
# Land Use Mapping at Catchment Scale

Principles, Procedures and Definitions

Edition 2


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## *Foreword*

Land use and land management practice changes (combined selectively with land cover changes and engineering solutions) are major tools for improving the management of land, vegetation and water resources. Recognition of the high levels of spatial and temporal variability in the Australian landscape, and the need to account for this in developing responses to natural resources management problems, has resulted in a focus on catchment scale activities.

Developing responses to catchment management issues such as salinity, water quality, and the maintenance of biodiversity will involve the investigation of options for land use, land cover and land management practice changes and trade offs between these options. Predictive modelling will help identify the most cost effective of these responses, and to maximise agricultural production and minimise disruption to catchment communities. Spatially explicit land use and land management practice data at scales appropriate to the problems being addressed are a critical input to the modelling of alternative response scenarios. Maps of current land use and alternative land use scenarios will also help communities participate in planning changes.

This is the second edition of *Land Use Mapping at Catchment Scale: Principles, Procedures and Definitions*. It provides nationally agreed land use mapping principles and procedures to assist agencies involved in the production of land use maps at regional or catchment scale. It is also the primary reference for the Australian Land Use and Management Classification and its application. The principles, procedures and the classification have been developed in collaboration with other Commonwealth and State agencies involved in land use mapping.

The information in this handbook will facilitate the development of a consistent approach to catchment scale land use mapping for the Australian continent.

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## *Executive Summary*

**Land use information at catchment scale is required for the sustainable use of natural resources**

Land use and land management practice information is needed at catchment scale in order to develop effective responses to Australia's natural resource management problems including salinity and water quality, rates of soil erosion, acidification, nutrient decline and carbon losses. Catchment scale land use information is also contributing to the assessment of agricultural productivity and opportunities for agricultural diversification, land value determination, local and regional planning, pest and disease control and emergency response planning.

**BRS is working collaboratively with State and Commonwealth agencies to promote the development of land use datasets for Australia**

BRS is working with Commonwealth and State agencies to develop land use and land management practice digital data sets for Australia. The Bureau's interests are in ensuring land use information is available to support land management and policy needs, establishing appropriate land use mapping standards and specifications, and facilitating land use mapping across jurisdictions. This handbook provides technical information to support catchment scale land use mapping programs in Australia, particularly collaborative Commonwealth-State programs supported by the National Land and Water Resources Audit, the Murray-Darling Basin Commission (MDBC) and AFFA. The handbook is also the primary reference for the Australian Land Use and Management (ALUM) Classification, describing the concepts and principles that underpin the classification, presenting definitions that apply to the current version (v5), and providing guidance in its application.

**Land use mapping includes stages in data collation, interpretation, verification, independent validation, and quality assurance**

Catchment scale land use mapping makes best use of available information. It is produced by combining State cadastre, public land databases, fine-scale satellite data, other land cover and use data, and information collected in the field. This involves successive stages in data collation, interpretation (including the production of draft land use maps), verification (involving field checking and editing), independent validation, quality assurance and the production of final outputs (including land use data, metadata and validation results). The procedure balances the need for reliable data, practicality and cost-effectiveness.

**The Australian Land Use and Management (ALUM) Classification is the nationally agreed land use classification**

The ALUM Classification is based on a land use classification developed for the MDBC in 1994 and has been refined in collaborative Commonwealth-State review processes. Five primary levels of land use are distinguished in order of generally increasing levels of intervention or potential impact on the natural landscape. Water is also included in the classification as a sixth primary class because of its importance for natural resources management. The classification has a three-tiered hierarchical structure. Tertiary classes can include commodity groups, commodities, land management practice, or vegetation information.

**Recommended dataset specifications address formatting, spatial referencing, and accuracy**

Recommended specifications for land use datasets provide for the attribution of the prime land use (represented by the ALUM code and associated descriptor), multiple land use, and source information (scale, date, and reliability). Specifications also address data formatting, spatial referencing, data resolution, spatial precision and attribute accuracy. An overall attribute accuracy of greater than 80 percent is the benchmark standard.

**Catchment scale land use mapping will extend to about 62 percent of the continent by 2002/03**

The aim is to keep the cost of mapping to a minimum (eg from $2.30 - $3.50/km$^2$ depending on the extent of the mapping and intensity of land use for 1:100,000 scale mapping). Land use information at catchment scale has been produced for Western Australia, the Fitzroy Basin (Queensland), a number of agricultural regions in South Australia and in Gippsland (Victoria), as well as parts of the Murray-Darling Basin. Once current mapping programs are completed in 2002/03, catchment scale coverage will extend to about 62 percent of the continent. Land use datasets are available through the Australian Natural Resources Data Library (adl.brs.gov.au) and State agencies.

## *Acknowledgements*

The land use mapping procedures described in this handbook have been developed and tested in collaboration with a number of State agencies. These include Agriculture Western Australia, New South Wales Department of Land and Water Conservation, Northern Territory Department of Lands, Planning and Environment, Primary Industries and Resources South Australia, Queensland Department of Natural Resources and Mines, Tasmanian Department of Primary Industries, Water and Environment, and the Victorian Department of Natural Resources and Environment.

Financial support for the development of the land use classification, mapping methods and the land use mapping undertaken to date has been provided by the National Land and Water Resources Audit, the Murray-Darling Basin Commission (Landmark Program), the Bureau of Rural Sciences and the Department of Agriculture, Fisheries and Forestry - Australia, through the Natural Heritage Trust. Substantial financial contributions have also been made by each of the State agencies collaborating in this work.

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# A. Introduction

Land uses have a major impact on Australia's natural resources including its soil, water, plants and animals. For example, crop selection and farm management practices such as stubble management and tillage practices can play a key role in processes affecting catchment salinity and water quality, and rates of soil erosion, acidification, nutrient decline and carbon losses.

Land use information is currently being used in Australia to manage catchment salinity, nutrient and sediment problems, measure greenhouse gas emissions and sinks, assess agricultural productivity and opportunities for agricultural diversification, for land value determination, in local and regional planning, pest and disease control and emergency response planning.

The Bureau of Rural Sciences (BRS) is working with the National Land and Water Resources Audit (Audit), the Murray-Darling Basin Commission (MDBC) and other Commonwealth and State agencies to develop a number of land use and land management practice digital data sets for Australia. The Bureau's interests include

- ensuring critical catchment scale land use information is available for land management and policy needs
- developing effective mapping tools for land use decision makers
- establishing appropriate land use mapping standards and specifications
- facilitating and coordinating land use mapping across jurisdictions.

The primary purpose of this handbook is to relate the key concepts and principles that underpin the Australian Land Use and Management (ALUM) Classification, present the land use classes and definitions that apply to the current version (v5) of the classification, and provide guidance in class allocation.

A joint Commonwealth-State workshop in February 1999 agreed that a modified version of a classification scheme developed by Baxter and Russell in 1994 (Baxter and Russell 1994) would be suitable as a land use classification for Australia (Barson 1999). It would promote the creation of nationally consistent, although not necessarily uniform, land use datasets, meet a wide range of user needs, and make the best use of existing data and available resources. This classification scheme, the ALUM Classification, was revised in July 2000 (v3) and again in October 2000 (v4) (BRS 2000) in consultative review processes involving State and Commonwealth agencies participating in land use mapping work. This document presents the current version (v5) of the classification.

Substantial progress has been made in applying the ALUM Classification to produce nationally consistent Australia-wide land use data sets. A national scale (1:2,500,000) data set which gives an overview of land use activities across the continent has also been completed. This mapping is based on coarse-scale satellite data (pixel size of 1.1km$^2$) and Agricultural Census data from the Australian Bureau of Statistics (ABS) for agricultural land uses, coupled with pre-existing finer resolution (principally 1:250,000 scale) data for other uses. This data set is being used at the national level for setting priorities and allocating resources for natural resource management problems such as dryland salinity risk.

However, most natural resource management problems, such as salinity, need to be tackled at a more detailed regional or catchment scale – mapping scales between 1:25,000 to 1:250,000 depending on land use intensity (Figure 2).

**Figure 1**
**Land Use Mapping at National Scale for the National Land and Water Resources Audit**
**Australian Land Use and Management Classification (v4)**

