Department of Science, Information Technology and Innovation

Land Use Summary 1999–2015

for the Northern Gulf NRM Region

Remote Sensing Centre

November 2016

Queensland Government

Prepared by

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We 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).

November 2016

Executive Summary

The Queensland Land use Mapping Program (QLUMP) has updated the land use mapping in the Northern Gulf Natural Resource Management (NRM) Region to 2015. QLUMP has revised the 1999 mapping and derived land use change mapping for 1999–2015. Land use is classified under the Australian Land use and Management (ALUM) Classification.

Grazing native vegetation, *marsh/wetland* and *nature conservation* are the dominant land use classes in the Northern Gulf NRM region. *Grazing native vegetation* accounted for 90% of the NRM region in 1999, reducing to 84% in 2015. *Nature conservation* accounted for 3% in 1999 and increased to 7% of the region in 2015.

Analysis of the **net** land use changes between 1999 and 2015 shows:

- *Nature conservation* increased by 745,802ha or 112%. This is the result of the establishment and expansion of conservation estates throughout the region.
- *Managed resource protection* increased by 466,720ha or 218% with the establishment of new nature refuges to the north and south of Georgetown and in the north-west near Kowanyama.
- *Grazing native vegetation* decreased by 1,130,027ha or 6.5%.
- *Production forestry* showed the largest reduction proportionally with a decrease of 77,987ha or 99.98% west of Mossman.
- *Cropping* increased by 2,067ha or 75% with the establishment of new crops along the Gilbert River, west of Georgetown.
- *Irrigated cropping* decreased by 1,754ha or 10%—generally around Dimbulah.
- *Irrigated perennial horticulture* increased by 1,903ha or 48%, also around Dimbulah.
- *Marsh/Wetland* decreased by 9,480ha or 1% as a result of the reclassification into the *nature conservation* land use class for 2015 (they now fall within a national park).

Land use change mapping products are derived at the secondary level of the ALUM classification. For the 1999–2015 period, the total area of land use change within the Northern Gulf NRM region is **1,247,608ha** or **6% of the region.** Of this 1,237,463ha (99%) is mapped as a decrease in land use intensity and 10,145ha (1%) is an increase.

Analysis of the 1999–2015 land use change shows a total of 1,132,371ha changed from *grazing native vegetation* in 1999 (91% of the total land use change) to:

- *Nature conservation* (642,723ha) due to the establishment and expansion of several national parks and the Brooklyn Nature Refuge.
- *Managed resource protection* (482,825ha) with the establishment of new nature refuges to the north and south of Georgetown and in the north-west of the region near Kowanyama.
- *Cropping* (2,040ha) around Dimbulah and also west of Georgetown.
- *Irrigated cropping* (1,187ha) and additionally 800ha changing to *irrigated cropping – sugar* around Dimbulah.

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Introduction

The Queensland Land use Mapping Program (QLUMP) is a joint initiative of the Department of Science, Information Technology and Innovation (DSITI) and the Department of Natural Resources and Mines (DNRM). 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, agricultural production and the environment. The availability of consistent and reliable spatial information regarding land use is critical for sustainable natural resource management by Australian, Queensland and local governments, Natural Resource Management (NRM) regional groups, industry groups, community groups and land managers.

QLUMP has updated the land use mapping in the Northern Gulf NRM region to 2015. This report presents and summarises land use mapping including:

- a revised 1999 land use dataset including improvements and corrections to the original
- a 2015 land use dataset
- land use change datasets between 1999–2015
- summary statistics derived from the above spatial datasets
- results of the accuracy assessment of the 2015 land use dataset.

Methodology

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

The Australian Land use and Management (ALUM) classification (Figure 1, page 6) shows five primary classes, identified in order of increasing levels of intervention or potential impact of land use; water is included separately as a sixth primary class. Within the primary classes is a three-level hierarchical structure. Primary, secondary and tertiary levels broadly describe the potential degree of modification or impact of land use on the landscape. 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 infrastructure, for example, crops such as cereals or infrastructure such as urban residential. Where possible, class attribution is performed to the tertiary level. For instance, QLUMP consistently maps land use classes *sugar* and *cotton* (dryland and irrigated) to tertiary level.

For the 2015 land use mapping, QLUMP added a ‘commodity’ attribute to specifically map avocado, banana, macadamia and mango orchards. They are classified under the secondary land use class of *perennial horticulture* and at tertiary level as *tree fruits* for avocado, bananas and mango or *tree nuts* for macadamia. The addition of the commodity attribute field allows for the classification of tree crops from other horticultural crops (apples, pawpaw, etc). All avocado, banana, mango and macadamia crops have been mapped as irrigated.

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

The 1999 land use map was revised and improved in addition to compiling an updated land use map for 2015. This was achieved primarily by interpretation of Landsat 8 Operational Land Imager (OLI) and SPOT6/7 satellite imagery, high-resolution orthophotography, scanned aerial photography and inclusion of expert local knowledge. An ESRI ArcSDE geodatabase replication environment was used to overlay land use datasets on imagery and digitise or modify areas previously omitted or incorrectly mapped in 1999. Land use change maps were then derived (at the secondary level of the ALUM classification) for the period 1999–2015.

Some land uses are difficult to differentiate using satellite imagery and existing databases, for example, dryland and irrigated agriculture. Therefore, local expert knowledge provided by state government regional staff, natural resource management groups, agricultural industries and landholders were an important component of the mapping methodology. Field surveys were also undertaken to verify areas of uncertainty.

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.

