Chapter **10**

Queensland Agricultural Land Audit

Central Queensland

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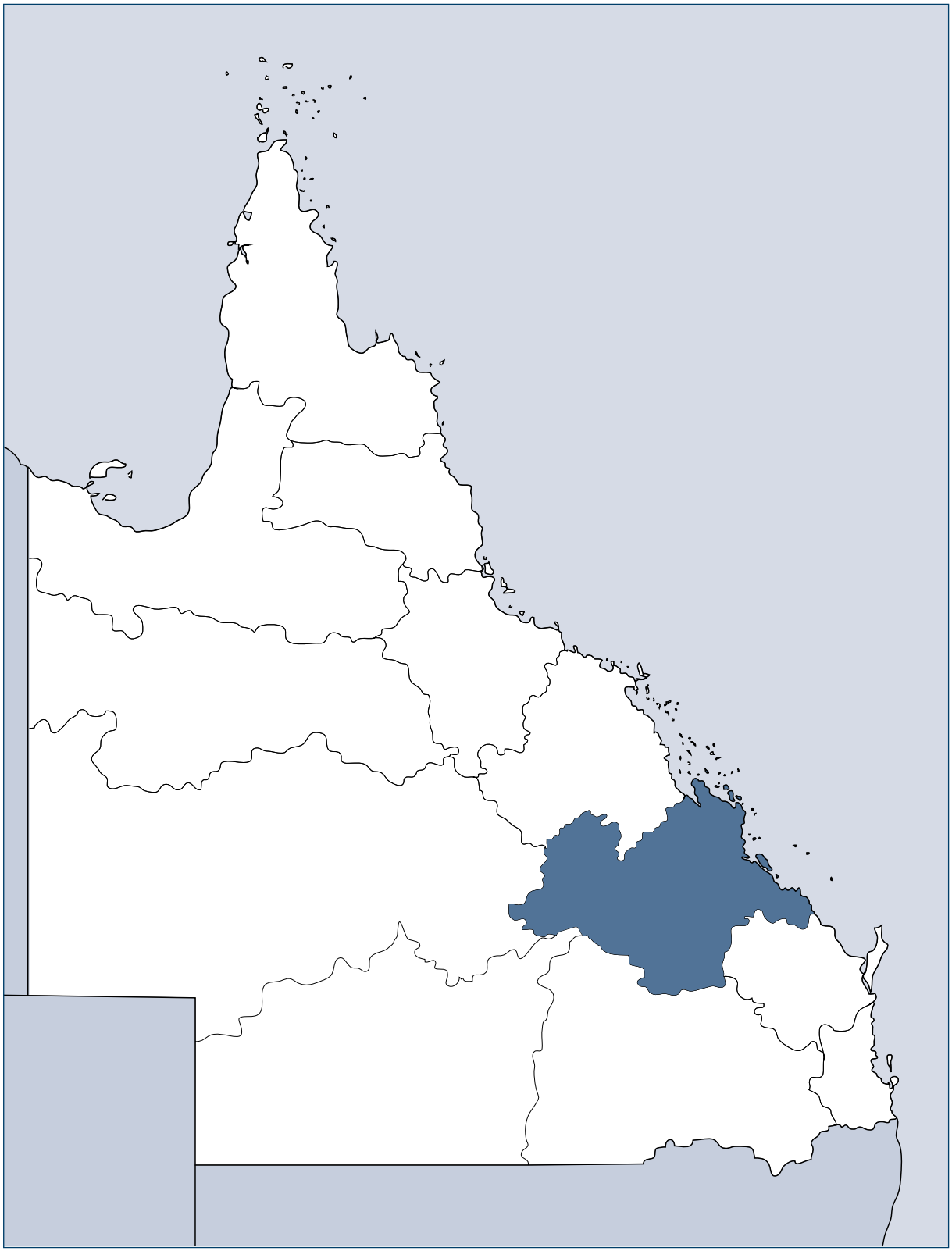

10.1.1 Economic profile

The Central Queensland region is located in the central coastal area of Queensland around Rockhampton and Gladstone and west to Bogantungan (see Map 10.1). The Central Queensland region, for the purpose of the audit, comprises the five local government areas of Banana Shire Council, Central Highlands Regional Council, Gladstone Regional Council, Rockhampton Regional Council and Woorabinda Aboriginal Shire Council. It has a total area of 116 631 km^2, or 6.6 per cent of the total area of the state.

The key centres for provision of agricultural and service facilities are Rockhampton, Emerald and Biloela. Rockhampton is the largest urban centre, with 51 per cent of the region's population in 2011, and provides support for agricultural industries and service-based industries such as retail, health, education and transport.

The Central Queensland region is an important agricultural production area dominated by beef cattle production, while also supporting rain-fed and irrigated cropping, horticulture and forestry. A significant cotton crop is produced in the Dawson Valley and Emerald areas. The region has a strong meat processing capability through three major meatworks near Rockhampton and Biloela, and supports the cotton sector with three cotton gins undertaking primary processing near Emerald and Moura.

The value of agricultural production in the region was $766 million in 2010–11. In 2010–11, the major agricultural commodities in the region were livestock (slaughtering and products) valued at $491 million and cropping at $263 million (including cotton at $65 million, wheat at $51 million, sorghum at $33 million and fruit at $29 million).

The Central Queensland region is susceptible to significant fluctuations in rain-fed cropping production due to its highly variable rainfall. Therefore, values of production for such cropping will vary between years. The available Australian Bureau of Statistics data does not show the value of forestry and forest products, although particularly for hardwood forestry there are significant levels of production in Central Queensland—see Section 10.2.2 (under 'Forestry').

The region is projected to have strong population growth over the coming years, particularly in the Central Highlands and Gladstone areas, largely due to the increase in mining and energy projects. On 30 June 2011, Central Queensland's estimated resident population was 227 451 people (5 per cent of the state's population) and by 2031 is projected to be 344 939 people, an increase of approximately 50 per cent.

This represents an annual average growth rate of 2.1 per cent, which is higher than the state's projected average of 1.8 per cent growth for the same period. Such strong population growth will result in an increased demand for infrastructure, energy, water and services, as well as environmental demands.

Traditionally, agriculture has been a key industry for the Central Queensland region, although the economic structure of the region is changing. Banana Shire (Biloela and the Dawson–Callide area) and the Central Highlands local government area (area around Emerald) have a strong agricultural sector along with the significant coalmining activity in the Bowen Basin.

The mining sector accounts for a significantly higher share of employment in the region compared with the state average—8.7 per cent of the workforce was employed in mining in 2011 compared with 2.6 per cent for Queensland as a whole. The beef and grain industries employed 4.6 per cent of the workers in the region, compared with 2.7 for Queensland as a whole. In the Central Highlands, the mining sector is the largest employer in the region, employing 26 per cent of the area's labour force.

There is significant variation in employment levels across the region, with the Central Highlands local government area and Banana Shire showing very low unemployment rates of 2.2 and 2.8 per cent respectively for the June 2012 quarter compared to the Rockhampton local government area at 5.9 per cent and Woorabinda Shire at 68.6 per cent.[1] The low level of unemployment in some specific areas of the region due to the mining sector puts pressure on the ability of agriculture to access labour and services in these areas.

Land values across the region vary according to the productivity of the land (see Table 10.1). All agricultural land types have seen significant market value increases for the period 2001 to 2012, ranging from 71 to 286 per cent.

In 2012, the highest value land was the irrigated arable land of the Central Highlands at $14 000 per hectare, which is relatively low compared to other areas of the state with the same land type.

In the Banana Shire, irrigated arable land has consistently been valued at four times that of dryland arable land. Remnant forest land of the region has the lowest value per hectare ($200–$350) and, because of the relatively low starting base, this land has seen a relatively higher market value increase over the past 10 years compared with other land types.

Over the past 10 years (2001–2012), there have been significant increases in land values across the region, although the post-boom (2012) land values are still largely within low to medium levels of the state range for the different land types. The Australian grazing property index[2] shows a 15 per cent increase per annum between 1980 and 2007, and a 27 per cent increase per annum between 1999 and 2007 for Central Queensland.

Compared with the Australian average increases of 6 and 13 per cent per annum respectively for the same periods, Central Queensland grazing lands have seen relatively high land value increases. This has been especially recognised in the brigalow blocks (scrub grazing), such as those around Dingo (Central Highlands Regional Council) where up to 400 per cent increases in the dollar value per improved hectare in the period 1990 to 2007 have been recorded. Although, as Table 10.1 shows, there has been some decline in post-boom (2007) prices.

1 Australian Bureau of Statistics 2012, Queensland regional profiles (generated 5 December 2012), Office of Economic and Statistical Research, Queensland Treasury and Trade, ‹http://statistics.oesr.qld.gov.au/qld-regional-profiles›.

2 The Australian grazing property index includes all sales of grazing properties greater than 2000 hectares from Queensland, New South Wales, Northern Territory, Western Australia and South Australia. Sale prices are divided by the land area to produce the $/ha sale price, adjusted for inflation and then indexed.

Table 10.1 The change in land values for the Central Queensland region

Local authority	Land type	Market valuation ($/ha)			Percentage change 2001–12	State market valuations range 2012 ($/ha)
		Pre-boom 2001	Boom (market peak) 2007	Post-boom 2012		
Banana Shire Council	Forest	400	1 200	1 000	+150	20 to 1 000
	Scrub	600	2 000	1 500	+150	400 to 1 600
	Dryland arable	1 000	2 500	2 000	+100	1 000 to 17 500
	Irrigated arable	4 000	10 000	8 000	+100	8 000 to 45 000
	Remnant forest	100	250	200	+100	35 to 8 500
Central Highlands Regional Council	Scrub grazing	500	1 300	900	+80	900 to 900
	Forest grazing	220	1 000	850	+286	24 to 15 000
	Arable irrigated	7 500	12 000	14 000	+87	8 000 to 45 000
	Mixed farming	500	1 500	1 500	+200	1 500 to 1 500
	Downs cultivation dryland	700	800	1 200	+71	1 200 to 1 200
	Remnant forest	75	250	200	+167	35 to 8 500
Gladstone Regional Council	Forest	300	800	800	+167	20 to 1 000
	Remnant forest	100	350	300	+200	35 to 8 500
Rockhampton Regional Council	Forest grazing	500	1 200	1 000	+100	24 to 15 000
	Arable	1 000	4 000	3 500	+250	1 150 to 450 000
	Remnant forest	150	400	350	+133	35 to 8 500
Woorabinda Aboriginal Shire Council	Forest	200	600	500	+150	20 to 1 000

Source: Data provided by the Department of Natural Resources and Mines, State Valuation Service, July 2012

10.1.2 Strengths, weaknesses, opportunities and threats

Key regional issues

- There is potential for additional irrigation development, as both soil and water resources are available subject to construction of further storage infrastructure, future demand for products and water pricing. Current high demand for water from the Fitzroy River by the mining industry does influence the price of water and will therefore determine future use.
- Further development of the region's major agricultural industries is heavily dependent upon the provision of infrastructure to transport materials and produce to and from agricultural enterprises for processing and marketing. It is proposed that a multi-cargo port facility to service container ships at Mackay would improve supply-chain efficiencies for the Central Queensland region.
- Significant impacts on agriculture from the mining sector include competition for land, water, transport and labour; natural resource impacts (such as potential issues with water quality and damage to the soil resource); and impacts on regional communities and services.
- Urban and peri-urban expansion in the Central Highlands and coastal towns are impacting on availability of land for commercial-scale agriculture and the ability to operate agricultural businesses.
- There is an opportunity to target higher value niche markets through enhanced production specifications, such as certified organic beef products.

Significant opportunity exists to expand agricultural production, subject to water availability and adequate transport services. Outlined below are the strengths (existing factors that favour agricultural production), weaknesses (unfavourable conditions that hamper the success of agricultural production), opportunities (actions that could be taken to enhance future agricultural production) and threats (issues that could negatively impact on agricultural production), which provide a snapshot of some of the key factors impacting on the potential for agricultural growth in the region.

Strengths

The strengths of the region include the following:

- The region has a good soil resource base and rainfall, with productive agricultural and pastoral land that underpins the region's cropping, horticultural, forestry (native) and extensive grazing industries, as well as reliable water resources (see Section 10.1.4).
- The importance of the Central Highlands and Dawson–Callide cropping zones is increased because they are geographically and climatically separate from the Darling Downs region. They offer alternative production zones when conditions in the Darling Downs region are unfavourable (and vice versa).
- Major abattoirs with large processing rates (approximately 3320 head of cattle per day) are located at Rockhampton and Biloela; a network of cattle sale facilities are located at Emerald, Biloela, Moura and Springsure; and the Gracemere saleyards have been recently upgraded.
- Central Queensland is a major cattle breeding region for northern Australia and a large number of bull sales are held in the region, which draw buyers from all over northern Australia.
- Central Queensland has been an important region for agricultural research and development by the Department of Agriculture, Fisheries and Forestry (Queensland) and the Central Queensland University, which has supported the growth of the beef cattle and cropping (irrigated and rain-fed) industries, and promoted the use of best management practice.

Weaknesses

The weaknesses of the region include the following:

- Key biosecurity issues for agricultural production in Central Queensland include
  - invasive plants and animals—for example, locusts, parthenium weed (*Parthenium hysterophorus*) and parkinsonia (*Parkinsonia aculeata*)
  - insect pests of plants—for example, *Heliothis* spp., solenopsis mealybug (*Phenacoccus solenopsis*) and stored grain insects
  - animal pests and diseases—for example, nutritional deficiencies, infertility and sheep blowfly (*Lucilia cuprina*).
- There is a reliance on road transport in the region (see Section 10.1.5). Allocation of rail to mining has resulted in a reduction in investment in grain storage infrastructure and a shift to on-farm storage and road transport. The expansion of on-farm storage has also been fostered by the deregulation of centralised grain marketing. This has increased travel times, there are problems in wet weather when the roads become impassable or are susceptible to damage, and there is increased heavy haulage on the region's roads, especially the Capricorn Highway. Beef products are transported predominantly by road (and some by rail) to Brisbane before being exported from the Port of Brisbane. While the Port of Gladstone has container export capacity, it does not have a critical mass of trade for container ships for regular schedules.
- For horticultural crops the cost of transport is high, as there is not a critical mass of produce and transport is required over short time frames. Therefore, it is difficult to leverage competitive transport rates.
- Due to its production of a small number of minimally processed commodities, Central Queensland's agricultural economy is largely export driven. This dependency results in significant exposure to world commodity price movements, competition and changes in export markets and economic patterns.
- There are a number of constraints on the use of consultants by producers in Central Queensland, particularly by the beef sector. Constraints include the large distances and the lack of critical mass of producers motivated to engage consultants, leading to a low number of consultants located in the region. Consultants are widely used in the cotton sector and relatively less in the grain sector, although this is increasing. There is a connection between the improved application of technology by producers and the use of consultants.
- Unreliable and inadequate telecommunications across the region, including a lack of mobile phone coverage in significant areas, is a constraint to running a modern agricultural business.
- Across the Fitzroy area there is limited access to three-phase power, which is a constraint to agriculture, particularly for intensive animal industries that require power for the mixing of feed and operating of sheds.
- There is degradation of natural resource condition across the region, such as soil degradation and erosion, deterioration of downstream water quality and in-stream health (e.g. high sediment loads in the Fitzroy catchment), and fertility run-down and structural decline. Significant work is being implemented to address and improve these conditions.

Opportunities

The opportunities for expanded agricultural production in the region include the following:

- There is potential for additional irrigation development, as both soil and water resources are available subject to construction of further storage infrastructure, future demand for products and water pricing. The key areas are the Dawson Valley below the proposed Nathan Dam and the lower Fitzroy area adjacent to and below the proposed Rookwood and raised Eden Bann weirs (see Section 10.1.4). However, the current high demand for water from the Fitzroy River by the mining industry does influence the price of water and will therefore determine future use.
- Identify niche opportunities that match production systems, target specific domestic or export markets and can achieve a premium, for example
  - diversification and branding of beef cattle production (e.g. grass-fed beef, Meat Standards Australia–graded beef, targeting the European Union market or certified organic beef)—the multinational beef processors within the region offer a plant that is available to process certified organic beef if required
  - expansion of existing and new horticultural operations in the Central Highlands to increase export volumes—if producers take up opportunities there are resources available to match market opportunities
  - development of an oilseed crushing plant—the Department of Agriculture Fisheries and Forestry (Queensland), in partnership with industry, is currently examining the potential of an oilseed crushing plant in the region, although a commercial partner is required to be able to realise the venture.
- Improve pasture productivity and address fertility run-down, particularly in northern landscapes where fertility is running down faster, through introducing perennial legumes into existing pastures to improve soil quality and structure. For example, there is potential in the area north of Dingo and around Taroom for increasing the proportion of sown pastures and legumes.
- Expand cattle feedlots in the lower Fitzroy area to take advantage of the proximity to large abattoirs in the region and to increase the consistent supply of higher value cattle to these processors, a ready supply of feeder cattle and grain, and close proximity to Rockhampton for staff and support services. However, this opportunity can only be realised if market conditions are suitable.
- Develop a multi-cargo facility at Mackay to attract container ships on a weekly basis to transport commodities such as frozen beef, grains and incoming inputs, which would benefit all of Central Queensland. The Port of Gladstone is a significant port with container capacity, but does not have the potential flow of product to attract container ships to routinely dock. A multi-cargo facility on the central coast would mean that agricultural commodities would be less reliant on the Port of Brisbane and could improve efficiencies through containerised supply chains.
- Agroforestry (plantation and native forestry) can improve economic resilience when mixed with existing primary production activities (e.g. beef grazing). Potential exists for increased forestry (and grazing) production in substantial areas that are under a silvopastoral system, by maximising production through practices such as thinning and harvesting.

Threats

The threats to agricultural production in the region include the following:

- With the number and extent of mining operations due to expand in the Central Queensland region, there may be agricultural land lost. Existing or proposed mining development has occurred or been proposed on rain-fed cropping lands and grazing land, particularly around Emerald, including exploration on irrigation properties in the Emerald Irrigation Area. Potential short-term and long-term impacts of coal seam gas (CSG) and other mining activities include
  - competition for land, water and transport
  - resources and related infrastructure projects putting substantial pressure on wages in the low and medium skills brackets, which creates shortages for on-farm labour and flow-on effects in the service sector (e.g. machinery mechanics need to pay higher rates to retain staff and costs passed onto producers)
  - impacts on water quality and quantity, and issues relating to disposal of salts from CSG water
  - land subsidence
  - disruption of farm operations, particularly during the construction phase
  - long-term effects on the soil resource
  - pressure on infrastructure and services (e.g. housing affordability and availability).

  The government aims to address these issues through coexistence mechanisms and regional planning processes.
- There is peri-urban encroachment on agricultural land around Emerald, the Capricorn Coast and to a lesser extent the Callide. In some areas, property values are being inflated by those with mining incomes seeking lifestyle blocks. Such blocks can set up small lot sizes, which are unviable for commercial-scale agriculture, create biosecurity management issues from the increased number of smallholdings and create natural resource management issues from the increased intensity of land use. A specific example is the pressure on pineapple production on the Capricorn Coast.

10.1.3 Climate

The region has an average daily temperature range of 15–28.2 °C, and on average receives 707 mm of rainfall per year. Average annual rainfall is significantly varied across the region, ranging from 600 mm inland to 1300 mm along the coast. Total rainfall in the dry season is half of that in the wet season. Rainfall totals vary significantly between years, affecting dryland crop production.

The Fitzroy River catchment has a well-documented history of flooding, dating back to 1859. Most major flooding stems from heavy rainfall events in the Dawson River or Connors–Mackenzie River catchment areas, which converge approximately 100 km west of Rockhampton and feed into the Fitzroy River.

The trend of increasing temperatures since 1910 is projected to continue. By 2030, average annual temperatures are expected to be around 1 °C warmer (than in the 1990s) and the average number of days over 35 °C is expected to increase from 16 to 26 in Rockhampton and from 87 to 110 in Barcaldine. Longer dry periods interrupted by more intense rainfall events are also expected, which will affect water supply and incidence of flooding.

10.1.4 Water resources

Central Queensland's water resources are dominated by the Fitzroy Basin, which covers the majority of the region. In addition, there is the Calliope River Basin, the Boyne River Basin and numerous coastal streams including Baffle Creek (see Map 10.2).

The Fitzroy Basin is the largest catchment in Queensland and consists of six major sub-catchments—Isaac Connors, Nogoa, Comet, Mackenzie, Dawson and Fitzroy. The Isaac Connors sub-catchment is situated in the Mackay, Isaac and Whitsunday region and the upper Dawson sub-catchment is mainly in the Darling Downs region. Access to water resources is managed through the water resource plans for the Fitzroy, Calliope and Boyne river basins and Baffle Creek.

A number of large dams (Callide, Fairbairn and Awoonga) and smaller weirs are located along the Fitzroy, Mackenzie and Dawson rivers and their tributaries, with an overall capacity of 2.5 million megalitres.

There are five water supply schemes in the Fitzroy Basin—Nogoa Mackenzie, Dawson, Callide Valley, lower Fitzroy and Fitzroy Barrage sub-catchments. Each water supply scheme supports a mix of high-priority urban and industrial users and medium-priority agricultural users. Supplemented water allocations have been established in all water supply schemes except the Callide Valley. The new *Water Resource (Fitzroy Basin) Plan 2011* (under the *Water Act 2000*) has provisions to convert interim water allocations to water allocations.

In the Central Queensland region, the major production uses of irrigation water are for irrigated cotton, horticulture, cereals, some dairy, hay and beef pastures. There are some opportunities for expansion of irrigated production across the region should additional water be made available.

Significant amounts of water are available within the Fitzroy Basin water resource plan area:

- The Fitzroy and lower Mackenzie sub-catchments have unallocated general reserve water that is potentially available for agriculture.
- The Fitzroy and Dawson rivers each have a strategic water infrastructure reserve where unallocated water will be made available with additional water infrastructure. Rookwood Weir and raised Eden Bann Weir are proposed for the Fitzroy River, where some of this unallocated water is currently reserved for industrial and urban requirements. Nathan Dam is proposed for the Dawson River, where it is likely that current mining interests will engage most of the available reserve.
- The Fitzroy Basin water resource plan allows the take of overland flow from a maximum storage size of 50 ML without the requirement of a licence upstream of the Fitzroy Barrage. This may be particularly useful for smaller scale horticultural operations. Downstream of the Fitzroy Barrage, the maximum storage size is restricted to 5 ML.
- The take of groundwater is managed in the Highlands, Carnarvon, Callide and Fitzroy Groundwater Management Areas. Each area and the volume of general unallocated water is defined in the Fitzroy Basin water resource plan. The largest reserve of unallocated water is in the Highlands Groundwater Management Area. Although the Highlands does not generally offer large volumes of groundwater, there is potential for it to be used for horticultural crops.
- The Comet sub-catchment does not have any general reserve of unallocated water available for the take of surface water. Groundwater may be accessible in the underlying Highlands Groundwater Management Area.

Other water resource plans in the Central Queensland region are for the Boyne River Basin, Calliope River Basin and Baffle Creek Basin. Each of these plans also specify volumes of general reserve unallocated water available.

There are water quality issues in some areas that may impact on agricultural use. Specific information can be obtained from the *Fitzroy River sub-basin environmental values and water quality objectives*. Mine water discharge into waterways can impact on water quality and is therefore managed through environmental management plans approved by the Department of Environment and Heritage Protection.

