Healthy Waters Management Plan

Condamine River Basin

This Healthy Waters Management Plan meets accreditation requirements for relevant water quality sections under the Water Act 2007- Basin Plan 2012

Queensland Government

Acknowledgement of the Traditional Owners of the Condamine region

The Department of Environment and Science (the department) would like to acknowledge and pay respect to the past and present Traditional Owners of the region and their Nations, and thank the representatives of the Aboriginal communities, including the Elders, who provided their knowledge of natural resource management throughout the consultation process. The department acknowledges that the Traditional Owners of the Condamine River basin have a deep cultural connection to their lands and waters. The department understands the need for recognition of Traditional Owner knowledge and cultural values in water quality planning.

Prepared by: Department of Environment and Science.

Citation

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Acknowledgements

The Department would like to thank all stakeholders for their input throughout the development of this document, including members of the local community, industry, environmental groups, Traditional Owner groups, government representatives and natural resource management organisations.

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Front cover photo: Condamine River, Warwick, B. Southwell, 2018.

February 2019

Foreword

This document has been prepared in accordance with the Healthy Waters Management Plan requirements under the Queensland *Environmental Protection Act 1994* and Environmental Protection (Water) Policy 2009. This document also contributes to meeting particular requirements of a Water Quality Management Plan under the Commonwealth *Water Act 2007—Basin Plan 2012* (Basin Plan). The requirement for a Water Quality Management Plan is listed under Chapter 10, Part 7 of the Basin Plan. Text boxes such as this include explanations as to how this Healthy Waters Management Plan for the Condamine River basin (Refer to Figure 1) contributes to meeting the requirements of a Water Quality Management Plan under the Basin Plan.

What is a Healthy Waters Management Plan?

The Environmental Protection (Water) Policy 2009 (EPP Water), subordinate legislation under the *Environmental Protection Act 1994* (Qld.), establishes Healthy Waters Management Plans (HWMPs) as a key planning mechanism to improve the quality of Queensland waters.

HWMPs advance achievement of the purpose of the EPP Water to protect Queensland's water environment whilst allowing for development that is ecologically sustainable.

HWMPs include:

- identification and mapping of environmental values, desired levels of aquatic ecosystem protection and management goals for Queensland waters;
- water quality objectives (under the National Water Quality Management Strategy (NWQMS)[1]) to protect the environmental values; and
- management responses, which address point and diffuse emission sources, and may include market-based instruments, best management practice and adaptive management.

HWMPs provide an ecosystem-based approach to integrated water management, supported by best available science. The preparation of HWMPs includes:

- engaging with the local government, natural resource management groups, industry groups, local Aboriginal Nations and the community;
- addressing identified priority threats to water quality; and
- incorporating local catchment-based approaches to develop management responses.

What is a Water Quality Management Plan?

The Commonwealth *Water Act 2007—Basin Plan 2012* (Basin Plan) requires a water resource plan to include a Water Quality Management Plan (WQM Plan), prepared in accordance with Chapter 10, Part 7 of the Basin Plan. WQM Plans advance the achievement of the Basin Plan objectives and outcomes through:

- identifying the key causes, or likely causes, of water quality degradation;
- including measures to address risks arising from water quality degradation;
- identifying water quality target values;
- specifying measures to be undertaken in, or in relation to, the water resources of the water resource plan area;
- identifying locations of water quality targets for irrigation water; and
- assessing and having regard to the impact of the WQM Plan on the water resources of another Basin State.

Queensland's approach to the WQM Plan is an index which refers to relevant State and Commonwealth instruments to fulfil the requirements of the Basin Plan Chapter 10, Part 7. The HWMP prepared under the EPP Water fulfils most requirements of a WQM Plan. As a result, the HWMP is the primary document referred to under the WQM Plan (Refer to Figure 2).

The sections of this report that fulfil requirements of a WQM Plan under the Basin Plan include parts of Section 4 and Section 7 to Section 10.

[1] The NWQMS is a joint strategy developed by two Ministerial Councils – the Australian and New Zealand Environment and Conservation Council (ANZECC) and the Agriculture and Resources Management Council of Australia and New Zealand (ARMCANZ).

Figure 1: The Queensland Healthy Waters Management Plan areas that intersect the Murray-Darling Basin. This HWMP applies to the Condamine River basin only.

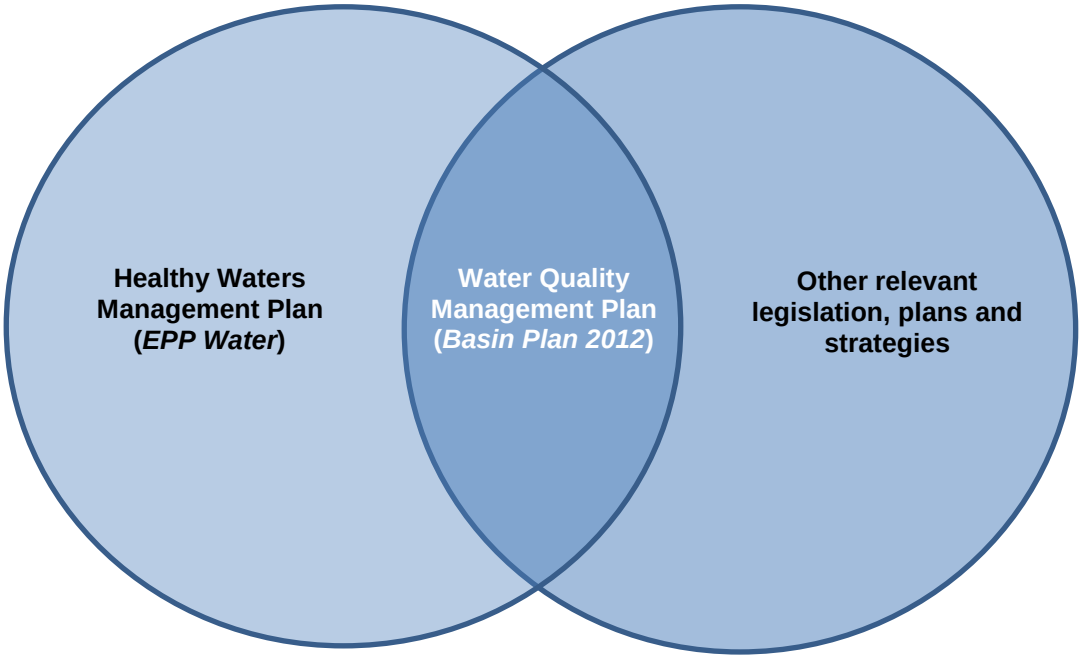

Figure 2: Queensland's approach to meeting Water Quality Management Plan requirements under Basin Plan.

The WQM Plan, prepared under Chapter 10, Part 7 of the Basin Plan, is an index that refers to relevant legislation, plans and strategies that address water quality. HWMPs, prepared under the EPP Water, are the primary documents referred to under the WQM Plan. Other relevant instruments that are referenced by the WQM Plan include Queensland Water Plans prepared under the Water Act 2000 and the Basin Salinity Management Strategy (Schedule B to the Murray-Darling Basin Agreement).

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Executive summary

The Healthy Waters Management Plan (HWMP) for the Condamine River basin has been prepared under the Environmental Protection (Water) Policy 2009 (EPP Water), which is subordinate legislation under the *Environmental Protection Act 1994* (Qld.). HWMPs present ways to improve the quality of water for a specified region in Queensland. As the Condamine River basin is located within the Murray-Darling Basin, this HWMP also contributes to the requirements of a Water Quality Management Plan (WQM Plan) under the Commonwealth *Water Act 2007— Basin Plan 2012.*

The HWMP for the Condamine River basin identifies the environmental, economic, social, cultural, spiritual and ceremonial values associated with the rivers, creeks, waterholes, floodplains, overflow channels, lakes, wetlands and groundwaters of the Condamine region. These are referred to under the EPP Water as 'environmental values' and are the qualities that make water suitable for supporting aquatic ecosystems and human use. The HWMP also identifies and maps the levels of aquatic ecosystem protection to inform the management of different types of aquatic ecosystems. The HWMP for the Condamine River basin was developed in consultation with a range of stakeholders, including Queensland and New South Wales government representatives, natural resource management groups, industry groups, environmental groups, local Aboriginal Nations, and the community.

Management goals are established in the HWMP for the Condamine River basin as the objectives and outcomes for water resources. They focus on achieving locally appropriate water quality target values (water quality objectives) that have been established at a sub-catchment level to protect identified aquatic ecosystem and human use environmental values for the waters. Long-term salinity planning and management is also addressed, with reference to the End-of-Valley Targets in Appendix 1 of Schedule B to the Murray-Darling Basin Agreement.

The extent and distribution of freshwater wetlands is the most important indicator of the state of wetland resources in Queensland, as any loss will mean that the services provided by that wetland will be diminished. Targets to maintain the extent of wetlands and riparian forest in the plan area are included in this report to help protect these important ecosystems.

A water quality risk assessment was conducted to identify the potential key types of water quality degradation that could occur in the Condamine River basin. It is important to note that just because a risk was highlighted through the assessment, does not mean the set of circumstances is currently present for the risk to materialise. The factors contributing to a potential risk are summarised in the healthy waters management plan.

