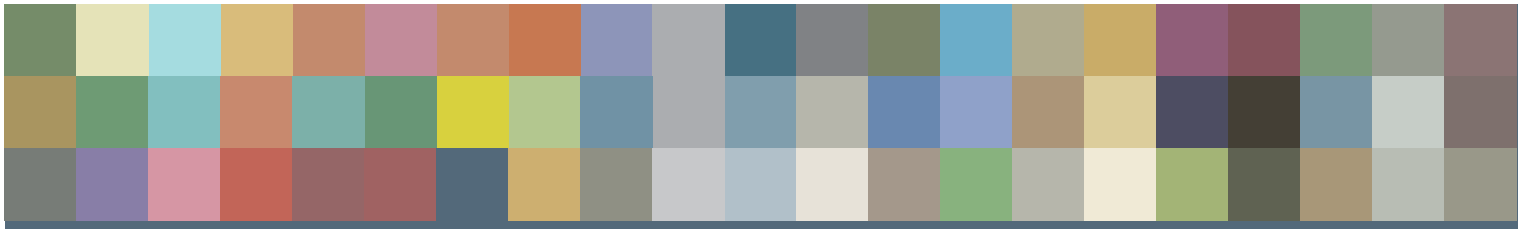


Land use summary 1999–2009

for the Wet Tropics NRM region

Department of Science, Information Technology, Innovation and the Arts
Department of Natural Resources and Mines

Queensland Government

Prepared by: Remote Sensing Centre, Science Delivery, Department of Science, IT, Innovation and the Arts

To access land use datasets we recommend using the Queensland Government Information Service(QGIS) and simply search for **land use mapping** in the type of data search, after restricting your search to **cadastral and land planning** in the topic category field. Metadata is also available from QGIS.

Disclaimer

This document has been prepared with all due diligence and care, based on the best available information at the time of publication. The department holds no responsibility for any errors or omissions within this document. Any decisions made by other parties based on this document are solely the responsibility of those parties.

If you need to access this document in a language other than English, please call the Translating and Interpreting Service (TIS National) on 131 450 and ask them to telephone Library Services on +61 7 3224 8412.

This publication can be made available in an alternative format (e.g. large print or audiotape) on request for people with vision impairment; phone +61 7 3224 8412 or email <library@derm.qld.gov.au>.

Citation

DSITIA. 2012. Land use Summary 1999–2009: Wet Tropics NRM Region. Queensland Department of Science, Information Technology, Innovation and the Arts, Brisbane.

Acknowledgements

The Queensland Land Use Mapping Program (QLUMP) wishes to acknowledge the significant funding provided by the Queensland Government Reef Protection Package to compile updated land use for 2009, improved 1999 land use and 1999–2009 land use change mapping in the catchments adjacent to the Great Barrier Reef stretching from Wet Tropics in the north to the Burnett–Mary in the south.

We also wish to acknowledge the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) who coordinate the Australian Collaborative Land Use and Management Program (ACLUMP).

The QLUMP team includes staff from DSITIA in Brisbane and eight business centres of the Department of Natural Resource and Mines (NRM) throughout Queensland. The input from the regions has been extremely valuable because of their local knowledge and capacity to engage regional experts in compiling updated land use mapping.

June 2012

Table of contents

List of tables

List of figures

Introduction

The Queensland Land Use Mapping Program (QLUMP) is part of the Australian Collaborative Land Use and Management Program (ACLUMP) coordinated by the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES). ACLUMP promotes nationally consistent land use information.

Land use and land management practices have a profound impact on Queensland's natural resources, the environment and agricultural production. The availability of consistent and reliable spatial information on land use is critical for catchment modelling applications to monitor sediment, nutrient and water quality flows discharged to the Great Barrier Reef (GBR).

With the support of the Queensland Government Reef Protection Package, QLUMP has compiled updated land use mapping for the year 2009 in the catchments adjacent to the GBR—stretching from Wet Tropics in the north to the Burnett–Mary in the south. These include the Wet Tropics, Burdekin, Mackay–Whitsunday, Fitzroy and the Burnett–Mary Natural Resource Management (NRM) regions.

This report presents and summarises the land use mapping in the Wet Tropics NRM region (which in area accounts for 6% of the priority GBR catchments) including:

- the revised 1999 land use dataset which includes improvements and corrections to the original 1999 dataset
- the 2009 land use dataset
- the land use change dataset from 1999–2009
- summary statistics derived from the above spatial datasets
- the results of the accuracy assessment of the 2009 land use dataset

Methodology

Mapping is performed in accordance with ACLUMP guidelines. The methodology is accurate, reliable and cost-effective, and makes best use of available databases, satellite imagery and aerial photography.

The Australian Land Use and Management (ALUM) classification has a three-level hierarchical structure (Figure 1). Primary, secondary and tertiary classes are broadly structured by the potential degree of modification or impact in the landscape. The basis of the classification shows five primary classes, identified in order of increasing levels of intervention or potential impact. *Water* is included separately as a sixth primary class. The secondary level in the three-level hierarchical structure is the minimum attribution level for land use mapping in Queensland.

Primary and secondary levels relate to land use (i.e. the principal use of the land in terms of the objectives of the land manager). The tertiary level includes data on commodities or vegetation, (e.g. crops such as cereals and oil seeds). Where required[1] and possible, attribution is performed to tertiary level.

