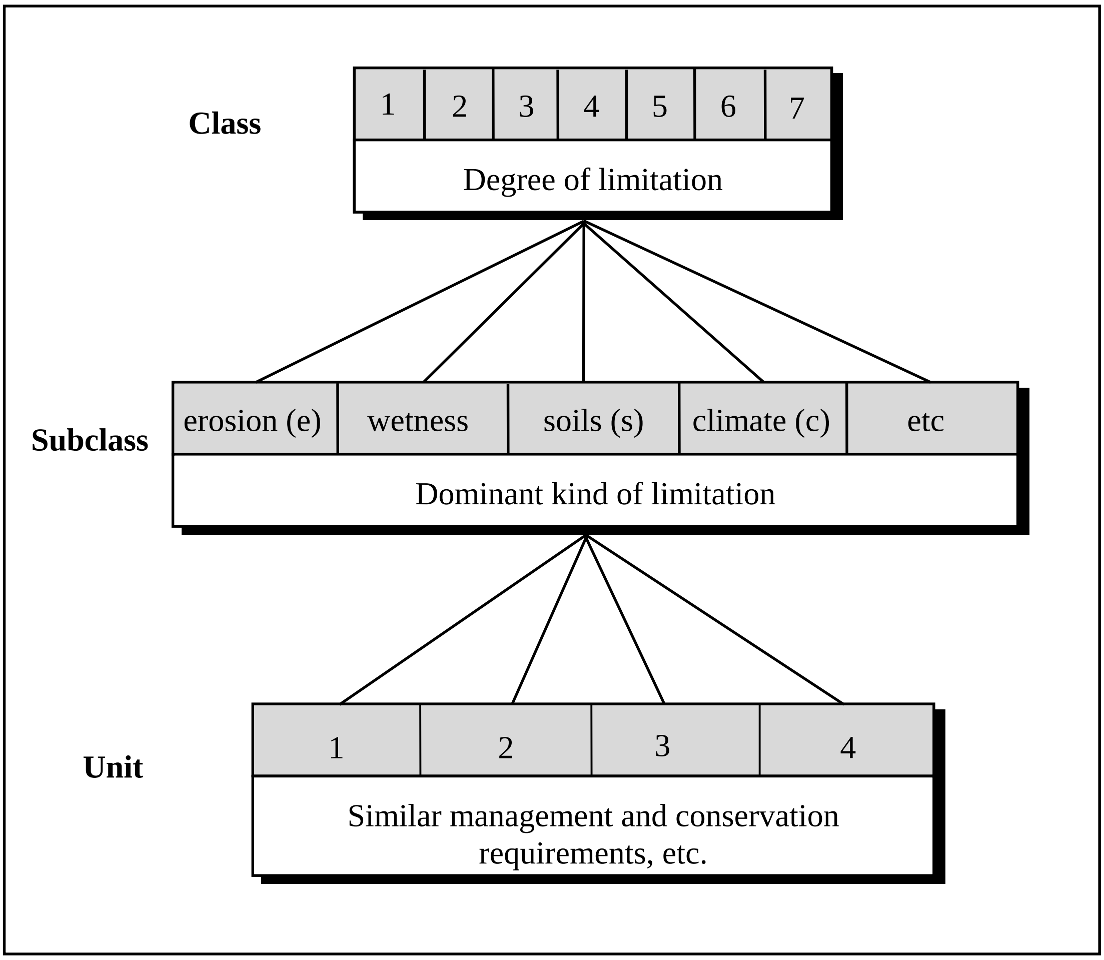


Figure 4. Levels of the land capability classification system. (Adapted from: National Water and Soil Conservation Organisation, 1979, Our Land Resources. NWASCO, Wellington, New Zealand).

Each land class can be subdivided into subclasses depending on the nature of the dominant limitation or hazard to the use of that land. 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. Some limitations can be removed or modified through normal management practices or other means. Where such improvements are considered feasible, both physically and economically, land may be classified higher than its current condition may indicate. Such improvements do not include the use of irrigation water but may include drainage or stone picking.

Each subclass may be further subdivided to unit level. Land capability units are areas of land with similar management and conservation requirements, or differences in productivity, which may not be significant at higher levels within the classification system. Thus an area identified as Class 4h may be further subdivided into 4h1 (Class 4h land subject to gully erosion) and 4h2 (Class 4h land subject to sheet erosion).

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, small-scale intensive activities like soft fruit orchards and floriculture are not considered when evaluating the versatility of an area. Opportunities for silviculture are another activity that the system does not consider. The main agricultural land uses that are considered when evaluating land include cereals, poppies, broadacre vegetable production, pyrethrum and essential oils, together with pastoral activities such as dairying, and beef, lamb and wool production.

The system considers degradation of the soil resource and does not take into account the possible effects of agricultural land use on landscape values or biodiversity, except where they might impact on the quality of the agricultural resource.

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

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

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 being applied to the land.

c) Appropriate soil conservation measures having been applied.

d) Where it is reasonable and feasible for an individual farmer to remove or modify physical limitations (eg. surface and sub-surface drainage, 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 (eg. 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. It 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.

j) Irrigation, or the potential access to irrigation, is not considered when evaluating land capability.

k) The system is consistent across the State.

It is important to remember that the land capability of an area can change as a result of improved farming practices, such as improvements in crop variety and technical innovations. The information in this report has a limited lifespan and care should be given to its interpretation in future years. Farming practices that today are only available for the advanced or innovative farmer may become common practice in the future.

3.2 Land Capability Class Definitions

The criteria used to define classes are based on observation and experience only, and not on experimental work. Figure 5 outlines the main features of the capability classes. Classes 1-4 only are considered capable of supporting cropping activities on a sustainable basis; Classes 5 and 6 are suitable for grazing activities only, although pasture improvement may be possible on Class 5 land (Class 6 land remaining as native pasture); Class 7 land is unsuitable for any form of sustainable agricultural activity.

Also, there is a range of land that can occur in any one capability class. Thus it is often possible, for example, to identify good and poor quality Class 4 land. While the intensity of mapping required to achieve this is not feasible when mapping land classes at 1:100 000 scale it would be possible to map such differences at the unit level.

The land capability class definitions are as follows:

CLASS 1

Land well suited to a wide range of intensive cropping and grazing activities. It occurs on flat land with deep, well drained soils, and in a climate that favours a wide variety of crops. While there are virtually no limitations to agricultural usage, reasonable management inputs need to be maintained to prevent degradation of the resource. Such inputs might include very minor soil conservation treatments, fertiliser inputs or occasional pasture phases.

Class 1 land is highly productive and capable of being cropped eight to nine years out of ten in a rotation with pasture or equivalent without risk of damage to the soil resource or loss of production, during periods of average climatic conditions.

CLASS 2

Land suitable for a wide range of intensive cropping and grazing activities. Limitations to use are slight, and management and minor conservation practices can readily overcome these. However the level of inputs is greater and the variety and/or number of crops that can be grown is marginally more restricted than for Class 1 land.

This land is highly productive but there is an increased risk of damage to the soil resource or of yield loss. The land can be cropped five to eight years out of ten in a rotation with pasture or equivalent during ‘normal’ years, if reasonable management inputs are maintained.

CLASS		LIMITATIONS	CHOICE OF CROPS	CONSERVATION PRACTICES
1	Under cultivation	very minor	any	very minor
2		slight	slightly reduced	minor
3		moderate	reduced	major
4		severe	restricted	major + careful management
5	Under pastoral use	slight to severe	grazing	
6		severe	grazing	
7		very severe to extreme	No agricultural value	

Figure 5. Features of land capability classes

CLASS 3

Land suitable for cropping and intensive grazing. Moderate levels of limitation restrict the choice of crops or reduce productivity in relation to Class 1 or Class 2 land. Soil conservation practices and sound management are needed to overcome the moderate limitations to cropping use.

Land is moderately productive, requiring a higher level of inputs than Classes 1 and 2. Limitations either restrict the range of crops that can be grown, or the risk of damage to the soil resource is such that cropping should be confined to three to five years out of ten in a rotation with pasture or equivalent during normal years.

CLASS 4

Land primarily suitable for grazing but which may be used for occasional cropping. Severe limitations restrict the length of cropping phase and/or severely restrict the range of crops that could be grown. Major conservation treatments and/or careful management is required to minimize degradation.

Cropping rotations should be restricted to one to two years out of ten in a rotation with pasture or equivalent, during ‘normal’ years to avoid damage to the soil resource. In some areas longer cropping phases may be possible but the versatility of the land is very limited.

CLASS 5

This land is unsuitable for cropping, although some areas on easier slopes may be cultivated for pasture establishment or renewal and occasional fodder crops may be possible. The land may have slight to moderate limitations for pastoral use. 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 productivity, 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.

E - Exclusion Areas

Land that is not private freehold or leased crown land, is not included for assessment. Other exclusions included urban centres and other obviously non-agricultural areas.

<u>Note on Class Definitions</u>
The length of cropping phase given for Classes 1-4 is intended as a general guide only. Some land will not support production beyond the intensity recommended due to the unacceptable risk of erosion or soil structure decline. Other areas are limited by the risk of loss occasioned by more unpredictable factors such as adverse climatic conditions or flooding. Also, the classification system takes into account the *variety* of crops that can be grown. Thus Class 4 land often incorporates areas where production may be sustainable over a longer period than one or two years out of ten but only a relatively small range of crops can be grown. Whereas in other areas, Class 4 land is such that significant periods of cultivation without a break can lead to severe structure decline, hindering germination, water infiltration, soil aeration and increasing the likelihood of erosion.

It should be noted that capability classes have not been defined on the basis of productivity although a general relationship does exist.

3.3 Land Capability Subclass Definitions

The major subclass limitations together with their respective codes are summarised below. The decision as to whether a subclass should be recorded at the unspecified level (e, w, s, c) or at a more specific level is dependent on the ease with which specific limitations can be identified. For example, the aeolian erosion limitation is recorded only if it is clear that erosion has been caused by wind. If the cause of erosion is uncertain then unspecified erosion is recorded.

- **e** (erosion). Unspecified erosion limitation.
  - **a** (aeolian). Erosion caused by the effects of wind. Usually affects sandy or poorly aggregated soils and can occur on slopes of very low gradient.
  - **h** (water). Erosion resulting from the effects of rainfall, either directly through raindrop impact or through secondary effects of overland flow and surface runoff (including stream bank erosion).
  - **m** (mass movement). Landslip, slumping, soil creep and other forms of mass movement.
- **w** (wetness). Unspecified wetness limitation.
  - **f** (flooding). Limitations created through the surface accumulation of water either from overbank flow from rivers and streams, run-on from upslope areas or because the area lies in a topographic depression.
  - **d** (drainage). Limitations resulting from the occurrence of a high groundwater table, or restricted or impeded permeability within the soil profile, leading to the development of anaerobic conditions.
- **s** (soils). Unspecified soil limitation.
  - **g** (coarse fragments). Limitations caused by excess amounts of coarse fragments (particles of rock 2 - 600mm in size), including gravel, pebbles and stones, which impact on machinery, damage crops or limit growth. Coarse fragments may occur on the soil surface or throughout the profile.
  - **r** (rockiness). Limitations caused by boulders or outcrops of bedrock material greater than 600mm in size.
  - **k** (conductivity). Land at risk from salinity (as indicated by high electrical conductivity readings of a 1:5 ratio soil:water paste).
  - **l** (limiting layer). Rooting depth or depth to some limiting layer.
- **c** (climate). Unspecified climatic limitation.
  - **p** (precipitation). Limitations resulting from insufficient, excessive or uneven distribution of rainfall.

  - **t** (temperature). Limitations caused by frost risk or by reduced length of growing season due to low temperatures.

- **x** (complex topography). Limitations caused by irregular, uneven or dissected topography which hinder vehicular access or cultivation.

Use of Information

A valid criticism of the Land Capability methodology is that it is very subjective and dependent on the interpretation of individual surveyors. For this reason, a set of guidelines is being developed (Grose *in prep*) to ensure consistency among surveyors. The guidelines are based on a quantitative assessment of a range of a land attributes critical to the evaluation of land capability. There will, however, always remain some subjectivity in the determination of cut-offs points for each land class. This is largely due to the gradational nature of boundary conditions between each class. The guidelines provide as high a level of consistency for land assessment as is possible at the time of writing of this report. Future improvements to the classification may result from increases in knowledge acquired during subsequent mapping programs.

The authors therefore welcome constructive comment and criticism of the report and accompanying map and, in the unlikely event that significant errors in classification are identified at a scale appropriate to the level of mapping, they should be reported to the Senior Land Assessment Officer, Land Assessment Section, Resource Management and Conservation, DPIWE.

4. SURVEY METHOD

Field work for the D'Entrecasteaux Land Capability map was undertaken between November 1999 and April 2000 using information drawn from a wide variety of sources. These included existing soil descriptions and maps held by DPIWE, the advice of farmers, land managers and agricultural advisers within DPIWE, field assessments, aerial photo interpretation and computer modelling.

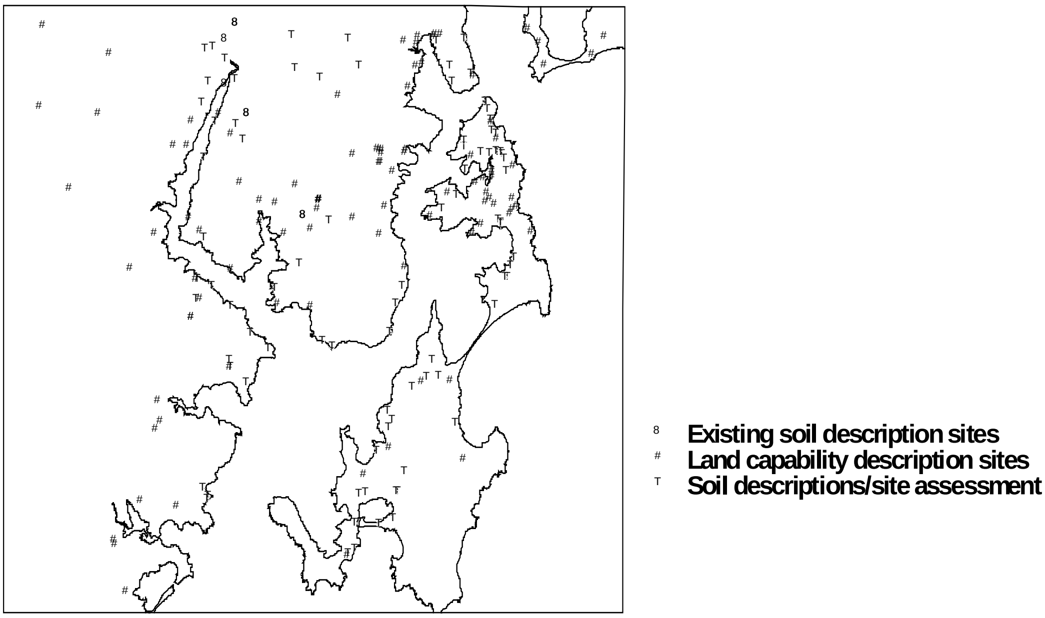
Field assessments involved land capability site descriptions and reconnaissance surveying to extrapolate and map class boundaries. In all, some 100 land capability site descriptions were recorded. This information was recorded on field sheets, which were then transferred to the DPIWE soils database. The field sheet records the site information required to justify the assessment, together with both the assigned land capability class and subclass. This information included site location, landform description, site aspect and slope. Soils were examined at the majority of sites. This was done using either a push-tube rig, a hand held soil auger, or by examination of existing soil exposures. The information collected included soil horizon depth, pH and 1:5 EC_e levels, texture, colour, structure and drainage characteristics. An example of a completed land capability description site card appears in Appendix A. Figure 6 presents the distribution of land capability description sites and existing soil description sites across the survey area.

Land capability assessments for the most part follow guidelines outlined in the revised Land Capability Handbook for Tasmania (Grose *in prep*). The guidelines provide criteria for determining the major subclass limitations. These involve assessments of land capability in relation to climate (rainfall, temperature), topographic limitations (slope, wetness, uneven ground, flood risk), soil factors (depth, stoniness, rock outcrops, salinity, drainage), and erosion hazard (wind, water, mass movement). Assessments of soil erosion are based primarily on soil texture and organic matter content in the case of wind erosion, and on topographic gradient, soil texture, dispersion (sodicity), and structure in the case of water erosion. In the case of tunnel and mass movement, assessments are based on erosion features evident on hillslopes.

Subclass codes appear only on digital versions of the map maintained by DPIWE. These codes are intended to provide further information for potential users as to the nature of limitations that might occur within a particular map polygon. However, as individual subclass boundaries are not identified at this scale of mapping, several subclass codes may appear within a single polygon. The dominant limitation for a polygon is always recorded. In addition, other limitations may be observed. For example, an area of land classified 5r on the basis of significant rock outcrop, may additionally contain small areas with a drainage limitation. Consequently, the land is assigned an additional drainage limitation subclass (hence 5rd), although the actual area limited by poor drainage has not been specifically identified. The first limitation recorded in the polygon is the dominant limitation.

Stereo-pairs of 1:42 000 black and white aerial photographs and computer generated slope maps and geology overlays were used extensively to extrapolate field assessments and delineate unit boundaries. The slope maps were derived from 1:25 000 contour data with a 10m contour interval and converted to a 40m grid. They portray slope information and spatially accurate base information not available with the air photo stereo-pairs. These two information sources were used in concert, whereby map unit boundaries were delineated on the stereo-pairs, then fine tuned according to the additional information provided on the slope map. Once defined accurately, these boundaries were transferred to 1:50 000 base maps from which they were eventually digitised.

Figure 6. Distribution of land capability description sites and existing soil description sites in the



D'Entrecasteaux survey area.

Existing maps, reports and site data were drawn upon where available. These included detailed soils information for the Huon valley (Taylor and Stephens 1935), 1:50 000 geology information (Farmer 1981, 1993) and 1:200 000 land systems information (Davies 1987). In general little soils information was available for the surveyed area. Consequently reliance was placed on the geology maps in order to give a general indication of soil parent materials and broad soil groups. Further to this, a field exercise was undertaken to determine the dominant soil type for each polygon, in effect producing a soil map with approximate boundaries indicated by the geology units. A total of 136 soils observations were made in addition to those documented during capability survey work.

Wherever possible, attempts were made to establish soil-landscape associations that could be used to provide additional information. In line with accepted land survey method, not all map units have been surveyed. Rather, informed assumptions have been made based on information extrapolated from other similar units. For example, it was generally found that there was a close association between current land use and field land capability assessments. Field mapping indicated that in most places forest margins tended to demarcate the boundary between Class 5 and 6 land. Consequently vegetation patterns were used during subsequent photo-interpretation to help delineate the Class 5/6 boundary. This method was applied only in areas where a good understanding existed of the relationships between known information, such as soil type or landform, and land capability class.

The 1:50 000 base maps, with land capability boundaries appended, were digitised and stored using ARC/INFO software. Final publication scale is at 1:100 000. Peers within the DPIWE with experience in agronomy and soil and land evaluation techniques have field checked the land capability map before publication.

5. THE D'ENTRECASTEAUX SURVEY AREA

5.1 Introduction

The study area lies in the south east of Tasmania and includes the smaller centres of Huonville, Cygnet, Dover, Margate and Blackmans Bay, and covers Bruny Island. It extends over an area of 1954km^2 of which 927km^2 are exclusion areas. Most of these exclusion areas comprise State and National Parks or Forest Reserves.

The area covers a diverse range of landforms, soils and climate. In most areas however, adverse soil and climatic conditions greatly restrict the range of agricultural activities undertaken. In general, there are few areas of high class agricultural land and broad scale cash cropping activities are normally not undertaken. The combination of generally poor soils and cold wet winters and springs, coupled with mild summer months, makes this area ideally suited to pome, stone and berry fruit production. By far the majority of agricultural land occurs within several kilometres of the coast, or follows the major rivers and many smaller rivulets throughout the survey area. Furthermore there is little agriculture activity undertaken above 300m elevation due to limitations imposed by topography, soils and climate. River flats to the north of Huonville provide the most extensively used agricultural area.

5.2 Climate

An evaluation of climate is an important aspect of land capability assessments as it generally determines the length of growing season and range of crops that can be grown. The D'Entrecasteaux region experiences a range of climatic conditions. Coastal areas experience a temperate maritime climate due to the stabilising effect of the Southern Ocean. Altitude and distance inland are the principal factors dictating local climatic conditions. Consequently, areas inland and at progressively higher elevation grade to a colder subalpine climate.

There are a number of climate recording stations throughout the survey area (Table 2). While most have recorded only rainfall data, five stations provide daily temperatures and frosts, and three provide measurements of pan evaporation. A number of climate stations occur just outside the boundary of the survey area, and these have been used to supplement climate information for northern areas (Grove, Kingston) and those at higher elevation (Hartz Mountain).

Spatial information presented in this section (Figures 8,12,13) has been derived from ANUCLIM climate modelling (Hutchinson et al. 1998). ANUCLIM was also used to provide estimates of pan evaporation for use in calculation of soil moisture availability. Both ANUCLIM data and point data from climate stations were cross checked where possible to ensure accuracy of data.

Rainfall

Table 2 shows mean monthly and annual rainfall for selected stations. The pattern of annual rainfall distribution across the survey area is illustrated in Figures 7 and 8. This pattern shows a general increase in rainfall gradient from the north and northeast towards the south and southwest. Coastal areas from South Arm to Blackmans Bay and along eastern North Bruny Island receive the lowest rainfall, being typically less than 700mm per year. Mountain River and the Huon River valley from Judbury through to an area about Cygnet generally receives between 740 and 770mm per year. Much of the remaining area to the south, including coastal locations from Woodbridge across South Bruny Island to Geeveston and Southport, generally receive in excess of 850mm per year and commonly over 900mm per year. Highest rainfalls are generally recorded in inland and mountainous areas, notably on the Snug Plains and southwest of Geeveston.

