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NSW Agriculture

Agricultural Land Classification

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Contents

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Cover: Agricultural land classes 2,3,4 and 5, Scone. The photo depicts a gradual change from class 2 land (cultivated and cropped river flats in the foreground) to class 3, class 4 (lower slopes) and class 5 (hills in the background). Photographer: John Hindle.

Inset: Class 5 land, Dorrigo, north coast NSW. The steepness of the slope and high erosion hazard are some of the severe constraints preventing agricultural land use.

Photos: Except for the cover photograph (see above), all photographs are from NSW Agriculture's Image Library. Photographers were Graham Johnson, John Gasparotto and Col Beg.

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1. Introduction

Land used for agriculture is often taken for granted. The popular belief is that Australia possesses unlimited resources, including land for agriculture.

Yet good quality agricultural land is a limited resource, and is under threat from a variety of sources. Urbanisation and land degradation alienate and deplete agricultural land resources. The reduced availability of lands highly suited to agricultural production reduces the sustainability of existing agricultural systems and encourages the use of more marginal lands for agriculture.

A knowledge of the relative suitability of land for agriculture will help with the development of strategic plans, which protect land highly suited to agriculture and identify land more suited to non-agricultural activities.

NSW Agriculture produces agricultural land classification maps, on a local government area basis, which rank land on its suitability for agricultural production. The maps are produced by evaluating biophysical, social and economic factors that influence the use of land for agriculture.

This publication describes NSW Agriculture's agricultural land classification system. It aims to help natural resource planners and managers in their use and interpretation of agricultural land classification maps. The publication is based on, and updates, information contained in *Rural Land Evaluation: A manual for conducting a rural land evaluation exercise at the local planning level,* revised edition (RLEM) (Department of Planning, 1988). It should be noted that the criteria on which the land classes are based remain unchanged from the RLEM.

2. Techniques for evaluating rural land

There are two techniques currently used to evaluate rural land in NSW: rural land capability and agricultural land classification. Although both systems are used to evaluate agricultural land, a direct comparison is difficult. Each system has a different aim and considers the various factors that influence land use in a different way.

A specific comparison between the systems was never intended and should not be attempted, because each system was established for a different purpose.

2.1 Rural land capability mapping

This eight class system, used by the Department of Land and Water Conservation (DLWC), considers the erosion hazards in the use of the land. It classifies land in terms of its inherent physical characteristics, or physical constraints, and denotes measures needed to protect the land from soil erosion and other forms of land degradation.

For further information on rural land capability, refer to *Rural Land Capability Mapping* (undated), available from the Department of Land and Water Conservation.

2.2 Agricultural land classification

This five class system used by NSW Agriculture classifies land in terms of its suitability for general agricultural use. This system was developed specifically to meet the objectives of the Environmental Planning and Assessment Act 1979, in particular 5(a) (i) 'to encourage the proper management, development and conservation of natural and man-made resources, including agricultural land...for the purpose of promoting social and economic welfare of the community and a better environment'.

Agricultural land is classified by evaluating biophysical, social and economic factors that may constrain the use of land for agriculture. In general terms, the fewer the constraints on the land, the greater its value for agriculture. Each type of agricultural enterprise has a particular set of constraints affecting production. A comprehensive list of all the constraints affecting each form of agriculture would be expensive to compile and unwieldy to use. Consequently, agricultural land classification is based on a set of constraining factors common to most agricultural industries. Section 6.3iii 'Factors that influence agricultural suitability' lists these factors.

Some types of agricultural enterprises do not depend on land suitability and so are not included in this system. Such activities include intensive animal industries (poultry, pig and cattle feedlots) as well as nurseries, glasshouses, hydroponics and mushroom sheds. NSW Agriculture and other agencies produce guidelines that address siting and management issues for these industries. However, many of these industries use agricultural land to manage effluent and provide a buffer zone, so agricultural land classification is still relevant.

It is an inherent feature of agricultural land classification maps that they have a limited life. The life span of the maps depends on changes to the biophysical, social and economic factors. For example, if an area classified as Class 3 agricultural land because of its ability to support occasional cropping becomes affected by salinity, and therefore becomes no longer suitable for cropping, it would need to be reclassified as Class 4 agricultural land.

In practice it takes a significant and widespread change of the factors to affect agricultural land classification maps. This is due to the scale of the mapping and the consideration of future trends at the time of map preparation. The types of changes that affect agricultural land classification maps are usually slow, so the maps produced are suitable for use for a number of years.

