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Water resource assessment for the Mitchell catchment

A report to the Australian Government from the CSIRO Northern Australia Water Resource Assessment, part of the National Water Infrastructure Development Fund: Water Resource Assessments

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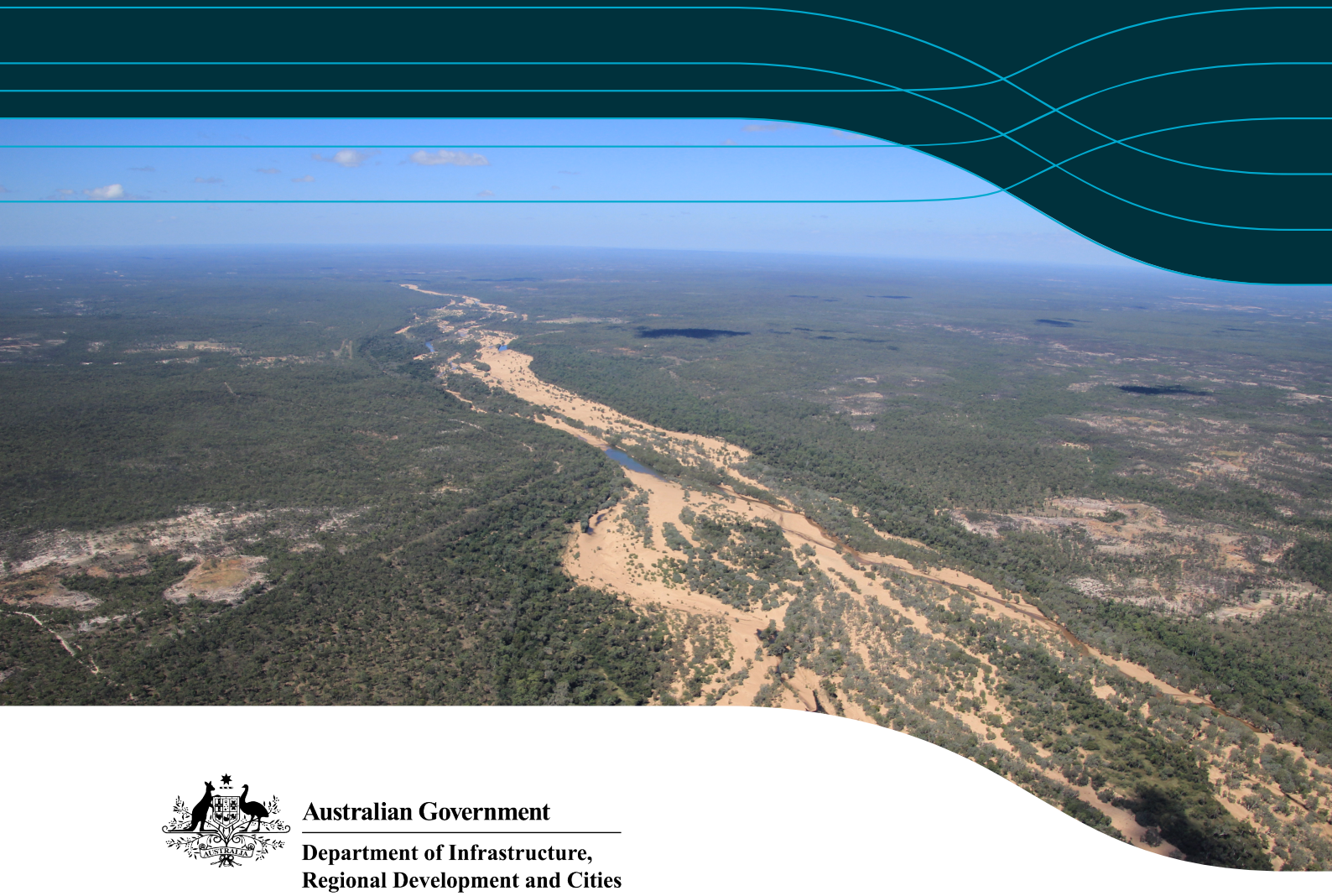

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CSIRO Northern Australia Water Resource Assessment acknowledgements

This report was prepared for the Department of Infrastructure, Regional Development and Cities. The Northern Australia Water Resource Assessment is an initiative of the Australian Government's White Paper on Developing Northern Australia and the Agricultural Competitiveness White Paper, the government's plan for stronger farmers and a stronger economy. Aspects of the Assessment have been undertaken in conjunction with the Northern Territory Government, the Western Australian Government, and the Queensland Government.

The Assessment was guided by three committees:

(i) The Assessment's Governance Committee: Consolidated Pastoral Company, CSIRO, DAWR, DIIS, DoIRDC, Northern Australia Development Office, Northern Land Council, Office of Northern Australia, Queensland DNRME, Regional Development Australia - Far North Queensland and Torres Strait, Regional Development Australian Northern Alliance, WA DWER

(ii) The Assessment's Darwin Catchments Steering Committee: CSIRO, Northern Australia Development Office, Northern Land Council, NT DENR, NT DPIR, NT Farmers Association, Power and Water Corporation, Regional Development Australia (NT), NT Cattlemen's Association

(iii) The Assessment's Mitchell Catchment Steering Committee: AgForce, Carpentaria Shire, Cook Shire Council, CSIRO, DoIRDC, Kowanyama Shire, Mareeba Shire, Mitchell Watershed Management Group, Northern Gulf Resource Management Group, NPF Industry Pty Ltd, Office of Northern Australia, Queensland DAFF, Queensland DSD, Queensland DEWS, Queensland DNRME, Queensland DES, Regional Development Australia - Far North Queensland and Torres Strait

Note: Following consultation with the Western Australian Government, separate steering committee arrangements were not adopted for the Fitzroy catchment, but operational activities were guided by a wide range of contributors.

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For further acknowledgements, see page xxii.

Photo Tate River, Mitchell catchment, Queensland. Source: CSIRO

Citation
Lyons P, Addison J, Austin J, Barber M, Bruce C, Ebner B, Higgins A, Horner N, Jarvis D, Kenyon R, Lau J, Merrin L, Macintosh A, Philip S, Pollino C, Ponce Reyes R, Stokes C, Stratford D, Waschka M and O'Sullivan J (2018) Chapter 3: Living and built environment of the Mitchell catchment. In: Petheram C, Watson I, Bruce C and Chilcott C (eds) (2018) Water resource assessment for the Mitchell catchment. A report to the Australian Government from the CSIRO Northern Australia Water Resource Assessment, part of the National Water Infrastructure Development Fund: Water Resource Assessments. CSIRO, Australia.

3 Living and built environment of the Mitchell catchment

Authors: Pethie Lyons, Jane Addison, Jim Austin, Marcus Barber, Caroline Bruce, Brendan Ebner, Andrew Higgins, Nerida Horner, Diane Jarvis, Rob Kenyon, Jacqui Lau, Linda Merrin, Andrew Macintosh, Seonaid Philip, Carmel Pollino, Rocio Ponce Reyes, Chris Stokes, Danial Stratford, Marie Waschka and Jackie O'Sullivan

Chapter 3 discusses a wide range of considerations relating to the living component of the catchment and the environments that support these components, the people who live in the catchment or have strong ties to it, the perspectives of investors, the existing transport, power and water infrastructure and the legal, policy and regulatory environment relating to the development of land and water.

The key components and concepts of Chapter 3 are shown in Figure 3-1.

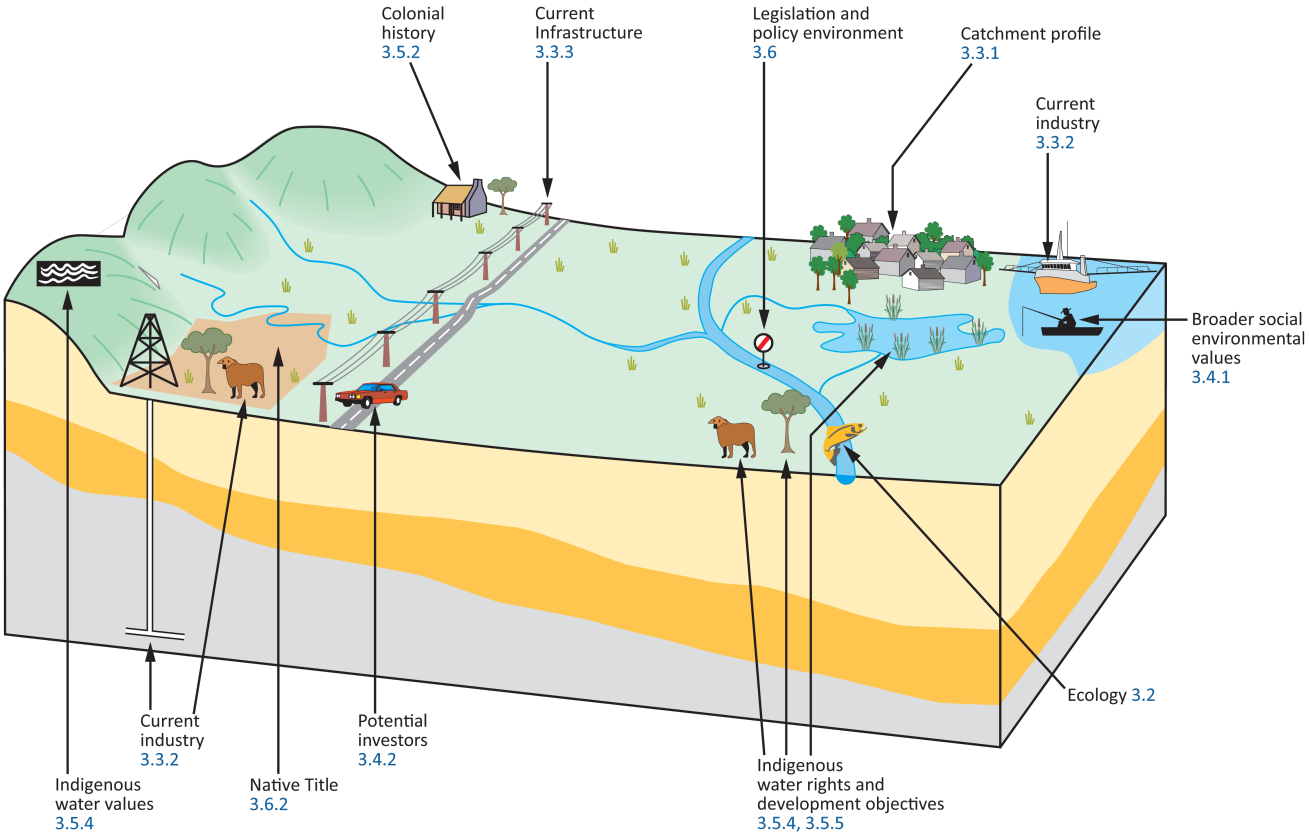

Figure 3-1 Schematic diagram of key components of the living and built environment to be considered in the establishment of a greenfield irrigation development

3.1 Summary

This chapter provides information on the living and built environment including information about the people, the ecology, the infrastructure and the institutional context of the Mitchell catchment. It also examines the values, rights, interests, and development objectives of Indigenous people.

3.1.1 KEY FINDINGS

Ecology

The Mitchell catchment supports a variety of aquatic and terrestrial ecosystems. The Mitchell River connects upland rainforests in the wet tropics through to tropical savanna landscapes and drains into the Gulf of Carpentaria, which has high conservation and economic values. The highly seasonal flows of the Mitchell catchment underpin river-floodplain productivity and provide critical habitats for species. These flows also support a range of fish species, including freshwater sawfish (*Pristis pristis*) (listed as vulnerable under the *Environment, Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act)), a commercial and recreational barramundi (*Lates calcarifer*) fishery and the extensive commercial Northern Prawn Fishery - one of the most valuable fisheries in the country.

The Mitchell catchment has four important bird areas and three wetlands of national significance: the Mitchell River Fan Aggregation (Mitchell River delta), Southeast Karumba Plain Aggregation, and the Spring Tower Complex. Of the four important bird areas the largest is the Southeast Karumba Plan Aggregation. This area provides important waterbird breeding habitat, including the second-largest summer population of wader birds in Australia, and is recognised by Environment Australia (2001) as having high wilderness value.

Given the permanent and unmodified aquatic habitats, the catchment has the second highest fish species richness nationally, with 57 species recorded. Freshwater migratory fishes, which are particularly vulnerable to inchannel barriers, are distributed throughout the Mitchell catchment, with the highest diversity concentrated at the bottom of the catchment. During the dry season, permanent waterholes are critical refugia in an otherwise dry landscape and allow plants and animals to colonise areas during the wet season. The Mitchell catchment also has extensive riparian zones, which are highly fertile and productive when compared to the surrounding terrestrial environment. Towards the end of the catchment, mangroves and salt flats are located along the catchments coastal margin. Salt flats contribute significantly to primary production in coastal areas, releasing high concentrations of nutrients and benthic algae during wetting periods.

While the Mitchell catchment is largely intact it is not pristine. The most widespread agricultural land use is pastoralism, although there has been relatively little clearing within the catchment.

Demographics, industries and infrastructure

The population in the Mitchell catchment is low (about 6500) and sparse with the largest settlement being Dimbulah (population 1050). Unemployment (11%) is high compared with the national average and the population is at a socio-economic disadvantage relative to the rest of the country. The main land use is pastoralism (95%) on large grazing leases where cattle graze native pastures and shrubs. Part of the Mareeba–Dimbulah Water Supply Scheme (MDWSS) extends into the upper reaches of the Mitchell catchment. The gross value of agricultural production is $225 million/year, about half of which is from beef production, with cropping (mangoes, sugarcane and avocados) making up most of the remainder.

The Mitchell catchment is characterised by a sparse road network with the Burke Development Road being the main access to Mareeba and Cairns in the east and to Normanton and Cloncurry in the south. All of the western part of the study area permits Type 2 road trains, which are vehicles up to 53 m in length. There is no rail infrastructure in the Mitchell catchment that can be used for freight transport. In terms of energy supply, the eastern part of the catchment (from near Chillagoe) contains the Tablelands regional distribution network.

Social and investor values

The diverse stakeholders in the Mitchell catchment sometimes have conflicting interests and values relating to the use of water resources and irrigated agricultural development. This has implications for the ability of developers to gain and maintain social licence to operate through the development process. Stakeholder values relate to: the purpose of development; the environmental conditions and ecosystem services that development may alter; how stakeholders are engaged; and to whom benefits accrue. Systematic social impact analysis that investigates stakeholders and their interests will be needed for development at scale. A survey of potential agricultural investors identified institutional certainty, simplicity and bureaucratic speed as the key perceived potential enablers of investment in irrigated agriculture. There was less consistency between investors regarding other enablers of irrigated development.

Indigenous values and development objectives

Indigenous people represent a substantial and growing proportion of the population of the Mitchell catchment, particularly in the lower catchment. They have recognised native title and cultural heritage rights, and control significant natural and cultural resource assets, including land, water, and coastline. Understanding key aspects of pre-colonial and post-colonial patterns of land and natural resource use in the Mitchell catchment is important to understanding both present circumstances and Indigenous responses to future possibilities. Indigenous people have strong expectations for involvement in water, catchment, and development planning. Indigenous people have a range of existing business development plans and objectives that may be impacted by development proposals. They wish to be crucial owners, partners, investors, and stakeholders in future development.

Legal, policy and regulatory environment

Government powers and responsibilities concerning the management of land and water resources in the Mitchell catchment are shared. The Australian Government oversees native title and the implementation of international law obligations. The Queensland Government manages land and

water assets. The four local councils are state agencies with responsibilities for land use planning. Land in the catchment is primarily held as Crown leasehold land, national parks, freehold land and Aboriginal land, with much of the catchment also subject to native title, a unique form of property interest that consists of a bundle of rights defined by the laws and customs of the relevant Indigenous community. The rights to the use, flow and control of all water in Queensland are vested in the Queensland Government, who controls the processes for water planning, the regulation of taking and interference with water, and the construction and operation of water infrastructure (e.g. dams, bores, levies and pipes). Land owners' rights to use and develop land are limited by government regulations. The most relevant government regulations are those imposed under federal and state planning, environment and heritage statutes.

3.1.2 INTRODUCTION

This chapter seeks to address the question 'What are the existing: ecological systems; the demographic and economic profile; the land use, industries and infrastructure, stakeholder values and investor perspectives; the values, rights, interests and development objectives of Indigenous people; and the legal, policy and regulatory environment in which development would occur in the Mitchell catchment?'

The chapter is structured as follows:

- Section 3.2 examines the ecological systems and assets of the Mitchell catchment including the key habitats and key biota, and their important interactions and connections.
- Section 3.3 examines the socio-economic profile of the Mitchell catchment including the current demographics and existing industries and infrastructure of relevance to water resource development.
- Section 3.4 examines the stakeholders, their values and potential engagement strategies and the perspectives of potential investors in the Mitchell catchment.
- Section 3.5 examines the Indigenous values, rights, interests, and development objectives generated through direct participation by Mitchell catchment Traditional Owners in the Assessment.
- Section 3.6 examines the legal, regulatory and policy environment relevant to water-related development.

3.2 Ecology of the Mitchell catchment

3.2.1 INTRODUCTION

A catchment as large as that of the Mitchell River inevitably encompasses great ecological diversity. It covers an area of over 72,000 km² in the southern part of Cape York Peninsula, extending from the Gulf of Carpentaria to the highlands of the Great Dividing Range, which to the south overlooks the coastal city of Cairns. The Mitchell catchment supports a variety of terrestrial and aquatic ecosystems in a wet-dry tropical climate that, in the west, includes estuarine and coastal systems. Moreover, it is largely intact in terms of the continuity of its plant and animal communities and the ecological processes that underpin them.

The size, diversity and condition of the Mitchell catchment means that it holds important ecological and environmental values, including species and communities listed under the EPBC Act, such as the golden-shouldered parrot (*Psephotus chrysopterygiu*), Gouldian finch (*Erythrura gouldiae*), and northern bettong (*Bettongia tropica*). Its eastern edge is part of the Wet Tropics World Heritage Area. The mouth of the Mitchell River lies within the Gulf Plains Important Bird Area, and the Mitchell River Fan Aggregation (Mitchell River delta), Southeast Karumba Plain Aggregation, and the Spring Tower Complex are on the Directory of Important Wetlands of Australia (DIWA) (Figure 3-2).

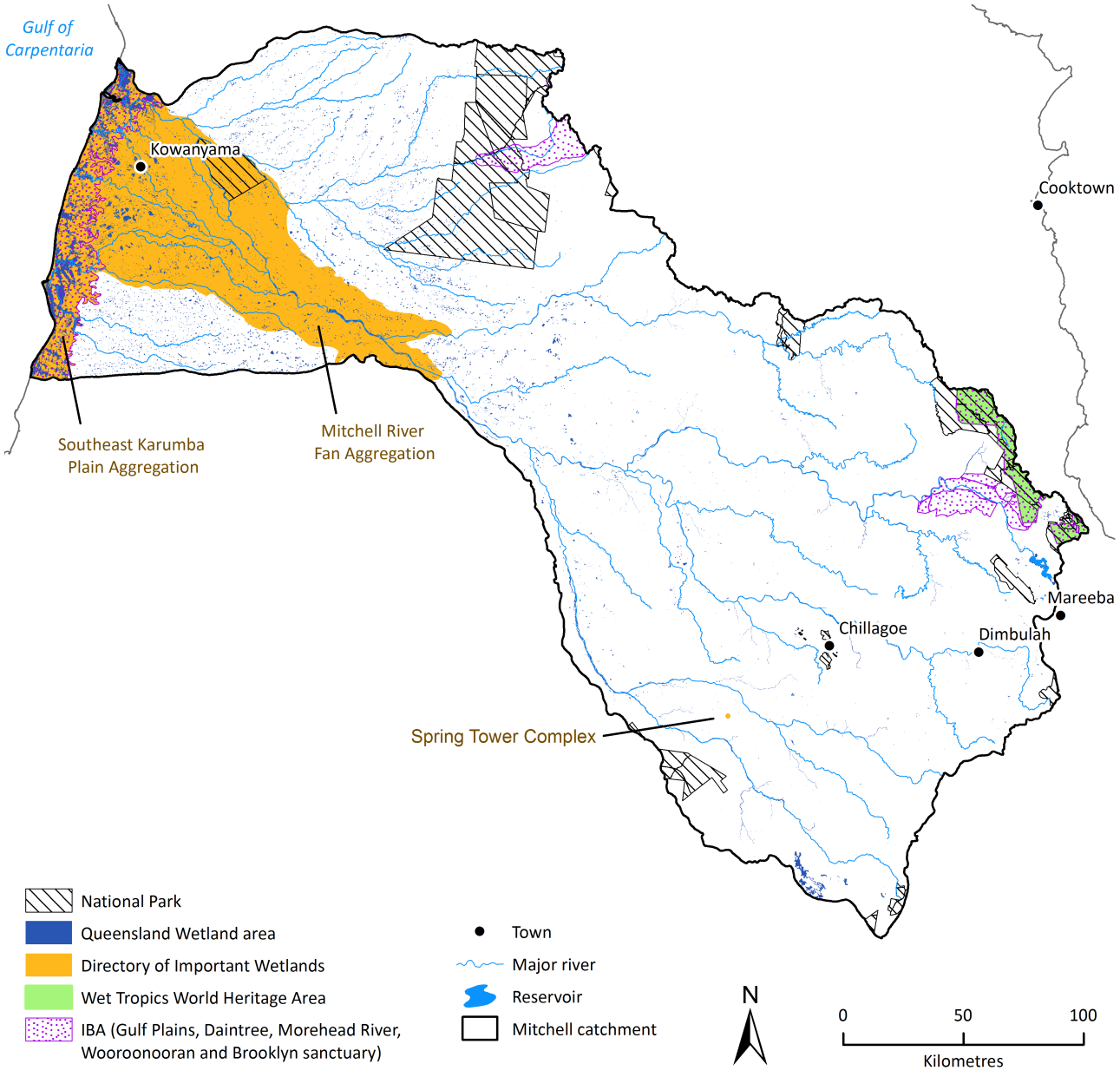

Figure 3-2 Distribution of important wetlands, important bird areas (IBA) and protected areas in the Mitchell catchment

The Mitchell River Fan Aggregation comprises deeply incised stream lines with numerous permanent waterholes and floodplains, and is habitat to a wide range of waterbirds (Environment Australia, 2001). The Southeast Karumba Plain Aggregation contains varied habitats, including tidal flats, stream channels, and ephemeral and permanent wetlands. This provides important waterbird breeding habitat, including the second largest summer population of wader birds in

Australia, and is recognised as having high wilderness value (Environment Australia, 2001). The Spring Tower Complex contains spring-fed freshwater cave systems and is recognised as a good example of a karst wetland, which have restricted distribution in Australia. The Spring Tower Complex contains relic fauna and flora, including vine thickets and blind amphipods (Environment Australia, 2001).

The Mitchell River discharges into the Gulf of Carpentaria and therefore its condition influences the ecological and economic values of that important part of northern Australia's marine environment. The Mitchell catchment also overlies part of the Great Artesian Basin and contributes to its recharge.

The study area contains an extensive network of wetlands and waterholes, which support fish, invertebrates, crocodiles, frogs, turtles and waterbirds. The extensive floodplain of the Mitchell catchment provides an important source of nutrients for a sub-set of fish species, including those feeding on benthic algae (Hunt et al., 2012). Fish, crayfish, prawns and shrimps access carbon from the floodplain as a source of energy. In turn, these animals are an important food source for large predators, particularly in waterholes during the dry season (Hunt et al., 2012). Studies in the catchment have consistently demonstrated the importance of connectivity between the river and floodplains for both large and small fishes and higher level predators, including crocodiles (Hunt et al., 2012; Jardine et al., 2017).

The Mitchell catchment has the second highest fish species richness nationally (Pusey, 2011). This is partly due to its extensive and diverse inland freshwater aquatic habitats, which are permanent and largely undisturbed (Pusey, 2011). Freshwater fishes perform central ecological functions and structure ecological communities within floodplain river ecosystems (Jardine et al., 2012). A sub-set of these fishes are large-bodied diadromous species (species that migrate between freshwater and seawater) which provide the basis for recreational and subsistence fisheries, and are of cultural significance (Close et al., 2014; Ebner et al., 2016). Species such as barramundi, threadfin salmon (*Polydactylus sheridani*) and mud crab (*Scylla serrata*) are particularly important to commercial and cultural fisheries, and they support fishing tourism in the south-eastern Gulf of Carpentaria (Bayliss et al., 2014). The freshwater sawfish is of conservation significance in the catchment. Other significant fauna in the estuarine and coastal waters of the Mitchell catchment include dugongs (*Dugong dugon*), sea snakes (members of the sub-family Hydrophiinae), speartooth sharks (*Glyphis glyphis*), and sea turtles (members of the super family Chelonioidea). Banana prawns (*Fenneropenaeus spp.*) are of considerable value to the Northern Prawn Fishery and are highly dependent on river flow.

To describe the ecology of the Mitchell catchment and discuss the likely impacts of future water resource development on this system, ecological assets have been selected. This chapter considers a key sub-set of assets, as shown in Table 3-1. More information on catchment assets and their distribution is available in the companion technical reports on ecology (Pollino et al., 2018a, 2018b). In Chapter 7, models are used to explore the potential of change to these assets, as a consequence of changes in flow. Figure 3-1 shows the spatial distribution of important areas for conservation (protected areas and important wetlands).

Table 3-1 Asset and asset types in the Mitchell catchment

All assets listed in this table are detailed in the companion technical reports on ecology (Pollino et al., 2018a, 2018b). Assets are water dependent on either surface water flows or groundwater, resulting in either periodic or sustained inundation. Assets consist of species of significance, functional groups, important habitats or ecosystem processes. An asterisk (*) represents assets included in analysis (see Section 7.5). Barramundi and sawfish are considered freshwater assets as the asset analysis only considers the freshwater stage of their life cycle.

CATEGORY	TYPE	ASSET	NOTES
Freshwater	**Important habitats**	Floodplain wetlands*	Critical habitat
		Waterholes-inchannel*	Critical habitat
		Ephemeral habitats	Critical habitat
		Riparian vegetation*	Critical habitat
	Functional groups	Migratory fish*	Commercial/ conservation
		Stable flow spawners*	Commercial/ conservation
		Turtles / Long-necked turtles	Conservation
	Species of significance	Barramundi*	Commercial/ conservation
		Freshwater whipray	Conservation
		Sawfish*	Conservation
	Ecological processes	Fluvial geomorphology	Critical process
		Floodplain and inchannel productivity	Critical process
Marine	**Important habitats**	Mangroves*	Critical habitat
		Seagrass	Critical habitat
		Salt flats*	Critical habitat
		Coral	Critical habitat
	Species of significance	Mullet spp.*	Commercial/ conservation
		Banana prawns*	Commercial
		Mud crabs	Commercial
		Longbums (mangrove whelks)	Commercial
		Snubfin dolphin*	Conservation
		King threadfin*	Commercial/ conservation
		Grunter*	Commercial/ conservation
		Saltwater crocodile*	Conservation

3.2.2 CURRENT CONDITION OF THE CATCHMENT

The Mitchell catchment is largely intact, but areas of the catchment are not in a pristine condition. In the upper parts of the catchment, the ecological composition and structure have been subject to human-induced changes. The most widespread land use has been pastoralism, which influences the environment by changing grazing and burning regimes and increasing rates of soil erosion. There has been relatively little clearing. The eastern portion of the catchment, where there has been more intensive agricultural development, has been subject to more drastic landscape changes, including clearing within the Mareeba–Dimbulah Water Supply Scheme. The catchment has also been subject to deliberate and accidental plant and animal introductions that, despite

benefits accruing to particular land users, can have environmental or economic consequences for other stakeholders. The downstream spread of introduced aquatic or terrestrial species from the more highly modified upper parts of the catchment is likely to be a continuing issue.

The hydrology of the Mitchell catchment has been modified, although not to anywhere near the same extent as more southerly catchments. The relatively small Southedge Dam (Lake Mitchell) in the upper catchment was completed in 1987 but there are no other major artificial barriers. The Mitchell catchment is one of the few remaining large catchments in Australia that is essentially unregulated. Exotic fish have been found in the catchment, with the greatest concern being the spotted tilapia. Concerns have been raised over the potential for exotic fish to enter the Mitchell catchment through the irrigation supply systems of the Mareeba–Dimbulah Water Supply Scheme, with recent evidence showing they are in the Mitchell catchment.

Soil erosion is a significant issue in the Mitchell catchment. Widespread gully erosion was initiated after European settlement, particularly in the period 1880 to 1950, and gullying has increased rapidly since 1949 (Shellberg et al., 2016). Dispersal of wet-season flows across the Mitchell catchment floodplains is vital for habitat connectivity. Yet since the removal of riparian vegetation and introduction of grazing cattle, erosion-resisting forces have been altered and floodplain sediment has become increasingly unstable (Brooks et al., 2009). Alluvial gully erosion and channel bank erosion are significant sources of sediment in the Mitchell River, whereas surface soil erosion is a relatively minor component of the total sediment load. Increases in the sediment load of a river such as the Mitchell can impact ecological processes in the river itself as well as beyond its mouth.