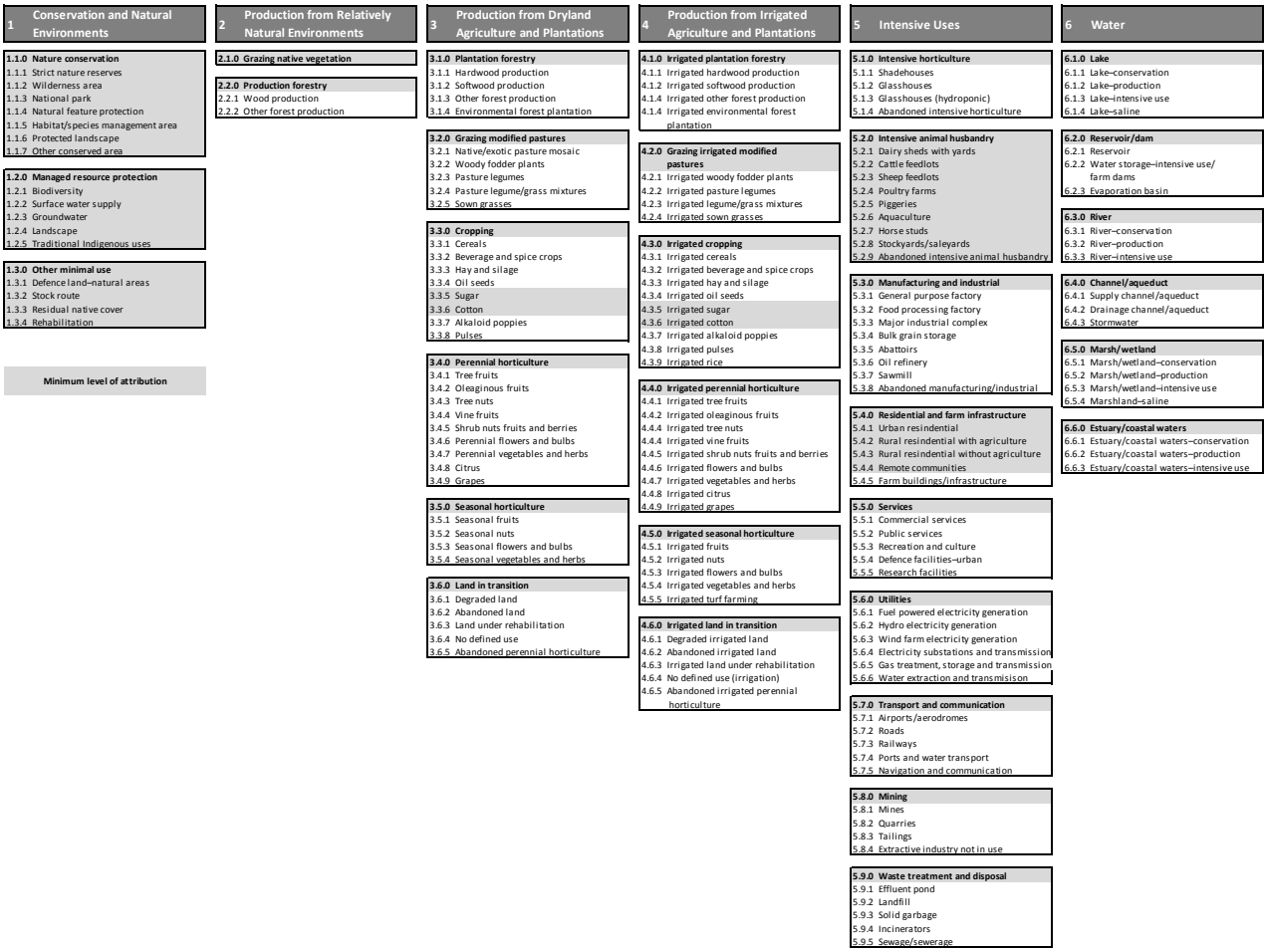


Figure 1: Australian Land use and Management (ALUM) classification, Version 7

Data Limitations

Land use features 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 within this land use type in Queensland. This is relevant to the following land use classes: (Figure 2a, page 8).

- *transport and communication*
- *rivers*

Similarly, land uses that fall under the QLUMP minimum mapping area of two 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, *grazing native vegetation* where roads, drainage lines, and small dams are included (Figure 2b, page 8).

Livestock grazing occurs on a range of pasture types including native and exotic as well as mixtures of both. Identifying and separating these pasture types using imagery, aerial photography and field observation is difficult and unreliable. Therefore, the ALUM classification secondary land use classes of *grazing modified pastures* and *grazing irrigated modified pastures* have not been mapped explicitly from the *grazing native vegetation* class.

The distinction between (dryland) *cropping* and *irrigated cropping* was not always evident and it is likely there is some misclassification in these classes. QLUMP undertook field surveys and together with local knowledge confirmed areas of irrigation where possible. An area's proximity to water sources (watercourse or dam) was also used. In addition, areas mapped as *irrigated cropping* are potentially only irrigated on a supplementary basis and may not have actually been irrigated in 1999 or 2015 (Figure 2c and d, page 8).

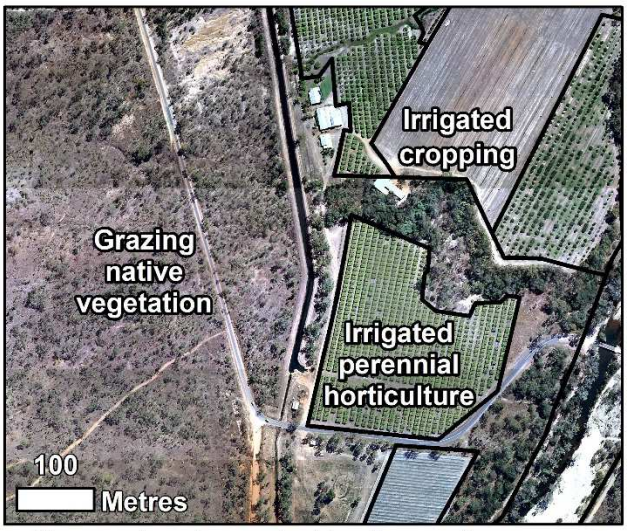
The *rural residential* land use class is a source of possible thematic error. Properties on the fringes of suburban settlements, hobby farms and subdivisions in isolated localities with comparatively small lot sizes were mapped to this class. The use of the Queensland Valuation System (QVAS) data was helpful in mapping this class, based on whether or not the land owner was classified as a primary producer. Residential features greater than 0.2 hectares and less than 16 hectares were mapped as rural residential. This class may be misclassified with *grazing native vegetation* and *other minimal use*, especially on larger properties.

The Queensland Herbarium's wetlands 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 as they may be present in one image and either absent or different in subsequent or earlier dated imagery. As a result, there may be errors, omissions and disagreement in the mapping of features such as farm dams, reservoirs, lakes, wetlands and other water features. Many water features, whilst exceeding the minimum mappable area requirements, do not meet the criteria for linear or uniform features. The mapping of all *water* land use class features was greatly aided by the interpretation of 2015 Landsat 8 OLI satellite imagery.

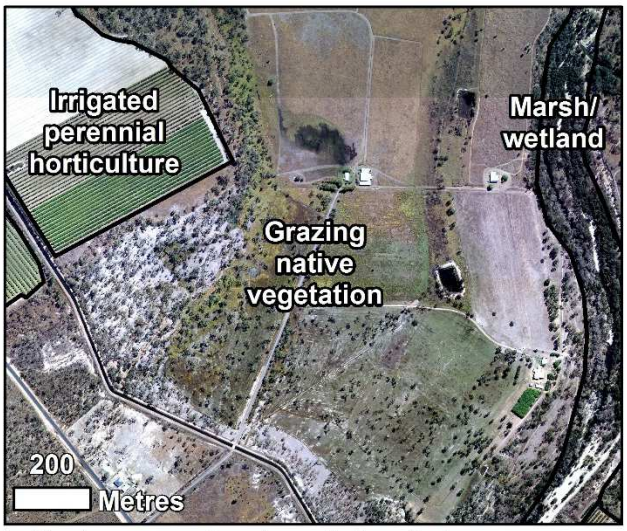
The 1999 and 2015 land use datasets are a snapshot of what was interpreted as the primary land use in these years**.** However, effort was given to distinguishing between an actual land use change and a rotation. For example, an area that is usually cropped, but is not used for that particular purpose in the year of interest, was still mapped as *cropping* in the 2015 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 field would still be *cropping.*

The 1999 land use mapping has been revised and improved through the interpretation of the most suitable imagery available. On occasion this was Landsat (30m), which raises some uncertainty in respect of accurately classifying the intensive land use classes. The minimum mapping unit (2ha) also contributes to the uncertainty through the aggregation of otherwise individual land use features, particularly at cadastral parcel level. These limitations may therefore lead to omission and commission errors in the classification of the intensive land use classes in earlier mapping products and the land use change products from which they are derived.