Agricultural land classification maps produced at small scales (1:50,000 to 1:100,000) are useful for strategic planning, including regional and local environmental planning instruments, regional economic development and natural resource management. They are inappropriate for making decisions relating to individual development applications or minor rezoning proposals. These types of applications involve decision making at the property level and require information at a scale of greater detail than is available from these agricultural land classification maps. See Section 4 'Limitations of scale' for further information.

In general, for small areas and detailed classification the use of a quantitative approach is appropriate. In order to use such an approach the range of agricultural enterprises to be considered needs to be reduced so that the number of biophysical, social and economic factors taken into consideration is manageable.

3. Agricultural land classification classes

Agricultural land classification maps place land into one of five classes according to its suitability for a wide range of agricultural activities. Class 1 land has few constraints to agricultural production, so a wide range of crops can be profitably grown; while Class 5 land has severe constraints and is, in general, unsuited to agriculture. The essential characteristics of these classes are described below.

Class 1: Arable land suitable for intensive cultivation where constraints to sustained high levels of agricultural production are minor or absent.

Class 2: Arable land suitable for regular cultivation for crops, but not suited to continuous cultivation. It has a moderate to high suitability for agriculture but edaphic (soil factors) or environmental constraints reduce the overall level of production and may limit the cropping phase to a rotation with sown pastures.

Class 3: Grazing land or land well suited to pasture improvement. It may be cultivated or cropped in rotation with sown pasture. The overall production level is moderate because of edaphic or environmental constraints. Erosion hazard, soil structural breakdown or other factors, including climate, may limit the capacity for cultivation and soil conservation or drainage works may be required.

Class 4: Land suitable for grazing but not for cultivation. Agriculture is based on native pastures or improved pastures established using minimum tillage techniques. Production may be seasonally high but the overall production level is low as a result of major environmental constraints.

Class 5: Land unsuitable for agriculture, or at best suited only to light grazing. Agricultural production is very low or zero as a result of severe constraints, including economic factors which prevent land improvement.

An additional class may occasionally be used where land has some special feature which allows a special crop to be grown (eg. bananas and other tropical horticultural tree crops).

Specialist class: Land which, because of a combination of soil, climate and other features, is well suited to intensive production of a crop or a narrow range of crops whose special requirements limit their successful culture to such land. This class includes some lands formerly described as unique.
Refer to Section 7 'Agricultural land class descriptions' for a description of the major attributes, benefits and constraints to production for each of the land classes.

4. Limitations of scale

When using agricultural land classification maps it is important to understand the limitations of the scale at which the maps were produced. In addition, it is essential that the map only be used within the limitations of the scale of mapping reliability.

Map scale is the relationship between a unit of length on a map and the actual length it represents on the ground. This scale is usually expressed as a ratio. A scale of 1:100,000 means that one unit on a map corresponds to 100,000 units on the ground. For example, 1 cm on the map corresponds to 100,000 cm (1 km) on the ground. One square centimetre corresponds to one square kilometre; one square millimetre represents one hectare. The minimum area that can be legibly delineated on a map is usually about 40 square millimetres (a circle of about 7 mm in diameter). At a scale of 1:100,000, this represents an area on the ground of approximately 40 hectares. Table 2 provides a summary of the minimum mappable area for five commonly used scales.

Table 2: Relation between minimum mapable area and scale

Map Scale	Ground distance (metres) represented by 1 mm on the map	Minimum mapable area (ha) represented by 40 mm^2 on a map
1:100 000	100 m	40.0 ha
1:50 000	50m	10.0 ha
1:25 000	25 m	2.5 ha
1:10 000	10m	0.4 ha
1:5 000	5 m	0.1 ha