3.2.3 KEY HABITATS

Northern Australia contains rivers with highly seasonal flow regimes that support a diversity of habitats. These habitats require flows across the flow regime and are key for breeding, supporting juvenile aquatic animals, foraging and refuge. Habitats of significance in the Mitchell catchment that can potentially be impacted by agricultural and water resource development are described below.

Waterholes and wetlands

During the dry season, many ephemeral rivers of northern Australia cease to flow but retain water in a series of disconnected instream waterholes (McJannet et al., 2014; Waltham et al., 2013). The waterholes that remain during the dry season are an important cultural resource and provide a range of ecosystem functions (Centre of Excellence in Natural Resource Management, 2010; McJannet et al., 2014). For example, at the landscape scale, the number of waterholes and their connectivity allows for movement of biota across the landscape (Department of Environment and Resource Management, 2010). While at the local scale, the size of waterholes confers water-dependent species a refuge in periods without surface flows (Department of Environment and Resource Management, 2010). Permanent waterholes retain water during the dry period, with some being maintained or supported by groundwater inputs. See Section 2.5 (Figure 2-44) for the distribution of permanent waterholes in the Mitchell catchment.

During dry season low-flow or cease-to-flow periods, the size, quality and connectivity of waterholes remaining within the landscape decreases (Department of Environment and Resource

Management, 2010; McJannet et al., 2014). Waterholes are typically surrounded by riparian vegetation, which offer shade and structural diversity, and act as an interface between aquatic and terrestrial ecosystems, supporting high biodiversity. Changes in the flow regime associated with water resource development, surface and groundwater extraction, and climate change have the potential to alter the natural filling and drying cycles of waterholes as well as water quality, including turbidity (McJannet et al., 2014; Waltham et al., 2013). Changes in waterhole permanence could have impacts on the plants and animals at a local scale and on habitats across regional landscapes.

The expansive wetlands of northern Australia are typically extensive and highly productive (see Figure 3-1 for the distribution of wetlands in the Mitchell catchment). Aquatic production in tropical rivers is primarily driven by hydrology and the annual flooding that occurs (Pettit et al., 2017). This cycle influences the availability of nutrients within rivers and the coastal zone (Junk et al., 1989), providing a boost to the overall annual energy budget. In rivers, this supports huge biomasses of fish and invertebrates, and large bird breeding events. Prolonged inundation of wetlands promotes the productivity and biomass of aquatic vegetation (Finlayson, 1991; Pettit et al., 2011; Warfe et al., 2011), which provides important habitat for aquatic fauna. Threats to wetlands are derived from changes in the water regime which can modify connectivity and change the extent and suitability of habitat, and changes to the physical habitat through modification of land use and the introduction of invasive species (plants and animals) (Finlayson and Rea, 1999).

Mangroves and salt flats

Mangrove communities are assemblages of trees and shrubs that are found fringing most of the coastline of mainland Australia, with the most extensive and diverse communities found along the northern coastline. Mangroves support diverse and complex food webs, including crustaceans such as prawns and mud crabs, and a diversity of fish species. While associated with the marine system, mangroves require freshwater input and many mangroves live close to their salinity tolerance levels. Changes in flow regimes can potentially affect mangroves.

Hydrology of mangroves is complex: tidal inundation, rainfall, groundwater seepage and evaporation all influence soil salinity and have a profound effect on mangrove growth and distribution. Freshwater flow into mangroves reduces salinity, creating conditions that are favourable. Extraction of water from rivers and subsequent changes to flow regimes can negatively impact the productivity and extent of mangroves (Röderstein et al., 2014). A reduction in the volume of wet-season flow is likely to reduce the productivity (growth) and composition of mangroves and their extent and connectivity, particularly in the upper reaches of estuaries and the high intertidal zone. Minor reductions in flow regimes have led to massive mortality of mangroves (Blasco et al., 1996).

Coastal salt flats or claypans are shallow coastal basins which are only infrequently tidally inundated. They are often found adjacent to coastal mangrove forests. Tropical northern Australia has extensive areas of these salt flats which remain relatively pristine. These low-lying systems are mostly vegetation-free, and are coated in a thick salt crust for most of the year. During large rainfall events when overbank flow occurs, or during sustained local rainfall, they may be flooded for extensive periods. Wetting of salt flats results in the release of high concentrations of nutrients and benthic algae, which become a food source for animals, including prawns. Salt flats contribute significantly to primary production in coastal areas (Burford et al., 2016). Reduced flows can

impact salt flats through reduced inundation, affecting the growth of primary producers that form the base of the food web, with impacts potentially extending into coastal areas (Burford et al., 2016). See Figure 3-3 for a map of the distribution of mangroves and salt flats in the Mitchell catchment.

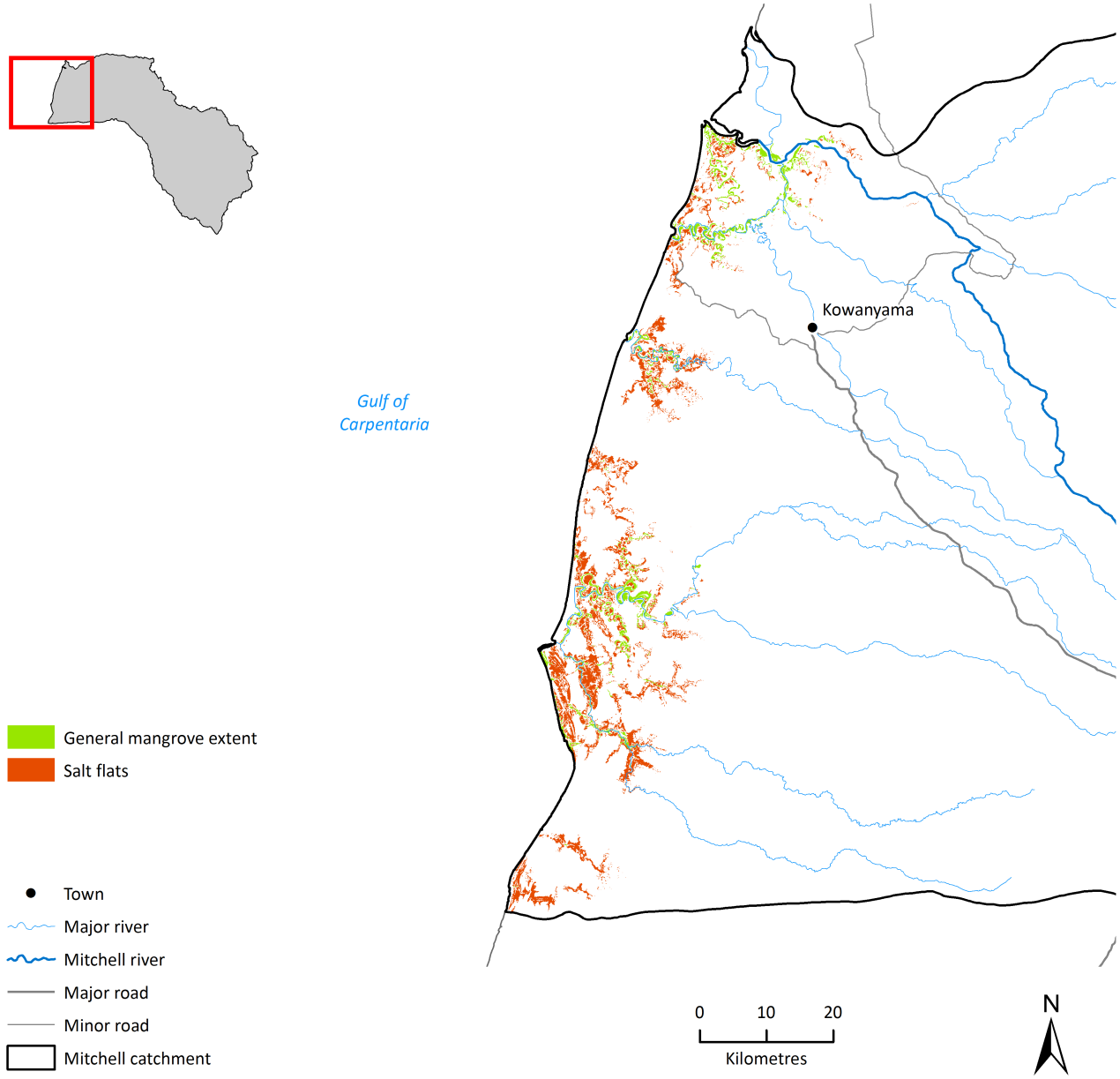

Figure 3-3 Distribution of mangroves and salt flats in the coastal area of the Mitchell catchment

Riparian vegetation

The interface between land and rivers is the riparian zone, which provides an important link between aquatic and terrestrial communities. Riparian zones are regarded as highly diverse, dynamic and complex habitats (Naiman and Decamps, 1997) that act as a thermal buffer to streams. They also influence a number of environmental processes such as instream primary production; nutrient interception, storage and release; enhancement of bank stability; the provision of coarse woody material as habitat and substrate for fish, invertebrates and microalgae; channel morphology and habitat diversity (Pusey and Arthington, 2003). Riparian vegetation is important for providing: bank stability, terrestrial and instream habitat and food resources, as well

as acting as corridors for wildlife movement and the movement of sediment, carbon and nutrients into rivers. Riparian zones are often more fertile and productive than surrounding terrestrial vegetation. The timing and quantity of water available to the riparian zone is critical for determining its structure, function and resilience, such that all aspects of the flow regime (i.e. precipitation, runoff and evapotranspiration) exert some control over how riparian vegetation accesses water (Tabacchi et al., 1998).

The ecological integrity of riparian zones across northern Australia is threatened by a range of existing processes, including land clearing, weed invasions and disturbance by livestock (Woinarski et al., 2000). Riparian zones in parts of the Mitchell catchment have become degraded as a consequence of cattle grazing. This has manifested as alluvial gullying (Brooks et al., 2009; Shellberg et al., 2010), which has changed vegetation cover and lead to the establishment of weeds. Management of riparian zones is important for maintaining terrestrial biodiversity as well as instream riverine environments, water quality and biodiversity (Pusey and Arthington, 2003).

Gulf of Carpentaria

The Gulf of Carpentaria is a geologically-recent (~10,000 years) shallow sea (<70 m deep) bounded by topographically-low, nutrient-poor landscapes to the east, south and west and the Arafura Sea and the southern coast of the island of New Guinea to the north (Chivas et al., 2001; Huey et al., 2014). It is roughly 600 km from east to west and 1000 km from south to north, although hydrologically (ignoring national borders) it is a west-opening shallow gulf (<100 m deep) that continues north to the New Guinea coastline (Condie et al., 1999; Condie, 2011). Hydrologically, a seasonal anticlockwise gyre dominates water currents in the Gulf, with a 4 m (approximate) tide range in the south and a 2 m (approximate) tide range in the north (Li et al., 2006). Its benthic sediments are characterised by muds and sandy muds used as habitat by a myriad of epifauna and infauna (Li et al., 2006; Long and Poiner, 1994; Somers and Long, 1994). Water quality is high, with relatively oligotrophic nutrient levels, although not nutrient limited, and a plankton community characteristic of tropical waters (Burford and Rothlisberg, 1999; Rothlisberg et al., 1994). Terrigenous inputs do not affect offshore Gulf waters; low sediment loads and nutrient re-suspended during rough weather drive plankton productivity (Burford and Rothlisberg, 1999; Rothlisberg et al., 1994).

Gulf of Carpentaria shorelines and littoral zones support mangrove (Duke et al., 2017) and seagrass (Poiner et al., 1987) communities, as well as bare sediments and sandy dune shores. Littoral flora stabilise shorelines and importantly, they support a species-rich faunal community for all or part of their life cycles. Key commercial fish and crustaceans comprise a portion of the coastal fauna and have been harvested commercially for over 50 years. Annual floodflows are pulsed and stochastic; large floods deliver sediments and nutrients to estuarine and nearshore habitats to stabilise depositional environments and enhance coastal productivity (Asbridge et al., 2016; Burford et al., 2012). Despite catchment-to-coast fluvial loads being transported and deposited by monsoon-driven floods, nutrient levels in estuaries and coastal waters are characteristically low due to the low fertility of the geologically-ancient, weathered catchment soils and landscapes (Hutley and Beringer, 2010). Primary productivity in Gulf of Carpentaria estuarine habitats is driven by water column and epibenthic phytoplankton communities, supporting meiofauna and larger epibenthos, which are eventually consumed by fishery species (Burford et al., 2012, 2016; Duggan et al., 2014). Tropical fish and crustaceans have co-evolved

with the monsoon-driven climate to respond to environmental cues. Wet-season floods sustain riverine habitats, optimise estuarine environments and cue ontogenetic emigration.

Historically, fishing in the Gulf of Carpentaria was a remote activity centred on the few townships scattered around Gulf shores (Baird, 1970; Pownall, 1994). However, from first exploration, Gulf waters supported iconic market species such as barramundi, mudcrabs, mackerel and prawns (Savage and Hobsbawn, 2015) as abundant stocks from which valuable harvests were irresistible, despite difficult operational conditions. In the 1980s, improved vessel design and construction, and refrigeration, allowed commercial fishers to travel across the Gulf for long periods in search of an abundant catch. A view of the Gulf as an 'un-explored' (hence under-exploited) frontier resulted in an overallocation of fishing licences for many species-groups. This view has necessitated a steady reduction in effort over the last 20 to 30 years for the Gulf to remain sustainable. Today, high-value fish and crustaceans are harvested seasonally from relatively 'self-contained' fishing vessels (Figure 3-4). For a range of fishery species, catch is positively correlated with wet-season floodflow (Halliday et al., 2012; Bayliss et al., 2014). However, compared with fisheries along extensive coastlines in other geologically-distinct eco-regions (e.g. the Malaysian peninsula), the Gulf of Carpentaria supports a modest total catch (Loneragan et al., 2005). In 2015–16, more than $300 million of fishery catch was taken from tropical Australian fisheries with $124 million of wild-caught prawns taken from the Gulf of Carpentaria (Mobsby and Koduah, 2017).

Figure 3-4 A prawn trawler (owned by A. Raptis & Sons) in the Gulf of Carpentaria

Inshore, gillnet and pot fisheries target barramundi, king and blue threadfin, barred javelin, sharks and mudcrabs (Griffiths et al., 2010). Offshore, otter trawl, fish trawl, gillnet and troll-line fisheries target a multi-species prawn fishery, tropical scalefish, sharks and mackerel, respectively (Bayliss et al., 2014; Griffiths et al., 2010). The inshore fisheries are managed by state and territory jurisdictions, while the offshore fisheries are managed by the Australian Government. In addition, over the last 20 years, land-based access to Gulf coastlines has become more achievable and resulted in an increase in recreational fishing in rivers, estuaries and near-coast habitats. Mining infrastructure has opened access to coasts (e.g. the McArthur River Mine road infrastructure in the south-west Gulf of Carpentaria), while improved roads, better engineered off-road vehicles and the opening of coastal pastoral properties to camping and fishing have improved access. In conjunction, improved design of recreational vessels has allowed fishers to travel further, and faster, from their remote camping grounds and access locations.

The remote, lightly-exploited habitats and ecosystems of the Gulf of Carpentaria continue to support iconic species that are vulnerable, endangered or extinct over much of their original geographic range. Sawfish, whiprays, river sharks and dolphin inhabit marine, estuarine and riverine habitats throughout the Gulf of Carpentaria and adjacent catchments. Once these species were widely distributed throughout Asia and the Indo-West Pacific. Today, riverine and estuarine habitats in Gulf of Carpentaria rivers such as the Wenlock, Mitchell, Flinders and Roper rivers, are among the last bastions of populations of a suite of these iconic species (Peverell, 2005; Pillans et al., 2009; Devitt et al., 2015).

3.2.4 KEY BIOTA

Native fish

Freshwater fish are an important component of the aquatic biodiversity in northern Australia (Pusey et al., 2017). Fishes comprise the dominant aquatic-vertebrate group in terms of species richness in tropical freshwater catchments of northern Australia. In a recent synthesis of a range of information sources, Pusey et al. (2017) mapped the distribution of 111 freshwater and 42 estuarine fishes across northern Australia, not including those that are elasmobranchs (sharks, rays and skates). An earlier publication documented 176 species of bony fish and six species of elasmobranch recorded in northern Australia (Pusey, 2011). A total of 86 of these species reside exclusively in freshwaters and 90 out of 176 require access to marine or estuarine waters for part of their life cycle (Pusey, 2011).

The Mitchell River supports a high species richness of freshwater fishes, with 57 species recorded, as well as high endemism for fish (Pusey et al., 2017). Studies have found 45 fish species in the catchment are limited to freshwater habitats while three elasmobranchs with at least one freshwater life cycle stage have also been recorded (Allen et al., 2002; Pusey et al., 2017).

Migratory fish

A fish group vulnerable to inchannel barriers and changes to flows are freshwater migratory fishes. Migratory fish are distributed throughout the Mitchell catchment, with a higher diversity of species concentrated at the bottom of the catchment (Figure 3-5). These include freshwater migratory fish groups with populations or subpopulations which undertake large-scale movement during their life cycle. These migrations may be required for reproductive purposes or exploiting

available habitat and food resources. While there are many species in this group, a range of species are distributed throughout freshwater habitats including inchannel and offchannel environments, as well as upper and lower catchment areas, such as the barramundi (*Lates calcarifer*), freshwater sawfish (*Pristis pristis*), bull shark (*Carcharhinus leucas*), black catfish (*Neosilurus ater*) and Hyrtl's tandan (*Neosilurus hyrtlii),* sooty grunter (*Hephaestus fugilinosus* and *H. jenkinsi*), freshwater longtom (*Strongylura kreffti*) and spangled perch (*Leiopotherapon unicolor*).

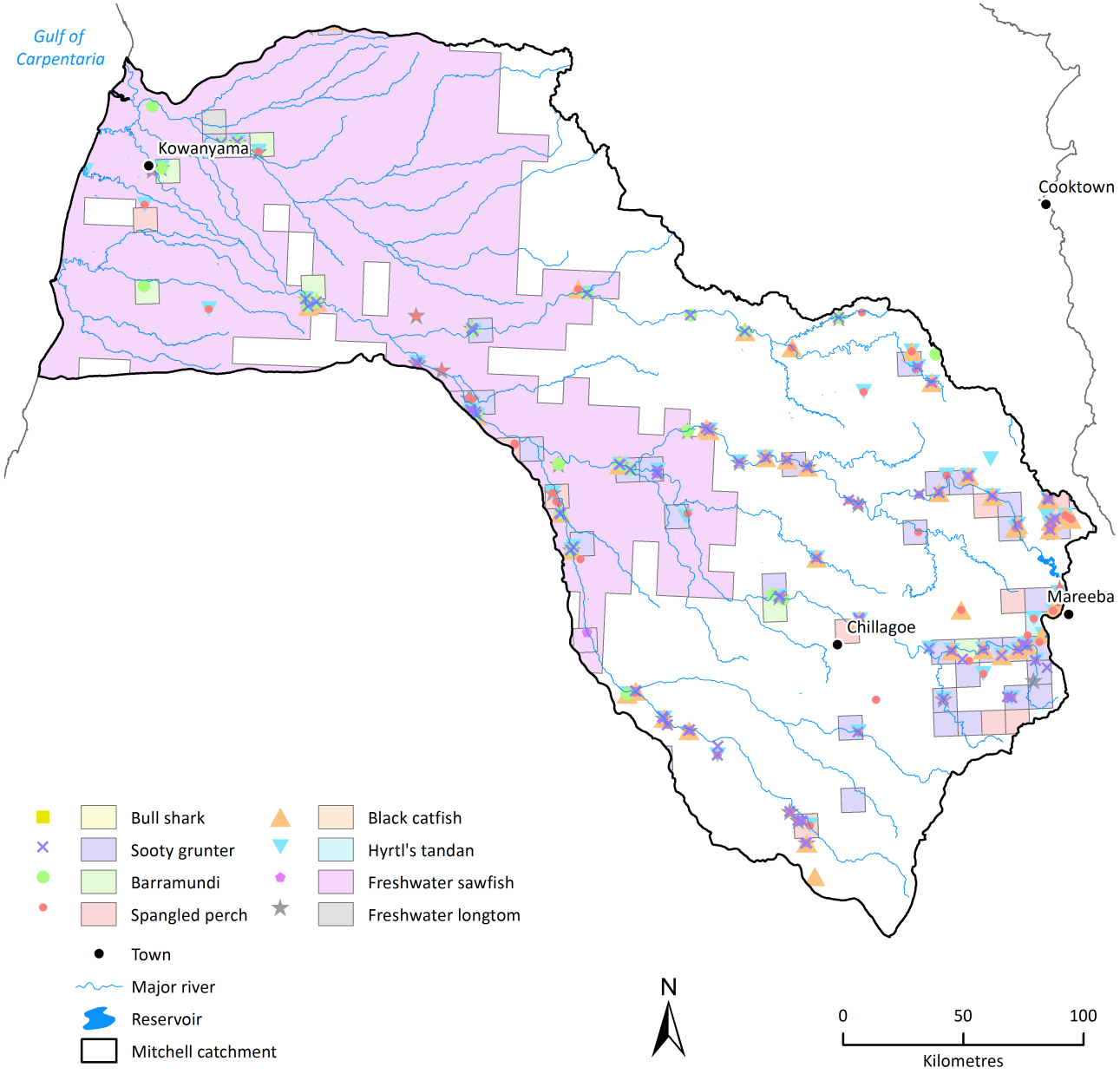

Figure 3-5 Distribution of focal migratory freshwater fishes in the Mitchell catchment
The squares represent the generalised distribution and density of species based on a 10 km grid. Each square may therefore represent one or many occurrence of a species.

Movement and migration of fishes in the Mitchell catchment is critical. Species can move over the Mitchell River floodplain for weeks to months during the wet season, but be confined to the main channel and distributary refugia during the dry season. The distributary refugia are in streams branching off and flowing away from the main stream channel. In the dry season, inundated

habitats play a critical role in providing resilience for fish. Infrastructure developments that change connectivity in catchments can impact on this group.

Stable flow spawners

Another important group of fish are the stable flow spawners. While they are distributed throughout the Mitchell catchment, this group is more prominent in the upper areas (Figure 3-6).

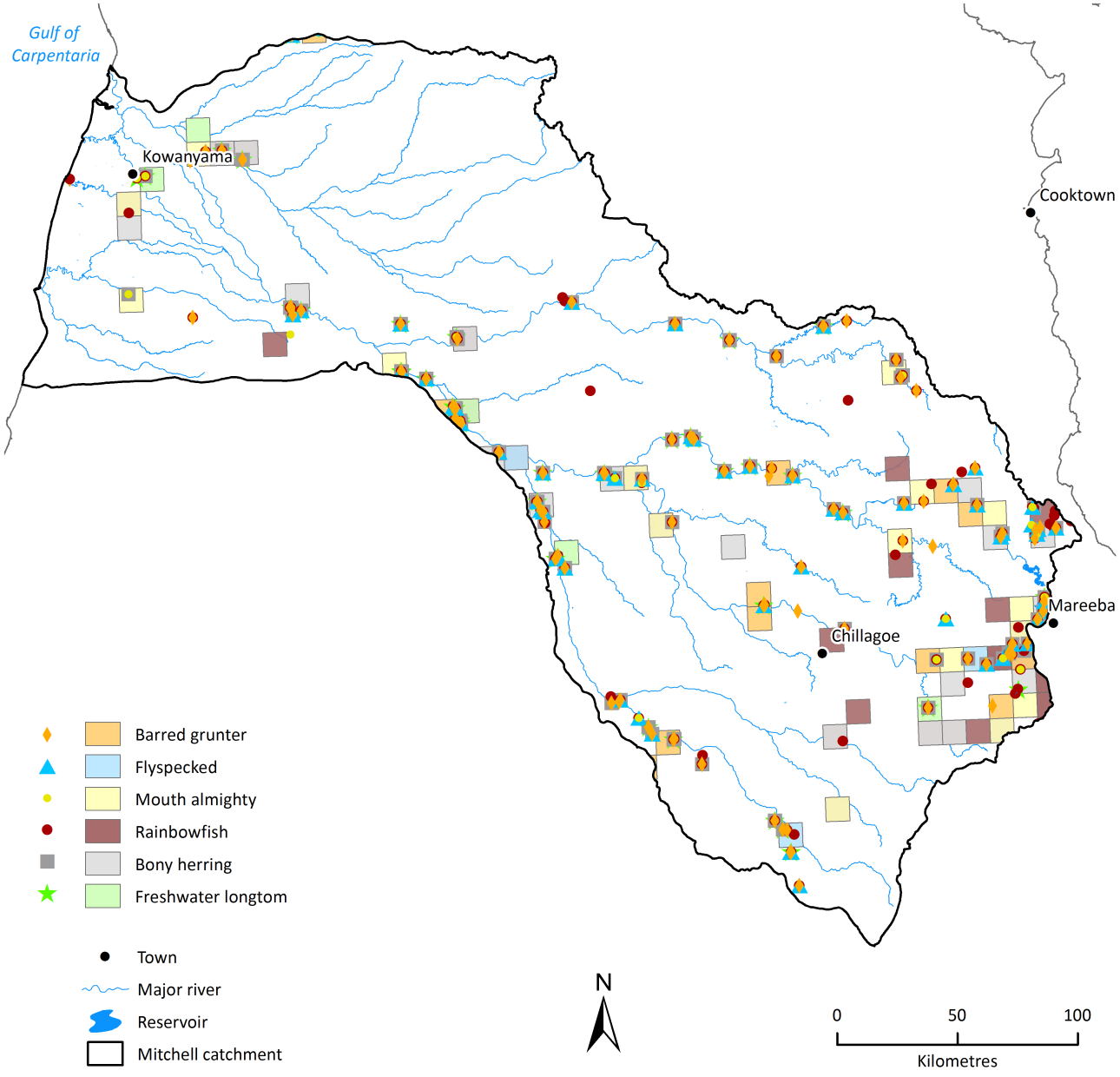

Figure 3-6 Distribution of focal stable flow spawning fishes in the Mitchell catchment
The squares represent the generalised distribution and density of species based on a 10 km grid. Each square may therefore represent one or many occurrence of a species.

This group of fish spawn in association with stable flows (low flow, baseflow and cease to flow) and have the potential to be impacted through flow regulation, due to changes in their habitat (such as availability, structure, size and quality). This group includes a large number of species, including the freshwater longtom, mouth almighty *(Glossamia aprion),* bony bream (*Nematalosa erebi),* barred grunter (*Amniataba percoides*), flyspecked (*Craterocephalus stercusmuscarum stercusmuscarum)* and freckled hardyhead (*Craterocephalus lentiginosus)* and the eastern

(*Melanotaenia splendida splendida)*, chequered (*Melanotaenia splendida inornata)* and western (*Melanotaenia australis)* rainbowfish.

Threatened and endangered fish species

Freshwater sawfish

The threatened freshwater sawfish is found throughout the Mitchell catchment (Peverell, 2005) (Figure 3-7; Figure 3-8). It is listed as vulnerable under the EPBC Act and as critically endangered by the International Union for Conservation of Nature (IUCN). Given the EPBC Act listing, any proposed action that is likely to have a significant impact on their populations or on their habitat may need an environmental impact assessment. Historically the freshwater sawfish occurred on the west coast of Australia, in the Northern Territory and in Queensland, including on the east coast. Currently this species is rarely detected on the east coast of Queensland, but occur as juveniles in the rivers and estuaries of the Gulf of Carpentaria (Morgan et al., 2016; Peverell, 2005).

The prospect of inchannel barriers along migration routes and in the lowlands of the Mitchell catchment poses a threat to the passage of migratory fishes, including the freshwater sawfish. The freshwater sawfish has a marine adult phase while the juvenile phase is in freshwater or saline environments (Morgan et al., 2016; Peverell, 2005). Pupping occurs in estuaries and river mouths (Last and Stevens, 1994), and juveniles and adults occupy large pools and waterholes, mostly in the main channel of larger rivers (Morgan et al., 2004; Peverell, 2005).

Figure 3-7 The freshwater sawfish (*Pristis pristis*)
Photo: James Cook University

Species of sawfishes can attain very large sizes (5 to 7 m total length) and live in tropical and subtropical coastal marine waters as adults (Last and Stevens, 1994). A key feature of the group is the tooth-lined rostrum (or saw) which is a flattened extension of the snout. The saw is important in the specialist, stealth feeding strategies of these species, being used to sense and in some cases strike and impale prey, including prawns and fish (Morgan et al., 2016). Occasionally they are also found in larger offchannel habitat. The freshwater sawfish is a top predator that feeds on fishes and crustaceans (Thorburn et al., 2014).