In Central Queensland, the Bowen Basin—from which CSG is and will be extracted—will realise only about 10 per cent of the water of the Surat Basin on the Darling Downs. Therefore, the volumes of potentially available water will not be as great as in other regions and may be used within the mining industry for use such as washing coal. If there is a possibility to use CSG water for agriculture, it will need to be affordable for farmers and of sufficient quality and quantity.

10.1.5 Infrastructure

Central Queensland's freight network for agriculture is based around Rockhampton and Emerald (see Map 10.3). There is a well-developed arterial road system with links to major highways. Rockhampton is at the junction of several major highways, so it is a major road freight centre and provides key transport links between areas of the Central Highlands and Capricorn Coast (around Yeppoon), and areas to the north and south of the region. Grain is exported out of the region through the ports of Gladstone and Mackay. Emerald forms an important hub for rail and road transport of agricultural inputs and commodities, although rail is largely allocated to coal and other freight. Although expansion of the coal, CSG and liquefied natural gas sectors means that there will be further development of infrastructure, this will generally be unavailable to agriculture.

Improved road and rail transport infrastructure to allow efficient transport of produce to ports (Gladstone and South East Queensland) and markets is a concern for continued agricultural development. Currently, the majority of the exports out of the deepwater Port of Gladstone are coal exports. Flooding in 2011 also highlighted the deficiencies in transport infrastructure, with road, air and rail access in and around Rockhampton heavily impacted (see Case study 10.1). Insufficient funds to restore and upgrade critical rural roads following the floods affected the ability of primary producers to benefit from a good growing season.

Increasing demands on hard (e.g. roads, rail) and soft (e.g. health, education facilities) infrastructure as a result of rapid growth from mining and related development is impacting on agricultural development and regional communities. For example, in Gladstone, housing affordability and availability, education facilities and social support services are all under significant pressure. This impacts on the long-term liveability of the region and in turn affects the region's ability to attract a suitable workforce.

The Central Queensland region is well supported for further processing, with access to cotton gins, significant cattle saleyards, abattoirs, timber sawmills and processing, horticultural packaging and cold storage (see Map 10.3). There is also a network of grain storage facilities, although some such as Biloela may close in the near future and the facilities are in decline due to the shift to on-farm storage.

Further development of irrigation infrastructure to support agriculture is desirable where possible (see Section 10.1.4).

Additional infrastructure issues that impact on agricultural development are unreliable and inadequate telecommunications across the region and limited access to three-phase power across the Fitzroy area, which constrains agricultural development.

Case study 10.1 Impacts of the 2011 floods on the beef industry

The 2011 floods highlighted the near total dependence of the beef sector on the road transport network and the deficiencies in transport infrastructure generally, with road, air and rail access in and around major centres being heavily impacted. The beef industry in Queensland relies almost exclusively on road transport for inputs and outputs, and most enterprises are a long way from major domestic markets, processors or export terminals. Roads can be vulnerable to closure during floods, and weight limits on both roads and bridges usually exist for a time following floods. During the 2011 event, all were affected.

During the 2011 floods, the beef supply chain—including grazing enterprises, livestock and fodder transporters, feedlotters, saleyards, rail operations and meat processors—were disrupted in many areas of Queensland. Grain and fodder supplies were unable to reach some feedlots, which ran very low in feed supplies. Cattle were unable to reach processors for many days, and in some cases weeks.

All transport routes into Rockhampton were closed. The two large meat processors in Rockhampton were closed for the traditional seasonal break, so no loss of production occurred during the flood period. However, road damage made it difficult for many producers to move cattle in or out for some months after the floods.

Lessons learned

While flood damage and repair were of primary consideration, the return to a consistent supply of cattle was paramount for getting the beef industry back in operation as quickly as possible. The floods highlighted existing infrastructure deficiencies, road loadings, bridge weight limits and the need for infrastructure improvements. They also highlighted the critical importance of collaboration and coordination between government departments in the emergency response, and the real-time intelligence from industry regarding regionally specific damage and hot spots.

Improved road and rail transport infrastructure can improve beef supply chain resilience to flooding. Suggested improvements include:

- investing in upgrading transport infrastructure (e.g. improvements to roads and bridges)
- linking different modes of transport, including hubs
- greater use of rail on main lines resilient to flood damage
- improved methods of information sharing between the Department of Transport and Main Roads and road or rail users in terms of road weight restrictions and blockages and alternate route selection.

While the 2011 floods were considered extreme, preparing for major events can minimise impacts on the industry and help meet industry production potential.

10.1.6 Vegetation

There are an extensive variety of soils and vegetation in the Central Queensland region that support a range of cattle enterprise types, cropping, horticulture and forestry. There are eucalypt forests and woodlands on a range of soils, which have bluegrasses, black speargrass and kangaroo grass, and provide valuable timber resources. Open downs, brigalow and coolabah woodlands provide valuable cropping/grazing and have bluegrasses and Mitchell grasses. The poplar box and ironbark woodlands tend to be used for breeding and growing, and have a variety of grasses including black speargrass, desert bluegrass and barbwire grass. Lancewood, rosewood and cypress pine areas provide timber for fencing and other local construction uses and support breeding enterprises with some speargrass, golden beardgrass and cotton panic.

Some of the communities have been extensively cleared in the past for agricultural production, including brigalow for grazing and cropping. Some of the land types are not suitable for clearing due to very fragile soil types (e.g. some of the poplar box forests). Extensive areas of brigalow were cleared as part of the Brigalow Development Scheme, a joint Queensland and Commonwealth scheme to award brigalow land by ballot, provide no-interest loans for clearing and other property developments, and to build significant infrastructure to support agricultural development in the Brigalow Belt.

There are restrictions on clearing areas of land within the Central Queensland region under the *Vegetation Management Act 1999* (see Map 10.4). In the region, 6.2 million hectares (or 53.5 per cent of the region) is able to be cleared, has been cleared or is naturally open, and nearly 680 000 hectares (or 6 per cent of the region) requires verification or approval before clearing. There is 4.7 million hectares (or 41 per cent of the region) that cannot be cleared, including areas of national park, state forest and military land.

Amendments to the *Vegetation Management Act 1999* (tabled in Parliament in March 2013) will remove constraints on clearing high-value regrowth vegetation on freehold land across the state, and create opportunities to clear vegetation for high-value agriculture. The audit mapping will be updated in the future to reflect these amendments when the laws come into force.

10.2 Current and potential agricultural land use

Current land use in Central Queensland is presented in Map 10.5. Based on the current datasets, 81 per cent of the region's land area is used for agriculture, with the vast majority used for grazing (74 per cent). The region is important for cropping, with 21 per cent of the land area in Queensland under broadacre cropping occurring in Central Queensland.

Other significant land uses in Central Queensland include the Shoalwater Bay Military Training Area (454 500 hectares), national parks (often contiguous with state forest areas) and mining (which is an increasingly significant land use for the region).

Horticulture and intensive animal production are very difficult to identify on Map 10.5 due to the very small areas of land used in such production relative to other land uses. For more information and detail about these land uses, refer to Maps 10.7–10.11.

Table 10.2 presents the current and potential areas for the range of agricultural land-use categories investigated by the audit. The total potential land-use area exceeds 100 per cent, as the same area may potentially be suitable for more than one agricultural land-use category.

Table 10.2 Current and potential land area

Queensland Land Use Mapping Program (2009)	Current land use			Potential land use*	
	Area (ha)	Percentage of region	Percentage of ALUC† that occurs in the region	Area (ha)	Percentage of region
Broadacre cropping	750 708	6.44	21.16	2 757 199	23.67
Sugarcane	0	0.00	0.00	166 529	1.43
Perennial horticulture	6 279	0.05	7.15	976 365	8.38
Annual horticulture	297	0.00	0.63	2 814 709	24.16
Grazing	8 671 976	74.45	5.86	10 220 140	87.72
Sown pastures	2 871 966	24.66	17.9	1 445 919	12.41
Intensive livestock	941	0.01	0.00	3 598 306	30.98
Aquaculture	140	0.00	3.08	105 691	0.91
Other land use (non-agricultural land uses and also may include some forestry)	2 217 973	19.04	11.06		
Total	**11 648 314**	**100.00**			
Forestry‡ (see Section 10.2.2)					
Managed in silvopastoral systems (mixed native or plantation forestry and grazing)	3 472 696	29.81	1.81		

Note: Refer to Sections 10.2.2 (under 'Forestry') and 10.3 ('Data confidence') for a further explanation regarding the forestry datasets and methodology used.

* Potential areas include where the majority of current production occurs as well as where production could potentially occur. Refer to Section 10.3 ('Data confidence').

† Agricultural land-use category

‡ Forestry includes land, irrespective of tenure, that has been established as forestry (native or plantation), but can also be used for other purposes such as grazing. Current plantation forestry locations are developed from data from the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), HQPlantations Pty Ltd and Forest Enterprises Australia Holdings. Current native forestry is based on data from the Department of Agriculture, Fisheries and Forestry (Queensland) and the Department of Environment and Heritage Protection. See Section 10.2.2 (under 'Forestry') for further information about forestry data.

10.2.1 Important agricultural areas

In the Central Queensland region, three areas have been identified as important agricultural areas.

An important agricultural area is an area that has all the requirements for agriculture to be successful and sustainable, is part of a critical mass of land with similar characteristics and is strategically significant to the region or the state. Map 10.6 shows the general location of the important agricultural areas for the Central Queensland region.

Central Highlands

The Central Highlands are characterised by extensive cropping, high-productivity grazing land and large areas of current and potential horticulture.

The Central Highlands are important for Queensland's agricultural economy. Gross value of total agricultural produce in 2010–11 for the Central Queensland region as a whole was $766.2 million with half of that coming from the Central Highlands. Cattle and calves in the Central Queensland region grossed $480.8 million in 2010–11, contributing 14 per cent of Queensland's total income from cattle and calves—43 per cent came from the Central Highlands.

The gross value of the area's cereal crops (primarily wheat, sorghum and maize) was $91.7 million, contributing 12 per cent of Queensland's total cereal harvest. Legumes were worth $30.8 million in 2010–11, which is one-third of the state's total legume crop. Cotton is also important, being worth $64.7 million or 8 per cent of Queensland's cotton crop. The Central Highlands contributed 82 per cent of the region's cereal crops, 60 per cent of the region's legumes and 80 per cent of the region's cotton.

The Central Highlands represents a traditional use for agricultural development in the Central Queensland region. That is, it is part of the defining character for agricultural history and ongoing use. The Springsure–Rolleston area is a well-known grazing area, and cropping of the north–south zone across Emerald is well developed. The Emerald irrigation area supports large citrus orchards and grape vines. These produced $3.5 million of mainly mandarins, limes and lemons in 2010–11, and $14.9 million of table grapes, which represented nearly 3 per cent of Queensland's citrus and 46 per cent of the state's table grapes.

The Central Highlands area is important for consistency of supply for the grains/cereals markets. It has a large production capacity. With a summer cropping system, it is also complementary to similar-scale cropping in the Darling Downs region that has a winter cropping system, enabling Queensland to consistently supply the market irrespective of weather conditions. It also provides a density of cattle feedlots and grazing activity.

Infrastructure investment has been significant to the agricultural development of the area. The large-scale Fairbairn Dam and the associated channels have been critical to irrigated agriculture, including cropping and horticulture. The reliable water supply also enables a density of cattle feedlot development. Processing facilities have also been established across the area, including cotton gins, a large citrus packing shed and grain silos/bulk handling facilities. The slopes of the area have also enabled large-scale machinery to be used, creating an efficient cropping system.

Dawson River Valley and Callide Valley

The Dawson River Valley is characterised by a mixture of irrigated and dryland cropping, high-quality grazing land, a number of feedlots and the potential for additional broadacre cropping and intensive livestock. There are a series of weirs along the Dawson River, which are used to access water for irrigation. There is approximately 7000 hectares of irrigated land around Theodore supported by a supplemented water supply scheme, which grows primarily cotton in summer and chickpeas and wheat in winter.

The Callide Valley is characterised by a mixture of irrigated and dryland cropping (currently mostly fodder crops) with high-quality grazing land, a number of piggeries and the potential for horticulture and additional intensive livestock. Water for irrigation comes mostly from underground water supplies and to a lesser extent from the Callide Dam and a weir. The use of water for irrigation is determined by the Fitzroy Basin water resource plan (see Section 10.1.4).

In 2010–11, the Banana Shire (which includes the Dawson River Valley and Callide Valley) produced $12.6 million of cotton, $10.6 million of legumes and $15.2 million of cereal crops. These represent 34 per cent of the Central Queensland region's legumes, 19 per cent of the region's cotton crop and 17 per cent of the region's cereal crop.

The Banana Shire is also an important area for intensive livestock production, with feedlots, piggeries, and some poultry production. The gross value of livestock production from the Banana Shire in 2010–11 was $151.8 million, which was 31 per cent of Central Queensland's livestock production. The gross value of pigs in 2010–11 was $5.4 million, which represents nearly 80 per cent of the total value of pigs for Central Queensland. There were $6.7 million of fodder crops grown in the Shire in 2010–11, representing 38 per cent of the Central Queensland region's forage crop harvest.

10.2.2 Industry profiles

Broadacre cropping

Current

Central Queensland is a major grain-producing area and generates approximately 13 per cent of Queensland's production, with important rain-fed and irrigated cropping zones supporting summer and winter crops. There are two major cropping zones from Clermont down through Emerald and south to Rolleston in the Central Highlands and the Dawson–Callide district (including the area around Moura, Theodore and Biloela)—see Map 10.7.

The highly variable climate has led to the development of cropping systems adapted to respond to the availability of moisture, and thus production varies significantly from year to year. The major grain crops grown in the region include (roughly in order of importance/volume) wheat, sorghum, chickpea and, depending on the season, areas of barley, maize, sunflower and mung beans.

The volume and variety of grain crops is driven by the season and world commodity prices. Growers have the advantage of being able to plant a crop variety in any month of the year given available soil moisture. The region is also a significant producer of cotton (approximately 8 per cent of Queensland production) and undertakes first-stage processing (ginning) within the region.

The area of dryland cropping near Bauhinia seems to be an overestimate of the area currently cropped. Although it is likely that a lot of this area has been cropped in the past, the current predominant land use in the area is grazing with sown pastures, and where cropping does occur it is likely to be forage crops for on-farm use.

There are cotton gins in Emerald and Yamala (Central Highlands), and Moura (Dawson–Callide)—see Map 10.7. There are also grain storage facilities at Springsure, Gindie, Emerald, Capella, Clermont, Mt McLaren, Moura, Biloela and Dingo, although some such as Biloela may close in the near future.

At the state level, Central Queensland is a significant broadacre cropping region, with 21 per cent of broadacre cropping in Queensland occurring in the region (see Table 10.2). Broadacre cropping is undertaken on 6.4 per cent of Central Queensland's area, which is much less than the 23.7 per cent of the region where the audit has identified the biophysical potential for broadacre cropping. However, there are constraints on the potential area—such as contiguity of suitable soils, highly variable rainfall and socio-economic factors—which are discussed further overleaf.

Potential

In Central Queensland, 24.5 per cent of the area identified as potential land for broadacre cropping is used for that purpose, but the vast majority of the potential cropping land is used for grazing (73 per cent). Only 2.5 per cent is used for other uses.

Therefore, a key factor limiting broadacre cropping expansion in the Central Queensland region is that potential land is currently used for other agricultural uses, especially grazing. Grazing within the potential broadacre cropping area is largely occurring on areas of high pasture production, sometimes in mixed farming systems (see Maps 10.11–10.14).

While most of the current broadacre cropping in Central Queensland occurs within the areas identified as having potential for such crops, there are a scattered number of small areas (e.g. south-west of Rolleston and west of Springsure) where broadacre crops are currently being grown outside the identified potential area (see Map 10.7).

Some of this cropping outside of the potential area may be occurring in pockets of better soil within larger areas of lesser quality soils. Such smaller pockets may not be identified due to the relatively coarser scale of the land system mapping on which the agricultural land classes are based and from which suitable areas for cropping are derived. In addition, identified cropping outside the potential areas in predominantly grazing areas is likely to be fodder crops grown for on-property use to feed livestock. Therefore, ideal growing conditions are relatively less important.

Only the very far west of the Central Queensland region, near the Claude River, sits outside of the rainfall criteria for broadacre cropping (average of 450 mm rainfall in 7 out of 10 years)—see Map 10.7. However, the highly variable rainfall affects production and will likely limit expansion to some extent. Some small pockets of broadacre cropping do occur in the far west of the region, south of the Claude River outside the 450 mm rainfall threshold. This area is most likely to be used for fodder crops within a predominantly grazing area. Therefore, although broadacre cropping is possible outside the identified potential area, current practice suggests that this will not expand greatly in the near future unless driven by market forces or changes in water availability for irrigated cropping.

Irrigated broadacre cropping in the Central region is largely based around Emerald and the Dawson–Callide water supply schemes. There are also scattered pockets of irrigated broadacre cropping on the Isaac, Dawson and Fitzroy rivers. Around Emerald, cotton and some corn is grown, whereas near Biloela there is diverse irrigated production with smaller holdings growing cereals, corn, leucaena (forage crop), lucerne and mung beans. On Map 10.7, the area of irrigated cropping shown around Bauhinia appears to be larger than what is locally known to currently occur and it is more likely to be sown pasture in this area. Similarly, the irrigated cropping results near Fernlees–Gindie and north-east of Springsure are more likely to be dryland rather than irrigated cropping.

Major opportunities for expanding agricultural production due to the availability of water include the following:

- Along the lower Mackenzie and Fitzroy rivers there is unallocated water that could potentially be used to the limited extent of the potential cropping zone that follows the rivers.
- Along the lower Dawson, Fitzroy and lower Mackenzie rivers there is an opportunity to trade allocated supplemented water.

The Emerald Irrigation Area could be used more intensively; however, water allocations are being sold from agriculture to the mining industry and water is being diverted to other areas for fodder crops such as leucaena.

There is unallocated water available in the Fitzroy Groundwater Management Area that will be released according to rules contained in the *Fitzroy Basin resource operations plan*, although there are limited soils that are suitable for broadacre cropping in this area. The Callide Groundwater Management Area does not provide for further allocation of water as the area is considered to be overcommitted.

Cotton is the annual crop that has generated the greatest return as an irrigated crop in the region. There are potential areas for expansion along the lower Dawson and lower Mackenzie rivers that would be suitable to grow additional areas of cotton and have available water. By contrast, the potential for cotton in the Nogoa Mackenzie sub-catchment (Fairbairn Dam and associated weirs) is limited by the availability of water, with additional production coming from improvements in water-use efficiency.

The Dawson Valley Irrigation Area primarily provides water for the irrigation of cotton, which is grown on the alluvial floodplain around Theodore. Currently, a major limitation for Dawson River irrigators is early season water reliability. Cotton growers cannot guarantee water in spring, when they want to pre-water soil prior to planting or apply early season irrigation post-planting.

Although there appears to be significant unrealised potential (see Map 10.7), this is generally constrained by a number of critical factors:

- Potential expansion of broadacre cropping in Central Queensland is relatively limited as the soils suitable for cropping are located on many small areas of land that are dispersed throughout the landscape. This is particularly the case in the areas near Bauhinia and Dingo, because the better soils are mixed with areas of shallow soils and there are low water-holding capacity and/or subsoil constraints. The scale of mapping does not capture this level of heterogeneity of soils.
- The highly variable climate influences the volumes of grain produced and accordingly the ability to reliably secure specific, long-term markets.
- Increasing cost pressures associated with transport and services restricts potential for expansion
  - Although there are greater economies of scale with rail transport, this is largely allocated to mining use and transport of produce has had to shift to road transport, further exacerbating costs for broadacre cropping producers.
  - Higher salary rates offered through mining are putting pressure on the ability of businesses that service broadacre cropping properties to retain staff and such costs are being passed on to producers.
- The relative prices of cropped commodities compared to cattle influences the risk a farmer is prepared to take when deciding to plant a crop or grow pasture. If prices are high per bale of cotton and there is a good soil moisture profile, the area growing cotton in Central Queensland expands. If the price drops significantly, generally producers choose not to grow cotton.
- Mining development has occurred or been proposed on rain-fed cropping lands, particularly to the north and south of Emerald—including the Golden Triangle district (Gindie–Rolleston–Springsure), which is a productive and reliable cropping area. Exploration has also taken place on irrigation properties in the Emerald Irrigation Area.
- Irrigated areas may decline as water moves according to what the market dictates is the highest and best use. For example, there was a recent sale of water from Fairbairn Dam near Emerald, which meant that 20 000 ML was purchased for mining use from previous agricultural use. This water has yet to be diverted to mining use as the mine is still in planning stages.

- Fertility run-down is evident throughout the region's cropping lands, resulting in declines in plant water-use efficiency—so crops potentially become less productive with the same amount of soil water. As a result, there have been shifts in land use from cropping to grazing, which is more suited to such conditions.
- A comparison between Maps 10.4 and 10.7 shows that in the potential cropping areas north of Capella through to Emerald and south to Rolleston there are areas which require further verification about clearing. Therefore, to expand cropping in such areas it would be necessary to first consult with the Department of Natural Resources and Mines to clarify any requirements.

Examination of specific areas identified as having potential suggests that significant expansion of cropping is unlikely in the following areas:

- West of Taroom the good soils are fractured, some of the area is at the high end of the slope threshold (which is generally not cropped in Central Queensland), the area is historically grazed and the lack of market access is a key constraint, with the nearest centre for sale of grain being Miles on the Darling Downs. Existing cropping in the area is largely forage cropping on grazing properties rather than cropping of grains. The portion of the upper Dawson catchment within the Central Queensland region has unallocated water, which could be used for irrigated cropping near Taroom.
- In the Dawson Valley, areas that were previously cropped when grain prices were relatively high compared to cattle are now planted to pastures as a response to the risks associated with cropping on duplex soils. If soil moisture levels drop in duplex soils during a cropping season, this can mean loss of the crop. However, if duplex soils are used for buffel grass for grazing, lower soil moisture will result in haying off of the pasture that remains and is suitable as cattle feed. The cotton-growing areas in the Dawson–Callide area could potentially use CSG water if suitable, although cropping in this area is also constrained by competition for land as the area around Moura and Theodore is a key area for petroleum, CSG and mining expansion.
- Around Bauhinia there are some shallow duplex soils (i.e. sandy or loamy surface with clear boundary to the clay subsoil), which are not ideal for growing crops, and the area is historically grazed.
- In the area north of Dingo, expansion is also unlikely as there is a lack of water, there are some brigalow duplex soils with high sodicity at depth making them unsuitable for cropping, and there is expansion of mining operations.
- The Arcadia Valley (south-east of Rolleston) is currently buffel grazing country, which is unlikely to change, and is also an area for CSG expansion, so cropping to the extent of the potential identified by the audit in this area is also unlikely.
- The potential areas in the drier western edge of the region, to the west and east of the Claude River, are outside irrigation areas and are generally only suitable for mostly opportunistic, forage or fodder crops.
- Biloela is considered to be the largest northern production area for lucerne. Lucerne is a temperate legume and, therefore, when grown in subtropical areas it requires extra water to keep the plant alive and be productive. The extent of lucerne growing is determined by the price of lucerne and water availability. Significant expansion is unlikely due to limited available water resources.