The risks that were identified are presented below and are addressed through management responses included in the HWMP:

- elevated levels of salinity as potential medium risk in the South-Eastern Condamine, North-Western, Central (with a hotspot at Hodgson Creek), Southern, and South-Western Condamine;
- elevated levels of suspended matter as a potential medium risk in surface waters of the North-Western and South-Western Condamine.
- elevated levels of nutrients as a potential medium risk in the surface waters of the South-Western Condamine (including a hotspot at Condamine River gauging station 422336A), North-Western and Central Condamine. A potential medium risk was also identified for the ground waters of Mt Tyson within the Upper Condamine Basalts (GS65) and of the Upper Condamine Basalts (GS65) SDL resource unit;
- elevated levels of cyanobacteria cell counts or biovolume and toxins and odour compounds as a potential high risk in surface waters of the North-Western and South-Western Condamine;
- water temperature outside of natural ranges as a potential high risk in surface waters of the North-Western Condamine downstream of Chinchilla Weir and in the Southern Condamine downstream of Leslie Reservoir if stratification occurs;
- dissolved oxygen outside natural (ambient) ranges as a potential high risk in surface waters of the North-Western Condamine downstream of Chinchilla Weir and in the Southern Condamine downstream of Leslie Reservoir if stratification occurs;
- elevated levels of pesticides and other contaminants as a potential medium risk in surface waters of the Central and South-Western Condamine between Dalby and Condamine and in groundwaters of the Upper Condamine Basalts (GS65) SDL resource unit;
- elevated pathogen counts as a potential medium risk in surface waters of the Central Condamine and groundwaters of the Upper Condamine Basalts (GS65) SDL resource unit, with a hotspot at Highfields due to peri-urban development;
- degradation of aquatic habitat connectivity and condition within and between water-dependent ecosystems and the degradation of riparian extent, connectivity and condition as a medium risk throughout the Condamine basin;
- climate change as a high risk in the Condamine, Balonne and Maranoa; and

- pest fauna (aquatic) as a high risk in the Condamine, Balonne and Maranoa.

The management responses included in this document seek to maintain, and where practical improve, water quality towards achieving water quality target values (water quality objectives) that protect the environmental values across the plan area. These management responses recognise the existing projects being conducted across Queensland Murray-Darling Basin drainage basins, which may inform future updates to this document. The HWMP for the Condamine River basin also presents opportunities to strengthen the protection of Aboriginal people's values and uses of water, based on consultation with people from Aboriginal Nations in the plan area. The HWMP also encourages the implementation of Aboriginal Waterways Assessments (AWAs), where funded opportunities are available. AWAs are an in-field assessment of stream health from the perspective of Traditional Owners, and are a key initiative to increase the participation of Traditional Owners in natural resource and waterway management.

This HWMP advances the protection of the aquatic environment of the Condamine River basin through the achievement of objectives and outcomes in relation to water quality and salinity. The plan seeks to maintain appropriate water quality for environmental, social, cultural and economic uses; protect and restore water-dependent ecosystems; and ensure water resources remain fit-for-purpose.

SECTION 1: INTRODUCTION

1 Introduction

A Healthy Waters Management Plan (HWMP) presents ways to improve the quality of water for a specified region. HWMPs are a component of the framework for managing water quality in Queensland under the Environmental Protection (Water) Policy 2009 (EPP Water), which is subordinate legislation to the *Environmental Protection Act 1994* (Qld.).

1.1 Water to which this plan applies

HWMPs address water quality improvement within spatially defined geographic planning areas referred to as 'management units', which may range in scale from sub-region, to whole of catchment, to whole of basin (comprised of multiple catchments). A HWMP applies to all Queensland State waters within the defined management units (that is rivers, creeks, wetlands, lakes and groundwaters), except the types of water listed in Part 4, section 10(3) of the EPP Water.

This HWMP applies to the surface waters and groundwaters in the Condamine River basin (Refer to Figure 3), which fall within the Southern Queensland NRM regional organisation area. This HWMP also contributes to the Water Quality Management Plan for the Condamine-Balonne water resource plan area under Chapter 10, Part 7 of the *Basin Plan 2012* (Basin Plan).

1.2 Healthy Waters Management Plans under the Environmental Protection (Water) Policy 2009

In the following section, terminology under the Basin Plan is indicated in brackets.

HWMPs, as defined by the EPP Water, support achievement of the purpose of the EPP Water by identifying the environmental values (values and uses), water quality objectives (water quality target values) and management goals (objectives and outcomes) of the waters in a specified region, and identifying and prioritising ways to improve water quality.

The issues identified through a HWMP are broader than 'just water quality'. They include land management issues that can impact water quality, such as the health of the riparian zone or the management of grazing lands.

The economic and social impacts of protecting environmental values through water quality objectives are considered through consultation and via a socioeconomic assessment. At the completion of consultation and consideration of all submissions, the environmental values and water quality objectives are subsequently recommended for inclusion under Schedule 1 of the EPP Water.

Water quality objectives under the EPP Water are long-term goals for water quality management. They are measurements, levels or narrative statements of particular indicators of water quality that protect identified environmental values. Once scheduled within the EPP Water, environmental values and water quality objectives inform statutory and non-statutory water quality management planning and decision-making.

1.3 Water Quality Management Plan under the Basin Plan

The Basin Plan, prepared by the Murray-Darling Basin Authority under the Commonwealth *Water Act 2007*, was approved in November 2012. The Basin Plan provides a coordinated approach to water use across the State and Territory government areas that intersect the Murray-Darling Basin (specifically Queensland, New South Wales, Victoria, South Australia and the Australian Capital Territory). The Basin Plan aims to achieve a balance between environmental, economic and social considerations.

The Basin Plan specifies that a WQM Plan is a component of a Water Resource Plan (Commonwealth Water Resource Plan). Commonwealth Water Resource Plans under the Basin Plan are to be submitted to the Murray-Darling Basin Authority for accreditation by the Commonwealth Minister responsible for water. In Queensland, Commonwealth Water Resource Plans will be comprised of a package of existing State instruments, primarily Queensland water plans and resource operations plans under the *Water Act 2000* (Qld.) (Refer to Section 1.5 of this report for more information) and HWMPs under the EPP Water.

A HWMP prepared under the EPP Water contributes to meeting the requirements of a WQM Plan under Chapter 10, Part 7 of the Basin Plan. HWMPs that fulfil select requirements of a WQM Plan have been developed for all Queensland Murray-Darling Basin (QMDB) drainage basins in collaboration with the natural resource management organisations for the region – currently Southern Queensland NRM. For each Commonwealth Water Resource Plan package submitted to the Murray-Darling Basin Authority for accreditation under the Basin Plan, the Queensland Government will include a HWMP for the relevant water resource plan area.

Three Commonwealth Water Resource Plan packages will be prepared for QMDB catchments, to be compliant with the Basin Plan by 2019:

1. Warrego-Paroo-Nebine water resource plan area
2. Condamine-Balonne water resource plan area
3. Queensland Border Rivers-Moonie water resource plan area.

Note: The Bulloo drainage basin is external to the Murray–Darling Basin and is therefore not subject to the Basin Plan.