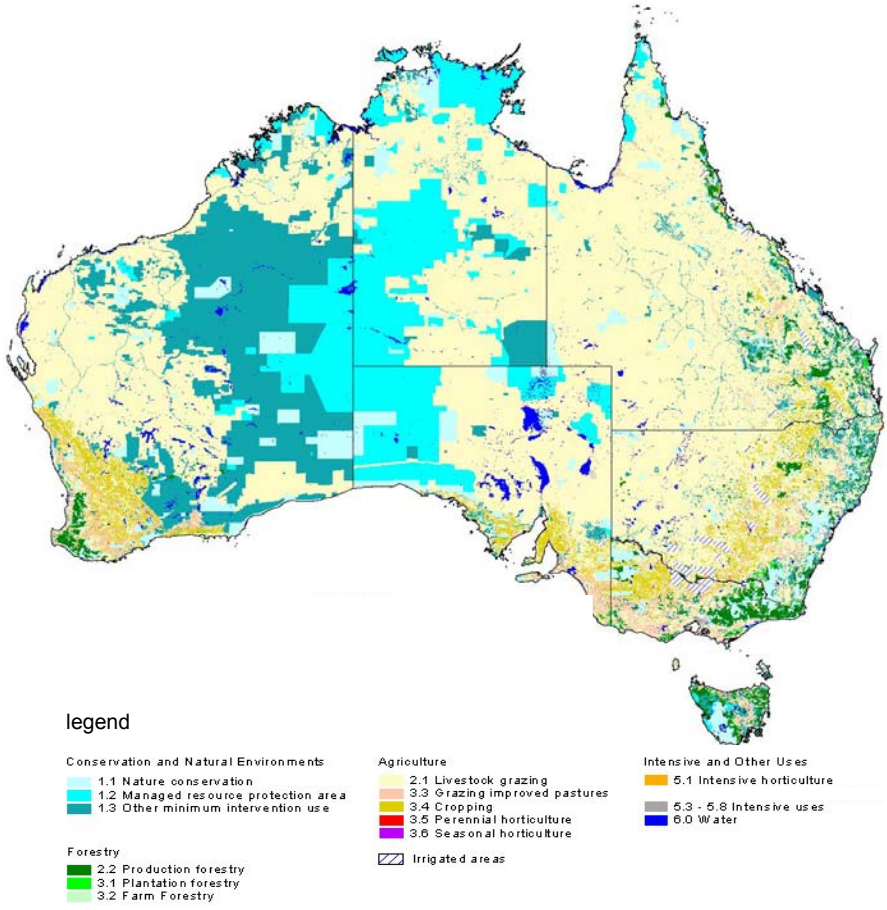
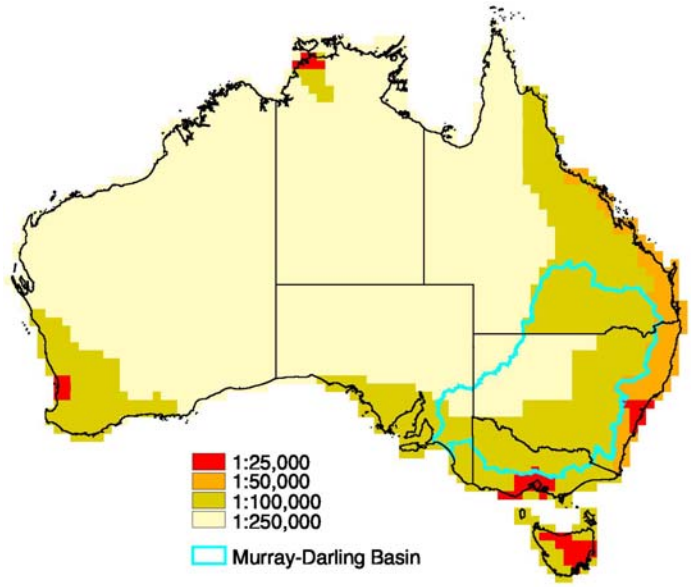
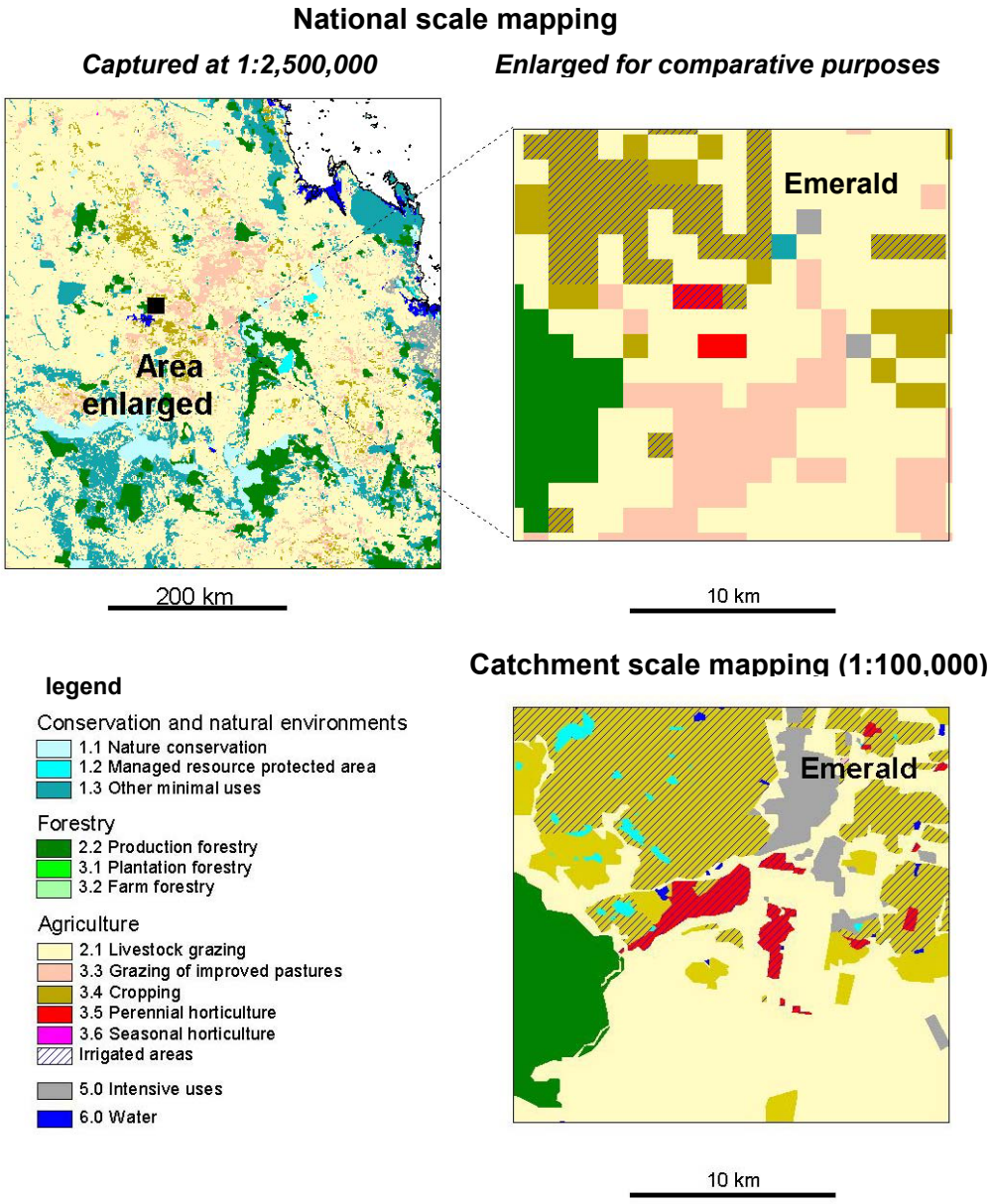



**Figure 2**
**Recommended Scales for Catchment Scale Land Use Mapping in Australia – January 2002**



Catchment scale mapping is produced by combining land tenure and other types of land use information, fine-scale satellite data and information collected in field. Figure 3 compares national and catchment scale land use maps for part of the Fitzroy Basin near Emerald in Queensland, showing the difference in the level of information contained in each type of mapping. National scale mapping provides insufficient detail for use in catchment scale applications.

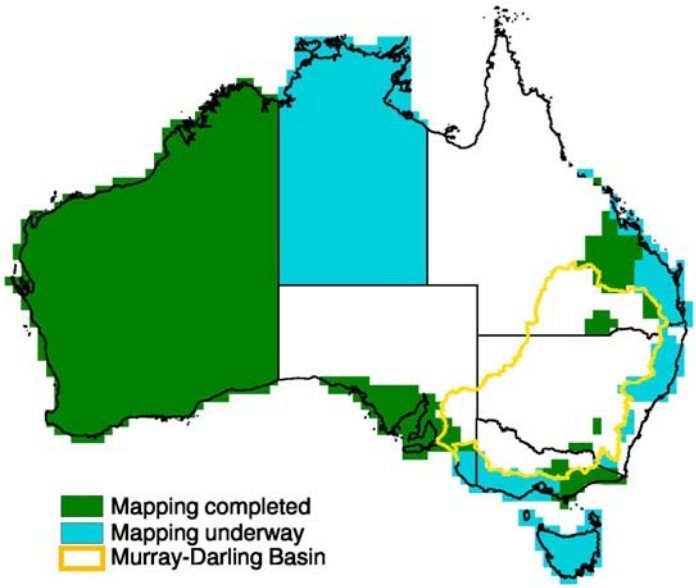
**Figure 3**
**Differences in Scale and Information Contained in the National (1:2,500,000) and Catchment Scale (1:100,000) Land Use Maps in the Fitzroy Basin, Queensland.**
**Australian Land Use and Management Classification (v4)**



An additional purpose of this handbook is to provide technical information to support catchment scale land use mapping programs in Australia, particularly collaborative Commonwealth-State land use mapping supported by the Audit, MDBC and AFFA. The handbook outlines the agreed basis of the mapping procedure, including data and metadata specifications. These methods provide for the cost-effective production of land use mapping, making best use of pre-existing land use information contained in sources such as State cadastre, public land databases and land cover mapping. The aim is to keep the costs of mapping to a minimum (eg from \$2.30 - \$3.50/km$^2$ depending on the extent of the mapping and intensity of land use for 1:100,000 scale mapping).

Land use information at catchment scale has been produced for Western Australia, the Fitzroy Basin (Queensland), a number of agricultural regions in South Australia and in Gippsland (Victoria). It has also been produced for several key parts of the Murray-Darling Basin (Figure 4). This land use data has been used in a wide range of applications, including planning flight lines for an \$8 m locust control program, and in developing Newcastle and Foot and Mouth disease preparedness programs in Western Australia. In Victoria the Environment Protection Authority is using land use data to plan sediment and nutrient management for the Gippsland Lakes. Sinclair Knight Merz Pty Ltd has used land use data for surface water quality and quantity modelling in the Macalister Irrigation District, and it is being used for land use planning by the Gippsland Local Government Network Program. In South Australia land use data has been used to help calculate emergency services taxes. BRS and the Queensland Department of Natural Resources and Management have used land use data to identify groundwater pollution risk associated with horticulture in the Bowen district, and to develop methods for collecting agricultural and veterinary chemical use information.

**Figure 4**
**Status of Catchment Scale Land Use Mapping in Australia - January 2002**



# B. ALUM Classification - key concepts

Because of the general reliance on remotely sensed data (either satellite-based or airborne) for land use mapping, there is often confusion between the terms ‘land use’ and ‘land cover’. The distinction between ‘land use’ and ‘land management practice’ is also poorly understood. Land tenure and commodities are other aspects of land occupation that can relate to land use and contribute to land use mapping. The Collaborative Australian Protected Areas Database (CAPAD), for instance, is a land tenure database that provides annually updated information enabling the accurate and cost-effective description of conservation and natural environment land uses.

The ALUM Classification framework is based on land use and provides a structure for attaching attributes describing commodities or land management practices. Land management practices information has been identified as a particular need of many users of land use data and is of critical importance in assessing sustainability. BRS is developing other datasets for land management practice information. Water, although a land cover attribute, is also a key part of the classification because of its importance for natural resources management.

**Land cover**

*The physical surface of the earth, including various combinations of vegetation types, soils, exposed rocks, water bodies as well as anthropogenic elements such as agriculture and built environments. Land cover classes can generally be discriminated by characteristic patterns using remote sensing. Land cover mapping at catchment scales has already been completed for the agricultural areas of Australia (see Barson, Randall and Bordas 2000).*

**Land use**

*The land management objective. Some land uses, such as agriculture, have a characteristic land cover pattern. These generally appear in land cover classifications. Other land uses, such as nature conservation, are not readily discriminated by a characteristic land cover pattern.*

**Land management practice**

*The means by which the land management objective is achieved - the 'how' of land use (eg cultivation practices such as minimum tillage and direct drilling). Patterns in land cover can relate to land management practice and land use.*

**Commodity**

*Usually refers to an agricultural or mining product that can be processed. Commodity information may relate to land use and land cover, particularly at finer divisions of classification. Agricultural commodity data are available through the Australian Bureau of Statistics’ Agricultural Census.*

**Tenure**

*The form of an interest in land. Some forms of tenure (such as pastoral leases or nature conservation reserves) relate directly to land use and land management practice.*

A land use nomenclature and classification scheme entails the ordering of land use in a systematic and logically consistent way. The ALUM Classification has a three-tiered hierarchical structure with primary, secondary and tertiary classes broadly structured in terms of the potential degree of modification and impact on a putative ‘natural state’ (essentially unmodified native land cover).

Primary and secondary classes relate to land use - the prime use of the land defined in terms of the management objectives of the land manager. Tertiary classes can include commodity groups, commodities, land management practice, or vegetation information.
Tertiary level data is of particular value in many natural resource planning and management applications, but it is often expensive to collect. The classification is intended to be flexible such that new land uses or management systems can be accommodated as long as there is no conflict with other existing items.

The principles that underpin the ALUM Classification / Baxter-Russell approach include

- **Level of intervention** - The classification is based on identification and delineation of types and levels of intervention in the landscape, rather than descriptions of land use based on outputs. Precedence is also given to the modelling capabilities of data over monitoring capabilities, and monitoring capabilities over descriptive uses.
- **Generality** - The classification is designed to provide for users who are interested in both processes (eg land management practices) and outputs (eg commodities)
- **Hierarchical structure** - A hierarchical structure provides for and promotes aggregation/disaggregation of related land uses, the addition of levels or classes and relevance at a range of scales.
- **Prime use / Ancillary use** – Parcels of land may be subject to a number of concurrent land uses. A multiple use production forest, for example, has as its main management objective the production of timber, although it also may also provide conservation, recreation, grazing and water catchment services. Land use class allocations based on prime use are based on the primary land management objective of the nominated land manager. Ancillary or secondary uses can also be recorded.

# C. ALUM Classification v5 - land use class definitions

Five primary levels of land use are distinguished in order of generally increasing levels of intervention or potential impact on the natural landscape. Water is also included in the classification as a sixth primary class. For catchment scale land use mapping currently being coordinated through BRS under AFFA, MDBC and Audit programs, the minimum expected level of attribution is to the tertiary level for 'Conservation and natural environments' and to the secondary level elsewhere (as shown in part D ALUM Classification v5 - summary). Tertiary classes presented here under primary levels 2, 3, 4, 5 and 6 are under continuing development, and are presented as suggestions/recommendations rather than mandatory elements of the classification.