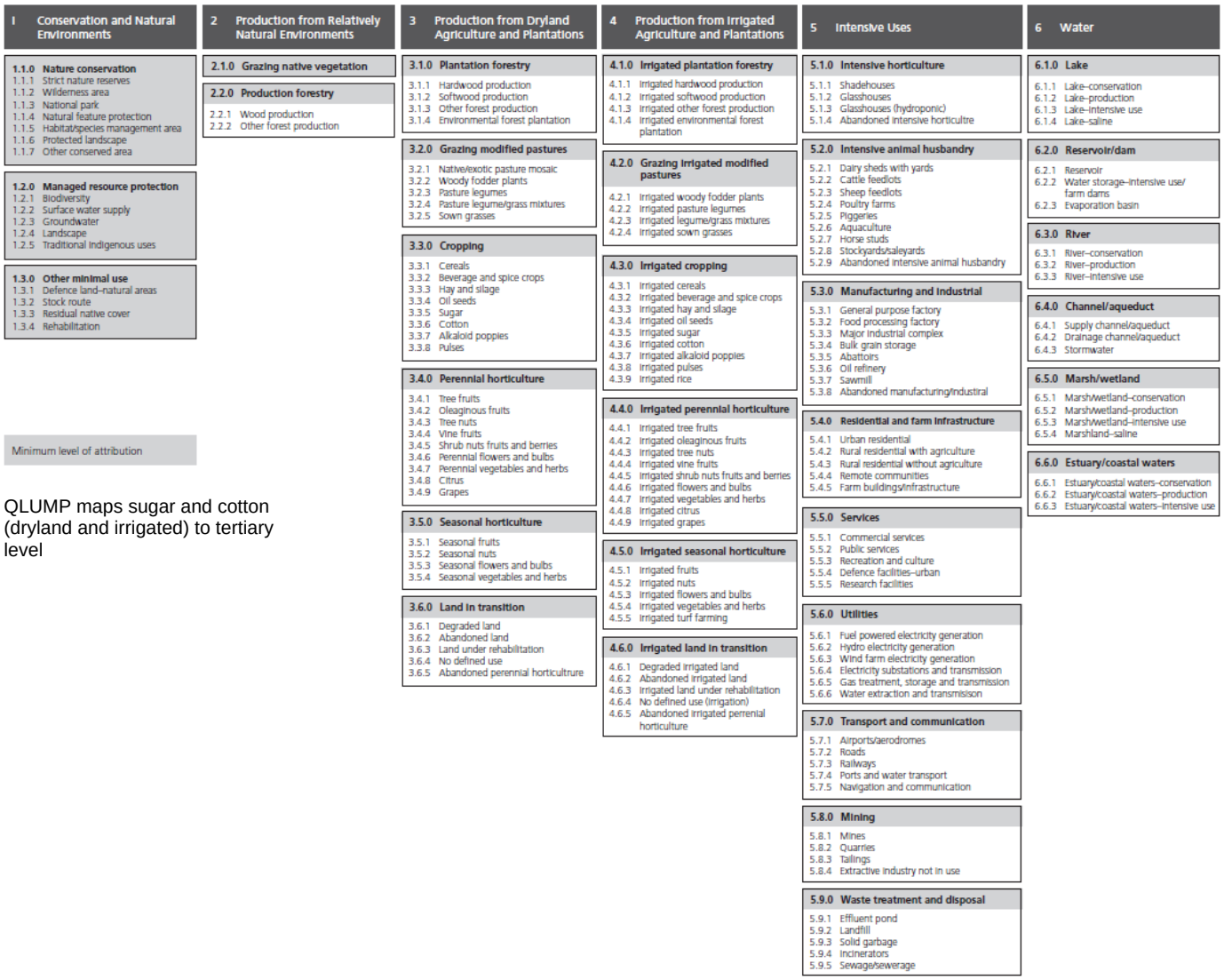
The mapping scale is 1:50 000 with a minimum mapping unit of 2 hectares and a width of 50 metres for linear features.

[1] QLUMP maps the land use classes of *sugar* and *cotton* (dryland and irrigated) to tertiary level.

The existing 1999 baseline (or later where available) land use dataset formed the basis for the 2009 land use dataset. The 1999, 2009 and 1999–2009 change datasets were then updated and improved primarily by interpretation of SPOT5 satellite imagery, high-resolution orthophotography, scanned aerial photography and inclusion of expert local knowledge. This was performed in an ESRI ArcSDE geodatabase replication environment, by overlaying the land use datasets on imagery and digitising or modifying areas previously omitted or incorrectly mapped in the 1999 mapping, as well as areas of actual land use change (2009).

Some land uses are difficult to differentiate using only satellite imagery and existing databases, for example dryland and irrigated *agriculture*. To overcome this, local expert knowledge has become an important component of the mapping methodology. This is provided by regional staff in state government agencies, natural resource management groups, shires, agricultural industries and landholders. A field survey is also undertaken to verify areas of uncertainty in the land use mapping.

The land use mapping methods used by QLUMP are described in full in the ABARES handbook: Guidelines for land use mapping in Australia: principles, procedures & definitions – Edition 4.



QLUMP maps sugar and cotton (dryland and irrigated) to tertiary level

Figure 1: Australian Land Use and Management (ALUM) classification, Version 7

Data limitations

Land uses that are linear, such as roads and railways, are not mappable at a scale of 1:50 000 with a specified minimum mapping width of 50 metres. As a result, the area estimates of these **linear features** represent only a small proportion of the actual area under this land use in Queensland. This is relevant to the following land use classes:

- *transport and communication*
- *utilities*
- *rivers.*

Similarly, land uses that fall under the QLUMP minimum mapping area of 2 hectares are not explicitly mapped but aggregated into the surrounding land use class. This will have the effect of over-estimating the area of some land use classes, for example *cropping – sugar* and *grazing native vegetation*, whereby tracks and farm infrastructure, road reserves and drainage lines are included.

The ALUM secondary classes of *grazing modified pastures* and *irrigated grazing modified pastures* have not been mapped explicitly by QLUMP, due to the difficulty in identifying and separating these classes using satellite imagery and aerial photography alone. On occasion, generally with the benefit of field verification, these classes can be mapped (e.g dairy pastures and fodder crops including leucaena).

Livestock grazing occurs on a range of pasture types including native and exotic as well as mixtures of both. Identifying and separating these using imagery, aerial photography and field observation is difficult and unreliable. Areas of pasture which appeared to be harvested for fodder or grazed off were mapped as *cropping*. This may contribute to an over-estimation of cropping in the region. Other areas mapped as *grazing native vegetation* include road reserves, cleared and uncleared land adjacent to rivers, as well as land immediately adjacent to or between cropped paddocks. *Other minimal use* may also be confused with this class. The appearance of these can be highly variable and classification may therefore not be consistent.

The distinction between (dryland) *cropping* and *irrigated cropping* was not always evident and it is likely there is some misclassification in these classes. Proximity to water sources (watercourse or dam), water entitlements (irrigation licences), field survey and local knowledge were used to confirm areas of irrigation as much as possible. Potentially areas mapped as *irrigated cropping* are only irrigated on a supplementary basis and were not actually irrigated in either 1999 or 2009.

A combination of the Queensland Herbarium's wetlands and regional ecosystem datasets provided the basis for mapping *marsh/wetlands*, *lakes*, *rivers* and *reservoir/dams*. The ephemeral nature of many of these **water features** can lead to confusion in that they may be present in imagery of one date and either absent or of differing extent in imagery of subsequent or previous dates. As a result, there are likely to be errors and omissions and some disagreement in the mapping of features such as farm dams, reservoirs, lakes, wetlands and other water features. Many water features exceed the minimum mappable area requirements, but do not meet the criteria for linear or uniform features.