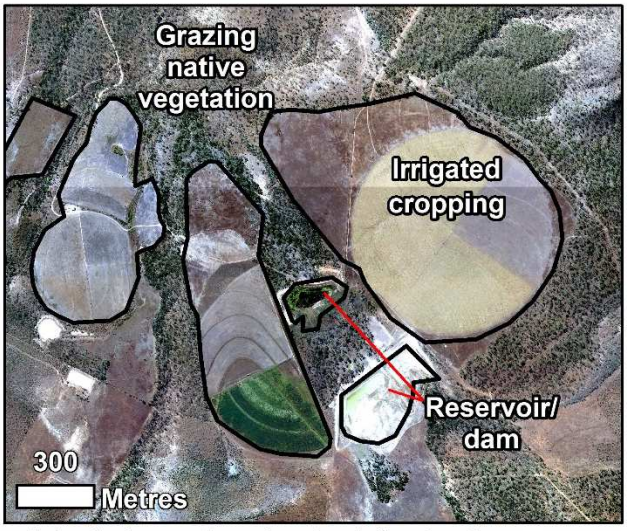
The 2015 land use map was largely compiled from Landsat 8 OLI satellite imagery, acquired in winter 2015 supplemented by scanned aerial photography. The 1999 land use map was revised with Landsat 7 Enhanced Thematic Mapper Plus (ETM+) satellite imagery (30m) acquired in winter. This was also supplemented by scanned aerial photography where available.



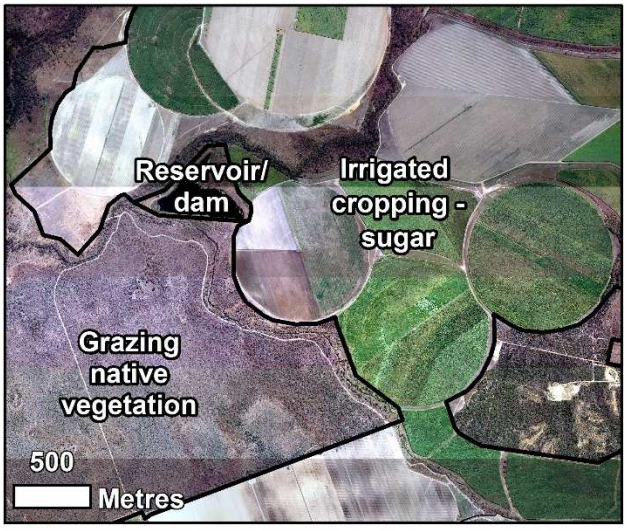
a. Transport and aqueduct land use – linear features not mapped



b. Drainage, road and small dam features are aggregated into the surrounding land use



c. Irrigated cropping showing infrastructure – central pivot irrigation



d. Irrigated cropping - Sugar

Figure 2: Examples (a–d) of land use features

Products

1999 and 2015 land use datasets

Land use datasets for the Northern Gulf NRM region are presented at the secondary level of the ALUM classification (Figure 1, page 6) in:

- the 1999 land use dataset — Figure 3, page 10
- the 2015 land use dataset — Figure 4, page 12

Summary statistics are presented for:

- 1999 land use — Table 1, page 11
- 2015 land use — Table 2, page 13

All statistics presenting the area of land use classes are reported in hectares (ha).

Grazing native vegetation, *marsh/wetland* and *nature conservation* are the dominant land use classes in the Northern Gulf NRM region. Table 1 and Table 2 show:

- *Grazing native vegetation* accounted for 17,418,689ha (90%) of the NRM region in 1999, reducing to 16,288,662ha (84%) in 2015
- *Nature conservation* accounted for 665,430ha (3%) in 1999 increasing to 1,411,231ha (7%) in 2015
- *Managed resource protection* increased from 214,512ha (1%) in 1999 to 681,232ha (4%) in 2015
- Dryland *cropping* accounted for 2,742ha (0.01%) in 1999 and increased to 4,810ha (0.02%) in 2015
- *Irrigated perennial horticulture* increased from 3,974ha (0.02%) in 1999 to 5,877ha (0.03%) in 2015.

Analysis of the specific land use changes from one secondary class to another for 1999–2015 is presented on page 17.