Station	Elevation (m)	J	F	M	A	M	J	J	A	S	O	N	D	Annual average
Grove	60	48	45	47	67	64	63	77	77	73	69	69	66	765
Huonville	10	44	48	53	54	59	53	77	74	69	65	66	64	738
Judbury	19	56	30	41	45	57	61	69	71	75	78	74	61	741
Kingston	52	46	46	52	59	55	59	56	56	52	68	62	66	677
Bull Bay	40	54	48	37	52	37	43	60	55	52	57	51	73	619
Middleton	20	59	59	71	75	71	85	86	89	83	85	81	77	931
Woodbridge	15	55	59	62	85	69	81	82	89	84	86	78	76	910
Snug Plains	380	80	81	82	91	98	86	124	126	113	110	113	114	1220
Lunawanna	25	55	56	61	76	74	80	85	85	69	74	65	76	858
Cape Bruny	55	62	57	69	82	85	90	96	91	80	84	77	77	948
Dover	16	56	53	65	69	73	79	88	88	82	88	74	76	890
Cygnet	34	50	52	55	53	48	53	70	78	70	63	65	74	734
Geeveton	60	57	52	56	65	76	66	94	93	81	89	75	74	879
Hartz Mt.	830	46	83	76	56	57	72	77	42	77	84	76	70	816
Hastings	38	74	72	88	114	122	130	147	147	128	136	117	108	1381
Southport	20	63	55	74	85	85	98	99	92	89	93	77	78	985

Table 2.   Average monthly rainfall and average annual rainfall for selected stations. Values have been rounded to the nearest mm.

Clearly, most areas receive ample rainfall for potential cropping activities. However, the length of growing season if often restricted by the seasonal distribution in rainfall (Figure 7). For example, wet winter months may restrict access to paddocks while dry summer months commonly lead to soil moisture deficits and poor plant growth. The seasonal distribution in rainfall across the D'Entrecasteaux region is broadly similar with relatively lower average monthly rainfall for the first sixth months of the year followed by a period of higher average monthly rainfall for the latter half of the year. Lowest monthly rainfall is generally recorded from January to March, whilst highest monthly rainfall is recorded from July to October. There are some differences in the seasonal pattern of rainfall across the survey area with the drier northeast having a more even rainfall distribution and peak rainfall in December, while the wetter southwest has a higher proportion of rainfall falling during autumn and peak rainfall occurring in winter months.

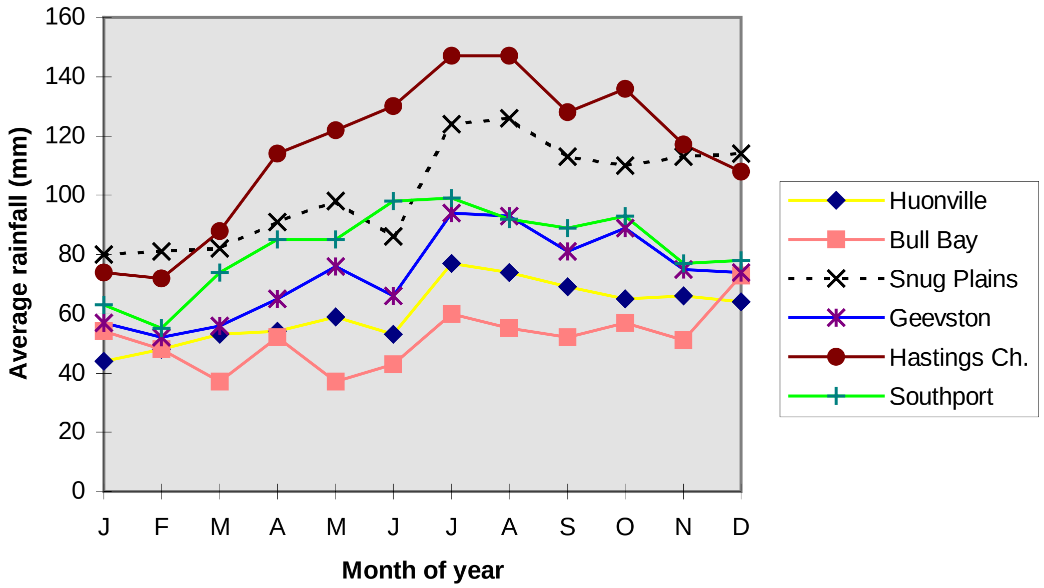


Figure 7. Seasonal rainfall for selected sites.

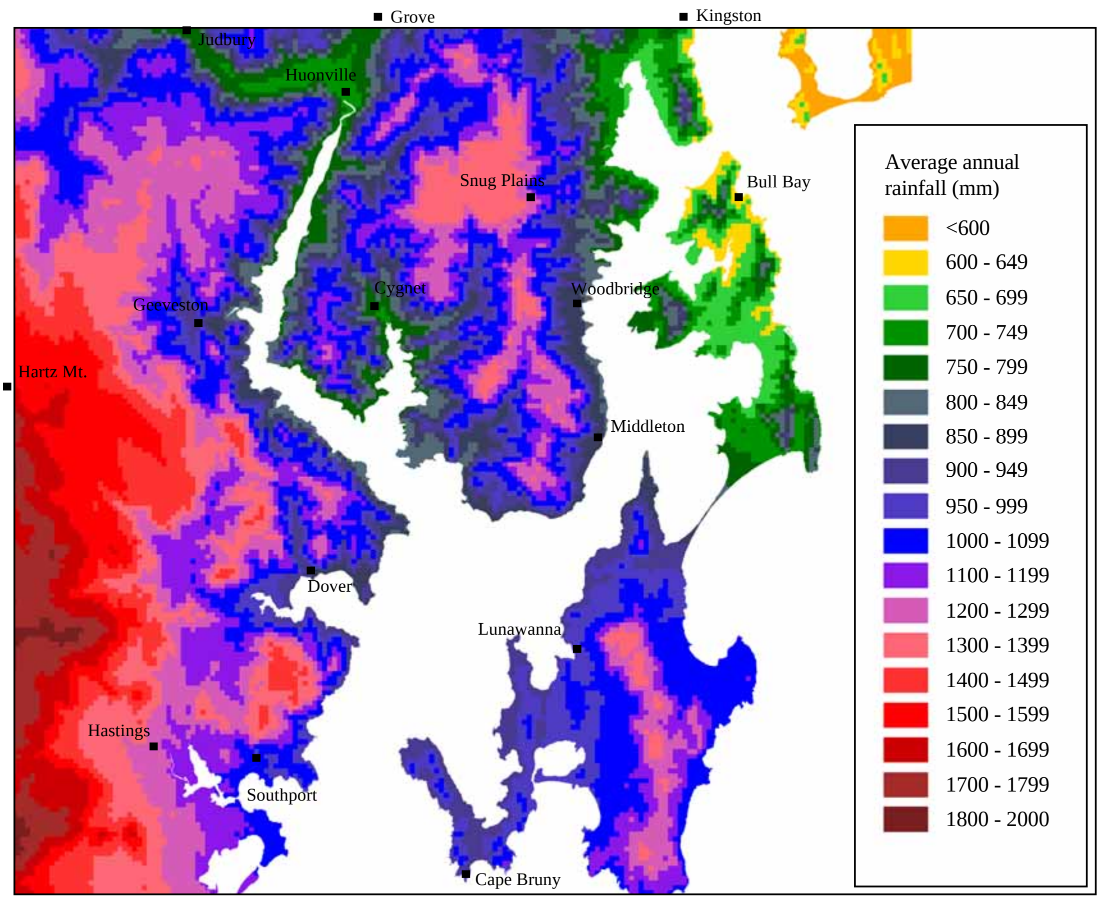


Figure 8. Average annual rainfall (ANUCLIM climate modelling) for the D'Entrecasteaux survey area. Selected climate stations recording rainfall are indicated.

Climatic extremes can have a major impact on agriculture activities. However, heavy snow falls and hailstorms are generally restricted to the higher inland areas and droughts are almost non-existent. Periods of low average monthly rainfall may occur during summer months from December to March, and this could impose a significant risk of crop failure. Minimum monthly rainfall as low as 3 to 10mm can be expected in some years. In comparison, minimum monthly rainfalls generally do not fall below 10 to 30 mm for the remainder of the year. Inland areas at higher elevation remain relatively wet throughout the year. Rainfall records at Kingston, although outside the survey area, indicate that dry periods can begin in spring months for northeastern areas. It is notable that the period of field survey was one of the driest on record in the region with many soils being in an unusually dry state. Thus field coring of some soils types was impracticable due to hard-setting subsurface horizons.

Moisture Availability

Moisture availability is important in determining the length of growing season. It is a function of both rainfall and evapotranspiration rates and can be estimated using the index $P/E_w^{0.75}$, where P equals average daily rainfall per month and E_w equals average daily pan evaporation per month (Prestcott and Thomas 1949). Index values above 0.8 indicate available moisture is adequate to sustain growth. Index values between 0.4 and 0.8 may be considered part of the growing season if preceded by substantial periods with values above 0.8. Figure 9 shows that index values remain near to or above 0.8 for most of the year. However, there is a short period from January to March in some coastal localities in the northeast, including north Bruny Island and South Arm and in some inland areas from Grove to Huonville and south to Geeveston and Cygnet, when index values can fall to 0.4. This indicates significant soil moisture stress at this time and a shortened growing season for these areas.

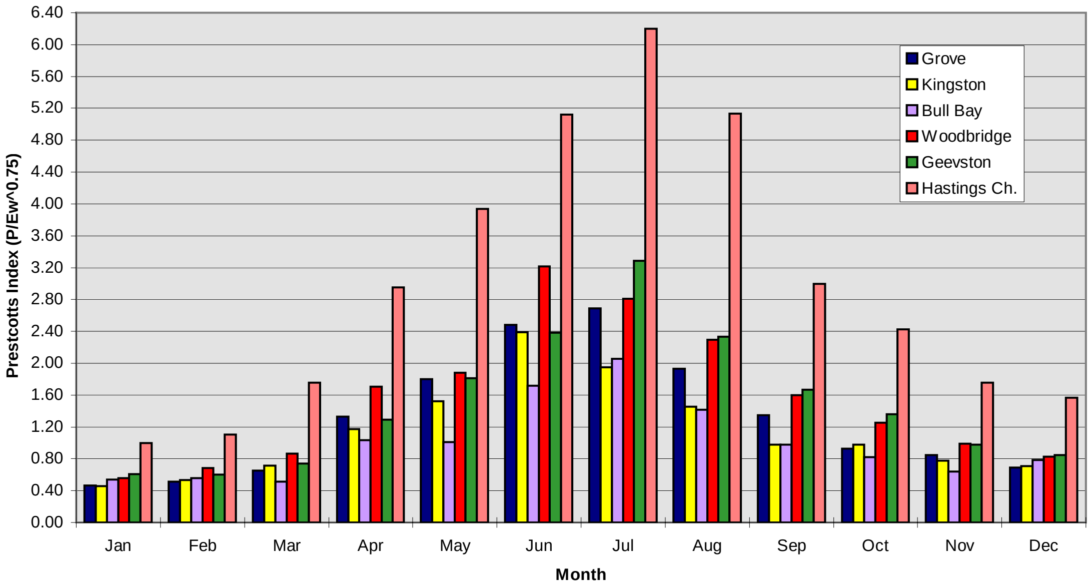


Figure 9. Prestcott's index of moisture availability per month for selected stations.

Prestcott's index is also useful for indicating periods of wet soil conditions. For example, index values above 1.0 indicate an excess of rainfall over evaporation. While this is generally not a problem for free draining soils, which lose excess soil moisture through subsurface runoff, soils with restricted subsurface drainage conditions or those in low lying areas will remain relatively wet at these times of the year. The Hastings site, which typifies areas towards the southwest and at higher elevations, indicates that soils may remain wet all year. Further north towards Geeveston and Woodbridge index values remain above 1.0 from April through to November. In north and northeastern localities the period of potential wet soil conditions is shorter lasting from April through to September.

Temperature

Seasonal variation in daily temperature can have an important impact of plant growth and the range of crops that can be grown in a locality. For example, an average monthly temperature of 6 °C is commonly accepted as the minimum for crop growth. Above this temperature, crop growth increases and reaches an optimum when daily temperatures are between 20 and 25 °C. Large diurnal variations in temperature, with cold night or very hot day temperatures, can have a deleterious impact on crop growth.

Average temperatures (Table 3, Figure 10) indicate a distinct seasonality with cold winter months and warm summer months in most areas. At low elevation, most areas remain above the 6 °C minimum temperature. However, relatively low average temperatures during winter months indicate that little growth can be expected at this time. In general, there is little difference in average summer temperatures across the survey area. Winter and spring months show greater regional variation with slightly colder average temperatures occurring towards the southwest. The Hartz Mountain station indicates that altitude is the principal factor governing variation in average monthly temperatures. At high elevations, cold temperatures persist into spring and early summer months.

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bull Bay	17	17	15	13	12	9	9	10	11	12	13	15
Cape Bruny	15	15	14	13	11	9	9	9	10	11	12	14
Dover	15	15	14	12	10	8	8	8	10	11	12	14
Geeveston	16	16	14	12	9	7	7	8	9	11	13	14
Hartz Mt.	14	12	9	7	6	5	4	4	7	7	8	8

Table 3. Average daily temperature for selected sites.

Comparison of average daily minimum and maximum temperatures across the survey area further illustrate the moderating effect of the oceanic climate in coastal regions (Figure 10). The warmer winter months on Bruny Island, for example, are solely due to higher average minimum daily temperatures. Conversely, during summer months, cooler ocean air currents moderate average daily maximums. The net result is for inland areas to suffer greater extremes in temperature on both a diurnal and seasonal basis compared with coastal regions. For example, average diurnal variation ranges from 10-13 °C in inland basins (eg. Grove, Geeveston) compared with 5-9 °C in coastal areas. At higher elevation, diurnal variation becomes compressed again (eg. Hartz Mt) due to much lower average maximum daily temperatures during the year, but with average minimums which are not that different from inland basins (particularly during winter months). Average maximum temperatures indicate that optimum growing conditions are only reached in the survey area during summer months. Spring months generally remain below 20 °C with daily temperatures ranging from 6 to 17 °C. This suggests that the area is restricted to cropping varieties that would be suited to cooler climatic zones.

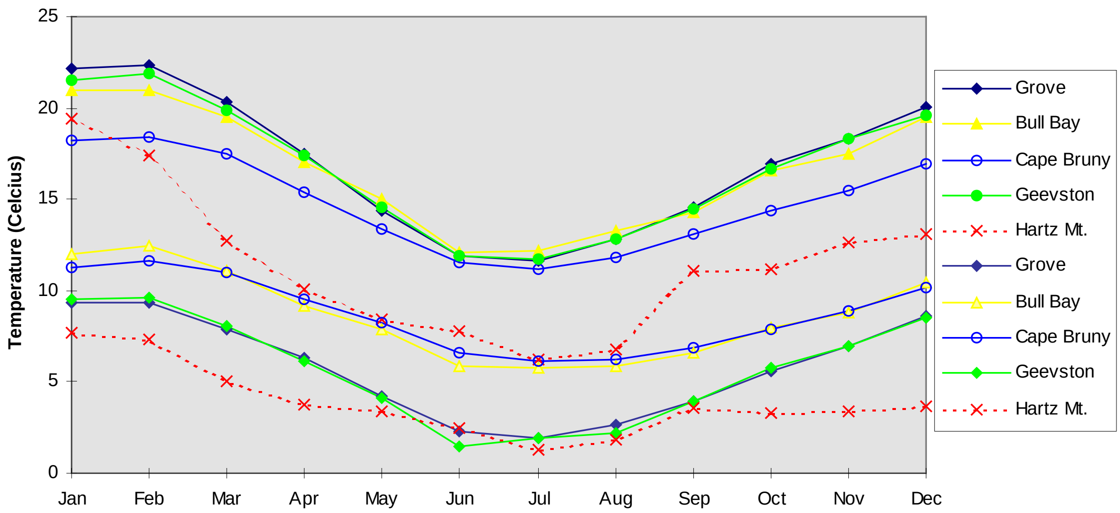


Figure 10. Mean daily maximum and minimum temperatures for selected climate stations.

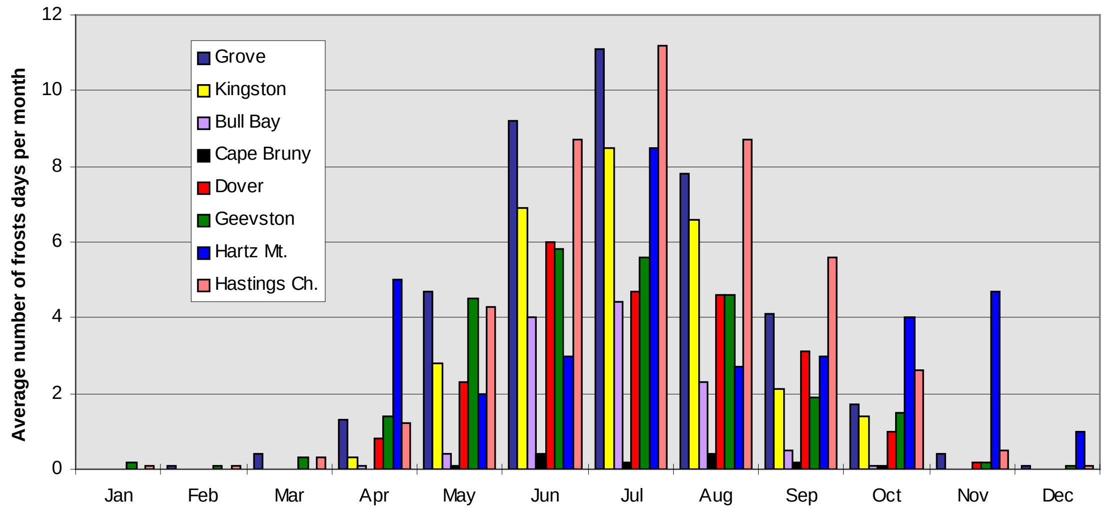


Figure 11. Average number of recorded frost days per month, or days with mean daily minimum temperature < 0 °C per month (Grove, Hartz Mt), for selected stations.

In regions that have cold winter months the length of the growing season is indicated by the first and last appearance of ground frosts (Figure 11). In the D'Entrecasteaux area frosts can be experienced in most places from April through to October. However, the northeastern coastal area including Bruny Island has a much lower incidence of frosts and these are generally confined to winter months. At higher elevation, frosts become increasingly common and can last through to December. Since only a few climate stations record frost days, an indication of the potential number of frosts can be determined from daily minimum temperatures below 0 °C. Figure 12 shows the variation in mean daily minimum temperature across the survey area during spring months: this being an important period for crop establishment. This provides a broad picture of frost incidence by relating mean daily minimums with actual frost incidence recorded at climate stations. For example, where means are above 6 °C (eg. coastal areas) few frosts can be expected. In contrast, below about 4 °C (eg. inland), over 10 ground frosts can be expected during spring months. Between 4 and 6 °C occasional spring frosts pose a significant risk to the establishment of frost sensitive crops.

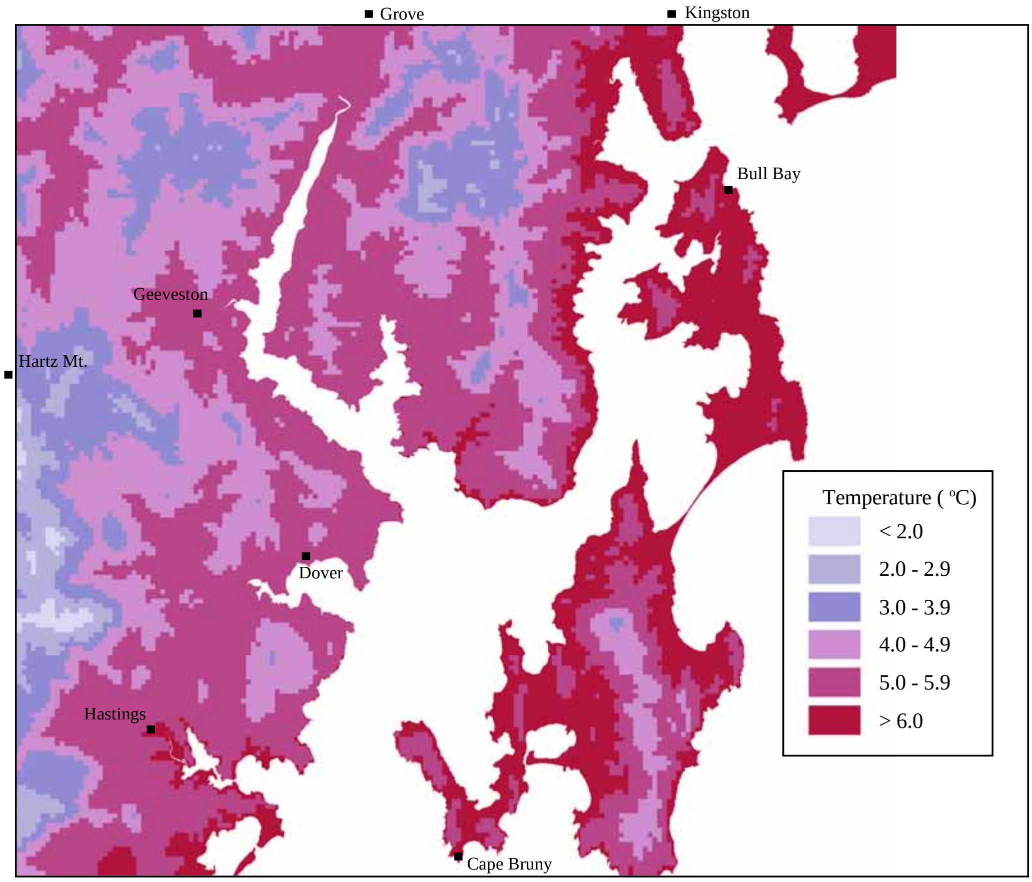


Figure 12. Average daily minimum temperature (from ANUCLIM) for spring months (September, October, and November) in the D'Entrecasteaux survey area. Climate stations recording frosts and daily minimum temperatures are indicated.

Length of growing season

Figure 13 shows the rapid change in soil moisture availability across the survey area from November through to February. It also illustrates how there is only a small window of opportunity for arable cropping activities in late spring and early summer months in most places, and that these activities will be confined to soils with relatively free drainage conditions. Three broad physiographic-climatic zones are evident with respect to length of growing season: coastal land to the northeast, inland basins, and high altitude slopes and mountains.