While tertiary level data is valuable in many natural resource planning and management applications, it is expensive to collect. Generally, mapping is completed to the tertiary level only where pre-existing data is available, or where tertiary level information (eg, crop type) is of particular interest to the mapping agency. BRS has tested alternative mapping approaches using geocoded data from the ABS Agricultural Commodities Census (Ag Stats) which could provide a cost-effective basis of mapping some of these data (Randall and Barson 2001).

**1. Conservation and natural environments** - Land used primarily for conservation purposes, based on the maintenance of the essentially natural ecosystems present.

**2. Production from relatively natural environments** - Land used primarily for primary production with limited change to the native vegetation.

**3. Production from dryland agriculture and plantations** - Land used mainly for primary production, based on dryland farming systems.

**4. Production from irrigated agriculture and plantations** - Land used mostly for primary production based on irrigated farming.

**5. Intensive uses** - Land subject to extensive modification, generally in association with closer residential settlement, commercial or industrial uses.

**6. Water -** Water features. Water is regarded as an essential aspect of the classification, but it is primarily a cover type.

### (i) CONSERVATION AND NATURAL ENVIRONMENTS

A relatively low level of human intervention, with the anticipated consequence of little change to natural ecosystems. There may be change in the condition of the land in response to natural processes in isolation from any imposed use. The land may be formally reserved by government for conservation purposes, or conserved through other legal or administrative arrangements. Areas may have multiple uses, however nature conservation is the prime use. Some land may be unused as a result of a deliberate decision of the government or landowner, or due to circumstance.

**1.1 Nature conservation** Tertiary classes 1.1.1 – 1.1.6 are based on the Collaborative Australian Protected Areas Database (CAPAD) classification (Cresswell and Thomas 1997).

**1.1.1 Strict nature reserve** Protected area managed mainly for science. An area of land possessing outstanding or representative ecosystems, geological or physiological features and/or species, which is available primarily for scientific research and/or environmental monitoring.

**1.1.2 Wilderness area** Protected area managed mainly for wilderness protection. A large area of unmodified or slightly modified land, retaining its natural character and influence, without permanent or significant habitation, which is protected and managed so as to preserve its natural condition.

**1.1.3 National park** Protected area managed mainly for ecosystem conservation and recreation. A natural area of land, designated to: a) protect the ecological integrity of one or more ecosystems for this and future generations; b) exclude exploitation or occupation detrimental to the purposes of designation of the area, and c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

**1.1.4 Natural feature protection** Protected area managed for conservation of specific natural features. Area containing one or more specific natural or natural/cultural feature which is of outstanding value because of its inherent rarity, representative or aesthetic qualities or cultural significance.

**1.1.5 Habitat/species management area** Protected area managed mainly for conservation through management intervention. Area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species. This may include areas on private land.

**1.1.6 Protected Landscape** Protected areas managed mainly for landscape conservation and recreation. Area of land where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, cultural and/or ecological value, and often with high biological diversity.

**1.1.7 Other conserved area** Land under forms of nature conservation protection that fall outside the scope of the CAPAD classification, including heritage agreements, voluntary conservation arrangements, registered property agreements etc.

**1.2 Managed resource protection** Tertiary classes 1.2.1 – 1.2.4 are based on the CAPAD classification. These areas are managed primarily for the sustainable use of natural ecosystems. This includes areas with largely unmodified natural systems managed primarily to ensure the long-term protection and maintenance of biological diversity, water supply, aquifer or landscape while providing a sustainable flow of natural products and services to meet community needs.

**1.2.1 Biodiversity** Managed for biodiversity.

**1.2.2 Surface water supply** Managed as a catchment for water supply.

**1.2.3 Groundwater** Managed for groundwater.

**1.2.4 Landscape** Managed for landscape integrity.

**1.2.5 Traditional indigenous uses** Managed primarily for traditional indigenous use.

**1.3 Other minimal use** Areas of land that are largely unused (in the context of the prime use) but may have ancillary uses. This may be the result of a deliberate decision by the manager or the result of circumstances. The land may be available for use but for various reasons remains 'unused'.

**1.3.1 Defence** Natural areas allocated to field training, weapon testing and other field defence uses.

**1.3.2 Stock route** Stock reserves under intermittent use or unused.

**1.3.3 Remnant native cover** Land under native cover, mainly unused (no prime use) or used for non-production or environmental purposes eg to conserve native vegetation and wildlife or for natural resources protection.

**1.3.4 Rehabilitation** Land under rehabilitation or unused because of weed infestation, salinisation, scalding and similar hazards.

### (ii) PRODUCTION FROM RELATIVELY NATURAL ENVIRONMENTS

Land generally subject to relatively low levels of intervention. The land may not be used more intensively owing to its limited capability. The structure of the native vegetation generally remains intact despite deliberate use, although the floristics of the vegetation may have changed markedly. Where the native vegetation structure is, for example, open woodland or grassland, the land may be grazed. Where the native grasses have been deliberately and extensively replaced with improved species, the use should be treated under 3. Production from dryland agriculture and plantations.

**2.1 Grazing natural vegetation** Land uses based on grazing by domestic stock on native vegetation with limited or no attempt at pasture modification. Some change in species composition will have occurred, but the structure of the native vegetation type will be essentially intact.

**2.2 Production forestry** Commercial production from native forests and related activities on public and private land. Environmental and indirect production uses associated with retained native forest (eg prevention of land degradation, wind-breaks, shade and shelter) are included in an appropriate class under 1. Conservation and natural environments.

**2.2.1 Wood production** - managed for sawlogs and pulpwood

**2.2.2 Other forest production** - managed for non-sawlog/pulpwood production, including oil, wildflowers, fire-wood and fence posts.

### (iii) PRODUCTION FROM DRYLAND AGRICULTURE AND PLANTATIONS

Land in this class is used principally for primary production, based on dryland farming systems. Native vegetation has largely been replaced by introduced species through clearing, the sowing of new species, the application of fertilisers or the dominance of volunteer species. The range of activities in this category includes plantation forestry, pasture production for stock, cropping and fodder production, and a wide range of horticultural production.

**3.1 Plantation forestry** Land on which plantations of trees or shrubs (native or exotic species) has been established for production or environmental and resource protection purposes. This includes farm forestry. Where planted trees are grown in conjunction with pasture, fodder or crop production, class allocation should be made on the basis of either prime use or multiple class attribution.

**3.1.1 Hardwood production -** managed for hardwood sawlogs or pulpwood.

**3.1.2 Softwood production** - managed for softwood sawlogs or pulpwood.

**3.1.3 Other forest production** - managed for non-sawlog/pulpwood production, including oil, wildflowers, fire-wood and fence posts.

**3.1.4 Environmental -** environmental and indirect production uses (eg prevention of land degradation, wind-breaks, shade and shelter).

**3.2 Grazing modified pastures** Pasture and forage production, both annual and perennial, based on a significant degree of modification or replacement of the initial native vegetation. Land under pasture at the time of mapping may be in a rotation system so that at another time the same area may be, for example, under cropping. Land in a rotation system should be classified according to the land use at the time of mapping. Suggested tertiary classes for legume and grass pasture types can be fitted to the pasture attributes collected through the ABS Agricultural Census.

**3.2.1 Native/exotic pasture mosaic** Pastures in which there is a substantial native species component despite extensive modification or replacement of native vegetation. This class may apply where native and exotic pasture is patterned at a relatively fine spatial scale.

**3.2.2 Woody fodder plants** Woody plants used primarily for the purpose of providing forage for livestock grazing. Examples include Tagastaste and Leucaena.

**3.2.3 Pasture legumes**

**3.2.4 Pasture legume/grass mixtures**

**3.2.5 Sown grasses**

**3.3 Cropping** Land under cropping. Land under cropping at the time of mapping may be in a rotation system so that at another time the same area may be, for example, under pasture. Land in a rotation system should be classified according to the land use at the time of mapping. Cropping can vary markedly over relatively short distances in response to change in the nature of the land and the preferences of the land manager. It may also change over time in response to market conditions. Fodder production, such as lucerne hay, is treated as a crop as there is no harvesting by stock.

At the tertiary level it is suggested that classes be based on commodities / commodity groups that relate to ABS level 2 agricultural commodity categories (see part J ABS agricultural commodity levels).

**3.3.1 Cereals**
**3.3.2 Beverage & spice crops**
**3.3.3 Hay & silage**
**3.3.4 Oil seeds**
**3.3.5 Sugar**
**3.3.6 Cotton**
**3.3.7 Tobacco**
**3.3.8 Legumes**

**3.4 Perennial horticulture** Crop plants living for more than two years that are intensively cultivated, usually involving a relatively high degree of nutrient, weed and moisture control. Suggested tertiary classes are based on the ABS commodities Level 2 categories that relate to horticulture (see part J, ABS agricultural commodity levels).

**3.4.1 Tree fruits**
**3.4.2 Oleaginous fruits**
**3.4.3 Tree nuts**
**3.4.4 Vine fruits**
**3.4.5 Shrub nuts fruits & berries**
**3.4.6 Flowers & bulbs**
**3.4.7 Vegetables & herbs**

**3.5 Seasonal horticulture** Crop plants living for less than two years that are intensively cultivated, usually involving a relatively high degree of nutrient, weed and moisture control. Suggested tertiary classes are based on the ABS commodities Level 2 agricultural commodity categories that relate to horticulture (see part J ABS agricultural commodity levels).

**3.5.1 Fruits**
**3.5.2 Nuts**
**3.5.3 Flowers & bulbs**
**3.5.4 Vegetables & herbs**

### (iv) PRODUCTION FROM IRRIGATED AGRICULTURE AND PLANTATIONS

This class includes agricultural land uses where water is applied to promote additional growth over normally dry periods, depending on the season, water availability and commodity prices. This includes land uses that receive only one or two irrigations per year, through to those uses that rely on irrigation for much of the growing season. Baxter and Russell (1994) argue that the degree of intervention involved in irrigation and its potential impacts on hydrology and geohydrology are sufficient to warrant creation of this primary class.

**4.1 Irrigated plantation forestry** Land on which irrigated plantations of trees or shrubs have been established for production or environmental and resource protection purposes. This includes farm forestry.

**4.1.1 Irrigated hardwood production -** managed for hardwood sawlogs or pulpwood
**4.1.2 Irrigated softwood production -** managed for softwood sawlogs or pulpwood
**4.1.3 Irrigated other forest production** - managed for non-sawlog/pulpwood production, including oil, wildflowers, fire-wood and fence posts
**4.1.4 Irrigated environmental -** environmental and indirect production uses (eg prevention of land degradation, wind-breaks, shade and shelter)

**4.2 Irrigated modified pastures** Irrigated pasture production, both annual and perennial, based on a significant degree of modification or replacement of the initial native vegetation. This class may include land in a rotation system that at other times may be under cropping. Land in a rotation

system should be classified according to the land use at the time of mapping. Cropping/pasture rotation regimes are treated as land management practices.

**4.2.1 Irrigated woody fodder plants** Irrigated woody plants used primarily for the purpose of providing forage for livestock grazing.
**4.2.2 Irrigated legumes**
**4.2.3 Irrigated legume/grass mixtures**
**4.2.4 Irrigated sown grasses**

**4.3 Irrigated cropping** Land under irrigated cropping. This class may include land in a rotation system that at other times may be under pasture. Land in a rotation system should be classified according to the land use at the time of mapping. Cropping/pasture rotation regimes are treated as land management practice.

**4.3.1 Irrigated cereals**
**4.3.2 Irrigated beverage & spice crops**
**4.3.3 Irrigated hay & silage**
**4.3.4 Irrigated oil seeds**
**4.3.5 Irrigated sugar**
**4.3.6 Irrigated cotton**
**4.3.7 Irrigated tobacco**
**4.3.8 Irrigated legumes**

**4.4 Irrigated perennial horticulture** Irrigated crop plants living for more than two years that are intensively cultivated, usually involving a relatively high degree of nutrient, weed and moisture control.