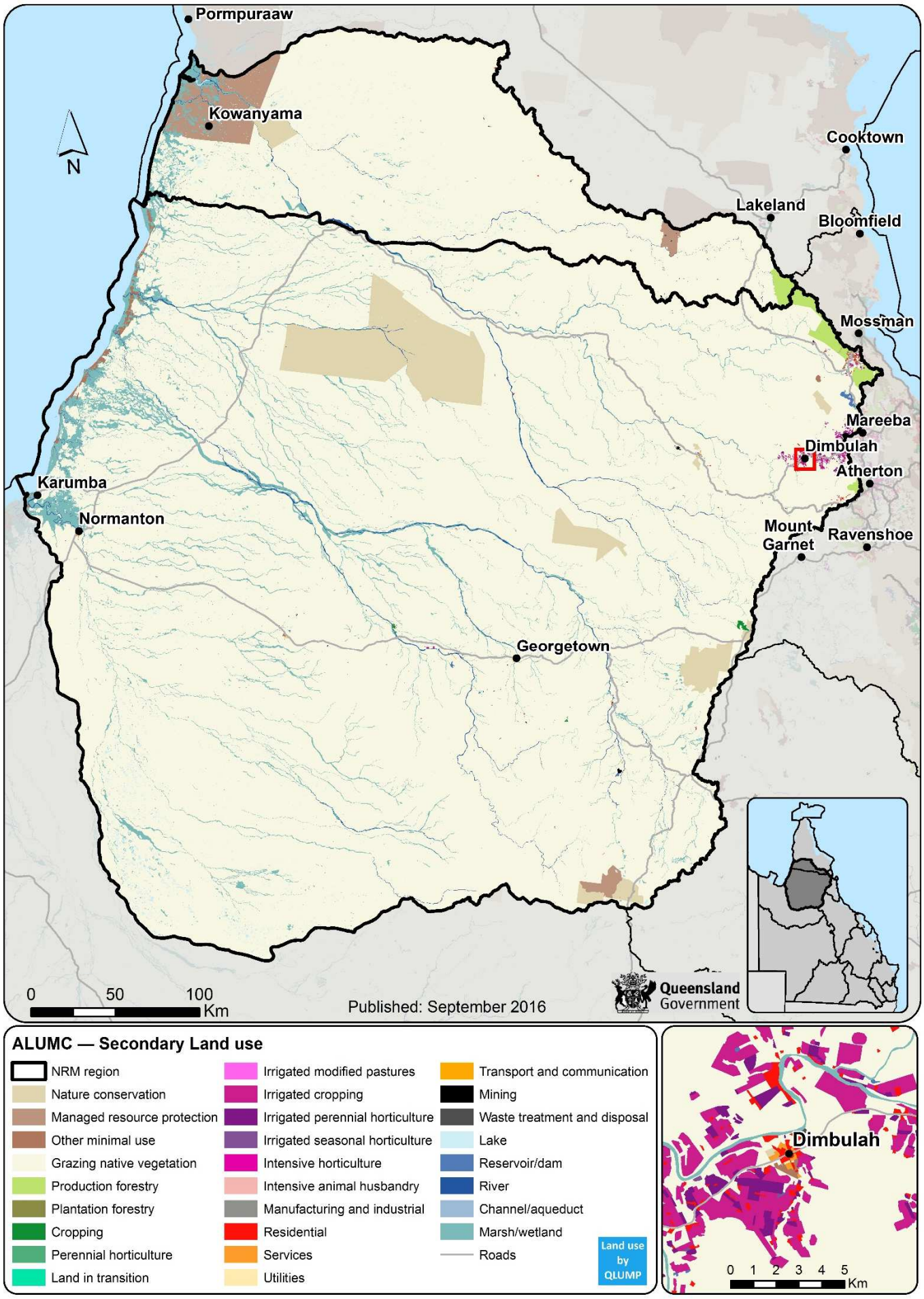


Figure 3: 1999 land use map for the Northern Gulf NRM region

Table 1: Summary statistics of land use in 1999 in the Northern Gulf NRM region

Land use code	Land use class	Area[3] (ha)	Area[3] (%)
1	**Conservation and natural environments**	**908,268**	**4.68**
1.1	Nature conservation	665,430	3.43
1.2	Managed resource protection	214,512	1.11
1.3	Other minimal use	28,327	0.15
2	**Production from relatively natural environments**	**17,495,719**	**90.15**
2.1	Grazing native vegetation[1]	17,418,689	89.76
2.2	Production forestry	77,030	0.40
3	**Production from dryland agriculture and plantations**	**2,864**	**0.01**
3.1	Plantation forestry	108	<0.01
3.3	Cropping	2,742	0.01
3.4	Perennial horticulture	3	<0.01
3.6	Land in transition	11	<0.01
4	**Production from irrigated agriculture and plantations**	**22,651**	**0.12**
4.2	Irrigated modified pastures	229	<0.01
4.3	Irrigated cropping	18,111	0.09
4.3.5	Irrigated cropping – Sugar[2]	10,082	0.05
4.4	Irrigated perennial horticulture	3,974	0.02
4.5	Irrigated seasonal horticulture	336	<0.01
5	**Intensive uses**	**11,028**	**0.06**
5.1	Intensive horticulture	6	<0.01
5.2	Intensive animal production	134	<0.01
5.3	Manufacturing and industrial	69	<0.01
5.4	Residential and farm infrastructure	5,830	0.03
5.5	Services	1,229	0.01
5.6	Utilities	20	<0.01
5.7	Transport and communication	1,035	0.01
5.8	Mining	2,625	0.01
5.9	Waste treatment and disposal	80	<0.01
6	**Water**	**966,278**	**4.98**
6.1	Lake	118,994	0.61
6.2	Reservoir/dam	9,099	0.05
6.3	River	93,819	0.48
6.4	Channel/aqueduct	10	<0.01
6.5	Marsh/wetland	744,355	3.84
Total		**19,406,808**	**100.00**

[1]*grazing native vegetation* includes all pastures (modified and unmodified). No distinction is made in respect of tree cover.

[2]the area of land use classes at or below the tertiary level are shown as a subset of the total area at the secondary level.

[3]total figures for primary land use class may contain rounding errors.