Areas at higher elevations remain relatively wet and cold throughout most of the year and are unsuited to broadacre cropping. Some mid-altitude sites may be suited to short rotation crops during summer months if rainfall is adequate. Inland basins are generally restricted to a short cropping season during late spring and early summer due to a combination of wet and frosty early spring months, and relatively dry mid-late summer months. The cropping phase could extend into summer months in places with suitable soils and higher summer rainfall. Coastal areas to the northeast generally have a slightly longer growing season (extending from early spring to early summer months) due to fewer frosts and generally warmer conditions. Furthermore, drier soil conditions in spring may permit both earlier cultivation and cultivation across a broader range of soil types (eg. those with imperfect subsoil drainage). This could potentially allow for a greater range of crops to be grown. However, as will be seen in following sections, both a hilly topography and generally poor soil conditions greatly restrict sites for cropping.

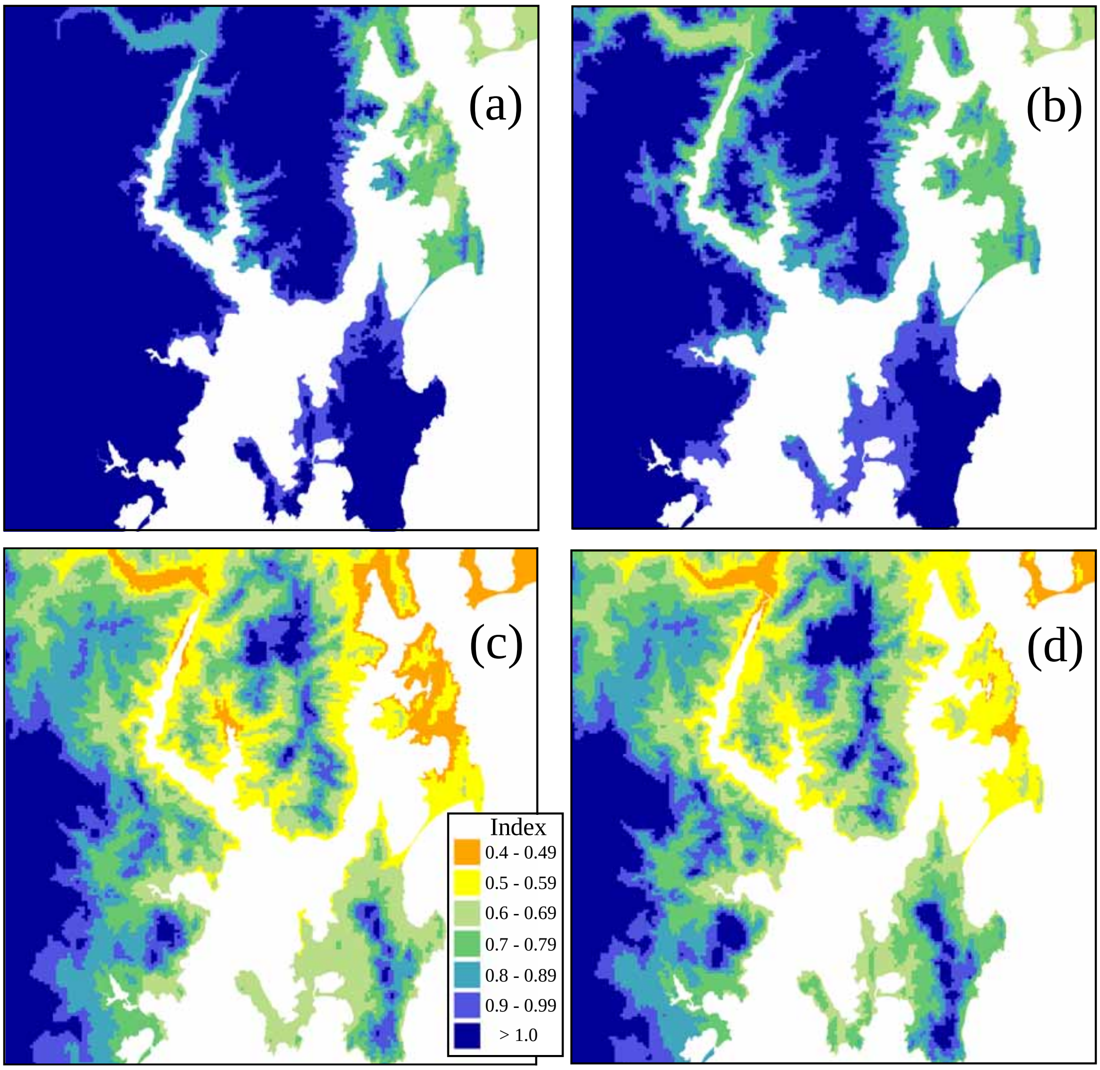


Figure 13. Prestcott's Index for the months of (a) November, (b) December, (c) January, and (d) February. Wet conditions (blue colours) prevail over most of the survey area until December.

5.3 Geology and Landforms

There is a wide range of rock types occurring within the D'Entrecasteaux survey area. These have had an important influence on the present day distribution of soils and landforms. For this reason geological information has played an important role in the land capability survey. The relationship between geology and landforms is illustrated in Figure 14 where a 1:250 000 scale geology map has been draped over a digital elevation model (DEM) of the survey area.

The principal lithologies are siliceous Permo-Triassic sediments and Jurassic dolerite. These together comprise 87% of the survey area. The remaining area is comprised of

Tertiary basalt together with Tertiary and Quaternary alluvial sediments. Small extents of Cretaceous syenite (an intrusive igneous rock) and Quaternary syenite talus occur distributed among the older Permian rocks within the survey area. Ordovician limestone and Precambrian dolomite occur in the south west but confined to exclusion zones and not considered in this report.

Geological formations have had a strong influence on erosion history and the formation of present day landforms and drainage patterns. Dolerite landforms dominate the survey area, forming most of the higher mountain peaks (eg. Grey Mountain, Mount Cygnet, Mount Mangana and Mount Bruny) and plateaux rising to 831m in elevation. Dolerite is generally more resistant to erosion than other lithologies and caps many of the lower mountain ranges and ridgelines. Radial drainage patterns are typical of coastal dolerite hills while more extensive fluvial drainage networks, which converge to form the larger rivers and streams, are typical of inland areas.

Permo-Triassic rocks typically underlie the dolerite cap rocks and these tend to crop out on lowerslopes and valley margins. In places, these rocks may extend to ridgelines of hills rising to between 100 and 500m. Tertiary basalt is of very limited extent and confined to valley margins. It tends to crop out on the side of terrace risers and is usually capped by more recent deposits.

Alluvial deposits of Tertiary and Quaternary age are generally confined to valley systems and coastal areas. Quaternary deposits comprise scree and talus at higher elevations, alluvium along valley flats, gravels and raised beach deposits along larger rivers and in coastal areas, and locally extensive wind blown sand sheets inland from large embayments and along beach foreshores.

The main area of this survey is covered by two 1:50 000 scale geology maps (Farmer 1981, 1993). To the west of the Huon River, only general 1:250 000 scale information is available. The main geological formations and associated landforms are described below from oldest to youngest. In order to help illustrate the associations between geology, landform, soils and land capability, idealized cross-sections (Figures 15 and 16) are presented for representative regions of the survey area.

Permian mudstone

Rocks of Permian age are the oldest exposed soil forming parent materials within the area surveyed. These occur mainly in the west and south and cover 20% of the total land area. Permian rocks generally comprise a sequence of alternating marine siltstones and mudstones. These rocks are glacio-marine sediments, which accumulated between 300 and 250 million years ago in a depression that widened and deepened towards the south east of Tasmania. Permian rocks are generally light grey or cream coloured and well bedded. Early Permian sediments (Truro Tillite) tend to be darker coloured and finer textured while younger sequences (Abels Bay Formation) are coarser textured, frequently containing beds of sandstone.

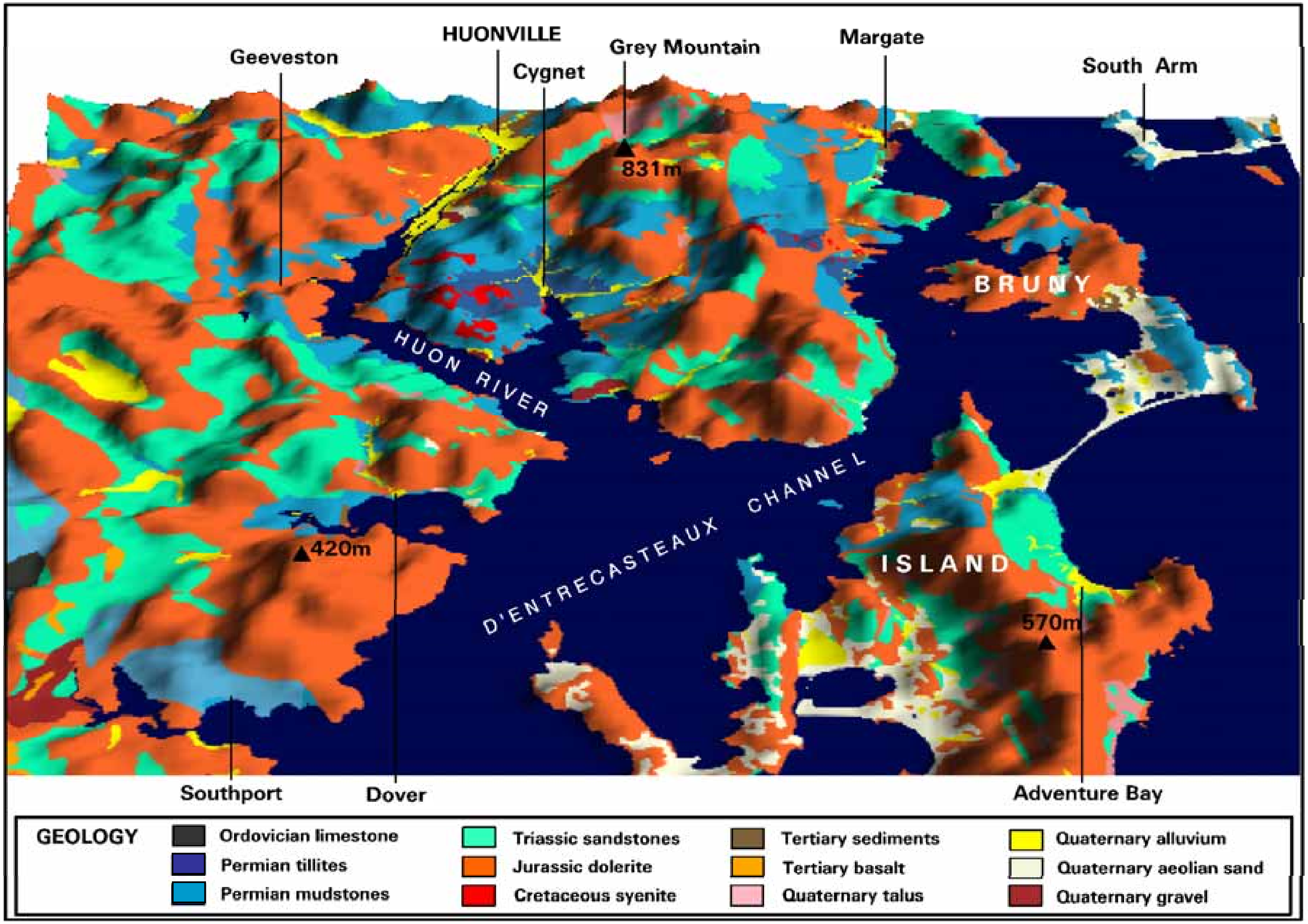
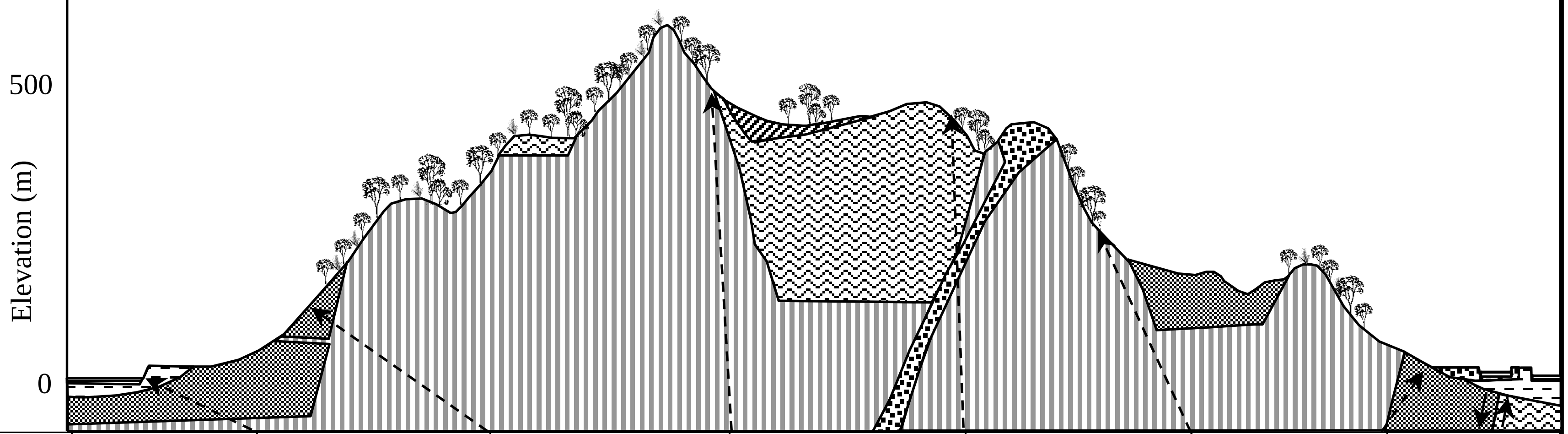


Figure 24. **Perspective view looking north showing geology in relation to landforms within the D'Entrecateaux survey area.**



Typical Landform	Flats	Dissected terraces and lowerslopes	Steep dissected hills and mountains	Highlands	Dissected hills	Foothills	Dissected terraces and coastal flats
Geology	Quaternary alluvium,	Tertiary sediments, Permian mudstone	Jurassic dolerite, Permian mudstone, Triassic sandstone	Triassic sandstone, Quaternary dolerite talus	Jurassic dolerite, Tertiary basalt, Triassic sandstone, Permian mudstone	Jurassic dolerite, Permian mudstone	Quaternary alluvium, Tertiary basalt, Tertiary sediments.
Soil Type	Kandosols, Dermosols	Kurosols, Podosols, Kandosols	Kurosols, Ferrosols, Dermosols	Kandosols, Ferrosols	Kurosols, Ferrosols, Kandosols	Kurosols, Sodosols, Kandosols	Dermosols, Ferrosols, Kurosols, Sodosols
Slope Range	0-12%	0-18%	12-56%	0-28%	5-45%	5-28%	0-12%
Drainage Status	Poor to imperfect	Imperfect to poor	Imperfect to well	Imperfect to well	Imperfect to well	Poor to moderate	Well to poor
Permeability	Moderate to high	Slow to high	Slow to moderate	Slow to moderate	Slow to high	Slow to moderate	High to slow
Erosion Risk	Low	Moderate to high	High	Low to moderate	Moderate to high	Moderate to high	Low to moderate
Main Limitations	Drainage, climate, soils, stoniness	Erosion, soils, drainage	Erosion, stoniness	Stoniness, climate, erosion	Erosion, stoniness	Drainage, erosion, soils, stoniness	Drainage, stoniness, rainfall
Land Capability Classes	5, 4	5, 6	6, 7	5, 6	6, 5	5, 6	5, 4, 3

Figure 15. Stylised cross-section through landforms from the Huon Valley to Margate in the east. The order of appearance of land capability classes reflects their areal extent within each landform.

Permian rocks are often exposed in valley systems, where they can form long gently sloping footslopes, as can be seen north of Huonville or about the township of Cygnet. In coastal regions, low hills with reasonably gentle hillslopes rising to 150m elevation have developed on Permian rocks. Further inland, slopes steepen, become highly dissected, and can rise to elevations of about 500m.

Triassic sandstones

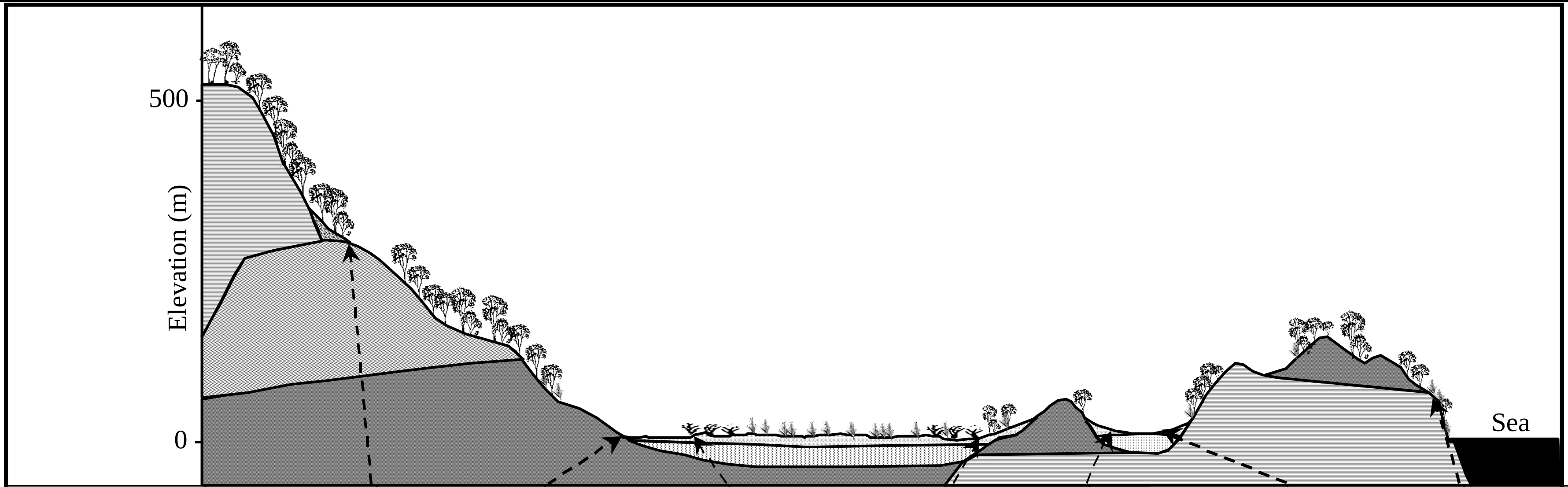
During the Triassic Period some 240 million years ago, thick sequences of predominantly medium to coarse quartz rich (siliceous) sandstones accumulated from sediment transported by rivers flowing towards the southeast of Tasmania. Today Triassic sandstone rocks crop out over 21% of the survey area. These rocks are commonly recognised by their coarse texture and yellow brown colour. They are often massive, displaying frequent cross-bedded sequences. There is little differentiation among sandstone in the survey area. Feldspathic members containing coal (Kaoota Coal Measures) occur at one locality to the north.

As with Permian rocks, Triassic rocks occur across a range of slope positions from gentle valley footslopes to ridge tops at elevations of about 600m. In places (eg. near Pelverata), hillslopes may become highly dissected and streams can be entrenched with steep valley sidewalls. In some coastal localities (eg. near Police Point, western Snug Tiers), stream incision has produced dissected plateaux with steep, often bare and rocky valley sideslopes. Landforms developed in Triassic rocks can be locally extensive, such as about North West Bay, the valleys and coastal flats southeast of Mount Cygnet, hillslopes to the west of Adventure Bay on Bruny Island, and large inland areas in the west of the survey area. Most of these occur within the SouthWest Conservation Area.

Jurassic dolerite

During the Jurassic Period (c.170 million years BP), the land was uplifted as large volumes of alkaline magma were intruded into the overlying Permo-Triassic sediments. Intrusion of this igneous rock, called dolerite, caused block faulting and large vertical displacements to occur within the older sediments. Subsequent erosion of the overlying sedimentary rocks has exposed large areas of dolerite.

Dolerite landforms comprise 46% of the survey area and are locally the most extensive rock type, covering large tracts of rolling hills or steep mountain land rising to 831m elevation. It also forms steep coastal cliffs (eg. eastern and southeast Bruny Island - Photo 2). Dolerite is commonly recognised as a hard, medium to coarse grained, dark coloured crystalline rock. However, its physical appearance in outcrops can vary considerably (Farmer 1985), particularly in relation to depth of weathering and fracturing. Commonly, exposures show mealy dolerite underlain by spheroidal weathered blocks containing kernels of fresher rock. In some places, exposures show much deeper weathering with dolerite ranging from fine-grained orange or red-brown to pinkish very coarse grained varieties.



Typical Landform	Steep Hills	Dissected hills	Flats and tidal marsh	Coastal dunes	Low hills	Undulating flats	Low hills	Coastal cliffs
Geology	Jurassic dolerite and talus deposits	Triassic sandstone, Permian mudstone	Quaternary alluvium, aeolian sands	Aeolian sands	Permian mudstone, aeolian sands	Tertiary sediments, aeolian sand, dolerite colluvium	Permian mudstone, Jurassic dolerite, aeolian sands	Jurassic dolerite
Soil Type	Ferrosols, Kurosols	Kurosols, Podosols	Kandosols, Hydrosols, Podosols	Rudosols, Podosols, Hydrosols	Kurosols, Podosols	Chromosols, Vertosols, Ferrosols, Podosols	Kurosols, Kandosols Sodosols, Podosols	Rudosols, bare rock
Slope Range	5-56%	5-45%	0-5%	5-45%	0-28%	0-12%	5-45%	>56%
Drainage Status	Moderate to poor	Imperfect to poor	Poor to very poor	Rapid	Imperfect to Rapid	Poor to well	Imperfect to well	Rapid
Permeability	Moderate to slow	Moderate	High to Moderate	Very high	Moderate	Slow to high	Slow to high	High
Erosion Risk	High	Moderate to high	Low	Extreme	Moderate to high	Moderate	Moderate to high	Extreme
Main Limitations	Erosion, stoniness	Erosion, soils, drainage	Drainage, salinity, wind erosion	Wind erosion	Soils, wind erosion, drainage	Wind erosion, soils, salinity, stoniness, drainage	Erosion, soils, stoniness	Rock, erosion
Land Capability Classes	E,6,7	6,5	5, 7	7,E	5,6	5,4	6,5	7, E

Figure 16. Stylised cross-section through landforms across the causeway joining north and south Bruny Island. The order of appearance of land capability classes reflects the areal extent within each landform.