Therefore, where there is potential for expansion of irrigated cropping due to available water, this is constrained by factors such as suitable soils interspersed with unsuitable soils; competition with mining for transport, land and water resources; and current agricultural land use.

As a result, any expansion of the area under broadacre cropping will largely be based on consolidating around currently cropped areas where there is existing supporting infrastructure. The area and range of crops will continue to fluctuate with changes in markets.

Case study 10.2 Potential to grow sugarcane

Currently, there is no sugarcane grown in the Central Queensland region and, therefore, there are no sugar mills. However, in the northern half of the Central Queensland region the conditions are suitable for potentially growing sugarcane (see Map 10.8).

Sugarcane is susceptible to frost and, therefore, the northern part of the region is suitable as it has less than 5 days per year where the temperatures reach less than 2 °C from where the temperature is measured (i.e. less than or equal to 0 °C at ground level). The southern part of the region does not meet this requirement.

Sugarcane could potentially be grown on over 166 000 hectares (1.4 per cent of the region). The current land uses on land with potential for sugarcane are grazing (81 per cent), cropping (14 per cent) and other land uses (3 per cent).

There are currently significant constraints to sugarcane becoming a commodity that is grown in Central Queensland. The key constraints are the capital costs of establishing a processing plant and transport issues.

The closest processing facilities in the neighbouring Mackay, Isaac and Whitsunday region are based around Mackay–Sarina, and are too far to service any potential sugarcane grown in the Central Queensland region. Therefore, if an industry was to be established, processing facilities would need to be built.

Currently, rail is largely allocated to coal. Although roads can be used to transport sugarcane, it requires specific transport equipment.

Expansion of sugarcane areas in other regions is generally in coastal areas or inland from coastal areas. In addition, higher value crops already dominate the potential sugarcane-growing areas, so it is unlikely to see a shift to sugarcane in the foreseeable future—especially as this region historically has no experience with the crop.

There have been attempts to consider or grow sugarcane in Central Queensland in the past, but these have not been viable. However, if there are market shifts in the future (e.g. there is increased demand for growing sugarcane for ethanol and it is economically viable to establish an industry in Central Queensland), there are some potential growing areas in the northern parts of the region.

Increasing temperature trends could also reduce the frost risk in some areas, which would expand the potential growing area further south.

Horticulture

Current

Central Queensland as a horticultural growing region has some key climatic advantages that, in some cases, allow it to access specific market windows. The key horticultural areas in the Central Queensland region are based around Emerald, Rockhampton, Gladstone and Yeppoon (see Maps 10.9 and 10.10).

Annual horticulture production includes sweet potatoes and zucchinis grown near Rockhampton, pineapples near Yeppoon, pumpkins and watermelons near Emerald, and some vegetable crops south of Gladstone (see Map 10.9).

Herbs are currently grown near Biloela, where some cotton farmers have shifted limited areas from cotton farming to herbs in recent years. This land use does not appear in the annual horticulture map, as most of the herb growing has occurred after the Queensland Land Use Mapping Program dataset was generated in 2009.

The leading lifestyle horticultural crop is turf production, with a small number of farms at Rockhampton and at the Capricorn Coast. Two farms use treated effluent water from the meatworks.

There are also scattered, significant perennial horticultural production areas, which follow a similar pattern to annual horticulture (see Map 10.10). There are key centres around Rockhampton (e.g. grapes, pawpaws and mangoes) and tropical fruits around Yeppoon (e.g. lychees, longans and mangoes), Emerald (e.g. table grapes, citrus and macadamia) and west of Gladstone (e.g. mangoes).

In June 2004, a citrus canker outbreak was identified in Emerald, which required removal of citrus trees in the area and quarantine procedures for 4.5 years, after which the area was officially declared free of citrus canker. Some producers shifted to grapes or other crops, whereas some replanted with higher yielding citrus varieties, rebuilding a viable citrus industry primarily targeting the export market.

Although horticultural industries in Central Queensland have a very small footprint—almost 300 hectares (less than 0.01 per cent of the region) for annual horticulture and 6000 hectares (0.05 per cent of the region) for perennial horticulture—in 2010–11, horticulture generated almost $54 million from fruit, vegetable and lifestyle horticulture (nurseries, cut flowers and turf).

There is no processing of horticultural products within the region, with horticultural products largely produced for the fresh domestic market (except for one major citrus producer). There are privately owned and operated cold storage and packing sheds at Emerald for citrus, and a number of small privately owned and operated packing facilities on the Capricorn Coast, in Gladstone, in Dululu and on Alton Downs. Most other packing is operated on farm and then transported by road direct to southern domestic markets or export markets (e.g. citrus). In 2011, 30 per cent of Queensland's processed pineapples and 20 per cent of the state's fresh market fruit were grown in Central Queensland.

In Central Queensland the cost of transport is relatively high for horticulture, as producers do not have the critical mass of produce and seasons are shorter than some other regions, thereby reducing the ability of producers to leverage competitive transport rates. The ability to access markets and manage freight costs is essential to economic viability and determines whether potential horticultural regions can be used.

Horticultural enterprises require labour at different times throughout the growing and harvesting season. Access to labour is a key component of being able to generate horticultural produce and meet market specifications during peak and critical periods. The population circles on the horticulture maps are indicators of the area around major towns (with a population of greater than 2000 people) with reasonable access to labour.

However, access to labour is only a soft constraint to horticulture. Operations on the Capricorn Coast around Yeppoon employ backpackers as well as local labour. Biloela uses local labour. Emerald's horticultural farms use a range of labour sources such as backpacker and grey nomad labour, a very limited number of local seasonal employees and labour through the Australia Pacific Island Seasonal Workers Scheme. The larger horticultural companies also employ a small permanent workforce.

Near Yeppoon, rainfall is adequate for the majority of the pineapple crop to be rain-fed and sweet potatoes are irrigated from groundwater interception trenches strategically located in the landscape. In Biloela, horticulture growers use groundwater for their crops. Producers of tree crops, such as macadamias and vine crops, use Fitzroy River water allocations and some overland flow as water sources.

In the Central Highlands area, irrigation is essential for profitable horticultural production due to the drier climate. The Emerald Irrigation Area is supplied by Fairbairn Dam, which was initially established for lucerne and fat lamb production. Cotton production expanded rapidly in the 1990s and in the past 10 years, some areas of lighter soils have shifted to higher value horticulture production, primarily citrus and table grapes. Large corporate horticultural operations near Emerald use allocated water to ensure access to water supplies. Vegetables are grown in winter to avoid excessive heat in summer.

Citrus and table grape production occurs in a different seasonal window to other regions and this allows a higher price niche in market access, which helps to overcome the impact of transport costs. Some vegetable producers seek to cover risk by producing a diverse range of vegetables, changing proportions of the mix to suit emerging market opportunities or climatic conditions.

Temperature is the most important climate variable for horticulture, because most horticulture is irrigated and horticultural crops have specific temperature requirements for the development of optimum yield and quality. An evaluation for pineapples in the region in the period to 2030 suggests that it is unlikely temperature increases will significantly impact pineapple production.[3]

The trend of increasing temperatures presents an opportunity to grow frost-sensitive fruit varieties in areas previously considered unsuitable due to frost risk. However, there may also be negative impacts for some horticultural crops in Central Queensland. Understanding temperature thresholds for crops will inform appropriate crop and variety choice. Planting times may also need to be adjusted.

A comparison of Maps 10.4, 10.9 and 10.10 indicates that availability of cleared land is generally not a constraining factor for horticultural development in Central Queensland. However, as horticultural operations occur on relatively small areas of land and the audit mapping is suited to interpretation at the regional level only, it would be important to clarify with the Department of Natural Resources and Mines if any restrictions on the clearing of vegetation apply to a specific area of land.

Urban expansion along the Capricorn Coast and around Emerald is restricting the potential for horticulture. Around Emerald this would also increase the distance from available irrigation infrastructure and proximity to population centres, which can be important for labour supply (although potentially, some horticultural production could move further out).

Around Yeppoon, urban expansion and the cost of coastal land is becoming a constraint for expansion of the pineapple industry. Some production has moved west onto marginal land to overcome this issue.

The footprint for pineapple production is decreasing in Central Queensland, although production levels have increased due to enhanced agronomic practices. In the past there has been a focus on production for canning; however, processing pineapple in this way is in decline due to the lack of competitive cost structure compared to overseas and the need for larger volumes to make value-adding viable. There is an early market window for the fresh pineapple market, where product is transported by road for domestic markets in Sydney and Melbourne.

Horticulture relies on relatively small production areas compared to other agricultural commodities, but is often located in areas with very specific microclimates or suitable patches of soil that may be within larger areas of relatively poorer quality soils. Where soils aren't ideal, soil condition can be modified through the addition of inputs. As such, there are significant horticultural businesses growing their crops on agricultural land class C where soil issues are managed. This is compensated by the land being suitable for horticulture due to other key factors, such as access to water and suitable climatic conditions.

3 P Deuter 2011, *Critical (temperature) thresholds and climate change impacts/adaptation in horticulture*, project number QP1005130 (1/5/2011), Department of Employment, Economic Development and Innovation, Queensland.

Specific areas include a number of sites where current annual horticultural production occurs (e.g. around Emerald, Yeppoon, Rockhampton and west of Mount Morgan) and where perennial horticultural occurs (e.g. around Yeppoon, Gladstone, Emerald and south-west of Rockhampton)—see Maps 10.9 and 10.10. North-west of Rockhampton the soils are 'cracking clays', which are not considered suitable for growing perennial crops. However, it is likely that the perennial crops growing in the area are in smaller patches of suitable soils that are not identified due to the relative scale of the data.

Potential

From a soil and rainfall suitability perspective, significant areas of the Central Queensland region have the potential to grow annual horticultural crops. Annual horticulture could potentially be produced on 24 per cent of the region (2.8 million hectares), of which only 0.03 per cent of the land is currently being used for annual horticulture (see Table 10.2 and Map 10.9). The current land uses on land with potential for annual horticulture are primarily grazing (74 per cent) and cropping (24 per cent).

There are large parts of the landscape where perennial horticulture could occur, with over 970 000 hectares identified as potential land for perennial crops (see Table 10.2 and Map 10.10). The current land uses on the potential land for perennial horticulture are grazing (86 per cent), cropping (11 per cent) and other land uses (2 per cent). Therefore, most potential horticultural land is predominantly used for grazing and cropping.

Availability of water and markets (access and prices) are key constraints for horticultural expansion in the Central Queensland region and key limiting factors as to whether areas of potential annual or perennial horticulture can be viable. In terms of water availability, there is potential for horticultural expansion:

- In the lower Mackenzie and lower Fitzroy rivers, unallocated water (general reserve) and water trading of allocated supplemented water is available. In 2007, the Fitzroy Industry and Infrastructure Study identified areas suitable for crops such as citrus, grapes and vegetables.
- Water is available from the lower Dawson River through trading of allocated supplemented water.
- In the Central Highlands there are small volumes of groundwater available and similarly in the Fitzroy Groundwater Management Area, although water quality particularly on the north bank would need to be checked to determine whether it was appropriate for horticultural use (see Section 10.1.4).

Potential for expansion of horticulture, where water is available, is constrained by factors such as transport costs, urban expansion and current agricultural land use. As horticulture from Central Queensland is largely based on the domestic fresh market, it is not in the interest of horticultural producers to produce large volumes of the same commodity as this reduces the return per unit. However, there is potential for expansion of existing and new horticultural operations to increase export volumes.

Intensive livestock

Current

Beef feedlots and piggeries are significant economic activities in the Central Queensland region and are complementary to other significant agricultural activities, such as extensive grazing and cropping (see Map 10.11). In 2010–11, cattle and calves slaughtered generated $481 million (recognising that this figure includes cattle from both extensive operations and feedlots) and pigs slaughtered generated $6.8 million. The region produced $3 million worth of eggs in 2010–11.

Intensive livestock (feedlot beef cattle, pigs and eggs) in Central Queensland currently use approximately 941 hectares of land. There are a number of cattle feedlot operations, generally of a small to medium scale, and in addition to the feedlots (greater than or equal to 150 head of cattle) identified on Map 10.11 there are also on-farm opportunistic operations when market conditions and/or the price of grain are favourable. The piggeries in the Central Queensland region are based around Rockhampton and Biloela. Eggs are produced near Calliope, Springsure and Avondale (south of Miriam Vale)—see Map 10.11.

There are aquaculture sites in various locations, including along the coast around Yeppoon, west of Calliope, Biloela, Theodore and Emerald (see Map 10.11).

Cattle from feedlots are either processed at one of the three major meatworks in Rockhampton and Biloela or transported out of the region. Pigs from the region are either transported to the only Queensland pork abattoir in Kingaroy or are processed by country butchers. There is an egg processor near Gracemere (see Map 10.11).

Potential

The potential area in which intensive livestock operations could occur is over 3.6 million hectares, which is much greater than the current land use (see Table 10.2). The current land uses on the potential land for intensive livestock are grazing (81 per cent) and cropping (19 per cent).

There are opportunities to expand intensive industries within Central Queensland. Intensive animal operations are best suited to areas where cropping occurs, as this provides for easy access to food supplies and there is potential for wastes generated by intensive animal enterprises to be used as treatments for cropping soils. Secure water supplies are also a requirement.

In 2007, the Fitzroy Industry and Infrastructure Study identified suitable land for the potential development of approximately ten 15 000-head cattle feedlots and irrigated crop production in the Stanwell and Fitzroy area. However, across the Fitzroy area there is limited access to three-phase power, which is a constraint to agriculture that would need to be addressed (particularly for intensive animal industries that require power for mixing feed). In the long-term, the study identified that there were opportunities to establish large piggeries if market demand was strong.

Therefore, there are opportunities for expansion of intensive livestock industries in Central Queensland, although the extent of this is driven largely by the relative prices of grain and livestock. The current wide distribution of piggeries and large feedlots suggests that access to labour is not a constraint.

Aquaculture could occur on nearly 106 000 hectares of coastal areas in the Central Queensland region (see Table 10.2 and Map 10.11). There are already several aquaculture sites along the coast around Yeppoon.

Grazing

Current

Grazing is the dominant agricultural land use in Central Queensland (see Map 10.5)—occurring on almost 8.7 million hectares (74 per cent of the region)—with the majority of this being cattle grazing.[4] Production systems include:

- producing yearling or weaner steers for grass and grain finishing
- breeding and finishing cattle on brigalow country targeting the European Union, Japanese ox and domestic markets
- stud breeding farms producing stud bulls and cows.

Extensive grazing systems in Central Queensland are rain-fed and availability of water is not a constraint to production. The vast majority of forested areas used for native forestry occur on grazing lands that are managed as silvopastoral systems, which combine forestry and grazing in a mutually beneficial way. See Section 10.2.2 (under 'Forestry') and compare Maps 10.12 and 10.15.

Central Queensland has a strong meat processing capability with three major meatworks—two in Rockhampton and one in Biloela. These process approximately 3320 head of cattle per day, largely for the export market. Processing facilities are sufficient to process cattle from within the region and are currently not a constraint to increasing production in Central Queensland. Facilities in Central Queensland process cattle from inside and outside the region. The industry is also supported by a network of cattle saleyards at Emerald, Biloela, Moura and Springsure, and the recently upgraded Gracemere saleyards.

Beef breeding services are available at Rockhampton for the extraction, processing and storage of cattle semen.

In Central Queensland, there is variation in the current productivity and potential productivity of grazing across the region. Map 10.12 presents an evaluation of pasture production that is based on modelling, assuming that all of Central Queensland is currently in B level land condition.[5] Land that is high-quality arable land suitable for broadacre cropping will generally also be high-quality grazing land (or used for mixed grazing/cropping). This is supported by Map 10.12, which shows that areas able to support high pasture growth follow, to a large extent, the areas where broadacre cropping occurs or near cropping areas.

Potential

Grazing could potentially occur on over 10 million hectares (87.7 per cent of the region), although significant expansion is unlikely due to existing land uses. In areas on Map 10.12 identified as having high annual pasture production, 81 per cent is currently grazed with 15 per cent used for cropping and 3 per cent for other uses. Similarly in areas of medium annual pasture production, 81 per cent is currently grazed with 12 per cent used for cropping and 5 per cent for other uses.

If grazing land is able to be managed using best management practice so that it is all restored to level A land condition[6], the area of high pasture production (and therefore the available area for high-quality grazing land) would increase significantly in the Central Queensland region (see Map 10.13). If the land condition is improved, the area of high potential grazing land increases from 2 million hectares to 3.5 million hectares (for cropping if the land condition shifted from level B to A, the current cropping area of over 372 000 hectares would increase to over 720 000 hectares).

4 The relative importance of cattle compared to other grazing livestock is demonstrated by value of agricultural commodities data. In 2010–11, $481 million was generated from cattle and calves, compared to $0.1 million from sheep and lambs and $1.5 million for goats (including feral goats).

5 Grazing land management land condition B is grazing land in 'fair' condition as defined at ‹http://futurebeef.com.au/topics/grazing-land-management/land-condition/›.

6 Grazing land management land condition A is grazing land in 'good' condition as defined at ‹http://futurebeef.com.au/topics/grazing-land-management/land-condition/›.

Increasing grazing production requires either improving the condition (and therefore productivity potential) of the land—i.e. moving the land from level B to A condition as shown by the difference between Maps 10.12 and 10.13—and/or sowing introduced pastures.

Map 10.14 outlines areas that are suitable to be sown with introduced pasture species in Central Queensland. Currently sown pasture is cleared land with appropriate land types for pasture where it is assumed that pasture is sown and potential for sown pasture are areas with suitable land types, but remnant or regrowth vegetation means that there are potentially restrictions or requirements under the *Vegetation Management Act 1999* (see Section 10.1.6 and Map 10.4). Sown pastures currently exist on 2.87 million hectares (25 per cent of the region) and an additional 1.4 million hectares (12 per cent of the region) is suitable for sown pastures. Low potential for sown pasture are areas with land types that are not suitable for growing sown pastures, but (as shown by Maps 10.12 and 10.13) may still be areas of high or medium pasture production based on native and/or naturalised pastures.

Comparing the area currently sown to pasture (Map 10.14) with the main areas of high and medium pasture growth production highlights that most of the areas of high or medium pasture growth are most likely to be sown to introduced pasture species. One exception is the area of medium and high pasture production north of Emerald, which is not currently sown to pasture because the area is used for broadacre cropping.

An evaluation of Maps 10.5 and 10.14 shows that many of the areas designated as potential for sown pasture are unlikely to be realised as they occur in riparian and other areas where clearing is not allowed under the *Vegetation Management Act 1999*. In addition, although biophysical constraints such as suitable land types may suggest that pastures are potentially able to be sown, it does not necessarily mean that doing so would be profitable or that the producer would receive a good return on investment.

A range of factors determine whether an area is sown to pasture including:

- the relative price of land (if land prices are low it may be more profitable to buy further land than to improve pastures with introduced species and vice versa)[7]
- persistence of the pastures due to soil fertility levels and whether it is profitable to manage the pasture through fertiliser input and/or resowing (the area north of Rockhampton is shown as 'potential' area for sown pasture; however, the persistence of sown pastures in this area would be marginal due to lower levels of soil fertility—pastures sown with introduced species may quickly revert to a being dominated by native species)
- the use of leucaena (leguminous forage tree) in grazing systems that is determined by the availability of higher fertility suitable soil types, which will inherently conflict with areas used for cropping (the decision to establish leucaena will be determined by market price of inputs and the return on investment).

The areas of high and medium pasture production in Central Queensland are either currently used for grazing or are used for broadacre cropping (sometimes in mixed farming systems in conjunction with grazing).

Improving calving rates and enhanced herd and business management will also improve the productivity of beef production systems in Central Queensland. In addition, only finishing cattle on the higher fertility, more productive country would further enhance productivity. Although this opportunity applies statewide due to the inherent quality of the region for grazing (see Maps 10.12–10.14), the potential gains are higher than for some other regions.

In terms of increasing costs and impacts on the natural resource base, recent and future mining expansion is impacting on the grazing industry in Central Queensland. Mining operations in the Bowen Basin have generally taken place on former beef cattle properties and, with the expansion of the industry, this is likely to further impact on productive grazing areas.

7 As discussed in Section 10.1.1, there have been significant increases in land values of grazing lands in the Central Queensland region between 1980 and 2007, although there has been some decline in prices since the market peak in 2007.

In some instances, grazing land is being leased to the former owner or a neighbour to use the area not actively mined for grazing. In addition, some mining areas may be able to be rehabilitated back to grazing land, although the effectiveness of rehabilitation to (close to) the original state will vary.

Access to labour is increasingly becoming an issue for grazing properties due to the relatively high wages offered by the mining industry. Although there are much greater economies of scale for producers if they transport livestock by rail than road, rail transport is no longer a viable option for the transport of livestock as most of the tonnage is taken up by coal movements.

Grazing will continue to be an important agricultural land use in Central Queensland. Although the area under grazing is unlikely to significantly expand, there are opportunities to improve the productivity of pastures by improving land condition (increasing the area of high-productivity pastures by approximately 1.5 million hectares). There are also opportunities to improve beef production systems and target niche markets to access premium prices.

Forestry

Current

Central Queensland is an important forestry production and timber processing region for the state. The region generates approximately 30 per cent of Queensland's native hardwood forestry production, 5–10 per cent of plantation softwood forestry production and less than 5 per cent of native cypress forestry production for the Queensland timber processing industry.

Forestry production predominately comes from timber resource areas (native and plantation) on state-owned lands administered under the *Forestry Act 1959*, native forest practice notification areas on private (freehold) land under the *Vegetation Management Act 1999*[8] and plantation forestry on private land. Most of this land is also grazed and generally managed as silvopastoral systems—production systems that combine forestry and grazing in a mutually beneficial way.

Native forestry currently occurs across the region on state-owned land and private land, generally on land that is also used for grazing (see Map 10.15). Native forestry—hardwood with some cypress (softwood)—produces a number of forest products including sawlogs, poles, bridging girders, fencing timbers and craftwood for a broad range of appearance, construction and mining timber processing purposes. Fencing timbers are an important resource for grazing and other agricultural land uses.

The key commercial native forestry tree species in Central Queensland include hardwoods such as spotted gum, Queensland blue gum, ironbark and box, with a broad range of other suitable species. White cypress pine forestry is present in the region but at a small scale compared to other regions of Queensland.

On state-owned land, the denotation of a management unit (MUID)[9] indicates commercial native forestry or quarry material interest; however, the actual native forest production area is generally restricted to the forested area within the parcel. There is currently timber interests based on MUIDs on 2.9 million hectares (25 per cent of the region), recognising that this figure is not the actual area of native forestry production on state land. Harvesting of these MUIDs is scheduled on a routine basis in conjunction with the current state timber supply commitments. The actual forestry area is restricted to the forested areas within the lot on plan (see Table 10.3).

On private land (freehold), forest practice notifications (managing, felling and removal of native trees for commercial purposes) cover 495 725 hectares (4.3 per cent of the region). The actual area of production is generally restricted to the forested areas within those areas (see Table 10.3).

8 Under the *Vegetation Management Act 1999,* 'forest practice' includes felling and removing trees for commercial gain. A landholder who conducts a native forest practice on remnant vegetation must do so according to the *Code applying to a native forest practice on freehold land* and must give formal notice of the location through a 'Notice of a forest practice' form.