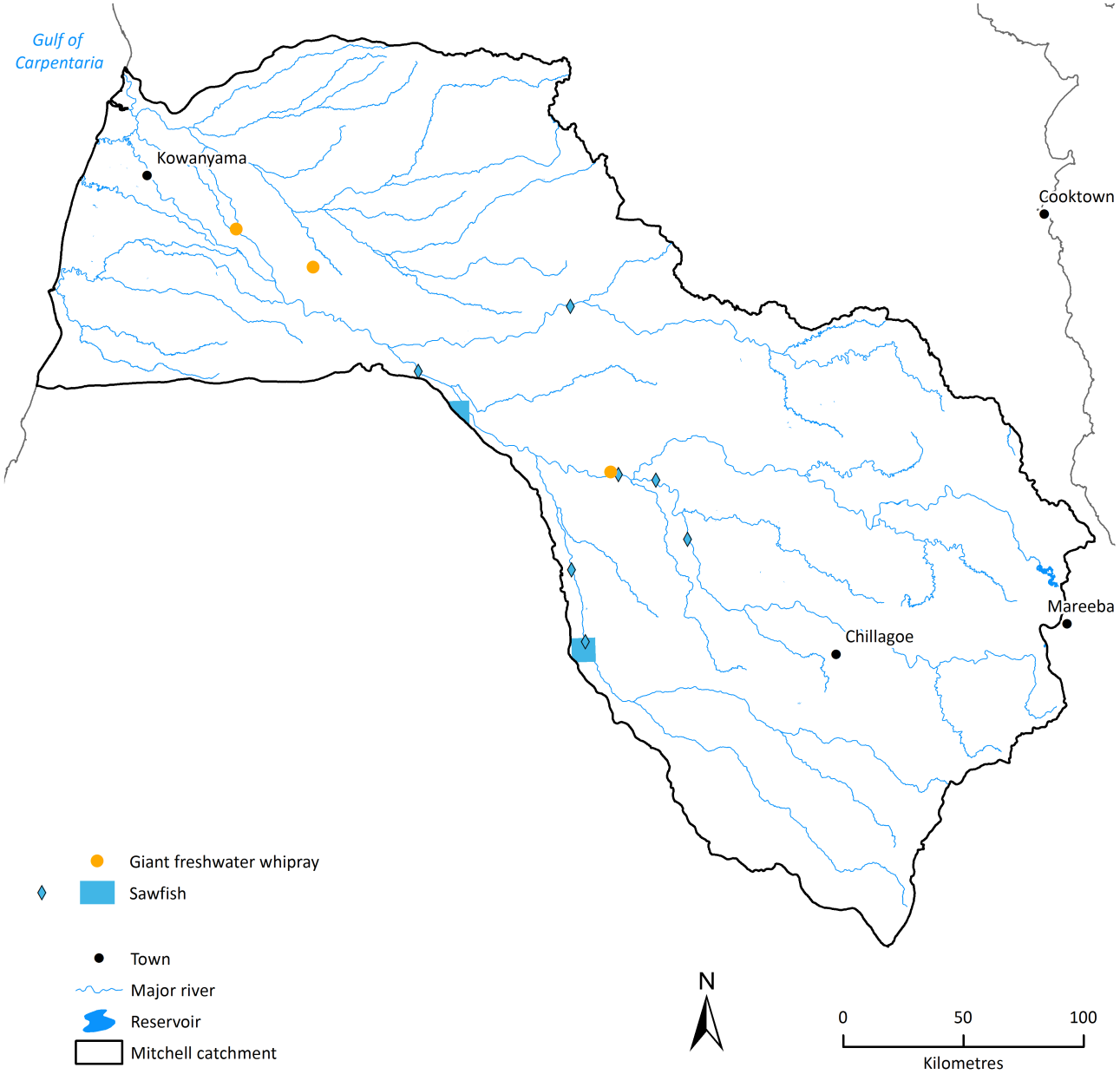

Figure 3-8 Distribution of sawfish (*Pristis pristis*) and giant freshwater whipray (*Urogymnus dalyensis*) in the Mitchell catchment

The limited observations of whiprays are a result of rarity rather than absence of the species.

The squares represent the generalised distribution and density of species based on a 10 km grid. Each square may therefore represent one or many occurrence of a species.

Giant freshwater whipray

The giant freshwater whipray (*Urogymnus dalyensis*) (Last et al., 2016) is a little-known species of stingray, found in a number of large rivers and associated estuaries in northern Australia (Ebner et

al., 2016). It is listed as being of least concern on the IUCN Red List, which means that currently it has a lower risk of extinction. There are few observations of the species in the Mitchell catchment (Figure 3-6). The restricted geographic range of the whipray in the Mitchell catchment, the rarity of individuals and the presumed limited interchange between rivers, increases the species' inherent sensitivity to threats (Kyne, 2016). As a large-bodied species with low capability to produce offspring, the freshwater whipray is vulnerable to direct exploitation and deterioration or loss of main channel and floodplain environments.

Whipray are born in estuaries and migrate upstream to spend their first years of life in the freshwater reaches of rivers and tributaries, moving up to 300 km inland (Burrows and Perna, 2006; Thorburn et al., 2003). As they mature, whiprays move down the river and enter the estuarine environment, and consequently can be affected by barriers such as causeways, weirs and dams. The species is a top predator, feeding on fishes and crustaceans (Ebner et al., 2016). Although the ecology and distribution of the species is poorly understood, making it difficult to evaluate the potential direct impact of water resource development, the whiprays are migratory species that can be affected by barriers.

Commercial and recreational species

Barramundi

Barramundi is a large fish that occurs throughout northern Australia in rivers, lagoons, swamps and estuaries. It is a voracious predator and arguably the most important fish species to cultural, recreational and commercial fisheries throughout wet-dry tropical Australia. The species makes up a substantial component of total commercial fish catch in northern Australia (Savage and Hobsbawn, 2015). Barramundi is also a fish of cultural significance, as well as being an important food source for Indigenous populations (Jackson et al., 2012; Toussaint et al., 2005). Barramundi is found extensively throughout the Mitchell catchment (Figure 3-9).

The barramundi is impacted by changes in the flow regimes of rivers and via infrastructure impacting movement of fish. Spawning occurs in the estuary at the beginning of the wet season and young male fish move into floodplain and freshwater habitats when suitable flows provide access (Russell and Garrett, 1985). Recent work has proposed three primary life cycle strategies employed by barramundi (Crook et al., 2017), whereby some male adults return to the estuary to spawn after spending up to several years in freshwater habitats, while some males may delay downstream spawning migrations for several years until they have undergone the transition to females in freshwater habitats. Migrations are thought to be triggered by variation in the flow regime (Crook et al., 2017), making the species particularly vulnerable to water resource development. Barramundi can be caught throughout all four fishing seasons, but higher catch rates occur during the build-up and wet season, as barramundi becomes more active with warmer temperatures.

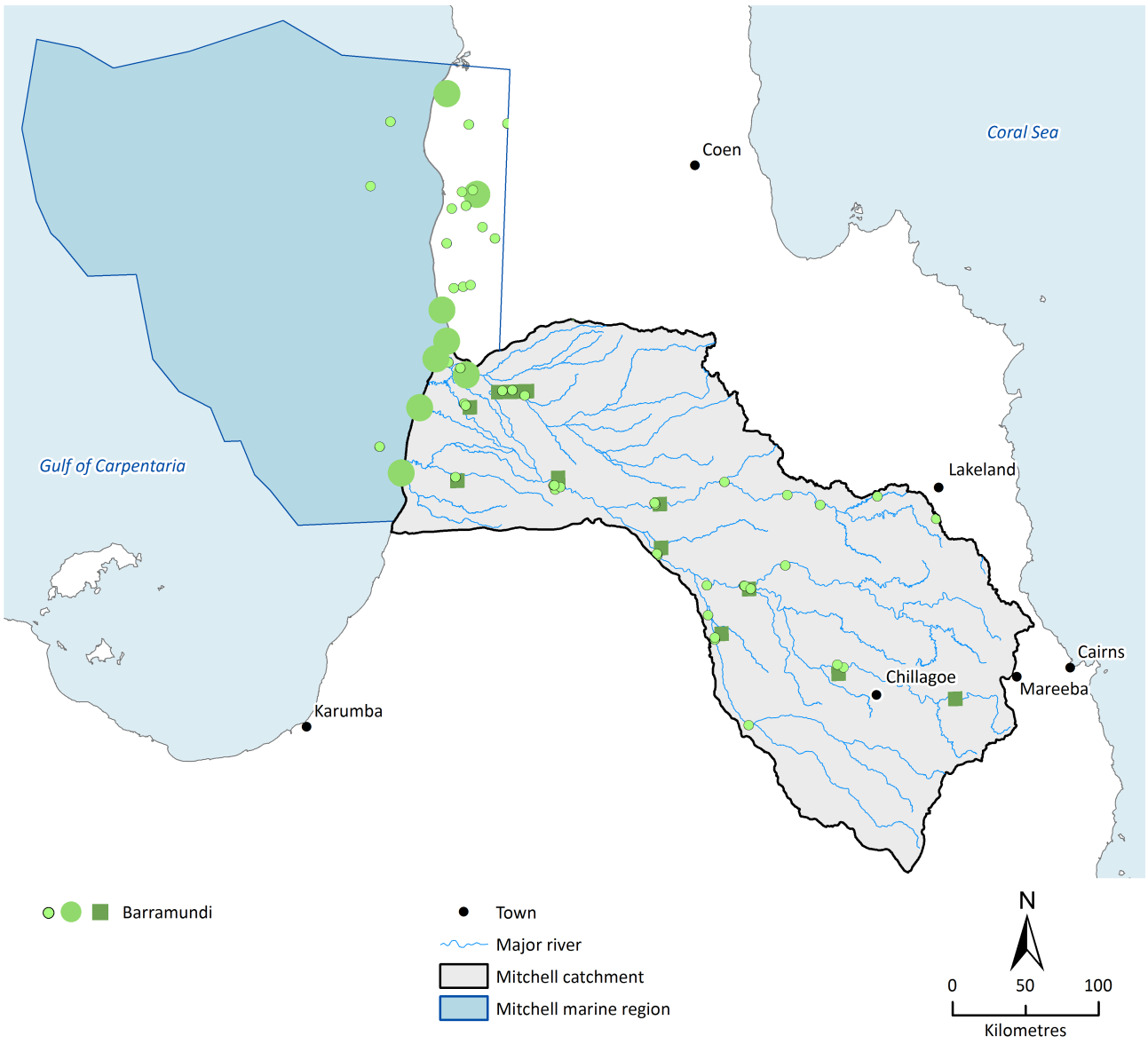

Figure 3-9 Distribution of barramundi (*Lates calcarifer*) in the Mitchell catchment
Square symbols (dark green) are from the species density grid in Queensland WildNet (Department of Science, 2017). The smaller round symbols (light green) are for all other catches collected from other datasets (e.g. Atlas of Living Australia (2016), Northern Australia Fish Atlas (TropWATER, 2017), Jardine et al. (2012) and Pusey et al. (2017)). Larger round symbols (medium green) are 5 nm-buffered records from Queensland Department of Agriculture and Fisheries (recreational fisheries catch).

White banana prawn

The white banana prawn (*Fenneropenaeus merguiensis*), is a short-lived, fast-growing crustacean species that is an important major commercial fishery resource across tropical Australia (see Section 3.3.2; Figure 3-10). White banana prawns complete their life cycle within a year and can be wild-harvested annually. Their stock is tied to key environmental drivers, particularly annual flood flow (Staples and Vance, 1986; Vance et al., 1985). Each year's catch of banana prawns is highly variable, being dependent on temporal cycles of monsoonal rainfall and river flows. In addition to forming a major constituent of a high value fishery, white banana prawns are an important ecological species and a key component of marine and estuarine food webs. They provide a significant food source for a myriad of commercially and recreationally valuable fish species in the coastal ecosystem.

A significant body of research has investigated the life cycle, growth, behaviour, and habitat use of the white banana prawn across multiple life stages to help inform the management of the Northern Prawn Fishery (NPF) (Vance et al., 1996; Wang and Haywood, 1999). The NPF is a very well-managed fishery of high economic value. Larger flow events increase prawn catch through greater juvenile emigration from estuaries to offshore habitats where growth is enhanced and mortality is lower for the sub-adult and adult phases (Robins et al., 2005). Recent studies suggest that nutrients exported during the flood flows support enhanced growth and survival and enhanced food availability through primary and secondary production in near-shore habitats (Burford et al., 2010). Assessing the potential impact of water resource development on the NPF is a critical issue, especially for white banana prawns, whose life cycles are intrinsically linked to natural flow regimes.

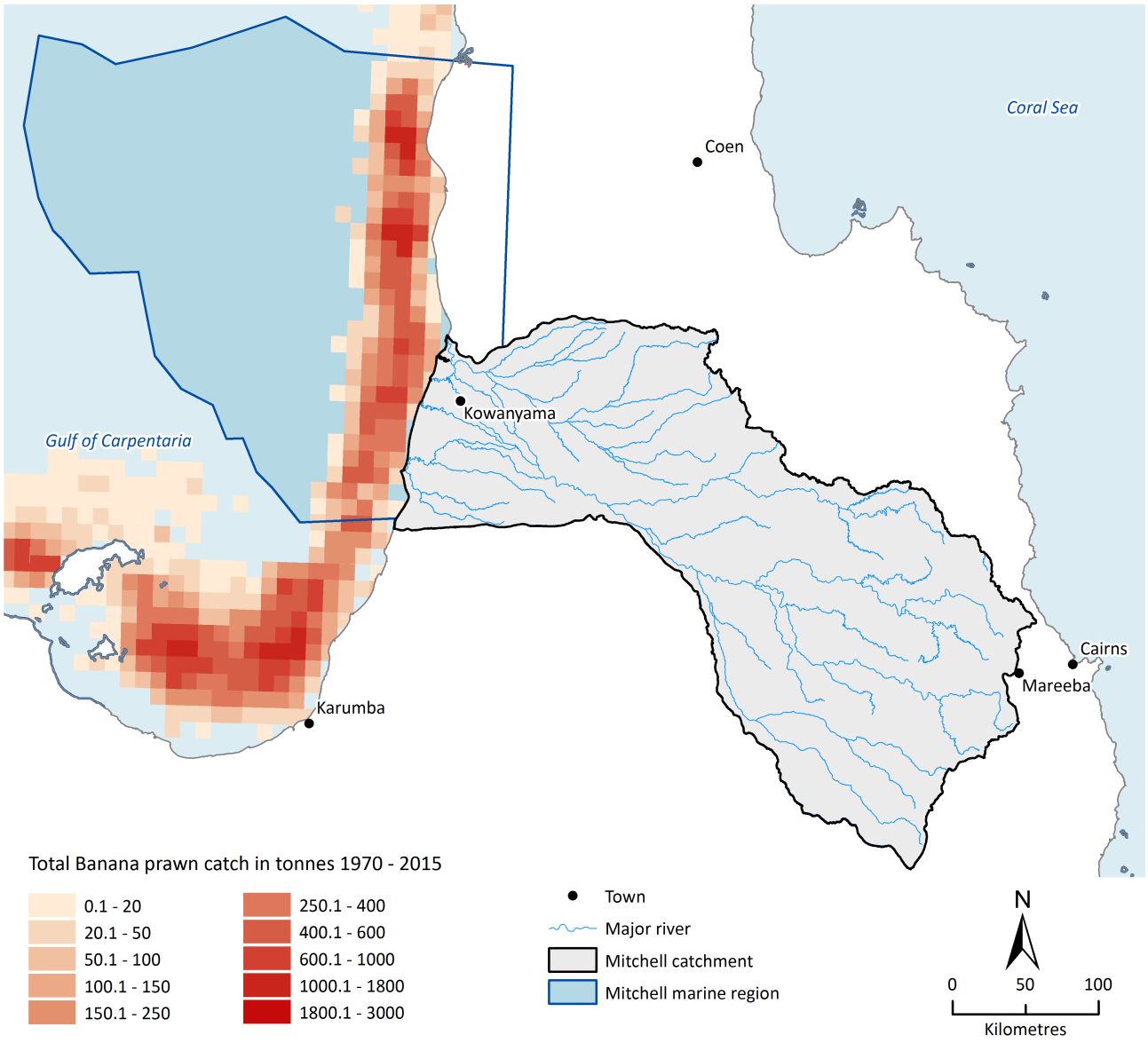

Figure 3-10 White banana prawn (*Fenneropenaeus merguiensis*) catch in the Mitchell catchment

3.2.5 TERRESTRIAL SYSTEMS

Australia's northern terrestrial systems are one of the few remaining mostly intact natural areas on Earth (Kutt et al., 2009). The monsoonal climate controls the ecology of northern Australia's plant and animal species, with annual fluctuations in resources, dictating migration and dispersal patterns, fruiting, seeding and flowering are synchronised with this highly seasonal pattern of rainfall (Woinarski et al., 2005).

Intensive agricultural development can cause habitat fragmentation as a consequence of land clearing but the extent of this is dependent on the scale and type of development and the extent to which it is contiguous or in a mosaic. Habitat fragmentation is a critical issue for biodiversity conservation. Fragment size, isolation and the impact of livestock, feral predators and weeds all affect conservation outcomes (Hobbs, 2001). In developing agricultural landscapes in northern Australia, lessons from fragmentation studies are critical. For savanna species, subtle landscape variations provide critical resources for wildlife, and the loss of this variation can lead to local extinctions (Woinarski et al., 2005).

Fragmented habitats in northern Australia are likely to be under extreme pressure from introduced weeds, altered fire regimes and altered hydrology. Taking those issues into account along with the subtle, complex and largely unknown spatial and temporal fluctuations in critical resources required for many vertebrates presents a considerable challenge.

3.2.6 ENVIRONMENTAL PROTECTION

There are a number of both aquatic and terrestrial species in the Mitchell catchment currently listed as critically endangered, endangered and vulnerable under the EPBC Act and *the Nature Conservation Act 1992* (Qld) (Figure 3-12).

Figure 3-11 Wetlands, critical ecosystems in the Mitchell catchment
Photo: Nathan Dyer

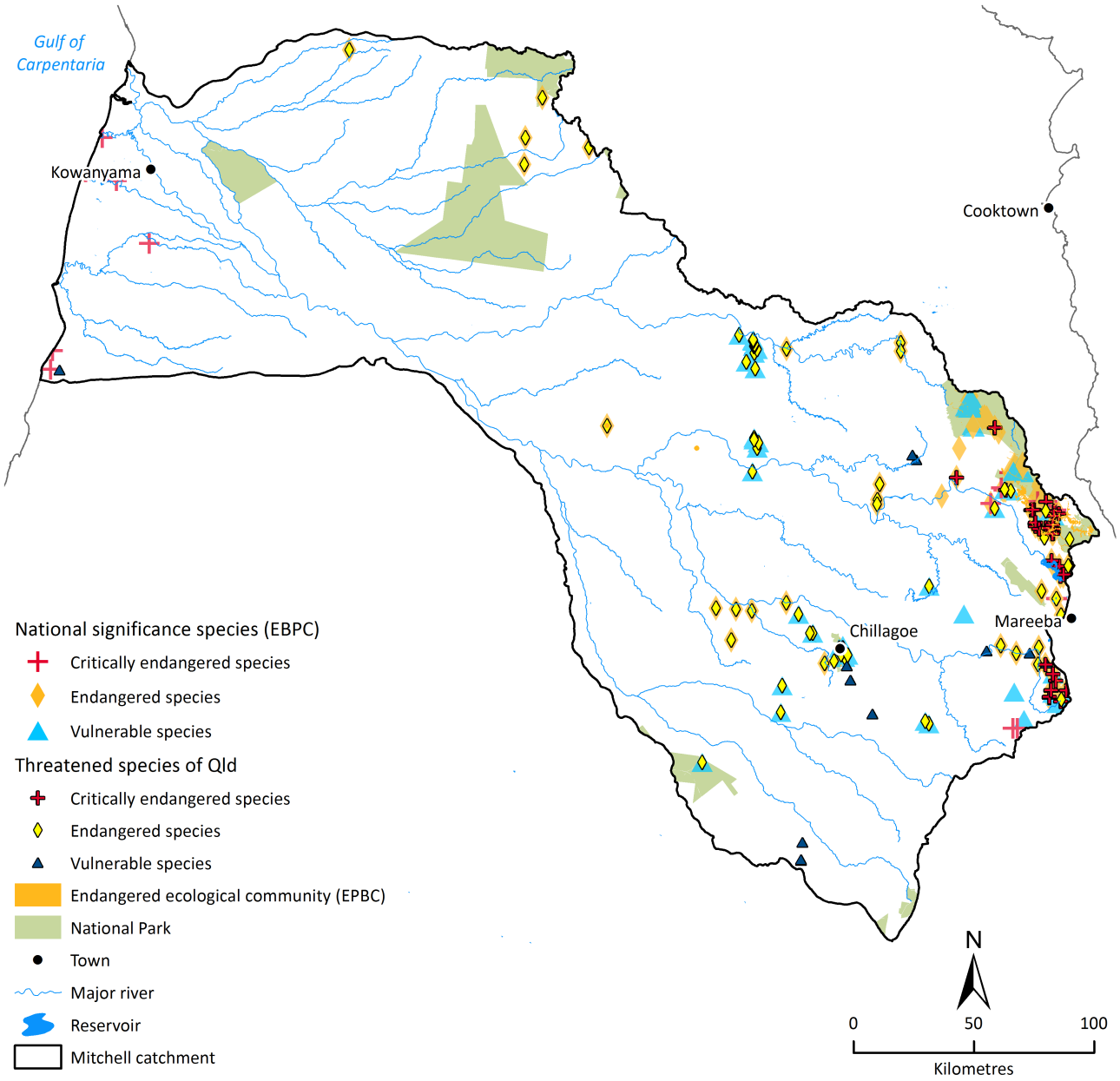

Figure 3-12 Distribution of species listed under the EPBC Act (Cth) and the *Nature Conservation Act 1992* (Qld), in the Mitchell catchment

If a proposed development is predicted to have a significant impact on a matter of national environmental significance (Table 3-2) it would require approval to proceed under the EPBC Act. This approval is required irrespective of local government policies. The *Nature Conservation Act 1992* lists 21 species, most of them mammals, birds and reptiles. This Act requires an approved species management program for any activity that will impact on breeding places of protected animals (Table 3-2).

Table 3-2 Definition of threatened categories under the EPBC Act (Cth) and the *Nature Conservation Act 1992* (Qld)

ACT	CATEGORY	DEFINITION
EPBC Act (Cth)	**Matters of National Environmental Significance**	World heritage properties, national heritage places, wetlands of international importance (listed under the Ramsar Convention), listed threatened species and ecological communities, migratory species protected under international agreements, Commonwealth marine areas, the Great Barrier Reef Marine Park, nuclear actions (including uranium mines), and water resources, in relation to coal seam gas development and large coal mining development.
	Critically endangered species	It has undergone, is suspected to, or is likely to undergo very severe reduction in numbers in the immediate future; its geographic distribution is precarious for the survival of the species and is very restricted. The estimated total number of mature individuals is very low and evidence suggests that the number will continue to decline at a very high rate and the probability of its extinction in the wild is at least 50% in the immediate future.
	Endangered species	It has undergone, is suspected to, or is likely to undergo severe reduction in numbers in the immediate future; its geographic distribution is precarious for the survival of the species and is restricted. The estimated total number of mature individuals is low and evidence suggests that the number will continue to decline at a high rate and the probability of its extinction in the wild is at least 20% in the near future.
	Vulnerable species	It has undergone, is suspected to, or is likely to undergo substantial reduction in numbers in the immediate future; its geographic distribution is precarious for the survival of the species and is limited. The estimated total number of mature individuals is limited and either evidence suggests that the number will continue to decline at a substantial rate and the probability of its extinction in the wild is at least 10% in the medium-term future.
	Critically endangered communities	Extremely high risk of extinction in the next 10 years or three generations of key species.
	Endangered communities	Extremely high risk of extinction in the next 20 years or five generations of key species.
	Vulnerable communities	Extremely high risk of extinction in the next 50 years or ten generations of key species.
Nature Conservation Act 1992 (Qld)	**Endangered**	There have not been thorough searches conducted for the wildlife and the wildlife has not been seen in the wild over a period that is appropriate for the life cycle or form of the wildlife; or the habitat or distribution of the wildlife has been reduced to an extent that the wildlife may be in danger of extinction; or the population size of the wildlife has declined, or is likely to decline, to an extent that the wildlife may be in danger of extinction; or the survival of the wildlife in the wild is unlikely if a threatening process continues.
	Vulnerable	Its population is decreasing because of threatening processes, or its population has been seriously depleted and its protection is not secured, or its population, while abundant, is at risk because of threatening processes, or its population is low or localised or depends on limited habitat that is at risk because of threatening processes.

The highest concentration of threatened species is near the Daintree in the eastern, wetter, higher altitude fringe of the Mitchell catchment (Figure 3-2), however the no-records of species in other areas can be a reflection of a lack of field studies, rather than a true absence of a species. There are four important areas for birds and three important wetlands (Figure 3-2). A previous synthesis

report overviewing terrestrial systems of northern Australia found large data gaps exist in the Mitchell catchment, particularly describing plants and animals (Kutt et al., 2009). This lack of data limits any potential analysis of impacts or conservation planning. Queensland Regional Ecosystem mapping (Queensland Herbarium, 2017) which is based on vegetation communities that are associated with a geology, landform or soil, shows that much of the upper Mitchell catchment is characterised as being of no concern, where remnant vegetation is over 30% of pre-clearing extent (Table 3-3; Figure 3-13). Note however, that there are small endangered vegetation communities (less than 10% of remnant vegetation remaining) and of concern vegetation communities (10 to 30% of remnant vegetation remaining) located in areas of the catchment. The lower catchment is largely dominated by communities of concern.

Table 3-3 Categories of regional ecosystem (vegetation) communities

CATEGORY	DEFINITION	SUBCLASS	AREA (ha)	PERCENTAGE OF CATCHMENT (%)
Endangered	Remnant vegetation is less than 10% of its pre-clearing extent across the bioregion; or 10–30% of its pre-clearing extent remains and the remnant vegetation is less than 10,000 ha.	Dominant†	13,902	0.2
		Sub-dominant‡	78	0
Of concern	Remnant vegetation is 10 to 30% of its pre-clearing extent across the bioregion; or more than 30% of its pre-clearing extent remains and the remnant extent is less than 10,000 ha.	Dominant	976,780	13.6
		Sub-dominant	1,005,689	14
No concern at present, least concern	Remnant vegetation is over 30% of its pre-clearing extent across the bioregion, and the remnant area is greater than 10,000 ha.	Dominant	5,044,862	70
Non-remnant	All vegetation that is not mapped as remnant vegetation. May include regrowth, heavily thinned or logged and significantly disturbed vegetation that fails to meet the structural and/ or floristic characteristics of remnant vegetation. It also includes urban and cropping land. Non-remnant vegetation may retain significant biodiversity values.		2,042	1.4
Plantation	Large-scale crops such as cotton and sugarcane.		116	0.0
Water	Large artificial deep-water impoundments (such as Lake Mitchell) and farm dams are mapped as 'water' on the remnant coverages, as they do not match any natural regional ecosystem.		2,946	0.1

†'Dominant' subclass means that greater than 50% of the polygon contains the regional ecosystem mapping.
‡'Sub-dominant' subclass means that less than 50% of the polygon contains the regional ecosystem mapping.

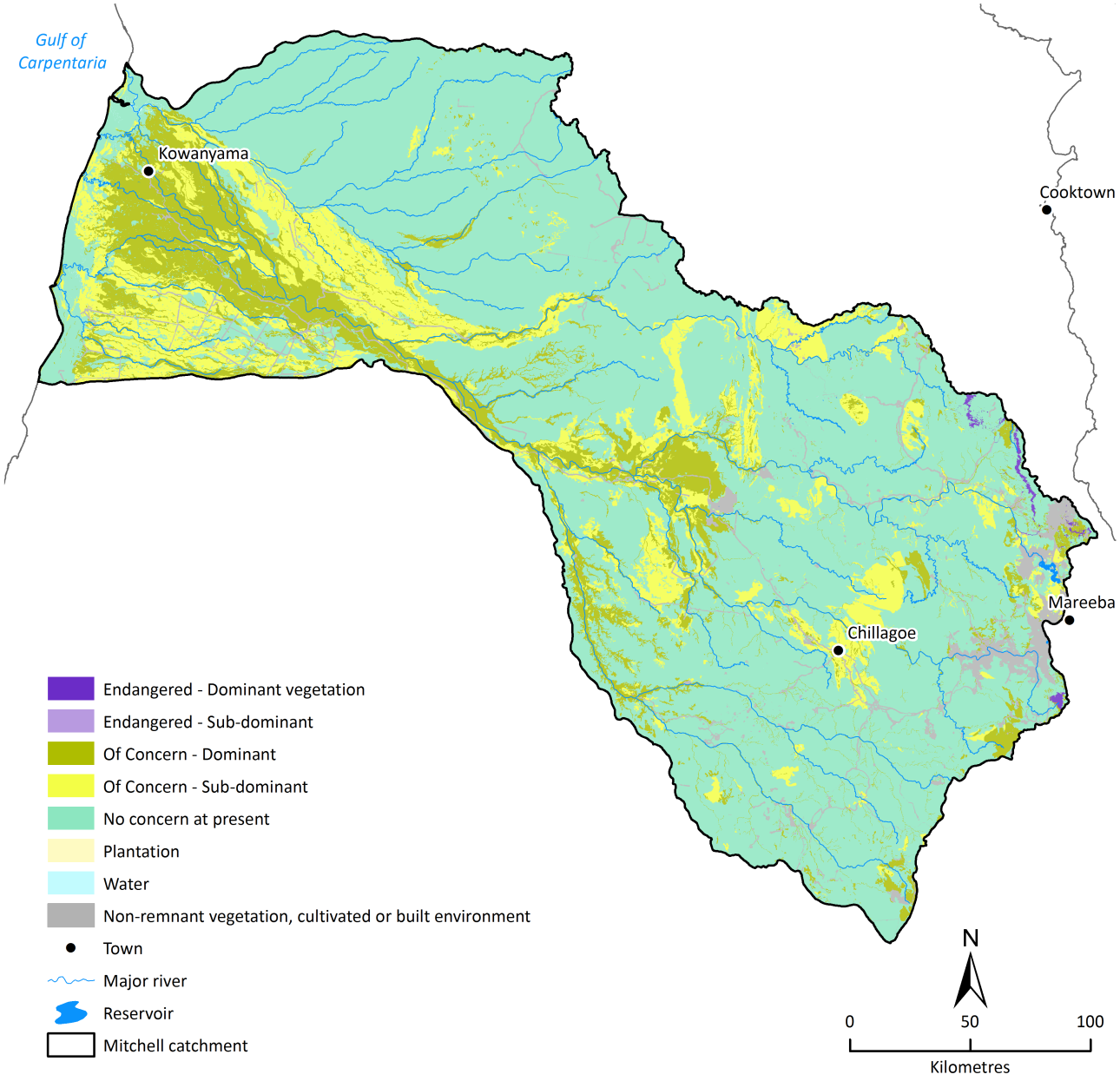

Figure 3-13 Regional ecosystem mapping in the Mitchell catchment
Source: Queensland Regional Ecosystem mapping (Queensland Herbarium, 2017).