Cretaceous Syenite

During the Cretaceous Period (146-65 million years BP) further intrusive igneous activity occurred, but this was of a much smaller scale and confined to areas centred about Cygnet and Oyster Cove. At that time alkaline rocks known as syenite were intruded into the surrounding sediments. Syenite occurs as numerous small dykes and sills which permeate rocks of early Permian age (eg Truro Tillite, Bundella Mudstone), although intrusions into younger rocks and dolerite are also recognised. Syenite is usually a drab grey or buff-coloured rock, which is generally hard and dense and contains abundant large feldspar minerals, embedded in a fine crystalline groundmass of ferromagnesian minerals. Distinctive landforms are generally not associated with Syenite rocks as they tend to occur scattered among Permian rocks. In places however, because syenite, like dolerite, is a hard rock and relatively resistant to erosion, it crops out along ridge tops, mountain tops (eg. Farewell Hill, Mt Mary, Silver Hill) or as narrow coastal headlands (Halliwells Point, Robleys Point).

Tertiary sediments and basalts

The end of the Cretaceous and beginning of the Tertiary period saw the formation of a sequence of northwest-southeast trending horst and graben structures in southern Tasmania. This time also marked initial development of many of the landforms and river systems we see in the region today. During the subsequent Tertiary Period (65 to 1.8 million years BP) geophysical evidence (Farmer 1985) indicates that large thicknesses of eroding sediment were deposited along the D’Entrecasteaux Channel, immediately offshore from Middleton and underlying the isthmus between North and South Bruny Island. Today, however, these rocks rarely outcrop as surface exposures, and the major development of Tertiary sediments on land relate to infill of the pre-Tertiary landscape peripheral to the main graben structure defined by the D’Entrecasteaux channel.

Tertiary sediments occupy less than 1% of the survey area. They are however, locally extensive, infilling valley floors north of Huonville, west of Oyster Cove, Port Esperance, Northwest Bay and Trial Bay. A thin veneer of Quaternary alluvium and aeolian deposits generally covers Tertiary surfaces. Where exposed, sediments are intensely weathered. These include ferricrete and silicastone (silcrete). Ferricrete is generally a deep red or reddish brown and represents intense oxidation and cementation of sand, gravel and clay deposits by iron oxides. Similarly, silicastone represents intense weathering and cementation of quartz rich sand and pebble conglomerates by secondary amorphous silica. Ferricrete often forms low rounded hills as can be seen either side of the highway towards the northern end of Great Bay on northern Bruny Island. Silicastone, while occurring as small discontinuous areas, is widespread and numerous among Tertiary deposits.

Another feature of the Tertiary period was the eruption of basalt flows and associated pyroclastics along valley margins. Subsequent intense weathering and erosion during the Tertiary has largely denuded and diminished the areal extent of basalt in the survey area. Surviving remnants of principally tephra and pyroclastic materials occur near Margate, at the lower end of Tinderbox peninsula, on South Arm, a hill west of Kaoota, and in the Huon and Mountain Rivers.

Quaternary sediments

The Quaternary Period in Tasmania is generally characterised by fluctuating climatic conditions: between colder glacial periods and warmer interglacials. During interglacial periods, climatic conditions were not dissimilar from the present and forest vegetation covered the survey area. In contrast, glacial periods were characterised by much lower tree lines and the prevalence of solifluction processes and freeze thaw activity on mountain slopes. A fluctuating climate and vegetation pattern almost certainly had an important role to play in the development of soils and landforms. As a result, Quaternary deposits in the region encompass a range of depositional forms and these include fluviatile, aeolian, slope, and marine sediments.

Talus deposits composed of boulders or angular rock fragments supported by a finer clay matrix occur about the base of many of the steeper and higher elevation hills and mountains in the region. These are interpreted to represent locally derived solifluction and fan deposits, which accumulated during glacial periods. Significant areas of dolerite talus, often containing boulders up to 4m in diameter, occur northwest of Snug Tiers, on south Bruny Island, in hills west of Middleton, the northern slopes of Mount Esperance and in western mountain lands. Syenite talus, which is usually comprised of angular rock fragments less than 250mm in diameter, occurs as reasonably extensive areas about the main Cretaceous syenite intrusives in hilly terrain west of Cygnet and Oyster Cove. Talus derived from Permo-Triassic sediments is generally much less extensive.

Aeolian coversands are extensive on Bruny Island and on South Arm. In most places these represent uniform fine to medium grade sands with no distinct dune morphology, and in which well developed Podosol soils have invariably developed. It is suggested (Farmer 1985) that these sands were deflated from the exposed beds of the Derwent River and D'Entrecasteaux channel during colder glacial periods. In contrast, recent aeolian sands and associated dune complexes with comparatively little profile development can be found contiguous with coastal bays. These areas include Cloudy Bay, The Neck joining north and south Bruny Island, Halfmoon Bay, and the causeway joining Cape Direction to Goat Bluff. Aeolian sand sheets also appear to cover older Quaternary and Tertiary alluvial sediments in coastal areas from Margate south and along Huon and Mountain Rivers.

The dissected remnants of Pleistocene gravel and boulder beds occur intermittently at elevations of 20 to 40m above present water levels bordering the Huon River, as localized deposits on Cygnet Peninsula, in the Randalls Bay area and along lower reaches of North West Bay River, and at Margate. These are generally well sorted and consolidated deposits consisting of well rounded clasts, usually less than 150mm in diameter. A primary distinction is made between deposits composed mainly of siliceous clasts and those composed mainly of dolerite clasts. Siliceous clasts remain relatively unweathered while dolerite clasts are often decomposed.

Recent alluvial deposits, comprising finer silts and sands over terrace gravels, occur along most of the major rivers systems in the survey area. While these deposits are relatively extensive in the region about, and south from Huonville, elsewhere they are generally confined to narrow strips of land following river courses. Lagoonal deposits on Bruny Island and South Arm represent infilling of depressions behind frontal foredunes. Raised beach deposits, corresponding to the high sea level at c.6 000 yrs BP, also occur in a number of localities immediately adjacent to present beaches. At higher elevation, for example on the Snug Tiers, swamp and marshland deposits have accumulated in depressions.

5.4 Soils

Little soils information is available for the survey area. The earliest survey (Taylor and Stephens 1935) was undertaken to assess apple-growing soils in the Huonville district. This still remains the most detailed survey to date, and while providing only very general information, it illustrates the often complex pattern of soils occurring along valley flats. A broad scale 1:1 800 000 soil map of Tasmania (Nicolls and Dimmock 1965) indicates the dominate soil groups in the region to be either grey-brown podzolic soils (Kurosols, Sodosols) derived from basic parent materials or yellow podzolic soils formed from siliceous parent materials. In addition, very small extents of Krasnozems (Ferrosols) are indicated to the west of Geeveston and on south Bruny Island, while podzols (Podosols) are indicated on South Arm and Bruny Island.

During the course of this survey, a broad range of soil types was recognised to occur on the main geological formations. Because profile form and morphology has a strong bearing on land capability classifications, indicating such limitations as rooting depth, stone content, drainage condition, particle dispersion and erodibility, the general soil types encountered during the survey are briefly described below in relation to the principal parent materials on which they occur. Their order of appearance reflects a general decreasing versatility for agricultural use. The Australian Soil Classification (Isbell 1996) has been used when classifying soils, while descriptive nomenclature follows the suggested standards, which appear in the Australian Soil and Land Survey Handbook (McDonald *et al* 1990).

Soils derived from Tertiary basalt

Small areas of basalt soils occur south of Kingston, near Margate, towards the end of Tinderbox Peninsula, and along Mountain River near Huonville. Just south of Kingston, basalt soils extend over the boundary between the Derwent Land Capability map and the present survey. These soils have previously been mapped as red-brown gradational soils from basalt (Dimmock 1957). They represent an association between neutral, well drained, clay loam soils on ridge crests and steeper slopes, and acid, mottled clay soils on the lower slopes, flats and along drainage lines (Brown Ferrosols, Black Dermosols). Profiles generally exhibit dark brown or black, strongly structured surface horizons which grade to less well structured dark brown or reddish brown horizons with increasing depth.

Similar dark brown soils from basalt occur on terrace risers near Margate. These are moderately well drained soils with alkaline pH trends. Basalt gravels and less commonly cobbles may occur in most soil horizons. On Tinderbox Peninsula, basalt soils occupy steeper slopes and are prone to tunnel erosion along drainage lines. This indicates the presence of sodic subsoil horizons. Large stones and boulders are common along ridge crests.

Soils derived from recent Quaternary alluvium

Alluvial soils occur on narrow strips of land either side of many of the major rivers and smaller rivulets and streams throughout the survey area. These soils have formed in relatively recent accumulations of fine sediment from flood events. They are gradational soils with sandy loam to sandy clay loam textures. The typical profile consists of a 20cm thick dark brown surface horizon over reddish brown, brown, or dark greyish brown subsoil (Brown Kandosols, Brown Dermosols, and Red Kandosols). This in turn overlies gravel at depths normally exceeding 80cm, although shallower soils may be present adjacent to streams. The brighter coloured soil members are associated with alluvium that has been locally derived from erosion of basalt materials, such as on alluvial flats just north west of Margate. Soil structures are generally weak or massive, although surface horizons may have moderate to strong polyhedral structures in undisturbed sites (eg. pasture). Alluvial soils tend to have high subsurface permeabilities and are commonly well drained. However, soils may become poorly drained where significant runon occurs from surrounding hillslopes, or where relatively high water tables are encountered near to major rivers and estuaries. In these cases, soils have dark grey to grey subsoils and strong mottling patterns and iron stains which extend into surface horizons (Grey Kandosols, Redoxic Hydrosols).

Much finer textured black clay soils occur along some drainage flats on Bruny Island (Saltwater Creek). These soils consist of a black self-mulching light clay surface horizon over a black to very dark grey medium clay subsoil, that is weakly structured and plastic (Black Vertosol). These are neutral pH, saline soils (ECe $\approx$ 14 - 18 ds m^{-1}) that remain wet during winter months but crack out during dry summer months.

Soils derived from Jurassic dolerite

Soils developed in dolerite rocks extend across a broad range of landforms, and exhibit a similarly broad range of profile form. By far the most common are texture contrast soils similar to the ‘Podzolic Soils on Dolerite’ mapped on the Hobart, Brighton, and Sorell reconnaissance soil surveys (Loveday 1955, Dimmock 1957, revised by Spanswick 2000). These soils, which are generally widespread throughout the survey area, comprise greyish brown sandy loam surface horizons over brown, light to medium clay subsoils (Brown Sodosols, Brown Kurosols). They commonly show either acid or strongly acid pH trends and nearly always have imperfect to poor drainage with ferrous mottles extending into surface horizons. This is commonly the case on low angle slopes where runoff is restricted and perching of water occurs above the low permeability subsoil. Surface horizons generally consist of a 9-15cm organic enriched A1 horizon and an underlying, sporadically to conspicuously bleached, A2 horizon. In places a layer of iron stone gravels may be present towards the base of surface horizons. These horizons show large textural variation ranging from fine sandy clay loams to loamy sands.

The sandier soils tend to have a loose consistency while those with significant clay content tend to hard set in summer months. Subsoils are of a more uniform clay texture and have moderate subangular blocky to prismatic structures. They are also dispersive and susceptible to gully and tunnel erosion. Some colour variation was noted from the usual brown or yellowish brown to olive browns in wetter sites. On footslopes, subsoils generally grade through to a light yellowish brown mealy weathered dolerite at depths between 80 and 100cm. On steeper slopes, subsoils grade to exfoliating dolerite boulders at much shallower depths of between 30 and 60cm. In addition, the A2 horizon is commonly absent and profiles are stony throughout and the ground surface may be littered with abundant surface stones and boulders. This is the common soil of steeper country.

Gradational brown soils, although less common than texture contrast soils, can be found in some coastal localities (eg, Bruny Island, Tinderbox Peninsula) and on footslopes and flats in some inland valleys where deeply weathered dolerite deposits occur (Brown Dermosols). These soils have neutral to acid pH trends and are generally unlike brown soils mapped in drier areas to the east and northeast of Hobart, which commonly have alkaline pH trends and occasionally calcareous subsoils. Within the survey area, shallow and stony brown soils tend to occupy north facing slopes. These are moderately well drained soils with weakly structured, dark brown, fine sandy clay loam topsoils over brown, moderately structured, clay subsoils. Deeper relatively stone free soils can occur on footslopes and valley flats. These soils commonly have a 20-30cm dark greyish brown fine sandy clay loam surface horizon, over dark yellowish brown, light clay subsoil horizons which may extend to depths exceeding 1m. They also have fine polyhedral or subangular blocky structures throughout and are generally moderate to imperfectly drained. In contrast, some soils have a weakly structured subsoil overlying compact mealy dolerite at shallower depths (Brown Kandosols). In these situations, poor drainage was indicated by paler coloured dark greyish brown horizons with distinct ferrous mottles, which may extend to the surface.

Black soils on dolerite, although rare, were encountered in a number of localities. Shallow black clay soils, passing to compact mealy fine dolerite gravel at depths as little as 40cm, were encountered along broad ridge crests on eastern Bruny Island. Deeper, uniform, clay loam soils that abruptly overlying relatively unweathered dolerite rock at depths of about 70cm, were encountered on steep north facing slopes southwest of Woodbridge (Black Dermosols).

An association between Krasnozem-like soils and those transitional to red podzolics was encountered on deeply weathered dolerite deposits in areas of higher rainfall towards the southwest. These soils are moderately well to well drained and characterised by much brighter coloured reddish brown to dark brown subsoil horizons, which may extend to depths greater than 1m, before passing to mottled, intensely weathered, dolerite material. Gradational profiles consist of a 20cm dark brown clay loam to light clay surface horizon, over a moderate to strongly structured light to medium clay subsoil horizon (Brown Ferrosols). Upper soil horizons sometimes include a paler A2 horizon and are generally of yellower hue. Dolerite stones are common in surface horizons. In most places, these Ferrosols are associated with texture contrast soils, to which they can grade laterally over relatively short distances. Texture contrast soils are characterised by loam textured surface horizons, the presence of a bleached subsurface A2 horizon and the presence of a layer of hard iron stone nodules at the top of the B horizon (Brown Chromosols). Soils similar to the yellow-brown soils of solifluction deposits (Loveday 1955) can be found at elevations above about 500m about the main dolerite mountain peaks (eg. Snug Tiers, Southeast Bruny Island).

Soils derived from early Quaternary gravel deposits

The type of soil developed on the older dissected gravel deposits depends very much on whether gravel beds are composed primarily of dolerite or siliceous clasts. The former produce either gradational or texture contrast soils akin to those developed on dolerite bedrock. For example, slightly stony gradational brown clay soils occur on raised terrace remnants north of Margate. Elsewhere, strongly acid, texture contrast soils appear to be the norm. On flats to the west of Margate poorly drained soils occur. Here, surface horizons comprise a shallow very dark brown structured loam over a massive, relatively compact, dark greyish brown sandy loam. These in turn overly a light olive brown, structured, gravelly medium clay subsoil which passes to weathered dolerite gravels at depths of about 70cm. Mottle patterns are most intense in the A2 and upper B horizons suggesting low permeability and perching of water during the wetter months of the year. South of Huonville, terrace remnants along the Huon River carry similar soils. However, in contrast, these soils are imperfect to moderately well drained, and have overall brighter soil colours together with a brown moderately developed fine angular blocky structured subsoil. The subsoil gradually passes to weathered gravel at depths greater than a metre. This soil is a Dystrophic Brown Kurosol and has previously been named the Woodbridge brown podzolic (Loveday 1959).

Siliceous gravel deposits composed primarily of well-sorted and rounded clasts produce quite different soils. These are very shallow soils, which typically comprise a very shallow organic sand surface horizon over a bleached gravelly sand that in turn overlies weakly weathered compact gravels and cobbles.

Cretaceous syenite

Syenite generally does not produce distinctive soils, as it tends to crop out as narrow dykes among predominantly Permian terrain. On hillslopes, soils are derived from a mixture of parent materials. However, the influence of the predominantly feldspathic mineralogy can be seen in the form of stronger brown soil colours and more gradational profiles. Where syenite rocks are more extensive, typically as Quaternary slope deposits west of Oyster Cove or west of Cygnet, gradational brown soils with strong fine polyhedral structured surface horizons have formed. These soils are commonly stony and confined to moderate to steeper mid to upper slope positions. In some coastal areas, such as south of Cygnet, deep loam textured soils have developed over syenite. These are well drained soils consisting of a 30cm dark brown loamy fine sand surface horizon over a yellowish brown sandy loam subsoil. Surface horizons have strong fine granular structures while subsoils tend to be weakly structured.

Soils derived from Triassic sandstone

Triassic sandstone, like dolerite, produces a range of soils from those with gradational profile forms to those exhibiting strong textural contrasts. In coastal areas (eg. Northwest Bay, Bruny Island) and some inland localities (eg. Garden Island Creek) Podosols are the normal soil encountered. These have developed in the coarser textured quartz sandstones, which may include aeolian cover sands. Soil profiles typically comprise a surface horizon consisting of 20-30cm of organic enriched black sand overlying variable thickness loose grey coarse sand. This in turn overlies ‘coffee rock’ (Bhs horizon), an organic hardpan which may occur at depths exceeding 1m (Aeric

Podosols). Soils are invariably strongly acid throughout and nutrient poor. Subsoils are rarely examined due to the impenetrable nature of hardpans. However, where exposed subsoils are commonly mottled yellow-brown, weakly structured, clayey sand. While most soils are well drained as a result of rapid permeabilities in surface horizons, those in low lying areas become poorly drained due to a lack of runoff and perching of groundwater (Aquic Podosols). These soils can remain wet for considerable periods during winter months.

Triassic sandstones also carry soils that have sandy loam textured surface horizons, that lack characteristics of Podosols (eg. no Bh or Bhs horizon). These soils usually consist of a dark grey to black surface horizon over a grey sporadically bleached subsurface A2 horizon. This in turn overlies a yellowish brown or olive brown, medium clay subsoil that is strongly mottled and dispersive (Brown Kurosols). They are also usually imperfectly drained on slopes, but become poorly drained on lower slopes and flats. As with Podosols, these Kurosols have acid to strongly acid pH trends with depth.

Gradational soils (Brown Kandosols) were also recognised to have developed on Triassic sandstones in a number of localities. These areas are usually located further inland on steeper mid slope positions (eg. east facing slopes south of Middleton, slopes south of Kaoota). While not examined in any detail, these soils consist of structured fine sandy clay loam surface horizons over mottled greyish brown subsoils.

Extensive areas of Triassic sandstone flats and peat swamps to the southwest of the survey area remain largely undeveloped and carry very poorly drained soils. Soils examined near Southport Lagoon consist of 15cm of decomposed black peat over mineral soil horizons (A/B) before contacting hard bedrock at 95cm. Subsoil horizons are a dark grey massive sandy clay loam. All horizons are strongly acid (pH = 4.2) and surface horizons have significant salinity (ECe $\approx$ 4 ds m^{-1}). Further inland (although most fall within exclusion zones), low lying areas carry very poorly drained soils that are characterised by intensely mottled and leached massive grey to light grey sandy clay subsoils (Redoxic Hydrosols).

Soils derived from Permian mudstones

Permian soils encompass a diverse range in soil type from those with gradational profile forms to those exhibiting strong texture contrasts, of which some contain massive hardsetting bleached horizons or hardpans. Despite this variability, the vast majority of soils examined in this survey were deeply weathered, nutrient poor, and had strongly acid pH trends. In addition, most soil horizons were weak or massive structured. Soil drainage conditions were highly variable, reflecting both variations in subsoil permeability and topographic position.

Gradational soils with structured surface horizons were commonly associated with the finer grained Permain rock types (Truro Tillite, Woody Island Siltstone), particularly those centred about Cygnet, on hills to the west of Oyster Cove, and on lower slopes near Woodbridge. These soils generally consist of a 20-30cm very dark greyish brown clay loam, silty loam or fine sandy clay loam surface horizon, over a brown, greyish brown, yellowish brown or olive yellow, light to medium clay subsoil. The subsoil commonly extends to depths exceeding 80cm before passing to weathered mudstone (Brown Kandosols, Grey Kandosols, Yellow Dermosols). Surface horizons normally have a moderate fine subangular blocky or polyhedral structure while subsoils have a weak angular blocky structure and are invariably mottled to some degree. Grey subsoil colours and bright ferric mottles indicate restricted subsurface drainage. The wide range in soil colour and degree of mottling suggest an equally wide range in drainage conditions. Most soils are imperfectly drained, while those in low-lying areas have distinct mottling patterns extending to within 10cm of the surface, and are considered poorly drained. In places, poor drainage conditions can extend onto steeper slopes. Moderately well drained soils can occur on steeper slopes and along ridge crests. These have subsoils with faint mottling patterns, brighter colours and generally stronger soil structure.

Gradational soils with generally weak structures and massive subsurface horizons are common on Permian rocks in the higher rainfall areas towards the western portion of the survey area (Photo 1). These soils typically have a shallow (≈10cm) dark grey fine sandy clay loam topsoil over a massive, dark grey to grey, thixotropic silty loam or silty clay loam subsurface A2 horizon that extends to between 20 and 40cm depth. This in turn overlies a strongly mottled light to medium clay subsoil that varies in colour from a dark greyish brown to light grey or light olive brown (Grey Kandosols, Brown Kandosols). These are exceedingly leached, very strongly acid soils (pH values as low as 3.4 were recorded in some subsoil horizons).

Photo 1. Grey Kandosol on Permian rocks. These are nutrient poor strongly acid soils, characterised by shallow topsoils, massive bleached A2 horizons and mottled clay subsoils. They require a high level of inputs to develop into pasture and are unsuited to arable cropping.