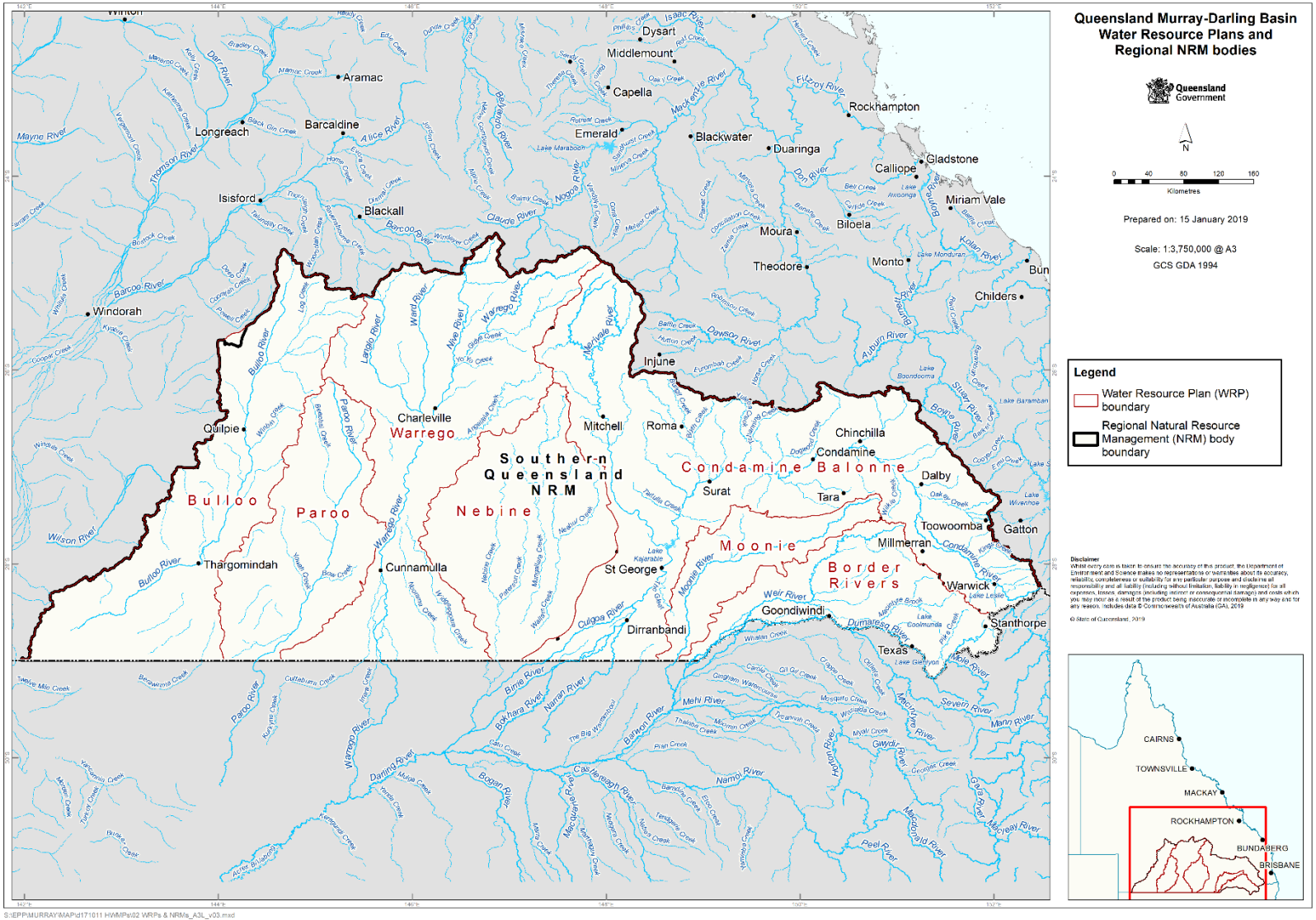

Figure 3: Queensland Murray-Darling Basin Water Resource Plan areas. This HWMP applies to the surface and groundwater of the Condamine River basin, in the Southern Queensland NRM regional organisation area.

1.4 Condamine River Basin

The Condamine River Basin covers approximately 25,440 square kilometres. The major towns in the region are Toowoomba, Warwick, Millmerran, Cecil Plains, Dalby and Chinchilla. The local government areas that intersect the plan area are Toowoomba Regional Council, Southern Downs Regional Council, Western Downs Regional Council and South Burnett Council (WetlandInfo, 2018a). National parks in the basin include Bunya Mountains National Park, Geham National Park and Main Range National Park. The eastern ranges in the Condamine region contains a World Heritage area, the Gondwana Rainforests of Australia.

The dominant land use in the Condamine region is irrigated cropping, dryland cropping and open grazing. Coal Seam Gas and coal extractive industries are also prevalent throughout the basin. Southern Queensland NRM is the regional body for natural resource management in the plan area.

1.4.1 Climate

The Condamine region has a summer dominant rainfall pattern. The mean annual rainfall is relatively consistent across the region, apart from on the edges of the Great Dividing Range (the headwaters of the Condamine River, east of Warwick) which receives the most rainfall in the region, experiencing approximately 1200mm annually. The remainder of the region experiences between 600-750mm of rainfall annually. Summer rainfall is dominated by high intensity storms from October to December, which can often be localised.

1.4.2 Surface water

The Condamine River basin comprises approximately 9% of the Queensland Murray-Darling Basin. The Condamine River basin forms part of the headwaters of the Murray-Darling Basin river system that flows through the southern states. The main channel in this basin begins in the headwaters of the Condamine River, near Warwick. This is within the Main Range National Park. The Condamine River flows north-west until around Brigalow, where the river turns west and crosses into the Maranoa and Balonne River basin. It then becomes the Balonne River between the town of Condamine and Surat and eventually discharges into the New South Wales intersecting streams (Bokhara, Ballandool, Culgoa and Briarie rivers).Tributaries of the Condamine River include Emu Creek, Glengallan Creek, Hodgson Creek, Oakey Creek, Wilkie Creek and Charleys Creek. The major water storage in the area is Leslie Dam (capacity 106 gigalitres).

1.4.2.1 Wetlands

Queensland's wetlands are important habitats and include rivers (riverine), lakes (lacustrine) and swamps (palustrine). Queensland's wetlands support the state's native biodiversity, including migratory birds, frogs, fish and threatened species. They are important for our economy because they provide nurseries for fish, water for farming and other uses. Wetlands remove sediments and transform nutrients and pesticides—protecting other downstream habitats. Wetlands are also great places to enjoy Queensland's natural wonders. Many of Queensland's wetlands are internationally important habitat for migratory birds and other values (WetlandInfo, 2018b). Wetlands are a focus of ecological diversity and abundance, and are subject to booms and busts determined by seasonal and sometimes decadal conditions. The Condamine region contains nationally important wetlands (DIWA) including Dalrymple and Blackfellow Creeks and Lake Broadwater.

For an extensive range of information, tools and maps on wetlands in Queensland refer to the Wetland*Info* website.

1.4.2.2 AquaBAMM

AquaBAMM is the state endorsed method for identifying and assessing wetlands in Queensland. AquaBAMM is a decision support tool that utilises existing information and expert input to assess conservation value in aquatic ecosystems. The output of the AquaBAMM method is an Aquatic Conservation Assessment (ACA) for a specified study area (WetlandInfo, 2013a).

The ACA for the wetlands of the Queensland Murray-Darling Basin (QMDB) was published in July 2011 (Fielder, Davidson, & Barratt, 2011). ACAs provide a source of baseline, wetland conservation/ecological information to support natural resource management and planning processes. They are useful as an independent product or as an important foundation upon which a variety of additional environmental and socio-economic elements can be added and considered. The ACA for the wetlands of the Queensland Murray-Darling Basin was a source of information for the development of this report.

The ACAs assess riverine and non-riverine (palustrine and lacustrine) wetlands separately. A project area, such as the Queensland Murray-Darling Basin, is divided into smaller sub-catchment units for the assessment.

The riverine or non-riverine wetlands within the subcatchment units are then assigned an AquaScore based on an assessment of eight criteria. The criteria are naturalness aquatic, naturalness catchment, diversity and richness, threatened species and ecosystems, priority species and ecosystems, special features, connectivity and representativeness. The AquaScore represents the overall conservation value of a subcatchment unit and varies from very low to very high.

Figure 4 and Figure 6 display the riverine and non-riverine AquaScores for the Condamine River basin. To highlight the significant wetland areas in the plan area, Figure 5 and Figure 7 present the riverine and non-riverine special features that were used in the development of the AquaScores. Special features are areas identified by flora, fauna and ecology expert panels. These features display characteristics which expert panels consider to be of the highest ecological importance. Special features include geomorphic features, unique ecological processes, presence of unique or distinct habitat, and presence of unique or special hydrological regimes e.g. spring-fed streams (WetlandInfo, 2013b).

1.4.2.3 Persistent waterholes

Persistent waterholes along the river systems in the plan area provide aquatic habitat during extended periods of low or no flow and, as a result, are referred to as ‘refugial waterholes’. They are critical components of a functioning ‘source and sink’ system for aquatic organisms in the semi-arid landscapes of the QMDB (Silcock, 2009). Refugial waterholes experience variable patterns of connection and disconnection which is a fundamental driver of ecological processes in these riverine environments and is vital for dispersal and survival of diverse populations of biota. Persistent refugial waterholes require careful management, not as individual waterholes, but as an integrated system of waterholes along the length of rivers and channels. The persistent waterholes for the Condamine River are listed in Appendix 4— Persistent Waterholes in the Condamine River basin.

1.4.2.4 Barriers to fish passage

Instream infrastructure, such as weirs, dams and road crossings, can limit the passage of aquatic fauna and affect their ability to migrate to new habitats for the purposes of food and spawning, and access to persistent waterholes. Some opportunities for fish passage are provided through barrier drown-out, where water depth downstream of the barrier increases during flooding to equal or exceed the height of the barrier. However, not all fish will be able to utilise these opportunities due to their size and speed. Note that barriers in the centre of a drainage basin impact inland fish more than barriers in lowland reaches, because barriers higher in the catchment typically drown-out less frequently (Kerr, Kimball, Prior, Ellaway, & Luke, 2015). Figure 8 displays the barriers to fish passage in the plan area based on best available information. Further work may identify additional barriers in the plan area. It is important to consider barriers to fish passage for the purposes of managing aquatic fauna in the plan area, particularly with respect to environmental flows/low flow levels and access to persistent waterholes during dry periods