**4.4.1 Irrigated tree fruits**
**4.4.2 Irrigated oleaginous fruits**
**4.4.3 Irrigated tree nuts**
**4.4.4 Irrigated vine fruits**
**4.4.5 Irrigated shrub nuts fruits & berries**
**4.4.6 Irrigated flowers & bulbs**
**4.4.7 Irrigated vegetables & herbs**

**4.5 Irrigated seasonal horticulture** Irrigated crop plants living for less than two years that are intensively cultivated, usually involving a relatively high degree of nutrient, weed and moisture control.

**4.5.1 Irrigated fruits**
**4.5.2 Irrigated nuts**
**4.5.3 Irrigated flowers & bulbs**
**4.5.4 Irrigated vegetables & herbs**

### (v) INTENSIVE USES

Land uses involving high levels of interference with natural processes, generally in association with closer settlement. The level of intervention may be sufficiently high as to completely remodel the natural landscape — the vegetation, surface and groundwater systems and the land surface.

**5.1 Intensive horticulture** Intensive forms of plant production.

**5.1.1 Shadehouses**
**5.1.2 Glasshouses**
**5.1.3 Glasshouses (hydroponic)**

**5.2 Intensive animal production** Intensive forms of animal production. Agricultural production facilities such as feedlots, piggeries etc may be included as tertiary classes.

**5.2.1 Dairy**
**5.2.2 Cattle**

**5.2.3 Sheep**
**5.2.4 Poultry**
**5.2.5 Pigs**
**5.2.6 Aquaculture**

**5.3 Manufacturing and industrial** Factories, workshops, foundries, construction sites etc. This includes the processing of primary produce eg sawmills, pulp mills, abattoirs, etc.

**5.4 Residential**

**5.4.1 Urban residential** houses, flats, hotels, etc
**5.4.2 Rural residential** Characterised by agriculture in a peri-urban setting, where agriculture does not provide the primary source of income.

**5.5 Services** Land allocated to the provision of commercial or public services resulting in substantial interference to the natural environment. Where services are provided land that retains natural cover an appropriate classification under (i) Conservation and Natural Environments should be applied (eg 1.1.7; 1.3).

**5.5.1 Commercial services** Shops, markets, financial services, etc
**5.5.2 Public services** Education, community services, etc
**5.5.3 Recreation and culture** Parks, sports grounds, camping grounds, swimming pools, museums, places of worship, etc
**5.5.4 Defence facilities** Defence research and development establishments, testing areas, firing ranges, etc. Defence lands of significant area, retaining natural cover should be allocated to 1.3.1
**5.5.5 Research facilities** government and non-government research and development areas

**5.6 Utilities**

**5.6.1 Electricity generation/transmission** Coal-fired, gas-fired, solar-powered, wind-powered or hydroelectric power stations, sub-stations, powerlines, etc
**5.6.2 Gas treatment, storage and transmission** Facilities associated with gas production and supply

**5.7 Transport and communication**

**5.7.1 Airports/aerodromes**
**5.7.2 Roads**
**5.7.3 Railways**
**5.7.4 Ports and water transport**
**5.7.5 Navigation and communication** radar stations, beacons, etc

**5.8 Mining**

**5.8.1 Mines**
**5.8.2 Quarries**
**5.8.3 Tailings** Tailings areas and other previously mined areas under rehabilitation are included in 1.3.4

**5.9 Waste treatment and disposal** Waste material and disposal facilities associated with industrial, urban and agricultural activities.

**5.9.1 Stormwater**
**5.9.2 Landfill** Disposal of solid inert wastes (but not including over-burden)
**5.9.3 Solid garbage** Disposal of wastes including waste from processing plants
**5.9.4 Incinerators**
**5.9.5 Sewage**

### (vi) WATER

Water features are regarded as essential to the classification because of their importance for natural resources management and as points of reference in the landscape. The inclusion of water is, however, complicated as it is normally classified as a land cover type. At the secondary level the classification identifies water features, both natural and artificial. Tertiary classes relate water features to intensity of use.

Because water is a land cover rather than a land use, water classes may not be mutually-exclusive with other land use classes at particular levels in the classification. Generally, water classes should take precedence so that, for instance, a lake in a conservation reserve will be classed as Lake (6.1) or Lake - conservation (6.1.1) rather than Nature conservation (1.1). Water features to which a conservation tertiary class applies may be attributed using multiple use attribution procedures (see part G for technical details).

**6.1 Lake**

**6.1.1 Lake - conservation** Feature relates to uses included in 1. Conservation and Natural Environments.
**6.1.2 Lake - production** Feature relates to uses included in 2. Production from Relatively Natural Environments.
**6.1.3 Lake - intensive use** Feature relates to uses included in 5. Intensive Uses.

**6.2 Reservoir or dam**

**6.2.1 Water storage and treatment**
**6.2.2 Reservoir - intensive use** Feature relates to uses in 5. Intensive Uses.
**6.2.3 Evaporation basin** Disposal of irrigation drainage waters.
**6.2.4 Effluent pond**

**6.3 River**

**6.3.1 River - conservation** Feature relates to uses in 1. Conservation and Natural Environments.
**6.3.2 River - production** Feature relates to uses in 2. Production from Relatively Natural Environments.
**6.3.3 River - intensive use** Feature relates to uses in 5. Intensive Uses.

**6.4 Channel/aqueduct**

**6.4.1 Supply channel/aqueduct**
**6.4.2 Drainage channel/aqueduct**

**6.5 Marsh/wetland**

**6.5.1, Marsh/wetland - conservation** Feature relates to uses in 1. Conservation and Natural Environments.
**6.5.2, Marsh/wetland - production** Feature relates to uses in 2. Production from Relatively Natural Environments.
**6.5.3, Marsh/wetland - intensive use** Feature relates to uses in 5. Intensive Uses.

**6.6 Estuary/coastal waters**

**6.6.1 Estuary/coastal waters - conservation** Feature relates to uses in 1. Conservation and Natural Environments.
**6.6.2 Estuary/coastal waters - production** Feature relates to uses in 2. Production from Relatively Natural Environments.
**6.6.3 Estuary/coastal waters - intensive use** Feature relates to uses in 5. Intensive Uses.

### (vii) COMPARISON WITH OTHER AUSTRALIAN LAND USE CLASSIFICATIONS

In addition to the ALUM Classification, other land use classifications presently in use in Australia are the Western Australian Standard Land Use Classification (WASLUC) and the Australian and New Zealand Land Use Classification (ANZLUC). Both the WASLUC and ANZLUC systems are hierarchical, with nine primary classes of land use (Table 1).

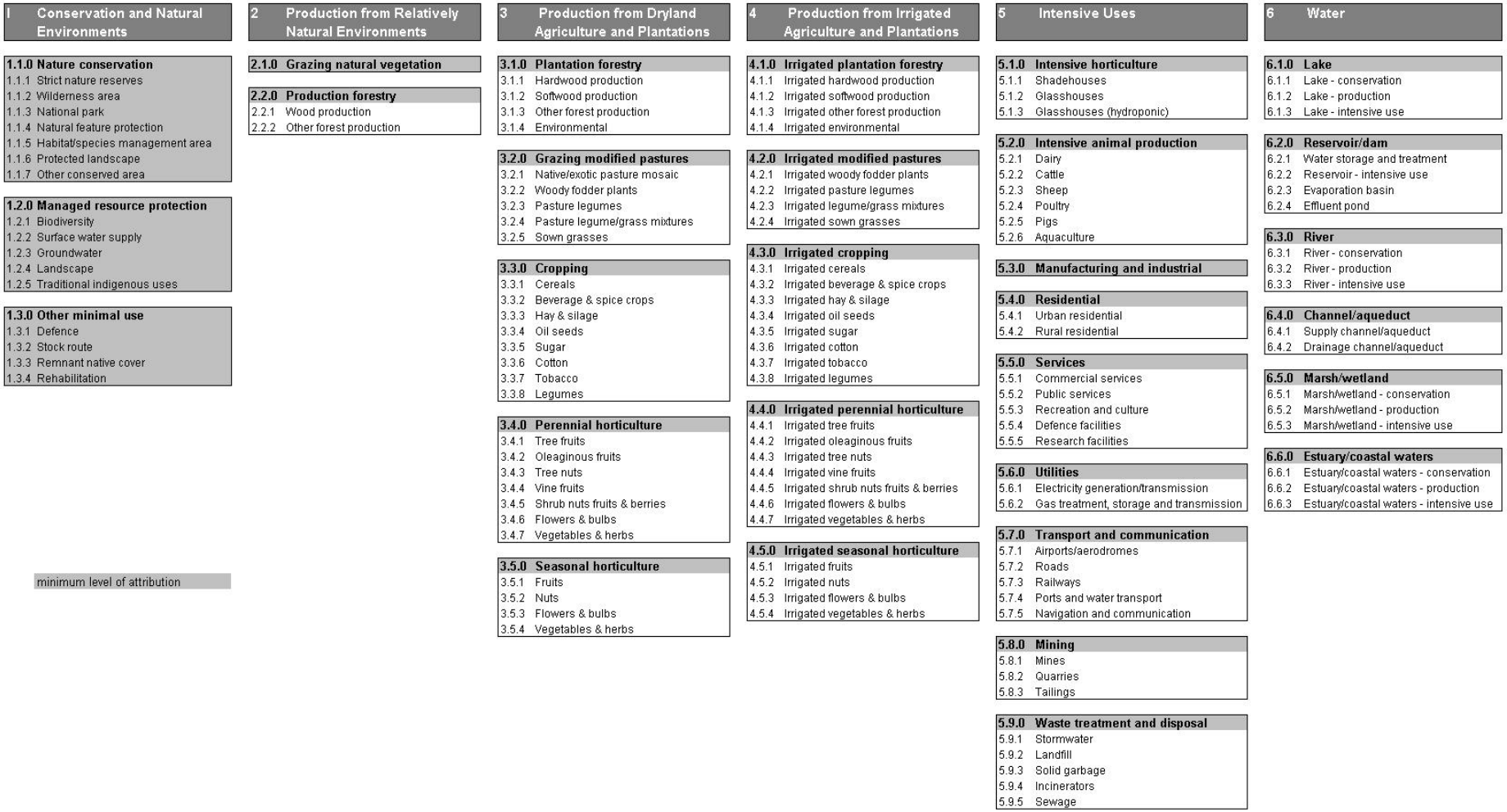
**Table 1**
**Primary Levels in the ALUM, WASLUC and ANZLUC Land Use Classification Systems**

| ALUM | WASLUC | ANZLUC |
|---|---|---|
| 1 Conservation and natural environments | 1 Housing | 1000 Accommodation |
| 2 Production from relatively natural environments | 2 Manufacturing | 2000 Manufacturing |
| 3 Production from dryland agriculture and plantations | 3 Fabricated metals manufacturing | 3000 Commerce |
| 4 Production from irrigated agriculture and plantations | 4 Transportation | 4000 Services |
| 5 Intensive uses | 5 Trade and industries | 5000 Agriculture, Forestry and Aquaculture |
| 6 Water | 6 Commercial land use | 6000 Mining or Extractive Indus |
| | 7 Cultural and recreational uses | 7000 Protected and Recreationa |
| | 8 Agriculture | 8000 Transport, Storage, Utilitie Communication |
| | 9 Conservation and unused land | 9000 Land not elsewhere classified |

The strength of the WASLUC and ANZLUC classifications is in their ability to discriminate intensive uses, especially those associated with commercial and industrial uses. The WASLUC and ANZLUC classifications comprise 1,122 and more than 1,400 classes respectively, with emphasis on commercial and industrial uses rather than rural and conservation land uses. For the 71 classes that discriminate dryland and irrigated agriculture at the tertiary level in the ALUM classification, there are 40 matching WASLUC and 64 ANZLUC classes. For the 19 tertiary ALUM classes describing uses associated with conservation and natural environments there are five WASLUC and 11 ANZLUC classes.