Texture contrast soils are associated with the younger and generally more siliceous Permian rock types (Abels Bay Formation, Mini Point Formation, Deep Bay Formation) occurring in the north and northeastern areas. These are similar to grey-brown podzolic soils described by Dymock (1953), although they are overall deeper soils. On hillslopes about Huonville, these soils are mapped as the Huon loam (Stephens and Taylor 1935). Soil profiles usually consist of a shallow very dark greyish brown, fine sandy loam to fine sandy clay loam surface horizon that abruptly overlies a greyish brown or grey, fine sandy clay loam to silty loam, bleached subsurface A2 horizon. The A2 may extend to depths of between 30 and 60cm (Grey Kurosol, Brown Kurosol). Surface horizons have little structure, are often hardsetting and may contain a layer of compact quartz gravels in the A2 horizon. In places the A2 horizon may form a dense indurated pan (duripan) which provides a barrier to root development and perches water during wetter months. The subsoil is commonly a dark grey or dark greyish brown light to medium clay. It is weakly structured and nearly always mottled to some degree, suggesting restricted drainage at depth in soil profiles. These soils are nearly always strongly acid and have exceedingly low natural fertility.

In some coastal localities (South Arm, Bruny Island), Podosols have developed on Permian rocks, possibly due to the localized influence of aeolian cover sands. These soils generally consist of a dark grey sandy loam to loamy sand surface horizon over grey bleached loamy sand to sand subsurface A2 horizon. This in turn overlies a thin (5-20cm) black, organic enriched, structured clay (Bh horizon), which may rest upon unweathered rock or a dark greyish brown medium clay subsoil (Semiaquic Podosols). The A2 horizons are commonly thixotropic and occasionally cemented into a dense hardpan. These soils have acid to strongly acid pH trends and can be moderately saline where drainage is restricted (ECe $\approx$ 2 - 10 ds m^{-1}).

Soils derived from Tertiary sediments

Tertiary sediments, despite their relatively small aereal extent, carry a diverse range of soils, most of which show a relatively advanced stage of soil development. These include podzols, ground water podzols, yellow-grey podzolics, lateritic podzolics and lateritic soils.

The most extensive area of Tertiary sediments extends north from Huonville. A detailed soil survey of the area (Taylor and Stephens 1935) shows the main soils to be, the Huon silty loam, loam, sandy loam and sand, Grove sand, Lucaston sand and Woodbridge series. With the exception of the Woodbridge series, these soils are all characterised by strongly acid pH trends, pronounced massive bleached A2 horizons and heavily mottled grey to olive yellow, medium to heavy clay subsoils.

The Huon sand is the most extensive of these soils and occurs adjacent to, or contiguous with, recent alluvial soils described above. It usually consists of dark grey and grey sand or loamy sand surface horizons overlying a mottled yellow heavy clay, or less commonly clay loam, subsoil (Yellow Kurosols, Grey Kurosols). This soil is particularly prone to hardpan formation with indurated layers containing considerable gravel common in places. Soils are prone to water logging in low lying areas and where hard pans occur. On elevated sites, soils with lighter textured subsoils generally have better drainage. Nearer to hillslopes, the Huon silty loam can be found in low-lying areas. This is a poorly drained soil developed in colluvial deposits from surrounding Permian rocks. It generally consists of silty loam surface horizons over strongly mottled heavy clay subsoil. The A2 is relatively thick (20-45cm) and strongly thixotropic.

The Grove and Lucaston sands are ground water Podzols having developed in the deeper coarse textured sand accumulations on small knolls and rises scattered along valley flats. The Grove sand consists of a dark grey sand surface horizon, over relatively thick (60cm) light grey massive sand that in turn overlies a largely impenetrable black or very dark brown thick organic hard pan (Semi-Aquic Podosol). The Lucaston sand is similar except that the grey subsurface A2 horizon also forms an extremely dense hardpan containing considerable quantities of embedded gravel. Both soils, while appearing well drained, are prone to severe waterlogging during wet months of the year. They are also strongly acid, nutrient poor soils.

Soils similar to the Grove and Lucaston sands are common on flats south of Margate, slopes west of Oyster Cove and on valley flats about central Bruny Island. In most cases these represent aeolian sand sheets overlying Tertiary or Quaternary sediments. Soils with profiles similar to the Lucaston sand are generally associated with silicastone and Quaternary lag deposits.

Intensely weathered lateritic soils occur on small knolls on central Bruny Island. These are predominantly duplex soils consisting of a very dark grey sand or loamy sand surface horizon over a variable thickness bleached sandy gravel composed largely of fine rounded ironstone nodules. This in turn overlies a yellowish red, moderate to weakly structured, medium clay subsoil (Red Kurosols). Where cultivation appears to have occurred in the past, surface layers are largely absent and the soil consists of a very shallow, very gravelly surface horizon directly overlying red clay subsoil. Although well drained soils, they support extremely poor pastures.

Soils derived from Quaternary aeolian sands

Soils with minimum profile development occur in association with recent sand dunes and rolling terrain on South Arm, about central Bruny Island and at Cloudy Bay, and as small areas along beach frontages in coastal regions. These soils usually consist of a slightly organic enriched loose surface horizon over coarse light brownish grey sand (Arenic Rudosols).

Elsewhere, Podosols are the dominant soil associated with aeolian sand sheets. These again occur predominantly on Bruny Island and South Arm. They may also occur as a thin blanket covering Tertiary and Quaternary sediments, and occasional older rock types. On southern Bruny Island extensive sand sheets occur in association with dolerite terrain, and quite deep accumulations of sand can be found along some of the lower elevation ridgelines rising to 100m. These soils are all characterised by an organic enriched surface sand horizon over a relatively thick (>30cm) grey coarse sand, which in turn overlies a very dark brown organic hardpan at depth. This may rest on bedrock or weathered clay enriched sands. In low lying areas these soils are prone to waterlogging (Aquic Podosols) while on slopes they are particularly drought prone (Aeric Podosols).

5.5 Vegetation

The vegetation of the study area has been described by Davies (1987), Kirkpatrick and Dickenson (1984) and in the Vegetation of Tasmania (University of Tasmania). Hence, a broad overview of only the principal vegetation associations is presented here.

The dominant vegetation communities identified are:
- dry sclerophyll in coastal areas and in the northeast,
- wet eucalypt forest towards the southwest and at higher altitude,
- dry coastal vegetation predominantly on Bruny Island,
- moorland and scrub mainly in the south, and
- cleared land consisting of introduced or native grasses

The distribution of native vegetation is broadly correlated with geology, altitude and climate. Remnant vegetation is generally confined to upland areas where a combination of soil and/or climatic conditions severely limits agriculture. Lowland and coastal areas have largely been cleared of the original forest cover and replaced by introduced grasslands. Some small areas of forest occur on private land in low lying areas where either slopes are steep or soils are excessively stony, wet, or acid and nutrient poor.

Within agricultural areas, improved pastures consist of perennial ryegrass (*Lolium perenne*) and white clover (*Trifolium repens*) among others. In wet or poorly drained sites rushes become common (eg. *Juncus spp*), while along saline valley flats, Buck's Horn Plantain (*Plantago coronopus)* is often the dominant plant. On sandier soils, poor pastures are often characterised by hardier plants such as bracken fern *(Pteridium esculentum*) or saggs (*Lomandra longifolia*). Unimproved pastures also commonly consist of a range of native grasses, which may include such species as Wallaby grass (*Danthonia spp*), Weeping grass (*Ehrharta stipoides*) and Tussock grass (*Poa spp*), together with a large number of volunteer weed species.

Dry coastal vegetation generally consists of a closed heath comprising a variety of species including Tea Tree (*Leptospernum spp*), Paperbark (*Malaleuca spp*), Banksia (*Banksia marginata*) and Sheoak (*Casuarina spp*). Drooping Sheoak (*C. stricta*) is common on very steep, stony dolerite hillslopes. Coastal dune systems typically support a grassland dominated by Marram grass (*Ammophila arenaria*) or shrubland dominated by Coastal Wattle (*Acacia sophorae*).

Dry sclerophyll forests consist of a wide variety of species that are usually characterised by floristic structure. Permo-triassic landforms are characterised by Black Peppermint Gum (*E. amygdalina*), Silver Peppermint Gum *(E. tenuiramis*), or Blue Gum (*E. globulus*) with a heathy understorey. Dolerite landforms generally carry grassy woodland dominated by Blue Gum, White Gum (*E. viminalis*) or White Peppermint Gum (*E. pulchella*). Poorly drained sites, particularly those on Permian landforms, carry open stands of Swamp Gum (*E. ovata*) or Stringybark (*E. obliqua*) with a shrubby or sedgy understorey.

Wet sclerophyll forests occur in areas of higher moisture availability and are characterised by a taller understorey of *Acacia* species and green leafy (mesophyll) shrubs. Typical forests consist of open stands of White Topped Stringybark *(E. delegatensis*) or Stringybark, with Swamp Gum *(E. regnans*) becoming increasingly common in gullies and on protected slopes. Where poorer soils occur, Smithton Peppermint Gum (*E. niteda*) may become the dominant tree species.

Moorland to the southwest generally consists of open woodland dominated by Stringybark, Swamp Gum or Black Peppermint Gum on rises, or sedgeland dominated by Buttongrass (*Gymnoschoenus sphaerocephalus*) and Swamp heath (*Sprengelia incarnata*).

Photo 2. View looking south along the eastern coast of Bruny Island at Trumpeter Bay showing dolerite cliffs in the foreground and landforms developed on Permian rocks in the background. There is often a close association between remnant native vegetation and geological units carrying the poorer soil types.

5.6 Land Use

The majority of lowland and coastal areas have been cleared of the native vegetation for agriculture. Land use is dominated by horticultural enterprises or grazing for beef, sheep and dairy production. Tourism is also an important component of the local economy and is focuses largely in coastal areas such as on Bruny Island, or in areas where the lands remain relatively undeveloped (mountain lands). The region has an important timber industry, which is located primarily in forests to the southwest of Huonville. There are few significant mineral deposits in the area. Mining of coastal alluvial gravel deposits and the more deeply weathered dolerite is undertaken for roading materials.

The area is traditionally recognised for its apple industry, although the production of berry fruits and stone fruits is also common in places. The area is ideally suited to this type of perennial horticulture due to a suitable climate of relatively cold winter months, ample rainfall during the growing season, and warmer and drier summer months for ripening of fruit. Although orchards are planted across a broad range of landforms and soil types, they are generally sited on footslopes and valley floors. Soil drainage can be a problem in many sites. Consequently mounding about tree roots is a common practice to help improve aeration and alleviate relatively poor drainage. The remnants of mounds and furrows are a common feature of many pastured hillslopes where apple trees have been removed. In recent years, there has been a move towards alternative horticultural enterprises in coastal areas such as hazelnuts, olives, and grapes for wine production. However, these are still in their infancy, with only relatively small plantings to date.

Broadacre cash cropping is generally not undertaken within the survey area largely due to a combination of unsuitable climate and poor soil types. In some coastal localities however, where a more moderate climate results in warmer winter and springs months, arable cropping is undertaken on the better alluvial soils along river flats. These sites are ideally suited to crops such as potatoes, cereals, corn, brassica, lettuce, beans and peas. The relatively small extent of these soil types, however, and lack of any significant industry for food processing, means that in most cases they have been utilised for propagation of fruit trees. In a few places, market gardens that supply the local domestic market are located on alluvial soils. Market gardening is also undertaken on some of the sandier soils where a higher intensity of inputs (eg. fertilizer, irrigation) is needed. The occasional crop of potatoes is also grown where sandier soils occur with reasonable drainage (eg. ridge tops). While maximum plant growth can be expected during the warmer late spring and summer months, irrigation is often required to offset risks associated with crop failure during dry periods.

The remainder of agricultural land is given over to grazing for sheep and beef production. Some fodder crops are occasionally established where better soils occur. Pasture renewal is often undertaken during summer and autumn months when paddocks are easier to cultivate. The higher rainfall experienced throughout much of the survey area provides for very productive pastures when compared to drier eastern areas such as the Coal River Valley. Production of sheep for fine wool tends to occur in the drier northeast, while beef cattle herds can be found throughout the survey area, particularly on gentle to moderate sloping hill country. Dairy farming also occurs in areas yielding good summer pastures. In recent years there has been a trend towards land subdivision for small lifestyle blocks, particularly in areas centred on townships.

The timber industry in southeast Tasmania is also centred in the Huon region. Timber is extracted from extensive wet sclerophyll and rainforests towards the southwest for sawlogs or for wood chipping and pulping for the export market. Plantation forests are being established in areas previously milled for timber or in some pastureland peripheral to forest further inland.

6. LAND CAPABILITY CLASSES ON THE D'ENTRECASTEAUX MAP

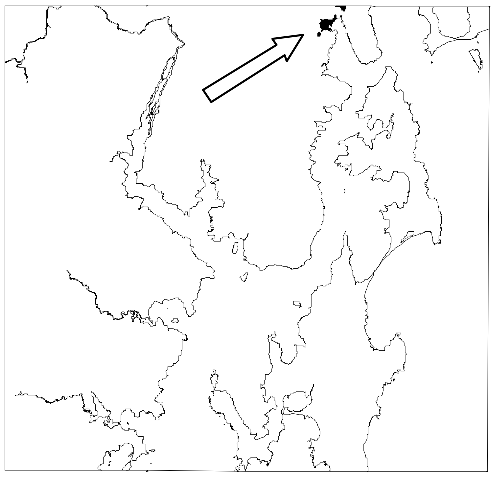
This chapter describes the different classes of land that have been identified during the course of the survey. General information on the nature of the land, climate, soil type and geology are given together with an indication of the major limiting factors to agricultural production. Throughout the text references are made to subclass codes and these are shown in parenthesis. A figure is presented for each class indicating its distribution across the map. The area of each map unit is also shown in hectares.

6.1 CLASS 1 AND 2 LAND

No Class 1 or 2 land is found in the survey area. Generally poor soil conditions (s) and low fertility coupled with an unsuitable climate of cold winter and spring months (t), together with low annual rainfall in coastal localities (p), limits land capability to Class 3 or poorer.

6.2 CLASS 3 LAND

Class 4+3 229ha



Small areas of Class 3 land occur on Quaternary alluvium and Tertiary basalt where average annual rainfall exceeds 700mm. These are relatively small areas where the dominant limitations restricting agricultural versatility are climate, stoniness, soil depth and erodibility. They are mapped in association with Class 4 land due to limitations imposed by map scale.

Class 3 Land on Tertiary Basalt

Small areas of Class 3 land occur where Brown and Red Ferrosols have developed on the sloping ridge crests of basalt flows near Kingston and on dissected basalt risers to the west of Margate. These are well drained, fertile soils limited in their productive capability by low rainfall (p), stoniness (g) and soil depth (l). Near Kingston, these soils tend to occur in association with imperfectly drained heavier textured Black Dermosols that are situated on flats or along drainage depressions and are classified as Class 4 land. In addition, on slopes bordering basalt flows where gradients exceed 12%, there is a moderate risk of erosion without careful management.

The small size of these areas, together with the intricate nature of their distribution, has meant that these areas can only be identified at the 1:100 000 scale as complex Class

4+3 map units. Current land use is primarily animal grazing while a few fields are cultivated for vegetable production. Some areas of this prime agricultural land, such as between Kingston and the Huon highway, have already been subdivided for residential development.

Class 3 Land on Quaternary Alluvium

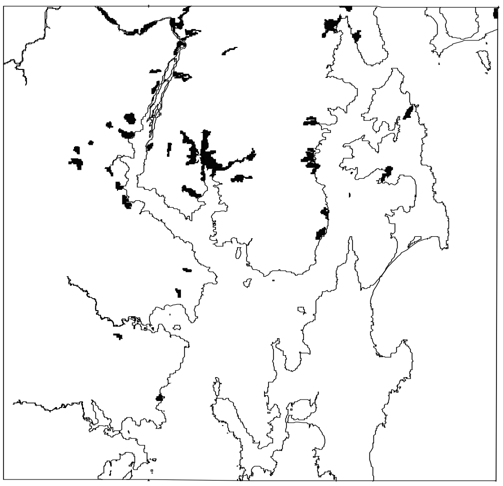
Small areas of Class 3 land occur on alluvial flats immediately to the west and north of Margate (Photo 3). Due to their small size and limitations of map scale, these areas have been mapped as a complex with Class 4 land occurring on adjacent higher elevation terraces. Class 3 land carries brown to reddish brown structured alluvial soils (Brown Dermosols) which are ideally suited to cultivation and production of a range of crops. The moderate coastal climate provides for a reasonable growing season from early spring to early summer months. However, the dominant limitation restricting the range of crops that can be grown is low rainfall (p). Summers are relatively dry and if cropping is to be considered at this time of year, irrigation will normally be required. While these are relatively free draining soils, care needs to be taken during wetter winter months to avoid soil compaction and structural decline. This is particularly relevant to the sandier and weaker structured soils with higher ground water tables. These areas, which are often located nearer to streams or coastal margins, thus have an additional wetness (w) and soils (s) limitation.

Inclusions of Class 5 land occur on steep terrace risers at the outer margins of lower terraces.

Photo 3. Small extents of Class 3p land occur on alluvial terraces in some coastal locations. Climate is the dominant limitation restricting the range of arable crops in this situation (Margate, GR. E521000 N5237300).

6.3 CLASS 4 LAND

Class 4	2 502ha
Class 4+3	229ha
Class 4+5	972ha



Class 4 land occupies relatively small areas and is generally situated on the better soils of valley floors or gentle lowerslopes. In some instances, Class 4 land is mapped in association with Class 5 land. The dominant limitations that restrict broadacre cropping include climate (c), poor soil conditions (s), wetness (w), erosion risk (e), and high stone content (g). Present land use is dominated by grazing or horticulture enterprises.

Class 4 Land on Quaternary Alluvium and Gravel Deposits

Class 4 land on Quaternary alluvium includes most areas of the modern day floodplain of rivers and the smaller streams and rivulets. These are generally relatively narrow strips of land immediately adjacent to rivers. Most extensive areas occur west from Huonville following the Huon River. Narrow strips of land also follow rivulets draining into Port Cygnet.

These areas of Class 4 land support relatively fertile light textured brown to reddish brown soils (Brown Kandosols, Brown Dermosols) which are ideally suited to cultivation and the occasional cash crop in rotation with pasture. However, soils are often weak structured (s) and care needs to be taken to avoid soil compaction and resultant loss in permeability and air fill porosity. Climate (c) and soil wetness (w) are the major limitations restricting the range of crops and agricultural versatility of these sites. Historically, cereals have been grown in places, although today horticultural crops are most common. Until recently, hops have been grown near Huonville.

Most valleys are relatively narrow and prone to cold air drainage and frosts during winter and spring months. Furthermore, dry summers restrict arable crops to short rotation late spring varieties suited to cooler climates. Wet soil conditions can further reduce the growing season by restricting vehicle access. Careful tillage management may be required to avoid risks of soil degradation through compaction and loss of soil porosity. Drainage in alluvial soils can be quite variable due to runon from surrounding slopes and high water tables in places (Photo 4). Terraces often have a backslope away from the river and this can cause waterlogging and ponding of water to occur at the break in slope between hillslopes and the terrace tread. Here, Class 4 land often merges with poorly drained Class 5 land over relatively short distances.

Photo 4. Class 4wc land can be found along valley flats adjacent to most rivers and streams in inland localities (Judbury, GR. E495600 N5237500). Here, late frosts and wet soil conditions towards the base of slopes (foreground) are the main limitations.

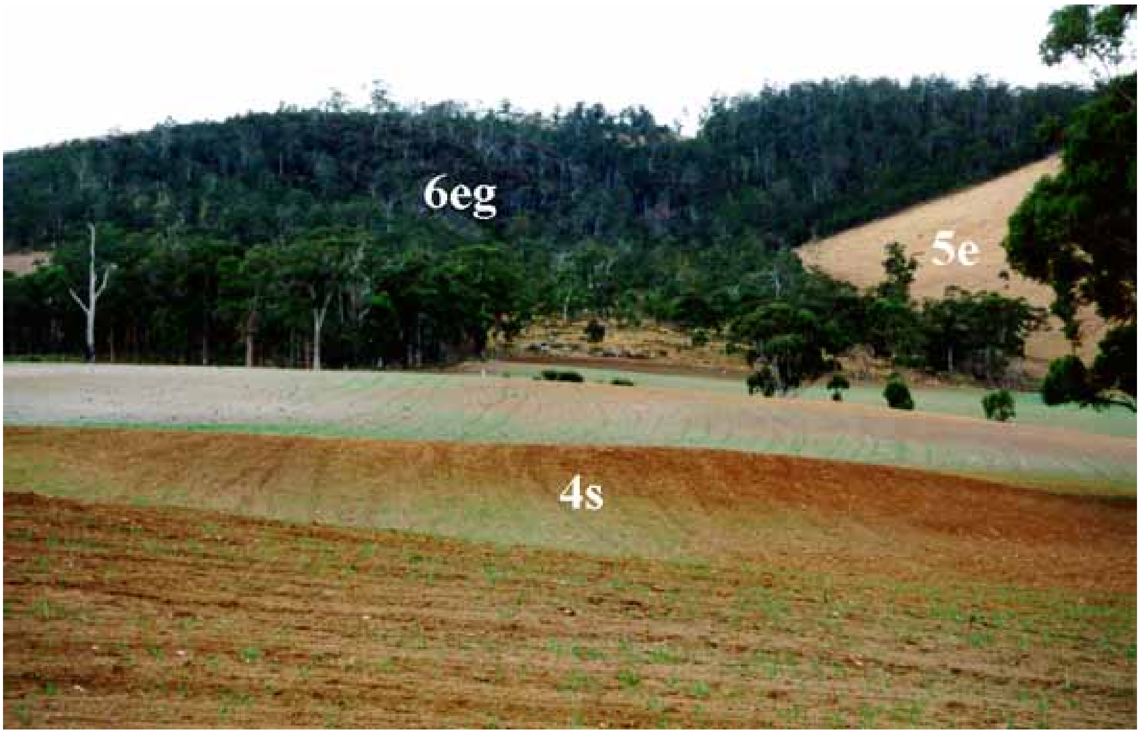


Photo 5. Class 4s land on Jurassic dolerite with Class 5e and 6eg in the background. Texture contrast soils are evident in areas with lighter surface colours.