The 1999 and 2009 land use datasets are both a **snapshot in time** showing what was considered the land use for each of those years. However, some effort was given to distinguishing between an actual land use change and a rotation. For example, an area that is usually cropped, but is not used for a particular purpose in the year of interest, was still mapped as *cropping* in the 2009

dataset even though no crop was present in that year. This was not considered an actual land use change, but rather a rotation, as the primary land use for that paddock would still be *cropping*.

Please refer to the metadata for details on the mapping of specific classes.

Products

1999 and 2009 land use datasets

Figure 2 and Figure 3 show the 1999 and 2009 land use datasets respectively, for the Wet Tropics NRM region, presented at the secondary level of the ALUM classification (Figure 1). Table 1 and Table 2 provide the summary statistics for each. All statistics presenting the area of land use classes are reported in hectares (ha).

Table 2 shows that *nature conservation* (33%) and *grazing native vegetation* (31%) are the major land use classes for 2009 in the Wet Tropics NRM region.

Analysis of the overall change between the land use from 1999 to 2009 show that *managed resource protection* has decreased by 31% or 29 258 ha, whilst *nature conservation* has increased by 9% or 58 725 ha. The land use classes which have increased in area since 1999 include *production forestry,* which increased by 15% or 18 776 ha, and *plantation forestry* which increased by 27% or 3485 ha. Collectively, *cropping – sugar* (both dryland and irrigated) has decreased by 6% or 11 352 ha, whilst *irrigated perennial horticulture* has increased by 3% or 753 ha. The *residential and farm infrastructure* land use class has increased by 7% or 2134 ha since 1999, due almost exclusively to the expansion of urban and rural residential classes, at the tertiary level.