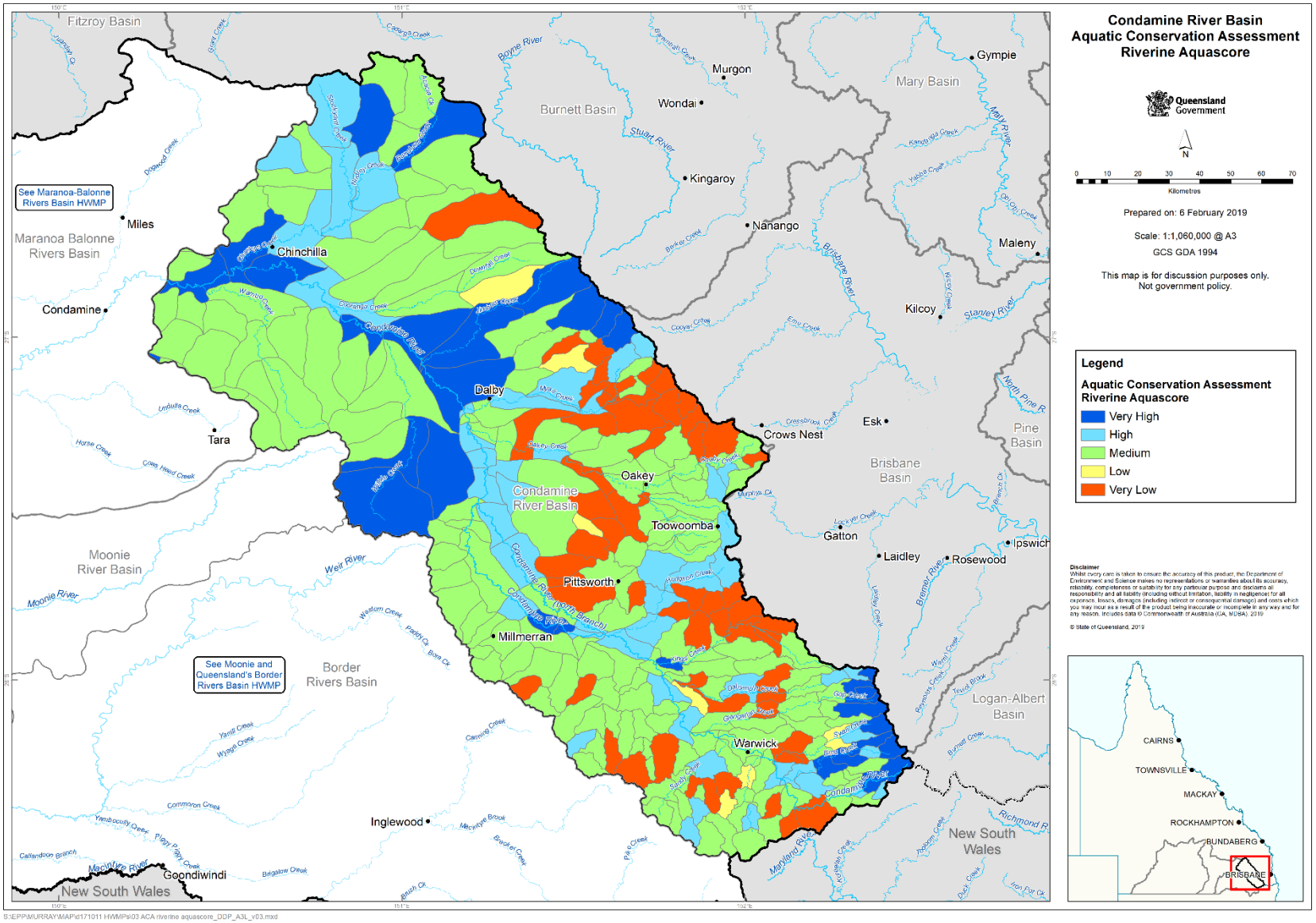

Figure 4: Riverine Aquatic Conservation Assessment AquaScores for the Condamine River basin

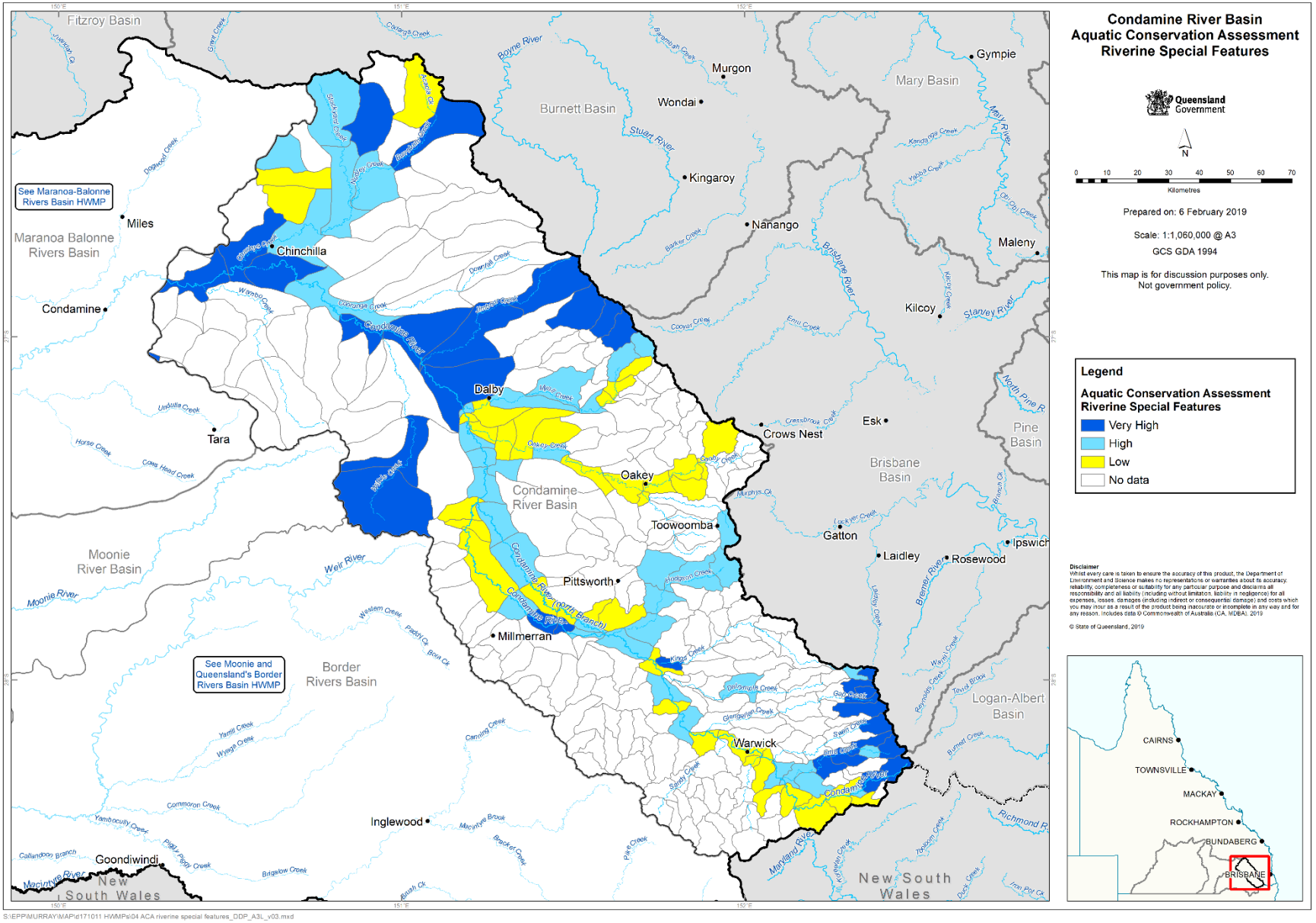

Figure 5: Riverine Special Features contributing to the Aquatic Conservation Assessment for the Condamine River basin