Class 4 land also occurs on higher dissected terraces north of Margate and between Huonville and Franklin. Here, although drainage is good, high stone content at shallow depths in soils (g), and risks of soil erosion (e) on the steeper terrace risers, greatly restrict the ability to cultivate soils and would further restrict the range of crops that could be grown. In addition, areas carrying duplex soils are prone to soil degradation and require careful management due to the shallow and poorly structured nature of topsoils. These soils are also strongly acid and nutrient poor, requiring reasonable fertiliser applications in order to maximise productivity from crops.

Class 4 Land on Cretaceous Syenite

Small areas of Class 4 land are mapped on syenite and related slope deposits on sloping ridge crests west of Cygnet and on coastal slopes south of Cygnet, along the western shore of Port Cygnet. These areas carry relatively free draining light textured and structured soils (Brown Dermosols) that could support occasional cropping. However, the combination of moderate slope (up to 18%) and light surface textures, indicate that there is a significant erosion risk (e) if regular cultivation were to be undertaken. Most areas presently remain under pasture.

Class 4 Land on Jurassic Dolerite

Small extents of Class 4 land can be found scattered throughout the survey area wherever soils with reasonable drainage have formed from dolerite parent materials (Photo 5). These are usually located on elevated sites along valleys or on footslope positions and include either moderately well drained gradational soils (Brown Dermosols, Brown Kandosols) or imperfectly drained texture contrast soils (Brown Kurosols, Brown Sodosols). The main limitations, which greatly restrict the use of these soils for broadacre cropping, include high stone content (g), imperfect drainage due to low subsoil permeability (d) and erosion potential on steeper slopes (e). Most areas of Class 4 land are limited to slopes of less than 18% in the case of better structured soils, or to slopes of less than 12% in the case of texture contrast soils. The latter soil types are more prone to soil degradation and to surface and tunnel or gully erosion processes owing to the weak soil structure and the slowly permeable and dispersive nature of subsoils which promotes runoff.

In narrow enclosed valleys, low temperatures (t) restricts the growing season and range of potential crops that can be grown as a result of cold air drainage and spring frosts. Similarly, a climate limitation (t) was also recognised for some Class 4 land identified at higher elevation of around 200m, principally west of Geeveston. This is a cold and wet region, but because rainfall is higher during summer months compared with coastal areas to the east, some cropping could be considered at this time of year. Additional limitations include a high stone and sometimes boulder content (g) and soil wetness, both of which would make areas difficult to cultivate. While soils are moderately well drained Brown Ferrosols, waterlogging can occur during wetter periods of the year. These usually coincide with winter months when evapo-transpiration rates are low.

By far the majority of Class 4 land on dolerite has been used for apple production, although many areas still remain under pasture and some areas at higher elevation in western areas are being used for plantation forestry.

Class 4 Land on Triassic Sandstone

Class 4 land on Triassic sandstones is relatively uncommon due to the lack of this rock type cropping out in favourable localities. In addition, most soils are coarse textured and prone to erosion. However, narrow strips of Class 4 land on sandstone occur along coastal localities south of Woodbridge. Imperfect drainage (d) caused by the low permeability of clay subsoils is the dominant limitation restricting access to land and the ability to cultivate soils without causing degradation. In general, Class 4 land on sandstone is confined to slopes between about 5 and 12% where drainage is better. Gentler slopes are generally poorly drained while steeper slopes have too high an erosion risk for cultivation other than irregular fodder crops. Most areas of Class 4 land remain under pasture.

A small area of Class 4 land was mapped on the western slopes of Tinderbox Peninsula near Howden. Here, there is a significant risk from aeolian erosion (a) due to the coarse sandy loam to loamy sand surface soil textures. Structured soils do occur in a few places on Triassic sandstone, although these are largely confined to steeper slopes. In this case potential cropping sites occur on slopes up to 18%. These could not be mapped owing to their small size and scale limitations of this survey.

Class 4 Land on Permian Mudstone

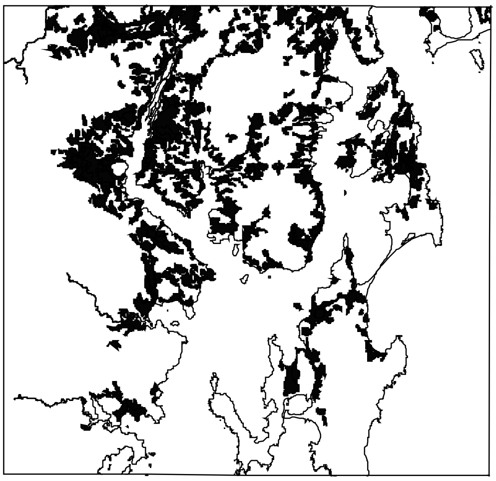
Class 4 land on Permian mudstone is largely confined to the gradational soil types (Brown Kandosols) possessing reasonable structure and drainage. These areas were generally found on the gently sloping crests and slopes of dissected benches along valley margins. Examples include slopes west of Woodbridge and valleys to the north and east of Cygnet. In places, the better soil types appear to relate to influences from colluvial igneous rock types such as dolerite and syenite. The dominant limitation restricting agricultural versatility is a short growing season resulting from imperfect subsoil drainage (d) and relatively cold and wet spring months. Furthermore, the low natural fertility of most soil types (s) greatly restricts the potential range of cropping varieties that can be grown. On steeper slopes, up to 18% in places, there is an increasing risk of soil degradation from erosion.

These areas of land are considered to be extremely marginal for broadacre cropping. Climate has a large role to play in this, not only due to frosty early spring months, but also wet conditions which can prevail through to December (see Figure 13). This maintains soils in a relatively plastic state during spring months, which means that machinery operations need to be carefully timed to avoid soil compaction and degradation. Only cold tolerant, short rotation late spring or summer cropping varieties are suited to this region. However, this land also produces high yielding pastures and grazing is the dominant land use, although the occasional fruit orchard can be found in places. Additions of lime and routine fertiliser applications are essential to maximise productivity.

In the Cygnet area, Class 4 land is mapped as a complex with Class 5 land owing to common inclusions of poorly drained soils along channels and flats and the steeper slopes of risers.

6.4 CLASS 5 LAND

Class 5	35 265ha
Class 4+5	972ha
Class 5+6	1 718ha
Class 6+5	575ha



Class 5 land is the second most common capability class, and makes up the bulk of currently utilised agricultural land within the D'Entrecasteaux survey area. Class 5 land is limited to grazing enterprises due to a combination of adverse climate (c) and poor soil conditions (s), which effectively prohibit broadacre agricultural enterprises. Other limitations on Class 5 include soil drainage (d), wetness (w), stoniness (g), and erosion risk (e) on steeper slopes where cultivation is precluded other than for pasture improvement or occasional fodder crops. Perennial horticultural crops such as apple orchards are commonly established on this class of land.

Class 5 Land on Quaternary Alluvium and Gravel Deposits

Class 5 land on alluvium is relatively uncommon, but occurs as narrow strips of land following rivers and smaller streams wherever soils are poorly drained due to periodic waterlogging (w). Many of the narrow valleys are characterised by poorly drained soils as the result of runoff from surrounding hills. In coastal areas, similar conditions result from high water tables. Where little land improvement has been implemented, flats are characterised by relatively poor pastures with scattered rushes. However, where drains have been installed this land provides excellent summer pastures and is ideally suited to grazing enterprises such as dairy production. Examples include alluvial flats near Huonville and following the eastern shore of the Huon River towards Cradoc. Garden Island Creek is a good example of a narrow valley system with poorly drained alluvial flats along its extent.

On Bruny Island, the majority of alluvial flats are also poorly drained (Photo 6). In addition, Black Vertosols that occur adjacent to streams (eg. Saltwater Creek) carry poor pastures due to high salinity levels (k).

In a few places, either immediately adjacent to streams or on older Quaternary gravels, land use is restricted to grazing due to physical limitations of shallow soil depth (l) and the stony nature of subsoils (g). On flats southeast of Margate, poor drainage (d) was recognised as the dominant limitation on deeper Brown Kurosols.

Class 5 Land on Tertiary Basalt

Several small extents of Class 5 land on basalt occur on Tinderbox Peninsula and near Kaoota. Slopes are relatively steep and consequently there is a high risk of erosion (e) if soils are cultivated or overgrazed. Furthermore, soils can be very stony along ridge crests making cultivation impracticable.

Photo 6. Class 5kw land on flats and 5as on sandy knolls. Poor drainage and high salinity levels can restrict land use to grazing on some alluvial flats in coastal areas with low rainfall (Saltwater Creek, Bruny Island, GR. E531000 N5220600).

Photo 7. Class 5w land on dolerite colluvium. Cultivation of this land for pasture renewal needs to be carefully timed to avoid clodding and soil compaction (Lunawanna, GR. E518900 N 5198250).

On Tinderbox Peninsula, tunnel erosion was evident along drainage lines indicating the presence of dispersive, sodic subsoils and the need for erosion control measures. Here Class 5 land is limited to slopes less than 28%. In contrast, the basalt soils on slopes near Kaoota have few apparent erosion problems due to strong soil structure and good subsoil drainage. In this situation, Class 5 land is mapped on slopes of up to 56%.

Class 5 Land on Cretaceous Syenite and associated Slope Deposits

Class 5 is the most common capability class on areas of hill country underlain by syenite dykes and associated Quaternary slope deposits (talus). Significant extents of this land occur on gentle to moderate slopes to the west of Oyster Cove and to the west of Cygnet in the region of Silver Hill and Mount Windsor. Here, high stone content (g) makes cultivation impracticable. Soils are comparatively more fertile than surrounding Permian slopes and consequently provide for good grazing land. On hillslopes from 12 to 28%, relative risks of erosion increase, and areas of land should be carefully managed to avoid overgrazing and to prevent erosion when cultivation for pasture renewal is undertaken.

Class 5 Land on Tertiary Deposits

Gently sloping Tertiary terrain consists predominantly of Class 5 land. This is due to a range of soil limitations (s) imposed by generally poor physical and chemical properties of most soils which restrict land use to grazing or perennial horticulture. In addition many areas are poorly drained or lie wet for considerable periods in winter and spring months due to a combination of low subsoil permeability (d) and lack of runoff (w).

Flats to the north of Huonville form the most extensive area of land underlain by Tertiary sediments. These carry a broad range of soil types, with the most common being the Huon series. A high risk of soil degradation due to poor physical properties and generally wet subsoil conditions throughout winter and spring months, makes these soils (Kurosols and Aquic Podosols) unsuitable for broadacre cropping. Careful grazing management is also required to avoid severe pugging at wet times of the year. They are also strongly acid and nutrient poor soils requiring significant fertiliser inputs to improve pasture yields. Pasture renewal is often undertaken during summer when access to paddocks can be gained. Class 4 inclusions are associated with soils having better subsoil drainage (eg Woodbridge loam, Huon sand light subsoil phase). These occur along some of the smaller rises, but are relatively small areas of only a few hectares.

Areas of Class 5 land are also associated with particularly sandy soils, such as the Grove and Lucaston sands which overlie Tertiary sediments. These soils usually contain hardpans (Aquic Podosols) which can cause perching of water in low-lying areas during winter and spring months. Consequently, these areas are also unsuited to cropping due to wet (w), as well as, poor soil conditions (s). Drainage is often somewhat better on rises and slight knolls, but the coarse surface textures result in rapid permeability and low soil moisture retention. As a result soils are drought prone during summer months. There is also a high risk of wind erosion (a) in exposed localities because of the lack of organic matter or clay to help provide soil cohesion and structure. Pasture renewal should be confined to aerial seeding or direct drilling unless intensive conservation management practices are implemented (eg. use of shelter belts).

Class 5 land is also associated with Red Chromosol and Red Ferrosol soils on gently rolling terrain on Bruny Island. Although well drained, these soils are unsuited to cropping due to either very shallow topsoil (l) or the highly erodible (e) nature of the coarse sand texture of topsoils. A layer of sandy iron stone gravels at or near the soil surface would also restrict root development for arable crops (g). Where land appears to have been cultivated in the past, topsoils are almost non-existent and pasture cover is very poor. In undisturbed sites, the coarse texture and lack of soil structure in surface horizons indicate a high risk of wind erosion (a).

In areas underlain by silicastone deposits, the cemented A2 horizon at shallow depths provides a barrier to root development (l), as well as imparting extremely poor soil physical and chemical properties. These areas often represent small inclusions of Class 6 land. Where significant areas of silicastone deposits occur, such as east of Oyster Cove, this has led to mapping of a complex of Class 5 and Class 6 land.

Class 5 Land on Jurassic Dolerite

Class 5 land is common throughout the survey area on mid to lowerslope positions in areas underlain by dolerite rocks. The dominant factors limiting the ability to cultivate and crop these sites include low subsoil permeability (d), seasonal inundation (w), high stone content (g) and erosion risk on the steeper slopes (e). Low temperatures (t) are an additional limitation restricting land use to grazing at elevations above about 450-500m. Most Class 5 land on dolerite is utilised as grazing for sheep and beef production, although some areas are used for orchards and berry fruit production (Photo 8).

Poorly drained soils are a feature of many lowerslope positions due to runoff from hillslopes and perching of water over slowly permeable subsoils (Brown Kurosols and Sodosols). Wet soil conditions often prevail during winter and spring months and this makes many areas unsuitable for broadacre cropping due to a high risk of soil degradation through soil compaction and clodding (Photo 7). Cultivation for pasture renewal or fodder cropping should only be considered at drier times of the year, although this may lead to wind erosion on soils with light textured surface horizons.

High stone content (g) makes Class 5 land unsuitable for cropping in most places. These areas tend to occur on steeper slopes and along ridge crests. For example, extensive areas of stony Class 5 land occur across northern Bruny Island. In many places a high level of surface stones (floaters) gives a good indication of this land type. In some places however, perhaps because of previous stone picking, fields at first impression can appear relatively stone free. In these instances, capability ratings were based on a high level of stones observed in soil pits or road cuts.

On moderately steep slopes (usually > 12%), the risk of soil erosion (e) becomes the main factor limiting agricultural versatility of this land. A reasonable level of management is generally required to maintain a good pasture cover and avoid generation of overland flow, which can lead to sheetwash, tunnel and gully erosion. Slope limits for Class 5 land on dolerite vary considerably, as some soil types are more susceptible to erosion than others. For example, coarse textured Brown Sodosols and Kurosols are considered very highly erodible and Class 5 land is restricted to slopes of less than 18%. Where topsoils are heavier textured (eg. sandy clay loams) and contain some structure, then risks of soil erosion are considered lower and good grazing pastures can extend onto steeper slopes of up to 28%. Similarly, Brown Dermosols and Ferrosols usually have heavier textured and well structured surface horizons. These soils are considered to have low erodibility and consequently Class 5 land is mapped to 56% in places, although in general these are of relatively small areal extent.

Class 5 Land on Triassic Sandstone

Class 5 land is the most common capability class mapped on Triassic sandstone and is locally extensive is some areas. The main physical limitations, which restrict land use to non-arable activities, relate to either the coarse soil textures and associated erosion risks (e) or wet soil conditions in areas of poor drainage (w, d). Most Class 5 land on Triassic sandstone is ideally suited to grazing although some areas could be considered for horticultural enterprises.

Podosols are the main soil type in coastal areas and some inland valley systems (eg. Garden Island Creek). These have particularly coarse surface textures lacking any structure. In general plant roots from grasses and shrubs provide the main source of soil cohesion. There is a relatively high risk from wind erosion (a) if plant cover is disturbed. These soils are also relatively infertile and drought prone during summer months. However, with careful management and fertiliser inputs these sites can yield good quality pastures. Pastoral grazing is the dominant land use, although some small areas of land are utilised for market gardening given the very easy tillage of soil. Potatoes could be grown on some of the flatter land where soils have higher organic levels in the topsoil, but such areas of potentially Class 4 land are too small to map at 1:100 000 scale. Dry summers pose a risk of crop failure and irrigation is generally required for economic yields.

On relatively flat land or along drainage depressions, poor soil drainage makes areas unsuitable for cropping because of problems associated with soil tillage, compaction, clodding and general vehicle access. Poor drainage is due to a combination of low subsoil permeability (d) and lack of runoff (w) in cases of low topographic relief. Principal soil types associated with this class of land are Brown Sodosols and Brown Kurosols, although Aquic Podosols can occur in some locations (eg. raised plateaux along Police Point Road). Wet soil conditions also become increasingly common in areas of higher rainfall as occurs towards the south and southwest of the survey area.

In some places (eg. Middleton), Class 5 land is mapped as a complex with better drained Class 4 land situated on risers and gentle footslopes. In most places however, Class 5 land limited by poor drainage is contiguous with Class 5 land on steeper slopes where risks from erosion (e) require major soil conservation and restrict land use to non-arable activities such as grazing or horticulture. On hillslopes carrying highly erodible coarser textured soils, Class 5 land is generally restricted to slopes of less than 18%. Where there is less risk of erosion, as is the case with heavier textured soils (Brown Kandosols) grazing land can extend onto steeper slopes of around 28%, but these areas will still require careful management. Examples of this land include hillslopes south of Kaoota, hillslopes southwest of Middleton, and hillslopes near Glendevie.

Class 4 inclusions of extremely limited areal extent are identifies in a few places where gradational soils with strongly developed surface structure occur on slopes with gradients of 12-18%.

Class 5 Land on Permian Mudstone

Class 5 land occurs extensively over areas underlain by Permian mudstones. These range from valley bottoms, through gentle footslopes along the perimeter of valleys, to moderately sloping hill country (Photo 9). Across most of the survey area, the main physical limitations restricting land use to non-arable agriculture are a combination of wet climate and poor soil conditions (s). In addition, hillslopes with gradients over 12% are considered to have a significant erosion potential (e). Low subsoil permeability (d) and excess soil wetness (w) in winter and spring months together with strongly acid and nutrient poor soils make these areas of land difficult to manage and generally unsuitable for broadacre crops. Most land use is restricted to grazing for beef and sheep production although fruit orchards are common in more favourable localities and where some of the better soil types are found.

Areas of Class 5 land are often unsuitable for broadacre cropping due to the poor physical and chemical properties (s) characteristic of most soil developed in Permian mudstones. Surface horizons are commonly a silty loam texture and are often massive showing little apparent structure. As with other soils in the Huon series, the thixotropic nature of massive A2 horizons limit vehicle access during wetter months of the year, which usually lasts from July through to December. Furthermore, the low permeability of clay subsoils can lead to surface ponding and extremely wet soil conditions resulting in low lying areas (w). This is most prevalent along concave breaks in slope where runoff from further upslope can lead to significant accumulation of water. These wet areas are subject to pugging and soil degradation unless carefully managed. It is also not uncommon for wet soil conditions to extend onto steeper slopes due either to low subsoil permeability (d) or lateral seepage through parent rocks. Soil wetness (w) is also the dominant limitation in areas of higher rainfall to the southwest where Grey Kandosols are the main soil type.

In drier coastal areas these soils are particularly prone to wind erosion (a), as surface horizons will turn to a fine powder if cultivated. On hillslopes, soils are subject to overland flow, with tunnel erosion evident along convergent zones in some localities. Careful grazing and conservation management practices are required to offset risks of erosion on steeper slopes. In general, Class 5 land is restricted to slopes of less than 18% for the more highly erodible soil types.

Class 5 land extends onto steeper slopes where gradational soil types are encountered. Most of this land occurs on moderately sloping hill country (Photo 9) with gradients ranging from 12 to 28%. Although these soils are less erodible than their coarser textured counterparts, careful management is still required on the steeper slopes to minimize risks from erosion (e). Any cultivation should be restricted to pasture renewal and undertaken during the drier summer months. These areas produce high yielding grazing land particularly with regular additions of fertiliser and lime to alleviate the strong acidity and low natural fertility common to soils.

Photo 8. Class 5ge land. In some locations at higher elevation, stony but fertile Brown Ferrosols occur on dolerite. These soils are ideally suited to fruit production (Kaoota, GR. E515400 N5237500).

Photo 9. Rolling hills of Class 5e land. Structured Permian soils produce good pastures on steeper slopes (Cradoc, GR. E506000 N5226700). Forested Class 6 and 7 land appears in the background.

Areas carrying the more freely draining soils, and with slopes less than 12%, are relatively small and comprise Class 4 inclusions. Where areas are more extensive, such as near Cygnet, limitations of mapping scale have led to identification of Class 4 + 5 land. Inclusions of Class 6 land may also occur on the steeper landforms where slopes locally exceed 28%.

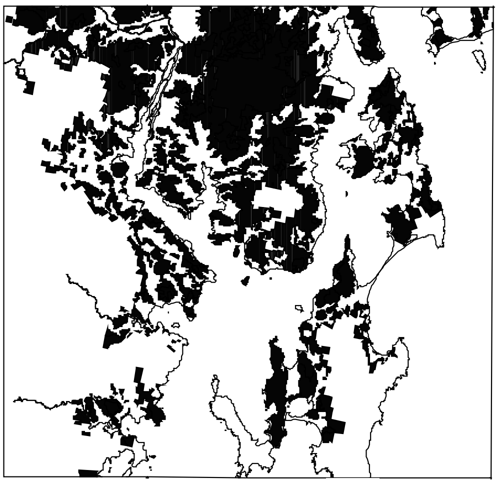
Class 5 Land on Aeolian Sands

Class 5 land occurs on gentle slopes less than 12% wherever wind blown sand deposits overlie basement lithologies, such as Triassic sandstone or Tertiary sediments. These areas are most extensive on South Arm and along the central to southern portion of north Bruny Island. Smaller areas occasionally occur in coastal areas, such as near Esperance Point, or west from Dover. The main soil type in most places is an Aeric or Semi-Aquic Podosol. These are coarse textured soils, which are nutrient poor and drought prone in summer months.