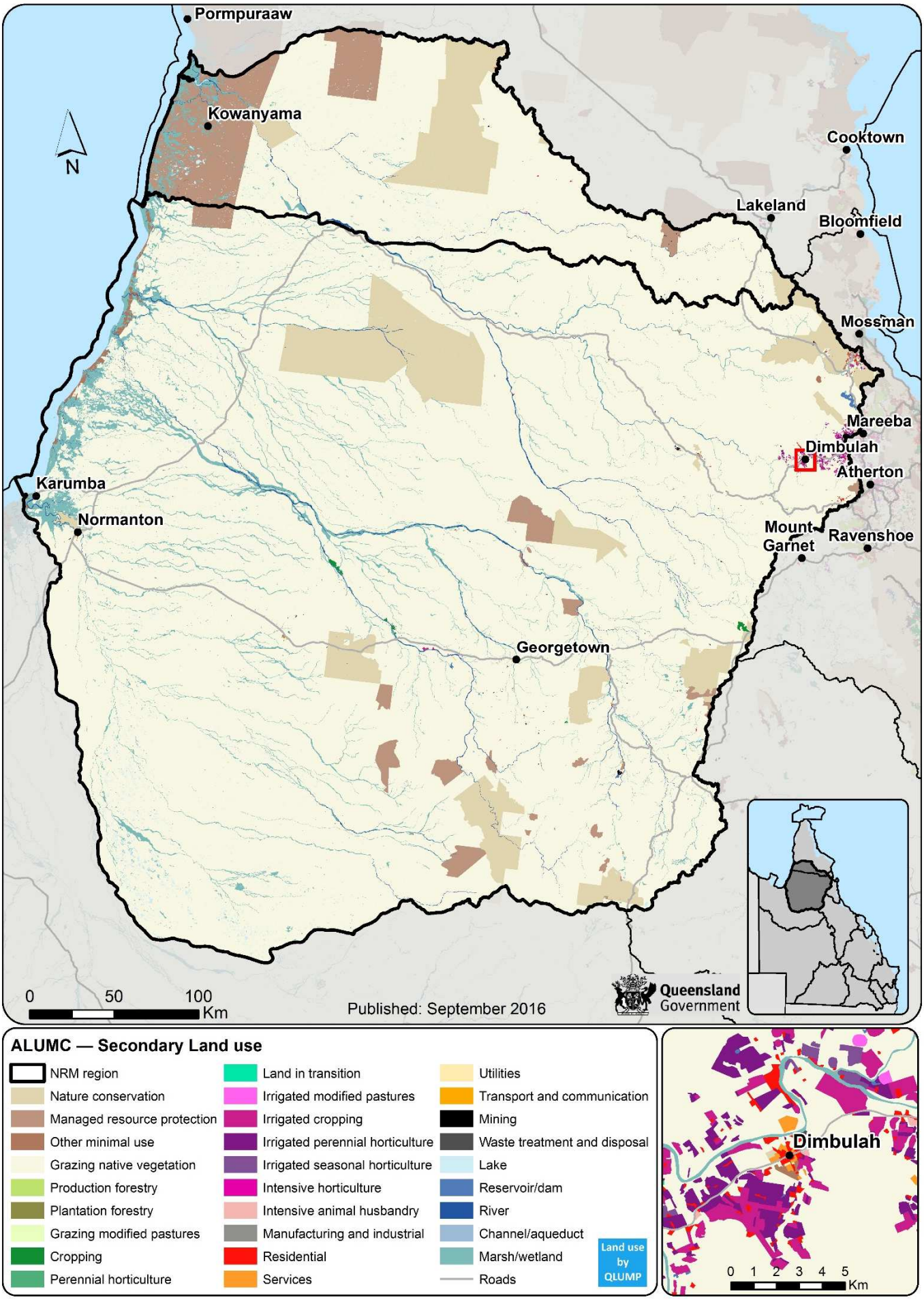


Figure 4: 2015 land use map for the Northern Gulf NRM region

Table 2: Summary statistics of land use in 2015 in the Northern Gulf NRM region

Land use code	Land use class	Area[3] (ha)	Area[3] (%)
1	**Conservation and natural environments**	**2,120,265**	**10.93**
1.1	Nature conservation	1,411,231	7.27
1.2	Managed resource protection	681,232	3.51
1.3	Other minimal use	27,802	0.14
2	**Production from relatively natural environments**	**16,288,676**	**83.93**
2.1	Grazing native vegetation[1]	16,288,662	83.93
2.2	Production forestry	14	<0.01
3	**Production from dryland agriculture and plantations**	**4,984**	**0.03**
3.1	Plantation forestry	110	<0.01
3.2	Grazing modified pastures	16	<0.01
3.3	Cropping	4,810	0.02
3.4	Perennial horticulture	3	<0.01
3.6	Land in transition	45	<0.01
4	**Production from irrigated agriculture and plantations**	**23,213**	**0.12**
4.2	Irrigated modified pastures	543	<0.01
4.3	Irrigated cropping	16,357	0.08
4.3.5	Irrigated cropping – Sugar[2]	10,669	0.05
4.4	Irrigated perennial horticulture	5,877	0.03
4.5	Irrigated seasonal horticulture	435	<0.01
5	**Intensive uses**	**12,538**	**0.06**
5.1	Intensive horticulture	10	<0.01
5.2	Intensive animal production	288	<0.01
5.3	Manufacturing and industrial	90	<0.01
5.4	Residential and farm infrastructure	6,319	0.03
5.5	Services	1,367	0.01
5.6	Utilities	22	<0.01
5.7	Transport and communication	1,082	0.01
5.8	Mining	3,259	0.02
5.9	Waste treatment and disposal	100	<0.01
6	**Water**	**957,133**	**4.93**
6.1	Lake	118,906	0.61
6.2	Reservoir/dam	9,522	0.05
6.3	River	93,819	0.48
6.4	Channel/aqueduct	10	<0.01
6.5	Marsh/wetland	734,875	3.79
Total		**19,406,808**	**100.00**

[1]*grazing native vegetation* includes all pastures (modified and unmodified). No distinction is made in respect of tree cover.

[2]the area of land use classes at or below the tertiary level are shown as a subset of the total area at the secondary level.

[3]total figures for primary land use class may contain rounding errors.

Net land use change

Analysis of the land use summary statistics for each land use map (1999 and 2015) by **primary land use class** shows that between 1999 and 2015 (Table 1, page 11 and Table 2, page 13):

- *Conservation and natural environments* increased by 1,211,997ha or 57%
- *Production from relatively natural environments* decreased by 1,207,043ha or 7%
- *Production from dryland agriculture and plantations* increased by 2,120ha or 43%
- *Production from irrigated agriculture and plantations* increased by 561ha or 2%
- *Intensive uses* increased by 1,510ha or 12%
- *Water* decreased by 9,145ha or 1%

Figure 5 presents the net changes in land use within the Northern Gulf NRM region by primary land use class. The chart shows the net reduction or gain between 1999 and 2015, and sums to zero. Note y-axis is not to scale.

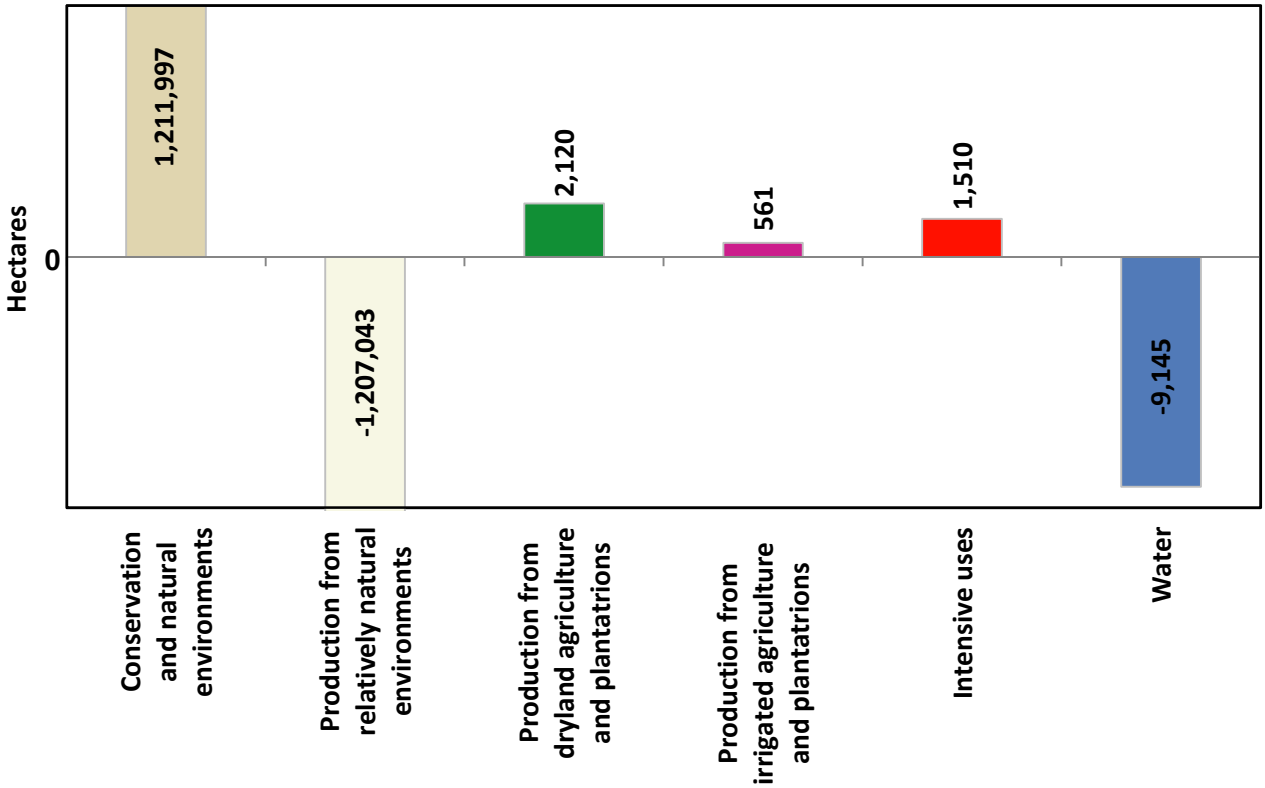


Figure 5: Net land use change by primary class (1999–2015) in the Northern Gulf NRM region

Further analysis of the **net** land use change between 1999 and 2015 at the **secondary land use class** level shows (Table 3, page 16):

- *Nature conservation* increased by 745,802ha or 112%. This is the result of the establishment and expansion of many estates including:
    - Olkola national and regional parks in the north of the region.
    - Daintree, Kuranda, Mount Lewis, Mount Spurgeon, Mount Windsor and Mowbray national parks and the Brooklyn Nature Refuge west of Mossman.
    - Rungulla national and regional parks south of Georgetown.
    - Littleton National Park east of Croydon.
    - Canyon Regional Park east of Georgetown.
- *Managed resource protection* increased by 466,720ha or 218% with the establishment of new nature refuges to the north and south of Georgetown and in the north-west of the region near Kowanyama.
- *Grazing native vegetation* deceased by 1,130,027ha or 6.5%.
- *Production forestry* showed the largest reduction proportionally with a decrease of 77,987ha or 99.98% west of Mossman.
- *Cropping* increased by 2,067ha or 75% with the establishment of new crops along the Gilbert River, west of Georgetown.
- *Irrigated cropping* decreased by 1,754ha or 10% generally around Dimbulah and west of Mareeba.
- *Irrigated perennial horticulture* increased by 1,903ha or 48%, also around Dimbulah and west of Mareeba.
- *Intensive animal production* increased by 154ha or 115%, mostly situated around Dimbulah and west of Mareeba.
- *Marsh/Wetland* decreased by 9,480ha or 1.3% as a result of the reclassification of these areas into the *nature conservation* land use class in 2015 (they now fall within national parks).