3.3 Demographic and economic profile

3.3.1 INTRODUCTION

This section describes the current social and economic characteristics of the Mitchell catchment including the demographics of local communities (Section 3.3.1), current industries and land use (Section 3.3.2), and the existing infrastructure (transport, supply chains, utilities and community infrastructure) on which any new development would build (Section 3.3.3). Unless stated otherwise material for this section was sourced from the companion technical report on socio-economics (Stokes et al., 2017).

3.3.2 DEMOGRAPHICS

The Mitchell catchment encompasses a number of different local government areas, including most of the regions served by Kowanyama Aboriginal Shire Council and Mareeba Shire Council, in addition to the southernmost region of Cook Shire and the northernmost region of the Shire of Carpentaria. The Mitchell catchment is almost entirely contained within the Queensland state electorate of Cook. At the federal level, the northern part of the Mitchell catchment falls within the Leichhardt electorate while the southern part of the study area falls within the Kennedy electorate. The major settlements within the study area are Kowanyama, Chillagoe, Dimbulah, Mount Carbine and Mount Molloy. With the exception of Dimbulah (population 1050), all settlements had populations of less than 1000 as at the 2016 census.

The demographic profile of the Mitchell catchment, based on data from the 2016 and 2011 censuses, is shown in Table 3-4. The catchment is sparsely populated and has a population that predominantly earns lower incomes and is older than the national average. It has a larger proportion of males and a larger proportion of Indigenous people than is typical within the state and the country as a whole. Trends suggest these characteristics are strengthening. The total population of the study area is growing at a slower rate than that of the state and country overall. The median weekly gross household income in 2016 was $986, below the average for the state and only 69% of the average for Australia, although trends indicate this gap may be narrowing.

Table 3-4 Major demographic indicators for the Mitchell catchment

INDICATOR	UNIT	MITCHELL CATCHMENT	QUEENSLAND	AUSTRALIA
Total population, 2016†	number	6,365	4,703,193	23,401,892
Total population, 2011‡	number	6,045	4,332,735	21,507,719
% change in population	%	5.3	8.6	8.8
Indigenous population, 2016, as % of total§	%	25.8	4.0	2.8
Indigenous population, 2011, as % of total∗	%	25.6	3.6	2.5
Male population, 2016, as % of total†	%	57.6	49.4	49.3
Male population, 2011, as % of total‡	%	56.0	49.6	49.4
Population density, 2016†	people/km^2	0.1	2.7	3.0
Median age, 2016†	years	42	37	38
Change in median age, from 2011 to 2016‡,†	years	2	1	1
Median weekly gross household income, 2016††	$	$986	$1,402	$1,438
Change in median household income, from 2011 to 2016‡‡,††	%	18.2	13.5	16.5
Average people per household, 2016†	number	2.7	2.6	2.6
Change in average people per household, from 2011 to 2016‡,†	number	–0.3	No change	No change

†Data sourced from ABS (2016c).
‡Data sourced from ABS (2011c).
§Data sourced from ABS (2016a).
∗Data sourced from ABS (2011a).

†† Data sourced from ABS (2016b).
‡‡ Data sourced from ABS (2011b).

Socio-Economic Indexes for Areas (SEIFA) scores, which provide measures of socio-economic advantage and disadvantage, indicate that the Mitchell catchment is relatively disadvantaged compared to the rest of the country (Table 3-5). The study area falls within the lowest 30% for three of the SEIFA measures.

Table 3-5 SEIFA scores of relative socio-economic advantage for Mitchell catchment
Scores are relativised to a national mean of 1000, with higher scores (smaller deciles) indicating greater advantage.

INDICATOR	MITCHELL CATCHMENT		QUEENSLAND	
	Score	(Decile)	Score	(Decile)
Index of Relative Socio-economic Advantage and Disadvantage†	928	(3)	996	(5)
Index of Relative Socio-economic Disadvantage‡	938	(3)	1,000	(5)
Index of Economic Resources	951	(3)	1,002	(5)
Index of Education and Occupation	944	(4)	980	(5)

†Based on both the incidence of advantage and disadvantage.
‡Based purely on indicators of disadvantage. Data sourced from ABS (2011e).

3.3.3 CURRENT INDUSTRIES AND LAND USE

New agricultural development could affect current land users and other industries that rely on natural resources. This section describes current agriculture and fisheries industries in the study area, and the other land uses and industries that might be impacted by new development projects.

Employment

The overall unemployment rate in the Mitchell catchment is significantly above that seen in the state, which itself is higher than the rate for the country as a whole (Table 3-6), reinforcing the view that the Mitchell catchment is a region of relative socio-economic disadvantage. According to census data, the rate of unemployment increased considerably from 2011 to 2016. There are noticeable differences in the industries providing the most jobs within the Mitchell catchment compared to both Queensland and Australia as a whole. While 'Education and training', 'Healthcare and social assistance', and 'Construction', are important employers in the study area and nationally, 'Retail trade' and 'Professional, scientific and technical services', which both feature within the top five industries by employment across the nation, are less significant within the Mitchell catchment. Instead, 'Agriculture, forestry and fishing' and 'Accommodation and food services' are far more important, employing almost one-third of the workforce in the catchment. These important differences have a significant impact on the regional economic benefits that can result from development projects initiated within the study area (see Section 6.5).

Table 3-6 Key employment data in the Mitchell catchment in relation to state and national means

EMPLOYMENT STATISTIC	MITCHELL CATCHMENT	QUEENSLAND	AUSTRALIA
Unemployment rate (%), 2016†	11.2	7.6	6.9
Unemployment rate (%), 2011‡	6.3	6.1	5.6
Major industries of employment – top five industries % of employment for each location†			
Agriculture, forestry and fishing	31.8	na	na
Education and training	9.3	9.4	9.1
Public administration and safety	8.6	na	na
Health care and social assistance	8.3	13.5	13.2
Construction	7.5	9.4	8.9
Retail trade	na	10.4	10.3
Accommodation and food services	na	7.7	na
Professional, scientific and technical services	na	na	7.6

†Data sourced from ABS (2016b).
‡Data sourced from ABS (2011b).
na = not applicable (only the top five industries are provided for each location).

Land use

Grazing is the overwhelming dominant land use (95.1%) in the Mitchell catchment (Figure 3-14; Figure 3-15). Approximately 90% of the catchment is under various forms of leasehold tenure, with most being pastoral leasehold. The remainder of the study area is mainly classified as conservation (2.9%), with 1052 km^2 falling within national parks and wetlands (1.6%), which are located in the delta at the bottom of the study area. There are some small areas of dryland (6000 ha) and intensive agriculture (19,000 ha) on the eastern margins of the Mitchell catchment, where it overlaps with the edge of the Mareeba–Dimbulah Water Supply Scheme (MDWSS).

Figure 3-14 Loading cattle onto Type 2 road trains
Photo: CSIRO.

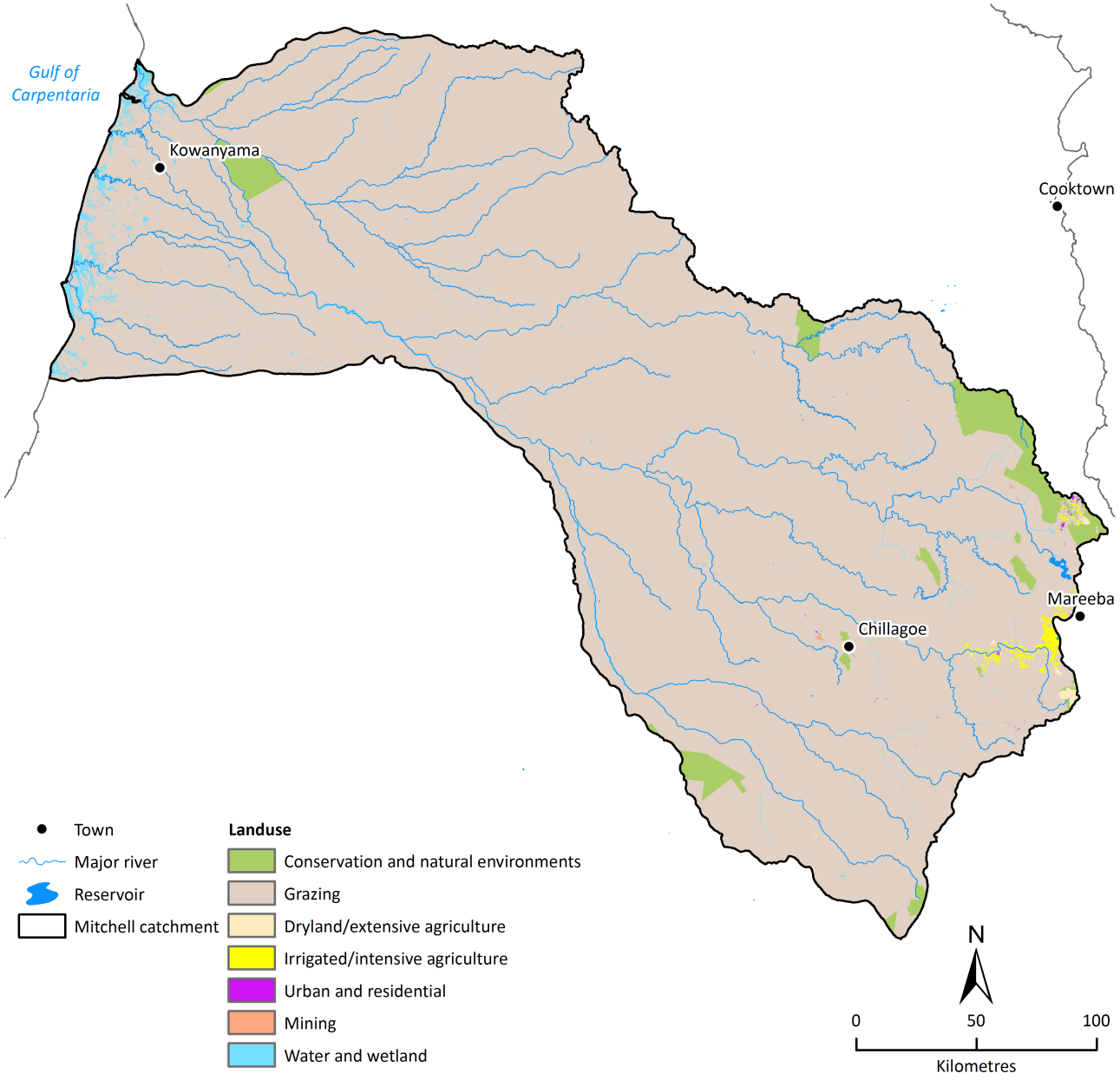

Figure 3-15 Land use classification for the Mitchell catchment
Source: ABARES (2016) Australian Land Use Classification, simplified following Stokes et al. (2017).

Agriculture and fisheries

Agriculture is the largest contributor to the economy of the Mitchell catchment, where the total gross value of agricultural production (GVAP) in 2015–16 was approximately $225 million (ABS, 2017). Livestock commodities ($130 million) account for just over half of the total GVAP, dominated by the beef industry ($117 million), which has been aided by recent large increases in cattle prices. Poultry contributed a further $13 million in 2015–16. Cropping accounted for $95 million, with the largest contributors being mangoes ($29 million), sugarcane ($17 million) and avocados ($14 million) (Note that confidentiality deletions affect subtotals in this GVAP data, so industry values are lower-bound estimates. This is particularly likely to be the case where there are only a few businesses in a category.). Across the Mitchell catchment, agriculture accounts for approximately 32% of employment (Table 3-6).

Grazing industry in the Mitchell catchment

The Mitchell catchment supports a variety of agricultural enterprises but agricultural production is dominated by extensive grazing of beef cattle on leasehold land. Beef production systems are based on dryland native and naturalised pastures that are constrained in quality and quantity by the region's climate and soils. Rainfall is highly seasonal (Section 2.4), there is great variation between years in the amount of rain received and the soils are typically of low fertility. These factors dictate that overall cattle carrying capacity is low (one animal per 10 to 20 ha) and they strongly influence the kinds of beef enterprises that can be conducted within the Mitchell catchment. The relatively remote nature of much of the Mitchell catchment also limits the kinds of markets that can be accessed by the region's beef enterprises. In spite of these constraints, the catchment carries approximately 185,000 head of cattle.

Low productivity per hectare and per animal means that properties need to be reasonably large, ranging from around 10,000 ha in the east of the catchment to over 500,000 ha in the west. Productivity levels and market access dictate that most beef enterprises are centred on cow-calf breeding operations rather than fattening of animals. They typically turn off weaners (120 to 160 kg) or yearling animals (250 to 350 kg) that are sold to operations in more fertile areas further south in Queensland. Yearling animals are also exported live to Asia. While recent cattle prices for livestock have led to optimism in the beef sector, the decade up to 2015 showed cattle properties in the Gulf region of Queensland making regular losses with declining equity (see the companion technical report on agriculture viability in the Mitchell catchment (Ash et al., 2018)).

Pasture production occurs mostly in the December to April period, where plant growth rates can be very high. Almost no pasture production occurs over the remainder of the year. A future irrigation development in the Mitchell catchment could strengthen the northern Australia beef industry by complementing the production of beef cattle, predominantly from extensive dryland grazing, with locally grown irrigated forages (Section 4.4). Greater diversity of markets would assist the industry, and this would be facilitated by the continued supply of higher quality beef for the domestic market (Gleeson et al., 2012).

Existing irrigation in the Mitchell catchment and the Mareeba–Dimbulah Water Supply Scheme

Irrigated agriculture in the Mitchell catchment is at present largely confined to the very east of the catchment in the Upper Walsh River (MDWSS) and in the upper Mitchell catchment, north of Mareeba in the Julatten area. In the late 1800s and early 1900s farming in the Mareeba–Dimbulah area was based on vegetables, maize, fruit and cattle, with tobacco becoming a successful crop some years later in 1928 (SunWater, 2018). Due to the challenges of growing dryland tobacco in the area, the Queensland Irrigation and Water Supply Commission built eight weirs on local rivers in the late 1940s and early 1950s, which permitted limited irrigation development (Griggs, 2002). However, it soon became clear that expansion of the industry would require considerably more water for irrigation. In 1953 construction of Tinaroo Falls Dam (Section 5.3) commenced and was completed in 1958. The primary purpose of the dam was to supply water to the MDWSS, originally known as the Mareeba–Dimbulah Irrigation Area (MDIA), largely to support an expansion of the tobacco industry. With the demise of the tobacco industry, irrigated agriculture in the MDWSS is now dominated by mangoes, bananas, avocados, sugarcane and a range of other tree, field and horticultural crops. The MDWSS currently irrigates an area of about 22,690 ha, around two-thirds

of which lies within the Mitchell catchment. This represents about 0.2% of the total area of the Mitchell catchment.

Northern Prawn Fishery

The Northern Prawn Fishery (NPF) spans the northern Australian coast between Cape Londonderry in WA to Cape York in Queensland (Figure 3-16). It is one of the most valuable fisheries in the country and is managed by the Australian Government (via the Australian Fisheries Management Authority) through input controls such as gear restrictions (i.e. number of boats and nets, length of nets) and restricted entry. The two most productive NPF regions – the Mitchell and Karumba NPF regions (Figure 3-12) – are located near the mouth of the Mitchell River and together account for about half of the total annual NPF prawn catch. Like many tropical fisheries, the target species exhibit an inshore/offshore larval life cycle and are dependent on inshore habitats, including estuaries, during the postlarval and juvenile phase (Vance et al., 1998). Monsoon-driven freshwater flood flows cue juvenile prawns to emigrate from estuaries to the fishing grounds and flood magnitude explains 30% to 70% of annual catch variation, depending on catchment region (Buckworth et al., 2014; Vance et al., 2003).

Initially consisting of over 200 vessels in the late 1960s, the number of vessels in the NPF has reduced to just 52 trawlers and 19 licensed operators after management initiatives, including effort reductions and vessel buy-back programs (Dichmont et al., 2008). Fishing activity for banana and tiger prawns, which constitute 80% of the catch, is also limited to two seasons: a shorter banana prawn season between April to June, and a longer tiger prawn season from August to November. The specific dates of each season are adjusted depending on catch rates. Banana prawns generally form the majority of the annual prawn catch by volume. Key target and by-product species are detailed by Woodhams et al. (2011).

The catch is often frozen on-board and sold in domestic and export markets. The catch from the NPF was valued at $106.8 million in 2015 by the Australian Fisheries Management Authority (AFMA, http://www.afma.gov.au/fisheries/northern-prawn-fishery). Given recent efforts to alleviate fishing pressure in the NPF, there is little opportunity for further expansion of the industry.

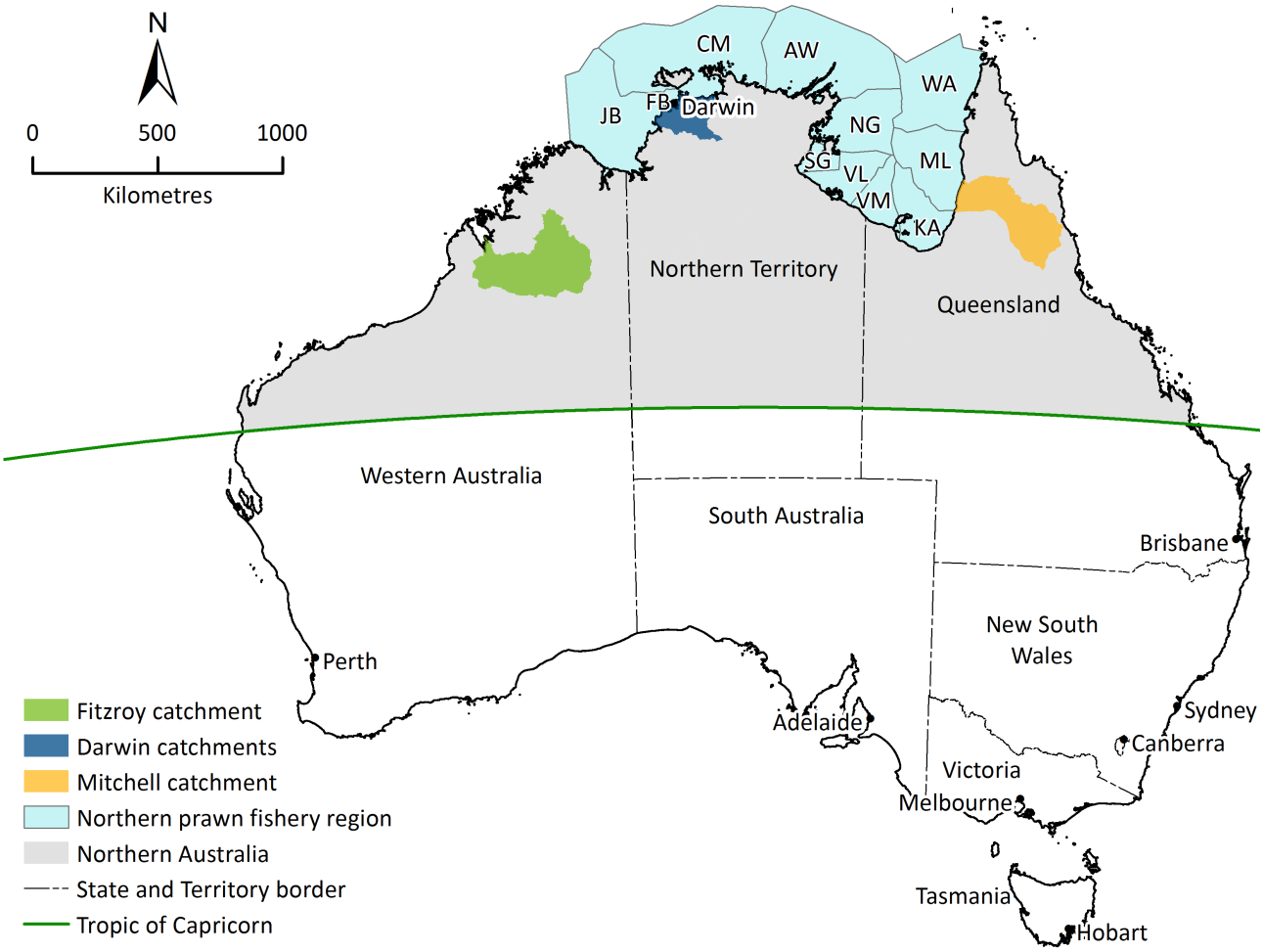

Figure 3-16 Map of regions in the Northern Prawn Fishery (NPF)
The regions in alphabetical order are Arnhem-Wessels (AW), Cobourg-Melville (CM), Fog Bay (FB), Joseph-Bonaparte Gulf (JB), Karumba (KA), Mitchell (ML), North Groote (NG), South Groote (SG), Vanderlins (VL), Weipa (WA), West-Mornington (WM). Source: Dambacher et al. (2015).

Land-based aquaculture in the Mitchell catchment

Land-based aquaculture in the Mitchell catchment is limited (Irvin et al., 2018). Two small red claw (freshwater crayfish) farms are located near Mareeba in the eastern part of the Mitchell catchment. A recent national-scale assessment (Preston et al., 2015) identified 594,000 ha of coastal land that could potentially be suitable for tropical land-based aquaculture in Queensland. Barramundi and tiger prawns were identified as established species suitable for aquaculture in this study area. Potential opportunities for land-based aquaculture in the Mitchell catchment are discussed in Section 4.6.

Tourism

Tourism contributed $52.9 billion (3.2% of GDP) to the Australian economy in 2015–16 (ABS Tourism satellite accounts, 2015–16). International visitors account for 29% of this total contribution to GDP, with the remainder generated by domestic day and overnight stay visitors. The countries providing the largest numbers of international visitors are New Zealand (NZ), China, the United Kingdom (UK) and United States of America (USA).

Of the 76 tourism regions for which Tourism Research Australia collects data, the 'Tropical North Queensland' (TATNQ) tourism region is most relevant to the Mitchell catchment. For some of the data, tourism regions can be further broken down into smaller ABS SA2 regions. The relevant ABS region for the Mitchell catchment is 'Tablelands' which covers approximately half of the Mitchell catchment. Much of the remainder of the Mitchell catchment falls within the 'Kowanyama-Pormpuraaw' SA2 ABS region; however, visitors to that region were not surveyed, so no such data are available. The boundaries of the Mitchell catchment, TATNQ tourism region, and smaller Tablelands SA2 region are shown in Figure 3-17.

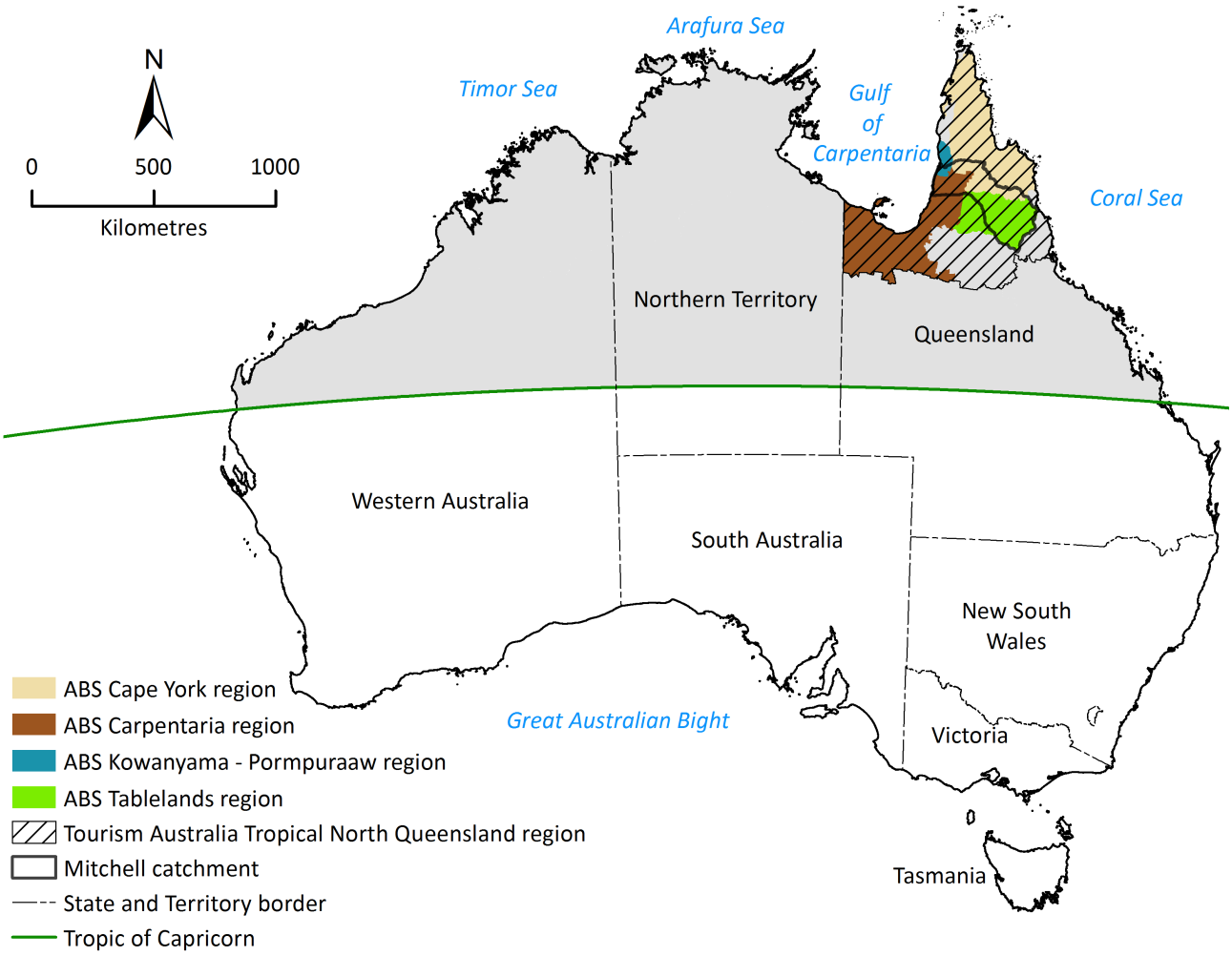

Figure 3-17 Tourism Research Australia and ABS statistical regions relevant to the Mitchell catchment
The smaller ABS Tablelands region falls within the Tropical North Queensland tourism region.

Recognised as one of the key natural tourism regions within the country, over 5 million people visit TATNQ per year (Table 3-7 but see Table 3-7 footnote, §§, for definition of a 'visitor'). However, the prime tourist attractions within the TATNQ tourism region, such as the Great Barrier Reef and rainforests, mainly fall outside the Mitchell catchment. A substantial proportion of the visitors are international, reflecting the major international airport at Cairns, with direct flights to a number of countries, including several regions within China. This is reflected in the top three countries of residence of visitors to the region, with China providing the most, followed by the USA and UK. The TATNQ tourism region also receives many day visitors drawn from elsewhere within Queensland, and the average length of stay for those visitors who stay overnight is around the

average for the state and for the country as a whole. However, the average spend per visitor, at $688, is larger than the average for the state or country.

There appears to be substantial capacity for additional visitors within the tourism region as there are fairly low room occupancy rates (Table 3-7). Even during the peak tourism period (July to September) there remains surplus accommodation capacity in the region.

Table 3-7 Key 2015 tourism data relevant to the Mitchell catchment
The extent of the Tropical North Queensland tourism region is shown in Figure 3-13.