9 MUID—management unit inventory data

Plantation forestry currently occurs on 25 621 hectares (0.2 per cent of the region)—see Map 10.16. Central Queensland is a significant region for hardwood production, with 22 per cent of the area under hardwood plantation in Queensland occurring in the region.

Hardwood plantations cover 9000 hectares, which are generally managed as silvopastoral systems. Softwood plantations cover 14 783 hectares and have a denser tree canopy. They only combine with grazing for around the first 5 years of a crop rotation until tree canopy closure.

Plantation forestry (softwood, hardwood and mixed plantations) produces a number of forest products including sawlogs, round timbers and pulpwood for a broad range of appearance and construction timber processing purposes. Plantation forestry is concentrated predominately in the higher rainfall coastal areas, around two distinct industrial-scale plantation forestry estates—around Byfield north of Yeppoon (exotic softwood) and surrounding Miriam Vale south of Gladstone (hardwood) (see Map 10.16), with some hoop pine (softwood) plantations in the Kalpowar area.

Most of the softwood plantations were established by the Queensland Government for sawlog production from the 1960s to the 1990s. The majority of the hardwood plantations were established from the 2000s by both the Queensland Government and private investors. The plantation forestry estates on state-owned land were licensed, and on freehold land sold, to private interests in 2010 by the Queensland Government. The hardwood plantation estate around Miriam Vale reached 20 000 hectares at the peak in 2007, but significant commercial performance failure (pest, disease and drought issues) has resulted in large reductions in area. The commercial performance of the majority of the remaining estate is also under consideration and, if proven unsatisfactory, replanting may not occur.

The softwood forestry plantation tree species are predominately exotic pine varieties that perform well across a range of soils, particularly less-fertile soils that receive annual average rainfall of greater than 800 mm for 7 out of 10 years (see Map 10.16), and some areas of native hoop pine that perform well on the more fertile soils that receive an annual average rainfall of greater than 700 mm for 7 out of 10 years.

Hardwood plantation forestry tree species include Dunn's white gum, spotted gum, rose (flooded) gum and eucalypt hybrids. Most of the hardwood plantings, with the exception of spotted gum, haven't generally commercially performed as expected due to drought and pest and disease attack. Spotted gum are performing quite well, particularly across a range of soil types (excluding vertisol soils) that receive annual average rainfall of greater than 700 mm for 7 out of 10 years (see Map 10.16).

There are a number of small to medium-sized timber processing facilities inside and outside the region sourcing the region's native forestry products (see Map 10.15). There are also a number of portable sawmills and fencing timber processors servicing the region's forestry production that are not mapped. Most of the stationary timber processors are located in the more southern and coastal parts of the Central Queensland region; however, there are some significant timber processors at Theodore and Dingo inside the region and a number of others just outside the region. Commercial haul distances can be 400 km or more, although will vary in line with the value of the product.

The region's softwood forestry plantation products are mostly processed outside the region, as the resource supply is currently not sufficient to support a local exotic softwood timber processor. There is one processor at Gladstone using plantation hoop pine to produce ice-cream sticks for the food industry. Hardwood plantations are mostly young and aimed at pulpwood production, and yet to come onstream.

Table 10.3 Current and potential land area for forestry

Forestry†	Current land use			Potential land use*	
	Area (ha)	Percentage of region	Percentage of ALUC‡ that occurs in region	Area (ha)	Percentage of region
Plantation forestry (ABARES, HQPlantations, FEA Holdings)					
Hardwood	9 002	0.08	21.6	169 651	1.46
Softwood	14 783	0.13	7.13	479 624	4.12
Mixed species (softwood and hardwood)	16	0.0001	5.35	94 508	0.81
Fallow (where plantation not currently planted to trees)	1 820	0.02	10.40		
Total	**25 621**	**0.22**			
Native Forestry					
State-owned land timber interests (area based on entire lot on plan, forestry restricted to forested area within that)	2 951 350§	25.33	2.99		
Private land (native forest practice notifications)	495 725	4.3	15.35		
High potential				2 379 390	20.42
Medium potential				1 254 519	10.77
Low potential				1 337 668	11.48
Total	**3 447 075**	**50.67**		**4 971 576**	**42.67**

* Potential areas include where the majority of current production occurs as well as where production could potentially occur. Refer to Section 10.3 ('Data confidence').

† Forestry includes land, irrespective of tenure, that has been established as forestry (native or plantation), but can also be used for other purposes such as grazing. Current plantation forestry locations are developed from data from the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), HQPlantations Pty Ltd and Forest Enterprises Australia Holdings (FEA Holdings). Current native forestry is based on data from the Department of Agriculture, Fisheries and Forestry (Queensland) and the Department of Environment and Heritage Protection. 'High potential' = higher value commercial timber species of suitable height for sawlog production. 'Medium potential' = commercial species but trees not of sufficient height for sawlog production or no height information available. 'Low potential' = areas with tree cover but not commercially viable species or may include timber species suitable for forest products other than sawlogs.

‡ Agricultural land-use categories

§ MUIDs (management unit inventory data) over leasehold land and reserves generally cover the entire lot on plan, though the actual native forest production area is restricted to the forested area within the lot on plan. Therefore, this figure does not represent the actual area of production.

Potential

There is significant potential for increased forestry production in the region. However, for hardwood plantation forestry the high risk for some species of pest/disease damage will need to be carefully considered given the recent experience with hardwood plantations in the region. Increased forestry production would provide further resource for existing timber processing facilities inside and near the region once increased supply comes onstream.

Forestry production is currently operating in some of the potential areas—in others, potential production is yet to be realised. While the native forestry mapping is reasonably accurate, it is primarily based on the regional ecosystem mapping data used for the *Vegetation Management Act 1999*. As such, there are some identified inaccuracies.

The potential production areas identified for native forestry expansion in Central Queensland are 2.4 million hectares for high potential production, 1.3 million hectares for medium potential production and 1.3 million hectares for low potential production (20, 11 and 11 per cent respectively of the region)—see Table 10.3 and Map 10.15. Opportunities exist to increase native forestry production on the mapped potential areas on a long-term basis, while having minimal impacts on the other pastoral land uses by creating silvopastoral systems.

The potential areas identified for plantation forestry expansion in Central Queensland are 479 624 hectares for softwood plantations and 169 651 hectares for hardwood plantations (1.5 and 4 per cent respectively of the region)—see Table 10.3 and Map 10.16. This is generally limited to the coastal and higher rainfall areas. The current land uses on potential softwood plantation areas are grazing (85 per cent), forestry (5 per cent) and other uses (8 per cent). For potential hardwood plantation areas, the current land uses are grazing (79 per cent), forestry (14 per cent) and other land uses (7 per cent).

There are two softwood plantations (an exotic pine plantation in the Byfield area and a native hoop pine softwood plantation in the Kalpowar area) that are growing outside the potential softwood plantation projected areas.

Exotic pine (softwood) and spotted gum (hardwood) varieties are considered the best potential forestry plantation performers for plantation expansion given the results of research trials in the region. Hardwood plantation forestry expansion has the advantage of being able to be integrated into the existing grazing landscape (particularly with spotted gum and similar tree varieties) and managed as silvopastoral systems.

The region is considered stable for further plantation forestry development, with:

- areas with good rainfall and low risk of severe cyclones that have the capability to produce commercial growth rates (in the areas mapped as potential)
- relatively affordable land prices (from a plantation growing perspective)
- potential access to the major port facilities of Gladstone and Bundaberg.

Most existing timber processors in the region, which are predominately native hardwood processors, have some capacity to expand production if increased log timber becomes available. Demand for native hardwood forest products is high, and demand for exotic and native softwood plantation forest products is medium to high. Demand for forest products is forecast to stay high in the medium to long term.

There may be potential for the establishment of a new exotic softwood timber processing facility in the Yeppoon–Rockhampton area to process the local resource in consideration of a recent increase (new planted areas) in the exotic softwood plantation forestry estate around the Byfield area. This increase in the size of the exotic softwood plantation forestry estate will potentially result in an increased resource supply.

Overall, the region is an important forestry production and timber processing region for Queensland. There is considerable opportunity for production growth in both native forestry and plantation forestry, which in turn will support growth in the downstream timber processing sector.

10.3 Data confidence

The data confidence map (see Map 10.17) indicates that the agricultural land class dataset used as the basis for most of the maps developed for the Central Queensland region (excluding grazing and forestry) was considered a low confidence level.

The confidence levels indicate how well the line work, soil data and soil quality information provided match reality. They are determined by how spatially accurate the lines around different soil types are on the map, how much information was available for soil data, how soil quality information was collected, what was collected and the skill of those collecting the information.

In most of Central Queensland there is low confidence that if you go to the actual site represented on the map, it will match the agricultural land class assigned to that area. The confidence level is medium along the coast.

The no data area in the top right hand corner of the map is Department of Defence land (Shoalwater Bay Military Training Area), which was outside of the scope of the audit and removed from the analysis.

Most of the current land-use information used in the audit has been obtained through the Queensland Land Use Mapping Program (QLUMP), which is dated 2009 for this region. Land use is determined through available databases, satellite imagery and aerial photos. As there are difficulties with differentiating land uses using imagery, local expert knowledge and some field surveys have been conducted to verify the data.[10]

The current locations of intensive animal production facilities are derived from data from the Intensive Livestock Environmental Regulation Unit, within the Department of Agriculture, Fisheries and Forestry (Queensland). The area for intensive land use and location of current aquaculture are based on QLUMP data. The location of egg production is based on the Safe Food Production Queensland egg register as at October 2012.

Current plantation forestry locations are developed from data from the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), HQPlantations Pty Ltd and Forest Enterprises Australia Holdings (FEA Holdings).

Apart from forestry and intensive livestock (where more up-to-date and specific datasets are available), QLUMP data represents the best available dataset for the other land uses and was used in the identification of current areas of agricultural production.

The QLUMP forestry data is based on state forest boundaries and some plantation forest information is also included (see Table 10.2). However, there is also native forestry on private land and other state land (for which state government information is available). There are also more accurate and up-to-date plantation forestry datasets available from ABARES, HQPlantations and FEA Holdings. Therefore, the forestry analysis (which is based on non-QLUMP datasets) is presented in Table 10.3.

As there will be differences between the current Intensive Livestock Environmental Regulation Unit data, forestry information and the QLUMP dataset, the current land-use information based on QLUMP data does not represent exact and current figures for land area (as it is 2009 data), but relative areas between the different land-use types.

Intensive animal operations represent a relatively small agricultural footprint. Therefore, differences in datasets for intensive livestock are not likely to significantly impact on the relative proportions of other land uses.

Grazing can be a mixed land use; therefore, the difference between the total area for forestry from QLUMP data and that derived from the other datasets will largely occur in areas where grazing and forestry are occurring on the same land.

When determining the potential for each of the different land uses, a number of assumptions had to be made (as a result of issues such as uncertainties in the mapping). The net result of these assumptions is that the area figures contained in Table 10.2 overestimate the true potential area for each agricultural land-use category.

10 The methods QLUMP apply to mapping land use are described in full in the ABARES handbook *Guidelines for land use mapping in Australia: principals, procedure and definitions* (4th edition), available at ‹http://adl.brs.gov.au/data/warehouse/pe_abares99001806/GuidelinesLandUseMappingLowRes2011.pdf›.

10.4 Sources of information

10.4.1 Bibliography

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10.4.2 Further studies

Pre-amalgamation shire handbooks

- Banana Shire (1972)
- Bauhinia Shire (1977)
- Emerald Shire (1972)
- Bauhinia Shire (1977)
- Taroom Shire (1971)

Studies

The references marked with an * are available to view (or download) from the Department of Environment and Heritage Protection electronic library at www.ehp.qld.gov.au (click on the 'Library catalogue' link).

Use the search function and the title of the reference to access the relevant documents in PDF format.

Note: Some of these documents are very large (up to 50 MB).

***Burgess, JW 2003, *Land resource assessment of the Windeyers Hill area, Isaac–Conners and Mackenzie River catchments*, Central Queensland, land resources bulletin: QNRM02189, Department of Natural Resources and Mines, Brisbane.**

Abstract: This report contains soil tests and profile morphology, including soil type and slope. The electronic version has information on vegetation and soils.

Connell Wagner Pty Ltd 1963, *Emerald Irrigation Project: outline of proposal*, Irrigation and Water Supply Commission, Brisbane, 4 pp.

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Department of Natural Resources 1998, *Dawson River Dam project report on feasibility of irrigation area development in the vicinity of Taroom*, Department of Natural Resources Engineering Services, State Water Projects, Queensland.

Department of Natural Resources 2000, *Towards sustainable land use in the Fitzroy*, Department of Natural Resources, Queensland, 17 pp.

Department of Natural Resources and Mines 1985, *Evaluation of agricultural land in the Taroom Shire*, project report series Q085032, State of Queensland, 37 pp.

Abstract: This dataset is a land resource areas map of the Taroom Shire, near Wandoan in South East Queensland. It is part of an investigation into land resources in the area. The project was undertaken at the request of the Taroom Shire Council, which had no single report or map describing the land resources of the whole Shire at a suitable scale for Shire planning. This study aimed to amalgamate data from the earlier studies and to present it in a form and at a scale that could assist the council with forward planning of land use and management of land under its influence or control. This project has identified the most valuable agricultural land, where the expansion of the grain cropping activity should occur. This project consists of digital data, a report and three published maps

***Department of Science, Information Technology, Innovation and the Arts 2012, *Land use summary 1999–2009: Fitzroy NRM region*, State of Queensland, 20 pp.**

Abstract: Satellite imagery was used to tabulate land-use classes. This report presents and summarises the land-use mapping in the Fitzroy natural resource management region (which, in area, accounts for 41 per cent of the priority GBR catchments), including the revised 1999 land-use dataset that 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 and the results of the accuracy assessment of the 2009 land-use dataset. The electronic version has a full text report.

***Forster, BA 1985, *Evaluation of agricultural land in Taroom Shire*, Department of Primary Industries, Brisbane.**

Abstract: This report presents the findings of a study undertaken in the Taroom Shire, which describes the land resources of the area at a suitable scale for shire planning.

***Forster, BA, Adsett, KR, Barton, AL & Pitt, GL 1995, *Land systems of the Capricornia Coast*, Department of Primary Industries, Brisbane.**

Abstract: This report contains land systems information (compiled to a scale of 1:250 000) and broadscale information on dominant landforms and geological types occurring in the area, as well as major soils and remnant native vegetation communities. The electronic version has maps of Calliope, Rockhampton, Yeppoon St Lawrence and Marlborough areas.

***Forster, BA & Sugars, MA 2000, Land suitability for irrigated agriculture along the Fitzroy River, land resources bulletin: DNRQ00027, Department of Natural Resources, Brisbane.**

Abstract: The lower Fitzroy irrigation study identifies areas of potentially irrigable land along the Fitzroy River. This report is the second of two components of the land evaluation study, which commenced in mid 1998. It is an assessment of the suitability of each of the mapping units identified in the soil survey for irrigation of a number of different crops. The electronic version details Fitzroy River irrigated land suitability for furrow irrigated crops, overhead spray irrigated crops and microspray or trickle irrigated crops.

***Gillies, CC 1978, *Agricultural land use suitability zones of the Capricornia region*, technical bulletin no. 35: Division of Land Utilisation, Queensland, 15 pp.**

Abstract: The Capricornia region referred to in this bulletin extends along the coast from 100 km north of Mackay to 40 km south of Gladstone, and extends westward to the Great Dividing Range, the Drummond Range and the Belyando River. There are vast areas of this zone not yet cultivated, which are favourably placed with regard to transport. However, large tracts suited to cropping are remote from adequate rail transport. These will remain as grazing areas unless mining or other high profit development causes new rail lines to be built.

***Gunn, RH, Fitzpatrick, EA, Pedley, L & Galloway, RW 1967, 'No. 18: Lands of the Nogoa–Belyando area, Queensland', *Land Research Surveys*, 1–201.**

Abstract: This is a detailed study of the soils vegetation and land use of the area, with supporting soils data in a separate volume.

***Isbell, RF 1957, *Soil and land use survey of part of the Dawson Valley*, Queensland Bureau of Investigation, 47 pp.**

Abstract: This dataset describes soils of an area of 760 square miles in the lower Dawson Valley. The survey is centred around a strip of land adjacent to the Dawson River extending upstream from Baralaba to the mouth of Orange Creek—some 25 miles above Theodore.

Kinhill Pty Ltd 1997, *Bauhinia–Emerald transport strategy study, stage 1: final report*, Department of Main Roads, Central Highlands.

Abstract: This study outlines a transportation planning strategy for the Bauhinia–Emerald area.

***McCarroll, S 1998, *Agricultural land evaluation of the Mackenzie River*, DNRQ980055, Department of Natural Resources, Queensland, 76 pp.**

Abstract: A total of 88 877 hectares were identified as suitable for irrigation development. This area comprises 61 800 hectares of cracking or non-cracking clay soils, or thin surface texture contrast soils suitable for furrow irrigation of cotton. A further 27 070 hectares of texture contrast soils, uniform sands and gradational soils are suitable for overhead spray irrigation of peanuts and/or trickle/microspray irrigation of citrus. The overall conclusion is that large areas of land along the Mackenzie River are suitable for irrigation development.

***McCarroll, SM 1997, *Agricultural land evaluation of key area transects to the Comet River*, DNRQ97075, Department of Natural Resources, Queensland, 60 pp.**

Abstract: The land uses of the study area consist of grazing, dryland cropping and an increasing amount of irrigated cropping enterprises. The major crops produced within the study area include wheat, grain sorghum, sunflower, chickpeas, mungbeans and cotton. The cultivation of other crops such as safflower, rape, linseed, peanuts, maize, triticale, barely, oats and horticultural crops shows the diversity of cropping alternatives. The area planted to irrigated cotton is increasing with the development of suitable production areas.

***McCarroll, SM 1997, *Agricultural land evaluation of key transects along the lower Nogoa River below the Emerald Irrigation Area*, DNRQ97076, Department of Natural Resources, Queensland, 33 pp.**

Abstract: An estimated 130 000 hectares of land were assessed as potentially suitable for irrigation, within 5 km either side of the Nogoa River from the proposed dam site below Rolleston to Springton Creek on the Mackenzie River. Approximately 65 per cent of this area was recognised as being flood prone.

***McCarroll, SM 1997, *Agricultural land evaluation of the upper Dawson River*, DNRQ97152, Department of Natural Resources, Queensland, 58 pp.**

Abstract: The results of this key area study show that there is a large proportion of land suitable for irrigation within 5 km of the river. Within the key area transects, 40.7 per cent of the area is suitable for cotton, 30 per cent is suitable for peanuts and 30 per cent is suitable for citrus.

***McClurg, JI 1999, *Soils and land suitability of the Gavial–Gracemere area*, DNRQ990146, Department of Natural Resources, Queensland, 39 pp.**

Abstract: This survey was undertaken to supplement existing broadscale land system information for the Gavial–Gracemere area. The study covers an area situated to the south of Gracemere. This report presents a general description of the soils of the study area, and an assessment of agricultural land suitability for plantation, tree and vine (including mango, custard apple, citrus, grape, pineapple and passionfruit), forage grain, sorghum, lucerne, curcurbit and vegetable crops (watermelons, pumpkins and cucumbers). Refer to the 'Land systems of the Capricornia coastal lands' series and 'Central Queensland coast horticultural lands' series.

***Muller, PG 2008, *Soils of the Banana area, central Queensland*, Department of Natural Resources and Water, Queensland, 44 pp.**

Abstract: The Banana land resource survey describes the soils, landforms, vegetation, geology and agricultural land suitability of the soils of the Banana 1:100 000 study area. The objectives of the study were to provide detailed information on the soils and land resources of the study area and evaluate the suitability of the land resources for irrigated and dryland cropping, and beef cattle production.

***Ross, DJ 1996, *Land suitability of the Mt Barmoya area, Queensland*, QI96040, Department of Primary Industries, Queensland, 14 pp.**

Abstract: This land resource survey assessed the horticultural potential of 16 selected areas along the Central Queensland coast, in the Calliope and Livingstone Shires. The site description file comprises descriptions of landform, vegetation and soil properties. This is one of 13 interim reports with maps illustrating soil distribution; the distribution of suitability classes for vegetable crops; plantation, tree and vine crops; sown pastures; and the distribution of agricultural land classes. The electronic version has PDF maps of agricultural land classes, suitability for plantation crops, suitability for vegetable crops, suitability for sown pastures, and soils, as well as a full text report.

***Ross, DJ 2000, *Soils and land suitability of the Targinie and Yarwun areas, Queensland*, DNRQ00144, Department of Natural Resources, Queensland, 20 pp.**

Abstract: This land resource survey assessed the horticultural potential of 16 selected areas (covering approx 51 200 hectares) along the Central Queensland coast in the Calliope and Livingstone Shires. The site description file comprises descriptions of landform, vegetation and soil properties. This is one of 13 interim reports with maps illustrating soil distribution; the distribution of suitability classes for vegetable crops; plantation, tree and vine crops; sown pastures; and the distribution of agricultural land classes. The electronic version has a full text report, map of Yarwun agricultural land classes, map of all soil types and maps of suitability for plantation, sown pastures vegetables, sown pasture, and suitability for plantation forestry.

***Rowland, T et al. 2006, *Land use change mapping from 1999 to 2004 for the Fitzroy River catchment'*, Department of Natural Resources and Water, Queensland, 18 pp.**

Abstract: The Fitzroy River catchment is approximately 14.26 million hectares in area and stretches from the Carnarvon Gorge National Park in the west to Rockhampton on the central Queensland coast. It is the largest river basin on the Queensland east coast and contains the regional centres of Rockhampton, Emerald, Biloela and Taroom. The catchment is dominated by savannah woodlands and grasslands, with livestock grazing the primary land use. Production forestry, cropping and national parks comprise the next major uses and extensive mining areas are also present in the catchment area. Cereals and cotton are the major crops grown. This project mapped land use.

***Shields, PG, Chamberlain, HJ & Booth, NJ 1993, *Soils and agricultural use in the Kilcummin area, Central Queensland*, land resources bulletin: QO93011, Department of Primary Industries, Queensland, 185 pp.**

Abstract: A detailed land resource survey and land suitability assessment was undertaken for the Kilcummin area. This project consists of digital data, two reports and two published maps. The electronic version has a full text report in PDF, two maps of Kilcummin area soils and a report of Kilcummin area land suitability for agriculture.

***Shields, PG & Williams, BM 1991, *Land resource survey and evaluation of the Kilcummin area, Queensland*, QV91001, Department of Primary Industries, Queensland, 185 pp.**

Abstract: Approximately half the area (54 per cent) is considered suitable land for rain-fed cropping. Almost 19 per cent is also suitable land for grazing a range of sown pastures, with the remainder being suitable for grazing only limited sown pastures but comprising highly productive native pastures. The soils are deep clays without melonhole gilgai or soluble salts close to the surface, and on gently undulating topography. These lands can be developed for both cropping and grazing sown pastures, or the latter can be used for grazing highly productive native pastures.

***Turner, EJ, Beeston, G & Ahern, CR 1978, *Western arid region land use study, part 4*, technical bulletin no. 23, Department of Primary Industries, Queensland.**

Abstract: This study focused on a land system survey of approximately 4 million hectares of pastoral land in central western Queensland, and was mapped into 36 land systems that are areas of country with similar patterns of landform, soils and vegetation. The electronic version has links to maps for vegetation and land systems.