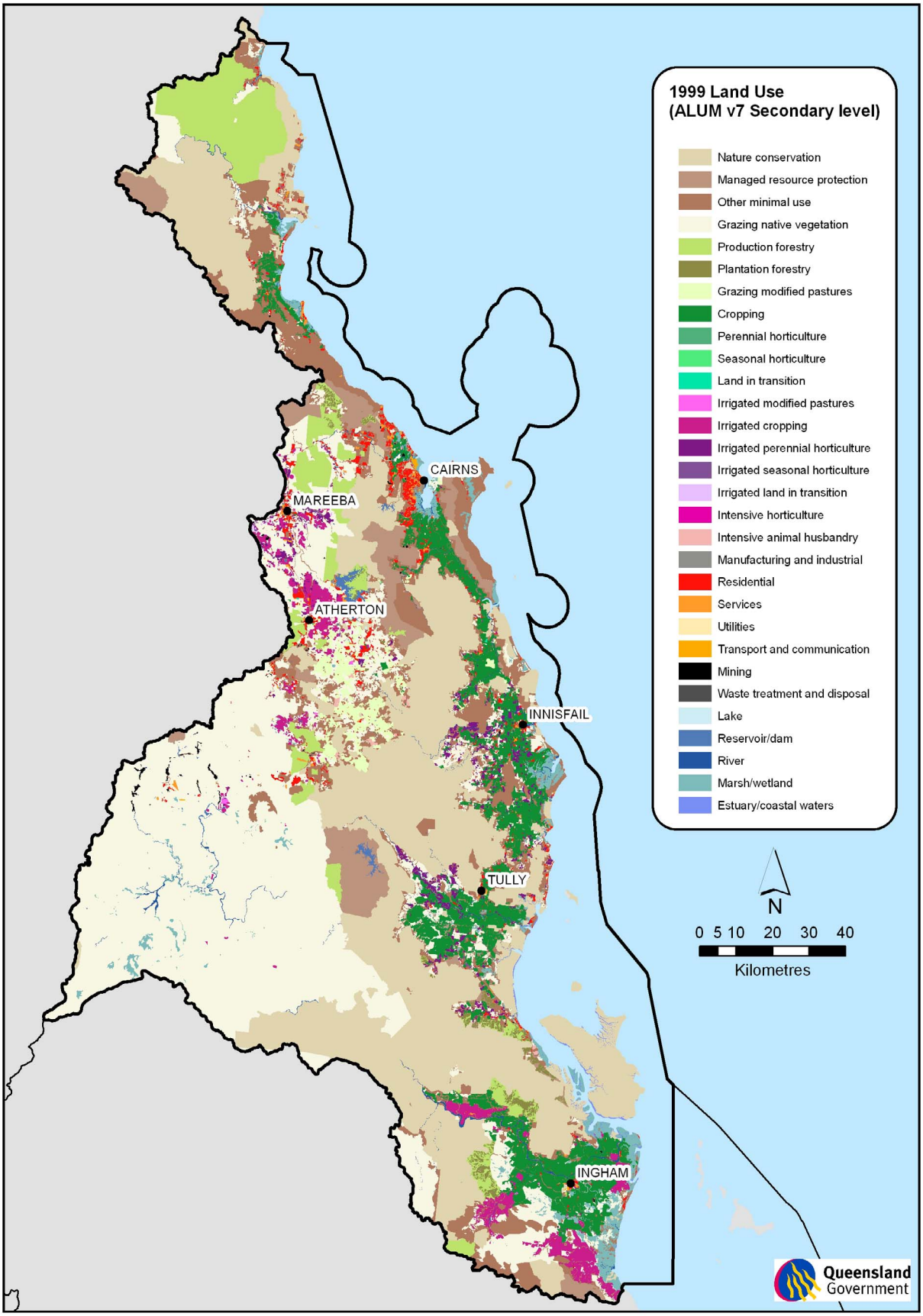


Figure 2: 1999 land use map for the Wet Tropics NRM region

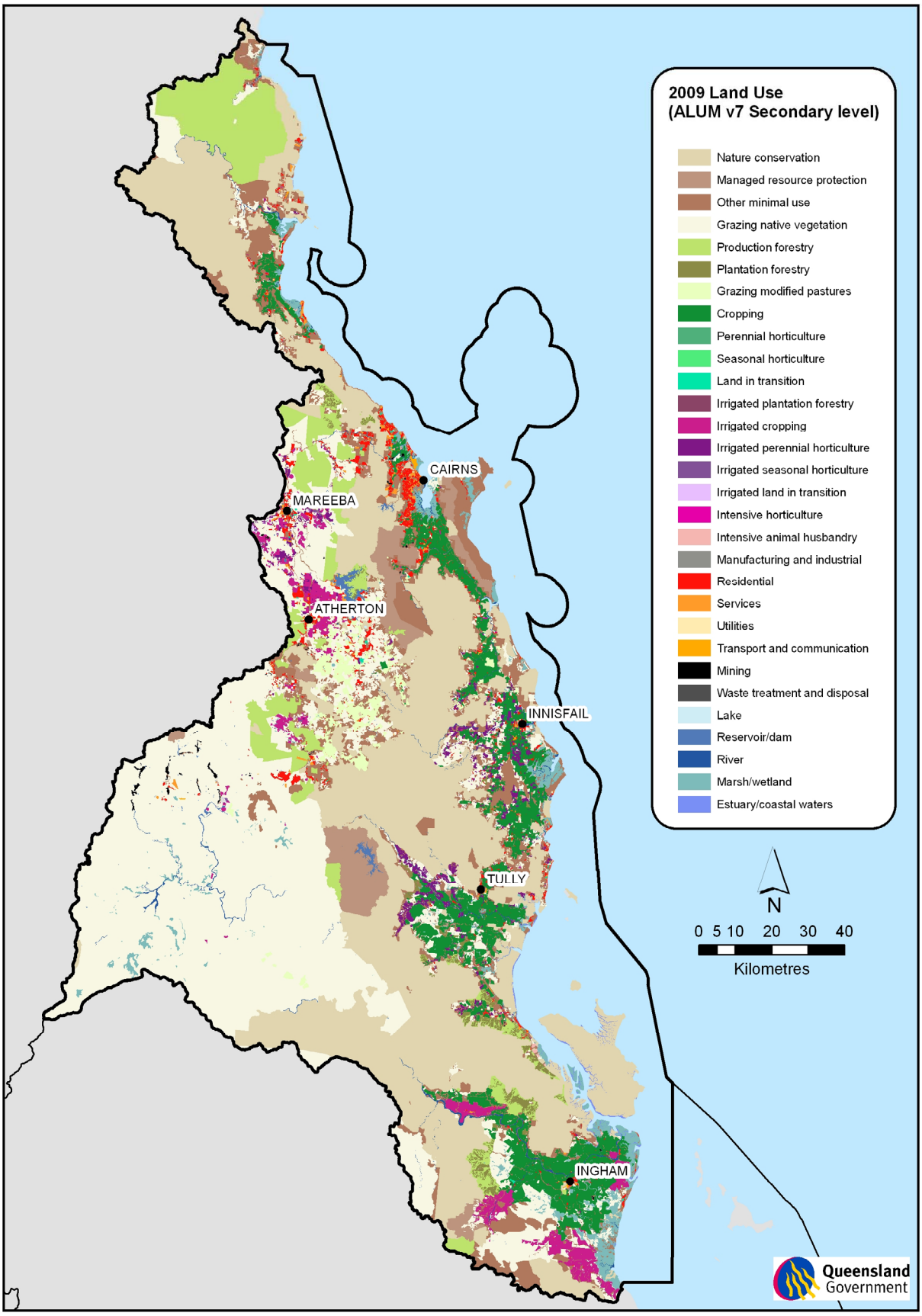


Figure 3: 2009 land use map for the Wet Tropics NRM region

Table 1: Summary statistics of land use in 1999 in the Wet Tropics NRM region

Land use code	Land use class	Area (ha)	Area %
1	Conservation and natural environments	999 963	44.28
1.1	Nature conservation	679 391	30.09
1.2	Managed resource protection	93 777	4.15
1.3	Other minimal use	226 795	10.04
2	Production from relatively natural environments	826 339	36.59
2.1	Grazing native vegetation	697 359	30.88
2.2	Production forestry	128 981	5.71
3	Production from dryland agriculture and plantations	206 866	9.16
3.1	Plantation forestry	13 103	0.58
3.2	Grazing modified pastures[1]	30 660	1.36
3.3	Cropping	162 726	7.21
3.3.5	Cropping – sugar[2]	161 986	7.17
3.4	Perennial horticulture	22	<0.01
3.5	Seasonal horticulture	17	<0.01
3.6	Land in transition	338	0.01
4	Production from irrigated agriculture and plantations	68 891	3.05
4.2	Grazing irrigated modified pastures[1]	462	0.02
4.3	Irrigated cropping	44 199	1.96
4.3.5	Irrigated cropping – sugar[2]	28 790	1.27
4.4	Irrigated perennial horticulture	22 638	1.00
4.5	Irrigated seasonal horticulture	928	0.04
4.6	Irrigated land in transition	664	0.03
5	Intensive uses	43 716	1.94
5.1	Intensive horticulture	188	0.01
5.2	Intensive animal husbandry	2377	0.11
5.3	Manufacturing and industrial	1540	0.07
5.4	Residential and farm infrastructure	29 418	1.30
5.5	Services	6389	0.28
5.6	Utilities	62	<0.01
5.7	Transport and communication	966	0.04
5.8	Mining	2592	0.11
5.9	Waste treatment and disposal	183	0.01
6	Water	112 314	4.97
6.1	Lake	155	0.01
6.2	Reservoir/dam	6940	0.31
6.3	River	13 303	0.59
6.5	Marsh/wetland	53 331	2.36
6.6	Estuary/coastal waters	38 585	1.71
	Total	**2 258 090**	**100**

[1]*Grazing modified pastures* and *grazing irrigated modified pastures* are not mapped explicitly. In this case the areas mapped are generally dairy pastures and fodder crops including leucaena.

[2]The area of *cropping – sugar* and *irrigated cropping – sugar* are subsets of the total area of *cropping* and *irrigated cropping* respectively.