TOURISM STATISTIC	TROPICAL NORTH QUEENSLAND	QUEENSLAND	AUSTRALIA
Visitors (thousands)†,‡,§§	5,281	58,691	266,874
International visitors (% visitors)†,‡,§§	15	4	3
Domestic day visitors (% visitors)†,‡,§§	45	62	66
Visitor nights (thousands)†,‡	16,930	131,214	560,116
International visitor (% visitor nights)†,‡	40	39	43
Average stay per overnight visitor (number of nights)†,‡	6	6	6
Spend ($ million)†,‡	$3,632	$22,977	$99,086
Average spend per visitor ($)†,‡	$688	$392	$371
International visitors (% spend)†,‡	28	20	23
Room occupancy rate 2015–16 for hotels, resorts, motels, guest houses and serviced apartments§,‡‡	64.6%	62.7%	66.0%
Top three/four countries of origin for international visitors†,*	China, USA, UK	NA	NZ, China, UK, USA
Number of tourism businesses in region†,††	3,658	51,276	273,512

†Tourism region data sourced from Tourism Region Profiles Demand 2015, https://www.tra.gov.au/tra/2016/Tourism_Region_Profiles/Region_profiles/index.html#.
‡State, territory and national data sourced from International Visitor Survey Results to Sept 2015, https://www.tra.gov.au/Research/International-visitors-to-Australia/international-visitor-survey-results, and from National Visitor Survey Results to Sept 2015, https://www.tra.gov.au/Research/Domestic-tourism-by-Australians/National-Visitor-Survey-results.
§ Region, state and territory data sourced from ABS Tourist Accommodation, Australia, 2015–16, http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/8635.02015-16?OpenDocument.
∗National data sourced from International Visitor Survey Results to Sept 2015, https://www.tra.gov.au/Research/International-visitors-to-Australia/international-visitor-survey-results.
††State, territory and national data sourced for June 2015 from https://www.tra.gov.au/Research/View-all-publications/All-Publications/Economic-reports/tourism-businesses-in-australia-june-2011-to-june-2015.
‡‡National data sourced from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/8635.02015-16?OpenDocument.
§§ Domestic 'visitors' represent the number of trips recorded in the National Visitor Survey†,‡ where trip types include (domestic) overnight trips, (domestic) day trips and outbound (international) trips. Some routine trips, such as same-day journeys to work, are excluded. International 'visitors' represents the number of short term travellers to Australia from overseas†,‡,∗.
NA = no available data.

As a rural and fairly remote area, much of the appeal of the TATNQ tourism region to visitors lies in the natural beauty of the environment and in the associated Indigenous cultural values of the land. The tourism region includes a wide range of protected areas, including nature reserves, conservation areas, and both state-managed and Indigenous co-managed national parks. Surveys of visitors indicate that bush walking and visiting national or state parks are among the most popular tourist activities (Stokes et al., 2017). The key attractions of this tourism region are the Great Barrier Reef and the Wet Tropics World Heritage Areas, listed in 1981 and 1988 respectively. Within the Mitchell catchment there are a number of protected areas that attract tourists, including all or part of the Daintree, Chillagoe–Mungana Caves, Forty Mile Scrub, Hann Tableland,

Undara Volcanic, Bulleringa, Mowbray, Kuranda, Mount Windsor, Mount Spurgeon and Mount Lewis National Parks, Kowanyama Indigenous land, and the Errk Oykangand Aboriginal National Park. Eco-cultural tourism based on a combination of natural and cultural values is an important development aspiration for local and regional development agencies.

Mining

Following WA, Queensland is the second-largest contributor to Australian mining industry jobs and revenue. However, the contribution of the Mitchell catchment to the total mining industry jobs and revenue in Queensland is negligible. In terms of employment by industrial sector, the Mitchell catchment supplied less than 0.5% of workers in the Queensland mining sector (ABS, 2011) (Table 3-8). Based on 2011 census data, the mining industry was the eighth most important industry within the study area (out of 19 industries).

Table 3-8 Key statistics relating to the mining industry in the Mitchell catchment

EMPLOYMENT STATISTIC	MITCHELL CATCHMENT	QUEENSLAND	AUSTRALIA
Numbers employed in mining, Census 2016†	66	49,997	177,640
Numbers employed in mining, Census 2011‡	205	52,952	176,560
Sales and service income of mining sector*, 2014–2015§	NA	$37,413 million	$195,519 million
% Employment within mining sector:			
Census 2016†	3.2	2.4	1.7
Census 2011‡	4.3	2.7	1.8

∗Mining sector is defined as coal mining, oil and gas extraction, metal ore mining, non-metallic mineral mining and quarrying; it does not include exploration and other mining support services.
†Data sourced from ABS (2016b).
‡Data sourced from ABS (2011b).
§Data sourced from ABS (2015).
NA = no available data.

The mining industry currently has a footprint covering less than 0.5% of the land within the Mitchell catchment, however, there are a number of mining exploration licenses in place, covering just over 20% of the land area, indicating the potential for further mining operations in the future (Figure 3-18).

The eastern-most third of the Mitchell catchment (around the towns of Chillagoe and Mount Garnet) holds promise for a number of commodities, hosting considerable economically exploitable mineral resources, predominantly tin, gold and copper.

Substantial alluvial tin was mined from the late 1800s to the late 1900s around Mount Garnet, however, current exploration is more focused on locating granite-hosted (‘hard rock’) tin resources. There are still numerous medium-scale tin mining operations in the Mitchell catchment, mainly near Mount Garnet but also south of Chillagoe and near Mount Carbine to the north.

Copper and other base metals (e.g. zinc, lead) are mainly found around Chillagoe. Although the area is past its prime, there are still several mines in operation (e.g. Mungana and Red Dome, north-west of Chillagoe) and exploration is still active. Based on current mining activity it is considered likely that relatively modest discoveries of base metals will be made in the future.

Figure 3-18 shows a considerable number of gold 'occurrences' between Mareeba and the Palmer River. However, the majority of these occurrences are classified as 'very small' and are mostly alluvial deposits. No gold mines are operating at present in the Mitchell catchment and it is likely that the alluvial gold resources have largely been excavated and are currently economically unviable to source (the Palmer River was the site of a gold rush in the late 19th century).

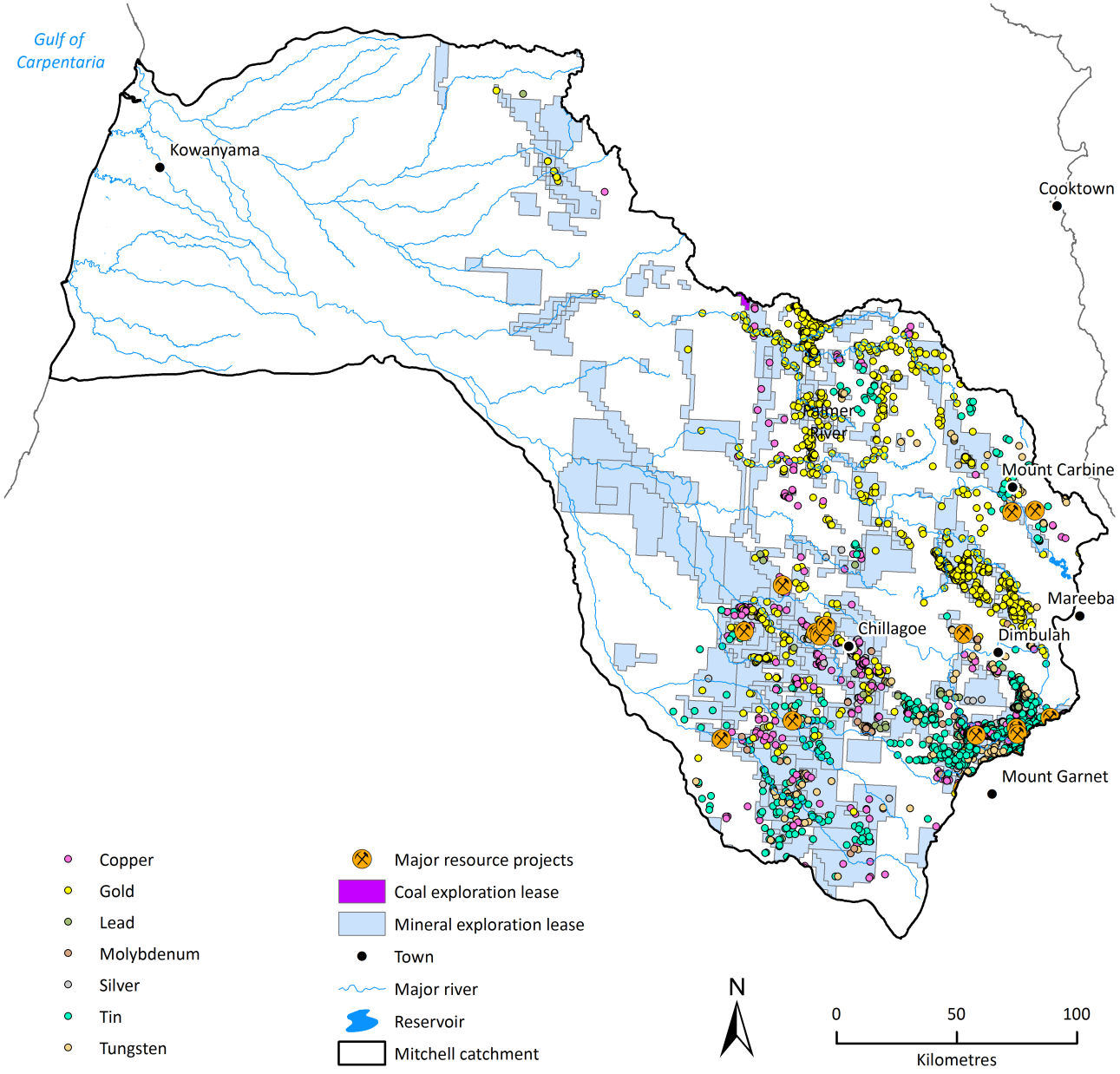

Figure 3-18 Mineral commodities (occurrences), major mines (active medium or larger occurrences) and exploration tenements in the Mitchell catchment

Exploration tenements are parcels of land on which a company has rights to explore for specific resources (e.g. minerals, coal or petroleum (oil and/or gas)).

The western two-thirds of the Mitchell catchment has negligible economic potential for mining.

There are no active hydrocarbon exploration leases in the Mitchell catchment. This is mainly due to the fact that the geological Carpentaria Basin (Figure 2-2) is relatively juvenile and there are no suitable source rocks deposited in the basin (e.g. organic-rich shales) within which hydrocarbons could form over geological time frames. There is one coal exploration lease, which straddles the edge of the north of the catchment, but in general the study area is not prospective for coal.

Furthermore, there are no geothermal leases, mostly likely due to a lack of deep crustal radiogenic rock at depth, coupled with the remoteness of the majority of the catchment.

3.3.4 CURRENT INFRASTRUCTURE

Existing infrastructure in the Mitchell catchment provides a base from which any future development could build. Current infrastructure is described below in terms of transport, supply chains and processing facilities, energy and water services, and community facilities. Costs of new infrastructure are discussed in Section 6.3.

Transport

The Mitchell catchment is characterised by a sparse road network (Figure 3-19; Figure 3-20) with the Burke Development Road being the main access to Mareeba and Cairns in the east and to Normanton and Cloncurry in the south. Burke Development Road is unsealed west of Chillagoe, with the sealed section linking with the Kennedy Highway to the east. All of the roads connecting the north and east of the Mitchell catchment are minor roads. These roads involve several creek crossings with limited or no causeway or bridge infrastructure. As a result, access to Kowanyama is often not possible during the wet-season months of December to February. The travel distances from Kowanyama to the nearest ports are 607 km to Cairns, to the east, and 372 km to the Port of Karumba, to the south. While Karumba has been used for livestock export, it does not have dry bulk storage required for other agriculture exports.

Figure 3-19 Creek crossings often have limited or no causeway and no bridge infrastructure
Photo: Nathan Dyer

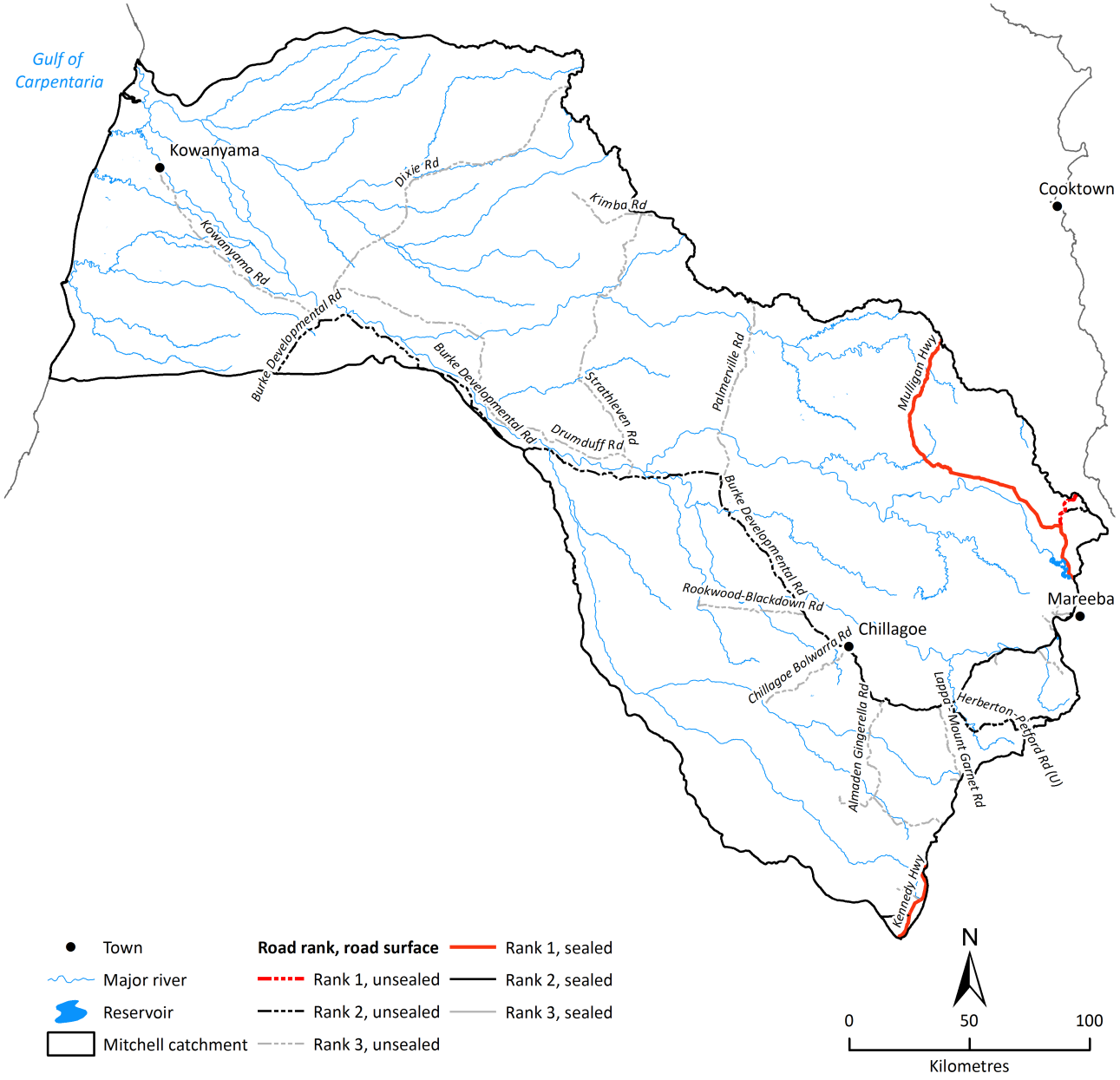

Figure 3-20 Road rankings and conditions for the Mitchell catchment
Rank 1 = well-maintained highways or other major roads, usually sealed; Rank 2 = secondary 'state' roads; Rank 3 = minor routes, usually unsealed local roads.

Figure 3-21 shows the heavy vehicle access restrictions for roads within the Mitchell catchment, as per the National Heavy Vehicle Regulator. All of the western part of the study area permits Type 2 road trains, which are vehicles up to 53 m in length, typically a prime mover pulling three 40-foot trailers (Figure 3-22). Despite the poorer road conditions in the north and west of the Mitchell catchment, these large road trains are permitted due to minimal safety issues from low traffic volumes and minimal road infrastructure restrictions (e.g. bridge limits, intersection turning safety). The sealed roads to the east and near Mareeba are limited to Type 1 road trains (36 m length restriction) and B-doubles (26 m). Transport to Cairns is limited to semitrailer access through the Atherton Tablelands with a detour B-double access via the Palmerston Highway. The Port of Karumba and towns along the Flinders Highway to the south are accessible using Type 2 road trains.

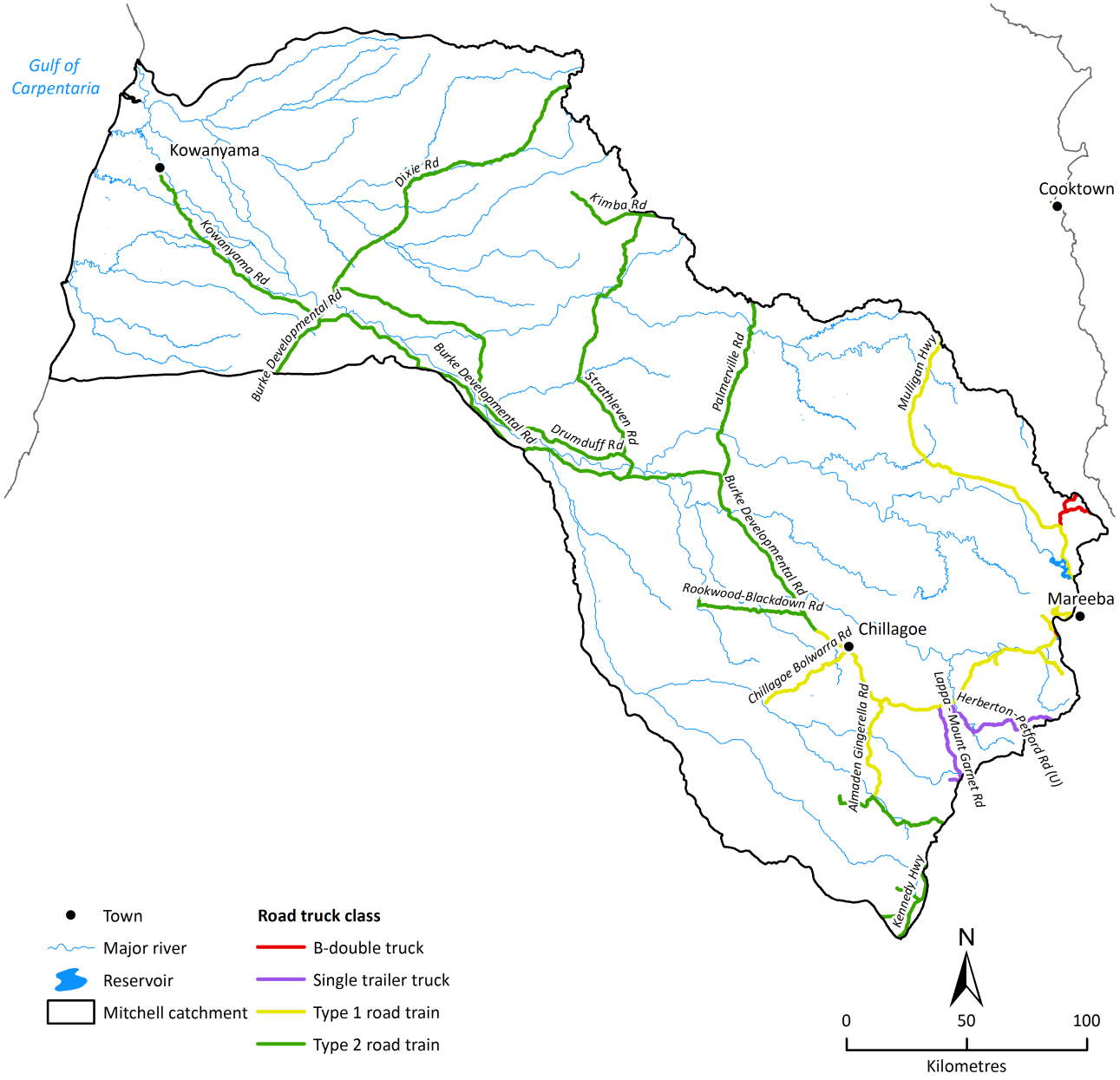

Figure 3-21 Vehicle access restrictions for the Mitchell catchment
Truck classes listed from shortest to longest in legend, as shown in Figure 3-22.

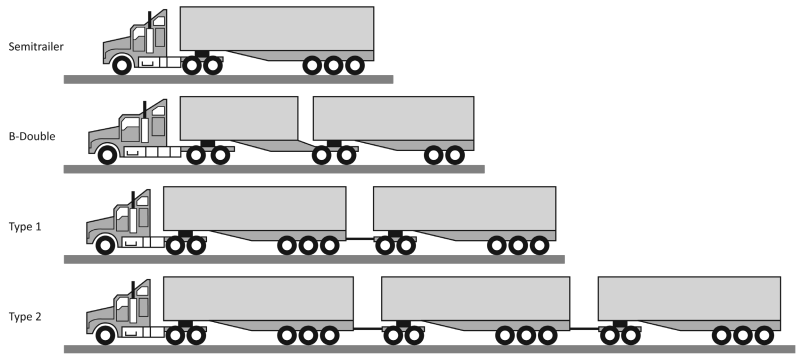

Figure 3-22 Typical vehicle combinations used for agriculture transport in Australia

Figure 3-23 shows the speed limits for the road network within the Mitchell catchment. These speed limits are usually higher than the average speed achieved for freight vehicles, particularly on

unsealed Rank 2 and 3 roads. Heavy vehicles using such unsealed roads would usually achieve average speeds of no more than 60 km/hour, often as low as 30 km/hour when transporting livestock. The travel time from Kowanyama to Cairns is about 11 hours.

Kowanyama is often inaccessible from Mareeba between December and February due to the wet season, when the key route (Kowanyama to Dunbar Road) closes due to flooding.

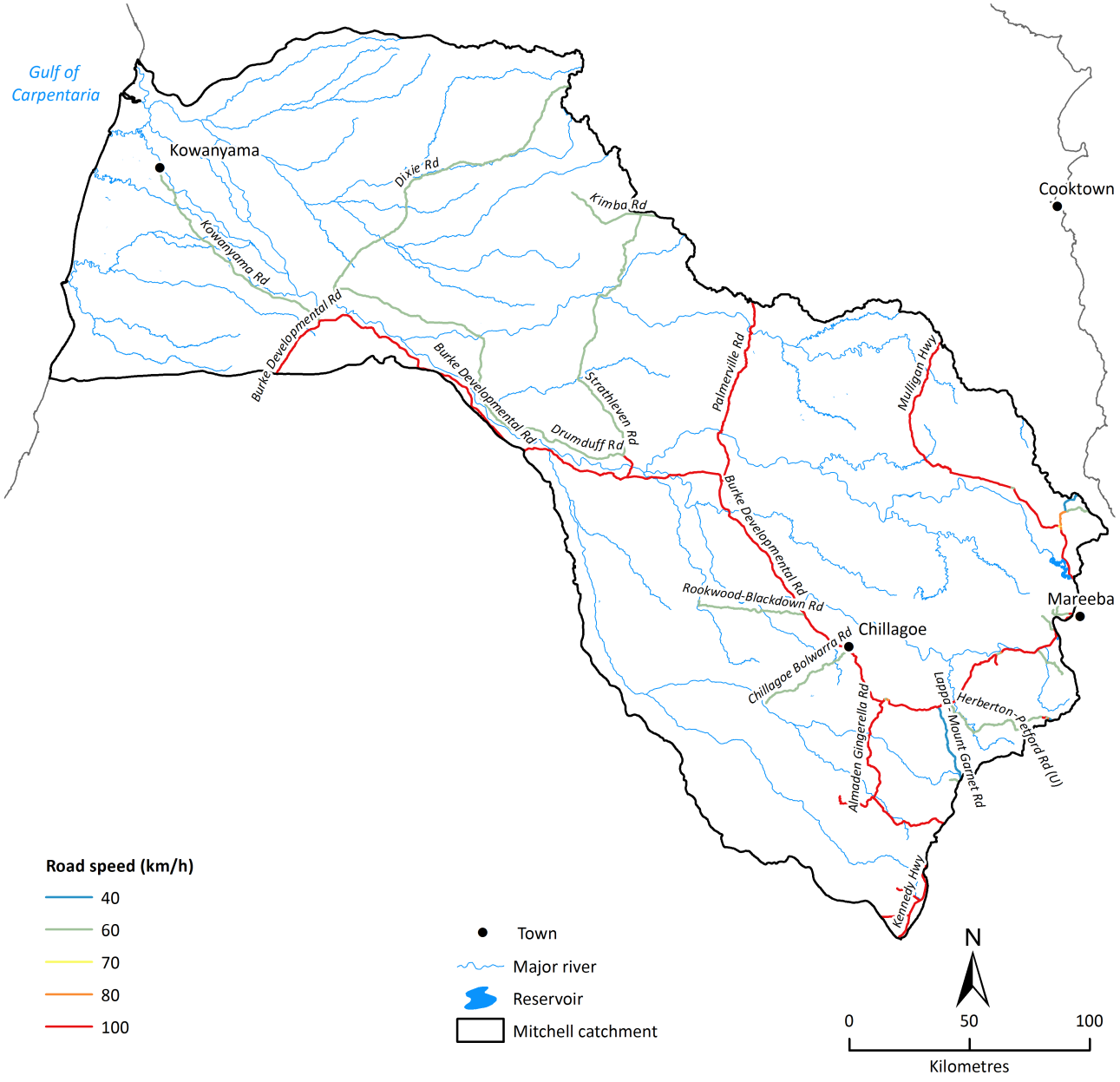

Figure 3-23 Road speed restrictions for the Mitchell catchment

While road closure data was not available, discussions with the Carpentaria Shire Council indicated the road is usually blocked during the wet season from December onwards, but can be cut from November and inaccessible for up to three months. Data on the location of road closures was not available, although roads have usually been inaccessible at creek crossings and causeways.

There is no rail infrastructure in the Mitchell catchment that can be used for freight transport (Figure 3-24), as the Queensland Rail network on the Atherton Tablelands has been progressively closed from 1958 to 2013, with the latest closure between Mareeba and Atherton. The nearest rail links are along the Townsville to Mount Isa rail line, to the south, or the north coast rail line, to the

east. These lines have high axle load limits and large crossing loops for efficient rail transport. A tourist train operates from Cairns to Atherton, but is currently unsuitable for heavy or regular freight movements. An alternative is air freight out of Kowanyama (via Skytrans or Hinterland Aviation chartered flights), which may provide backloading capacity to cater for high value agriculture/aquaculture transport to Cairns. However, this capacity is limited to a few tonnes per week given the low frequency of service and use of small planes. It would also require additional cold or dry storage near the airport as well as loading/unloading, which would be low cost given the volumes transported. Airfreight would be an alternative when access from Kowanyama to the Burke Development Road is cut during the wet season.

Supply chains and processing

Outside of the Atherton Tablelands, agricultural production is currently limited to low intensity cattle grazing (Figure 3-25). The road network shows low volumes of annual truck movements in these areas. Beef cattle in the Mitchell catchment are primarily transported to live export and abattoirs, with some transported to feedlots or saleyards in Mareeba. The closest port, the Port of Kurumba, exports fewer than 20,000 head per year, while Townsville exported around 200,000 head in 2015. JBS Swift Australia Meat Works at Stuart is the nearest major meat processing facility, approximately 400 km from Mareeba. There has been some feedlotting on the Atherton Tablelands, although cattle are usually transported south to feedlots closer to the major abattoirs. There is no cotton production in the Mitchell catchment and the nearest cotton gin (Emerald) is 995 km from Mareeba.

Figure 3-24 There is no rail infrastructure in the Mitchell catchment that can be used for freight transport
Photo: CSIRO

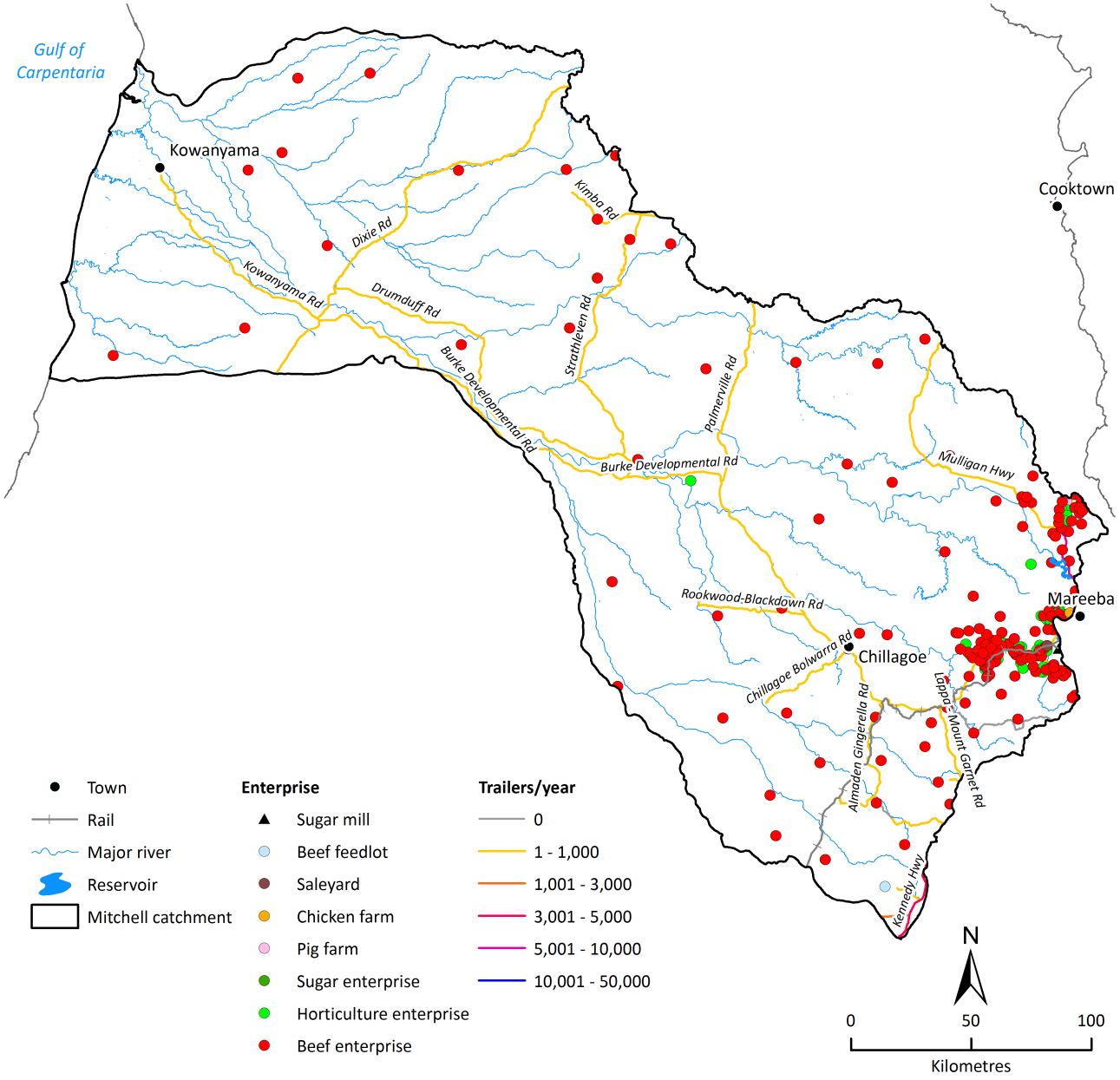

Figure 3-25 Agricultural enterprises in the Mitchell catchment
Roads are colour-coded to show the number of trailers per year of agricultural produce transported along them.