# D. ALUM Classification v5 - summary

The minimum expected level of attribution relates to land use mapping programs currently coordinated through BRS using the ALUM Classification (v5) as indicated below.



# E. ALUM class allocation – issues and special cases

It is inevitable that there will be areas of uncertainty in the application of the ALUM Classification. It may be unclear, for instance, which land use class applies to a particular activity - or an appropriate class may not be available. Alternatively, it may not be possible to confidently determine land use on the basis of available data or from field observations.

The purpose of this section is to identify currently known areas of uncertainty associated with the ALUM Classification, and to provide advice on how this uncertainty may be handled. In most cases suggestions are developed from the experience gained in State and Commonwealth land use mapping programs. These suggestions provide a common basis for handling areas of uncertainty, and for promoting consistency and comparability between different mapping programs.

The list of class allocation issues presented here is not exhaustive - additional issues will be identified as mapping expands into new regions with previously unmapped land uses. Any issues that arise, including suggestions as to handling, should be forwarded to BRS for inclusion in future editions of this document (see **Further information**, p46).

## (i) GENERAL ISSUES

### Hierarchical ordering

Where a particular land use cannot be allocated to a land use class at a given level in the classification due to ambiguity (eg several classes could apply at a particular level in the classification hierarchy) it should be allocated to the more generalised class at the next higher level in the hierarchy. If the problem is the absence of an appropriate class at a particular level of the classification hierarchy, then for the purposes of the project, a new class at that level in the hierarchy may be created.

### Prime use

The prime land use is determined on the basis of the primary management objective of the land manager. This means, for example, if there is a developed residential area within a national park, this town area would be classed as 5.4.1 'Urban residential', because the prime use of this area is urban/residential, not nature conservation.

### Handling multiple uses

A number of uses may apply to a particular parcel of land. Common examples include grazing in State forests, opportunity logging in grazed woodlands; rural residential areas on land where nature conservation agreements exist, grazing on land under rehabilitation, and strip cropping. If prime use only is recorded, important information about other uses of the land may be lost. Ancillary or secondary uses of the land should be recorded as a part of the land use mapping process where this information exists (see part G for technical details).

### Temporal change

The temporal frequency of land use change in human-dominated landscapes varies considerably. Some land uses may be relatively stable, remaining in place over decades or more. In other cases, land use turnover may be extremely rapid - this particularly applies where land use change is geared to seasonal or annual cycles, for example crop/pasture rotations. Where rapid turnover occurs, the temporal mis-match between source data and field verification poses difficulties. The agreed principle applying to current land use mapping work is to assign land use classes to land parcels at a particular point in time. This means, in the case of crop/pasture rotations, that the assigned land use

will be either a cropping class (3.3) or a modified pasture class (3.2). The particular rotation regime (which may be of critical importance in natural resource management terms) is a separate land management practice attribution issue.

**Source information**

More than one source of information may be available for assigning land use to a particular parcel of land. This information may be conflicting. Generally, the technical specifications and other metadata will indicate which information source should take precedence. However, if this is not self-evident then, as a general principle, the order of reliance should be 1) field observation, 2) expert knowledge (eg agriculture extension officer), 3) ancillary data, and 4) evidence from the adjoining/local areas.

**Attaching additional information**

A wide range of additional land information - particularly information about land cover and land management practices - can enhance the interpretation of land use. Indeed, land management practices information (the 'how' of land use) is critical for addressing sustainability and other natural resource management issues. Important ancillary information of this kind may be attached to the land use classification framework as supplementary attributes. Additional information can also be incorporated in project working codes (see part G for technical details).

**Managing uncertainty in class allocation**

During the mapping process immediate decisions about class allocation may be difficult (ie land use is not clearly identified or several different classes could apply). The use of project working codes referring to particular uncertainties means that hasty decisions about class allocation can be avoided and, if retained as a part of the land use dataset, enables class reallocation if needed in future (see part G for technical details). The use of working codes is not a basis for avoiding formal class allocation, nor is it a substitute for thorough field checking.

### (ii) CLASS RELATED ISSUES

**1.3.3 Remnant native cover**

All land uses involving conservation of, or production from, relatively natural environments retain native cover to a greater or lesser extent. However, the 'Remnant native cover', class is only appropriate where there is no applicable prime use, or where land use is indeterminate. Livestock may, for instance, occasionally graze 'Remnant native cover' but where grazing takes place on a regular or semi-regular basis, and this is the intended prime use for the land then 2.1 (or 3.2.1) is the appropriate class. This class also includes unusable land, such as cliffs, rock faces, boulders and tors.

**2.1 Grazing natural vegetation**

Difficulties may be encountered distinguishing livestock grazing on relatively natural environments from grazing on modified pastures. Some pastures, for example, can be dominated either by native species or exotics depending upon the season. Generally, where an exotic or native pasture component has been deliberately introduced or actively promoted, 3.2.1 'Native/exotic pasture mosaic' is most appropriate class. If native pasture is irrigated, it should be allocated to class 4.2. 'Irrigated modified pastures'.

**4. Production from Irrigated Agriculture and Plantations**

Land which is developed for irrigation may not always be actively irrigated due to seasonal or market conditions. In these circumstances, land may be left unused or put to alternative uses such as livestock grazing. Notwithstanding the general principle that land use classes be determined on the basis of use at a particular point in time, it is suggested that areas should be assigned to irrigation if permanent infrastructure for irrigation is present.

### 5.4.2 Rural residential

If rural land is managed as a hobby farm, it should assigned to 5.4.2 'Rural residential' - if not, it should be assigned to another use. The size of rural allotments or local government zoning plans may be useful indicators of rural residential land use.

## (iii) OTHER ISSUES

### Cemeteries and crematoria

Assign to 5.5.2 'Public services'.

### Eucalyptus oil plantations

Assign to 3.4 'Perennial horticulture' or 4.4 'Irrigated perennial horticulture' where trees are more intensively managed (eg coppiced and therefore in a shrub form); otherwise assign to 3.1.3 'Other forest production' or 4.1.3 'Irrigated other forest production'.

### Fallow/ploughed land

Rely on context in assigning fallow or ploughed land to a particular land use – make a judgement of the most likely land use option based on the dominant activity conducted in comparable nearby areas. Make note of fallowed or ploughed status in 'work_code' field (see part G Data specifications).

### Recreation areas

Assign to 1.1.7 'Other conserved area' if primarily native cover. If primarily cleared of native vegetation, then assign to 5.5.3 'Recreation and culture'.

### Tea-tree plantations

Assign to 3.4 'Perennial horticulture' or 4.4 'Irrigated perennial horticulture'.

### Tourist developments

Assign to 5.5.3 'Recreation and culture'.

### Turf farming

Assign to either 3.4 'Perennial horticulture' or 4.4 'Irrigated perennial horticulture'

### Cropping of pasture species for seed

Assign to 3.3.8 'Legumes' or 4.3.8 'Irrigated legumes' if legumes, or create new tertiary class if not.

### Strip cropping

Use multiple attribution at the tertiary level, or map to the secondary level 3.3 Cropping

### Zoos

Assign to 5.5.3 'Recreation and culture'.

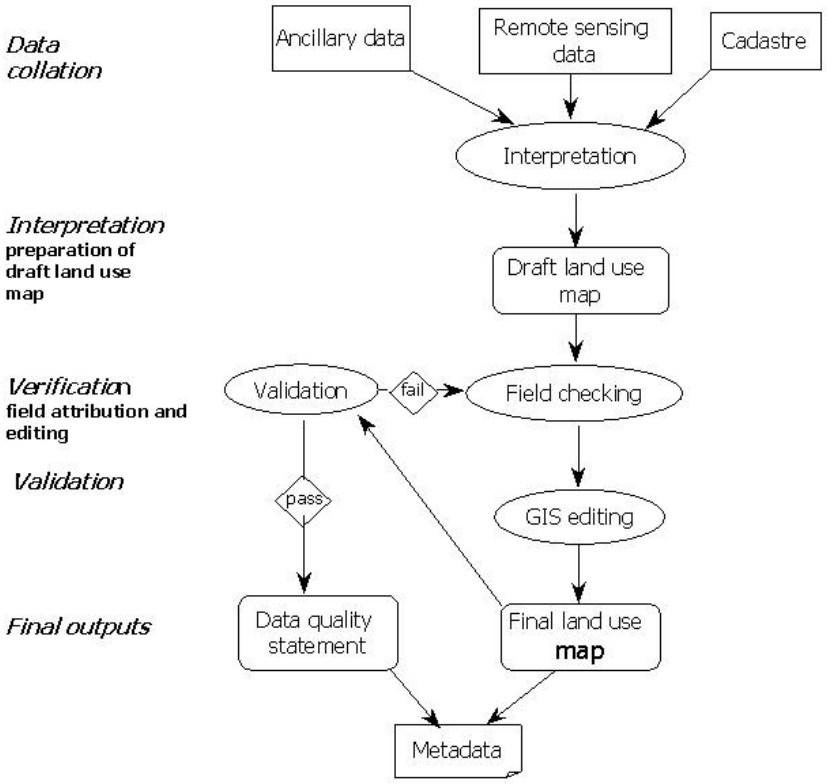
### Aquaculture

Assign to 5.2.6 'Aquaculture' under 5.2 'Intensive animal production'.

# F. Land use mapping procedure

The following section describes the agreed procedure for catchment scale land use mapping being undertaken through collaborative Commonwealth-State land use mapping programs supported by the Audit, MDBC and AFFA.

**Figure 5**
**Land Use Mapping Procedure**




**(i) DATA COLLATION**

1. Acquire cadastral boundaries.

2. Acquire appropriate remotely sensed data (air photos, Landsat Thematic Mapper (TM), Enhanced TM).

3. Acquire ancillary data. Ancillary data include state digital topographic mapping, State agency land capability, forestry, vegetation, and reserve mapping, and other state and regional vegetation, land cover and land management data.

4. Collate data in ARC/INFO GIS, check projection and adjust if necessary. Since remotely sensed data is in Universal Transverse Mercator, it is probably better to capture the GIS data in AMG and convert it to Geographic for the final outputs.

5. Create a list of mapsheets for project and assign progress code and date:

   Mapsheet number, name, progress date:
   Study area:

**Table 2**
**Project staging**

| Code | Description | Date | Action |
|---|---|---|---|
| 1 | Data collation complete | | Amend code and notify BRS. |
| 2 | Interpretation complete (prodn of draft land use maps) | | Amend code and notify BRS. |
| 3 | Field verification complete | | Amend code and notify BRS. |
| 4 | GIS edits complete | | Amend code and notify BRS. |
| 5 | Validation complete | | Amend code and notify, submit error matrix to BRS. |
| 6 | Project outputs for checking | | Amend code and notify, submit data to BRS, revise to standards |
| 7 | Outputs accepted by BRS | | Amend code |

### (ii) INTERPRETATION

6. Interpret data into appropriate land use classes and create land use mask data set with land use code attribute. Open lu_code.lut and enter land use code against the appropriate description (use fields lu_code; multiple_uses; work_code).

7. Enter interpreted data details into metadata table.

8. Check extent of interpreted classes against remotely sensed data.

9. Set vector tolerances for new features (see part G Data specifications, Table 10).

10. Capture new features, assigning them land use codes and update lu_code (multiple_uses; work_code) accordingly.

11. Clean and build draft land use data. Amend progress table.

### (iii) VERIFICATION

12. Plan field mapping. Meet with local field/extension officers, review draft mapping and identify problem areas for assessment in the field. Overlay roads and plan data collection routes.

13. Create field maps. Plot two sets of field maps; draft land use with cadastral boundaries and remotely sensed data with cadastral boundaries. The field maps should be at a finer scale (eg for 1:25,000 mapping, use 1:15,000 field maps). Create and print a look-up table with all land use codes for reference.