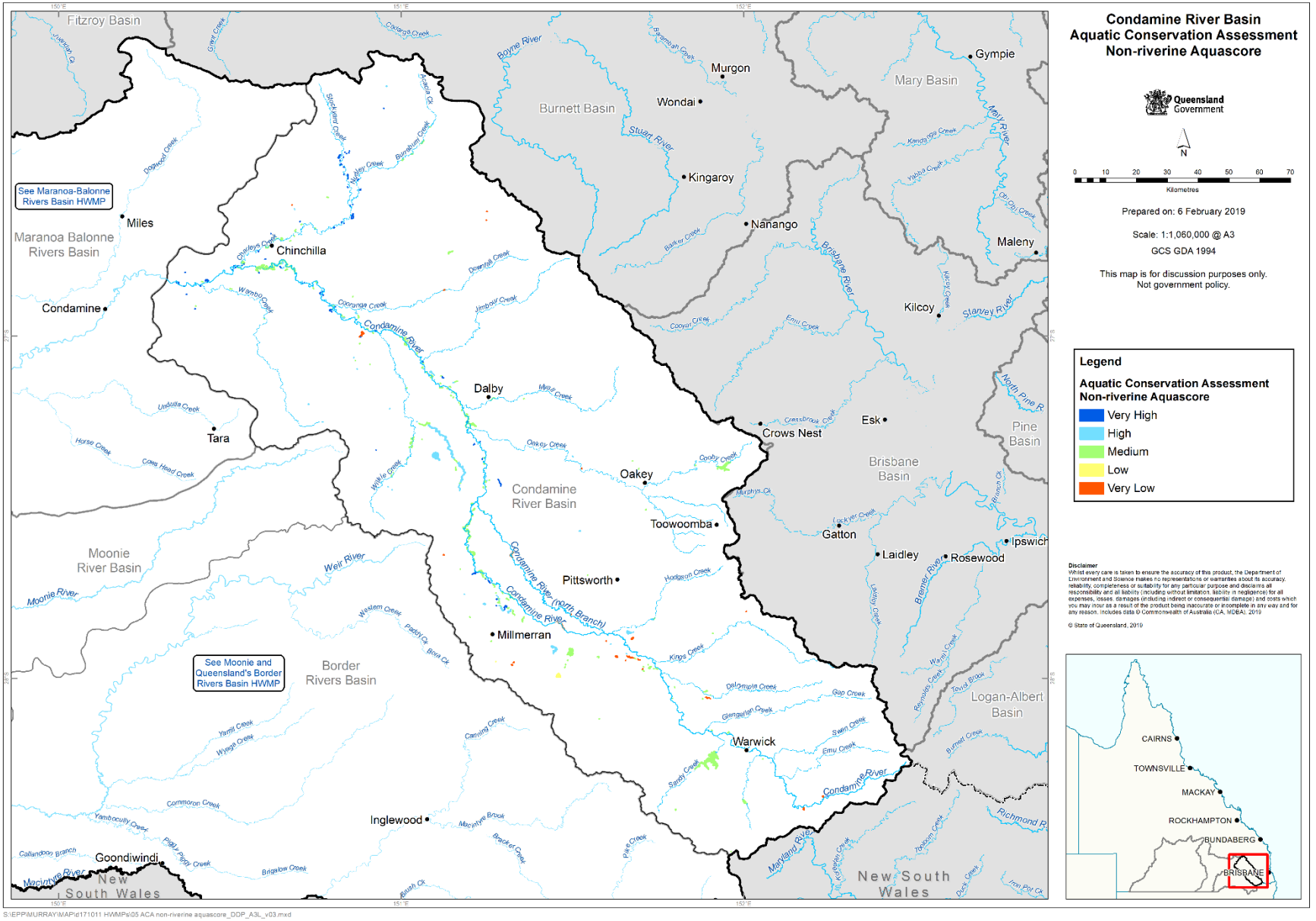

Figure 6: Non-Riverine Aquatic Conservation Assessment AquaScores for the Condamine River basin

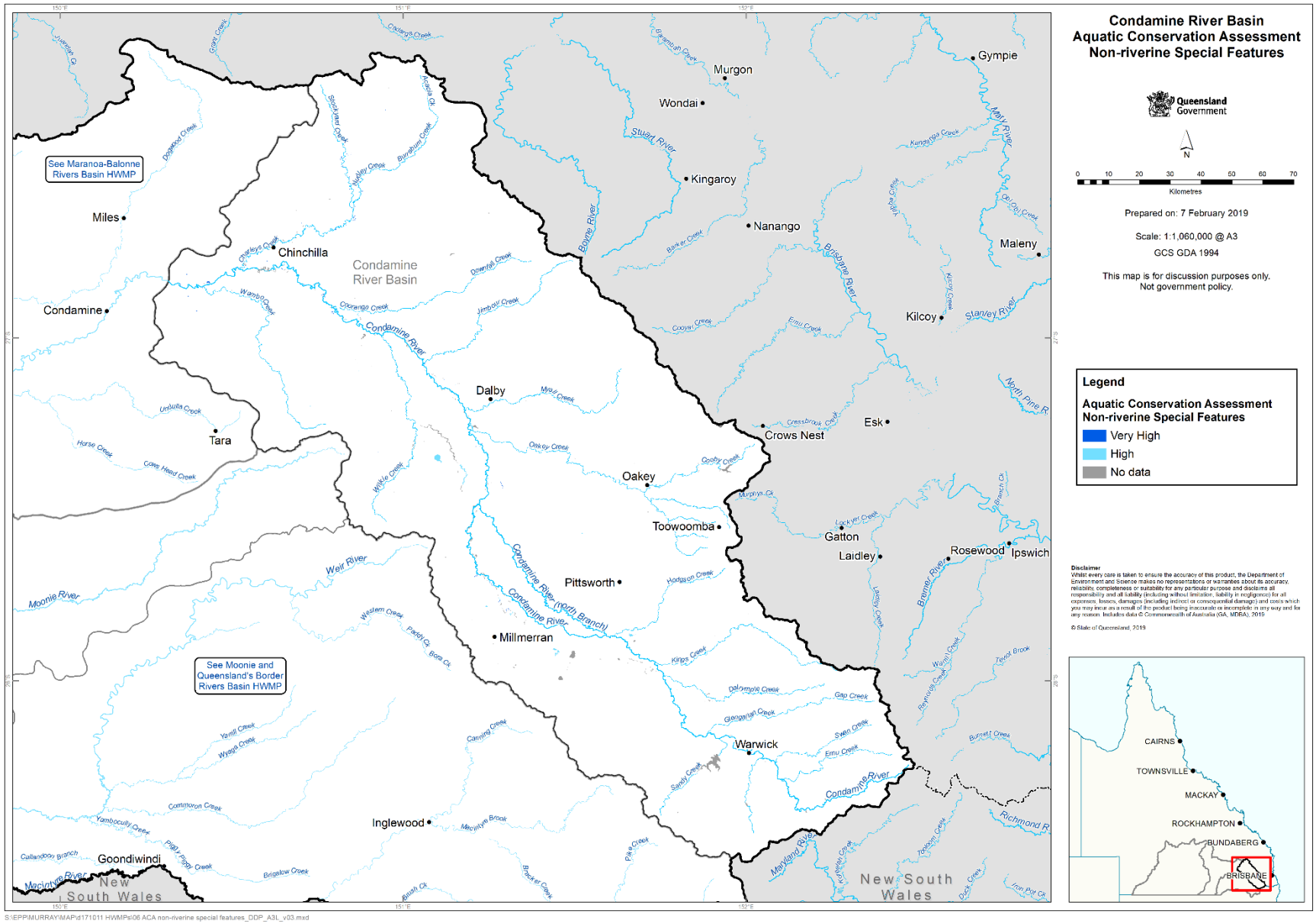

Figure 7: Non-Riverine Special Features contributing to the Aquatic Conservation Assessment for the Condamine River basin

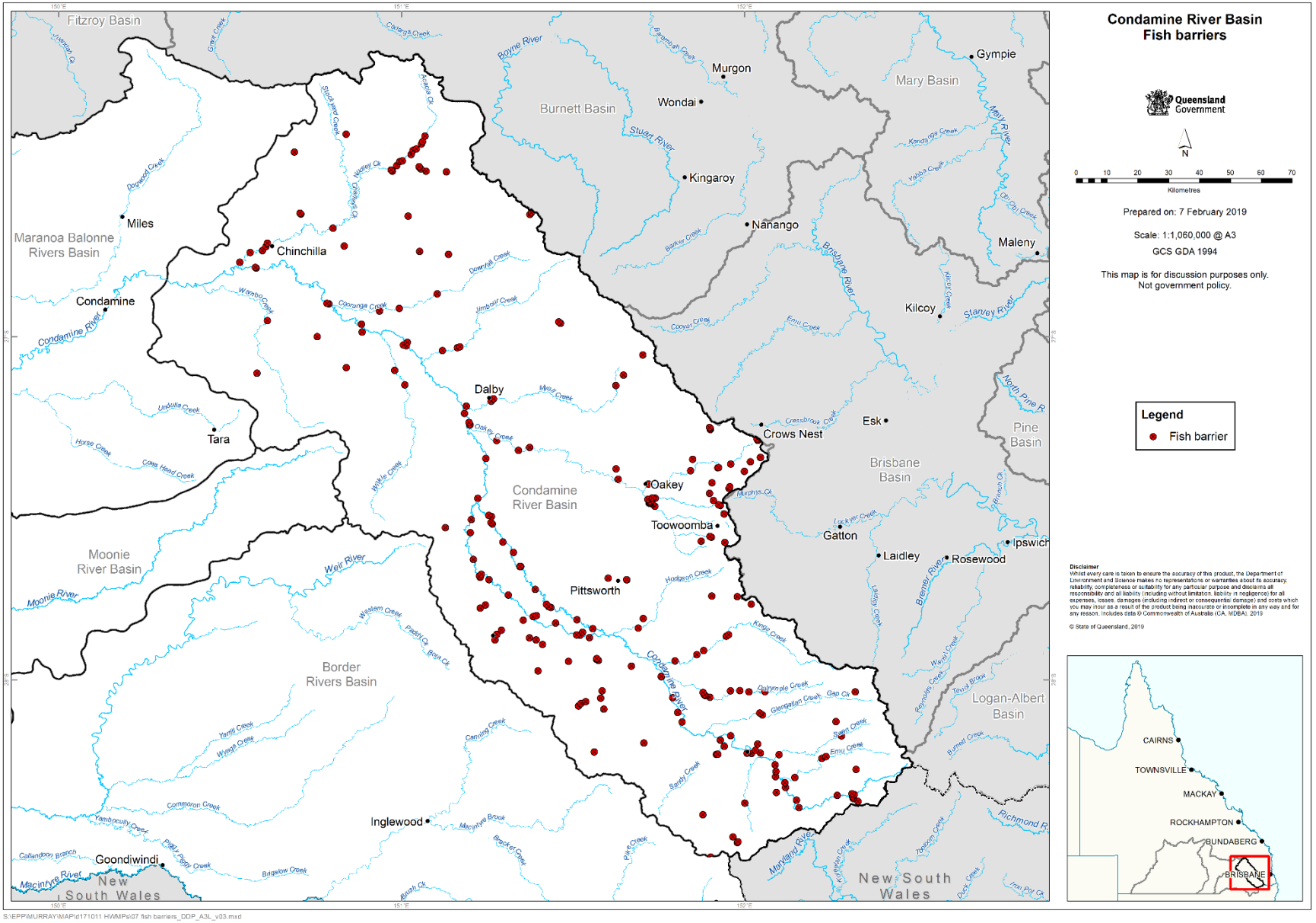

Figure 8: Barriers to fish passage, including weirs and road crossings, in the Condamine River basin