Source: Riddler 1987

Table 1: Guide to agricultural land classification

Suitability Classes		Land Uses									
Class	Description	Horticulture				Field Crops		Grazing:Pasture			
		Vegetables		Tree Crops				Improved		Native	
		Irrigated	Rainfed	Sensitive	Tolerant2	Irrigated	Rainfed	Irrigated	Rainfed	Seasonal	Light
1	Arable land suited to continuous cultivation[1] for uses such as intensive horticulture and field crops. Constraints to sustained high levels of production are absent or minor.	☆	★	☆	★	★	★	★	★	★	★
2	Arable land suited to regular cultivation for uses such as intensive horticulture and field crops. Constraints to sustained levels of production are minor to moderate.	●	☆	●	★	☆	☆	☆	★	★	★
3	Land suited to cropping but not continuous cultivation. Production risks are managed through: a pasture phase, conservation tillage and/or fallowing. Constraints to sustained levels of production are moderate.	●	●	●	☆	●	●	●	☆	★	★
4	Land suited to grazing but not cultivation. Agriculture is based on native pastures and/or improved pastures established using minimum tillage techniques. Overall level of production is comparatively low due to major environmental constraints.	○	○	○	●	○	○	○	●	☆	★
5	Land not suited for agriculture or only light grazing. Agricultural production, if any, is low due to major environmental constraints.	○	○	○	○	○	○	○	○	○	●

★ Class having requirements in excess of those needed for sustained production from the land use
☆ Class having the minimum requirements for sustained production from the land use
● Class may be suited to the land use depending on the nature of the limiting factors to cultivation and crop production
○ Class not suited to land use because of limiting factors to cultivation and/or production

Notes:
1 The ability to cultivate is a pre-requisite for cropping in this table.
2 Tolerant to changes in soil conditions eg acidity, salinity.

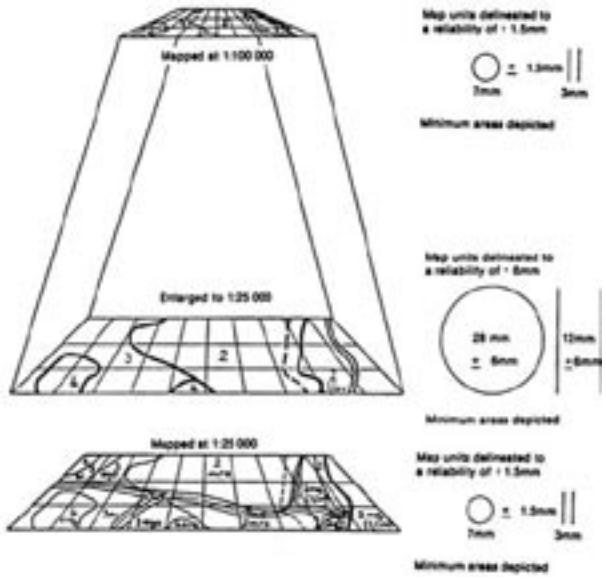
Biophysical features usually have transitional zones between unique groups or classes. In the field, there are few instances where a sharp boundary line divides classes. In the maps, the boundary line represents the best-fit position or a halfway point between the two classes. The accuracy for locating the class boundary lines is expressed as a confidence limit. For a 1:100,000 map this limit is 1.5 mm, representing a confidence limit of 150m in the field (Riddler 1987).

As the boundary precision is a function of the level of detail recorded and observed in the field, the scale of agricultural land classification maps should not be enlarged.

In addition, while the final maps show areas as being divided into discrete classes, in practice nature usually presents a mix of geology, terrain and soils, and sudden changes are unusual. Any map unit will include areas whose characteristics differ from those of the dominant class. For an area less than 40 mm^2 (7 mm diameter) on the map, these inclusions are too small to be legibly shown at the scale of mapping, but they may occupy up to 40% of the unit. This is important to note, as errors in interpretation will occur if the map is enlarged beyond its original scale because these inclusions will not be shown. It is particularly easy and, therefore tempting, to enlarge maps when they are in digital form; however, this should not be done. Figure 1 illustrates the affect of enlarging a map from 1:100,000 to 1:25,000. Note the increased level of detail provided when the area is originally mapped at 1: 25,000.

For further information on the production of agricultural land classification maps and detailed surveys refer to Section 6 'The mapping process'.

Figure 1: Relationship between scale of mapping, enlargement and map reliability (adapted from Riddler 1987) - click for clearer, larger image.



5. Using agricultural land classification maps for land use planning

NSW Agriculture's agricultural land classification maps can be used to recommend the quality and quantity of rural land that should be zoned for agricultural production and protection from incompatible development.

Higher quality lands (Classes 1 and 2) have fewer constraints and a greater versatility for agriculture than the poorer quality lands (see table 1), and their long-term value to the state is often greater than a strict economic appraisal might indicate. Their relative lack of constraints allows greater flexibility in management and enables farmers to more easily adapt to changing economic conditions. The high suitability of these lands, also, significantly reduces the potential for environmental damage from agricultural activities.