14. Meet local officers and annotate land use maps using their knowledge. Re-plan route for field data collection.

15. Label polygons with appropriate codes and annotate polygons for additional edits or deleting. Capture commodities and land management practices information where practicable. If class allocation is not possible at the time, annotate the map and photograph the site.

16. If attributing directly into ArcView with Blue Marble Geographic Tracker connected to a GPS, use field maps as a back-up.

17. Amend progress table and e-mail to BRS.

### (iv) GIS EDITING

18. Check all the features are correctly labelled and any problems are sorted out prior to final edits. Update lu_code.lut and metadata document.

19. Clean and build data and project (see part G Data specifications, Table 5).

20. Create data structure (see part G Data specifications, Table 6).

21. Build data and prepare it for validation. Complete metadata statement. Amend progress table.

### (v) VALIDATION

For land use mapping, validation is primarily concerned with assessing thematic or attribute accuracy under the ALUM Classification (see part G Data specifications (iii) Accuracy). Validation may be approached in a number of ways. Focus may, for instance, be placed on assessing the accuracy/reliability of the interpreter; alternatively the assessment may be designed to measure the accuracy of mapping in comparison to the 'real world' at a particular point in time. The cost of the validation exercise must remain reasonable in relation to the cost of producing the land use dataset.

The recommended validation procedure compares attribute information in the land use dataset with attribute information obtained from high quality data not used previously for base mapping (field survey or large-scale aerial photography). The procedure is as follows:

22. Field validation should be carried out shortly after completion of the land use dataset by a team that has not participated in its compilation.

23. A minimum of 50 sample sites should be established per mapsheet at the nominated scale of mapping. The time taken to field validate 50 sites should be approximately 1 day (2 people; 1 vehicle).

24. A frequency analysis of the mapsheet by land use code should be compiled to ascertain the percentage of the map covered by each land use class. The number of sample sites allocated to each land use will be proportional to the area of each land use class. For example, 25 sites out of 50 will be located in a land use class that covers 50% of the map sheet area. If a land use covers less than 2% of the mapsheet, it is not assessed. Exclude from consideration land use classes that cannot readily be tested/validated by field observation. This includes land use classes defined by tenure or management (see Table 3).

**Table 3**
**ALUM Classes Not Amenable to Field Validation**

| | | | |
|---|---|---|---|
| 1.1 | Nature conservation | | |
| | | 1.1.1 | Strict nature reserves |
| | | 1.1.2 | Wilderness area |
| | | 1.1.3 | National park |
| | | 1.1.4 | Natural feature protection |
| | | 1.1.5 | Habitat/species management area |
| | | 1.1.6 | Protected landscape |
| | | 1.1.7 | Other conserved area |
| 1.2 | Managed resource protection | | |
| | | 1.2.1 | Biodiversity |
| | | 1.2.2 | Surface water supply |
| | | 1.2.3 | Groundwater |
| | | 1.2.4 | Landscape |
| | | 1.2.5 | Traditional indigenous uses |
| 1.3 | Other minimal use | | |
| | | 1.3.1 | Defence |
| | | 1.3.2 | Stock route |

25. Sample sites are located in a three stage process.

(i) A sampling grid (125m for 1:25,000; 250m for 1:50,000; 500m for 1:100,000; 1.5k for 250,000) is intersected with the sealed and unsealed road network. Where complex road networks exist, the network may be rationalised to promote efficiency in field effort.

(ii) Potential sample sites are identified within land use polygons adjoining each intersection. Exclude sites within 500m of road intersections and houses to allow for edge effects.

(iii) The required number of sampling sites are randomly selected within each identified land use class. Sites may need to be re-defined (eg by locating additional access routes) if the initial road selection does not pass adjacent to all mapped land uses.

26. Land uses at sample sites are recorded by independent observers.

27. Construct an error matrix, comparing mapped land use classes at sample sites with independently observed land use classes: eg Table 4.

**Table 4**
**Field Validation Error Matrix (example)**

| **Classified data** | **3.4.0** | **4.6.0** | **5.1.0** | **2.3.0** | **Row total** | **Row %** |
|---|---|---|---|---|---|---|
| **3.4.0** | 10 | 1 | 2 | 0 | 13 | 76.92 |
| **4.6.0** | 1 | 7 | 1 | 0 | 9 | 77.77 |
| **5.1.0** | 1 | 0 | 3 | 0 | 4 | 75.00 |
| **2.3.0** | 1 | 0 | 0 | 21 | 22 | 95.45 |
| **Column total** | 13 | 8 | 6 | 21 | 48 | |
| **Column %** | 76.92 | 87.50 | 50.00 | 100.00 | | |

overall accuracy = (10+7+3+21)/48 = 85.42%

28. Overall accuracy greater than 80% meets the specification. If the map fails, check which land uses cause failure and re-map them (do not only update the polygons found to be wrong during validation). Carry out validation procedure again.

29. Report to include frequency analyses, map of sample sites and error matrix for each mapsheet.

This validation procedure is designed to give users a general indication of the attribute accuracy of mapping. The number of sample points, for instance, limits the confidence that can be placed in measures of accuracy for land use classes of small areal extent.

A validation procedure based on non-field information (eg large-scale aerial photography) can be developed in a similar way. In this instance, the existing road network does not confine the location of sample sites. The information used for validation should not have been used as the original mapping base. The error matrix and data source(s) used for validation should be included in the metadata for the dataset.

### (vi) FINAL OUTPUTS

30. Send BRS mapsheet data set as ARC/INFO export or TAR file onto BRS FTP site (ftp.brs.gov.au/incoming/1LW1) and e-mail BRS. Complete metadata and send as accompanying text file (see part H Metadata specifications).

31. BRS will carry out a data quality assessment, including positional accuracy, returning data that do not meet specifications to State agencies for corrections (see part I Data quality statement).

32. Complete final edits as per data quality statement. Complete metadata. BRS will carry out a final check and notify State agencies of data set acceptance.

# G. Data specifications

## (i) DATA FORMAT AND SPATIAL REFERENCING

**Table 5**
**Data Format and Spatial Referencing**

| | |
|---|---|
| **Final data format** | ARC/INFO polygon coverage |
| **Coordinate system** | Geographic with GDA94 datum<br>Spheroid GRS1980<br>Projection geographic<br>Units dd (decimal degrees)<br>Datum GDA94 |

## (ii) DATA STRUCTURE

The recommended data structure for land use datasets provides for the attribution of land use polygons with information about

- the prime land use (represented by ALUM code and associated descriptor),
- the primary information source (scale, date, and reliability - ie information type),
- secondary or 'ancillary' land uses (optional), and
- a working code (optional) relating information about particular land use and classification issues.

**Table 6**
**Data Structure**

| Attribute | Format* | Description | Example |
|---|---|---|---|
| Lu_code | C 8 8 | ALUM land use code | 4.5.1 |
| Lu_description | C 36 36 | Description of land use | Irrigated fruits |
| Source_scale | C 8 8 | Scale of source data | 1:100,000 |
| Source_date | D 8 10 | Date of spatial feature eg image date, air photo date, ancillary data date | xx/xx/xxxx (day/month/year) |
| Reliability | B 4 5 | Reliability of attribute | 1 = field mapping/local knowledge<br>2 = ancillary dataset<br>3 = air photo<br>4 = SPOT imagery<br>5 = Landsat ETM/TM<br>6 = other |
| Luc_date | D 8 10 | Date of land use code | xx/xx/xxxx (day/month/year) |

* ARC/INFO item definition

| Attribute | Format | Description | Example |
|---|---|---|---|
| Multiple_uses | B 4 5 | Ancillary uses associated with a parcel of land - ALUM codes | 1 - n (link to lookup table - see example below) |
| Work_code | B 4 5 | Project working code - description of project specific situations & classification decisions | 1 - n (link to lookup table - see example below) |
| xxxxxx | xxxxx | Other attributes as required | |

Lookup tables are linked to Multiple_uses and Work_code attribute fields. Examples of appropriate lookup table formats are shown below (Table 7).

**Table 7**
**Multiple Uses Lookup Table Format**

MULTIPLE_USES.LUT

| MULTIPLE_USES | CODES |
|---|---|
| 1 | 2.2.0 |
| 1 | 2.1.0 |
| 1 | 5.5.3 |
| 2 | 3.4.0 |
| 2 | 3.3.0 |
| 3 | 5.4.2 |
| 3 | 3.3.1 |

1 = a production forest, with livestock grazing and recreation as ancillary uses
2 = strip cropping, cropping represented as prime use with grazing modified pastures as an ancillary use
3 = rural residential as prime use, with livestock grazing in native/exotic pasture mosaic
(**note** - prime use included in code listing).

**Table 8**
**Work Code Lookup Table Format**

WORK_CODE.LUT

| WORK_CODE | DESCRIPTION |
|---|---|
| 1 | Pastures are dominated by improved species, but with more than 30% of the area now dominated by weeds. Principal weeds observed in the aerial photographs are bracken fern and blackberry. |
| 2 | Native forest - filter strips in softwood plantation - in State forest. |
| 3 | Native forest - filter strips in softwood plantation - outside State forest. |

### (iii) ACCURACY

The accuracy of a dataset refers to the relationship between a measurement or record in the dataset, compared with 'reality' (usually a standard or accepted value). It is a relative concept that requires judgement as to whether 'reality' is represented with sufficient accuracy for a particular purpose. Accuracy can be considered in terms of data resolution, spatial precision, and thematic or attribute accuracy.

**Data Resolution**

When used to describe vector data, data resolution is the size of the smallest geographic entity that can be mapped at a given scale and still effectively communicate the entity's location and shape - the minimum mapping unit. Minimum data resolution is generally not absolute, but is determined on the basis of the scale of the information sources from which the dataset is derived, the purposes of the data, the intended final mapping scale, data processing requirements and cartographic conventions. It also represents a trade-off between mapping cost and information need.

Land use datasets are generally developed using a wide variety of information sources (such as satellite imagery and cadastre) and have potential use in a wide range of applications.

Data resolution standards for land use mapping are flexible, constrained primarily by the data resolution of source data. The recommended data structure (Table 6) allows source and scale information for each feature to be retained in the attribute field, with information about particular spatial standards also detailed in the metadata. This means that data resolution specifications for features may vary within a single land use dataset according to the standards that apply to source information.

Data resolution standards may also vary according to the significance of features being mapped. Intensive land use features that are readily discriminated may, for instance, be mapped with higher resolution standards than extensive, low intensity land uses. Minimum standard guidelines nevertheless promote consistency in the way land use features are handled and represented, particularly for the preparation of original mapping. Suggested specifications are indicated in Table 9.

**Table 9**
**Data Resolution Specifications for Land Use Datasets**

| **Scale of mapping** | 1:25,000 | 1:50,000 | 1:100,000 | 1:250,000 |
|---|---|---|---|---|
| **Surface area of the smallest mapped feature** | | | | |
| field area | 0.25ha | 1ha | 4ha | 25ha |
| graphic area | 2x2mm | 2x2mm | 2x2mm | 2x2mm |
| **Minimum width for linear features *** | | | | |
| field area | 25m | 50m | 100m | 250m |
| graphic width | 1mm | 1mm | 1mm | 1mm |

Land use information produced by the current mapping program is likely to be widely used by local authorities and community groups such as Landcare. Roads and water features are commonly used as points of reference in the landscape and may be important in applications such as water quality assessment and emergency services planning. Major roads - sealed roads of two or more lanes (outside built-up areas) - should be represented in all catchment scale land use mapping. Road and water course information may be incorporated into mapping by several means:

I. sourcing from topographic datasets at appropriate scale;

II. sourcing from the State cadastre (for roads) using ancillary information as a guide to identification, and
III. on-screen digitising directly from source imagery using ancillary information as a guide.

The methods and data sources used for mapping these features should be detailed in the metadata.