1.4.3 Groundwater

Groundwater is present in the region in shallow alluvial and sandstone aquifers, and within the deeper confined strata of the Great Artesian Basin. Due to the climate variability, recharge of the groundwater aquifers is strongly episodic and relies on periods of unusually high rainfall or wetter than average winter to increase deep drainage rates (McNeil, Raymond, Bennett, & McGregor, 2017). The Great Artesian Basin (GAB) is recharged from infiltration occurring on the north-west slopes of the Great Dividing Range.

The Basin Plan identified four groundwater Sustainable Diversion Limit (SDL) resource units for the plan area:

- Condamine Fractured Rock (GS53);
- Upper Condamine Alluvium (Central Condamine Alluvium) (GS64a);
- Upper Condamine Alluvium (Tributaries) (GS64b); and
- Upper Condamine Basalts (GS65).

The Basin Plan does not apply to groundwater of the GAB and as such, SDL resource units do not include GAB waters. However, for Queensland legislative and planning purposes, this HWMP includes waters of the GAB.

Refer to Figure 9 for a map of the groundwater SDL resource units that intersect the plan area.

1.4.3.1 Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDEs) are ecosystems which require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services (Richardson, et al., 2011). Ecosystem dependency on groundwater may vary temporally (over time) and spatially (depending on its location in the landscape). GDEs can include aquifers, caves, lakes, palustrine wetlands, lacustrine wetlands, rivers and vegetation (WetlandInfo, 2017a). It is important to note that not all groundwater dependent ecosystems are associated with a spring. Some groundwater dependent ecosystems will access groundwater that does not express at the surface, such as the roots of vegetation (WetlandInfo, 2015).

Refer to Figure 10 for a map of the groundwater dependent ecosystems in the plan area. A basic requirement for managing groundwater and GDEs is to understand where and how groundwater moves through the landscape. Potential GDE aquifer mapping seeks to achieve this through identifying the extent and key characteristics of GDE aquifers in a landscape. Potential GDE aquifer mapping incorporates a range of criteria including, but not limited to, confinement, geology, porosity, groundwater flow system, salinity, pH and recharge processes (WetlandInfo, 2017b). Figure 11 displays the potential GDE aquifers across the plan area.

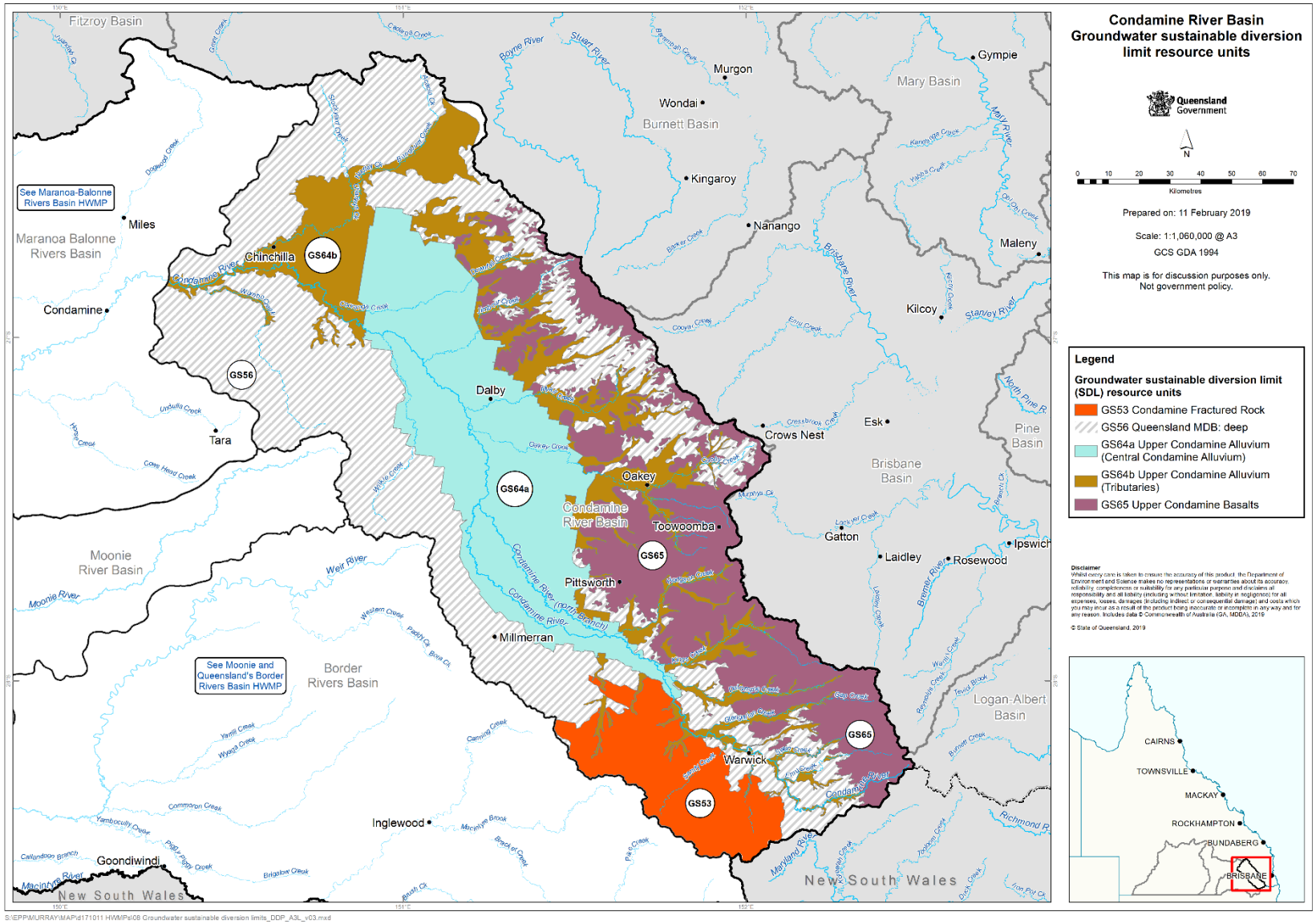

Figure 9: Groundwater Sustainable Diversion Limit resource units identified under the Basin Plan for the Condamine River basin (MDBA, 2018)