Land use planning recommendations need to be drawn up on the basis of local government areas using the principle of protecting the land of greatest agricultural value, and directing nonagricultural uses onto lands less suitable for agriculture. Following are some general principles, which may help in formulating land use planning recommendations.

- Identify the main agricultural industries and their land requirements within the local government area. Many agricultural industries require access to a range of agricultural land classes for good management, to ensure diversity of enterprise and security of production.

  For example, land used for dairy cattle on the coastal plains is often a mix of Class 2 and/or 3 as well as Class 4 agricultural land. The Class 2 and 3 land is used for production of high value pastures or fodder crops, while the Class 4 land is used as the dry-run country. The mixture of land classes used by these industries should be protected.
- Protect highly productive agricultural land (Classes 1,2, 3 and Specialist Class) from competing land uses. It is preferable to use land of lower agricultural quality for incompatible developments where this is available and suitable for the purpose.
- Give priority to protection of Class 1 lands from incompatible development. They are elite, of limited extent and considered to be of significance to the state.
- Class 2 lands are also of superior quality and of limited extent. They are worthy of protection and retention for agriculture because of their state and regional importance.
- Protect Class 3 lands for agricultural production if adequate and suitable areas of Classes 4 and 5 are available for competing uses.
- Specialist Class lands which, by their nature, are unique in the state for agricultural activity need to be protected unless there are strong economic reasons for not doing so. This includes areas which, by virtue of their remoteness or special location, are under cultivation for foundation seed, bud stock or root stock production, or used as quarantine zones.
- Take into consideration social and economic factors when making recommendations about changes to land use in areas of Class 3 or lower quality land currently used for full time agriculture.
- Class 4 lands play an important role in some agricultural industries: for example, fine wool production on the tablelands of New South Wales depends on comparatively large areas of Class 4 agricultural land.
- Class 5 land can be of some value for agriculture: for example it may provide shelter for livestock, or offer flood-free refuge areas.
- When recommending rural lands for non-agricultural uses, the particular requirements for use need to be considered so that land is not inappropriately lost from agriculture. For example, rural residential use may best be located on non-productive land, preferably with trees, (usually Class 4 or 5), while hobby farms may require land with pastures suitable for year round grazing (land of Class 4 may often be suitable). Because of the environmental fragility of Classes 4 and 5 land, care is needed when proposing more intensive uses.
- Irrigated areas are generally recommended for retention in agriculture because of the existing infrastructure (channels, pipes, dams etc.) and relatively high production potential.
- Some farm forestry enterprises require good quality agricultural land, and may need to be situated on agricultural land.
- Agricultural lands that can use organic wastes need to be identified so that agricultural industries are able to use these wastes sustainably.

- Around the perimeter of urban areas where high land prices and small lot sizes are common, even the best agricultural land may have potential conflict with urban neighbours as one constraint, limiting versatility and affecting productivity. However, close proximity to urban markets may outweigh the constraints.

6. The mapping process

Two methods are used to produce agricultural land classification maps: field surveys, and interpretation of remotely sensed data. Both processes require personnel experienced in natural resource survey techniques and with local knowledge of the area to be mapped, particularly the details of agricultural management practice. Agricultural land classification maps are generally produced on a local government area basis. Figure 2 depicts an extract from an agricultural land classification map, while Figure 3 depicts the line work for the same map area laid over a false colour satellite image.

6.1 Field surveys

Using this technique, agricultural land classification maps are produced by mapping directly onto topographic sheets in the field. The scale of the maps used may be 1: 25 000, 1:50 000 or 1:100 000, depending on the scale of the topographic map available for the area. A preliminary investigation of the area identifies key factors such as soil, geology, slope and climatic data using available information and local expertise. If available, recent aerial photographs, photomaps, orthophotomaps and satellite imagery of the area under study may provide useful information.

Knowledge of the agricultural enterprises and estimates of productivity from well-managed farms provide reliable indications of the class of that particular type of land. Lands with similar properties (such as soil, slope and microclimate) are often placed in the same class although management may influence the productivity levels realised. Boundaries of any irrigation areas/districts are identified before mapping.

The field survey often starts in the better known areas, then concentrates on areas for which little information or knowledge is available. The mappers drive over a pre-determined route which, wherever possible, crosses the 'grain' of the country, geology or soils, so that the maximum variability is encountered.This makes it easier to place the boundaries between classes. Where access is poor, class boundaries may be identified using aerial photographs (stereoscopic series) or satellite imagery.