The main capability limitation is related to the poor physical and chemical properties of soils (s) which support relatively poor pastures. In addition there is a high risk from wind erosion (a) as there is little or no soil structure or clay content to help maintain soil cohesion. Most cohesion is provided by plant roots, or occasionally high organic matter contents. Pasture renewal should be restricted to aerial seeding or direct drilling techniques.

6.5 CLASS 6 LAND

Class 6	59 030ha
Class 5+6	1 718ha
Class 6+5	575ha
Class 6+7	394ha
Class 7+6	86ha



Class 6 land is the most extensive capability class and covers relatively large areas across the D'Entrecasteaux survey area. It identifies all marginal agricultural land. The dominant physical limitations, which severely restrict agricultural activities include excessive stoniness (g), soil wetness (w), extremely poor soil conditions (s) and steep slopes with high erosion risk (e). Most areas of Class 6 land remain under native vegetation although some areas support relatively poor improved pastures.

Class 6 Land on Quaternary Alluvium and Gravel Deposits

Small extents of Class 6 land occur on low-lying alluvial flats along the Huon River between Huonville and Cradoc. Class 6 land is also found on valley flats to the west and southwest of Strathblane. These areas carry very poor pastures and lie wet for most of the year. Thus, prolonged periods of soil saturation (w) due to high but fluctuating water tables is the main limitation restricting agricultural use of these areas. Where drainage has been installed, it appears to have had little success in improving pasture condition.

Class 6 is also the main class of land associated with higher dissected terraces underlain by siliceous gravel deposits. Here limiting factors are the high gravel and stone content (g) close to the ground surface, which create a barrier to root development (l). Most extensive areas of this land occur near Randalls Bay and Gourlays Bay, either side of Port Cygnet. Smaller areas can be found along the Huon River to the west of Huonville.

Class 6 Land on Jurassic Dolerite

Class 6 land is extensive across the survey area in regions underlain by Jurassic dolerite rocks. It is largely confined to the steeper slopes in inland locations where a combination of high stone content (g) and erosion risk (e) are the main limitations severely restricting use of this land. Class 6 land can extend onto gentle slopes if stone contents remain high. Most areas remain under native forest cover. Attempts have been made to remove surface stones during pasture establishment in areas of more gentle terrain on Bruny Island. Often, high surface stone contents are still visible in areas bordering forested hillslopes. Most stones are between 200-600mm in diameter and well rounded through weathering processes (exfoliation). In general, profile stone contents were in the region of 50-70%, with increasing levels present along ridgelines and on steep slopes. Any attempts at cultivation generally bring these stones to the surface and this can result in reduced net pasture cover. Inclusions of Class 7 land are common in places where stone cover locally exceeds 90% (Photo 12). These areas are invariably forested with sparse understorey vegetation. Similarly inclusions of Class 5 land, of generally not more than a few hectares, may occur within Class 6 land as patches where stone contents are low and soils deeper.

A high risk of soil erosion is the main limitation restricting land use on the steeper areas of Class 6 land. These areas require a high level of conservation management and are only marginally suited to grazing activities. They should retain their forest cover to help protect soils and are therefore more suited to well managed forestry. As most areas are currently protected by forest, active erosion processes are rarely seen. However, it is not unusual to see surface compaction and sheetwash of topsoils where ground had been laid bare by stock trampling along forest margins.

Slope limits for Class 6 land limited by erosion vary somewhat because some soils are more erosion prone than others. Brown Sodosols for example are highly erodible and Class 6 land extends onto gentler slopes as low as 18%. Removal of forest from these slopes will lead to increased overland flow and could result in the development of rill and gully erosion. Where soils are heavier textured (eg. Brown Kurosols intergrading to Brown Dermosols) there is generally less potential for erosion and Class 6 land is confined to steeper slopes of 28 to 56%. Similarly, clay textured soils with strongly developed soil structure (Brown Dermosols and Brown Ferrosols) have low erodibility and a high risk of erosion is only recognised on the very steep hillslopes above 56% gradient.

Class 6 Land on Triassic Sandstone

Class 6 land on Triassic sandstone is largely confined to the steeper hillslopes where erosion risk (e) is the major limitation affecting agricultural versatility. This class of land is common near Blackmans Bay and on hillslopes southeast of Snug and foothills of the Snug Tiers. Class 6 land can also be found on hillslopes to the southwest of Middleton near Mt Grosse and across to Coulsons Hill, from Pelverata to Upper Woodstock, and on hillslopes to the west of the Huon River such as near Police Point. Most areas of Class 6 land currently remain under native vegetation, although towards the southwest some areas are clear-felled for the forest industry.

As with Class 6 land on dolerite, slope limits for Class 6 land on sandstone vary depending on the erodibility of soils, and this in turn relates to the surface texture and degree of structural development within soils. In general, the coarser textured and more dispersive soil types require a higher level of conservation management for the same slope, when compared with less erodible soils. Progressively coarser textured soils have weaker soil structure and cohesion, and have less ability to withstand vegetation and soil disturbance before eroding. This is reflected in the lower slope limits for the different areas of Class 6 land occurring on Triassic sandstones, which are 12% for coarse textured Podosols, 18% for Brown Kurosols and Brown Sodosols, and 28% for the more gradational, heavier textured soil types (Brown Kandosols). The slope limits to some degree also reflect differences in fertility and resistance to drought.

Coarse textured soils often carry very poor pastures due to low natural fertility and poor soil moisture retention. Consequently these areas require a higher level of management in order to avoid soil degradation.

Class 6 land is occasionally associated with very shallow depths of soil (l) overlying sandstone. This severely limits soil moisture availability and rooting depths for plants. These areas are not always confined to steep slopes and may occur along the crest of dissected benches. For example, shallow soils consisting of 30cm of sandy surface horizons, overlie impenetrable “coffee-rock” or bedrock on gentle hillslopes to the east of Blackmans Bay and on slopes south of Margate. These are extremely drought prone soils supporting scrubland or poor pastures dominated by bracken fern. Similarly, shallow sandy soils are typical of steep dissected hillslopes, such as those bordering the Huon River near Police Point. Here, inclusions of Class 7 land also occur due to localised areas of bare rock (r) and very steep slopes of over 56% gradient. Inclusions of Class 5 land can obviously occur where slopes are locally less than the lower slope limits for Class 6 land, and these commonly represent broader ridge crests.

Some areas of Class 6 land is associated with peat swamps towards the southwest of the survey area near Southport Lagoon (Photo 10). Here, the strongly acid peat soils and lack of topographic runoff on flats support swamp vegetation dominated by button grass.

Photo 10. Class 6ws land. Coastal button grass plains carry acid nutrient poor peat soils which are marginally suited to grazing (Southport, GR. E493300 N5184100).

Photo 11. Class 6sl land (background) is often associated with Permian rock types producing extremely hardsetting, nutrient poor, gravelly soils. These areas carry very poor pastures. Class 5eg land (forground) is more suited to development for grazing athough some areas can be extremely stony (Bruny Island, GR. E5227500 N5226600).

The very poor soil conditions (s) severely restrict any grazing activities and prolonged periods of soil wetness (w) restrict access by vehicles as well as stock. These areas are best suited to conservation reserves.

Class 6 Land on Permian Mudstone

Class 6 land on Permian mudstones can cover locally extensive areas across most of the D'Entrecasteaux region. It is largely confined to mid to upper slope positions with slope gradients exceeding 28%. The dominant limitation is a very high erosion risk (e) which restricts potential land use to marginal grazing or forestry. Examples of this land type include Collins Spring Hill on South Arm, steep hillslopes from Allens Rivulet to Farwell Hill and along the eastern margin of the Snug Tiers. It also includes similarly steep slopes running from the western slopes of Woodbridge hill to Port Cygnet, and locally steep slopes in the area about, and to the west of, Cygnet township itself. Extensive areas of Class 6 land may also found either side of the Huon River to the west of Huonville. Most areas carry native forest, although some areas on Bruny Island have been recently developed for grazing.

As with other rock types, slope limits for Class 6 land on Permian sediments depend on soil type. Soils with strong texture contrasts, such as Podosols or others with coarse, massive sandy surface horizons (Kurosols), require a very high level of management to avoid soil erosion and degradation. Class 6 land in this instance extends onto gentler slopes of 18% or more. In contrast, the finer textured Brown Kandosols generally have some degree of structural development in surface horizons (albeit weak in many cases), and are less erosion prone, only requiring a similarly high level of conservation management on slopes above 28%. The main erosion process is considered to be surface wash, although tunnel and gully erosion is often evident where concentration of overland flow occurs. Some shallow soil slips may occur on very steep slopes if cleared of forest cover. Inclusions of Class 7 land are present wherever erosion risks are too high to support any form of agricultural use. These are typically steeply incised hillslopes with slopes exceeding 56%.

Some areas of Class 6 land carry very poor pasture cover (Photo 11) due to very poor soil conditions (s). This results from the very low natural fertility and very poor physical properties of some soils, which have gravelly and massive hardsetting surface horizons (Grey Kurosols). In places, bleached subsurface A2 horizons can set into an impenetrable concrete-like mass during dry periods. Most root development for smaller plants is confined to the shallow topsoil and consequently a depth limitation (l) is recognised in these soils. Heavy fertiliser applications can help to alleviate the poor nutrient status and acidity in these soils, but is unlikely to be economic in most situations. Most areas of this class of land remain forested. Examples of this land class include hillslopes near Turners Hill on south Bruny Island, and coastal footslopes southeast of Geeveston from White Bluff to Killara Bay.

Class 6 Land on Aeolian Sands

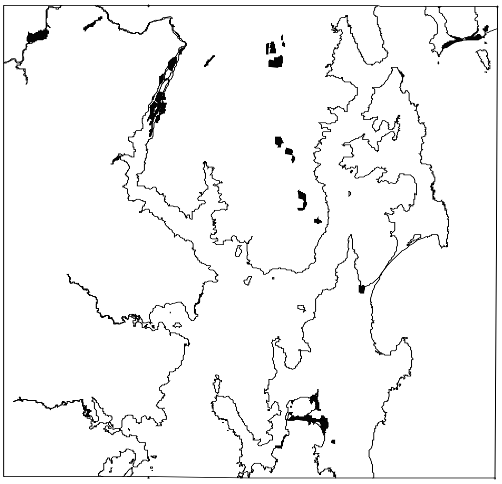
Recent aeolian sands carry soils with little profile development (Rudosols). The general lack of cohesion in surface horizons composed mainly of sand grains makes these soils particularly prone to wind erosion (a) if disturbed in any way. Since there is a very high risk from erosion, any agricultural use should ensure minimal impact on topsoils.

Pasture renewal and fertilising should be restricted to aerial application only. As this Class of land occurs in areas of relatively low rainfall, it is also particularly drought prone. This can further exacerbate the potential for erosion unless stocking rates are kept to an absolute minimum during summer months. The most extensive areas of this land occur on gently sloping grassed dunes on South Arm Neck.

Class 6 land also occupies small areas where sand has been deflated from coastal sites or from ancient riverbeds and blown onto surrounding hills. Most extensive areas of this land occur on south Bruny Island in the region of Cloudy Bay. The main soil types in this instance are Aeric Podosols on slopes, or Semi-Aquic or Aquic Podosols along depressions and valley flats. These are characterised by a thick bleached subsurface horizon consisting of almost pure quartz sand grains. In contrast to recent aeolian sand deposits, surface horizons can contain significant organic matter contents, and this can improve moisture retention and impart a somewhat less risk of erosion. Consequently, Class 6 land is restricted to moderate slopes with gradients from 12 to 28%. On these slopes, overgrazing and stock "bathing" can cause sand blowouts. Class 7 inclusions occur where slope gradients locally exceed 28%.

6.6 CLASS 7 LAND

Class 7	1 961ha
Class 6+7	394ha
Class 7+6	86ha



Class 7 land represents areas unable to support agricultural activities on a sustainable basis. These are usually either very steep slopes with extremely erodible soils (e), patches of ground with excessive stone content (g), very wet swamps with high ground water tables, or mountain tops which have a cold and windy exposure (c). Although some Class 7 land can be found within the survey area at elevations above 800m, most exists as small areas in coastal localities. These areas are usually complexed with Class 6 land owing to limitations of map scale.

Class 7 Land on Jurassic dolerite

Areas of Class 7 land on dolerite are found at high elevation along mountain tops and plateaus or in some coastal areas, generally as inclusions within Class 6 land (Photo 12). Examples include the Snug Tiers and associated mountains in that area, coastal cliffs predominantly on Bruny Island (see Photo 2), and forested low coastal hills south of Southport.

Photo 12. An almost complete cover of stones illustrates Class 7g land. Due to their small individual extent, these patches of ground are often mapped in association with Class 6 land (Southport, GR. E497300 N5187800).

Photo 13. Class 7w land. Very high water tables in coastal alluvial swamps makes grazing impracticable (Cradoc, GR. E501700 N5228400).

In most cases the physical limitations prohibiting agricultural activities are either an excessive ground cover (visually > 70-90%) of stones and small boulders (g) or large areas of bare rock (r) associated with very steep coastal cliffs.

Class 7 Land on Quaternary alluvium

Small areas of Class 7 land can be found on alluvial sediments in coastal bays and on low lying flats adjacent to the Huon River (Photo 13). These are essentially wetlands supporting dense swamp vegetation dominated by rushes. Water is at or near the ground surface for most of the year and consequently the main limitation is one of wetness (w).

Class 7 Land on Triassic sandstone

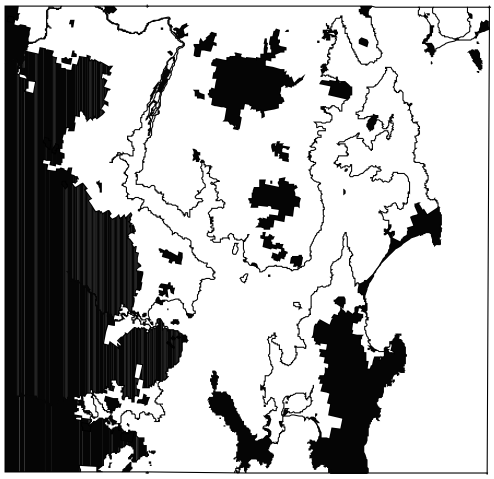
Occasionally, fluvial dissection of sandstone plateau has produced rocky bluffs towards the top of steep slopes in some coastal localities (eg. Police Point north of Dover). These represent small areas of Class 7 land where the main limitation is bare rock (r). An erosion limitation is also recognised as slopes are often above 56%. These areas are not been mapped separately and occur as inclusions within Class 6 land.

Class 7 Land on aeolian sands

Class 7 land on aeolian sand is associated with coastal dune systems where very fragile loose sandy soils are susceptible to degradation by wind erosion (a) if vegetation disturbance occurs. Dunes are stabilised predominantly by coastal vegetation communities. The most extensive dune systems occur along South Arm Neck, along the Neck on central Bruny Island and adjacent to Cloudy Beaches on southern Bruny Island. A general erosion limitation (e) is also recognised on steeper hillslopes above 28% slope where the more organic enriched Aeric Podosols are found. The dense root mat of the native vegetation provides the only cohesion in what would otherwise be loose sands. An example of Class 7e land occurs on the southeast facing slopes of Collins Springs Hill on South Arm.

6.7 EXCLUSION AREAS

Exclusion areas 92 656ha



The D'Entrecasteaux survey area contains areas of State Forest and other reserves, which are not included in the land capability classification survey. Many of these areas represent high land or rugged hills and include most of the Snug Tiers, the greater proportion of land to the west of Geeveston and Dover, and mountainous land on southern Bruny Island. These areas, together with major urban areas, Conservation Areas, State Recreation and Protected Areas, Hydro Electric Commission areas and Commonwealth administered areas are collectively termed Exclusion areas and do not form part of the area surveyed. These areas appear as white with the letter E on the accompanying Land Capability map.

The boundaries for these areas have been supplied by Forestry Tasmania and some discrepancies have been identified in comparison to the published 1:100 000 scale Land Tenure maps. In addition, arbitrary boundaries have been defined by the survey team and represent areas excluded from agricultural activity on the basis of current land use (usually urban). These boundaries are not intended to represent the boundaries of individual land titles or local council planning schemes and do not purport to identify exact cadastral locations.

6.8 SUMMARY TABLES

Table 3 summarises the major land capability map units and their characteristics. It does not represent an exhaustive list of all possible units, but instead identifies the most common groupings present within each land capability class. The table attempts to draw upon links between land capability, landforms and geology identified during mapping, and is therefore useful as a guide to the nature of map units identified within the survey area. It also provides an indication of agricultural versatility for each unit in relation to broad-acre cropping and stock grazing. A general indication is given of the main land management practices required to sustain this versatility.

Land Capability Class	Land Characteristics						Land Management Issues		
	Geology	Slope range	Topography and elevation	Erosion type and potential severity	Climatic limitation	Principal soil	Main limitations to agricultural use	Main land management requirements (under cultivation)	Agricultural versatility
3	Tertiary basalt	0-12%	crests of low hills <120m	minor sheet and rill	low rainfall <850mm	Red Ferrosol Brown Ferrosol	rockiness (g), soil depth (l), low rainfall (p)	stone picking, moderate soil conservation	restricted range of crops, very good grazing
3	Quaternary alluvium	0-5%	alluvial plains <30m	very minor sheet	low rainfall <850mm	Brown Dermosol Brown Kandosol	low rainfall (p)	minor soil conservation	restricted range of crops, very good grazing
4	Recent alluvium	0-5%	narrow flood plains <120m	very minor sheet and minor wind	moderate frost, minor flood risk	Brown Kandosol Red Kandosol	frosts (c) wetness (w), soil structure (s)	soil drainage, moderate soil conservation	severely restricted range of crops, good grazing
4	Quaternary gravel deposits	0-12%	dissected terrace remnants <40m	moderate sheet and wind	minor frost	Brown Kurosol	soil structure and fertility (s), erosion (e), some stones (g)	moderate soil conservation, erosion control	severely restricted range of crops, good grazing, horticulture
4	Tertiary basalt	0-18%	slopes and footslopes of risers <120m	minor sheet and rill	-	Black Dermosol	wetness (w) and permeability (d), erosion (e)	minor soil conservation, soil drainage	severely restricted range of crops, good grazing
4	Cretaceous syenite	0-18%	ridge crests, coastal footslopes <260m	minor sheet and rill	minor frost, wind exposure	Brown Dermosol	erosion (e) stoniness (g)	erosion control, moderate soil conservation, stone picking	severely restricted range of crops, good grazing
4	Jurassic dolerite	0-18% (>12%)*	north facing footslopes of coastal regions <100m	minor sheet and rill	low rainfall (to the east), frosts (to the south)	Brown Dermosol	stoniness (g), erosion (e) climate (c)	minor soil conservation, erosion control	severely restricted range of crops, good grazing
4	Jurassic dolerite	0-12%	colluvial footslopes and valley floors <150m	moderate sheet, rill and wind	low rainfall, minor frost	Brown Sodosol Brown Kurosol	erosion (e), permeability (d), stoniness (g), soil structure (s)	erosion control, moderate soil conservation, stone picking	severely restricted range of crops, good grazing
4	Jurassic dolerite	0-18% (>12%)*	ridge crests and upperslope of low hills <240m	minor sheet and rill	moderate frost risk, wind exposure	Brown Ferrosol Brown Chromosol Brown Dermosol	climate (c), stoniness (g), wetness (w)	stone picking, erosion control, moderate soil conservation	severely restricted range of crops, good grazing, horticulture
4	Triassic sandstone	5-12%	colluvial footslopes, northeast aspect <100m	moderate sheet, rill and wind	wet spring months	Brown Sodosol Brown Kurosol	permeability (d) erosion (e) soil structure (s)	erosion control, moderate soil conservation	severely restricted range of crops, good grazing
4	Triassic sandstone	12-18%	mid-upper slopes of low hills < 150m	minor sheet and rill, and moderate soil creep	moderate frost, wet spring months	Brown Kandosol	erosion (e) climate (c)	erosion control	severely restricted range of crops, good grazing
4	Permian mudstone	0-12%	gentle slopes and crests of low hills <100m	minor sheet	moderate frost, wet spring months	Brown Kandosol Brown Dermosol	permeability (d), fertility and structure (s)	moderate soil conservation, drainage	severely restricted range of crops, good grazing, horticulture

Table 3: Characteristics of Class 3 and 4 Land identified in the D'Entrecasteaux survey area.