Table 3: Net land use change by primary and secondary class 1999–2015

Land use code	Land use class	1999 Area[3] (ha)	2015 Area[3] (ha)	Difference[3] (ha)	Difference (%)
1	**Conservation and natural environments**	**908,268**	**2,120,265**	**1,211,997**	**133.4**
1.1	Nature conservation	665,430	1,411,231	745,802	112.1
1.2	Managed resource protection	214,512	681,232	466,720	217.6
1.3	Other minimal use	28,327	27,802	-525	-1.9
2	**Production from relatively natural environments**	**17,495,719**	**16,288,676**	**-1,207,043**	**-6.9**
2.1	Grazing native vegetation[1]	17,418,689	16,288,662	-1,130,027	-6.5
2.2	Production forestry	77,030	14	-77,016	-99.98
3	**Production from dryland agriculture and plantations**	**2,864**	**4,984**	**2,120**	**74.0**
3.1	Plantation forestry	108	110	2	2.0
3.2	Grazing modified pastures		16	16	NA
3.3	Cropping	2,742	4,810	2,067	75.4
3.4	Perennial horticulture	3	3	0	0.0
3.6	Land in transition	11	45	34	305.9
4	**Production from irrigated agriculture and plantations**	**22,651**	**23,213**	**561**	**2.5**
4.2	Irrigated modified pastures	229	543	313	136.7
4.3	Irrigated cropping	18,111	16,357	-1,754	-9.7
4.3.5	Irrigated cropping - Sugar[2]	10,082	10,669	587	5.8
4.4	Irrigated perennial horticulture	3,974	5,877	1,903	47.9
4.5	Irrigated seasonal horticulture	336	435	99	29.5
5	**Intensive uses**	**11,028**	**12,538**	**1,510**	**13.7**
5.1	Intensive horticulture	6	10	4	64.0
5.2	Intensive animal production	134	288	154	115.2
5.3	Manufacturing and industrial	69	90	21	31.0
5.4	Residential and farm infrastructure	5,830	6,319	490	8.4
5.5	Services	1,229	1,367	137	11.2
5.6	Utilities	20	22	2	8.0
5.7	Transport and communication	1,035	1,082	47	4.6
5.8	Mining	2,625	3,259	634	24.2
5.9	Waste treatment and disposal	80	100	21	25.7
6	**Water**	**966,278**	**957,133**	**-9,145**	**-0.9**
6.1	Lake	118,994	118,906	-88	-0.1
6.2	Reservoir/dam	9,099	9,522	424	4.7
6.3	River	93,819	93,819	0	0.0
6.4	Channel/aqueduct	10	10	0	0.0
6.5	Marsh/wetland	744,355	734,875	-9,480	-1.3

[1]*grazing native vegetation* includes all pastures (modified and unmodified). No distinction is made in respect of tree cover.

[2]the area of land use classes at or below the tertiary level are shown as a subset of the total area at the secondary level.

[3]total figures for primary land use class may contain rounding errors.

Land use change 1999–2015

Table 4, page 18 and Figure 6, page 19 show the land use changes within the Northern Gulf 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 3.3.0 (*cropping)* is an increase in land use intensity, whilst change from 2.1.0 (*grazing native vegetation*) to 1.1.0 (*nature conservation*) is a decrease. This is highlighted in the ALUM classification (Figure 1, page 6). Moving down and from left to right through the classification, the level of intervention or potential impact of land use increases.

For the 1999–2015 period at the secondary level of the ALUM classification, the total area of land use change within the Northern Gulf NRM region is **1,247,608ha** or **6% of the region.** Of this 1,237,463ha (99%) is mapped as a decrease in land use intensity and 10,145ha (1%) is an increase.

Summary statistics presenting the land use change at the secondary level for 1999–2015 are shown in Table 4. This table illustrates the land use changes between 1999 and the updated land use map for 2015. For example, 2,040ha of *grazing native vegetation* land use in 1999 changed to *cropping* land use in 2015.

Changes in selected secondary land use classes show:

- From a total of 1,132,371ha of *grazing native vegetation* in 1999 the land use change shows:
    - 642,723ha (57%) changed to *nature conservation* due to the establishment and expansion of: Olkola National and Regional Parks (326,043ha) in the north of the region; Rungulla National and Regional parks (122,662ha) south of Georgetown; Littleton National Park (79,181ha) east of Croydon; Brooklyn Nature Refuge (58,232ha) and Hann Tableland National Park (3,966ha) to the west of Mossman; and the Canyon Regional Park (48,871ha) east of Georgetown.
    - 482,825ha (43%) changed to *managed resource protection* with the establishment of new nature refuges to the north and south of Georgetown and in the north-west of the region near Kowanyama.
    - 2,040ha changed to *cropping* around Dimbulah and west of Georgetown
    - 1,187ha changed to *irrigated cropping*, and additionally 800ha changed to *irrigated cropping – sugar,* around Dimbulah.
- 21,185ha of *managed resource protection* (2% of the total land use change) changed to *nature conservation,* primarily associated with the conversion of Blackbraes Resource Reserve to National Park.
- The *production forestry* land use class was all but wiped out in the 2015 land use map losing a total of 77,021ha (6% of the total change). Of this, 71,987ha changed to *nature conversation* and 5,034ha changed to *managed resource protection*, all of which can be attributed to the establishment of Kuranda, Mount Lewis, Mount Spurgeon, Mount Windsor and Mowbray National Parks as well as Baldy Mountain and Kuranda West Forest Reserves.
- Of the 4,236ha of land use change from *irrigated cropping* in 1999:
    - 1,721ha changed to *irrigated perennial horticulture* located around Dimbulah
    - 1,385 changed to *grazing native vegetation*
    - 622ha changed to *irrigated cropping – sugar*
    - 277ha changed to *irrigated perennial horticulture*
- 9,541ha of *marsh/wetland* changed to *nature conservation* associated with the conversion and expansion of national park estates in 2015 (they now fall within national parks).