Map 10.2 Water resources

This map provides an overview of current water resources and water infrastructure.

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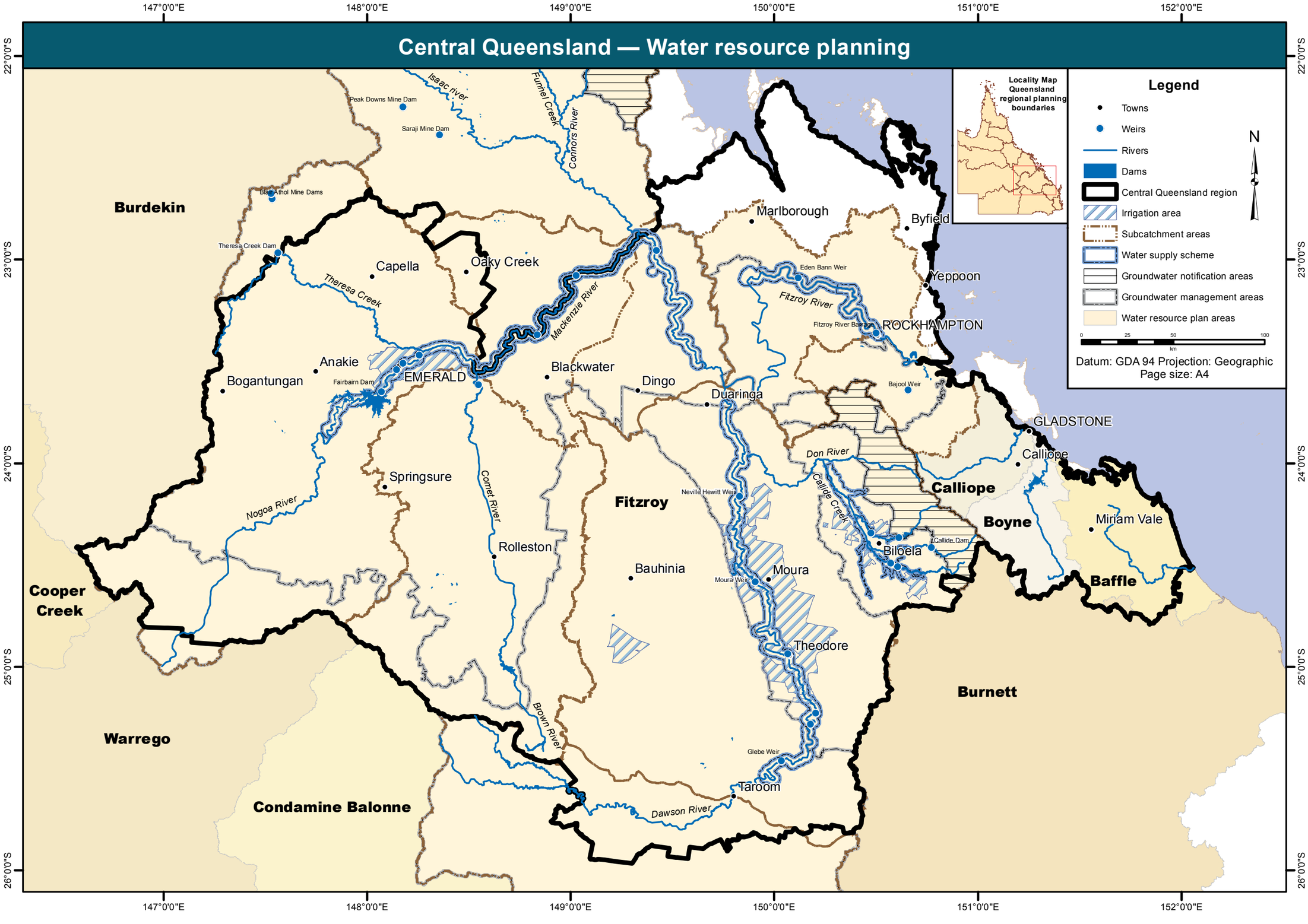
© Geoscience Australia, 2012
© State of Queensland, 2012.

Disclaimer: While every care is taken to ensure the accuracy of this data, all data custodians and/or the Queensland Government make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs that you might incur as a result of the data being inaccurate or incomplete in any way and for any reason.

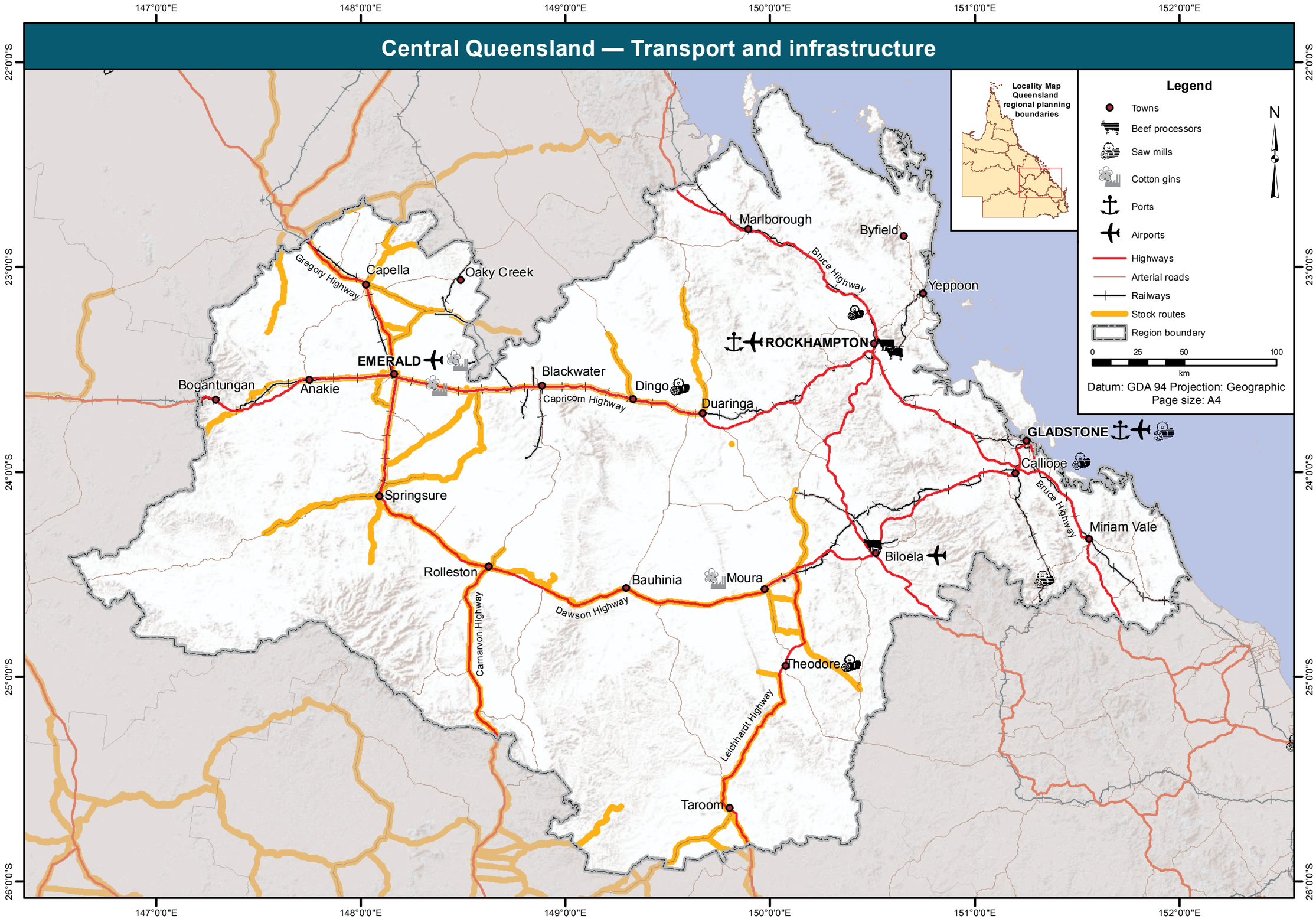
Central Queensland — Water resource planning



Map 10.3 Infrastructure

This map shows key infrastructure components, major agricultural processing plants and natural features relevant to current and future agricultural development within the region.

Central Queensland — Transport and infrastructure



Map 10.4 Vegetation management

This map shows land where, based on currently available information, agricultural use is potentially impacted by the provisions of the *Vegetation Management Act 1999* or associated Regulations protecting native vegetation. It has been compiled from information available to the audit at 28 September 2012 and reflects the legislative and policy regime in place at that time. The map shows areas where no clearing is permitted and areas where clearing requires further verification.

'Clearing requires further verification' can be split into two categories. Category A is where clearing for agriculture purposes may be constrained to varying levels under the Vegetation Management Act. These areas need further verification on the ground, depending on the types of activities taking place. Land that is category A has been denoted:

- high-value regrowth

or

- Schedule 4 Grassland regional ecosystem—homogeneous or heterogeneous polygons

or

- Schedule 5 Grasslands—heterogeneous polygons.

Category B indicates land for which regional ecosystems have not been reliably mapped. This land may or may not contain areas of regional ecosystems where clearing for agricultural purposes is constrained under the Vegetation Management Act. This land requires regional ecosystem mapping before its status can be confirmed. Land that is in this category has been denoted remnant vegetation on the 'remnant map' as per the description on the Department of Environment and Heritage Protection website at www.ehp.qld.gov.au (search 'remnant vegetation').

'No clearing permitted' identifies land for which clearing for agriculture purposes is constrained under the Vegetation Management Act. This land has been denoted:

- remnant vegetation other than Schedule 4 Grasslands on the regional ecosystem map

and

- category A or B on a PMAV.

Central Queensland
Restrictions on clearing based on the Vegetation Management Act (1999)
Uncoloured areas within region are already cleared or have no restrictions to clearing

Legend

- No clearing permitted
- Clearing requires further verification
- National parks and state forests
- Region boundary
- Roads
- Rivers
- Towns

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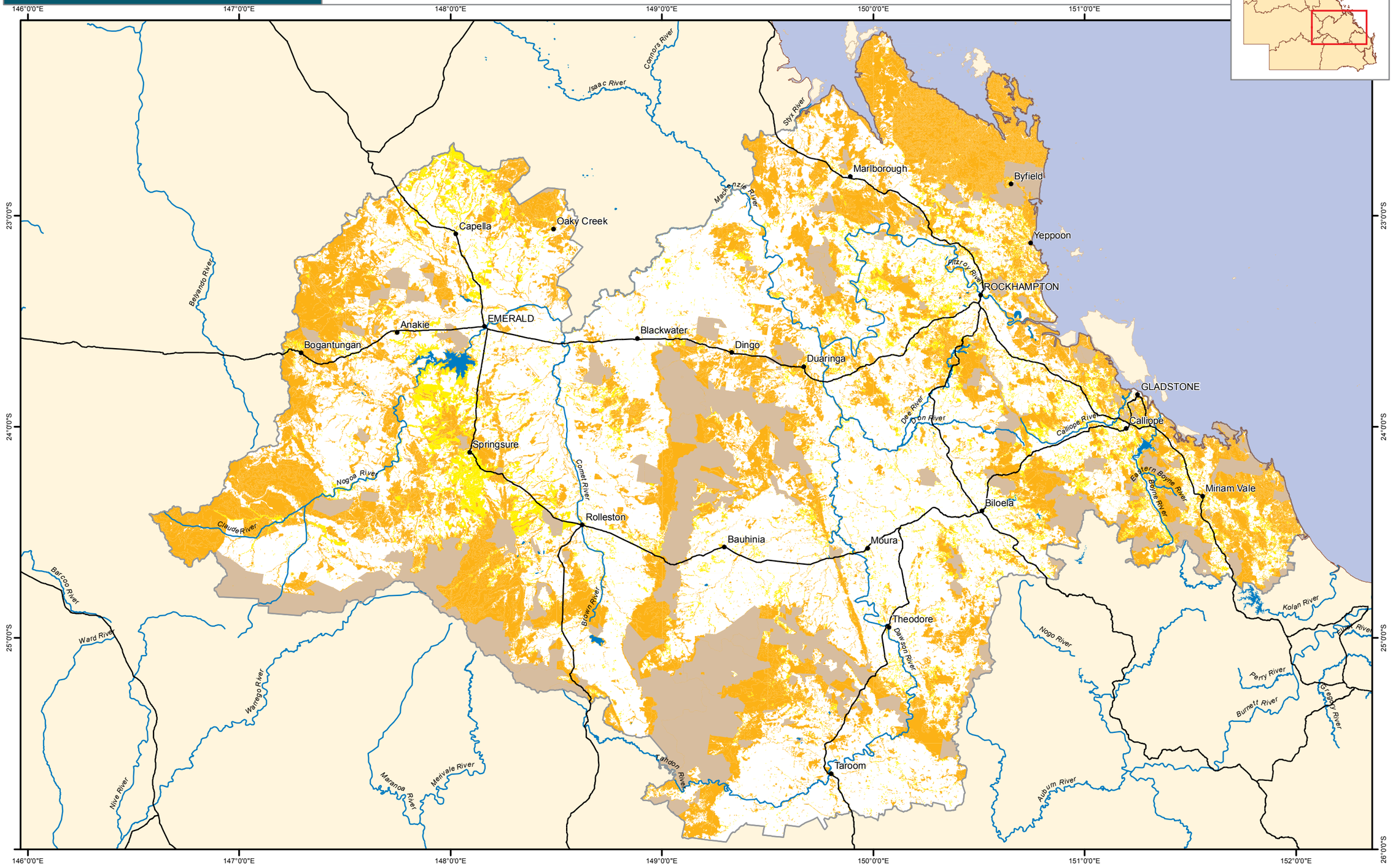
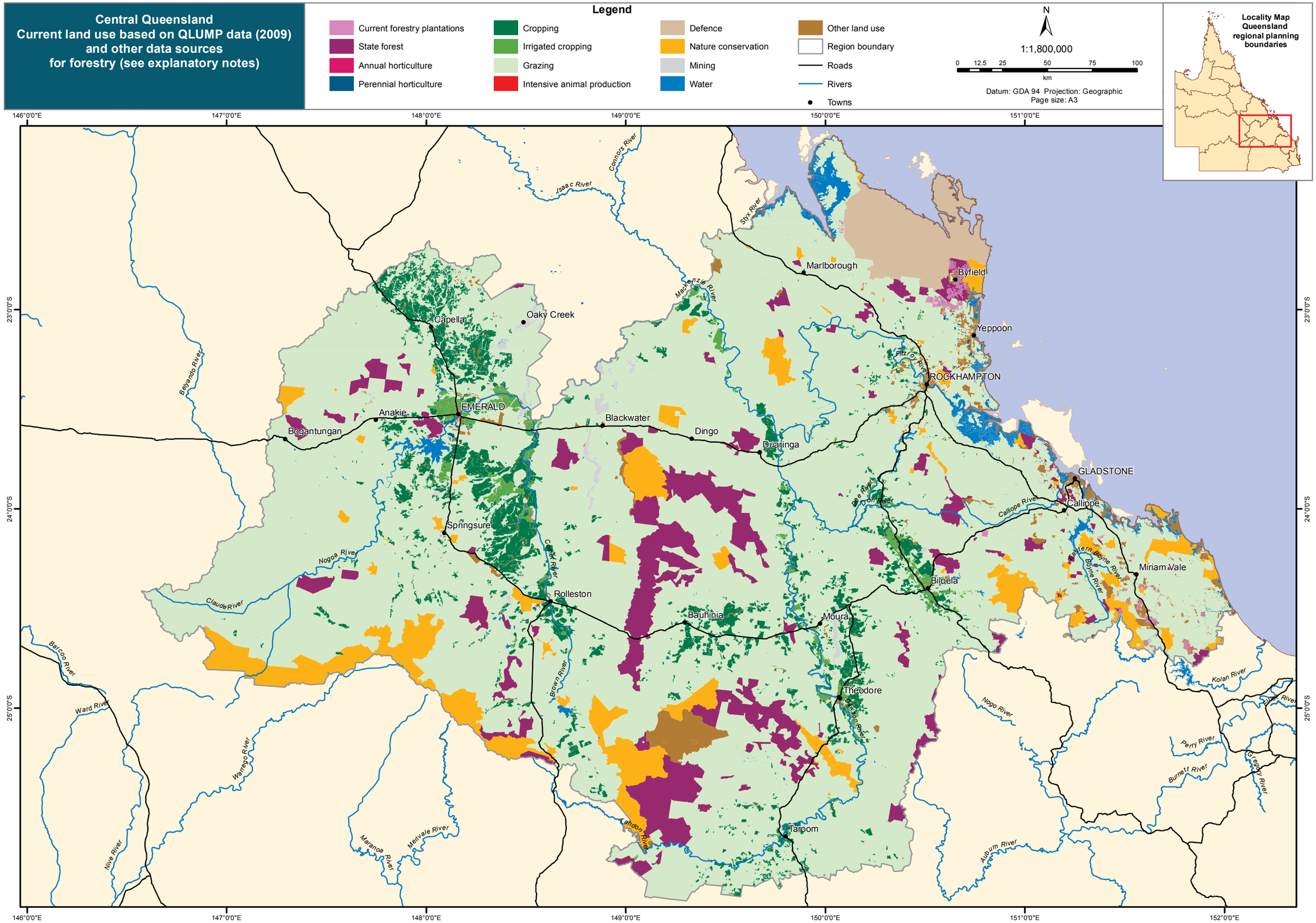
0 12.5 25 50 75 100 km
Datum: GDA 94 Projection: Geographic
Page size: A3



Map 10.5 Current land use

This map shows the extent and distribution of land used for each of the agricultural land-use classes adopted by the audit. It has been produced mainly using data collected by QLUMP. QLUMP mapping has been generated using a combination of satellite image interpretation and ground validation. Its nominal scale is 1:100 000 and for this region it is current as at 2009. For further information about QLUMP visit www.derm.qld.gov.au (search 'QLUMP'). Forestry plantations are mapped using data provided by ABARES and HQPlantations and state forest boundaries have been extracted from the Queensland Government tenure spatial layer.


Central Queensland
Current land use based on QLUMP data (2009)
and other data sources
for forestry (see explanatory notes)
Legend
Current forestry plantations
State forest
Annual horticulture
Perennial horticulture
Cropping
Irrigated cropping
Grazing
Intensive animal production
Defence
Nature conservation
Mining
Water
Other land use
Region boundary
Roads
Rivers
Towns
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km
Datum: GDA 94 Projection: Geographic
Page size: A3
Locality Map
Queensland
regional planning
boundaries
146°0'0"E
147°0'0"E
148°0'0"E
149°0'0"E
150°0'0"E
151°0'0"E
152°0'0"E
23°0'0"S
24°0'0"S
25°0'0"S
Marlborough
Byfield
Yeppoon
ROCKHAMPTON
GLADSTONE
Calliope
Miriam Vale
Biloela
Moura
Theodore
Taroom
Bauhinia
Rolleston
Springsure
Capella
Oaky Creek
EMERALD
Anakie
Bogantungan
Blackwater
Dingo
Duaringa
Isaac River
Connors River
Styx River
Mackenzie River
Fitzroy River
Dee River
Dawson River
Callide River
Comet River
Nogoa River
Claude River
Belyando River
Barcoo River
Ward River
Warrego River
Nive River
Maranoa River
Merivale River
Lahdon River
Brown River
Calliope River
Eastern Boyne River
Boyne River
Kolan River
Elliott River
Nogo River
Perry River
Burnett River
Gregory River
Auburn River

Map 10.6 Important agricultural areas

This map shows the important agricultural areas identified by the audit within this region. An area is identified by the audit as being important for agriculture if it has all the requirements for agriculture to be successful and sustainable, is part of a critical mass of land with similar characteristics and is strategically significant to the region or the state. The areas shown on this map have been identified by the audit on the basis of advice from regional and industry experts and from synthesis of maps and information on current and potential use of land for the range of agricultural land uses considered by the audit. The information used to derive this map varies in its spatial accuracy and resolution. In recognition of these limitations, the information has been generalised for use in strategic decision-making at the regional level. It is indicative only of broad areas within which land important for agriculture is located. More detailed investigation to map the spatial extent and location of important land would be required before the information is suitable for finer scale decision-making such as in statutory land-use planning.

Central Queensland
Important agricultural land areas

Legend

- Central Highlands
- Dawson River Valley
- Callide Valley
- Areas excluded from potential (see explanatory notes)
- Region boundary
- Roads
- Rivers
- Towns

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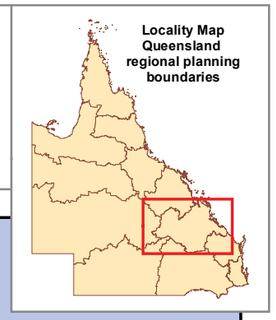
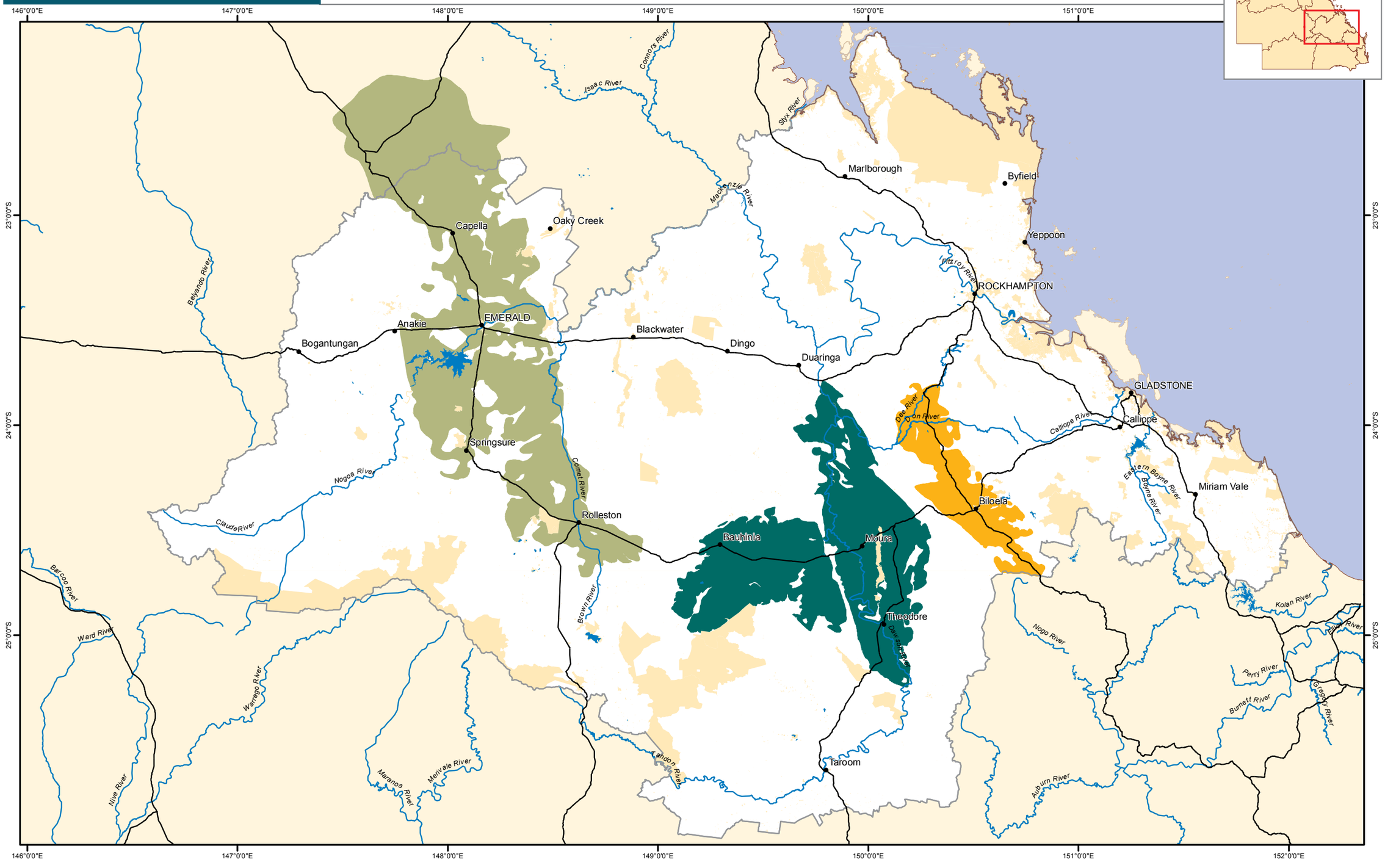
0 12.5 25 50 75 100 km

Datum: GDA 94 Projection: Geographic
Page size: A3





Map 10.7 Broadacre cropping

This map shows land identified by the audit as currently being used for the agricultural land-use category 'broadacre cropping' (rain-fed or irrigated). It also shows land identified as not currently used for broadacre cropping but having potential to be used for this purpose. Land shown as currently being used for broadacre cropping has been identified on the basis that it was mapped by QLUMP as secondary class 'cropping' or 'irrigated cropping'.