**Spatial Precision**

Spatial precision or positional accuracy is the variation among individual measurements of geographic coordinates from a spatial reference. The spatial precision of final outputs is affected by the spatial precision of source information, digitising and data processing methods. Spatial accuracy should be tested by comparing the positions of points whose locations are shown with corresponding positions as determined by surveys of a higher accuracy (see part I Data quality statement).

**Table 10**
**Spatial Precision Specifications for Land Use Datasets**

| | | | | |
|---|---|---|---|---|
| **Positional accuracy** | | | | |
| vector | Graphical deviation from source material should not exceed 0.5mm at the nominated scale of mapping (50m at 1:100,000 scale) | | | |
| raster | Image rectification at 0.5 pixel root mean square, absolute image displacement at 4 pixels | | | |
| **Raster processing** | no greater than original pixel size | | | |
| **Vector tolerances** | *Fuzzy tolerance (m)* | *Snap distance (m)* | *Weed (m)* | *Grain (m)* |
| at 1:100,000 | 5.080 | 50.8 | 50.8 | 50.8 |
| at 1:50,000 | 2.540 | 25.4 | 25.4 | 25.4 |
| at 1:25,000 | 1.270 | 12.7 | 12.7 | 12.7 |
| **Output extent** | extent of mapsheets covering project area plus 1 km on all sides for edge-matching | | | |

**Thematic or Attribute Accuracy**

Thematic or attribute accuracy is a measure of success (usually expressed as a percentage) in assigning the polygons of a thematic map to their correct categories. The required attribute accuracy for land use mapping is greater than 80 percent.

Attribute accuracy is determined by locating a sample of land use features on the ground, classifying them under the ALUM nomenclature and comparing them to the land use classes depicted in the land use dataset. The validation procedure outlined in this document (see part F Land use mapping procedure, (v) Validation) is concerned with establishing thematic or attribute accuracy.

**Dataset size and complexity**

Particular care needs to be taken to ensure that stages in the assembly of land use datasets, particularly the processing of polygonal data, do not lead to unnecessary size, complexity, or the corruption of topology. Unnecessarily large and complex datasets reduce manageability and severely limit the utility of the data. In particular, the area of polygons should be no smaller than the recommended minimum data resolution of source data (Table 9). For example, if 1:25,000 scale input data is available for use in developing a land use dataset at a nominal 1:100,000 scale, the minimum area for polygons derived from this input data should be no smaller that 0.25ha.

The integrity of data topology should also be maintained, with particular attention given to ensuring that the 'fuzzy tolerance' matches the scale of data being processed (Table 10). The fuzzy tolerance is the minimum distance separating arc coordinates in an ARC/INFO coverage. If two or more coordinates are within this distance, they are snapped together. In addition

- no sliver polygons should be present in the dataset (very small polygons that are artefacts of data processing) and
- there should be no 'dangle' errors (arcs not forming part of a polygon).

## H. Metadata specifications (after ANZLIC metadata standards)

Metadata is a structured summary of information that describes the data. Metadata includes, but is not restricted to, characteristics such as the content, quality, currency, access and availability of the data. The following specifications derive from the ANZLIC set of core metadata elements, or page 0 (version 2, February 2001). Further details are available at the ANZLIC web page: www.anzlic.org.au/asdi/metaelem.htm

| Category | Element | Definition of Element | Obln | Max Occ | Field Type |
|---|---|---|---|---|---|
| **Dataset** | Title | The ordinary name of the dataset. | M | 1 | Text(160) |
| **Custodian** | Custodian | The business name of the custodial organisation or responsible party associated with the dataset. | M | 1 | Text(120) |
| | Jurisdiction | The state or country in which the Custodian of the dataset is domiciled. | M | 1 | Text(30) |
| **Description** | Abstract | A brief narrative summary of the content of the dataset. | M | 1 | Text(2000) |
| | Search Word | Words likely to be used by a non-expert to find the dataset. | M | N | Text(60) |
| | Geographic Extent Name (GEN) | The ordinary name of one or more pre-defined, known geographic objects that reasonably show the extent of geographic coverage of the dataset. This element is usually implemented as three discrete elements as listed below | O | N | |
| | GEN Category | Category to which the Geographic Extent Name belongs including map series, local government area, and drainage divisions and major river basins. | C | 1[1] | Text(80) |
| | GEN Custodial Jurisdiction | Country, state or territory that is responsible for maintaining the detail of the geographic object | C | 1[1] | Text(30) |
| | GEN Name | Name of the geographic object. | C | 1[1] | Text(80) |
| | Geographic Extent Polygon | Boundary enclosing the dataset expressed as a closed set of geographic coordinates (latitude, longitude) of the polygon referenced to GDA94. This is an alternate way of describing geographic extent of the dataset if no pre-defined area is satisfactory. | O | N | Text(1000) |
| | Geographic Bounding Box | A rectangle defining the minimum and maximum coordinates of the entire data. This element is implemented as four discrete elements as listed below. | M | 1 | |
| | North Bounding Latitude | Northern-most coordinate of the limit of the dataset expressed in latitude, in decimal degrees. | M | 1 | Signed Real Number |
| | South Bounding Latitude | Southern-most coordinate of the limit of the dataset expressed in latitude, in decimal degrees. | M | 1 | Signed Real Number |
| | East Bounding Longitude | Eastern-most coordinate of the limit of the dataset expressed in longitude, in decimal degrees | M | 1 | Signed Real Number |
| | West Bounding Longitude | Western-most coordinate of the limit of the dataset expressed in longitude, in decimal degrees. | M | 1 | Signed Real Number |
| **Data Currency** | Beginning date | Earliest date at which the phenomena in the dataset actually occurred. | M | 1 | Text(10) |
| | Ending date | Latest date at which the phenomena in the dataset actually occurred. | M | 1 | Text(10) |

| | | | | | |
|---|---|---|---|---|---|
| **Dataset Status** | Progress | The status of the process of creation of the dataset. | M | 1 | Text(20) |
| | Maintenance and Update Frequency | Frequency of changes or additions that are made to the dataset after its initial completion. | M | 1 | Text(20) |
| **Access** | Stored Data Format | The format in which the dataset is stored by the custodian. | M | 1 | Text(500) |
| | Available Format Type | The format in which the dataset is available. | O | N | Text(240) |
| | Access Constraint | Any restrictions or legal prerequisites that may apply to the access and use of the dataset including licensing, liability and copyright. | M | 1 | Text(500) |
| **Data Quality** | Lineage | A brief history of the source and processing steps used to produce the dataset. | M | 1 | Text(4000) |
| | Positional Accuracy | A brief assessment of the closeness of the location of spatial objects in the dataset in relation to their true position on the Earth. | M | 1 | Text(4000) |
| | Attribute Accuracy | A brief assessment of the reliability assigned to features in the dataset in relation to their real world values. | M | 1 | Text(4000) |
| | Logical Consistency | A brief assessment of the degree of adherence of logical rules of data structure, attribution and relationships. Data structure can be conceptual, logical or physical. | M | 1 | Text(4000) |
| | Completeness | A brief assessment of the extent and range in regard to completeness of coverage, completeness of classification and completeness of verification. | M | 1 | Text(4000) |
| **Contact Information** | Contact Organisation | Name of the organisation from which the dataset may be obtained. | M | 1[2] | Text(120) |
| | Contact Position | The position in the Contact Organisation that will answer questions about the dataset. | M | 1[2] | Text(40) |
| | Mail Address | Postal address or delivery point of the Contact Position. | M | 2[2] | Text(40) |
| | Locality | Locality associated with the Mail Address. | M | 1[2] | Text(60) |
| | State | State associated with the Mail Address | M | 1[2] | Text(40) |
| | Country | Country associated with the Mail Address. | M | 1[2] | Text(40) |
| | Postcode | Postcode associated the Mail Address. | M | 1[2] | Text(10) |
| | Telephone | Telephone number of the Contact Position. | O | 1[2] | Text(25) |
| | Facsimile | Facsimile number of the Contact Position. | O | 1[2] | Text(25) |
| | Electronic Mail Address | Electronic Mail Address of the Contact Position. | O | 1[2] | Text(80) |
| **Metadata Date** | Metadata Date | Date on which the metadata record was created or modified. | M | 1 | Text(10) |
| **Additional Metadata** | Additional Metadata | Any additional metadata the supports documentation of the dataset including a reference to another directory or report.<br><br>Include funding statement: Funds for the completion of dataset were provided by [nominee agencies]. Data quality statement is contained in attached file. | O | 1 | Text(4000) |

[1] Dependent upon the repeatability of the parent element.
[2] Number of occurrences associated with each contact – a dataset may have many contacts
M mandatory
O optional
C conditional

# I. Data quality statement


**DATA QUALITY STATEMENT**

**Data set details**

Coverage name:
Stored on:
Date:
Contact officer:
Contact address:

Type:
Size:
Custodian:
Contact telephone:
E-mail:

**Compliance with specifications**
(for more detail see http://www.affa.gov.au - links to BRS, Landscape Management Sciences, Land Use and Land Management Practices Mapping for Australia)

| | | Details of Compliance | ✓/✖ |
|---|---|---|---|
| Metadata | ANZLIC Page 0 | | |
| | ANZLIC Page 1 | | |
| | Report | | |
| | Map | | |
| Spatial data standards | Topology | | |
| | Attributes | | |
| | Labelling | | |
| | Errors | | |
| | Lookup tables | | |
| | Tolerances | | |
| | Unique IDs | | |
| Classification | Classes | | |
| Spatial referencing systems | Projection | | |
| | Position | | |
| | Overlap | | |
| Data transfer standards | Transfer file | | |
| | Media | | |
| Validation | Data | | |
| | Currency | | |

| *Assessment of data formats and structure*: |
|---|
| |

| *Assessment of classification*: |
|---|
| |

| **Compliance requirements:** | ✓/✖ |
|---|---|
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Data compliance

| Compliant / not yet compliant |
|---|

Checked by: XXXXXX Date: XX/XX/XXXX

Bureau of Rural Sciences
PO Box E11
Kingston ACT 2604

Tel : XXXXXXXX
E-mail: XXXXX@brs.gov.au

# J. Conversion of ABS commodities to ALUM v5 classification

| ABS Commodities | Comments | ALUM Code v5 | |
|---|---|---|---|
| | | dryland | irrigated |
| ***Cereals*** | | | |
| barley | | 3.3.1 | 4.3.1 |
| grain sorghum | | 3.3.1 | 4.3.1 |
| oats | | 3.3.1 | 4.3.1 |
| rice | | 3.3.1 | 4.3.1 |
| wheat | | 3.3.1 | 4.3.1 |
| maize | | 3.3.1 | 4.3.1 |
| canary seed | | 3.3.1 | 4.3.1 |
| Millet and pancium | (incl. Canary seed) | 3.3.1 | 4.3.1 |
| buckwheat | | 3.3.1 | 4.3.1 |
| triticale | | 3.3.1 | 4.3.1 |
| ***Vegetables*** | | | |
| artichokes | | 3.5.4 | 4.5.4 |
| asparagus | | 3.4.7 | 4.4.7 |
| broad beans | cf faba bean | 3.5.4 | 4.5.4 |
| french beans | cf snap, kidney, string, haricot, common bean | 3.5.4 | 4.5.4 |
| beetroot | cf sugar, silver, spinach, chard and fodder beet | 3.5.4 | 4.5.4 |
| bitter melon | cf gourd | 3.5.4 | 4.5.4 |
| broccoli | | 3.5.4 | 4.5.4 |
| brussels sprouts | | 3.5.4 | 4.5.4 |
| cabbages | | 3.5.4 | 4.5.4 |
| chinese cabbages | | 3.5.5 | 4.5.5 |
| capsicums | also known as sweet pepper | 3.5.4 | 4.5.4 |
| carrots | | 3.5.4 | 4.5.4 |
| cauliflowers | | 3.5.4 | 4.5.4 |
| celery | | 3.5.4 | 4.5.4 |
| chicory | | 3.4.7 | 4.4.7 |
| chokos | | 3.4.4 | 4.4.4 |
| cucumbers | | 3.4.4 | 4.4.4 |
| eggplants | also known as aubergine | 3.5.4 | 4.5.4 |
| fennel | also aniseed, dill | 3.4.7 | 4.4.7 |
| garlic | | 3.5.4 | 4.5.4 |
| gherkins | | 3.4.4 | 4.4.4 |
| herbs | | 3.5.4 | 4.5.4 |
| leeks | | 3.5.4 | 4.5.4 |
| lettuces | | 3.5.4 | 4.5.4 |
| marrows and squashes | | 3.5.4 | 4.5.4 |
| melons | includes rock melon, cantaloupe, musk and honeydew melon | 3.4.4 | 4.4.4 |
| watermelons | cf jam, camel melon | 3.4.4 | 4.4.4 |
| mushrooms | | 5.1.1 | |
| okra | | 3.4.5 | 4.4.5 |
| Onions, white and brown | cf spring onions, shallots | 3.5.4 | 4.5.4 |
| parsley | | 3.5.4 | 4.5.4 |
| parsnips | | 3.5.4 | 4.5.4 |
| peas | cf garden pea | 3.5.4 | 4.5.4 |