Table 2: Summary statistics of land use in 2009 in the Wet Tropics NRM region

Land use code	Land use class	Area (ha)	Area %
1	Conservation and natural environments	994 014	44.02
1.1	Nature conservation	738 116	32.69
1.2	Managed resource protection	64 519	2.86
1.3	Other minimal use	191 379	8.48
2	Production from relatively natural environments	839 930	37.20
2.1	Grazing native vegetation	692 172	30.65
2.2	Production forestry	147 757	6.54
3	Production from dryland agriculture and plantations	202 191	8.95
3.1	Plantation forestry	16 588	0.73
3.2	Grazing modified pastures[1]	29 784	1.32
3.3	Cropping	154 378	6.84
3.3.5	Cropping – sugar[2]	153 598	6.80
3.4	Perennial horticulture	32	<0.01
3.5	Seasonal horticulture	0	<0.01
3.6	Land in transition	1410	0.06
4	Production from irrigated agriculture and plantations	64 749	2.87
4.2	Grazing irrigated modified pastures[1]	229	0.01
4.3	Irrigated cropping	40 036	1.77
4.3.5	Irrigated cropping – sugar[2]	25 826	1.14
4.4	Irrigated perennial horticulture	23 391	1.04
4.5	Irrigated seasonal horticulture	713	0.03
4.6	Irrigated land in transition	380	0.02
5	Intensive uses	46 168	2.04
5.1	Intensive horticulture	245	0.01
5.2	Intensive animal husbandry	1394	0.06
5.3	Manufacturing and industrial	1598	0.07
5.4	Residential and farm infrastructure	31 552	1.40
5.5	Services	7397	0.33
5.6	Utilities	59	<0.01
5.7	Transport and communication	996	0.04
5.8	Mining	2740	0.12
5.9	Waste treatment and disposal	185	0.01
6	Water	111 037	4.92
6.1	Lake	162	0.01
6.2	Reservoir/dam	6966	0.31
6.3	River	13 303	0.59
6.5	Marsh/wetland	51 962	2.30
6.6	Estuary/coastal waters	38 645	1.71
	Total	**2 258 090**	**100**

[1]*Grazing modified pastures* and *grazing irrigated modified pastures* are not mapped explicitly. In this case the areas mapped are generally dairy pastures and fodder crops including leucaena.

[2]The area of *cropping – sugar* and *irrigated cropping – sugar* are subsets of the total area of *cropping* and *irrigated cropping* respectively.

1999–2009 land use change dataset

Figure 4 shows the 1999–2009 land use change dataset for the Wet Tropics NRM region. The data has been presented relative to the **change in intensity** of the land use at the secondary level of the ALUM classification. For example, change from 2.1.0 (*grazing native vegetation*) to 2.2.0 (*production forestry*) is an increase in land use intensity, whilst change from 2.1.0 (*grazing native vegetation*) to 1.1.7 (*nature conservation*) is a decrease. See Figure 1 for the classification, noting that as you move down and from left to right in the classification the level of intervention or potential impact on the natural landscape increases.

The total area of land use change at the secondary level from 1999–2009 is 129 411 ha. This is equivalent to 5.73% of the region. Of this 38 976 ha (30% of the total change) is mapped as an increase in land use intensity, whilst 90 435 ha (70%) is a decrease.

Summary statistics presenting the land use change classes at the secondary level are shown in Table 3. Whilst the primary class of *conservation and natural environments* has remained relatively static (44.28% in 1999 versus 44.02% in 2009, see Tables 1 and 2), there has been significant changes at the secondary level. The change from *managed resource protection* to *nature conservation*, of some 29 842 ha (or 23% of the total change area), can be attributed to the extensive Statewide Forests Process, as state forests in the Wet Tropics region have been progressively added to the protected area estates. The land use change from *other minimal use* to *nature conservation* of 26 628 ha (21%) can be attributed to the conversion to, or expansion of existing national parks in the region. The other major land use change from 1999–2009 was from *grazing native vegetation* to *production forestry,* of 13 896 ha (11%). Interestingly, 1396 ha of *cropping – sugar* and 1395 ha of *grazing native vegetation* changed to *plantation forestry*, which was observed in the field as predominately teak plantations.

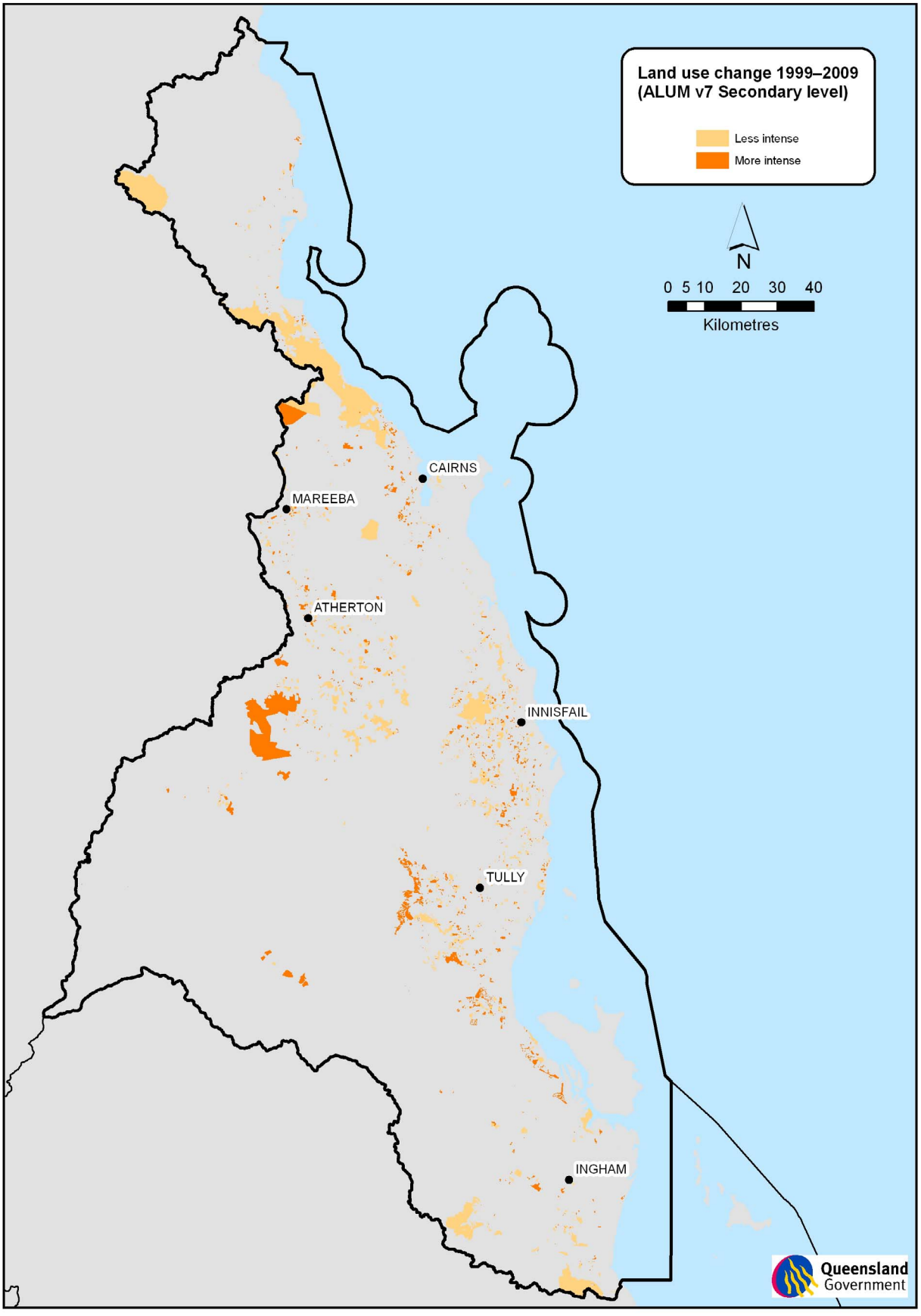


Figure 4: 1999–2009 land use change map at secondary level for the Wet Tropics NRM region