Land shown as having potential for broadacre cropping:

a) **includes** land of agricultural land class (ALC) A with slope less than 8 per cent and mean annual rainfall greater than 450 mm for 7 out of 10 years

b) **excludes** land that is urban, intensive use (such as mining), national park, state forest, managed by the Department of Defence or permanently under water.

In identifying this land, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses and competing potential land uses) that are important influences on management decisions made by producers who drive land use.

It should not be assumed from this study that all (or any particular portion of) land identified as having potential to be used for broadacre cropping should or will be converted to that use. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by constraints that have not been included as criteria in the mapping, for example the availability of water for irrigation (see Map 10.2). See Section 10.1 for further constraints.

Central Queensland
Biophysical potential for broadacre cropping and current broadacre cropping

Potential based on ALC 'A', slope <8%, rainfall >450mm 7 in 10 years

Legend

- Potential cropping
- Cropping
- Irrigated cropping
- Areas excluded from potential (see explanatory notes)
- Cotton gins
- Roads
- Rivers
- Towns

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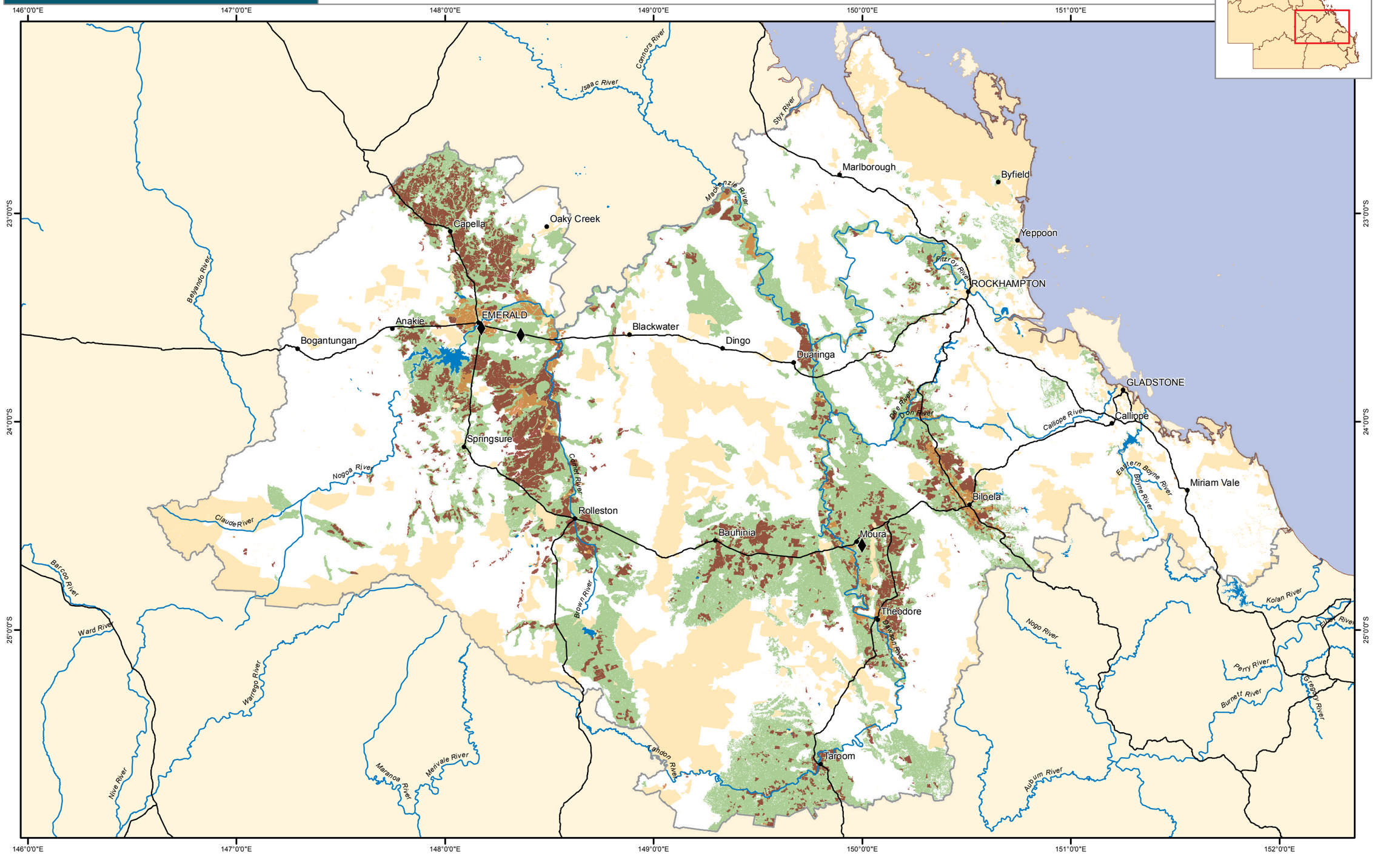
Page size: A3



Map 10.8 Sugarcane

This map shows land identified as not currently used for sugarcane cultivation but having potential to be used for this purpose. Land shown as currently being used for sugarcane cultivation has been identified on the basis that it was mapped by QLUMP as tertiary class 'sugarcane'.

Land shown as having potential for sugarcane cultivation:

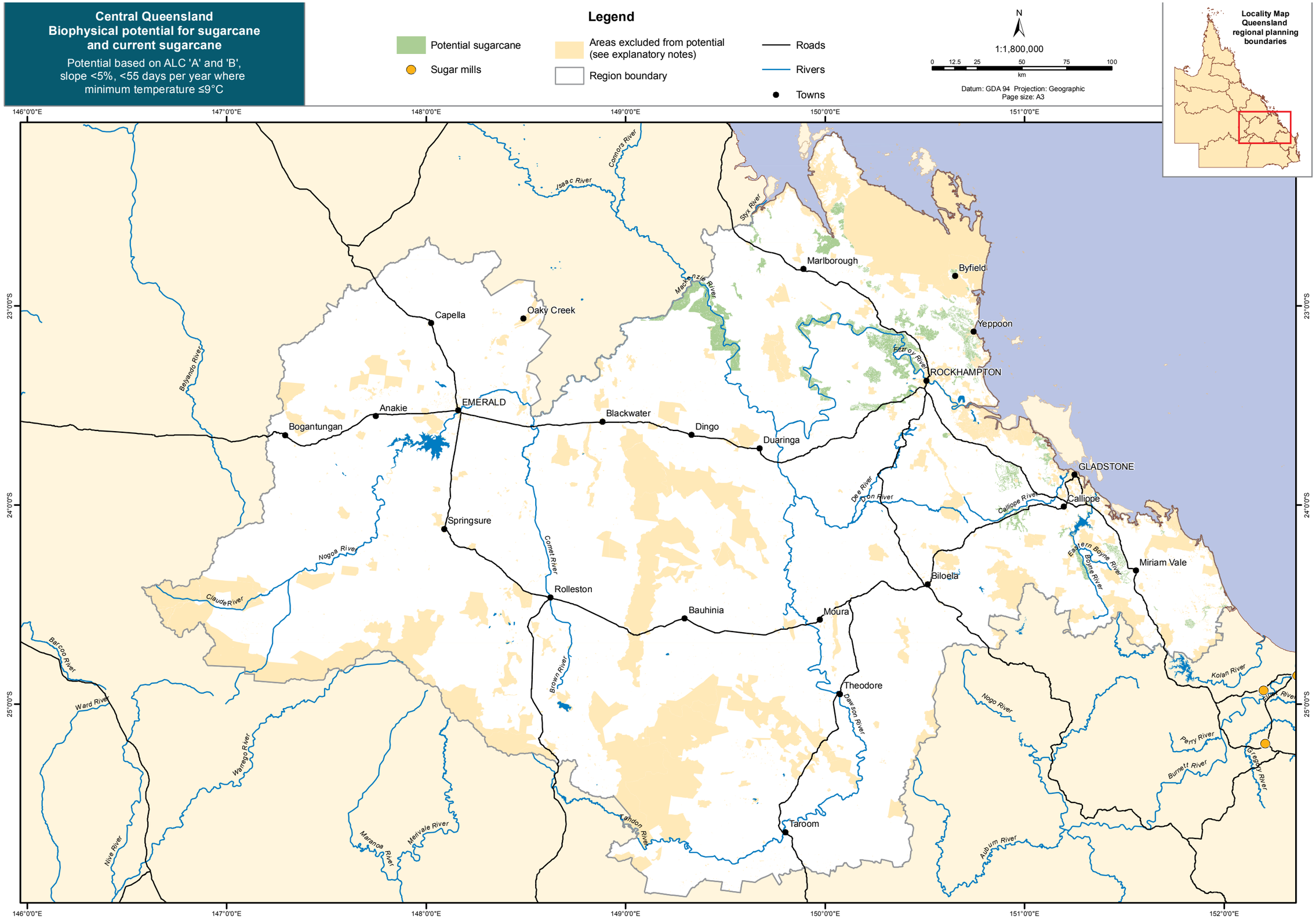
a) **includes** land of agricultural land class A and class B with slope less than 5 per cent and fewer than 55 days per year with a minimum temperature of 9 °C or less

b) **excludes** land that is urban, intensive use (such as mining), national park, state forest, managed by the Department of Defence or permanently under water.

In identifying this land, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses and competing potential land uses) that are important influences on management decisions made by producers who drive land use. These factors and how farmers respond to them are highly variable across space and through time. It was not possible to measure the effects of these factors with any confidence within the time and resources available to the audit.

Access to a sugar mill is an important consideration in determining the potential for land to be used for growing sugarcane. The locations of current mills are shown on the map for information.

It should not be assumed from this study that all (or any particular portion of) land identified as having potential to be used for sugarcane cultivation should or will be converted to that use. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by constraints that have not been included as criteria in the mapping, for example the availability of water for irrigation (see Map 10.2). See Section 10.1 for further constraints.


Central Queensland
Biophysical potential for sugarcane and current sugarcane
Potential based on ALC 'A' and 'B', slope <5%, <55 days per year where minimum temperature ≤9°C
Legend
Potential sugarcane
Sugar mills
Areas excluded from potential (see explanatory notes)
Region boundary
Roads
Rivers
Towns
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km
Datum: GDA 94 Projection: Geographic
Page size: A3
Locality Map
Queensland
regional planning
boundaries
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Marlborough
Byfield
Yeppoon
ROCKHAMPTON
GLADSTONE
Calliope
Miriam Vale
Biloela
Moura
Theodore
Taroom
Bauhinia
Rolleston
Springsure
Capella
Oaky Creek
EMERALD
Anakie
Bogantungan
Blackwater
Dingo
Duaringa
Connors River
Isaac River
Styx River
Mackenzie River
Fitzroy River
Dee River
Boyne River
Calliope River
Eastern Boyne River
Belyando River
Nogoa River
Comet River
Claude River
Brown River
Barcoo River
Ward River
Warrego River
Nive River
Maranoa River
Merivale River
Landsborough River
Dawson River
Nogo River
Auburn River
Kolan River
Perry River
Burnett River
Creedy River

Map 10.9 Annual horticulture

This map shows land identified by the audit as currently being used for the agricultural land-use category 'annual horticulture'. It also shows land identified as not currently used for annual horticulture but having potential to be used for this purpose. Land shown as currently being used for annual horticulture has been identified on the basis that it was mapped by QLUMP as 'seasonal horticulture', 'irrigated seasonal horticulture' or 'intensive horticulture'.

Land shown as having potential for annual horticulture:

a) **includes** land of agricultural land class A and class B with slope less than 8 per cent and April to October rainfall less than 500 mm

b) **excludes** land that is urban, intensive use (such as mining), national park, state forest, managed by the Department of Defence or permanently under water.

In identifying this land, the audit did not consider a range of business factors (such as markets, pre-existing land uses and competing potential land uses) that are important influences on management decisions made by producers who drive land-use. These factors and how farmers respond to them are highly variable across space and through time. It was not possible to measure the effects of these factors with any confidence within the time and resources available to the audit.

Also, the audit did not consider temperature or flood risk. Temperature is a major determinant of suitability of land for horticulture. It affects whether a crop can grow and its performance. However, due to the large range of different horticultural crops grown in Queensland and the widely variable temperature requirements for these crops, it is not possible to determine meaningful criteria for temperature for the category 'annual horticulture'. Flood risk is similarly difficult to map. Reliable data on flood frequency and severity currently exists for comparatively few parts of the state and the extent to which agricultural land use and management are affected by flooding varies greatly from farmer to farmer depending on their individual circumstances and perceptions.

Availability of labour, especially during harvest season, is an important consideration in selecting suitable land for many forms of annual horticulture. To reflect this, areas that are within 50 km of a centre with a population of 2000 or more are highlighted on the map. However, labour is not always a critical factor (e.g. for crops that are mechanically harvested) and the size and proximity of the nearest population centre is not always the best surrogate for labour force availability (e.g. many horticultural businesses make extensive use of itinerant seasonal workers or backpackers).

It should not be assumed from this study that all (or any particular portion of) land identified as having potential to be used for annual horticulture should or will be converted to that use. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by constraints that have not been included as criteria in the mapping, for example the availability of water for irrigation (see Map 10.2). See Section 10.1 for further constraints.

Central Queensland
Biophysical potential for annual horticulture and current annual horticulture

Potential based on ALC 'A' and 'B', slope <8%, April - October rainfall <500mm

Legend

- Potential annual horticulture
- Current annual horticulture (not to scale)
- Areas excluded from potential (see explanatory notes)
- Region boundary
- 50 km from a population >2000
- Roads
- Rivers
- Towns

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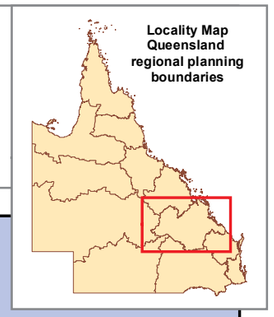
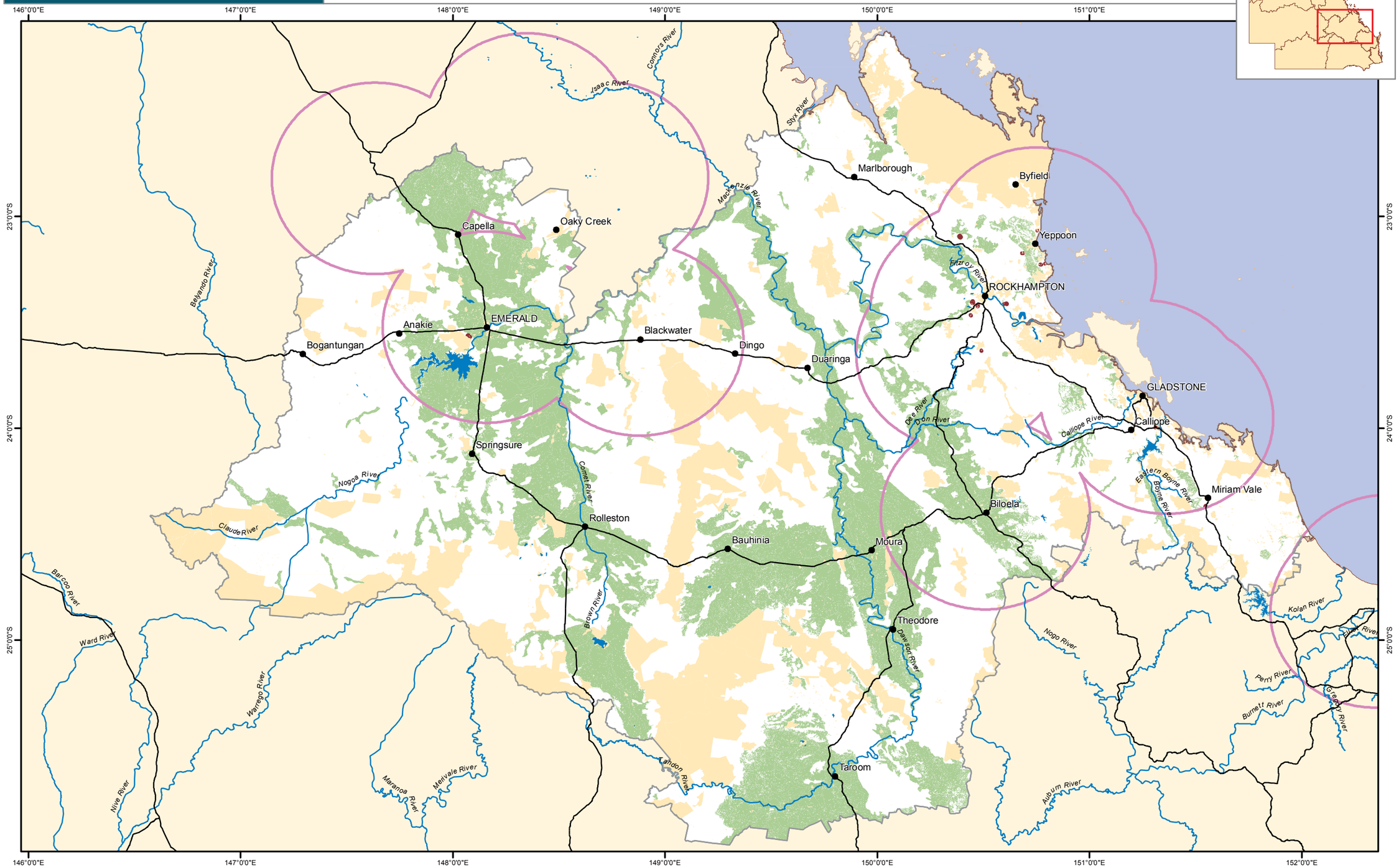
0 12.5 25 50 75 100 km

Datum: GDA 94 Projection: Geographic
Page size: A3





Map 10.10 Perennial horticulture

This map shows land identified by the audit as currently being used for the agricultural land-use category 'perennial horticulture' (rain-fed or irrigated). It also shows land identified as not currently used for perennial horticulture but having potential to be used for that purpose. Land shown as currently being used for perennial horticulture has been identified on the basis that it was mapped by QLUMP as 'perennial horticulture' or 'irrigated perennial horticulture'.

Land shown as having potential for perennial horticulture:

a) **includes** land of agricultural land class A and class B with slope less than 15 per cent and April to October rainfall less than 500 mm

b) **excludes** land that is urban, intensive use (such as mining), national park, state forest, managed by the Department of Defence or permanently under water and land that has cracking clay soils.

In identifying this land, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses and competing potential land uses) that are important influences on management decisions made by producers who drive land use These factors and how farmers respond to them are highly variable across space and through time. It was not possible to measure the effects of these factors with any confidence within the time and resources available to the audit.

Also, the audit **did not consider** temperature or flood risk. Temperature is a major determinant of suitability of land for horticulture. It affects whether a crop can grow and its performance. However, due to the large range of different horticultural crops grown in Queensland and the widely variable temperature requirements for these crops, it is not possible to determine meaningful criteria for temperature for the category 'perennial horticulture'. In addition, the inability to map microclimates at the appropriate scale means that temperature cannot be included in the criteria. Flood risk is similarly difficult to map. Reliable data on flood frequency and severity currently exists for comparatively few parts of the state and the extent to which agricultural land use and management are affected by flooding varies greatly from farmer to farmer depending on their individual circumstances and perceptions.

Availability of labour, especially during harvest season, is an important consideration in selecting suitable land for many forms of perennial horticulture. To reflect this, areas that are within 50 km of a centre with a population of 2000 or more are highlighted on the map. However, labour is not always a critical factor (e.g. for crops that are mechanically harvested) and the size and proximity of the nearest population centre is not always the best surrogate for labour force availability (e.g. many horticultural businesses make extensive use of itinerant seasonal workers or backpackers).

It should not be assumed from this study that all (or any particular portion of) land identified as having potential to be used for perennial horticulture will be converted to that use. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by constraints that have not been included as criteria in the mapping, for example the availability of water for irrigation (see Map 10.2). See Section 10.1 for further constraints.