Table 4: Summary statistics for land use change at secondary class for 1999–2015 in the Northern Gulf NRM region

Land use change 1999–2015		2015 land use (ha)																									
		Nature conservation	Managed resource protection	Other minimal use	Grazing native vegetation	Production forestry	Plantation forestry	Grazing modified pastures	Cropping	Land in transition	Irrigated modified pastures	Irrigated cropping	Irrigated cropping - Sugar	Irrigated perennial horticulture	Irrigated seasonal horticulture	Intensive horticulture	Intensive animal production	Manufacturing and industrial	Residential & farm infra.	Services	Utilities	Transport and communication	Mining	Waste treatment and disposal	Reservoir/dam	Marsh/wetland	Total
1999 land use (ha)	Managed resource protection	21,185																					26	7			**21,219**
	Other minimal use	338	71		119	5				4			1					3	47	14			8				**609**
	Grazing native vegetation	642,723	482,825				4		2,040	15	42	1,187	800	841	42		87	7	453	115	2	47	802	14	327		**1,132,371**
	Production forestry	71,987	5,034																								**77,021**
	Plantation forestry																2										**2**
	Cropping		9																								**9**
	Land in transition																	11									**11**
	Irrigated cropping				1,385			16	20	2	163		622	1,721	277		16		9	2					3		**4,236**
	Irrigated cropping - Sugar				559				17		109	194		153	26		14										**1,071**
	Irrigated perennial horti.				161					7		485	189		41	2	22		6				2				**914**
	Irrigated seasonal horti.				108							30	47	101													**285**
	Intensive animal prod.				3																						**3**
	Residential & farm infra.															2	16	0		7							**25**
	Mining	1		84	8					17															93		**203**
	Lake	27																								62	**88**
	Marsh/wetland	9,541																									**9,541**
	Total	**745,802**	**487,939**	**84**	**2,343**	**5**	**4**	**16**	**2,076**	**45**	**313**	**1,895**	**1,658**	**2,816**	**385**	**4**	**157**	**21**	**515**	**137**	**2**	**47**	**837**	**21**	**424**	**62**	**1,247,608**

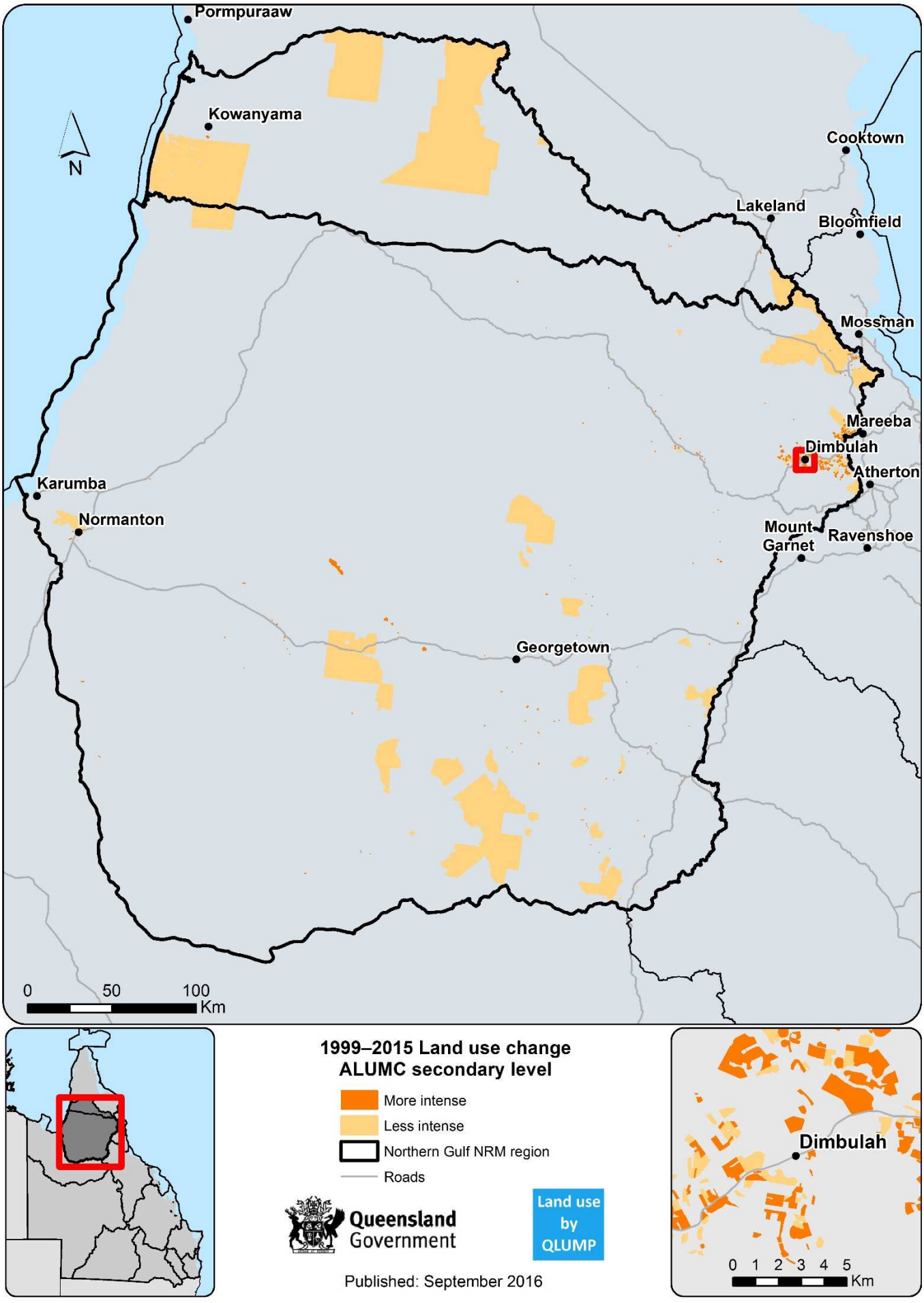


Figure 6: 1999–2015 land use change map at secondary class for the Northern Gulf NRM region

Data format and availability

Download land use datasets

Use the Queensland Spatial Catalogue QSpatial to access land use data sets. Search for **"land use mapping"** in the search term field then refine your results by selecting the **“Planning Cadastre”** filter from the choose categories field. Metadata is also available from QSpatial.

The dataset comprises an ESRI vector geodatabase (10.3.1) at a nominal scale of 1:50,000. Within this are three feature classes: 1999 improved land use, 2015 updated land use and 1999–2015 land use change layer. The feature classes are polygon datasets with attributes describing land use. Land use is classified according to the Australian Land Use and Management Classification (ALUMC) Version 7, May 2010. Note: a representation showing land use at secondary level is available when working within a geodatabase. Layer files are also available to present the land use mapping at primary, secondary or tertiary level.

Digital Data is 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.

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View land use data online

The most current land use web map can be viewed online via the QLUMP website.

Map and feature services

Use the Queensland Spatial Catalogue QSpatial to access the web mapping services of the state-wide land use layer. Search for **"land use mapping"** in the search term field then refine your results by using then *choose content type* filter and selecting **“Service”**.

Request a land use map

It is possible to request a land use map from the QLUMP website based upon a specific location (lot on plan, street address or central latitude/longitude coordinates) in Queensland. The land use maps are emailed in portable document format (PDF).The maps present the most recent land use information available at the secondary level of the ALUMC.

Appendix A Accuracy assessment

The accuracy assessment provided reference data suitable for assessing the 2015 land use map. For each of the sample points, the true land use class was independently determined (this provided the reference data) based on desktop interpretation of the same imagery and ancillary datasets available to the mapper. These points were then compared to the mapped class (map data) and the information 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. However, the total accuracy may be misleading, particularly when a dominant class exists. 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 only marginally improved compared to 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 the user's accuracy of class A is estimated to be 0.84, then from a random sample of 100 points chosen from areas on the map in this class, approximately 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, approximately 84 would also be in class B according to the map. An accurate map should have both high user's and producer's accuracies.

The per-class estimates of accuracy are often not precise, as 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 may indicate a true misclassification problem rather than inadequacies in sample size.