On the eastern border of the catchment on the Atherton Tablelands, annual agricultural produce includes 372,000 chickens (Table 3-9), about 20,000 t of grain, and 800,000 t of sugar transported to Tableland Mill per year. Many of the supply chains are split across the eastern boundary of the Mitchell catchment. For example, the chicken broiler farms are east of the catchment while the processing plant is marginally inside. There is also a diversity of horticultural production on the eastern border of the Mitchell catchment. Cairns is the nearest airport with export air freight capacity, and opportunities for horticulture air freight from these major regional airports is currently being evaluated in a separate project (Hort Innovation AM16012: Study of airfreight capacity for Australian horticulture exports to Asia and the Middle East).

Table 3-9 Overview of agricultural commodities transported into and out of the Mitchell catchment
Prices for horticultural produce can vary substantially over time, which in turn can affect what farmers choose to grow.

COMMODITY	DESTINATION	INBOUND	OUTBOUND	INDICATIVE PRICES ($/kg)
Beef (head)	Live export	0	0	2.70
	Abattoirs	0	2400	2.68
	Property	13,400	21,600	2.15
	Feedlots	1,680	240	2.60
	Other	10,320	9,360	NA
Sugar (t)	Mill	805,000	169,000	0.42
	Export		125,995	0.42
Grains (t)		20,831	0	NA
Chicken (head)		0	372,986	NA
Bananas (t)		0	14,986	1.92
Mango (t)		0	2,962	3.14
Oranges (t)		0	88	NA
Mandarins (t)		0	61	NA
Pumpkins (t)		0	2,454	0.75
Potatoes (t)		0	295	NA
Onions (t)		0	10	0.45
Lettuce (t)		0	43	NA
Pineapples (t)		0	3,592	NA

NA = not available

Energy

In terms of energy supply, the Mitchell catchment is served by the Tablelands regional distribution network (sometimes abbreviated to the Tablelands network/grid) in the 'Far North: Tablelands' Ergon planning area (Figure 3-26) (QDNRM, 2017; EQL, 2016). This distribution network is centred on the major rural towns of Atherton and Mareeba and includes the smaller rural communities of Malanda, Millaa Millaa, Ravenshoe, Mount Molloy, Dimbulah and Chillagoe. The coastal communities of Mossman, Port Douglas and Cooktown are also supplied from the Tablelands network. The network is served from the one 132/66 kV connection point to the National Electricity Market (NEM: the wholesale market of the major national transmission network covering the east of Australia), the T55 Turkinje substation located about 8 km south of Mareeba. The Tablelands system consists of a 66 kV sub-transmission network, a dual circuit 132 kV transmission line from Turkinje to the Craiglie 132/22 kV zone substation near Port Douglas, and a single circuit 132 kV line to the Lakeland 132/66/22 kV substation that supplies the Cooktown area (Ergon Energy, 2017). Energy Queensland Limited (EQL, formerly Ergon Energy and Energex), the state-owned energy utility company, manages this regional electricity distribution network, as well as most of the energy grid for Queensland (EQL, 2016).

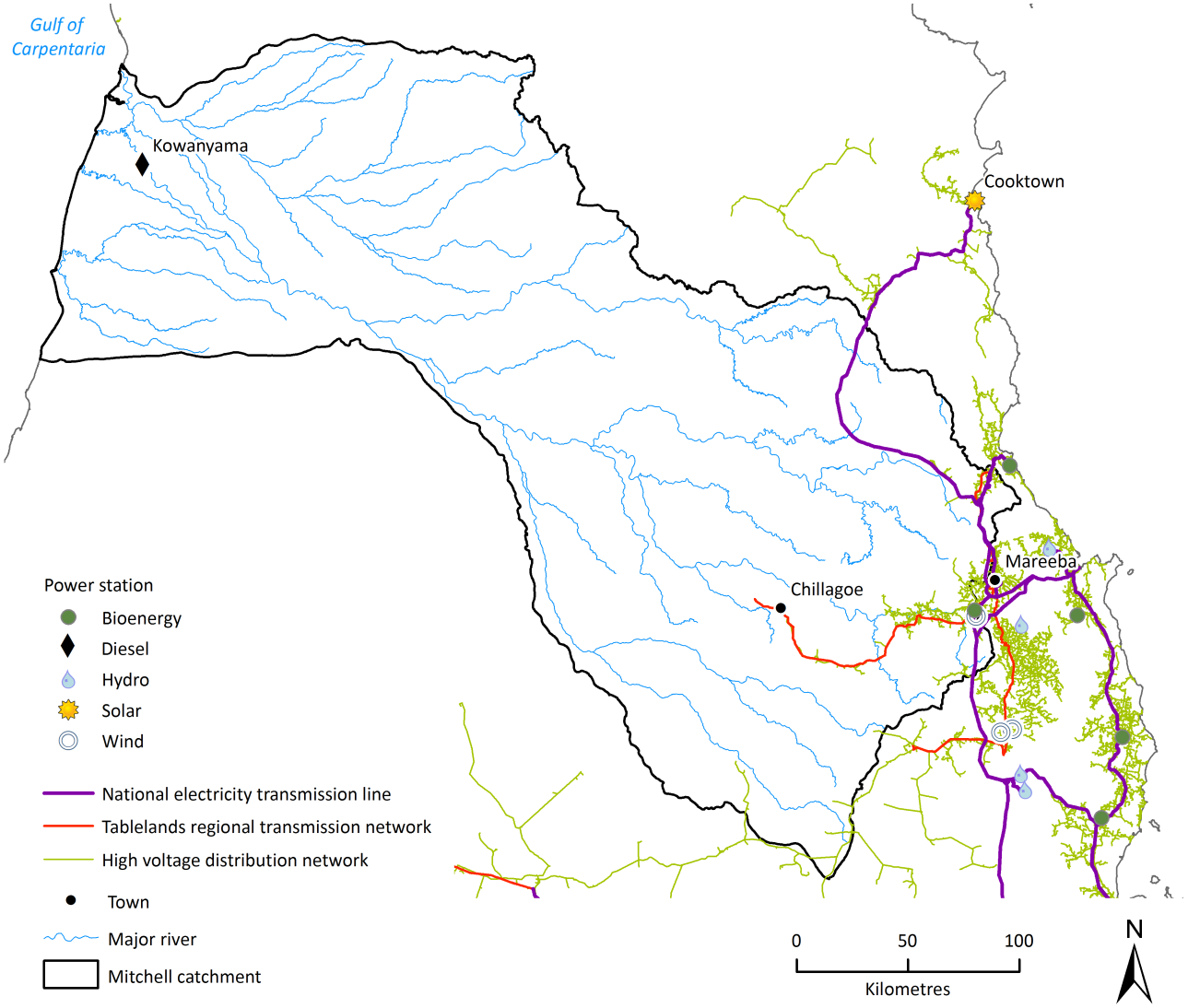

Figure 3-26 Tablelands regional transmission and distribution network and connected energy generation facilities
Source: QDNRM (2017)

A number of commercial-scale energy generation facilities lie within the Mitchell catchment or just beyond its eastern boundary, and supply energy directly to the NEM grid (Figure 3-26 and Table 3-10). This includes two bioenergy (sugarcane bagasse/fibre combustion) facilities; the 11 MW Mossman Mill just outside the Mitchell catchment, and the 7 MW Tablelands Mill within it, and two hydro-electric power facilities to the east of the Mitchell catchment; the 60 MW Barron Gorge and the 1.6 MW Tinnaroo Hydro schemes (QDNRM, 2017). Currently under construction is the $380 million 180 MW Mount Emerald Wind farm, near Mount Emerald between Atherton and Mareeba (QDNRM, 2017; RAC, 2016). The facility is anticipated to be commissioned in late 2018, and will connect to the northernmost point of the 275 kW NEM Powerlink Transmission line that runs north-south along the Mulligan Highway (RAC, 2016). Energy generation in the western portion of the Mitchell catchment, where it exists, is off-grid, small (<1 MW), isolated diesel power systems in the townships of Kowanyama and Pompuraaw, and are also managed by EQL (EQL, 2016). Ergon owns and manages 33 such isolated power systems in remote Indigenous communities across Queensland (EQL, 2016).

Table 3-10 Energy generation facilities in or near the Mitchell catchment

ID	POWER STATION FACILITY NAME	CAPACITY (MW)	ANNUAL ELECTRICITY PRODUCTION (MWh)	GRID	PRIMARY FUEL
A	Mount Emerald Wind Farm†	180	Proposed 500,000 to 600,000	NEM	Wind
B	Barron Gorge Hydro†	60	106,884	NEM	Hydro
C	Mossman Mill†	11	NA	NEM	Bagasse
D	Tableland Mill†	7	NA	NEM	Bagasse
E	Tinaroo Hydro†	1.6	NA	NEM	Hydro
F	Kowanyama	<1	NA	Off-grid	Diesel
G	Pompuraaw	<1	NA	Off-grid	Diesel
	Total	259.6		na	na

†Denotes power station just outside the Mitchell catchment boundary.
NEM = National Electricity Market, NA = no available data, na = not applicable .
Source: Clean Energy Regulator (2017)

Within the Mitchell catchment, potential renewable energy generation opportunities include bioenergy, solar, wind, hydro and pumped hydro. There is likely sufficient electricity demand on the Tablelands network for small new renewable generators to connect directly to this network.

Water

Water provision to the towns in the Mitchell catchment is primarily by local government or a designated service provider under authority from the Queensland Department of Energy and Water Supply (QDEWS). Mareeba Shire Council provides water sourced from Lake Tinaroo to Chillagoe, Dimbulah, Mount Carbine, Kuranda and Mount Molloy, and maintains water infrastructure, including restrictions and billing, across the local government area (MSC, 2017). Kowanyama Aboriginal Shire Council provides water supplies to Kowanyama's 260 connections.

Before investigating the potential for new dams in the Mitchell catchment it is prudent to first examine existing dams and the extent of regulation and quantities of general and strategic reserves in river systems. Table 3-11 lists existing large dams (>10 GL capacity and >10m wall height) in the Mitchell catchment and the adjacent upper Barron catchment.

Table 3-11 Constructed large dams in the Mitchell catchment
Locations in parentheses indicate catchment.

NAME OF DAM	NEAREST TOWN	ORIGINAL OWNER	YEAR CONSTRUCTED	HEIGHT ABOVE BED LEVEL (m)	STORAGE CAPACITY AT FSL (GL)	PRIMARY INTENDED PURPOSE	TYPE OF DAM
Lake Mitchell Dam (Mitchell)	Mareeba	Southedge Daintree Pastoral Pty Ltd	1987	17	190	Residential/ peri-urban†	Earth embankment
Tinaroo Falls‡ (Barron)	Atherton	SunWater	1958	42	439	Irrigation	Concrete gravity

‡Not in study area but adjacent to the Mitchell catchment and supplies water for irrigation in the Mareeba–Dimbulah Water Supply Scheme, some of which is located in the upper Mitchell catchment.
†ANCOLD Register of Large Dams lists the intended primary use as irrigation.
Source: ANCOLD Register of Large Dams (https://www.ancold.org.au/)

One large dam has been constructed in the Mitchell catchment, the privately funded Lake Mitchell Dam. Tinaroo Falls Dam in the adjacent Barron catchment is also listed in Table 3-11 because it supplies water to the MDWSS, part of which lies within the Mitchell catchment.

Lake Mitchell Dam

Lake Mitchell Dam (also known as Southedge Dam and as Quaid's Dam) is a privately developed dam located approximately 27 km north north-west of Mareeba (Figure 3-27). Originally intended to support commercial and residential development with associated recreation, the dam has never been used. There are small areas of soil downstream that could be used for irrigation development.

Figure 3-27 Main cross-river embankment of the Lake Mitchell Dam and spillways
Photo taken looking downstream. Two spillways are located on the left bank abutment.
Photo: CSIRO

If the Lake Mitchell Dam owners agreed to supply water at a price comparable to that charged by SunWater it is technically feasible that water could be pumped from Lake Mitchell to parts of the MDWSS near Mareeba. The existing water plan provides for a general reserve volume of 20 GL/year in the Mitchell River section upstream of the Rifle Creek junction, which includes the Lake Mitchell Dam. A further dam on the Mitchell River - Northedge Dam with a capacity of 275 GL - has been previously proposed. If developed, the reservoir associated with this dam would back up close to the toe of Lake Mitchell Dam.

Tinaroo Falls Dam

Tinaroo Falls Dam is a concrete gravity dam on the Barron River (Figure 3-28). The Tinaroo Falls Dam reservoir supplies water to the MDWSS, of which about 16,000 ha lies in the upper Mitchell

catchment. The site was ultimately adopted over the Nullinga dam site (Section 5.3) because of its more suitable location and elevation to service the irrigation area.

Figure 3-28 Tinaroo Falls Dam in the Baron catchment
The Barron catchment is adjacent to the Mitchell catchment. Tinaroo Falls Dam is a concrete gravity dam that supplies water to the Mareeba–Dimbulah Water Supply Scheme.
Photo: CSIRO

Tinaroo Falls Dam has a stated annual water yield of 205 GL for irrigation and an assured water yield of 72 GL for power generation at the Barron Gorge power station (66 MW). Between 2007–08 and 2015–16 water use from Tinaroo Falls Dam reservoir increased from about 50% to 79%. The Tinaroo hydro-electric power station on the irrigation release channel has a capacity of 1.6 MW and became operational in 2004. Water released from the Tinaroo Falls Dam is subject to the Mareeba–Dimbulah Water Supply Scheme Resource Operations Licence (DNRM, 2017), which requires the licence holder to make releases from the Tinaroo Falls Dam to meet minimum Barron River flows.

Current surface water use and allocation

A total of 45 surface water licences exist in the Mitchell River catchment. The total allocation of these licences is 5.4 GL/year. These are classified predominately as ‘rural’ and include water used for irrigation from the Walsh River above Leafgold Weir and water for the town of Chillagoe. A strategic reserve of 5 GL/year for Indigenous landholders in the Kowanyama area is stipulated in the Mitchell Water Resources Plan.

Current groundwater use and allocation

Groundwater use is prominent across the Mitchell catchment, although the main use is for stock and domestic purposes which is authorised, but not licensed and does not include a volumetric allocation. This is particularly prevalent in the east of the catchment where many bores (>100) are drilled in the fractured rock aquifer of the Hodgkinson Formation (see Section 2.2) and extract small amounts of water over a large area. In total, 14 licensed groundwater allocations exist in the Mitchell catchment, 13 licenses are for stock and domestic use with no volumetric allocation, only one licence has a volumetric allocation. Eight allocations are for groundwater from the Bulimba Formation aquifer, two from the Gilbert River Formation aquifer and the Wyaaba Beds aquifer and one for the Rolling Downs Group aquifer. The only licensed volumetric allocation is an allocation of 500 ML/year for Kowanyama's town water supply which is sourced from the Bulimba Formation aquifer. None of the authorised or licensed groundwater extraction is metered, therefore current estimates of groundwater use do not exist.

Projected urban and industrial water demand

The reticulated network currently meets Cairn's urban and industrial needs of approximately 25 GL/year by supplying water from Copperlode Falls Dam and Behanna Creek. By 2030, the demands on Cairn's reticulated network is expected to increase to about 33 GL/year under a medium growth projection or 44 GL/year under a medium water demand growth projection plus additional demand from a 'special' project, such as the $8 billion Aquis Integrated Resort being constructed at Yorkeys Knob (DEWS, 2014).

Some stakeholders have proposed that a dam at the Nullinga dam site on the Walsh River in the Mitchell catchment could be used to service a portion of the future urban demand in Cairns (Advance Cairns, 2016). A dam at the Nullinga site could provide for an expansion of irrigated production of riparian lands to the Walsh River downstream as far as the Leafgold Weir area. With a delivery pipeline to the West Barron Main Channel, it could supply areas currently supplied from Tinaroo Falls Dam. This would potentially free up supply from the dam which then could be used to supplement supply to Cairns and to the Barron Gorge hydro-electric power station. However, the Cairns Regional Council has indicated that access water from a future regional dam (e.g. Nullinga dam site) is only considered as a potential long-term proposition (CRC, 2015). Short and medium-term initiatives involve demand management, developing the Mulgrave River (increase in system water yield of 8.5 GL/year) and access to a supplemented reserve of the Barron River (an increase in system water yield of 5.5. GL/year). Other options being investigated to augment water supply for agricultural use in the MDWSS include changes to bulk storage rules and operations and modernising existing distribution infrastructure to reduce system losses (Building Queensland, 2017).

Community infrastructure

The availability of community services and facilities can play an important role in attracting or deterring people from living in newly-developed areas in the Mitchell catchment. The Mitchell catchment is served by 24 schools and total student numbers have risen between 2012 and 2016 from 7010 to 7367 (Stokes et al., 2017).

There are no hospitals in the Mitchell catchment but there are primary health care centres in Chillagoe and Kowanyama, and an outpatient clinic at Dimbulah. There are three hospitals just

outside the eastern border of the study area (Table 3-12). Each 1000 people in Australia require 4.0 hospital beds served by 28 fulltime equivalent hospital staff and $4.0 million/year funding to maintain current mean national levels of hospital service (AIHW, 2017a).

Table 3-12 Healthcare centres and hospitals in or near (distance in km from boundary) the Mitchell catchment

HOSPITAL NAME	URBAN CENTRE	BEDS	PUBLIC/ PRIVATE	EMERGENCY	OTHER SERVICES	PEER GROUP CLASSIFICATION†
Chillagoe Primary Health Centre	Chillagoe	<50	Public	Yes	Yes	Outpatient hospitals
Kowanyama Primary Health Care Centre	Kowanyama	<50	Public	Yes	Yes	Very small hospitals
Dimbulah Outpatients Clinic	Dimbulah	<50	Public	Yes	Yes	Unpeered and other hospitals
Mareeba Hospital (3 km)	Mareeba	52	Public	Yes	Yes	Public acute group C
Atherton Hospital (6 km)	Atherton	<50	Public	Yes	Yes	Public acute group C
Herberton Hospital (2 km)	Herberton	38	Public	Yes	No	Mixed subacute and non-acute

†Data sourced from AIHW (2015).
Sources: AIHW (2017b); MyHospitals website; Queensland Health (2017).

Recent census data showed that approximately 12% of private dwellings were unoccupied in the Mitchell catchment, a larger proportion than the state and national average (Table 3-13). This suggests that the current pool of housing may be able to absorb some increase in population.

Table 3-13 Number and percentage of unoccupied dwellings and population for the Mitchell catchment

INDICATOR	UNIT	MITCHELL CATCHMENT	QUEENSLAND	AUSTRALIA
Total population, 2016†	number	6,365	4,703,193	23,401,892
Total unoccupied private dwellings, 2016‡	number	336	195,570	1,039,874
% private dwellings that are unoccupied‡	%	12.3	10.6	11.2

†Data sourced from ABS (2016a).
‡Data sourced from ABS (2016c).

3.4 Stakeholder and investor values

3.4.1 INTRODUCTION

There are a diverse set of stakeholders with different and sometimes conflicting interests and values relating to the use of water resources and irrigated agricultural development across the Mitchell catchment. If greenfield developments were to proceed, the diversity of stakeholder perspectives has implications for the ability of developers to gain and maintain social licence to operate throughout the development process.

3.4.2 STAKEHOLDERS, THEIR VALUES AND POTENTIAL ENGAGEMENT STRATEGIES

Stakeholder analysis and a literature review suggests that northern Australia is highly valued, with the extent and nature of these values shifting through time and between stakeholder groups. For example, from about the late 20th century, northern Australia has become increasingly valued for the environmental, aesthetic, cultural and recreational services it provides, alongside its ability to

produce agricultural commodities. The rainbow diagram in Figure 3-29 illustrates the diversity of local, regional and national stakeholders in the Mitchell catchment, and their likely support for greenfield development of irrigated agriculture in their catchment. It is important to note that many context-specific factors are missed in this top-down process, and that factors such as the scale of the benefits and to whom benefits may flow may impact support.

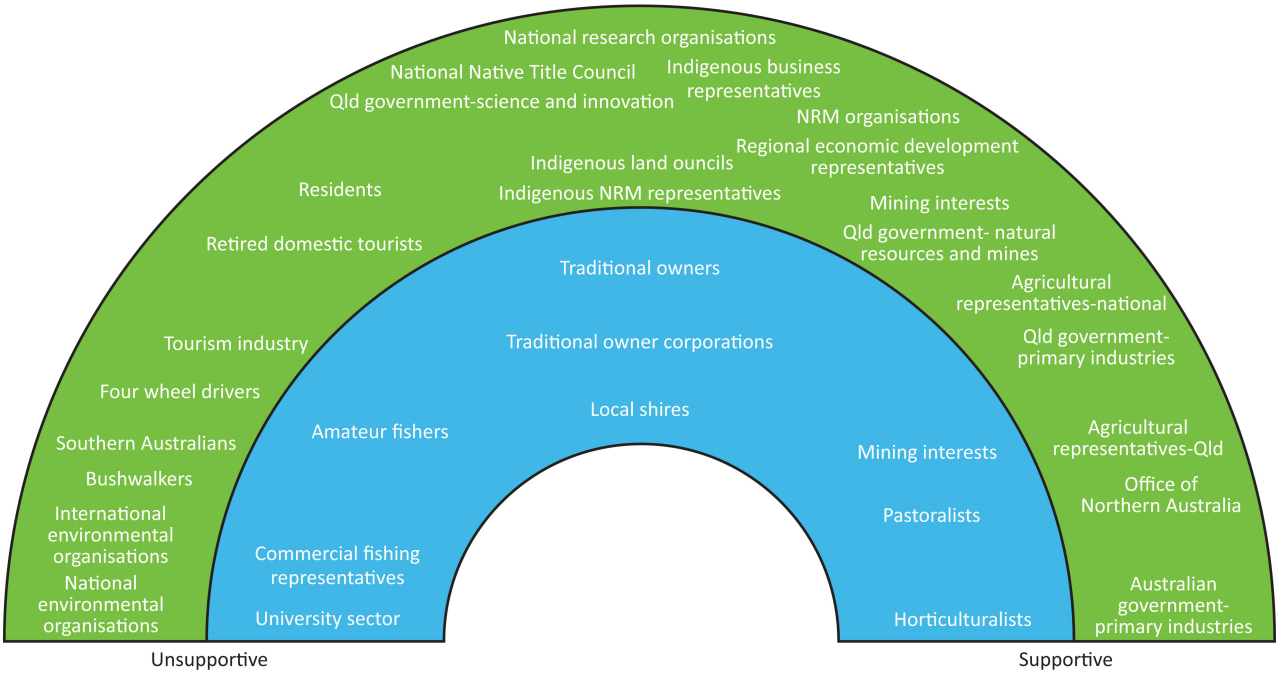

Figure 3-29 Rainbow diagram classifying stakeholders according to their likely support of irrigated agriculture in a greenfield site in the Mitchell catchment

Stakeholders towards the right of the diagram are more likely to be supportive. Internal ring = local stakeholders, external ring = regional, national and international stakeholders, NRM = natural resource management.
Based on stakeholder analysis and literature review (see Stokes et al., 2017).

Underpinning the likely support, or lack thereof, of stakeholder or interest groups for the potential development of greenfield irrigated agriculture in northern Australia are a set of social values, beliefs, attitudes and norms that are often shared within each group. In general, demographers and commentators note a shift from productivist values (see Irving, 2014) centred around the belief that economic productivity and growth are desirable outcomes, towards consumptive (for amenity) and protectionist values in northern Australia (Holmes, 2012). Table 3-14 summarises key stakeholder values that may impact the social licence to operate of development initiatives such as greenfield agriculture. Indigenous-specific values are summarised in Section 3.5.

Table 3-14 Summary of published stakeholder and interest group values relevant to the development of greenfield irrigated agriculture in northern Australia

Ordered least likely to support development through to most likely to support development (as per Figure 3-23). Stakeholder groups who broadly share values related to potential development are combined.

STAKEHOLDER	VALUES, ATTITUDES, BELIEFS AND NORMS
(Inter)national environmental organisations Four-wheel drivers, retired domestic tourists, international tourists, bushwalkers, safari hunters	Want natural environment protected, Indigenous culture valued, sustainability maintained. The 'real Australia', utopia, setting for psychological challenges, a 'proving ground'. Current human geography valued (e.g. few people, poor roads/lack of 2WD access). Valued for nature-based activities, large fish populations, scenic areas and secluded locations. Concern about land clearing, threats to Indigenous values, river diversion, irrigated agriculture, water as a public asset, rivers not dammed, no inter-basin transfer of water or groundwater extraction.
Southern Australians	High value placed upon condition of floodplains, quality of recreational fishing, condition of waterholes. High willingness to pay for rivers to be managed for recreation, cultural and environmental services. Small proportion consider irrigated agriculture important, or wish it to increase significantly.
Residents Amateur fishers and their representatives	Passion for rivers, camping, fishing, strong place attachment to rivers and related recreation. Strongly value perceived easy lifestyle (current human geography). Environment and recreation more important than new commercial/retail business and primary industries. Low value placed on income from irrigation agriculture, high value on environmental and cultural assets. Less willing to pay for management of cultural services than southern Australians. Lack of trust in government driven planning.
Local shires Regional economic development representatives	Vision: highly productive, innovative, resilient, commercially exciting economy, culturally diverse, dynamic, inclusive communities, relaxed. Value developments that leverage and consider social, economic and environmental assets, impacts. Interest in carbon trading, arts and culture sector, nature and culture based tourism. Infrastructure, institutions and social capital cited as higher concerns to development than lack of water.
Pastoralists Agricultural representatives	Occupation as a lifestyle choice and for identity. Environmental stewardship goals and lifestyle goals more important than economic goals Low ability to adapt to change. Free trade, open markets, property rights and private enterprise. Want institutions and infrastructure (largely road networks, but also soft infrastructure) for development.
Horticulturalists	Self-identify as innovators, high adaptive capacity, strong motivations towards profitability. Express concern about the environment (including water quality) but not the rhetoric of wilderness.

Stakeholders are also differentiated in terms of their level of interest in, and influence over, an action or change. These differences can help guide engagement strategies, especially when combined with an understanding of stakeholder values like those highlighted in Table 3-14. Interest/influence matrices were generated by the Assessment's stakeholder analysis, a literature review and the research informing Section 3.5. The matrices mapped stakeholders into four broad types of appropriate engagement: (i) partner, (ii) involve/engage, (iii) consult, and (iv) inform

(Table 3-15). It is important to note that this approach is indicative: a bottom-up stakeholder identification process is a more intensive, rigorous and best-practice approach (Reed et al., 2009) for understanding stakeholders.

Table 3-15 Stakeholder engagement typology for the Mitchell catchment, as determined via influence/interest matrices related to the development of irrigated agriculture in a greenfield site
Partner = High interest, high influence. Involve/engage = Low or moderate interest, high influence. Consult = High interest, low or moderate influence. Inform = Low interest, low influence.