| ABS Commodities | Comments | ALUM Code v5 | |
|---|---|---|---|
| | | dryland | irrigated |
| potatoes | cf sweetpotatoes | 3.5.4 | 4.5.4 |
| pumpkins | also squash, cattle pumpkin | 3.5.4 | 4.5.4 |
| radishes | | 3.5.4 | 4.5.4 |
| rhubarb | | 3.4.7 | 4.4.7 |
| silverbeet and spinach | | 3.5.4 | 4.5.4 |
| snowpeas | | 3.5.4 | 4.5.4 |
| spring onions and shallots | | 3.5.4 | 4.5.4 |
| swedes | cf turnips | 3.5.4 | 4.5.4 |
| sweetcorn | cf maize, corn | 3.5.4 | 4.5.4 |
| sweetpotatoes | | 3.5.4 | 4.5.4 |
| tomatoes | | 5.1.2 | |
| turnips | | 3.5.4 | 4.5.4 |
| zucchini | Also known as courgette, Cucurbita pepo | 3.5.4 | 4.5.4 |
| ***Fruit and nuts*** | | | |
| grapefruit | | 3.4.1 | 4.4.1 |
| lemons and limes | | 3.4.1 | 4.4.1 |
| mandarins | | 3.4.1 | 4.4.1 |
| oranges | | 3.4.1 | 4.4.1 |
| tangelos | | 3.4.1 | 4.4.1 |
| grapes | | 3.4.4 | 4.4.4 |
| apples | | 3.4.1 | 4.4.1 |
| pears | | 3.4.1 | 4.4.1 |
| nashi pears | | 3.4.1 | 4.4.1 |
| quinces | | 3.4.1 | 4.4.1 |
| apricots | | 3.4.1 | 4.4.1 |
| cherries | | 3.4.1 | 4.4.1 |
| nectarines | | 3.4.1 | 4.4.1 |
| peacharines | | 3.4.1 | 4.4.1 |
| peaches | | 3.4.1 | 4.4.1 |
| plums and prunes | | 3.4.1 | 4.4.1 |
| avocadoes | | 3.4.1 | 4.4.1 |
| carambolas | | 3.4.1 | 4.4.1 |
| custard apples | | 3.4.1 | 4.4.1 |
| dates | | 3.4.1 | 4.4.1 |
| figs | | 3.4.1 | 4.4.1 |
| guavas | | 3.4.1 | 4.4.1 |
| jackfruit | | 3.4.1 | 4.4.1 |
| loquats | | 3.4.1 | 4.4.1 |
| longans | | 3.4.1 | 4.4.1 |
| lychees | | 3.4.1 | 4.4.1 |
| mangoes | | 3.4.1 | 4.4.1 |
| persimmons | | 3.4.1 | 4.4.1 |
| rambutans | | 3.4.1 | 4.4.1 |
| babacos | | 3.4.1 | 4.4.1 |
| bananas | | 3.4.1 | 4.4.1 |
| blackcurrants | | 3.4.5 | 4.4.5 |
| blueberries | | 3.4.5 | 4.4.5 |
| gooseberries | | 3.4.5 | 4.4.5 |

| ABS Commodities | Comments | ALUM Code v5 | |
|---|---|---|---|
| | | dryland | irrigated |
| kiwifruit | | 3.4.5 | 4.4.5 |
| loganberries | | 3.4.5 | 4.4.5 |
| papaws | | 3.4.1 | 4.4.1 |
| passionfruit | | 3.4.4 | 4.4.4 |
| pepinos | | 3.4.1 | 4.4.1 |
| pineapples | | 3.4.5 | 4.4.5 |
| raspberries | | 3.4.5 | 4.4.5 |
| rosella | | 3.4.5 | 4.4.5 |
| strawberries | | 3.4.7 | 4.4.7 |
| ***Nuts*** | | | |
| almonds | | 3.4.3 | 4.4.3 |
| cashews | | 3.4.3 | 4.4.3 |
| chestnuts | | 3.4.3 | 4.4.3 |
| hazelnuts, filberts and cobnuts | | 3.4.3 | 4.4.3 |
| macadamia | | 3.4.3 | 4.4.3 |
| pecan nuts | | 3.4.3 | 4.4.3 |
| pistachio | | 3.4.3 | 4.4.3 |
| walnuts | | 3.4.3 | 4.4.3 |
| ***Oil seeds and oleaginous fruits*** | | | |
| canola/rapeseed | | 3.3.4 | 4.3.4 |
| cotton seed | | 3.3.4 | 4.3.4 |
| linseed/linola | | 3.3.4 | 4.3.4 |
| mustard seed | | 3.3.4 | 4.3.4 |
| oil poppies | | 3.3.4 | 4.3.4 |
| peanuts | | 3.3.4 | 4.3.4 |
| safflower | | 3.3.4 | 4.3.4 |
| sesame | | 3.3.4 | 4.3.4 |
| soybeans | | 3.3.4 | 4.3.4 |
| sunflower | | 3.3.4 | 4.3.4 |
| ***Flowers and bulbs*** | | | |
| cut flowers | | 3.5.6 | 4.5.6 |
| mushroom spawn | | 5.1.1 | |
| nursery stock | | 5.1.0 | 5.1.0 |
| orchard trees | | 3.4.1 | 4.4.1 |
| nut trees | | 3.4.3 | 4.4.3 |
| turf | | 3.4.0 | 4.4.0 |
| ***Beverage and spice crops*** | | | |
| cocoa | | 3.3.2 | 4.3.2 |
| coffee | | 3.3.2 | 4.3.2 |
| tea | | 3.3.2 | 4.3.2 |
| ginger | | 3.3.2 | 4.3.2 |
| pepper | | 3.3.2 | 4.3.2 |
| ***Tobacco*** | | 3.3.7 | 4.3.7 |
| ***Sugar manufacturing*** | | | |
| sugarcane | | 3.3.5 | 4.3.5 |
| sugarbeet | | 3.5.4 | 4.5.4 |
| ***Raw vegetable materials*** | | | |

| ABS Commodities | Comments | ALUM Code v5 | |
|---|---|---|---|
| | | dryland | irrigated |
| seed cotton | | 3.3.6 | 4.3.6 |
| cotton lint | | 3.3.6 | 4.3.6 |
| cotton, raw | | 3.3.6 | 4.3.6 |
| ***Crops for seed*** | | | |
| lupins | | 3.3.8 | 4.3.8 |
| vetches | | 3.3.8 | 4.3.8 |
| ***Hay and silage*** | | | |
| hay | | 3.3.3 | 4.3.3 |
| cereal legume mixtures | | 3.3.3 | 4.3.3 |
| cereal crops cut for hay | | 3.3.3 | 4.3.3 |
| pastures cut for hay | | 3.3.3 | 4.3.3 |
| other crops cut for hay | | 3.3.3 | 4.3.3 |
| lucerne | | 3.3.3 | 4.3.3 |
| ***Other crops*** | | | |
| aloe vera | | 3.3.0 | 4.3.0 |
| essential oil crops | | 3.3.4 | 4.3.4 |
| chickpeas | | 3.3.8 | 4.3.8 |
| field beans | | 3.3.8 | 4.3.8 |
| olives | | 3.4.2 | 4.4.2 |
| field peas | | 3.3.8 | 4.3.8 |
| hops | | 3.3.0 | 4.3.0 |
| lupins | | 3.3.8 | 4.3.8 |
| tea tree | | 3.4.5 | 4.4.5 |
| ***Sown pastures*** | | | |
| pure lucerne | | 3.2.3, 3.3.3 | 4.2.3, 4.3.3 |
| lucerne/pasture mixtures | | 3.2.4 | 4.2.4 |
| pasture legumes | | 3.2.3 | 4.2.3 |
| perennial grasses/lucerne mixture | | 3.2.4 | 4.2.4 |
| annual grasses/lucerne mixture | | 3.2.4 | 4.2.4 |
| sown grasses | | 3.2.5 | 4.2.5 |
| ***Native pastures*** | | 2.1.2 | |
| ***Pasture seed*** | If not legumes, create new class | 3.3.8 | 4.3.8 |
| ***Livestock numbers*** | | | |
| cattle/calves | depends on pasture type or production intensity | 2.1.9, 3.2.0, 5.2.1, 5.2.2 | 4.2.0 |
| sheep/lambs | depends on pasture type or production intensity | 2.1.0, 3.2.0, 5.2.3 | 4.2.0 |
| pigs | | 5.2.5 | |
| horses | depends on pasture type | 2.1.0, 3.2.0 | 4.2.0 |
| beehives | | 5.2.0 | |
| chickens | | 5.2.4 | |
| ducks | | 5.2.4 | |
| turkeys | | 5.2.4 | |
| ***Forest type*** | | | |
| native forests | | 2.2.0 | |
| softwood plantation | | 3.1.2 | 4.1.2 |
| hardwood plantation | | 3.1.1 | 4.1.1 |
| agroforestry | depends on tree type | 3.1.0 | 4.1.0 |

# References


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***Land use datasets***


Land Use Mapping of the Fitzroy Catchment, Queensland. (2000) 1:100,000 scale, National Land and Water Resources Audit. Queensland Department of Natural Resources.

Land Use Mapping Mount Loft Ranges, South Australia. (1999) 1:50,000 scale, National Land and Water Resources Audit. Primary Industries and Resources South Australia.

Land Use of Australia 1996/97, Version 2, National Land and Water Resources Audit.

## Further Information

This document will be updated from time to time. The current version, and further information about land use mapping in Australia is available from the

**Bureau of Rural Sciences** - www.affa.gov.au (follow the links to Landscape Management Sciences, Land Use and Land Management Practice Mapping for Australia), and the **National Land and Water Resources Audit** - www.nlwra.gov.au

Inquires should be directed to


| | |
|---|---|
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Land use data is available through the Australian Natural Resources Data Library (adl.brs.gov.au) and relevant State and Territory agencies:

| | |
|---|---|
| **New South Wales** | |
| Department of Land and Water Conservation | www.dlwc.nsw.gov.au |
| New South Wales Agriculture | www.ag.nsw.gov.au |
| **Victoria** | |
| Department of Natural Resources and Environment | www.nre.vic.gov.au |
| **Queensland** | |
| Department of Natural Resources and Mining | www.dnr.qld.gov.au |
| **Western Australia** | |
| Agriculture Western Australia | www.agric.wa.gov.au |
| **South Australia** | |
| Primary Industries and Resources South Australia | www.pir.sa.gov.au |
| **Tasmania** | |
| Department of Primary Industries, Water and Environment | www.dpiwe.tas.gov.au |
| **Northern Territory** | |
| Department of Lands, Planning and Environment | www.lpe.nt.gov.au |