Land Capability Class	Land Characteristics						Land Management Issues		
	Geology	Slope range	Topography and elevation	Erosion type and potential severity	Climatic limitation	Principal soil	Main limitations to agricultural use	Main land management requirements (under cultivation)	Agricultural versatility
5	Tertiary basalt	18-56%	mid to upper slopes and ridge crests <500mm	minor sheet and creep, moderate tunnel	low rainfall	Brown Ferrosol Brown Dermosol	erosion (e), stoniness (g)	erosion control, moderate soil conservation	grazing, fodder crops
5	Cretaceous syenite	0-28%	mid to upper slopes and ridge crests <500m	moderate sheet	moderate frost	Brown Dermosol	erosion (e), stoniness (g)	erosion control, moderate soil conservation	grazing, fodder crops
5	Jurassic dolerite	0-28% (>18%)*	lower to mid slopes of hills <200m	minor to moderate sheet	low rainfall	Brown Dermosol Brown Kandosol Brown Chromosol	stoniness (g), erosion (e), permeability (d)	moderate soil conservation, erosion control	grazing, fodder crops, horticulture
5	Jurassic dolerite	0-18% (>12%)*	valley flats to slopes of hills <500m	moderate sheet and gully, major wind	low rainfall moderate frost, wet spring	Brown Sodosol Brown Kurosol	stoniness (g), erosion (e), wetness (w)	erosion control, major soil conservation, stone picking	grazing, fodder crops, horticulture
5	Jurassic dolerite	12-56% (>18%)	mid to upper slopes of hills <550m	minor to moderate sheet and creep	high frost, wet spring	Brown Ferrosol Black Dermosol	stoniness (g), erosion (e)	stone picking, erosion control, moderate soil conservation	grazing, fodder crops, horticulture
5	Quaternary alluvium & gravel beds	0-12%	terrace flats and back slopes <120m	minor sheet, moderate wind	high frost wet spring	Brown Kandosol Brown Kurosol	wetness (w), stoniness (g), rooting depth (l)	soil drainage, moderate soil conservation	grazing, fodder crops, horticulture
5	Quaternary alluvium	0-3%	low lying areas and depressions <30m	very minor sheet	low rainfall	Black Vertosol	salinity (k) wetness (w)	salt tolerant pasture species, surface drains	grazing, pasture improvement
5	Tertiary sediments	0-12%	raised terraces <40m	major wind, moderate sheet	high frost, wet spring	Yellow/Grey Kurosol Grey Kandosol Semi-Aquic Podosol	wetness (w) thixotropic A2 (s) wind erosion (a)	major soil conservation and erosion control	grazing, horticulture
5	Tertiary laterites	0-12%	knolls along valley flats <40m	major wind	low rainfall	Red Chromosol Red Ferrosol	wind erosion (a), gravels (g) rooting depth (l)	major erosion control, moderate soil conservation	grazing, pasture improvement, fodder crops
5	Triassic sandstone	0-12% or 0-18%	lower to mid slopes and benches of hills <200m	major wind, sheet and tunnel	low rainfall,	Aeric/Aquic Podosol Brown Kurosol Brown Sodosol	wind erosion (a), wetness (w) coarse texture (s)	major erosion control and soil conservation	grazing, pasture improvement, horticulture
5	Triassic sandstone	0-28% (>12%)*	lower to upper slopes and benches of hills <550	moderate sheet and minor slumping	moderate frost, wet spring	Brown Kandosol Brown Kurosol	erosion (e), wetness (w)	moderate erosion control, major soil conservation	grazing, pasture improvement, horticulture
5	Permian mudstone	0-18%	lower - mid slopes and ridge crests of hills <300m	major wind and tunnel	moderate frost, wet spring	Grey Kurosol Yellow Kurosol Aeric Podosol	erosion (e), thixotropic A2 (s), wetness (w)	major soil conservation and erosion control	grazing, pasture improvement, horticulture
5	Permian mudstone	0-28% (>12%)*	hillslopes and rolling hills and benches <450m	moderate sheet and tunnel, minor soil slip	major frost, wet spring	Brown Kandosol Grey Kandosol	erosion (e) permeability (d) fertility (s)	major soil conservation and erosion control	grazing, pasture improvement, horticulture
5	Aeolian sand	0-12%	lowerslopes and valley floors <100m	major wind	low rainfall	Aeric Podosol Semi-Aquic Podosol Chernic Tenosol	fertility (s), wind erosion (a), wetness (w)	major soil conservation and erosion control	grazing, pasture improvement

* For erosion limitation only

Table 3: Characteristics of Class 5 Land identified in the D'Entrecasteaux survey area.

Land Capability Class	Land Characteristics						Land Management Issues		
	Geology	**Slope range**	**Topography and elevation**	**Erosion type and potential severity**	**Climatic limitation**	**Principal soil**	**Main limitations to agricultural use**	**Main land management requirements (under cultivation)**	**Agricultural versatility**
6	Jurassic dolerite	all (>28%)*	rolling to steep hills <400m	major creep and sheet	minor frost wind exposure	Brown Dermosol Brown Kandosol Brown Chromosol	stoniness (g) erosion (e)	no cultivation erosion control	limited grazing, silviculture
6	Jurassic dolerite	<56% (>18%)*	rolling to steep hills <500m	severe sheet, rill and gully	moderate frost wind exposure	Brown Sodosol Brown Kurosol	erosion (e) stoniness (g)	no cultivation erosion control	limited grazing, silviculture
6	Jurassic dolerite	all (<56%)*	steep hills <800m	major creep and sheet	very high frost, wind exposure	Brown Ferrosol Black Dermosol	stoniness (g), erosion (e), temperature (t)	no cultivation erosion control	limited grazing, silviculture
6	Quaternary alluvium	level	coastal flats	-	minor frost major flood	Redoxic Hydrosol	wetness (w)	no cultivation	limited grazing
6	Quaternary gravel beds (siliceous)	0-56%	raised terraces and steep risers	severe sheet moderate wind	moderate frost	Brown Kurosol Leptic Rudosol	stoniness (g) rooting depth (l)	no cultivation erosion control	limited grazing, silviculture
6	Triassic sandstone	>12% or >18%	slopes of hills <500m	major wind, severe sheet and tunnel	wind exposure moderate frost low rainfall	Aeric/Aquic Podosol Brown Kurosol Brown Sodosol	erosion (e) rooting depth (l) rock outcrop (r)	no cultivation erosion control	limited grazing, silviculture
6	Triassic sandstone	>28%	slopes of steep hills and incised benches <700m	major sheet and creep, minor slumping	major frost, wind exposure	Brown Kandosol Brown Kurosol	erosion (e) temperature (t)	no cultivation, erosion control	limited grazing, silviculture
6	Triassic sandstone	0-12%	coastal plains and inland valley flats	-	major frost high rainfall	Redoxic Hydrosol	wetness (w) fertility (s)	no cultivation	limited grazing, silviculture
6	Permian mudstone	0-56% (>18%)*	low to mid slopes and ridge crests of hills <450m	severe sheet, rill and tunnel	moderate wind moderate frost wet spring	Grey Kurosol Yellow Kurosol	erosion (e) rooting depth (l) fertility (s)	no cultivation, erosion control	limited grazing, silviculture
6	Permian mudstone	0-56% (>28%)*	low to mid slopes and benches of hills <450m	major sheet moderate soil slip minor slumping	high frost, wet spring	Brown Kandosol Brown Dermosol Grey Kandosol	erosion (e) fertility (s) wetness (w)	no cultivation, erosion control	limited grazing, silviculture
6	Recent aeolian sands	0-12%	footslopes and rounded dunes. <50m	severe wind	wind low rainfall	Arenic Rudosol	wind erosion (a),	no cultivation, erosion control	limited grazing
6	Quaternary aeolian sands	12-28%	lower-mid slopes of low hills <100m	major wind	wind low rainfall	Aeric Podosol	wind erosion (a), soil fertility(s)	no cultivation, erosion control	limited grazing

*For erosion limitation only

Table 3: Characteristics of Class 6 Land identified in the D'Entrecasteaux survey area.

Land Capability Class	Land Characteristics						Land Management Issues		
	Geology	Slope range	Topography and elevation	Erosion type and potential severity	Climatic limitation	Principal soil	Main limitations to agricultural use	Main land management requirements (under cultivation)	Agricultural versatility
7	Recent sand dunes	variable	coastal dunes <20m	severe wind	wind low rainfall	Arenic Rudosol	wind erosion (a), soil texture (s)	protection	unsuitable for agriculture
7	Quaternary aeolian sands	>28%	mid to upper slopes of coastal hills <100m	severe wind	wind low rainfall	Aeric Podosol	wind erosion (a)	protection	unsuitable for agriculture
7	Recent sediments	level	river and tidal flats <1m	very minor sheet	none	Extratidal Hydrosol	high water table (w), salinity (k)	protection	unsuitable for agriculture
7	Jurassic dolerite	variable	mountain tops and slopes. >500 m, steep coastal cliffs, coastal hills	minor rock fall on slopes, severe sheet	severe frost, strong winds	Brown Ferrosol, Brown Kurosol Clastic Rudosol	boulder fields (g) stoniness (g) rock outcrops (r) erosion (e)	protection	unsuitable for agriculture
7	Triassic sandstone	>56%	very steep slopes and cliffs	moderate rock fall, severe sheet	sever frost at high elevations	Brown Kurosol	rock outcrop (r) erosion (e)	protection	unsuitable for agriculture

Table 3 (cont): Characteristics of Class 7 Land identified in the D'Entrecasteaux survey area. Note: most Class 7 land occurs as inclusions within, or is complexed with Class 6 Land at the 1:100 000 scale of mapping.

GLOSSARY

Aggradation: The sequential accumulation of sediment in fluvial environments.

Alluvial deposits: Sediment transported by rivers and deposited on flood plains.

Basalt: Rock rich in base cations formed from the cooling and solidification of volcanic lava.

Clay: Soil particles of diameter less than 0.002mm.

Coarse fragments: Particles of diameter greater than 2mm which have not formed in soil profile.

Colluvial deposits: Weathered rocks and soil transported and redeposited by gravity, generally at the base of slopes or in hollows.

Complex: A map unit where two land classes are identified but cannot be separated at the scale of mapping. In a complex unit the proportion of the two land classes is between 50/50 and 60/40.

Chromosols: A soil order defined in the *Australian Soil Classification* (Isbell 1996) as having strong texture contrast, is not sodic in the upper B horizon and a pH in the upper B horizon greater than or equal to 5.5.

Degradation: Deterioration of a resource through inappropriate or uncontrolled management or use.

Dermosols: A soil order defined in the *Australian Soil Classification* (Isbell 1996) as having structured B-horizons and no strong texture contrast.

Dispersive Soils: Soils composed of aggregates which break down to primary particles as they absorb water. Dispersive soils are inherently unstable and easily eroded. In most cases, dispersive soils are sodic.

Dolerite: A medium grained, basic rock formed from the cooling and crystallisation of magma near the surface of the earth's crust.

Drainage: A description of local soil wetness conditions as defined in the *Australian Soil and Land Survey Field Handbook* (McDonald, et al. 1998). Drainage is controlled by landscape position, soil permeability, and the extent of impediments to water movement within the soil profile.

EC_e: Electrical conductivity of the saturation extract of soil. This is usually derived by multiplying the 1:5 soil:water mixture electrical conductivity by a constant that is a function of soil texture.

Ferrosols: A soil order defined in the *Australian Soil Classification* (Isbell 1996) as having a free iron content in the greater part of the B2 horizon greater than 5%.

Ferruginous gravel: Gravel which is composed dominantly of iron-rich materials; also known as ironstone or laterite gravel. It often forms within the soil profile.

Fine sand: Particles of diameters from 0.06 to 0.1mm. They are just visible with the naked eye and feel similar to coarse flour or table salt.

Glacio-marine: Refers to sediments that accumulated in marine environments offshore from glaciated landmasses.

Graben: Down faulted area of land generally forming a valley.

Horizons: Layers within a soil profile, which have morphological properties different from those above and below (Northcote 1979).

Horst: Elevated areas of land between grabens.

Hydrosols: A soil order defined in the *Australian Soil Classification* (Isbell 1996) other than Organosols, Podosols and Vertosols which is saturated for at least 2 to 3 months in most years.

Kandosols: A soil order defined in the *Australian Soil Classification* (Isbell 1996) as having no strong texture contrast and a weakly structured B-horizon which is not calcareous.

Kurosols: A soil order defined in the *Australian Soil Classification* (Isbell 1996) other than Hydrosols, as having strong texture contrast and a pH in the upper B-horizon less than 5.5.

Land Capability: The potential of the land to support a range of practices or uses without degradation. In this report only agricultural uses are considered. Land Capability considers only the physical attributes of the land.

Land Suitability: The potential of the land to support a defined land use. Land suitability usually considers the economic and cultural suitability of a land use in addition to the physical attributes of the land. A comparison of land suitability evaluations for a range of different uses can identify the most suitable use for a particular area.

Limitation: The physical factors or constraints, which affect the versatility of uses of a land unit. Dominant limitations determine land capability for long term agricultural use.

Moisture availability: A measure of the amount of moisture held in the soil which is available for plant uptake. It is defined as the difference between the field capacity and the wilting point of the soil.

Natural fertility: Nutrient status of the soil as determined by organic matter content, cation exchange capacity and the degree of base saturation.

Nutrient availability: The ability of a soil to retain and supply nutrients for plant growth. It is principally governed by the CEC, the organic matter content and the pH of the soil.

Organosols: A soil order defined in the *Australian Soil Classification* (Isbell 1996) as having profiles dominated by organic materials which is not inundated by tides.

Permeability: A description of the potential of a soil to transport water internally as defined in the *Australian Soil and Land Survey Field Handbook* (McDonald, et al. 1998).

Podosols: A soil order defined in the *Australian Soil Classification* (Isbell 1996) as having B-horizons dominated by the accumulation of compounds of organic matter and aluminium, with or without iron.

Profile: A vertical cross section of a soil extending from the surface down to the lower limit of soil development.

Rudosols: A soil order defined in the *Australian Soil Classification* (Isbell 1996) as having negligible pedological development.

Saline soil: Where the electrical conductivity of the saturation extract (Ec_e) of soil material indicates the presence of salts. The following approximate categories were used to indicate relative salinity levels in this report:

Low:	<2ds m^{-1}
Moderate:	2 - 8ds m^{-1}
High:	>8 ds m^{-1}

Scree: Accumulation of rocks and boulders at the foot of a cliff or steep slope, often with little vegetative cover.

Sedimentary rock: Rock formed from particles which have been transported, deposited and fused through cementing and/or compaction.

Siliceous: Pertaining to rocks or soils, which contain a high proportion of silicon rich minerals such as quartz.

Sodic soils: Soils with a proportion of the cation exchange capacity occupied by sodium ions of greater than 6%. With respect to land use, a soil is considered sodic when the sodium concentration reaches a level that affects soil structure.

Soil pH: A measure of the acidity or alkalinity in a soil. A pH of 7 denotes a neutral soil with a log scale of increasing alkalinity of pH 7 to 14, and a log scale of increasing acidity of pH 7 to 1.

Soil structure decline: The degradation of soil structure. Soil aggregates may be destroyed by excessive cultivation/harvesting or trampling by stock, leaving a compacted, massive or cloddy soil. Soils are particularly susceptible to structural decline when wet.

Sodosols: A soil order defined in the *Australian Soil Classification* (Isbell 1996) as having strong texture contrast, a sodic upper B horizon and a pH in the upper B horizon greater than or equal to 5.5.

Subsoil compaction: Potential for development of traffic compaction pan below the surface, usually 10 to 30cm deep. Pans restrict root growth into the subsoil. Yield response can be obtained on some soils by deep ripping to break the traffic pan.

Sustainable agriculture: The use of farming practices and systems which maintain or enhance economic viability of agricultural production; the natural resource base; and other ecosystems which are influenced by agricultural activities. There are five principles of sustainable agriculture.

1. Farm productivity is sustained or enhanced over the long term.

2. Adverse impacts on the natural resource base of agriculture and associated ecosystems are ameliorated, minimised or avoided.

3. Residues resulting from the use of chemicals in agriculture are minimised.

4. The net social benefit derived from agriculture is maximised.

5. Farm systems are sufficiently flexible to manage risks associated with the vagaries of climate and markets.

Syenite: An alkaline igneous rock dominated by large phenocrysts of alkali feldspars and containing little or no quartz.

Talus: Accumulation of clastic sediments at the foot of a cliff or steep slope.

Tenosols: A soil order defined in the *Australian Soil Classification* (Isbell 1996) as having only weak pedological development.

Texture contrast soils: Soils in which the boundary between two horizons (usually the A and B horizons) is smaller than 50mm (clear, abrupt or sharp), **and**
the clay content in the upper horizon is less than 20% and the clay content in the lower horizon double that of the upper horizon (In this case the clay content must be greater than 20% in the upper B horizon), **or**
the clay content in the lower horizon is 20% higher than the upper horizon where the upper horizon is between 20 and 35% clay.

Thixotropic: Tendency of soil material to liquefy under vibration. Relates to soils with low strength in a moist state and characterised by "spewy" surface horizons.

Vertosols: A soil order defined in the *Australian Soil Classification* (Isbell 1996) as having shrink swell properties with strong cracking when dry, slickensides and/or lenticular structure, and a clay field texture of more than 35% throughout.

Water erosion hazard: The potential for sheet, rill, tunnel or gully erosion to occur on a land surface. The land surface is most prone to water erosion when cultivated and/or when little or no vegetative cover is present. Land management to suit site conditions can minimise the severity, and often prevent most occurrences of water erosion. The degree of hazard depends on soil erodibility, amount of ground cover, slope gradient and length, and rainfall (intensity and amount).

Wind erosion hazard: The potential for a land surface to erode by the action of wind. The land surface is most prone to wind erosion when cultivated and/or when little or no vegetative cover is present. Appropriate land management including maintaining good ground cover will protect the soil surface from wind erosion. The degree of hazard depends on soil erodibility (especially particle size and soil structure), amount of ground cover, the timing and degree of exposure to the wind and wind speed. Loose, structureless soils are most at risk.

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APPENDICES

APPENDIX A Example of a completed Land Capability site description.

APPENDIX A. Example of a completed Land Capability site description.

LAND CAPABILITY DESCRIPTION CARD

Project code	Site No.	Map Name	Sheet No.	Easting	Northing	Describer	Date
DENT	36	BARNES BAY	5222	529050	5222150	RDER	1 - 2 - 2000

Rainfall	TS	TP	SP	Permiability	Drainage	Elevation	Australian Soil Class	LCC	Geology	Geology map
680 mm		CORE	X	1 2 **(3)** 4	1 2 **(3)** 4 5	65 m	450 AB FN EX	5e	Jd	88

Element slope class(p.12)		
LE	Level	(<1%)
VG	Very Gentle	(1-3%)
GE	Gentle	(3-10%)
(MO)	Moderate	(10-32%)
ST	Steep	(32-56%)
VS	Very steep	(56-100%)
PR	Precipitous	(100-300%)
CL	Cliffed	(>300%)

Element Morphological Type	
C	Crest
H	Hillock
R	Ridge
S	Simple slope
U	Upper slope
(M)	Mid slope
L	Lower slope
F	Flat
V	Open depression
D	Closed depression

Mode of Geomorphic activity	
ER	Eroded
(EA)	Eroded or aggraded
AG	Aggraded

Element Type	
BKP	Backplain
BAR	Bar
BRI	Beach ridge
BEN	Bench
BOU	Blow-out
DDE	Drainage depression
DUN	Dune
EST	Estuary
FAN	Fan
FOO	Footslope
FOR	Foredune
GUL	Gully
HCR	Hillcrest
(HSL)	Hillslope
LAG	Lagoon
LDS	Landslide
LEV	Levee
LUN	Lunette
MOU	Mound
PLA	Plain
SCA	Scarp
STC	Stream channel
SWP	Swamp
TEP	Terrace plain
TEF	Terrace flat
TDF	Tidal flat
VLF	Valley flat
	Or code (page 24)

Pattern Type	
ALF	Alluvial fan
ALP	Alluvial plain
BEA	Beach ridge plain
COL	Covered plain
DEL	Delta
DUN	Dunefield
FLO	Flood plain
HIL	Hills
LAC	Lacustrine plain
(LOW)	Low hills
MEA	Meander plain
PNP	Peneplain
PLT	Plateau
PLA	Plain
SAN	Sand Plain
TEL	Terraced land
	Or code (page 48)

15	Slope angle (eg 10%)
270	Aspect (eg 010)

Surface Condition When Dry	
G	Cracking
M	Self-mulching
L	Loose
S	Soft
(F)	Firm
H	Hard setting
C	surface crust
X	Surface flake

Degree Of Erosion		
X	X	Not apparent
(0)	0	None
1	1	Minor
2	2	Moderate
3	3	Severe
4	4	Very severe

State of Erosion		
A	A	Active
S	S	Stabilized
P	P	Partly stabilized

Type of Erosion		
W	W	Wind
S	S	Sheet
R	R	Rill
G	G	Gully
C	C	Scald
T	T	Tunnel
B	B	Streambank
V	V	Wave
M	M	Mass movement

Inundation Frequency (p. 96)	
(0)	No Inundation
1	< once per 100 years
2	Once in 50-100 years
3	Once in 10-50 years
4	Once in 1-10 years
5	> once per year

Duration of Inundation	
1	< 1 day
2	1-20 days
3	20-120 days
4	>120 days

Coarse Fragments — Abundance of Coarse Frag.		
0	None	0%
(1)	Very few	(<2%)
2	Few	(2-10%)
3	Common	(10-20%)
4	Many	(20-50%)
5	Abundant	(50-90%)
6	Very abundant	(>90%)

Size of Coarse Fragments		
1	Fine gravel	(2-6mm)
2	Med. gravel	(6-20mm)
3	Cos. gravel	(20-60mm)
4	Cobbles	(60-200mm)
(5)	Stoned	(200-600mm)
6	Boulders	(600mm-2m)
7	Large boulders	(>2m)

Rock Outcrops		
(0)	No rock outcrop	
1	V slightly rocky	(<2%)
2	Slightly rockey	(2-10%)
3	Rocky	(10-20%)
4	V rockey	(20-50%)
5	Rockland	(>50%)
	Lithology code (p 160)	

Notes

Substrate: Weathered dolerite and slope deposits. Sodic subsoil.

Profile: Podzolic on dolerite, sandy phase.

Location: 800 m South of Lennon Road, Bruny Island on property "Murrayfield"

General: Light surface textures indicate potential for wind erosion if disturbed.

Horizon	Lower depth	Moist colour: Hue	V	C	Primary mottles: Abundance	Size	Contrast	Field Texture: Qualifier	Code	Primary structure: Grade	Size	Type	Plus/Parting to 2^ND stru: Grade	Size	Type	Coarse fragments: Abundance	Size	Field tests: pH	EC
A1	10	10YR	3	2	**(0)** 1 2 3 4	1 2 3 4			LS	V **(G)** W M S	1 2 3 4 5 6 7	PL PR CO AB SB PO LE GR CA				2	5	6.1	0
A2	18	10YR	5	2	**(0)** 1 2 3 4	1 2 3 4			S	V **(G)** W M S	1 2 3 4 5 6 7	PL PR CO AB SB PO LE GR CA				–		6.2	0
B1	23	10YR	4	3	0 1 2 3 4	1 2 3 4	F		mc	**(V)** G W M S	1 2 3 4 5 6 7	PL PR CO AB SB PO LE GR CA				–		5.9	0.1
B2	80+	10YR	4	3	0 1 2 3 4	1 2 3 4	F		mc	V G **(W)** M S	1 **(2)** 3 4 5 6 7	PL PR CO AB **(SB)** PO LE GR CA				–		5.7	0.1
					0 1 2 3 4	1 2 3 4				V G W M S	1 2 3 4 5 6 7	PL PR CO AB SB PO LE GR CA							
					0 1 2 3 4	1 2 3 4				V G W M S	1 2 3 4 5 6 7	PL PR CO AB SB PO LE GR CA							