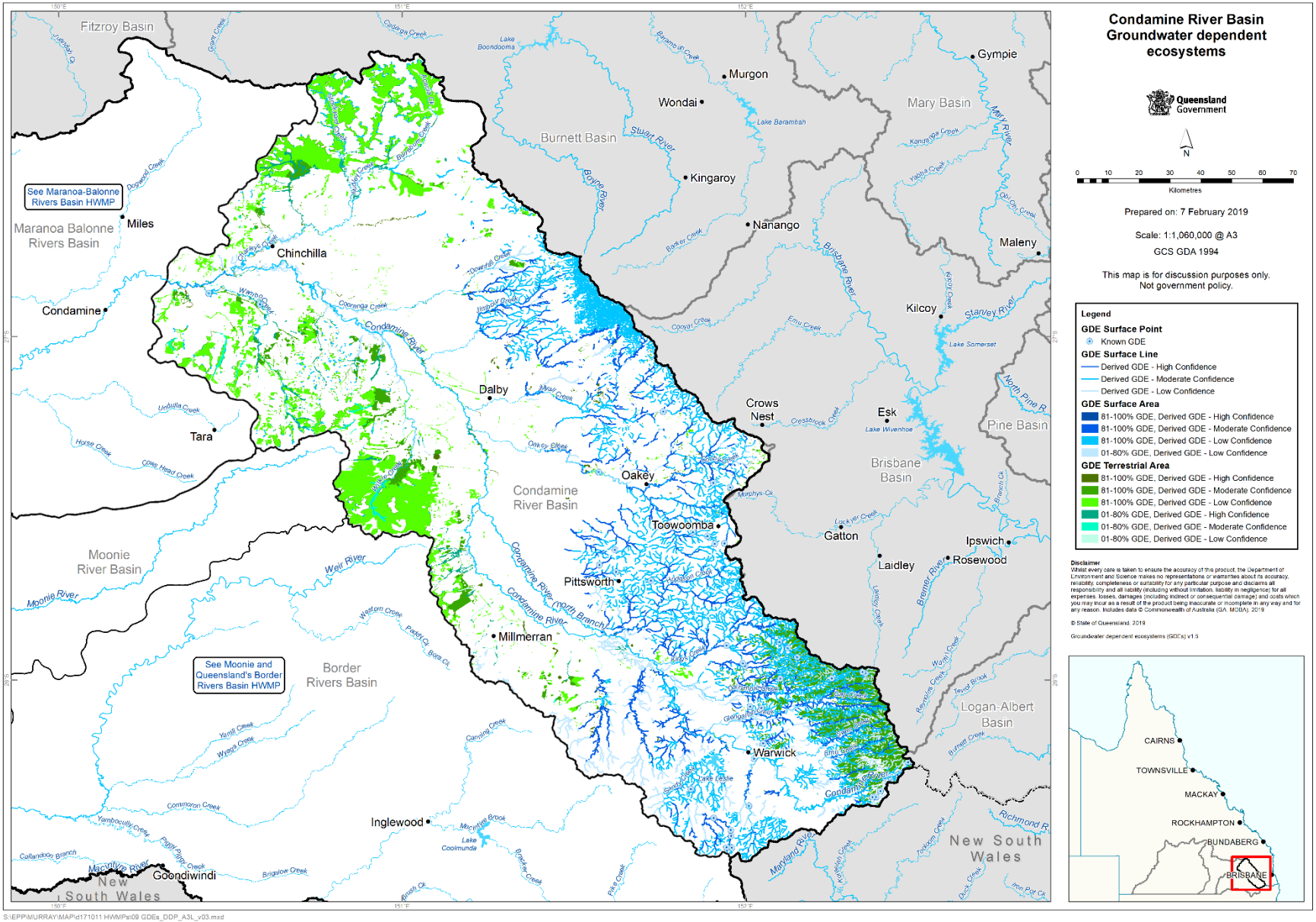

Figure 10: Groundwater Dependent Ecosystems in the Condamine River basin

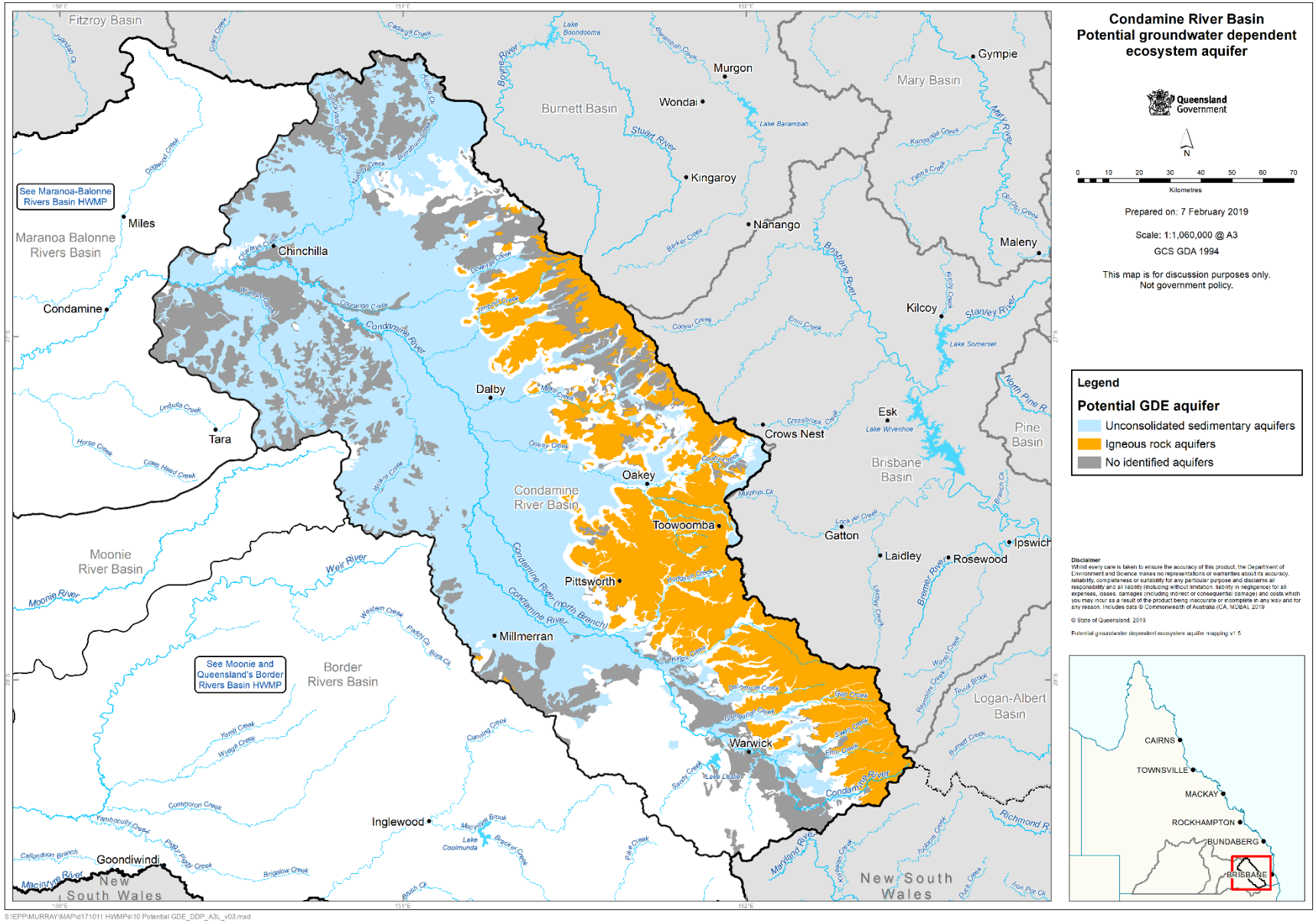

Figure 11: Potential Groundwater Dependent Ecosystems aquifer mapping within the Condamine River basin

1.5 Queensland water resource planning

The allocation and sustainable management of water in Queensland is accomplished through the water planning process. This process involves the preparation of statutory water plans under the *Water Act 2000* (Qld.) and accompanying water entitlement notices, water management protocols, resource operations licences, distribution operations licences and operation manuals. The statutory water plan for the area covered by this HWMP is the *Water Plan (Condamine and Balonne) 2019*. The water plan states the strategic outcomes, objectives and strategies for achieving a sustainable balance between water for industry, irrigators, town water supply, the community and environment. This includes the economic, social, cultural and ecological outcomes that apply to the plan area, as well as water allocation security objectives and environmental flow objectives.

The Basin Plan requires Commonwealth Water Resource Plans to be submitted to the Murray–Darling Basin Authority for accreditation by the Commonwealth Minister responsible for water. The Commonwealth Water Resource Plans are different from Queensland's existing statutory water plans. They will comprise a package of existing State instruments and other relevant documents that together meet the requirements of the Basin Plan. Key components of this package include the Queensland water planning instruments, as well as the healthy waters management plan and other relevant documents. Currently there are three Queensland water plans that intersect the Murray-Darling Basin—Warrego, Paroo, Bulloo[2] and Nebine; Condamine and Balonne; Border Rivers and Moonie.

1.5.1 Environmental flow objectives and ecological outcomes

The Water Plan (Condamine and Balonne) 2019 states the environmental flow objectives and ecological outcomes that apply to the plan area. Refer to the Department of Natural Resources, Mines and Energy water plan areas website to access a copy of the plan.

1.5.2 Great Artesian Basin

The Great Artesian Basin (GAB) underlies majority of the QMDB. The allocation and sustainable management of water from the GAB is managed separately under the Water Plan (Great Artesian Basin and Other Regional Aquifers) 2017 and the Water Management Protocol for the Great Artesian Basin and Other Regional Aquifers 2017. The Great Artesian Basin management areas within the Condamine River basin plan area includes groundwater sub-basin Surat Basin.

1.6 State Planning Policy

The State Planning Policy (SPP) defines the Queensland Government's policies about matters of state interest in land use planning and development (a state interest is defined under the *Planning Act 2016*).

1.6.1.1 Regional plans

The Queensland Government prepares regional plans which are long term strategic plans in partnership with local authorities that support local growth and development while also protecting a region's natural resources. At a regional and state level, regional plans guide overall growth patterns. At a local level, they are given effect by local government planning schemes, which are required to demonstrate they have appropriately integrated the relevant regional plan.

The Darling Downs Regional Plan was completed in October 2013. This plan covers a large proportion of the Queensland Murray-Darling Basin and describes environment and heritage matters but does not state strategic directions requiring statutory compliance by councils when preparing their planning schemes.

Current Regional Plans are available at the Queensland Planning System website at https://planning.dsdmip.qld.gov.au/planning/better-planning/state-planning/regional-plans.

[2] Although the Bulloo drainage basin is not connected to the Murray-Darling Basin, it is included in the Queensland water plan area with the Warrego, Paroo and Nebine drainage basins for State planning purposes.