6.2 Remote sensing

Agricultural land classification maps can also be produced by mapping directly onto satellite images, either as hard copies or displayed on computer screens. The agricultural land class boundaries on hard copies of images can be digitised and entered into the computer for production of maps.

Satellite images contain detailed records of ground cover features, land use patterns and quality of agricultural land at the time of exposure. Systematic examination by a skilled interpreter familiar with the area can identify the nature of physical objects and landform features.

There are six characteristics recorded for each landform feature represented on an image. These are size, shape, shadow, tone or colour, pattern and texture. These characteristics are assessed using interpretation strategies such as location and association, temporal change and convergence of evidence to determine the agricultural land class boundaries.

As for field mapping, it is necessary to conduct a field reconnaissance survey of the area. This includes ground truthing the satellite image and acquiring the preliminary information as outlined for the field survey technique: soil, geological, slope and climatic data, relevant topographic map sheets and information on the type and productivity of agricultural enterprises.

6.3 General considerations

Regardless of the method used to produce agricultural land classification maps, the procedures below are followed in the production of the maps.

i. Lands that need not be evaluated

Before mapping begins, all lands that can be clearly excluded from agriculture are identified and marked on the map to reduce the area to be assessed. Such lands include:

- national parks, nature reserves, state recreation areas and other lands reserved under the National Parks and Wildlife Act 1974
- state forests and timber reserves, although sometimes these areas may be suitable and available for grazing
- designated foreshores and foreshores of prescribed streams and lakes where land use restrictions apply
- quarries and mining areas
- areas zoned urban or village
- land with slope greater than 50%, greater than 70% rock outcrop, coastal dunes and beaches, and land subject to permanent inundation (i.e. DLWC's land capability class VIII).

ii. Land management assumptions

In classifying agricultural land the following assumptions are made about agricultural land use:

- Land is managed using a moderate to high level of agricultural management practice.
- Land with constraints that have been modified or removed is assessed on its present status eg. irrigation areas, flood mitigation areas, cleared land.
- Land with constraints that could be economically

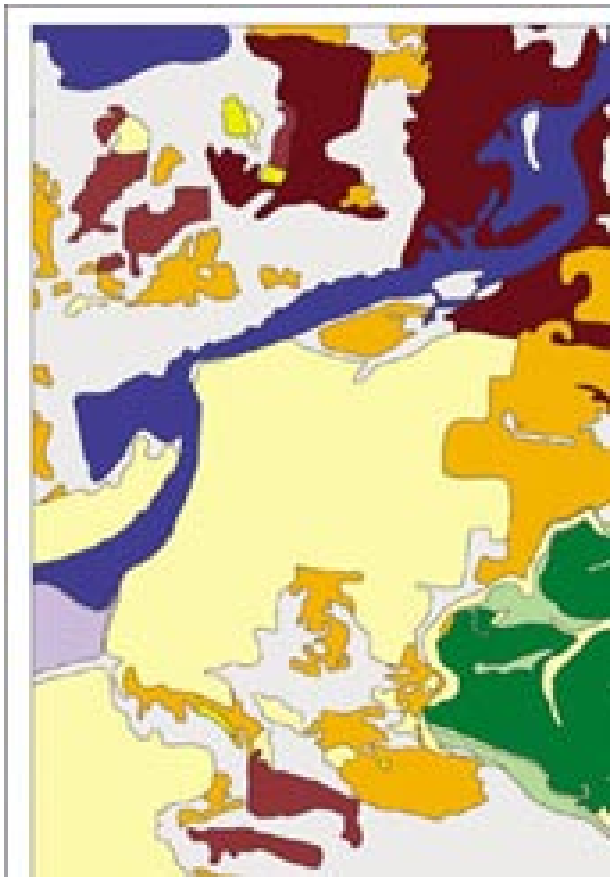


Figure 2: An extract of the Tweed Shire Agricultural Land Classification map - click for clearer, larger image.

Figure 3: The line work for the extract of the Tweed Shire Agricultural Land Classification map used in Figure 2 laid over a false colour satellite image - click for clearer, larger image.

removed (eg. soil acidity, low chemical fertility) is assessed as if they have been removed provided there are no regulatory or legislative constraints.