Table 3: Summary statistics for land use change at secondary level for 1999–2009 in the Wet Tropics NRM region (showing only the land use changes >300 ha)

Land use code 1999	Land use class 1999	Land use code 2009	Land use class 2009	Area (ha)	Area (%)	Total change (%)
1.2.0	Managed resource protection	1.1.0	Nature conservation	29 842	1.32	23.06
1.3.0	Other minimal use	1.1.0	Nature conservation	26 628	1.18	20.58
2.1.0	Grazing native vegetation	2.2.0	Production forestry	13 896	0.62	10.74
1.3.0	Other minimal use	1.2.0	Managed resource protection	6075	0.27	4.69
1.2.0	Managed resource protection	2.2.0	Production forestry	4978	0.22	3.85
3.3.5	Cropping - sugar	2.1.0	Grazing native vegetation	4595	0.20	3.55
3.3.5	Cropping - sugar	4.4.0	Irrigated perennial horticulture	4029	0.18	3.11
3.2.0	Grazing modified pastures	2.1.0	Grazing native vegetation	3972	0.18	3.07
4.4.0	Irrigated perennial horticulture	2.1.0	Grazing native vegetation	2359	0.10	1.82
4.4.0	Irrigated perennial horticulture	3.3.5	Cropping - sugar	2033	0.09	1.57
2.1.0	Grazing native vegetation	4.4.0	Irrigated perennial horticulture	1989	0.09	1.54
2.1.0	Grazing native vegetation	3.2.0	Grazing modified pastures	1849	0.08	1.43
4.3.5	Irrigated cropping - sugar	2.1.0	Grazing native vegetation	1763	0.08	1.36
4.3.0	Irrigated cropping	2.1.0	Grazing native vegetation	1713	0.08	1.32
3.3.5	Cropping - sugar	3.1.0	Plantation forestry	1396	0.06	1.08
2.1.0	Grazing native vegetation	3.1.0	Plantation forestry	1395	0.06	1.08
6.5.0	Marsh/wetland	1.1.0	Nature conservation	1346	0.06	1.04
2.1.0	Grazing native vegetation	3.3.5	Cropping - sugar	1258	0.06	0.97
1.3.0	Other minimal use	2.1.0	Grazing native vegetation	1226	0.05	0.95
1.3.0	Other minimal use	5.4.0	Residential & farm infrastructure	1091	0.05	0.84
1.3.0	Other minimal use	3.3.5	Cropping - sugar	941	0.04	0.73
5.2.0	Intensive animal husbandry	2.1.0	Grazing native vegetation	848	0.04	0.66
3.3.5	Cropping - sugar	1.3.0	Other minimal use	834	0.04	0.64
1.3.0	Other minimal use	5.5.0	Services	777	0.03	0.60
4.4.0	Irrigated perennial horticulture	1.3.0	Other minimal use	748	0.03	0.58
3.3.5	Cropping - sugar	3.2.0	Grazing modified pastures	604	0.03	0.47
3.3.5	Cropping - sugar	5.4.0	Residential & farm infrastructure	474	0.02	0.37
1.3.0	Managed resource protection	3.1.0	Plantation forestry	458	0.02	0.35
4.3.5	Irrigated cropping - Sugar	3.1.0	Plantation forestry	393	0.02	0.30
5.2.0	Intensive animal husbandry	3.2.0	Grazing modified pastures	391	0.02	0.30
2.1.0	Grazing native vegetation	4.3.0	Irrigated cropping	382	0.02	0.29
4.4.0	Irrigated perennial horticulture	4.3.0	Irrigated cropping	381	0.02	0.29
1.3.0	Other minimal use	3.6.0	Land in transition	367	0.02	0.28
2.1.0	Grazing native vegetation	1.3.0	Other minimal use	355	0.02	0.27
4.3.0	Irrigated cropping	3.2.0	Grazing modified pastures	338	0.01	0.26
3.2.0	Grazing modified pastures	1.1.0	Nature conservation	315	0.01	0.24
2.1.0	Grazing native vegetation	3.6.0	Land in transition	314	0.01	0.24
2.1.0	Grazing native vegetation	5.4.0	Residential & farm infrastructure	312	0.01	0.24
2.2.0	Production forestry	1.1.0	Nature conservation	302	0.01	0.23
Total				**129 411**	**5.73**	**100**

Data format and availability

To access land use datasets we recommend using the Queensland Government Information Service (QGIS) and simply search for **land use mapping** in the type of data search, after restricting your search to **cadastral and land planning** in the topic category field. Metadata is also available from QGIS.

The dataset comprises an ESRI vector geodatabase at a nominal scale of 1:50 000. The feature classes are each a polygon dataset with each class having attributes describing land use. Land use is classified according to the Australian Land Use and Management Classification (ALUMC) Version 7, May 2010. Note that a representation showing land use at the secondary level is available when working within a geodatabase.

Digital data are supplied with a licence and by using the data you confirm that you have read the licence conditions included with the data and that you agree to be bound by its terms.

Appendix A Accuracy assessment

The accuracy assessment provided reference data suitable for assessing the 2009 land use map. For each of the sample points, the true land use class was determined (reference data) based on aerial photograph interpretation, landholder contact or expert knowledge. These points were then compared to the mapped class (map data) and the information was summarised in the error matrix. The accuracy is summarised in terms of total accuracy, Kappa and user's and producer's accuracies. Each accuracy parameter is reported using a point estimate and a 95% posterior interval. Accuracy figures are provided as probabilities between 0 and 1.

Total accuracy provides an estimate of the overall accuracy of the map, and can be expressed as the probability that a point is mapped correctly. Total accuracy can be misleading, particularly when one class dominates the others. The Kappa statistic attempts to overcome this problem by adjusting for chance agreement. A common rule of thumb suggests a value of Kappa between 0.6 and 0.8 represents moderate agreement between the map and the ground truth; a value greater than 0.8 suggests strong agreement. Values less than 0.2 suggest the map is little better than a map produced by random allocation.