Central Queensland
Biophysical potential for perennial horticulture and current perennial horticulture

Potential based on ALC 'A' and 'B', slope <15%, April - October rainfall <500mm, no cracking clays

Legend

- Potential perennial horticulture
- Current perennial horticulture (not to scale)
- Areas excluded from potential (see explanatory notes)
- Region boundary
- 50km from a population >2000
- Roads
- Rivers
- Towns

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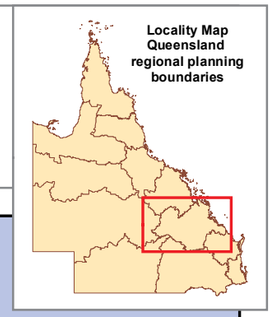
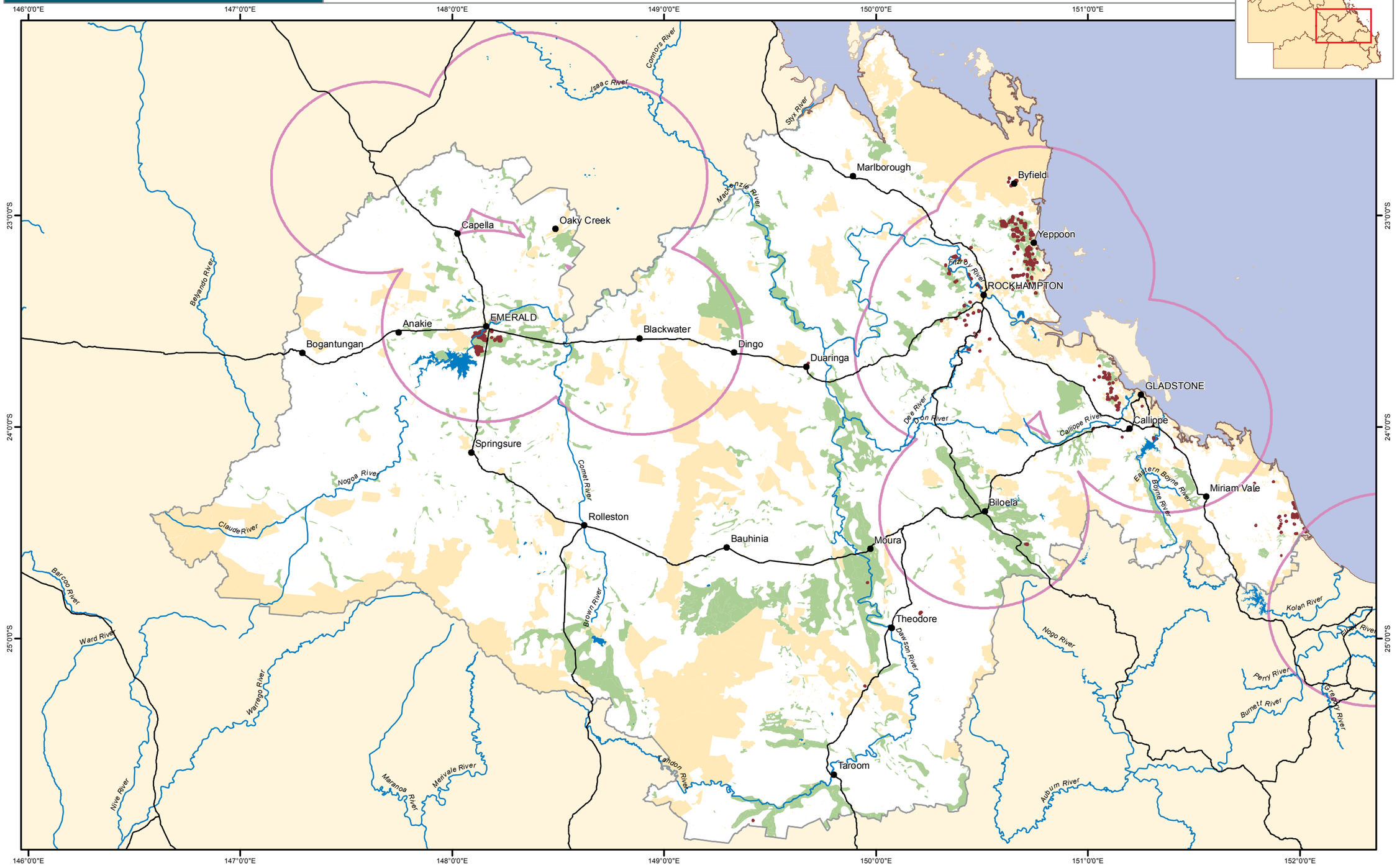
0 12.5 25 50 75 100 km

Datum: GDA 94 Projection: Geographic
Page size: A3





Map 10.11 Intensive livestock

This map shows land identified by the audit as currently being used for the agricultural land-use category 'intensive animal industries' (feedlot cattle and pigs). It also shows land identified as not currently being used for intensive animal industries but having potential to be used for that purpose. Land shown as currently being used for intensive animal industries has been identified on the basis that it is listed in the database of the Department of Agriculture Fisheries and Forestry (Queensland) Intensive Livestock Environmental Regulation Unit. Cattle feedlots are only included where they have a capacity greater than 150 head. Individual intensive animal enterprises are smaller in area than enterprises involved in other agricultural land-use categories and most intensive animal enterprises would not be visible when represented to scale on audit maps. Because of this, the spatial extent of each current intensive animal enterprise is not shown; instead, each enterprise is mapped using a symbol centred on the centroid of the property.

Major beef abattoirs are shown on the map for information. Their locations have not been used in the analysis to identify land with potential for intensive beef industries as the location of many other smaller-scale abattoirs or country butchers that process animals was not available and therefore it could not be determined where access to processing was a constraint on potential intensive animal production.

Land shown as having potential for intensive animal industries:

a) **includes** land of agricultural land class A and class B (and class C1 where it is within 10 km of current cropping) with slope less than or equal to 8 per cent

b) **excludes** land that is urban, intensive use (such as mining), national park, state forest, managed by the Department of Defence or permanently under water.

In identifying this land, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses and competing potential land uses) that are important influences on management decisions made by producers who drive land use. These factors and how farmers respond to them are highly variable across space and through time. It was not possible to measure the effects of these factors with any confidence within the time and resources available to the audit.

It should not be assumed from this study that all (or any particular portion of) land identified as having potential to be used for intensive animal industries should or will be converted to that use. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by constraints that have not been included as criteria in the mapping, for example the availability of water (see Map 10.2) and natural resource regulations such as those for vegetation management.

Aquaculture—current and potential

This map shows land identified by the audit as currently being used for the agricultural land-use category 'aquaculture'. It also shows land identified as not currently used for aquaculture but having potential to be used for that purpose. Land shown as currently being used for aquaculture has been identified on the basis that it was mapped by QLUMP as the tertiary class 'aquaculture'. Individual aquaculture enterprises are smaller in area than enterprises involved in other agricultural land-use categories and most aquaculture enterprises would not be visible when represented to scale on audit maps. Because of this, the spatial extent of each current aquaculture enterprise is not shown; instead, each enterprise is mapped using a symbol centred on the centroid of the property.

Land shown as having potential for aquaculture:

a) **includes** land that is within 2 km of an estuarine water source, is above the highest astronomical tide and has an elevation less than 10 m, slope less than 5 per cent and clay content greater than 20 per cent

b) **excludes** land that is urban, intensive use (such as mining), national park, state forest, managed by the Department of Defence, permanently under water, fish habitat area, of high ecological significance or mapped as containing acid sulfate soils.

In identifying this land, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses and competing potential land uses) that are important influences on management decisions made by producers who drive land use. These factors and how farmers respond to them are highly variable across space and through time. It was not possible to measure the effects of these factors with any confidence within the time and resources available to the audit.

The map also shows areas where there are vulnerable groundwater systems. Contamination of groundwater systems is an important consideration in selecting sites for aquaculture enterprises. However, mapping of groundwater vulnerability in Queensland is relatively coarse and a range of measures can be used to mitigate this risk. Therefore the occurrence of vulnerable groundwater is not included in the criteria for mapping potential for aquaculture but is shown on the map for information.

It should not be assumed from this study that all (or any particular portion of) land identified as having potential to be used for aquaculture should or will be converted to that use. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by constraints that have not been included as criteria in the mapping, for example the availability of water for irrigation (see Map 10.2). See Section 10.1 for further constraints.

Central Queensland–Biophysical potential for cattle feedlots, piggeries and marine aquaculture and current intensive animal production and aquaculture

Feedlots and piggeries potential: 'A' + 'B' class land + 'C1' class land within 10km of current cropping, slope ≤8%
Marine aquaculture potential: within 2km of estuarine water source, above HAT, <10m elevation, soil >20% clay content

Legend

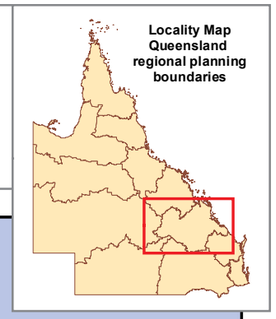
- Potential feedlot and piggeries area
- Current cattle feedlots (above 150 head)
- Current egg producers
- Current piggeries
- Current aquaculture sites
- Potential marine aquaculture area
- Beef processors
- Egg processors
- Areas excluded from potential (see explanatory notes)
- Region boundary
- Roads
- Rivers
- Towns

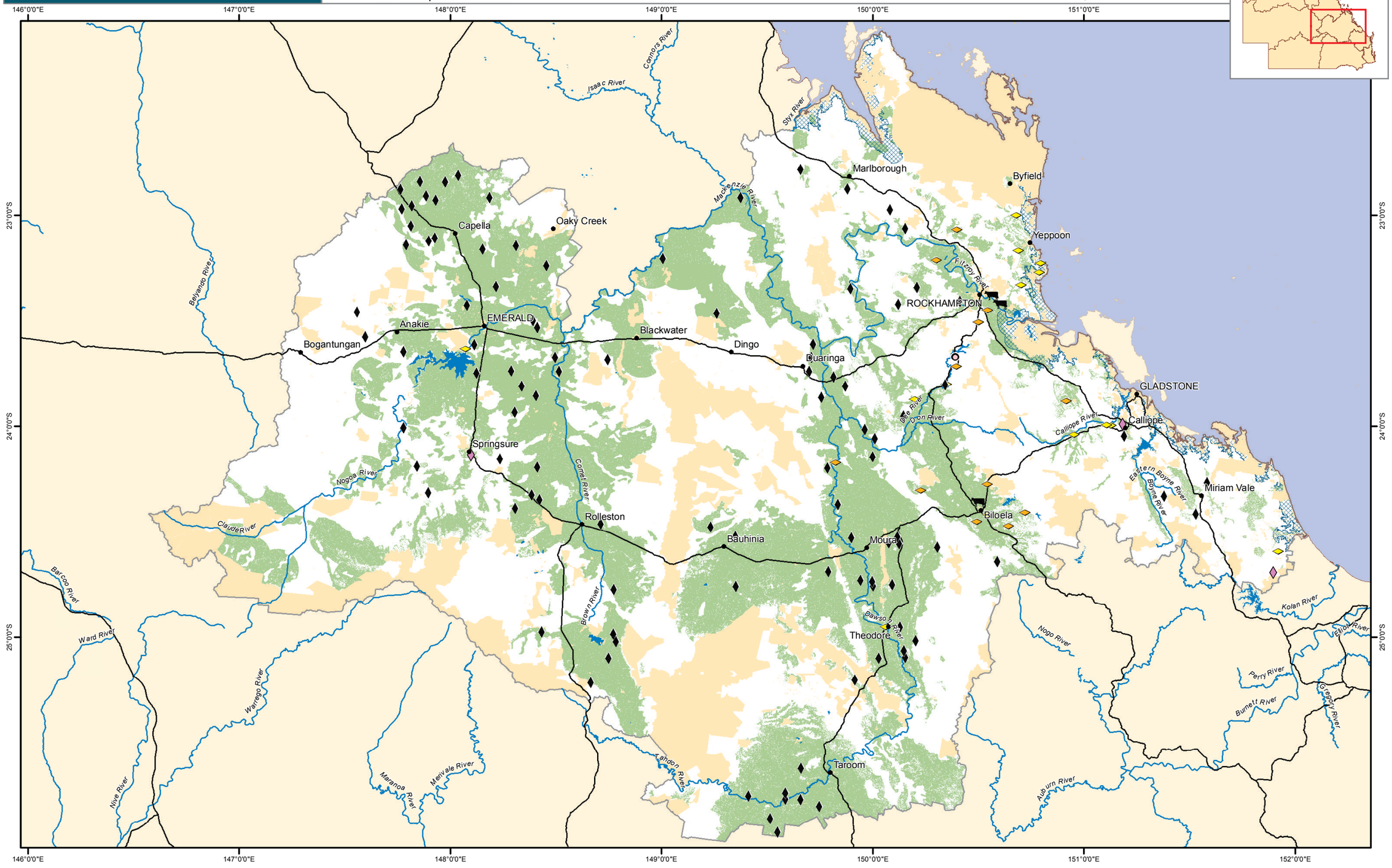
N

1:1,800,000

0 12.5 25 50 75 100 km

Datum: GDA 94 Projection: Geographic
Page size: A3





Map 10.12 Current pasture production (land condition B)

This map shows the current pasture biomass production that was modelled by the audit. For the purpose of this modelling, the land was assumed to be in fair condition (grazing land management (GLM) class B).

Current modelled pasture biomass production of land:

a) is **calculated** using the GRASP model of pasture biomass production (www.longpaddock.qld.gov.au—search 'GRASP') parameterised for each GLM land type (http://futurebeef.com.au) and discounted according to the amount of existing tree basal area on the land (as mapped by SLATS) and with pasture condition set to B (http://futurebeef.com.au)

b) **excludes** production from land that is urban, intensive use (such as mining), national park, managed by the Department of Defence or permanently under water.

In modelling this production, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses or competing potential land uses) that are important influences on management decisions made by producers who drive land use. These factors and how farmers respond to them are highly variable across space and through time. It was not possible to measure the effects of these factors with any confidence within the time and resources available to the audit.

It should not be assumed from this study that the current modelled pasture biomass production of all land (or any particular portion of land) will be achieved. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by natural resource regulations such as those for vegetation management.

Central Queensland
Current yearly pasture production (long term average)

GRASP model, modified by tree basal area and land condition (B)

Legend

Yearly pasture production (long term average)
(Dry matter yearly growth in kg/ha)

- High >3500
- Medium 1500-3500
- Low <1500

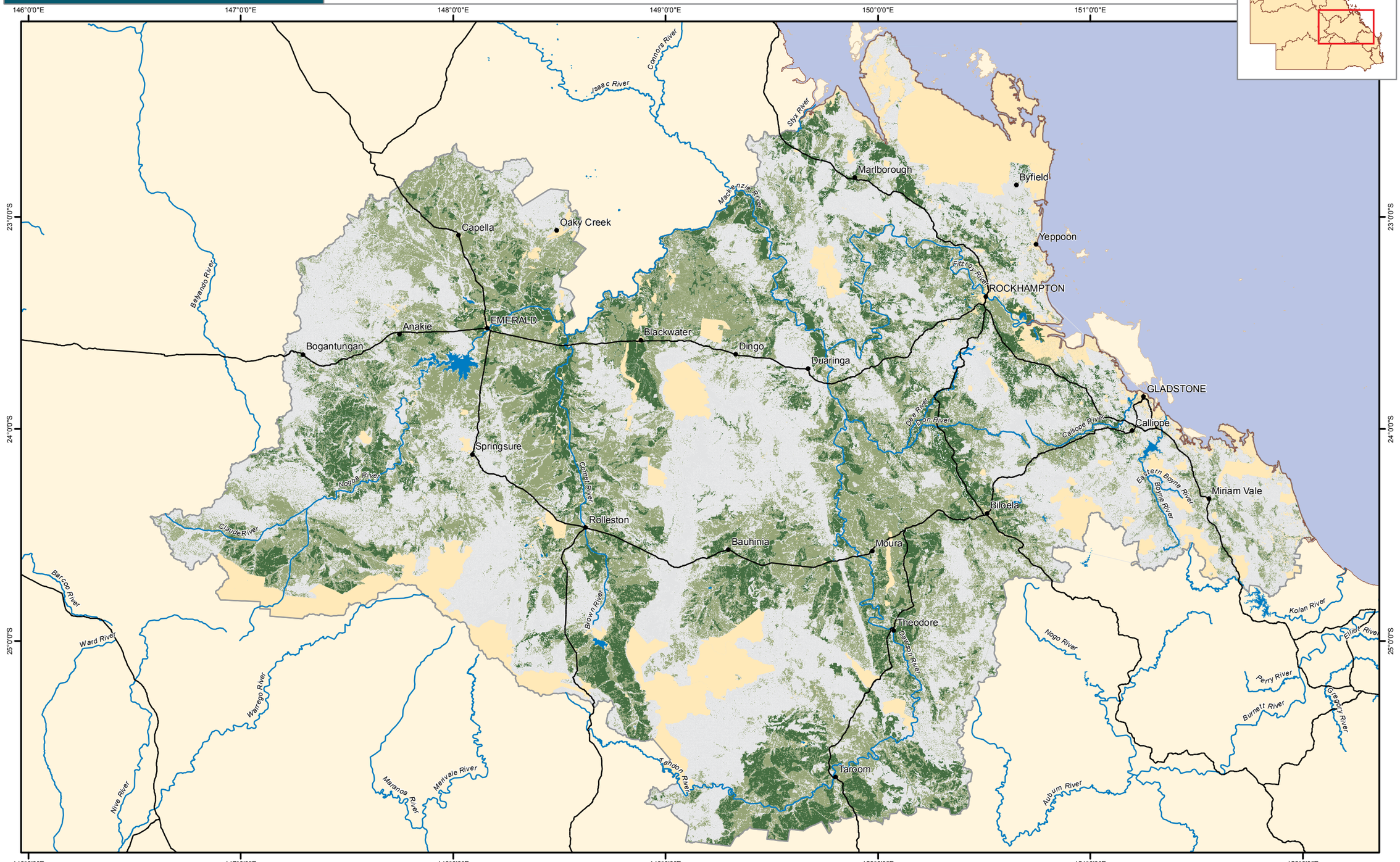
- Areas excluded from potential (see explanatory notes)
- Region boundary
- Roads
- Rivers
- Towns

N

1:1,800,000

0 12.5 25 50 75 100 km

Datum: GDA 94 Projection: Geographic
Page size: A3



Map 10.13 Potential pasture production (land condition A)

This map shows the potential pasture biomass production that was modelled by the audit. For the purpose of this modelling, the land was assumed to be in good condition (GLM class A).

Potential modelled pasture biomass production of land:

a) is **calculated** using the GRASP model of pasture biomass production (www.longpaddock.qld.gov.au—search 'GRASP') parameterised for each GLM land type (http://futurebeef.com.au) and discounted according to the amount of existing tree basal area on the land (as mapped by SLATS) and with pasture condition set to A (http://futurebeef.com.au)

b) **excludes** production from land that is urban, intensive use (such as mining), national park, managed by the Department of Defence or permanently under water.

In modelling this production, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses and competing potential land uses) that are important influences on management decisions made by producers who drive land use. These factors and how farmers respond to them are highly variable across space and through time. It was not possible to measure the effects of these factors with any confidence within the time and resources available to the audit.

It should not be assumed from this study that the potential modelled pasture biomass production of all land (or any particular portion of land) will be achieved. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by natural resource regulations such as vegetation management.

Central Queensland
Potential yearly pasture production (long term average)

GRASP model, modified by tree basal area and land condition (A)

Legend

Yearly pasture production (long term average)
(Dry matter yearly growth in kg/ha)

- High >3500
- Medium 1500-3500
- Low <1500

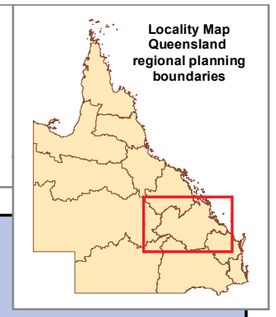
- Areas excluded from potential (see explanatory notes)
- Region boundary
- Roads
- Rivers
- Towns

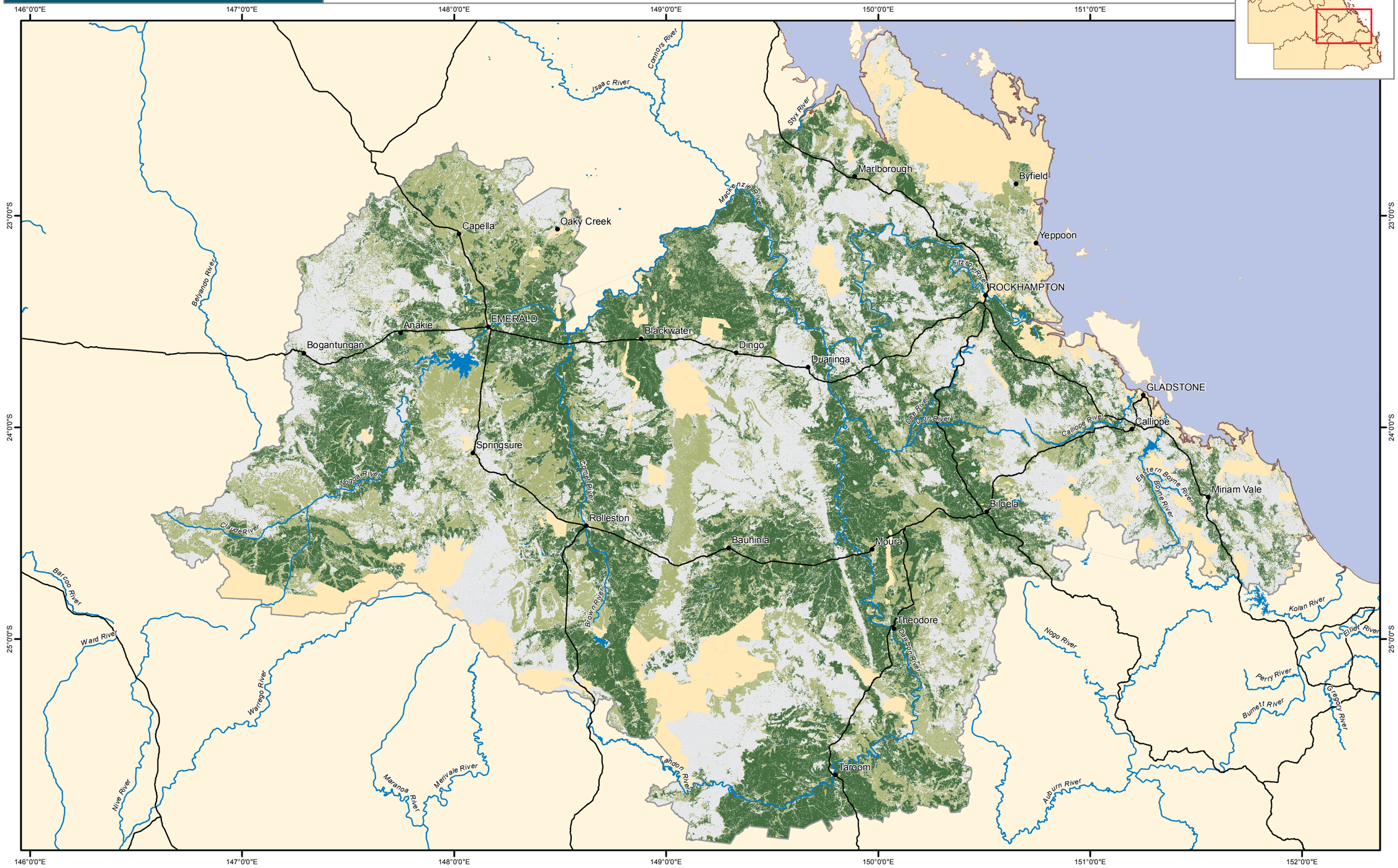
N

1:1,800,000

0 12.5 25 50 75 100 km

Datum: GDA 94 Projection: Geographic
Page size: A3





Map 10.14 Sown pastures

This map shows land identified by the audit as currently sown to pasture grasses. It also shows land identified as not currently sown to pasture grasses but having potential to be used for that purpose. For the purpose of the audit, sowing of pastures is considered to be the deliberate introduction of pasture grass varieties and species. It includes distribution of pasture grass seed preceded by cultivation or other management actions (such as fire) to create conditions conducive to successful establishment of the introduced grasses. It does not include naturalised introduction of exotic grasses without deliberate management or the supplementation of native grass pastures with introduced legumes. It is not possible with the data and tools available to the audit to map the occurrence of these supplemented pastures.

Land shown as currently sown to pasture has been identified using the approach outlined by Peck et al. (2010). This is land that currently has no (or very little) tree cover, has a mean annual rainfall greater than 500 mm and is of a GLM land type (http://futurebeef.com.au) that is considered to be suitable for pasture improvement. Land that is urban, intensive use (such as mining), national park, managed by the Department of Defence, permanently under water or currently cropped is **excluded**.