- Land suited for intensive uses such as cropping is also suited to less intensive land uses such as grazing, forestry etc.
- The assessment reflects long term capacity for sustainable agricultural productivity.
- The assessment reflects the versatility of the land for various agricultural activities (Class 1 is the most versatile, Class 5 the least versatile).
- The assessment may need to be reviewed if technological advances later permanently change the productive potential of the land eg. development of an irrigation area.

Given the above assumptions, existing land use may not always be a good indicator of appropriate land use and hence land class. The system of land classification is aimed at assessing physical, social and economic attributes of land rather than its current use. Nevertheless it must be noted that current land use often reflects land suitability. Where land is used beyond its physical capability land degradation is often evident.

iii. Factors that influence agricultural suitability

Biophysical, social and economic factors are all considered when determining agricultural land classification. These determine the types of agricultural enterprises that are, or could be, adapted to the area. Not all of these factors need to be considered in every assessment, and in some situations key factors may need to be considered in more detail than others are.

It must be recognised that the process of agricultural land classification relies upon interpretation of information by an expert, and that the map marks a point in time reflecting current understanding of agricultural systems, infrastructure, and market and resource conditions.

The following lists are not comprehensive:

Biophysical factors

- environmental impact: fertilisers, pesticides, wastes, erosion, salinisation, siltation, vegetation clearing
- topography: slope (angle and length), erosion hazard, aspect, altitude, flood liability, exposure, land slip, surface drainage
- soil physics: texture, structure, erodibility, depth, water holding capacity, internal and surface drainage, rockiness, stoniness, depth to watertable, permeability, clay type, colour, surface crusting, density, aeration, trafficability, stability under irrigation
- soil chemistry: fertility, toxicity, organic matter, soil reaction, cation exchange capacity, salinity, sodicity, rates of fixation, dispersibility
- climate: length of growing season, temperatures,

rainfall, evaporation, wind, humidity, frost occurrence, irrigation, hail, exposure
- pests and diseases: presence of noxious or pest animals, noxious weeds, insects, plant or animal pathogens (field and storage)

Social factors
- legislative and/or regulatory constraints
- potential conflict with other land users: eg. noise, odour, dust
- availability of permanent or seasonal, skilled or unskilled labour

Economic factors
- regional and local infrastructure to support agriculture
- geographic location
- accessibility and location with respect to transport requirements and costs
- accessibility to local and export markets
- presence of any comparative market advantage
- structure of local farming and marketing, e.g. co-operatives and marketing bodies
- availability and cost of land locally and elsewhere
- costs of removing biophysical constraints
- site contamination from previous land use

iv. Accompanying report

The report accompanying the agricultural land classification map outlines the major constraints and describes how these affect agricultural production. Decision rules used to delineate the agricultural land class boundaries are based on these constraints.

The report supplied with the map should be read in conjunction with the map to help with interpretation. Depending on major agricultural activities in the region, some areas may have been mapped with a different emphasis placed on the factors used in classifying the land.

7. Agricultural land class descriptions

This section describes the major attributes, benefits and constraints to production for each of the agricultural land classes. Appendix 1 includes a selection of photographs depicting examples of each agricultural land classes.

Class 1

Arable land suitable for intensive cultivation where constraints to sustained high levels of agricultural production are minor or absent.

Class 1 lands have all, or nearly all, of the following characteristics:
- Productivity is high to very high for a very wide range of field crops adapted to the area.
- Access to local and export markets is satisfactory.
- Local or regional infrastructure to support intensive forms of agriculture is present and a ready supply of suitable labour is available, if required.
- Potential for land use conflict with neighbours as a result of standard agricultural practices is low.
- Slopes are level to very gently inclined.
- Soils are deep.
- The land is capable of sustaining regular cultivation.
- The soil profile is well drained to moderately well drained.
- Erosion hazard is low, so only simple soil conservation management practices are required to protect the soils from erosion.
- Any soil physical and chemical constraints are capable of being economically overcome for a very wide range of field crops.
- A recurrent extreme of climate does not seriously affect productivity.
- Potential economic losses due to flooding are very low, in the long term.
- The level of economic constraint from factors such as weeds, site contamination, standing timber and feral animals is very low.

Class 2

Arable land suitable for regular cultivation for crops but not suited to continuous cultivation. It has a moderate to high suitability for agriculture but edaphic (soil factors) or environmental constraints reduce the overall level of production and may limit the cropping phase to a rotation with sown pastures.