The user's and producer's accuracies summarise the map's accuracy on a per-class basis. User's accuracy for class A is the probability that a point mapped as A is truly in class A. If we estimated the user's accuracy of class A to be 0.84, then from a random sample of 100 points chosen from areas on the map in this class, around 84 would be found to be correct when checked in the field. Producer's accuracy for class B is the conditional probability that the map will show a site as class B given its true state is class B. If the producer's accuracy for class B were 0.84, then from a random sample of 100 points known to be in class B around 84 would also be in class B according to the map. An accurate map should have both high user's and producer's accuracies.

Within the user and producer accuracy assessment, the per-class estimates of accuracy are often not very precise, since only part of the total sample points are used to estimate them. As a guide, if the upper bound of the interval for either user's or producer's accuracy is less than 0.5, this can indicate a true misclassification problem, rather than one due to inadequacies in sample size.

Sometimes points that differ between the map and the reference data are due to positional or spatial errors. Inaccurate registration of datasets is an example of spatial error. Thematic errors are the incorrect labelling of an area due to difficulties in determining the true land use in that area, or by oversight or other operational errors. Spatial errors influence thematic accuracy. The purpose here is to assess the thematic accuracy of land use data. However, the separation of spatial and thematic errors can be difficult and has not been undertaken. As a result, the accuracy assessment reflects properties of the land use data as a whole.

Note that the revised 1999 land use data and the 1999–2009 land use change datasets were not accuracy assessed.

2009 land use dataset

The 2009 land use dataset was accuracy assessed with 566 points based on a random sampling strategy, using the map classes (area and frequency) as the strata. The stratified estimate of total accuracy is 0.90 (0.87, 0.92) and Kappa is 0.86 (0.82, 0.90). As the lower bound of the confidence interval for total accuracy is greater than 0.8, the mapping meets ACLUMP specification.

Table 4 provides the error matrix for the accuracy assessment of the 2009 land use data. For the majority of classes, the reference data agreed with the map data. For example, *cropping – sugar* had 69 sample points identified. For 64 of those points, the map data was also *cropping – sugar* and therefore correct. For five of the points the map data was incorrect with two points falling onto the mapped class *other minimal use*, and one point in each of the classes *land in transition*, *irrigated cropping*, and *irrigated perennial horticulture*.

The column 'proportion' in Table 4 is the relative proportion in area of the classes that were assessed, not of the catchment as a whole. The areas of other classes that are not amenable to assessment—for example, *nature conservation*—are removed from the total area before the proportions are calculated. This column will thus sum to 100%.

Table 5 provides the user's and producer's accuracy for the 2009 Wet Tropics NRM land use dataset. The majority of land use classes in this catchment have been mapped accurately. The largest assessable land use class in this catchment is *grazing native vegetation* which has been mapped with a very high user's and producer's accuracies of 0.963 and 0.985 respectively. The next largest class by area is *other minimal use* which also returned a high user's and producer's accuracy. *Cropping – sugar* returned with user's and producer's accuracies of 0.919 and 0.995. This suggests that some areas mapped as *cropping – sugar* were actually a different land use. The error matrix (Table 4) provides more detail on the misclassifications. The very high producer's accuracy suggests that most areas of actual *cropping – sugar* have been captured in the map.

Accuracy estimates based on samples with fewer than two points are not considered sufficiently reliable, and are presented as NA (not available) in the table. An example of this is *managed resource protection*.

Note also that the *grazing modified pastures* land use class is usually excluded from the validation as identifying and separating this using satellite imagery, aerial photography and field observation alone is known to be unreliable. However, points were generated and assessed, most of which were shown in the reference data as *irrigated cropping*, hence the poor user's and producer's accuracy. This result further highlights the known uncertainty in mapping this land use class.

The user's and producer's accuracy results should be interpreted individually for their respective classes—noting that the smaller classes proportionally to the overall area assessed, and also a small sample size will return a wide confidence interval. The overall accuracy shows a much tighter confidence interval as it effectively summarises the accuracy results for all the assessable classes.

Some classes with low accuracies have insufficient sample points to provide precise estimates. The producer's accuracy for *residential and farm infrastructure* is 0.625; however, from the 95% interval (0.337, 0.851) we see that more sample points would be required to confidently determine how accurate this class is. The other classes with a relatively low accuracy and very large confidence intervals constitute a small proportion (<0.2% each) of the area assessed.

Table 4: Error matrix for the Wet Tropics NRM region 2009 land use dataset

		Reference data																											
	2009 land use class	**Other conserved area**	**Managed resource protection**	**Other minimal use**	**Grazing native vegetation**	**Production forestry**	**Plantation forestry**	**Grazing modified pastures**	**Cropping – sugar**	**Land in transition**	**Irrigated cropping**	**Irrigated cropping – sugar**	**Irrigated perennial horticulture**	**Irrigated seasonal horticulture**	**Irrigated land in transition**	**Intensive horticulture**	**Intensive animal husbandry**	**Manufacturing and industrial**	**Residential & farm infrastructure**	**Services**	**Utilities**	**Transport and communication**	**Mining**	**Waste treatment and disposal**	**Reservoir/dam**	**River**	**Marsh/wetland**	**Estuary/coastal waters**	**Total**	**Proportion (%)**
Map data	**Other conserved area**	**12**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	14	1.44
	Managed resource protection	0	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.18
	Other minimal use	0	0	**64**	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	70	12.4
	Grazing native vegetation	0	0	1	**68**	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	70	46.8
	Production forestry	0	1	0	0	**29**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	9.58
	Plantation forestry	0	0	1	0	0	**29**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	1.07
	Grazing modified pastures	0	0	0	0	0	3	**0**	1	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0.05
	Cropping – sugar	0	0	2	0	0	0	0	**64**	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	69	9.96
	Land in transition	0	0	0	0	0	0	0	0	**10**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0.09
	Irrigated cropping	0	0	1	1	0	0	0	0	0	**13**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0.92
	Irrigated cropping – sugar	0	0	0	0	0	0	0	0	0	2	**13**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	1.67
	Irrigated perennial horticulture	0	0	0	0	0	1	0	0	0	0	0	**28**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	1.52
	Irrigated seasonal horticulture	0	0	0	1	0	0	0	0	0	0	0	0	**9**	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0.05
	Irrigated land in transition	0	0	0	1	0	0	0	0	0	0	0	0	0	**7**	0	0	0	0	0	0	2	0	0	0	0	0	10	0.02
	Intensive horticulture	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**8**	0	0	0	0	0	0	0	0	0	0	0	9	0.02
	Intensive animal husbandry	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**9**	0	0	0	0	0	0	0	0	0	0	10	0.09
	Manufacturing and industrial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**10**	0	0	0	0	0	0	0	0	0	10	0.1
	Residential & farm infrastructure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**30**	0	0	0	0	0	0	0	0	30	2.05
	Services	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**13**	0	0	0	0	0	0	0	15	0.48
	Utilities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**10**	0	0	0	0	0	0	10	<0.0
	Transport and communications	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**10**	0	0	0	0	0	10	0.06
	Mining	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**10**	0	0	0	0	10	0.18
	Waste treatment and disposal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	**7**	0	0	0	10	0.01
	Reservoir/dam	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**10**	0	0	10	0.45
	River	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**14**	0	15	0.86
	Marsh/wetland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**30**	30	3.37
	Estuary/coastal waters	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**15**	2.51
	Total	12	1	72	75	29	33	0	65	12	22	13	29	9	7	8	9	12	34	14	10	10	14	7	10	14	30	15	**566**	100