SCALE	PARTNER	INVOLVE/ ENGAGE	CONSULT	INFORM
Local	Traditional Owners Traditional Owner corporations	–	Commercial fishers Horticulturalists Pastoralists Residents	–
Regional	Australian Government – primary industries – water Queensland Government – natural resources – primary industries – water – natural resources and mines	Office of Northern Australia Southern Australians	Commercial fishing representatives Environmental organisations (international and national) Indigenous business representatives Indigenous land councils Indigenous natural resource management organisations Queensland government – state development – science and innovation Regional economic development representatives (regional and national)	Agricultural representatives – national level Bushwalkers Creative industry Four-wheel drivers Mining interests Retired domestic tourists Safari Hunters Tourism industry

Stakeholders in the 'partner' section are likely to have a high level of interest and influence related to potential developments in the Mitchell catchment. Early, intensive, iterative engagement with these groups, resulting in the co-design of development initiatives, may be most appropriate for these groups. Regular discussions are likely to be appropriate with involve/engage/consult stakeholders. Stakeholders in the 'inform' section may accept occasional one-way communication about development in the Mitchell catchment.

The results of this analysis suggest that careful thought is needed as to the purpose of development, which ecosystem services may change through the development, how stakeholders are engaged and to whom benefits are intended, as key stakeholder values relate to all of these factors. At scale, development planning and implementation is likely to require a systematic and robust social impact analysis, including an investigation of, and ongoing engagement with, stakeholders and their interests.

3.4.3 POTENTIAL INVESTORS IN IRRIGATED AGRICULTURE

Very little is known about pre-existing or potential investors based on published literature. To help address this gap, this section contains an initial exploration of potential investors in irrigated agriculture in northern Australia. An initial typology of potential investors across northern Australia highlighted the variety of potential groups and their disparate investor potential, indicated by access to natural and human/financial/social capital. For example, Indigenous

landholding/leaseholding corporations have potential access to a significant level of natural capital for development, whereas family trusts may have high levels of human/financial/social capital but little access to natural capital. From this typology, six groups were interviewed (see Section 3.5 for the results of interviews with native title holders, Indigenous Land Use Agreement groups, and Indigenous landholding/leaseholding corporations). Investors or potential investors from the international agribusiness, large companies with agricultural interests and small-scale owner operator horticulturalist types were also interviewed across northern Australia, with two from the Mitchell catchment. Mitchell catchment investors perceived similar constraints as investors across northern Australia, and there was no difference between investor perspectives and investor type. In order of importance, these perceived constraints were: i) institutional uncertainty, ii) institutional complexity, iii) economy of scale issues, iv) poor infrastructure, and v) training and retaining a skilled workforce. Investor concern about institutional uncertainty is illustrated by the following:

'*There is no grandfathering of laws at the moment. For projects of significant size, there should be a permanent agreement between government and the operator around approvals. Banks want to fund over a 15-year period but between state and federal government lifespans there is a change in government every two years. Big projects are long-term investments, two to three generations. So there is a major business change every two years. We need to know that once an approval is in, it cannot be changed.*' (Queensland participant)

Institutional certainty, simplicity and bureaucratic speed were the key perceived potential enablers of investment in irrigated agriculture. There was less consistency between investors regarding other enablers of irrigated development. Regardless, government support was the most consistently cited enabler of further investment.

The data represents a preliminary sample that acts as a marker of the additional information required to secure investor potential. This is particularly so for small- to medium-scale investors (including local landowners and leaseholders) whose views may not be so effectively represented at higher levels of decision making.

3.5 Indigenous values, rights, interests and development objectives

3.5.1 INTRODUCTION AND RESEARCH SCOPE

Indigenous people represent a substantial and growing proportion of the population across northern Australia and control significant natural and cultural resource assets, including land, water, and coastlines. They will be crucial owners, partners, investors, and stakeholders in future development. Understanding the past is important to understanding present circumstances and future possibilities. Section 3.5 provides some key background information about the Indigenous Australians of the Mitchell catchment and their specific values, rights, interests and objectives in relation to water and irrigated agricultural development. Section 3.5.2 reviews some key evidence of past habitation by Indigenous people, the significance of water in past patterns of habitation and the impact of exploration and colonisation processes. Section 3.5.3 reviews the contemporary situation with respect to Indigenous residence, land ownership and access. Section 3.5.4 outlines Indigenous water values and responses to development, and Section 3.5.5 describes Indigenous-generated development objectives.

The material provided here represents a short summary of the research undertaken, and further details regarding this component of the Assessment are contained in the companion technical report on Indigenous values, rights and objectives for the Mitchell catchment (Lyons and Barber, 2018) and for the other two study areas of the Assessment (Barber, 2018; Barber and Woodward, 2018). There has been some previous information about Indigenous water values in the Mitchell catchment, but far less consideration of Indigenous perspectives on general water development and associated irrigated agricultural development more specifically. The work undertaken here directly addresses these data needs.

Engagement with Indigenous people is a strong aspiration across governments and key industries but models of engagement can vary considerably and competing understandings of what 'engagement' means (consultation, involvement, partnership, etc.) can substantially affect successful outcomes. Standard stakeholder models can also marginalise Indigenous interests, reducing what Indigenous people understand as prior and inalienable ownership rights to a single 'stake' equivalent to all others at the table. The Assessment interviewed an overall majority of the board members of Indigenous Traditional Owner organisations and board-nominated senior Indigenous decision makers from within the Mitchell catchment to establish a representative range of Indigenous leadership views. The companion technical report (Lyons and Barber, 2018) provides details of this data. A small number of comments are replicated in the following sections to show the type of data obtained, complemented by key themes emerging from the data analysis. The Assessment does not provide formal Indigenous group positions about any of the issues raised and does not substitute for formal processes required by cultural heritage, environmental impact assessment or water planning legislation. Nevertheless, the research undertaken for this component of the Assessment identifies key principles, important issues and potential pathways to provide effective guidance for future planning and for formal negotiations with Indigenous groups.

3.5.2 PRE-COLONIAL AND COLONIAL HISTORY

Pre-colonial Indigenous society

Pre-colonial Indigenous society is distinguished by four primary characteristics: long residence times; detailed knowledge of ecology and food gathering techniques; complex systems of kinship and territorial organisation; and a sophisticated set of religious beliefs, often known as Dreamings (Cole, 2004; Strang, 1997). The Mitchell catchment contains archaeological evidence of Indigenous habitation stretching back many thousands of years, but the published archaeological record for many locations is relatively sparse. Resource-rich riverine habitats were central to Aboriginal economies based on seasonally-organised hunting, gathering and fishing (Cole, 2004; Strang, 1997). Rivers were also major corridors for social interaction, containing many sites of cultural importance (Cole, 2004; Strang, 2002). Indigenous religious cosmologies provided a source of spiritual and emotional connection as well as guidance on identity, language, law, territorial boundaries, and economic relationships (Williams, 1986). The connection between spirit, language, country and water is explained by a Kowanyama Traditional Owner:

'The other old fellers talk to you in language when you die, they'll… send your spirit back to your own homeland… they can't send you anywhere else to a drier spot, your spirit will have to go back

to a well water or a big waterhole – and no salty water, got to be fresh water… ' (Winstone Gilbert, p. 251 in Strang (1997)).

From an Indigenous perspective, ancestral powers are present in the landscape in an ongoing way, intimately connected to people, country, and culture. Those powers must be considered in any action that takes place on the country.

Colonisation

European colonisation resulted in very significant levels of violence towards Indigenous Australians, with consequent negative effects on the structure and function of existing Indigenous societies across the continent. Avoidance, armed defensiveness, and overt violence were all evident in colonial relationships as hostilities arose as a result of competition for food and water resources, colonial attitudes and cultural misunderstandings. The establishment of pastoralism was a focus for conflict as pastoral homesteads and outstations were sited close to permanent water and the animals grazed fertile plains and river valleys used by Indigenous people for food and other resources (McGrath, 1987). As a consequence, Indigenous attacks on colonial pastoral operations were made both in retaliation for past attacks by colonists and as a response to shortages of food and other resources.

The discovery of gold in the Palmer River in the late 19th century established the mining industry in the Mitchell catchment (Kirkman, 1980). The gold rush led to the development of roads and settlements, and industries such as pastoralism that could provide provisions to miners (Cole, 2004; Kirkman, 1982). The gold rush was short-lived, but left a significant legacy of social and environmental damage, and pastoralism became firmly entrenched in the aftermath of the boom. By the 1940s, starvation, the threat of further violence and inconsistent access to water forced the remaining Indigenous inhabitants of the Mitchell catchment to settle on pastoral stations or on the fringes of towns. The use of Indigenous labour for domestic and stock work for much of the 20th century was crucial to the industry, and also meant that some Indigenous people were able to access traditional areas, albeit in a different way.

3.5.3 CONTEMPORARY INDIGENOUS OWNERSHIP, MANAGEMENT, RESIDENCE AND REPRESENTATION

The pressures of colonial violence and forced relocations meant that previously important residential sites were no longer inhabited and in a significant number of cases rarely visited. However, such areas remain crucial to people's lives, sustaining a distinct individual and group identity as well as connections to past ancestors and future descendants. People are connected to places through a combination of genealogical, traditional and residential ties, only some of which are formally recognised.

Indigenous ownership

Indigenous interests are currently formally recognised by the Australian legal system over at least 60% of the Mitchell catchment. There are three major forms of Indigenous-specific interest: native title, Indigenous land use agreements (ILUAs) connected with native title, and Deed of Grant in Trust land (DOGIT). Indigenous people also hold a range of lands under pastoral lease and freehold title. Native title provides a series of rights (such as access) determined through a legal process.

ILUAs are voluntary registered agreements between native title claimants or holders and other interested parties for the use and management of land and resources. DOGIT land is primarily land that was a former Indigenous mission or reserve. Figure 3-30 shows the current situation with respect to native title claims and determinations. Further discussion of Indigenous land tenure and native title appears at Section 3.6 below.

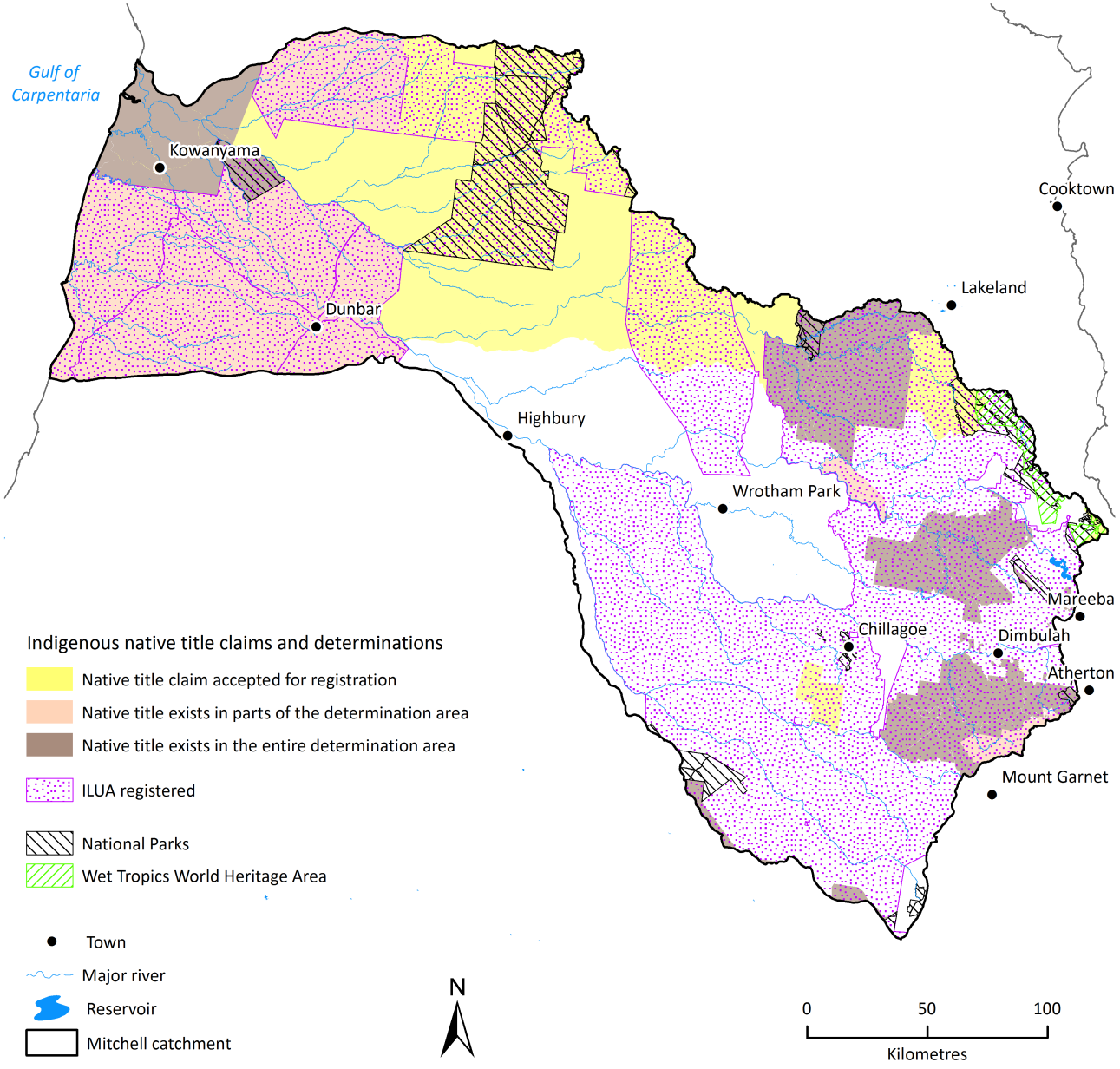

Figure 3-30 Indigenous native title claims and determinations in the Mitchell River catchment as at July 2017
Data source: National Native Title Tribunal

Indigenous residence

Australian Bureau of Statistics census data shows a significant Indigenous population of 26% in the Mitchell catchment (Table 3-4). This includes Indigenous people who are part of recognised local ownership groups, as well as residents who identify as Indigenous but have their origins elsewhere. Indigenous owners of the Mitchell catchment are concentrated in the regional towns of Kowanyama, Chillagoe, Dimbulah, Mareeba, Atherton, and Cairns. This concentration of owners means that residential location differs from the group and tenure boundaries; for many owners

(including the Western Yalanji, Wakamin, Kuku Djungan, and Mbabaram peoples) primary residential locations may be outside the catchment. These patterns of residence and dispersal reflect a combination of historical involuntary relocation, voluntary movement to seek jobs and other opportunities, and kinship and family links. Research participants from many groups expressed a strong desire for conditions that would enable more of their people to reside on their own traditional lands.

Indigenous governance and representation

Indigenous organisational and political structures within the Mitchell catchment are quite diverse. Three levels of organisation are particularly relevant to this study: local Indigenous corporations based on recognised Traditional Owner groups; regional Indigenous land councils; and Indigenous representation in catchment management organisations. Group-based local Indigenous corporations are increasingly significant representative structures and were crucial in enabling the current study. Table 3-16 summarises the existing situation in terms of Indigenous ownership, residence, management, and representation in the Mitchell catchment. It shows significant variations in existing capacity, resourcing, and ability to participate in natural resource management decision making. This shapes Indigenous development priorities. Planning processes need to be grounded in the specificities of local groups as well as to be coordinated at catchment and regional levels.

Key regional Indigenous land councils for the Mitchell catchment are the Cape York Land Council (representing Kowanyama and Olkola interests) and the North Queensland Land Council (NQLC) (representing a larger set of groups from the middle and upper catchment). Natural resource management in the Mitchell catchment is jointly overseen by the Northern Gulf Resource Management Group and the Mitchell River Watershed Catchment Management Group. These have previously been guided by Indigenous input through the Alliance of the Northern Gulf Indigenous Corporation and the Mitchell River Traditional Custodian Advisory Group. During the Assessment, a new body was established by Mitchell catchment Traditional Owners, supported by the NQLC to oversee Indigenous catchment management and engagement with future development initiatives.

Table 3-16 Summary of current Indigenous group tenure, residence and natural resource management arrangements in the Mitchell catchment

ILUA = Indigenous Land Use Agreement

GROUP FEATURE	MBABARAM	MULURIDJI	WAKAMIN	KUKU DJUNGAN	WESTERN YALANJI	KOWANYAMA
Key townships	Irvinebank	Mareeba	Chillagoe	Dimbulah	Mount Carbine	Kowanyama
Significant number of people identifying primarily as group member	Yes	Yes	Yes	Yes	Yes	Yes
Group ownership of town land on traditional country	Yes	Yes	Yes	Yes	Yes	Yes
Infrastructure on town land	Yes	Yes	Yes	Yes	Yes	Yes
Local Indigenous corporation with paid staff and office	Yes	Yes	No	No	Yes	Yes
Ownership of significant rural land	Yes	No	Yes	Yes	Yes	Yes
Significant residential presence on traditional lands	No	Yes	No	No	No	Yes
Indigenous ranger program operating on traditional lands	No	No	No	No	Yes	Yes
Native title application currently registered	No	No	Yes	No	No	No
Native Title claim determined	Yes	Yes	No	Yes	Yes	Yes
Current ILUAs	Yes	Yes	Yes	Yes	Yes	Yes
Native Title representation/assistance from Land Council	Yes	Yes	Yes	Yes	Yes	Yes
Formal Indigenous catchment and natural resource management entity	No	No	No	No	No	Yes
Indigenous representation in water planning	No	No	No	No	No	No

3.5.4 INDIGENOUS WATER VALUES AND RESPONSES TO DEVELOPMENT

Introduction: attachment, ownership, protection

Indigenous values in relation to their country encompass principles of attachment, ownership, and the responsibility to protect it. These are manifested in practical terms through:

- The assumption of Indigenous ownership of land and water resources.
- The need for formal external recognition of that ownership.
- The role of local histories in establishing local Indigenous connections and authority.

- The ongoing role of religious and spiritual beliefs (known as the Dreaming).
- The existence of ongoing knowledge of group and language boundaries and identities.
- The importance of hunting and fishing activity to Indigenous cultures.
- Inter-generational obligations to both ancestors and descendants to care for the country.
- Regional responsibilities to near neighbours and downstream groups to maintain the integrity of the country.
- Ongoing access and resource use issues to large tracts of traditional country subject to various forms of non-Indigenous tenure.

These principles also apply to Indigenous attitudes to non-Indigenous activities on Indigenous lands. Development proponents will need to ensure that they follow four frequently highlighted principles:

- consultation with the relevant owners
- their consent for development
- compliance with the terms of policies and agreements, including Traditional Owner employment
- compensation for the access and use of resources.

These principles have clear implications for native title, cultural heritage and environmental impact assessment, as well as for broader issues of sustainable development.

Cultural heritage

Indigenous cultural heritage is a crucial manifestation of the principles of attachment, ownership, and protection. Cultural heritage itself has a number of components: archaeological sites; places associated with traditional stories or traditional knowledge; and places of historical or contemporary importance. Cultural heritage is strongly correlated with permanent water, meaning that riverine and aquatic areas that are the focus of development interest are also likely to contain significant cultural heritage. Three major cultural heritage issues were identified by research participants in this study: ongoing damage to known existing sites; a lack of documented heritage knowledge that hampers Indigenous responses to current development proposals; and potential development impacts on Indigenous abilities to fulfil cultural responsibilities. One participant described how poor consultation by the mining industry had significant implications for water-related cultural heritage and created concerns for him as a senior custodian:

'*I'm really worried about those miners. They never employed a Traditional Owner from Chillagoe, man or woman ... I asked them 'where you getting your water from?' They said 'from the lagoon from out the back'. I was mad they were getting water from my country, where they were pumping that water it was sacred site*.'

Wakamin elder

The Queensland *Aboriginal Cultural Heritage Act 2003* protects heritage sites regardless of the tenure status of the land and protects areas whether or not they actually contain physical evidence of the past. Figure 3-31 shows the general concentration of cultural heritage listed in the state records collated through the Act. This record is known to be very incomplete – the map demonstrates the presence of a layer, not its extent. Consultations between development

proponents and Traditional Owners will be significantly aided by early stage field scoping of cultural heritage issues and requirements.

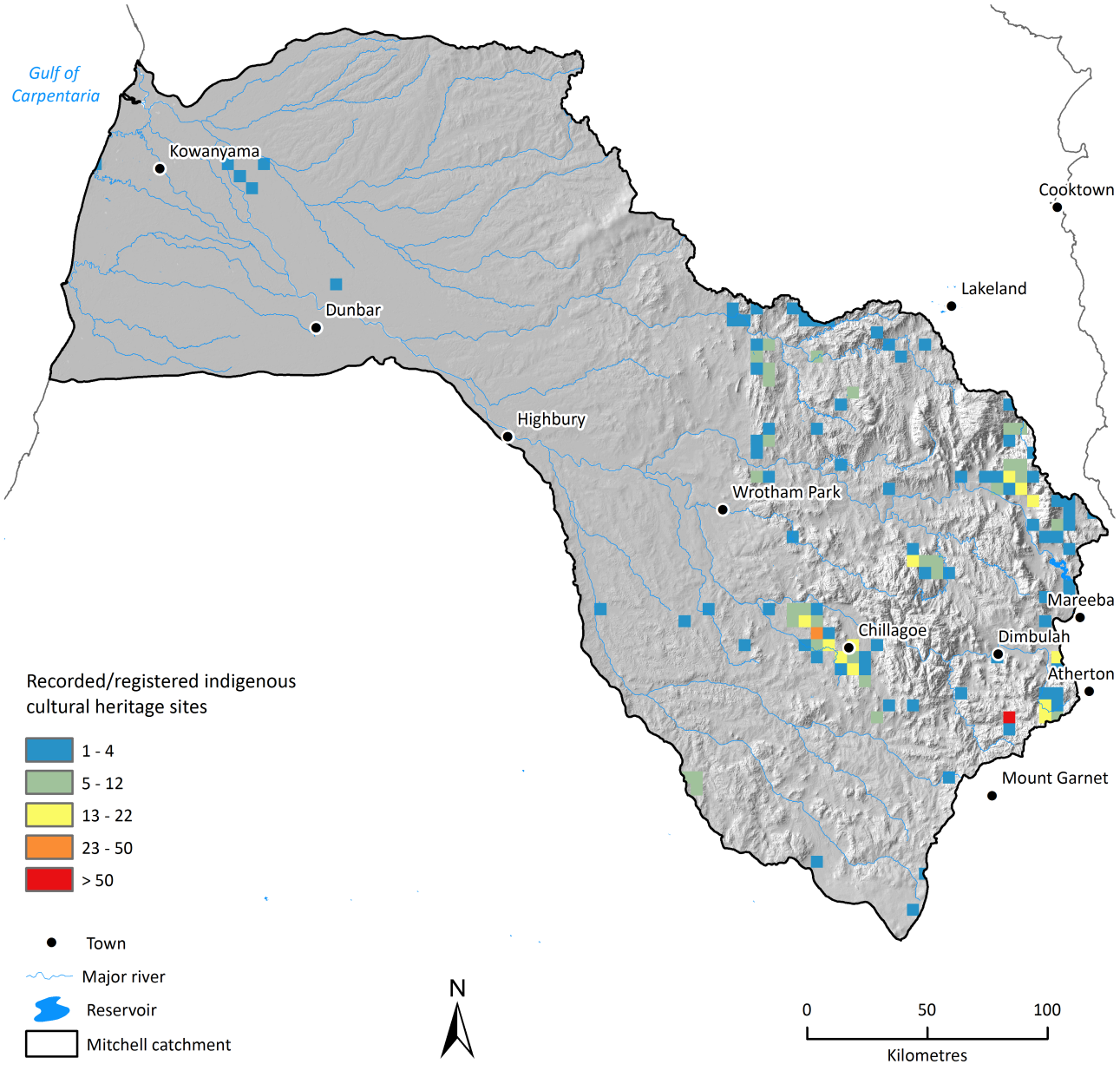

Figure 3-31 Registered Indigenous cultural heritage sites in the Mitchell catchment as at July 2017
Data source: DATSIP, Queensland Government

Contemporary Indigenous water values

Internationally, Indigenous water rights, values and interests have been outlined in a number of significant forums and documents (World Water Council, 2003) including some produced in Australia (NAILSMA, 2009; NAILSMA and UNU-IAS TKI, 2008). During the Assessment, Traditional Owners from across the Mitchell catchment began generating a declaration outlining the importance of protecting the cultural and environmental heritage values of the Mitchell River. Data from research participants in the Assessment clearly demonstrates the overall importance of water to Indigenous people across the Mitchell catchment:

Water is associated with a lot of cultural values. That's why we regard it not only as sacred but also [have] protocols for how you approach that place…in places you can't even swim in that waterhole.

That groundwater you're referring to - soaks and springs - they've all got stories to it because it preserves life [and] anything that preserves life must be held in high value. So we have the result of water [being] in that category.

Kuku Djungan elder

In general terms, Indigenous water values emphasise securing sufficient water to maintain healthy landscapes and to support Indigenous needs. Those needs can be defined in multiple ways, and from an economic perspective encompass such activities as art and cultural production, hunting and gathering, and traditional medicine supply, as well as pastoralism, ecotourism, agriculture and aquaculture. All of these needs depend on natural resources, highlighting the importance of securing and maintaining water supplies for Indigenous people.

Responses to water and irrigation development

In general, large-scale water development was seen as incompatible with contemporary Indigenous values and lifeways. Such development is also interpreted through negative Indigenous perceptions of past development. For example, the past 100 years of mining in the upper catchment has encompassed alluvial mining and the use of cyanide and harmful chemicals. Pastoral development is also seen to have contributed to erosion and degraded water quality. Indigenous concerns about water development noted during the Assessment included the impacts of water extraction, dam scale and location, dam failure, reservoir inundation, effects on animals, the consequences of intensified land use (weeds, erosion, water quality, chemicals, salinity, etc.) and cumulative impacts from other industries, particularly mining. Indigenous research participants also noted particular Indigenous vulnerabilities to negative impacts, largely related to their position as long-term custodians and their marginalised socio-economic and educational status. These issues affected Indigenous assessments of the relative risks and benefits associated with development proposals. From an Indigenous perspective, development that cannot be managed in accordance with customary beliefs (for example, by polluting water sites) represents an ongoing form of colonial dispossession of land and disruption to valued forms of identity (Strang, 2005).

Noting the above issues, Indigenous participants also recognised that power imbalances may see large-scale development proceed. In this context, some data on preferences for particular kinds of water development were gathered, and the general trend from most to least favourable was:

1. flood harvesting to supply smaller, offstream storages
2. smaller instream dams (e.g. gully dams) constructed in side tributaries or branches which do not restrict all of the flow
3. bore and groundwater extraction
4. large instream dams in major river channels.

Proposals for specific sites may not accord with this general trend, and new information may alter the above order at both local and regional scales. With respect to major water and irrigation development, key Indigenous criteria for evaluation include:

- early and further formal group consultations about options, impacts and preferences

- development that specifically address Indigenous needs (for example, access, education, amenity, and recreational opportunities)
- appropriate cultural heritage surveys of likely areas of impact
- Indigenous employment and other benefits during construction
- the need for ongoing monitoring of impacts that employs Traditional Owners
- support for Indigenous roles in development projects that connect water development with both water planning, wider catchment management and enterprise development.

Water planning

Water planning is understood as one way of managing water development risk, but water planning also has particular challenges. In Australia, the National Water Initiative (Department of Agriculture and Water Resources, 2017) led to intergovernmental agreement that water plans must recognise Indigenous needs in terms of access and management. This encompasses Indigenous representation, incorporation of Indigenous social, spiritual and customary objectives, and recognition of native title needs and uses. However, progress in implementing that recognition has been slow due to a lack of knowledge about those interests, competing water demands and the challenges of accommodating Indigenous perspectives in conventional planning frameworks. Queensland has performed better than some other states, and the Mitchell River water plan has a small water allocation specifically reserved for Indigenous people. However, this allocation remains unused, and participants noted the difficulties in participating in water planning forums:

Planning is always top heavy. It's intimidating when you go to these meetings where you got all these ones talking about water management and they've got more letters after their name. You need to have people with knowledge but you need to have people who are actually sitting on the country too. You need to bring the management level down not up.

Western Yalanji country manager

Based on the data generated during the Assessment, formalising and refining Indigenous water values and water planning issues in the Mitchell catchment may require:

- Formal scoping discussions catchment, land council, and local group levels about how best to support Indigenous involvement in water planning.
- Refinement of Indigenous rights, roles and responsibilities in water planning and resourcing of Indigenous involvement in water planning.
- Indigenous-specific tradeable water allocations.
- Further specification of cultural heritage impacts and current and potential future native title rights.
- Articulating water planning with irrigation development, mining and catchment management processes.
- Addressing continuing Indigenous water research needs and information priorities to inform the ongoing development of water resource plans.

Catchment management

Mitchell catchment Indigenous people have a long history of involvement in catchment management. The original Mitchell River Group was created through the initiative of Traditional Owners at Kowanyama and was the first catchment management group in Queensland. As a result, Indigenous catchment management plans and aspirations have been clearly articulated for the Mitchell catchment over a long period. These include care for the country, the management of tourism impacts on cultural heritage, access, Indigenous ranger program support, cultural knowledge revival, partnerships, and enterprise development. However, resources for catchment management have been increasingly constrained, limiting the ability of groups such as Northern Gulf Resource Management and the Mitchell River Watershed Catchment Management Group to function effectively and limiting the level of engagement between these groups and Traditional Owners.