Class 2 lands have all, or nearly all, of the following features:
- Productivity is high to very high for a wide range of field crops adapted to the area.
- Access to local and export markets is satisfactory.
- Local or regional infrastructure to support intensive forms of agriculture is present and a ready supply of suitable labour is available, if required.
- Potential for land use conflict with neighbours as a result of standard agricultural practices is low.
- Slopes are level to gently inclined.
- Soils are deep to moderately deep.
- The land is capable of sustaining regular cultivation; however, conservation tillage practices may be required.
- The soil profile is either moderately well drained or rapidly drained.
- Erosion hazard is low to moderate, so soil conservation measures may need to be adopted to avoid erosion.
- Any soil physical and chemical constraints are capable of being economically overcome for a wide range of field crops.
- Recurrent extremes of climate are unlikely to affect productivity.
- Potential economic losses due to flooding are low, in the long term.
- The level of economic constraint from factors such as weeds, site contamination, standing timber and feral animals is low.

Class 3

Grazing land or land well suited to pasture improvement. It may be cultivated or cropped in rotation with sown pasture. The overall production level is moderate because of edaphic factors or environmental constraints. Erosion hazard, soil structural breakdown or other factors including climate may limit the capacity for cultivation, and soil conservation or drainage works may be required.

Class 3 lands have generally moderate levels of social, economic or physical limitations, restricting the extent of arable agriculture. For example, erosion hazard, soil structural breakdown or other factors including climate may limit the capacity for cultivation, and soil conservation or drainage works may be required. However, a high to very high level of one particular characteristic may result in an area being classified as Class 3 even where other limitations are absent.

Class 3 lands are characteristically lands with the following features:

- Productivity is high for locally adapted pastures and moderate for crops well suited to the area.
- Access to local and export markets is satisfactory.
- Local and regional infrastructure to support extensive forms of agriculture is present, and a ready supply of suitable labour is available.
- Potential for land use conflict with neighbours as a result of standard agricultural practices may restrict agricultural activities.
- Slopes are level to moderately inclined.
- Soils are moderately deep to shallow.
- The land has moderate to limited suitability for cultivation, so cultivation is only sustainable in rotation with pastures.
- The soil profile is well drained to imperfectly drained.
- Erosion hazard is low to high, so intensive measures of soil conservation may be required to control erosion in the long term.
- Soil physical and chemical properties may limit crop and pasture productivity.
- Recurrent extremes of climate may affect productivity.
- Potential economic losses due to flooding are moderate, in the long term.
- The level of economic constraint from factors such as weeds, site contamination, standing timber and feral animals is moderate.

Class 4

Land suitable for grazing but not for cultivation. Agriculture is based on native pastures or improved pastures established using minimum tillage techniques. Production may be seasonally high, but the overall production level is low as a result of major environmental constraints.

Class 4 lands have generally moderate to high levels of social, economic or physical limitations, restricting the agricultural productivity. The inability for the preparation of a cultivated seedbed on these lands typifies their limitations. It should be noted that a severe to extreme level of one particular characteristic may result in an area being classified as Class 4 even where other limitations are absent.

Class 4 lands are characteristically lands with the following features:

- Productivity levels for locally adapted pastures are low to moderate; however, productivity for selected tree crops may be high.
- Access to local and export markets may be restricted by location.
- Local infrastructure to support extensive forms of agriculture is present, however suitable labour resources may be limited.
- Potential for land use conflict with neighbours as a result of standard agricultural practices may restrict agricultural activities.
- Slopes are level to steeply inclined.
- Soils are mostly shallow.
- The land is unsuitable for cultivation, but minimum tillage techniques can be used to establish perennial pastures.
- The soil profile is well drained to poorly drained.
- Erosion hazard is low to very high; intensive measures of soil conservation may be required, but erosion may still be significant in the long term.
- Soil physical and chemical properties limit crop and pasture growth, and low productivity levels limit the ability to economically manage this constraint.
- Recurrent extremes of climate are likely to affect productivity.
- Potential economic losses due to flooding are high, in the long term.
- The level of economic constraint from factors such as weeds, site contamination, standing timber and feral animals is high.

Class 5

Land unsuitable for agriculture or at best suited only to light grazing. Agricultural production is very low or zero as a result of severe constraints, including economic factors which preclude land improvement.