Land shown as having potential to be used for sown pastures:

a) **includes** land of a GLM land type that is considered to be suitable for establishing and maintaining sown pasture but currently has trees on it

b) **excludes** land that is urban, intensive use (such as mining), national park, managed by the Department of Defence or permanently under water.

In identifying this land, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses or competing potential land uses) that are important influences on management decisions made by producers who drive land use. These factors and how farmers respond to them are highly variable across space and through time. It was not possible to measure the effects of these factors with any confidence within the time and resources available to the audit.

It should not be assumed from this study that all (or any particular portion of) land identified as having potential to support improved pastures will or should be converted to that use. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by constraints that have not been included as criteria in the mapping, for example natural resource regulations relating to vegetation management.

Central Queensland
Areas suitable for sown grass species and areas predicted to have sown grass species established

Legend

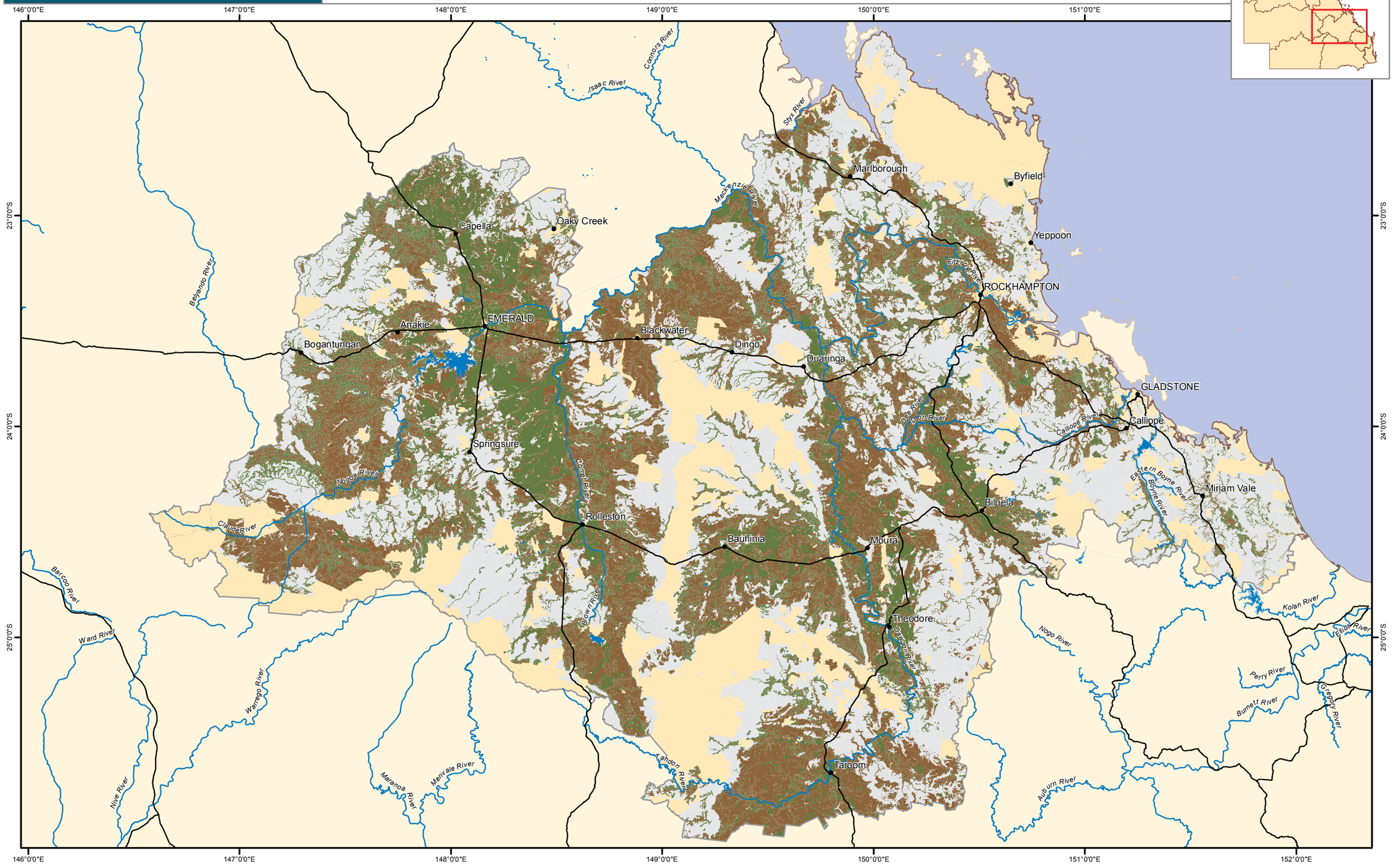
- Sown grasses present in a significant density
- Potential for broadscale introduction of sown grass species
- Low potential for broadscale introduction of sown grass species
- Areas excluded from potential (see explanatory notes)
- Region boundary
- Roads
- Rivers
- Towns

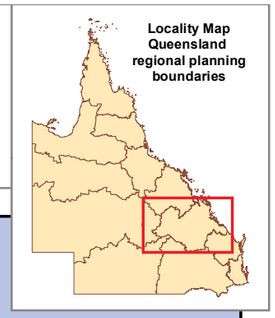
N

1:1,800,000

0 12.5 25 50 75 100 km

Datum: GDA 94 Projection: Geographic
Page size: A3





Map 10.15 Native forestry

This map shows land identified by the audit as currently being used for production of sawlogs and/or other timber products from native forestry. This land has been identified on the basis that it is either freehold land that is covered by a forest practice notification under the *Vegetation Management Act 1999* or is state-owned land over which the Queensland Government has a timber interest (as indicated by it being covered by a Department of Agriculture Fisheries and Forestry (Queensland) Forestry Division MUID).

The map also shows land identified as not currently being used for production of sawlogs and/or other timber products from native forestry but having potential to be used for that purpose.

For land to be rated by the audit as having potential for sawlog as well as non-sawlog timber production, it must also be a regional ecosystem that contains species (as listed in the REDD description) known to produce commercial sawlogs. For land to be listed as high potential for sawlog production, the canopy top height for that regional ecosystem must also exceed the threshold determined by the audit as indicating high-productivity site conditions for production of sawlogs of that type.

Land shown as having potential for native forestry:

a) **includes** land that is mapped as currently having a woody vegetation canopy of greater than 15 per cent (SLATS foliage projective cover)

b) **excludes** land that is cleared of forest, urban, intensive use (such as mining), national park, managed by the Department of Defence or permanently under water.

In identifying this land, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses and competing potential land uses) that are important influences on management decisions made by producers who drive land use. These factors and how farmers respond to them are highly variable across space and through time. It was not possible to measure the effects of these factors with any confidence within the time and resources available to the audit.

Access to processing facilities can also be a major consideration in determining the potential for land to be used for native forestry. However, it was not possible in this analysis to determine with any confidence what the critical threshold distances are. Therefore, while the locations of existing sawmills are shown on the map as a general guide to those interested in considering this factor, distance from sawmills has not been included in the analysis.

It should not be assumed from this study that all (or any particular portion of) land identified as having potential to be used for native forestry should or will be converted to that use. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by natural resource regulations such as those for vegetation management.

Central Queensland
Potential and current native forestry

Potential based on commercial tree species, tree height, FPC>15%

Legend

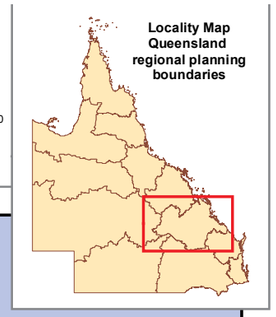
- High potential for sawlog and non-sawlog products
- Potential for sawlog and non-sawlog timber products
- Potential for non-sawlog timber products only
- State owned land timber interests (Forestry Act 1959)
- Forest practice notifications on private land (Vegetation Management Act 1999)
- Region boundary
- Areas excluded from potential (see explanatory notes)
- Saw mills for native timber (within 100km of region)
- Roads
- Rivers
- Towns

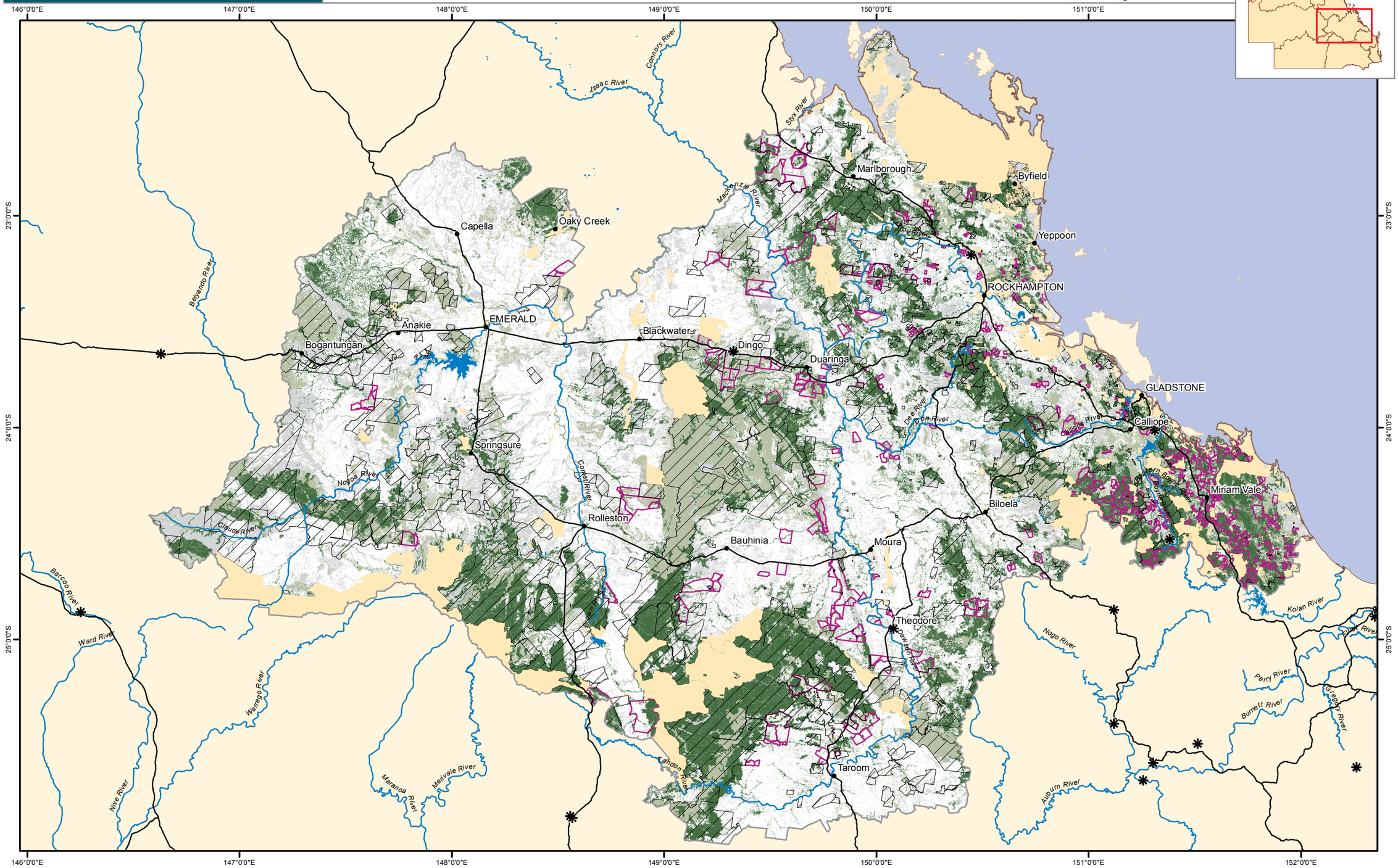
N

1:1,800,000

0 12.5 25 50 75 100 km

Datum: GDA 94 Projection: Geographic
Page size: A3





Map 10.16 Plantation forestry

This map shows the land identified by the audit as currently being used for the agricultural land-use category 'plantation forestry'. It also shows land identified as not currently used for plantation forestry but having potential to be used for this purpose. Land shown as currently being used for plantation forestry has been identified from mapping provided by HQPlantations, ABARES and FEA Holdings. Areas represented in this mapping have been classified as either hardwood or softwood by experts with local knowledge.

Land shown as having potential for plantation forestry:

a) **includes** land of agricultural land class A, class B and class C1 (as well as class C2 and class C3 for softwoods) that has slope less than 25 per cent and rainfall greater than 700 mm (or 800 mm for softwood) for 7 out of 10 years

b) **excludes** land that is urban, intensive use (such as mining), national park, managed by the Department of Defence or permanently under water as well as land that has cracking clay soils.

In identifying this land, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses and competing potential land uses) that are important influences on management decisions made by producers who drive land use. These factors and how farmers respond to them are highly variable across space and through time. It was not possible to measure the effects of these factors with any confidence within the time and resources available to the audit.

Access to processing facilities can also be a major consideration in determining the potential for land to be used for plantation forestry. However, it was not possible in this analysis to determine with any confidence what the critical threshold distances are. Therefore, while the locations of existing sawmills that predominantly process plantation timber are shown on the map as a general guide to those interested in considering this factor, distance from sawmills has not been included in the analysis.

It should not be assumed from this study that all (or any particular portion of) land identified as having potential to be used for plantation forestry should or will be converted to that use. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by constraints that have not been included as criteria in the mapping, for example the availability of water for irrigation (see Map 10.2). See Section 10.1 for further constraints.

Central Queensland Biophysical potential for rainfed plantation forestry and current plantations

Hardwood potential based on ALC 'A', 'B' and 'C1', slope <25%, rainfall >700mm 7 in 10 years, no cracking clays
Softwood potential based on ALC 'A', 'B' and 'C', slope <25%, rainfall >800mm 7 in 10 years, no cracking clays

Legend

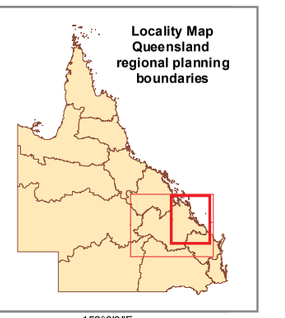
- Potential softwood plantations
- Potential hardwood plantations
- Current fallow
- Current hardwood
- Current mixed species
- Current softwood
- Areas excluded from potential (see explanatory notes)
- Region boundary
- Sawmills for plantation timber
- Roads
- Rivers
- Towns

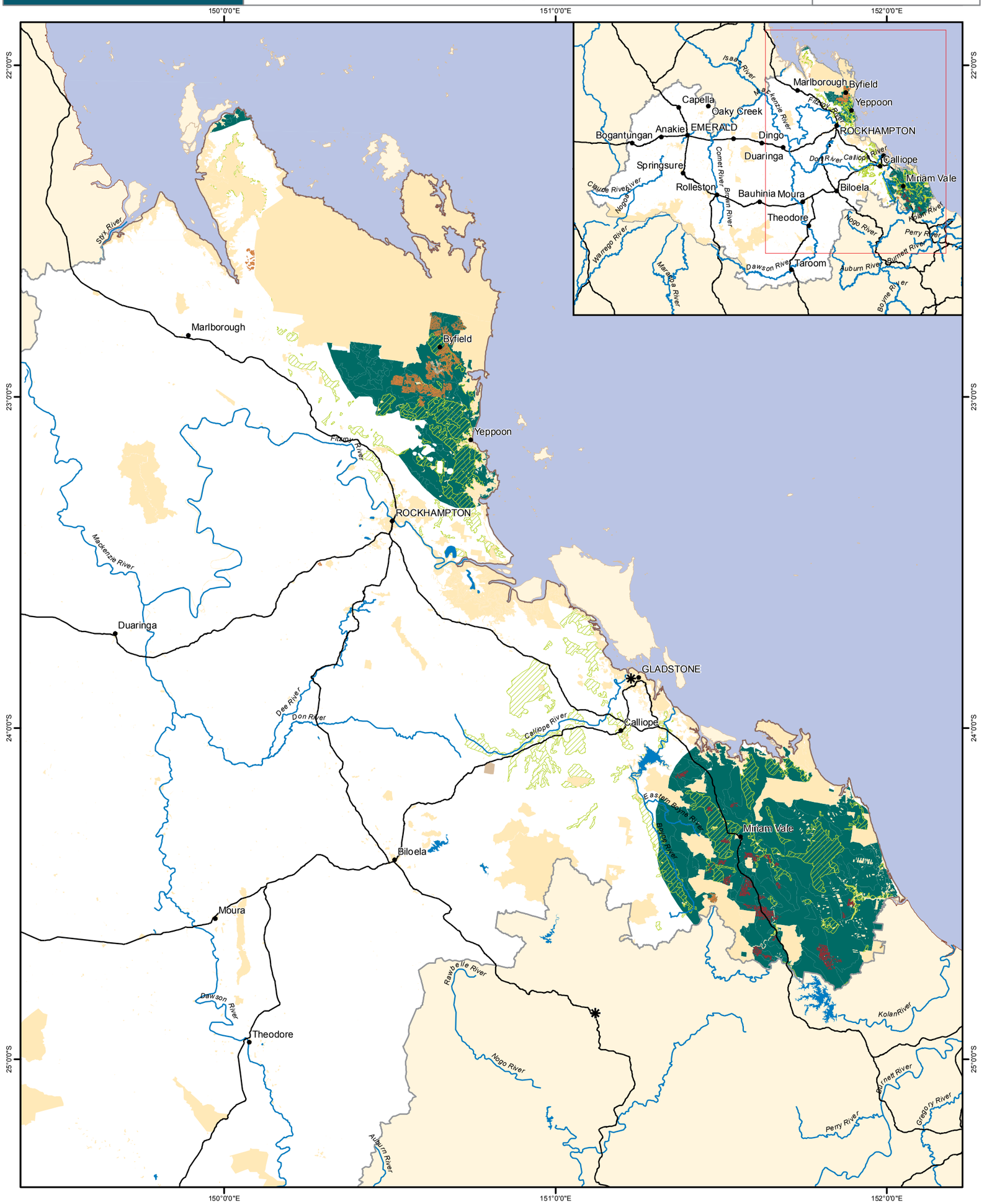
N

1:1,150,000

0 10 20 40 60 80 km

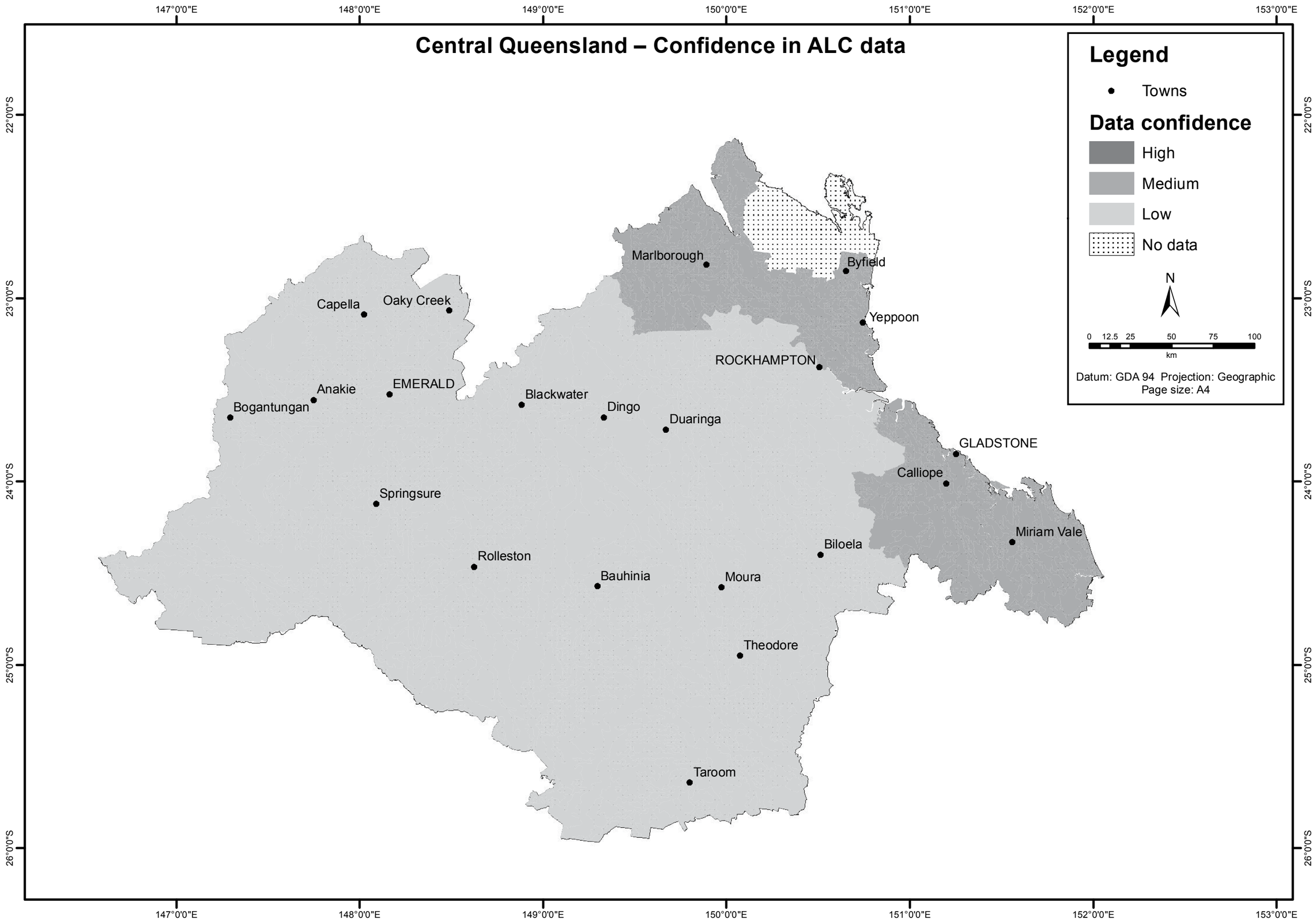
Datum: GDA 94 Projection: Geographic
Page size: A3





Map 10.17 Data confidence in soil mapping

This map shows the variation in the relative confidence in the audit's mapping of land-use potential across the region. Land-use potential maps have been generated by the audit by combining a number of different datasets. The level of confidence in the final product is determined by the most limiting of the datasets used. This is generally the agricultural land class mapping, which was derived from a number of different land resource studies, each covering different parts of Queensland often at differing scales of resolution and with different standards of information reported. Confidence in land resource data ranges from high (where mapping is detailed and map units are described in terms of their suitability for a full range of relevant crop types and uses) to low (where mapping is coarse and map units are described in general terms only). For some parts of the state, the only available land resource information is from the *Atlas of Australian soils*. The quality of this information is considered inadequate for the audit; therefore, those areas are shown on this map as having no data.


Central Queensland – Confidence in ALC data
Legend
Towns
Data confidence
High
Medium
Low
No data
N
0 12.5 25 50 75 100
km
Datum: GDA 94 Projection: Geographic
Page size: A4
147°0'0"E
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25°0'0"S
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Marlborough
Byfield
Yeppoon
Capella
Oaky Creek
ROCKHAMPTON
Anakie
EMERALD
Bogantungan
Blackwater
Dingo
Duaringa
GLADSTONE
Calliope
Springsure
Miriam Vale
Biloela
Rolleston
Bauhinia
Moura
Theodore
Taroom