3.5.5 INDIGENOUS DEVELOPMENT OBJECTIVES

Indigenous people have a strong desire to be understood as development partners and investors in their own right, and have generated their own development objectives. This stance informs responses to development proposals outlined by others. As a group, Indigenous people are socially and economically disadvantaged, but also custodians of ancient landscapes. They therefore seek to balance short- to medium-term social and economic needs with long-term cultural, historical and religious responsibilities to ancestral lands. Past forums have outlined Indigenous development agendas that are consistent with Mitchell catchment Traditional Owner perspectives (NAILSMA, 2012, 2013). These agendas are informed by two primary goals:

1. greater ownership of and/or management control over traditional land and waters
2. the sustainable retention and/or resettlement of Indigenous people on their country.

These goals are interrelated, because retention and/or resettlement relies on employment and income generation, and the majority of business opportunities identified by Indigenous people are land- and natural-resource dependent: conservation services, pastoralism, bush foods and products, horticulture, aquaculture, and ecotourism. All groups have multiple management roles but, based on geography, residence, assets, governance and/or skills, some may more easily be able to sustain multiple business activities, while others may be better off focusing on a single activity. Natural and cultural resource management is an ongoing process for Indigenous custodians, but formal paid roles in this sector are particularly valued and Indigenous ranger programs play a crucial incentivising and seeding role. The creation and/or expansion of such programs is a high priority for the research participants in the Mitchell catchment.

Partnerships and planning

In terms of generating wider business partnerships, a range of options may be useful in improving the opportunities for business to understand and invest in Indigenous people and Indigenous lands in the Mitchell catchment. The development of a full business analysis may include the following key potential actions:

- The production of one or more regional prospectuses to define Indigenous assets and opportunities and to communicate with investors.

- Further information and training for Indigenous people about the opportunities and constraints of partnerships with private industry, including discussion of the effect of changes in Indigenous resource rights (acquisition of land, granting of native title rights, securing of water rights and allocations, etc.).
- Wider regional non-Indigenous community training regarding partnerships with Indigenous people, including models for shared benefit agreements and partnership arrangements, employment and training opportunities, etc.
- Creating incentives for Indigenous involvement, including relocation and resettlement allowances, pathways from training to jobs, employer incentives to hire and retain Indigenous staff, etc.
- Training for younger Indigenous people about career planning as well as formal job skills.

Indigenous development objectives, and Indigenous development partnerships, are best progressed through locally specific, group and community-based planning and prioritisation processes that are nested in a system of regional coordination. Such planning and coordination can greatly increase the success of business development and of the opportunities for Indigenous employment, retention and resettlement that arise from them. Modest but targeted resourcing to appropriate entities (e.g. local corporations, rangers, catchment management groups, land councils,) to coordinate further Indigenous capacity building in local group prioritisation, catchment management, water planning, and enterprise development can provide significant returns on investment for major developers, communities, and government.

3.6 Legal, policy, and regulatory environment

3.6.1 INTRODUCTION

This section provides an overview of the legal and policy institutions relevant to water-related development in the Mitchell catchment. The term 'institutions' is used here to refer to the rules and norms that govern water-related development that stem from international and domestic law and policy. The analysis sheds light on the nature of the rights and interests that are necessary to undertake, and could be affected by, water-related development. Four themes are used to structure the analysis: legal and policy context, interests in land, interests in water, and government approvals.

3.6.2 LEGAL AND POLICY CONTEXT

Government powers and responsibilities concerning the management of land and water resources in the Mitchell catchment are shared between the Australian Government, Queensland Government and four local councils (Kowanyama Aboriginal Shire Council, Carpentaria Shire Council, Mareeba Shire Council and Cook Shire Council). While there is a degree of overlap between the powers and responsibilities of these three levels of government, each perform discrete functions.

Australian Government

The Australian Government performs two key functions: oversight of native title; and the implementation of Australia's obligations under international law. Unlike other types of interests in land, native title is a federal responsibility and is managed under the *Native Title Act 1993* (Cth). Similarly, in relation to international law, the Australian Government is responsible for ensuring Australia meets its international obligations. Under Australian law, international legal obligations have no direct effect on domestic law until and unless they are incorporated into it by an act of parliament. The most relevant federal statutes that give effect to international obligations and responsibilities are the *Racial Discrimination Act 1975* (Cth) and *Australian Human Rights Commission Act 1986* (Cth), which prohibit discriminatory behaviour, and the EPBC Act, which regulates activities that adversely affect 'Matters of National Environmental Significance'.

Queensland Government

The Queensland Government is primarily responsible for the management of land and water resources within the Mitchell catchment. It is the ultimate 'owner' of almost all land in Queensland, is responsible for the system of land title in the state, manages Crown lands, reserves and national parks, regulates access to and the use of surface and groundwater, and manages the positive and negative externalities associated with development through planning, environmental and heritage regulations.

Local councils

Local councils have no status under the Australian or Queensland constitutions. Formally, they are state agencies established under local government legislation. The most important functions the four councils in the Mitchell catchment perform in the current context relate to land use planning. They are responsible for preparing and administering local planning schemes, which guide and regulate land use and development within their municipalities.

3.6.3 INTERESTS IN LAND

Proponents of water-related developments will require legal entitlements to access and use the subject land. This could involve the grant or acquisition of a freehold or leasehold interest in the land or the issuance of a licence for a period of time. Freehold and leasehold interests give the holder a legal interest in the land. In contrast, the holder of a licence obtains no property rights in relation to the land. Depending on the nature of the licence, the licensee will either have personal rights of access that are enforceable under contract or the licence will simply make an act lawful that would otherwise be unlawful. For proponents of water-related developments, licences will typically be used for initial exploratory purposes only. To undertake any material development, proponents will usually need to acquire a freehold or leasehold interest in the land from the current landholder, or have a freehold or leasehold interest granted by the state or territory government. Freehold and leasehold interests provide greater security and control than licences, and enable the holder to exclude most third parties from the land and the benefits that stem from its development and use.

Most of the land in the Mitchell catchment is held as Crown leasehold land, national parks, freehold land and Aboriginal land.

Crown leasehold land

Crown leasehold land is government-owned land held under a lease, typically by a private party. The management of, and issuance of leasehold interests in, Crown land in Queensland is governed by the *Land Act 1994* (Qld). There are three main types of Crown leasehold interests that can be issued under this Act: term leases; perpetual leases; and freeholding leases. Most of the Crown leases in the Mitchell catchment are term leases (leases for a fixed term, usually of up to 50 years), and most of these are 'rolling term leases', where the term of the lease can be extended at any time for the same length as the original term. Four types of pastoral leases that existed under the previous legislative regime (pastoral holdings, pastoral development holdings, preferential pastoral holdings and the stud holdings) are now treated as term leases. All Crown leases can be subject to restrictions on the use, development and transfer of land. For example, unless otherwise authorised, they can only be used for the specific purposes identified in the lease and cannot be transferred or sublet. They are also subject to a 'general duty of care', which explicitly includes obligations to take all reasonable steps to avoid causing dryland salinity, conserve soil, protect riparian vegetation, maintain native grassland free of encroachment from woody vegetation, manage declared pests and conserve biodiversity.

National parks

National parks are generally either government-owned land or Aboriginal land that has been declared a national park under the *Nature Conservation Act 1992* (Qld). National parks are required to be managed for conservation purposes in accordance with statutory management principles. Where they are located on Aboriginal land, they must also be managed, as far as practicable, in a manner consistent with Aboriginal traditions applicable to the area. Generally, people wanting to use a national park must obtain a lease, licence or other authority under the *Nature Conservation Act 1992* to do so and there are restrictions on the circumstances in, and purposes for which these interests and authorisations can be issued.

Freehold land

Freehold land is land in which a freehold estate has been granted. Freehold estates are the most complete legal interest in land under Australian law. While close to absolute ownership, freehold estates do not give the landholder the right to use the land as they please. The estates are almost always subject to reservations and the use and development of the land is regulated under planning, environment and other similar statutes.

Aboriginal land

Aboriginal land is freehold land held on trust by Aboriginal land trusts and so-called 'CATSI corporations' (corporations registered under the federal *Corporations (Aboriginal and Torres Strait Islander) Act 2006* (Cth)) for Indigenous groups or communities under the *Aboriginal Land Act 1991* (Qld). Aboriginal land is subject to special restrictions, including that trustees cannot sell or mortgage it. Use and development of Aboriginal land can be facilitated through leases, which are subject to specific rules under the *Aboriginal Land Act 1991*.

In addition to the need for a freehold or leasehold interest, or a licence, any water-related development must be consistent with the native title arrangements that apply to the land. A substantial proportion of the Mitchell catchment is subject to native title and registered native

title claims. Native title is a unique form of property interest under Australian law consisting of a bundle of rights defined by the laws and customs of the relevant Indigenous community. Reflecting its unique status, native title has its own system of determination (through the Federal Court of Australia), registration (at the National Native Title Registry, maintained by the National Native Title Tribunal) and protection (under the *Native Title Act 1993*).

Where native title or a native title claim exists over an area of land, proponents of water-related development will be required to engage with relevant Traditional Owners and the federal native title process. Importantly, water-related development in the catchment could involve 'future acts' that could be rendered invalid by the operation of the *Native Title Act 1993*, or trigger a right to compensation. In this context, relevant 'future acts' could consist of special legislation (or legislative amendments) made to facilitate the development, the issuance of property interests and approvals to support or authorise the development, and the conduct of related public works. There are a number of ways of avoiding invalidity of future acts, one of the most notable being entry into Indigenous land use agreements (ILUAs) with Traditional Owners. ILUAs are agreements between native title parties and others about the use of land and waters subject to native title, or over which native title is claimed. Where a determination is made that native title exists, ILUAs can be used to settle arrangements concerning the area and the treatment of native title. Even when native title has not been determined, ILUAs can be used to proactively settle arrangements concerning native title and the use and development of an area with Traditional Owners.

3.6.4 INTERESTS IN WATER

The 'rights' to the use, flow and control of all water in Queensland are vested in the Queensland Government under the *Water Act 2000* (Qld). This legislation contains processes for water planning and the regulation of taking and interference with water. The regulation of the construction and operation of water infrastructure (e.g. dams, bores, levies and pipes) is done through the *Planning Act 2016* (Qld) and the *Water Act 2000*.

Water planning

The Water Act's planning process involves the preparation of statutory water plans, which provide the basis for 'water entitlements' (water allocations, interim water allocations and water licenses), as well as for the allocations of water for environmental and other public purposes. The implementation of each water plan may be supported by a 'water management protocol' that outlines, for the plan area, volumes, purpose and location of unallocated water and processes for releasing unallocated water, and rules for allocating water as well as rules for assigning seasonal allocations. 'Water entitlement notices' also support the implementation of a water plan by providing rules governing the grant, amendment and cancellation of water entitlements such as water licences or allocations for the plan area. The *Water Plan (Mitchell) 2007* is the primary water plan for the Mitchell catchment. It identifies available water in the Mitchell catchment water plan area and provides a framework for regulating the taking and interference with water in the region. The *Water Plan (Mitchell)* deals with water in a watercourse or lake, springs not connected to Great Artesian Basin (GAB) water, underground water that is not GAB water, and overland flow water, other than GAB spring water. The *Water Plan (Great Artesian Basin and Other Regional Aquifers) 2017* regulates access to and use of GAB water either underground or in springs in the Mitchell catchment area. The *Water Plan (Barron) 2002* is also of relevance to the Mitchell

catchment as there is an inter-basin transfer of water from the Barron River into the Walsh River (in the upper Mitchell catchment) to support part of the Mareeba–Dimbulah Water Supply Scheme (MDWSS).

Approvals for taking water

Under the Water Act's regulatory regime, activities involving the taking or interference with water are divided into two categories: those that can occur without an authorisation; and those that can only occur under an authorisation. The Act provides for six main types of authorisations: water licences; water allocations; water permits; resource operations licences; distribution operations licences; and operations licences. Rules for issuing and managing these authorisations are detailed in the *Water Act 2000, Water Regulation 2016* (Qld) and water management protocols (for particular water plan areas).

Water-related works approvals

The regulation of the construction and operation of water-related facilities and infrastructure (e.g. dams, levees and bores) is mainly done through the *Planning Act 2016*). Generally, the construction of water-related facilities and infrastructure require development approval under the *Planning Act 2016*, as well as authorisations under the *Water Act 2000* to engage in the actual taking or interference. The details of the development approval requirements are spread across the *Planning Act 2016* and Parts 19 and 20 of the *Planning Regulation 2017* (Qld), and the *Water Act 2000* and Part 10 and Schedule 9 of the *Water Regulation 2016*.

3.6.5 GOVERNMENT APPROVALS

In addition to holding the requisite rights and interests to access the land, and to take water, proponents of water-related development must have the necessary privileges to undertake the development. Some of these privileges will come with proponents' interests in land. However, ownership of an interest in land does not provide the holder with the legal ability to use and develop the land as they please. Government regulations can control the use and development of land and water resources. The most relevant government regulations are those imposed under federal and state planning, environment and heritage statutes.

Australian Government regulations

The Australian Government does not have planning legislation that applies to the Mitchell catchment. However, it does have both environmental and heritage regulations that could apply to water-related development in the region. The principal federal environmental statute is the EPBC Act, which regulates actions that have significant impacts on 'Matters of National Environmental Significance', the environment on Commonwealth land, and the environment generally where the relevant action is carried out by a Commonwealth agency or on Commonwealth land. There are nine Matters of National Environmental Significance, the most relevant of which are World Heritage areas (Wet Tropics World Heritage Area), National Heritage places (Ngarrabullgan National Heritage Place), listed threatened species and ecological communities, and listed migratory species. Water-related development that could have significant adverse impacts on these matters must be referred under the EPBC Act for assessment and approval. Guidelines have been published by the federal environment department to help

proponents determine when projects are likely to have significant impacts on matters protected under the Act. Due to the ambiguity associated with determining the significance of potential impacts, proponents should consult with the federal environment department about the need for referrals before undertaking water-related developments. In addition to the regulatory requirements under the EPBC Act, stakeholders interested in water-related development should be aware of the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Cth) (ATSIHP Act). Declarations can be issued under the ATSIHP Act to protect significant Aboriginal areas and objects from injury or desecration. These declarations are rarely made but they can be powerful, forcing the cessation of projects affecting the relevant area or object. There are a number of other federal regulatory regimes that could apply to proponents involved in water-related development. Foreign investors should take particular note of the federal regulation of foreign investment under the *Foreign Acquisitions and Takeovers Act 1975* (Cth) and *Foreign Acquisitions and Takeovers Fees Imposition Act 2015* (Cth). Under this regulatory regime, the federal Treasurer can impose conditions and even block foreign investment proposals in Australia. Foreign interests in agricultural land are also required to be registered with the Australian Taxation Office under the *Register of Foreign Ownership of Agricultural Land Act 2015* (Cth).

Queensland regulations

Planning

Land use planning in Queensland is mainly governed by the *Planning Act 2016* (Qld). There are four local planning schemes that apply in the Mitchell catchment: Kowanyama Aboriginal Shire Planning Scheme; Shire of Carpentaria Planning Scheme; Cook Shire Planning Scheme; and Mareeba Shire Planning Scheme. The local planning schemes divide development into three categories: prohibited development (the type of development cannot be carried out on the subject land); assessable development (the type of development can only be carried out with development approval); and accepted development (the type of development can be carried out without approval). Where a development is assessable, the relevant planning scheme will designate whether the assessment must be 'code assessment' (less intensive) or 'impact assessment' (more comprehensive and involves public notification and comment). The *State Development and Public Works Organisation Act 1971* (Qld) operates alongside the *Planning Act 2016* and provides for the coordinated planning, assessment and approval of projects of economic, social and/or environmental significance to the state. For this process to apply, projects must be declared 'coordinated projects' under the Act by the Queensland Coordinator-General. To be eligible to be declared a coordinated project, projects must have complex approval requirements (federal or state), strategic significance to a locality, region or the state, significant environmental effects or significant infrastructure requirements. While these factors are considered in making the decision, ultimately, whether projects are declared is at the discretion of the Coordinator-General. If projects are declared a coordinated project, they must undergo an Environment Impact Statement (EIS) or Impact Assessment Report (IAR). In addition to approvals required under the *Planning Act 2016*, water-related developments in the Mitchell catchment involving broadacre cropping or water storage activities may require a regional interests development approval under the *Regional Planning Interests Act 2014* (Qld).

Environment

The main environment protection statute in Queensland is the *Environmental Protection Act 1994* (Qld). Under the Act, it is an offence to carry out an 'environmentally relevant activity', or to cause material or serious environmental harm, without an environmental authority. Environmentally relevant activities are defined for these purposes as activities that could contaminate and harm the environment that are prescribed under the regulations. Schedule 2 of the *Environmental Protection Regulation 2008* (Qld) contains a list of prescribed environmentally relevant activities, which includes aquaculture facilities, intensive animal feedlots, poultry farming, piggeries, food processing and beverage production, and waste and water treatment services. Where an environmental authorisation is required, it triggers a four-stage assessment and approval process.

Heritage

There are two main state heritage statutes that apply in the Mitchell catchment: one governing non-Indigenous cultural heritage, the *Queensland Heritage Act 1992* (Qld); and one governing Indigenous cultural heritage, the *Aboriginal Cultural Heritage Act 2003* (Qld). The *Queensland Heritage Act 1992* establishes the Queensland Heritage Register to record places of state cultural heritage significance, with the exception of places of Indigenous heritage significance. Protection of places of state and local heritage significance is afforded through the *Planning Act 2016*. The *Aboriginal Cultural Heritage Act 2003* imposes a general 'cultural heritage duty of care' not to harm Aboriginal cultural heritage. This duty of care requires a person who carries out an activity to take 'all reasonable and practicable measures to ensure the activity does not harm Aboriginal cultural heritage'. There are a number of ways proponents can satisfy their cultural heritage duty of care, including by ensuring they carry out the development in accordance with the cultural heritage duty of care guidelines issued under the Act, or entering into a Cultural Heritage Management Plan or ILUA (under the *Native Title Act 1993*) with relevant Traditional Owners.

Major projects

There are two processes for major projects in Queensland: the *State Development and Public Works Organisation Act 1971* (Qld) (SDPWO Act) process for coordinated projects; and the State Assessment and Referral Agency (SARA) (which forms part of the Queensland Department of Infrastructure, Local Government and Planning) process for projects requiring assessment under the *Planning Act 2016* that affect state interests and require assessment by state agencies against the state development assessment provisions. Both of these processes are intended to lower transaction costs for major project proponents by streamlining state government approval requirements.

3.6.6 DURATION OF GOVERNMENT ASSESSMENT AND APPROVAL TIMES

Proponents of water-related developments should be aware that government assessment and approval processes can be resource intensive and time consuming. To illustrate this, an analysis was undertaken of the length of environmental assessments under the SDPWO Act and the EPBC Act. The state analysis covered all projects assessed under the SDPWO Act since 2004, while the EPBC Act analysis covered all projects located in Queensland that were referred and approved over the period July 2010 to March 2018.

Figure 3-32 shows the median length of each stage of the environmental assessment process for the sampled projects under the SDPWO Act. The results are presented by industry and for the entire sample of 65 projects. There are four main stages in the process (not all of which are mandatory for all projects): i) screening (where the Coordinator-General determines whether the project requires formal assessment), ii) scoping (where the Coordinator-General determines the Terms of Reference for the environmental assessment), iii) assessment documentation (where the proponent prepares the assessment documentation), and iv) Coordinator-General report (where the Coordinator-General prepares its advice on the project).

The aggregate of the median length of each stage was 867 days (Figure 3-32), with the longest part of the process being the preparation of the assessment documentation (532 days). The median total assessment time was 1049 days, with an average of 1185 days. While these results are noteworthy, the length of the process varied considerably between projects and project types. For example, 20% of assessments took under 550 days, while 25% took longer than 1500 days. The variability in assessment times reflects the flexibility of the process and the factors that influence its length, including the size and complexity of the proposals, the nature, magnitude and likelihood of relevant economic, social and environmental impacts, resource constraints within the Office of the Coordinator-General, and the speed with which proponents are able to produce relevant assessment information.

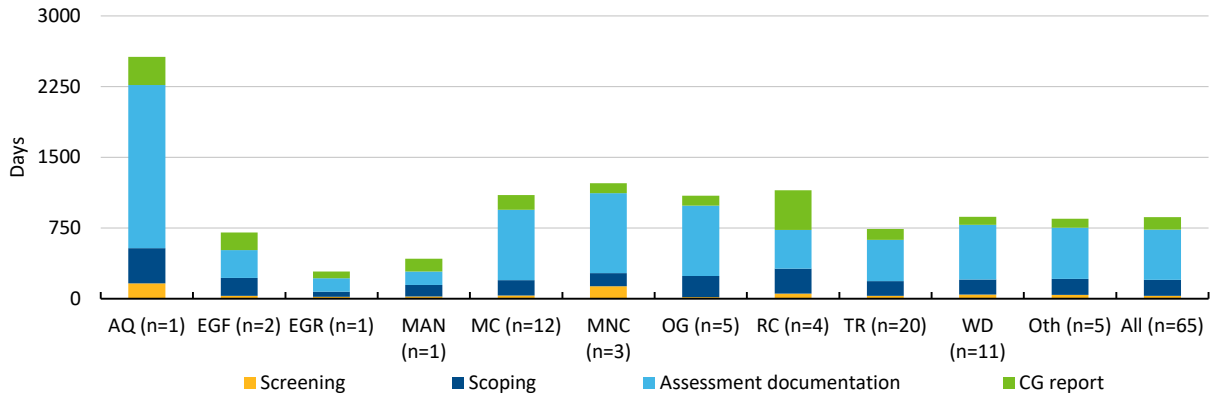

Figure 3-32 Median length of each stage of the assessment process under the *State Development and Public Works Organisation Act 1971* (Qld) (SDPWO Act), 2004–2018

Industry codes: AG = agriculture; AQ = aquaculture; EGF = energy generation (fossil fuels); EGR = energy generation (renewables); MAN = manufacturing; MNC = mining (non-coal); MC = mining (coal); OG = oil and gas; RC = residential and commercial; TR = transport; WD = water resource development; Oth = other. The number of projects in each industry code is provided in parentheses.

Source: Queensland Department of State Development, Manufacturing, Infrastructure and Planning

The federal EPBC Act assessment and approval process often runs in parallel with state processes, meaning it does not necessarily add to project delays. Further, under the EPBC Act, assessments are frequently undertaken through relevant state and territory processes. For example, where a project requires state government approval under the *Planning Act 2016* and Australian Government approval under the EPBC Act, the assessment carried out under the SDPWO Act that guides and informs the *Planning Act 2016* approval will often also cover, and be used for, the federal approval process. While the EPBC Act process has been designed to minimise duplication and delays, it can still be time consuming, particularly where state and federal approvals are sought sequentially.

Figure 3-33 shows the median length of the three main stages of the EPBC Act assessment and approval process (screening, assessment and approval) for the 100 Queensland projects referred and approved over the period July 2010 to March 2018. Again, the results are presented by industry and for the entire sample.

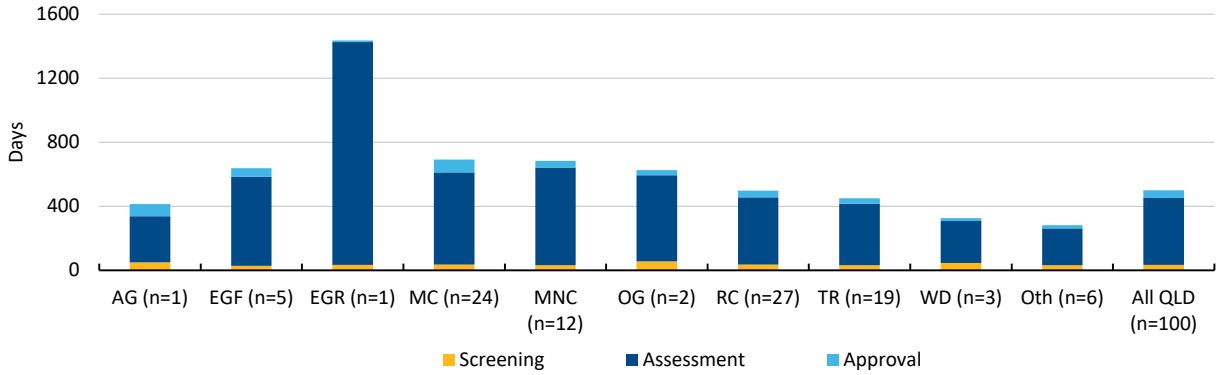

Figure 3-33 Median length of each stage of the assessment and approval process under the EPBC Act, all projects in Queensland over the period July 2010 to March 2018
Source: Department of the Environment and Energy

The aggregate of the median length of each stage was 500 days. The assessment phase accounted for almost 84% of that time, highlighting the importance of proponents ensuring assessment information is provided in a timely manner. Similar to the results from the state analysis, the length of the EPBC Act assessment and approval process was highly variable, ranging from 78 to 2447 days. Just over one third (31%) of approvals took less than 365 days, while 34% took more than 730 days (Figure 3-34).

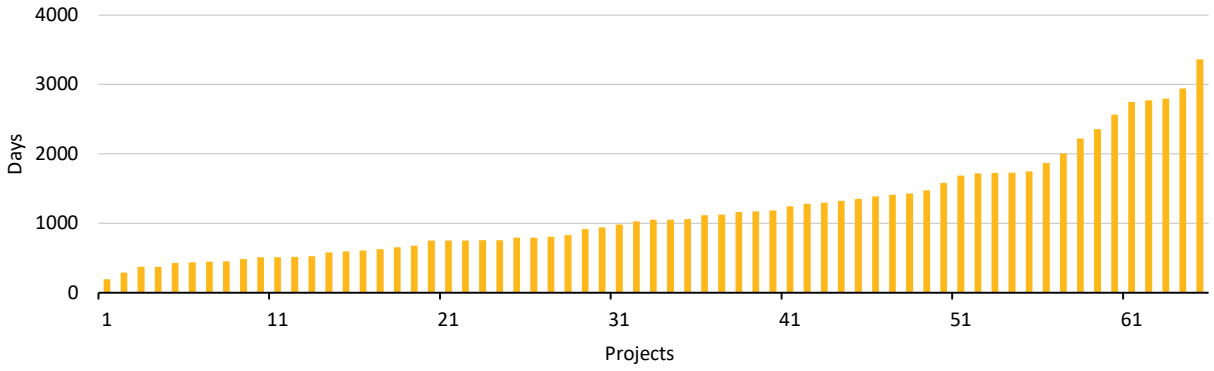

Figure 3-34 Total length of EPBC Act assessment and approval process, Queensland projects from 2010-2018, by length of process
Source: Department of the Environment and Energy.

The potential for government assessment and approval processes to cause delays, and the factors that contribute to them, are illustrated by the two aquaculture and agriculture developments in the SDPWO Act and EPBC Act samples.

The aquaculture development was a prawn farm project at Guthalungra, 40 km north of Bowen in Queensland. The project involved the construction of 259 x 1 ha x 1.5 m deep ponds, which are intended to produce approximately 1600 t of black tiger prawns (*Penaeus monodon*) per year for domestic and international markets. The main environmental concerns associated with the project centred on its potential impacts on water quality and the natural heritage values of the Great

Barrier Reef. The project site is located near the coast and adjacent to the Elliot River, which flows into the reef.

The original proponent of the project, Pacific Reef Fisheries Pty Ltd, submitted an Initial Advice Statement to the Queensland Coordinator-General under the SDPWO Act in January 2001 and referred the project under the EPBC Act in the same month. To reduce duplication, the Australian Government accredited the SDPWO Act assessment process for the purposes of the EPBC Act, meaning the state assessment was used for the final federal approval decision. The assessment was extensive, lasting seven years and ending on 11 January 2008. The EPBC Act approval took a further two years, being finally granted on 4 March 2010.

The length of the state and federal processes highlights the delay risks associated with government approvals. However, it also demonstrates the importance of site selection in project development. The environmental acceptability of aquaculture developments are a function of a number of factors, one of the most important of which is the sensitivity and values associated with the surrounding environment. In this instance, the project site had a number of characteristics that made it appealing from a commercial and production perspective. Yet the site was adjacent to, and would discharge production wastes into, the high profile and highly protected World and national heritage-listed Great Barrier Reef. Siting the project in this location was one of the main contributing factors to the length of the assessment and approval process.

The agriculture development in the EPBC Act sample was a cropping development on the 21,500 ha Meadowbank Station, west of Ravenshoe in north Queensland. The project involved the clearing of 1,365 ha of native vegetation for forage cropping associated with cattle production. Originally, the proposal involved the clearing of over 6,000 ha. This was initially scaled back to 1,470 ha, and later to the final 1,365 ha. The project received state approval under the now repealed *Sustainable Planning Act 2009* (Qld) in November 2016 on the basis of being a high value agriculture development. However, due to potential impacts of the clearing on nationally listed threatened species, including the black-throated finch, the proposal was referred under the EPBC Act in December 2016, after the state approval had been granted. The project was assessed by way of 'preliminary documentation', a low level of assessment that is typically relatively short. Despite this, the EPBC Act approval still took over a year, with final approval granted in early February 2018.

The Meadowbank Station case illustrates the importance of considering government approval timelines when designing projects. By applying for state and federal approvals sequentially, the proponent potentially extended the delays associated with these processes. Where multiple state and federal approvals are required, delays can often be avoided, and costs reduced, by applying for them in parallel.

The SDPWO Act and the EPBC Act will not apply to all water-related developments in the Mitchell catchment. Proponents should seek advice on the government approvals required for their projects well in advance of commencement, including on the likely cost and duration of the processes.

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