Points that differ between the map and the reference data may be due to positional or spatial errors. Inaccurate registration of datasets is an example of spatial error. Spatial errors influence thematic accuracy. 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. The purpose is to assess the thematic accuracy of land use data. However, as described above, the separation of spatial and thematic errors may be difficult and were not undertaken. As a result, the accuracy assessment reflects properties of the land use data as a whole.

Note: the revised 1999 land use and the land use change data were not accuracy assessed.

2015 land use dataset

The 2015 land use dataset was accuracy assessed with 451 points based on a stratified random sampling strategy, using the map classes (area and frequency) as the strata. The estimate of total accuracy is 0.93 (0.87, 0.97) and Kappa is 0.8 (0.66, 0.9). As the lower bound of the confidence interval for total accuracy is greater than 0.8, the mapping meets the ACLUMP specification.

Table 5 shows the error matrix for the accuracy assessment of the 2015 land use data. For the majority of classes, the reference data agreed with the map data. For example, *grazing native vegetation* had 70 sample points identified. For 66 of those points, the map data was also *grazing native vegetation* and therefore correct. For four points the map data was incorrect, as the land use was found to be *lake* or *marsh/wetland.* These misclassifications reflect both thematic and spatial errors.

The column ‘proportion’ in Table 5 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, *perennial horticulture* is removed from the total area before the proportions are calculated. This column totals 100%.

Table 6 provides the user’s and producer’s accuracy for the 2015 Northern Gulf NRM region land use dataset. This demonstrates the majority of land use classes in the catchment have been mapped accurately. The largest assessable land use class in this catchment is *grazing native vegetation* which has been mapped with very high user’s and producer’s accuracies of 0.934 and 0.995 respectively. The next largest class by area is *nature conservation* which also returned very high user’s and producer’s accuracies of 0.967 and 1. The error matrix (Table 5) provides more detail on the misclassifications.

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 being *intensive horticulture.*

The user’s and producer’s accuracy results should be interpreted individually for their respective classes. It should be noted that the classes with a small area in proportion to the total 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. For example, the producer’s accuracy for irrigated *other minimal uses* is 0.966—however from the 95% interval (0.168, 1) it can be seen that more sample points would be required to confidently determine class accuracy.

Table 5: Error matrix for the Northern Gulf NRM region 2015 land use dataset

Map data \ Reference data	Nature conservation	Managed resource protection	Other minimal uses	Grazing native vegetation	Production forestry	Plantation forestry	Cropping	Perennial horticulture	Land in transition	Irrigated cropping	Irrigated sugar	Irrigated perennial horti.	Irrigated seasonal horti.	Intensive horticulture	Intensive animal prod.	Manufacturing & industrial	Residential & farm infra.	Services	Utilities	Transport & communication	Mining	Waste treatment & disposal	Lake	Reservoir/dam	River	Channel/Aqueduct	Marsh/wetland	Total	Proportion (%)
Nature conservation	**20**	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	**20**	7.27
Managed resource prot.	0	**30**	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**	3.51
Other minimal uses	0	0	**13**	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**15**	0.14
Grazing native vegetation	0	0	0	**66**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	**70**	83.94
Production forestry	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	<0.01
Plantation forestry	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	<0.01
Cropping	0	0	0	2	0	0	**7**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	**10**	0.02
Perennial horticulture	0	0	0	1	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	<0.01
Land in transition	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	<0.01
Irrigated cropping	0	0	0	2	0	0	0	0	0	**5**	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**10**	0.03
Irrigated sugar	0	0	0	0	0	0	0	0	0	1	**14**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**15**	0.05
Irrigated perennial horti.	0	0	0	0	0	0	0	0	0	1	0	**9**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**10**	0.03
Irrigated seasonal horti.	0	0	0	2	0	0	0	0	0	0	1	1	**6**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**10**	<0.01
Intensive horticulture	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	<0.01
Intensive animal prod.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**9**	0	0	1	0	0	0	0	0	0	0	0	0	**10**	<0.01
Manufacturing & industrial	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	0	0	**10**	<0.01
Residential & farm infra.	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	**12**	0	0	0	0	0	0	1	0	0	0	**15**	0.03
Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**9**	0	1	0	0	0	0	0	0	0	**10**	0.01
Utilities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**9**	1	0	0	0	0	0	0	0	**10**	<0.01
Transport & communication	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**9**	0	0	0	0	0	0	0	**10**	0.01
Mining	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**8**	0	0	0	0	0	0	**10**	0.02
Waste treatment & disposal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**9**	0	0	0	0	1	**10**	<0.01
Lake	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**66**	1	0	0	1	**70**	0.61
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	**15**	0	0	0	**15**	0.05
River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**14**	0	1	**15**	0.48
Channel/Aqueduct	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	**1**	<0.01
Marsh/wetland	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	**62**	**70**	3.79
Total	**20**	**30**	**13**	**87**	**1**	**1**	**7**	**0**	**1**	**7**	**16**	**12**	**6**	**1**	**9**	**10**	**13**	**10**	**9**	**11**	**8**	**9**	**70**	**18**	**15**	**0**	**67**	**451**	**100**

Table 6: User's and producer's accuracy for the Northern Gulf NRM region 2015 land use dataset

Class	User's			Producers		
	Estimate	95% interval		Estimate	95% interval	
Nature conservation	0.967	0.834	0.999	1.000	0.930	1.000
Managed resource protection	0.979	0.885	0.999	0.999	0.860	1.000
Other minimal uses	0.830	0.595	0.958	0.966	0.168	1.000
Grazing native vegetation	0.934	0.862	0.977	0.995	0.991	0.998
Production forestry	NA	NA	NA	NA	NA	NA
Plantation forestry	NA	NA	NA	NA	NA	NA
Cropping	0.648	0.348	0.887	0.783	0.027	0.998
Perennial horticulture	NA	NA	NA	NA	NA	NA
Land in transition	NA	NA	NA	NA	NA	NA
Irrigated cropping	0.456	0.196	0.737	0.501	0.021	0.875
Irrigated sugar	0.891	0.675	0.985	0.852	0.081	0.983
Irrigated perennial horticulture	0.842	0.561	0.975	0.745	0.036	0.969
Irrigated seasonal horticulture	0.554	0.270	0.820	0.205	0.002	0.974
Intensive horticulture	NA	NA	NA	NA	NA	NA
Intensive animal husbandry	0.840	0.555	0.974	0.195	0.002	0.976
Manufacturing & industrial	0.935	0.698	0.998	0.085	0.001	0.934
Residential & farm infrastructure	0.762	0.523	0.922	0.824	0.034	0.990
Services	0.841	0.553	0.975	0.558	0.010	0.981
Utilities	0.844	0.560	0.977	0.019	0.000	0.712
Transport & communication	0.842	0.560	0.977	0.463	0.008	0.942
Mining	0.743	0.448	0.934	0.723	0.019	0.998
Waste treatment & disposal	0.839	0.556	0.975	0.087	0.001	0.938
Lake	0.934	0.862	0.977	0.210	0.078	0.600
Reservoir/dam	0.958	0.796	0.999	0.683	0.079	0.916
River	0.894	0.683	0.985	0.879	0.402	0.991
Channel/Aqueduct	NA	NA	NA	NA	NA	NA
Marsh/wetland	0.878	0.788	0.940	0.610	0.341	0.902