Table 5: User's and producer's accuracy for the Wet Tropics NRM region 2009 land use dataset

Class	User's			Producer's		
	50%	95% interval		50%	95% interval	
Other conserved area	0.818	0.574	0.955	0.964	0.337	0.999
Managed resource protection	NA	NA	NA	NA	NA	NA
Other minimal use	0.906	0.822	0.959	0.913	0.742	0.970
Grazing native vegetation	0.963	0.901	0.991	0.985	0.942	0.995
Production forestry	0.946	0.829	0.992	0.996	0.792	1.000
Plantation forestry	0.946	0.832	0.992	0.891	0.307	0.976
Grazing modified pastures	0.000	0.000	0.030	0.000	0.000	0.065
Cropping – sugar	0.919	0.841	0.967	0.995	0.805	1.000
Land in transition	0.935	0.704	0.998	0.288	0.034	0.756
Irrigated cropping	0.826	0.593	0.956	0.615	0.209	0.839
Irrigated cropping – sugar	0.827	0.595	0.957	0.969	0.368	0.999
Irrigated perennial horticulture	0.942	0.820	0.992	0.877	0.367	0.986
Irrigated seasonal horticulture	0.836	0.560	0.973	0.446	0.016	0.981
Irrigated land in transition	0.649	0.351	0.886	0.241	0.007	0.956
Intensive horticulture	0.823	0.525	0.973	0.212	0.005	0.940
Intensive animal husbandry	0.841	0.555	0.976	0.603	0.033	0.988
Manufacturing and industrial	0.937	0.705	0.998	0.653	0.039	0.974
Residential & farm infrastructure	0.978	0.891	0.999	0.625	0.337	0.851
Services	0.831	0.602	0.961	0.716	0.147	0.961
Utilities	0.935	0.695	0.998	0.068	0.001	0.811
Transport and communications	0.936	0.699	0.998	0.565	0.030	0.988
Mining	0.937	0.684	0.998	0.497	0.061	0.883
Waste treatment and disposal	0.649	0.358	0.878	0.137	0.003	0.924
Reservoir/dam	0.937	0.695	0.998	0.901	0.151	0.999
River	0.893	0.681	0.984	0.942	0.233	0.999
Marsh/wetland	0.979	0.884	0.999	0.987	0.596	1.000
Estuary/coastal waters	0.958	0.794	0.998	0.982	0.478	1.000

Table 4: Error matrix for the Wet Tropics NRM region 2009 land use dataset

		Reference data																											
	2009 land use class	Other conserved area	Managed resource protection	Other minimal use	Grazing native vegetation	Production forestry	Plantation forestry	Grazing modified pastures	Cropping – sugar	Land in transition	Irrigated cropping	Irrigated cropping – sugar	Irrigated perennial horticulture	Irrigated seasonal horticulture	Irrigated land in transition	Intensive horticulture	Intensive animal husbandry	Manufacturing and industrial	Residential & farm infrastructure	Services	Utilities	Transport and communication	Mining	Waste treatment and disposal	Reservoir/dam	River	Marsh/wetland	Estuary/coastal waters	Total	Proportion (%)
Map data	**Other conserved area**	**12**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	14	1.44
	Managed resource protection	0	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.18
	Other minimal use	0	0	**64**	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	70	12.41
	Grazing native vegetation	0	0	1	**68**	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	70	46.83
	Production forestry	0	1	0	0	**29**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	9.58
	Plantation forestry	0	0	1	0	0	**29**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	1.07
	Grazing modified pastures	0	0	0	0	0	3	**0**	1	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0.05
	Cropping – sugar	0	0	2	0	0	0	0	**64**	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	69	9.96
	Land in transition	0	0	0	0	0	0	0	0	**10**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0.09
	Irrigated cropping	0	0	1	1	0	0	0	0	0	**13**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0.92
	Irrigated cropping – sugar	0	0	0	0	0	0	0	0	0	2	**13**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	1.67
	Irrigated perennial horticulture	0	0	0	0	0	1	0	0	0	0	0	**28**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	1.52
	Irrigated seasonal horticulture	0	0	0	1	0	0	0	0	0	0	0	0	**9**	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0.05
	Irrigated land in transition	0	0	0	1	0	0	0	0	0	0	0	0	0	**7**	0	0	0	0	0	0	0	2	0	0	0	0	10	0.02
	Intensive horticulture	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**8**	0	0	0	0	0	0	0	0	0	0	0	9	0.02
	Intensive animal husbandry	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**9**	0	0	0	0	0	0	0	0	0	0	10	0.09
	Manufacturing and industrial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**10**	0	0	0	0	0	0	0	0	0	10	0.1
	Residential & farm infrastructure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**30**	0	0	0	0	0	0	0	0	30	2.05
	Services	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**13**	0	0	0	0	0	0	0	15	0.48
	Utilities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**10**	0	0	0	0	0	0	10	<0.01
	Transport and communications	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**10**	0	0	0	0	0	10	0.06
	Mining	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**10**	0	0	0	0	10	0.18
	Waste treatment and disposal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	**7**	0	0	0	10	0.01
	Reservoir/dam	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**10**	0	0	10	0.45
	River	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**14**	0	15	0.86
	Marsh/wetland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**30**	30	3.37
	Estuary/coastal waters	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**15**	2.51
	Total	12	1	72	75	29	33	0	65	12	22	13	29	9	7	8	9	12	34	14	10	10	14	7	10	14	30	15	**566**	100