Class 5 lands suffer extreme limitations for agricultural production. These limitations may be one of, or a combination of, the following features:

- Productivity levels for all types of agricultural crops and pastures are very low.
- Access to local and export markets may be very restricted by location.
- Local infrastructure to support extensive forms of agriculture may be absent, as may suitable labour resources.
- Extremes of slope can be expected.
- The land is unsuitable for cultivation.

- The soil profile is very poorly drained.
- Erosion hazard is extreme, and economic control using conventional soil conservation measures is impractical.
- Soil physical and chemical properties present an extreme limitation to the growth of agricultural plant species.
- Recurrent extremes of climate may seriously affect productivity.
- Potential economic losses due to flooding are high, in the long term.
- The level of economic constraint from factors such as weeds, site contamination, standing timber and feral animals is very high to extreme.

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Appendix 1

Class 1

Class 1 land is suitable for a wide range of agriculture. It may be regularly cultivated. There are few, if any, constraints to production other than the need for good management.

Photo 1: Vegetables on class 1 land at Cudgen, North Coast, NSW. Class 1 lands are capable of growing a wide variety, of crops.

Photo 2: Vegetables on class 1 land at Windsor, Western Sydney Basin. Due to their low level of constraints to plant growth, class 1 lands can be continuously cropped. They are generally used for the production of high value crops such as vegetables.

Class 2

Class 2 land is suited to a wide range of horticulture in rotation with pastures. Several minor constraints may limit suitability for continuous cultivation. These include stony and shallow phases of soil, moderate erosion hazard and degradation of the soil surface.

Photo 3: Vegetables on class 2 lands at Mangrove Mountain, Central Coast NSW. Slope and the resulting erosion hazard represent a limit to continuous cultivation.

Photo 4: Cereal production on class 2 lands at Breeza Plains, northwest NSW. Wind and water erosion hazard necessitates farming practices based on stubble retention and minimum or zero tillage.

Class 3

Class 3 land is well suited to grazing, including the use of improved pastures. Cultivation is limited to cash or forage crop in rotation with pastures. The limitations to production include shallow, stony or eroded soils.

Photo 5: Lucerne on class 3 land at Warialda, northwest NSW. Land management practices such as contour banks may be required to minimise erosion on class 3 land.

Photo 6: Sugar cane production, class 3 land on the north coast, NSW. High or seasonally high water tables, potential acid sulphate soils and other soil factors can limit the range of crops capable of being sustainably produced on class 3 lands.

Photo 7: Young wheat crop on class 3 land, Coonabarabran, northwest NSW. The lower soil quality of class 3 land may lead to patchiness in crop establishment and growth.

Photo 8: Sheep grazing improved annual pasture, Cowra, central west NSW. Class 3 lands can only be sustainably cropped in rotation with pastures.

Photo 9: Windrowed canola crop with waterlogged patches on class 3 land, central west NSW. Susceptibility to waterlogging may be a factor limiting productivity of class 3 lands.

Photo 10: Citrus production on class 3 land in the Murrumbidgee irrigation area, south west NSW.

Class 4

Land suitable for grazing, but not for cultivation. Pasture improvement relies on minimum tillage techniques. Productivity may be seasonally high but overall productivity is low as a result of major environmental constraints.

Photo 11: Class 4 grazing lands near Annidale, northern tablelands NSW. Productivity is limited by shallow soil depth, low soil fertility and slow plant growth during winter due to adverse climatic conditions.

Photo 12: Erosion on class 4 land, central tablelands, NSW. Poor soil structure and steep slopes often make class 4 lands highly susceptible to erosion.

◀ Photo 13: Cattle grazing class 4 lands, Kangaroo Valley, southcoast NSW. While pasture production may be high, slope and erosion hazard limit more intensive production.

Class 5

Class 5 land is generally unsuited to agriculture, or at best suited only to light grazing. Agricultural production is very low or zero as a result of severe constraints.

◀ Photo 14: Class 5 land, Dorrigo, north coast NSW. The steepness of the slope and high erosion hazard are some of the severe constraints preventing agricultural land use.

Specialist Use

Land which, because of climate and soil, is well suited to intensive production of a crop or narrow range of crops whose special requirements limit their successful culture to such land.

◀ Photo 15: Bananas and macadamias on specialist use land at Bangalow, north coast NSW. Aspect and drainage are important factors in banana production in NSW.
This combination of factors results in lands otherwise poorly suited for agricultural production being well suited to the production of this individual crop.