1.6.1.2 Local planning schemes

Every local government has a planning scheme. These describe a council's plan for the future direction of a local government area and can span for 20 years or more. Depending on when planning scheme was drafted, planning schemes may or may not align with the current SPP. More recent schemes (prepared after 2014) are likely to include mapping and codes which align with the current SPP and its water quality, biodiversity and heritage guidelines. The more recent planning schemes are likely to contain a biodiversity overlay (or equivalent) which maps the extent of land subject to matters of local environmental significance and codes which regulate development where matters of environmental significance are mapped. For more information on planning schemes, refer to Department of State Development, Manufacturing, Infrastructure and Planning (DSDMIP) planning system webpage at https://planning.dsdmip.qld.gov.au/?jumpTo=map.

1.6.2 State Planning Policy: state interest—biodiversity

The State Planning Policy (SPP) lists biodiversity as a state interest and seeks to ensure that matters of national, state and local environmental significance are valued and protected and the health and resilience of biodiversity is maintained or enhanced to support ecological integrity. The SPP (and the accompanying SPP Guideline: Biodiversity) guides plan makers preparing or reviewing town planning schemes, regional plans or community infrastructure designations. The SPP and supporting guideline are available from the DSDMIP website.

1.6.3 State Planning Policy: state interest—cultural heritage

The State Planning Policy (SPP) lists cultural heritage as a state interest and seeks to ensure that 'the cultural heritage significance of heritage places and heritage areas, including places of Indigenous cultural heritage, is conserved for the benefit of the community and future generations'. It includes provisions to integrate the state interest—cultural heritage when making or amending a planning scheme and designating land for community infrastructure. This includes considering and integrating matters of Aboriginal cultural heritage and Torres Strait Islander cultural heritage to support the requirements of the *Aboriginal Cultural Heritage Act 2003* and the *Torres Strait Islander Cultural Heritage Act 2003*[3]. World heritage properties, national heritage places and non-Indigenous cultural heritage places are additional considerations under the state interest—cultural heritage.

The SPP (state interest—cultural heritage) is supported by the State Planning Policy: state interest guideline—cultural heritage (April 2016 and as updated). The SPP and supporting guideline are available from the DSDMIP website.

1.6.4 State Planning Policy: state interest —water quality

The State Planning Policy (SPP, July 2017) guides local governments in preparing and amending planning schemes to ensure 17 State Interests are considered. The State Interest for Water Quality specifies that the environmental values and quality of Queensland waters are protected and enhanced. Policy elements and development benchmarks are specified in the SPP for the State Interest for Water Quality to ensure development is planned, designed, constructed and operated to manage stormwater and wastewater in a way that supports the protection of environmental values identified in the Environmental Protection (Water) Policy 2009. The policy elements and benchmarks include the consideration of receiving waters and development in water resource catchments and water supply buffer areas.

The development benchmarks refer to applicable stormwater management design objectives outlined in Tables A and B in Appendix 2 of the SPP. Table A specifies construction phase stormwater management design objectives which apply to all climatic regions in Queensland and aim to minimise the risk of sediment washing off sites and polluting waterways during construction. Table B specifies post-construction phase stormwater management design objectives to address pollutants known to be generated from urban land uses. For the Western Queensland region, post construction phase stormwater management design objectives for total suspended solids, nutrients, gross pollutants and waterway stability management apply to population centres greater than 25, 000 persons.

[3] The *Aboriginal Cultural Heritage Act 2003* (ACHA) and *Torres Strait Islander Cultural Heritage Act 2003* (TSICHA) provide for the recognition, protection and conservation of Aboriginal and Torres Strait Islander cultural heritage and impose a duty of care in relation to the carrying out of activities. The requirements of the ACHA and TSICHA apply separately and in addition to the SPP.

Therefore, these objectives currently apply to the city of Toowoomba in the QMDB region, as it classifies as a population centre greater than 25,000 persons.

The SPP State Interest for Water Quality is supported by the State Planning Policy: state interest guideline—water quality (July, 2016). The guideline includes a model code to guide Local Governments in specifying performance outcomes and acceptable solutions that can be incorporated into planning schemes. Environmental values and water quality objectives under the Environmental Protection (Water) Policy 2009 are core concepts under this guideline. The SPP and supporting guideline are available from the DSDMIP website.

SECTION 2: EXISTING CONDITION AND EXTENT

2 Existing condition and extent

2.1 Condition

The Queensland Government Q-catchments Program assessed the threats to the condition of the aquatic ecosystem in the eastern portion of Queensland's Murray-Darling basin (Negus, et al., 2015). The basins assessed in this program were Condamine, Balonne, Maranoa, Lower Balonne, Moonie and Border Rivers. Threats to the aquatic ecosystem were identified and prioritised for each basin. The Q-catchments Program combined Condamine, Balonne and Maranoa basins into a single assessment and as such, this section will report on the findings for the combined basin area. The following priority threats were identified for the Condamine, Balonne and Maranoa basins:

1. Instream pest fauna – High priority threat
2. Climate change – High priority threat
3. Deposited sediment – High priority threat
4. Hydrology- sub-threat: Flow regime general – Medium priority threat
5. Riparian disturbance – Medium priority threat

The Q-catchments report notes that the identified list of priority threats will be used to support the selection and prioritisation of riverine condition indicators for application in future monitoring activities. This further assessment of the catchment condition informs the management of additional threats to water quality, as it is unlikely that ecological outcomes can be achieved through the management of flow regime alone. Due to the focus of the Q-catchment report on ecosystem condition related to flow regime, this HWMP includes additional sources of information to inform the existing condition of the Condamine River basin.

2.1.1 Instream pest fauna

The presence of instream pest fauna is often associated with a decline in the populations and communities of native flora and fauna (Negus, et al., 2015), particularly where native populations are already under stress from poor water quality or habitat degradation. This is due to the increased predation and competition with native species. Pest fish are introduced into the ecosystem in a number of ways including dumping of unwanted fish to waterways, the use of pest fish as bait, and stocking of fish in dams and impoundments. Of the 12 species of instream pest fauna present in the Murray-Darling basin (Lintermans, 2007), four fish species and one amphibian are known to occur, and one fish species has a real potential to occur in the Condamine, Balonne, and Maranoa (Table 1).

Table 1: Presence of instream pest fauna in the Condamine, Balonne and Maranoa basins (Negus, et al., 2015)

Species	Condamine, Balonne and Maranoa
European carp (*Cyprinus carpio)*	✓
Eastern mosquitofish *(Gambusia holbrooki)*	✓
Goldfish (*Carassius auratus)*	✓
Mozambique tilapia *(Oreochromis mossambicus)*	× (at risk)
Pearl cichlid *(Geophagus brasiliensis)*	✓
Cane toad *(Bufo marinus)*	✓

2.1.2 Climate change

A changing climate is likely to impact the water resources and freshwater ecosystems of the QMDB (Negus, et al.,

2015). Rainfall variability is likely to increase with current climate modelling predicting that rainfall during winter and spring will decrease and the frequency of intense downpours will increase (State of Queensland, 2017). It is likely that this will be associated with changes to river flows and to the frequency and extremity of droughts and floods. Climate change is predicted to impact fish species, particularly the cold-water tolerant species (Balcombe, et al., 2011). Reductions to flood frequency and duration may impact vegetation (river red gums - *Eucalyptus camaldulensis* for example), reducing river shading and reducing the contribution of organic matter to stream. This will impact fish species as stream water temperature will increase and food and habitat availability will decrease. Drought refugia may dry out faster under current climate predictions due to increased evapotranspiration and changes to flood frequency and duration (Balcombe, et al., 2011).

Refer to the Queensland Government webpage for more information about climate change predictions, and adaptation and mitigation strategies https://www.qld.gov.au/environment/climate/climate-change. Refer to Section 8 for information on management strategies to address risks of climate change in the Condamine River basin.

2.1.3 Deposited sediment

Intermittently flowing river systems of the eastern catchments of QMDB are often characterised by a series of waterholes which vary in persistence. Waterholes offer critical refuges for aquatic biota, terrestrial plants and animals and other water users, including for social, cultural and economic purposes during periods of low or no-flow periods (Lobegeiger, 2010). Alterations to hydrology can threaten waterhole persistence due to changes to the frequency with which waterholes are filled and sediment is flushed through the system (DSITI, 2015).

The eWater Source Water Quality Model for the Queensland Murray-Darling Basin (Davidson, 2018), provides information about the sources in the landscape contributing sediment to stream in the Condamine River basin (Table 2). The model also indicates the proportion of sediment being contributed to stream from each land use in the Condamine River basin (Table 3). This information is useful for determining where investment in land management will be most effective for reducing instream sedimentation rate.

Table 2: Proportion of total suspended solids contributed to stream by each source in the Condamine River basin (Davidson, 2018).

Source of sediment	Condamine (%)
Channel remobilisation	1
Gully	19
Hillslope	14
Streambank	66
Undefined	0

Table 3: Contribution of total suspended solids to stream from exported tonnes per hectare, by land use in the Condamine River basin (Davidson, 2018).

Land use	Condamine (%)
Conservation	11
Cropping	13
Grazing	27
Forestry	7
Horticulture	3

Land use	Condamine (%)
Intensive animal industry	5
Mining	7
Other	4
Rural residential	6
Urban	3
Waste treatment	7
Water	8

2.1.4 In-channel flow variability

Many rivers in QMDB naturally cease to flow and resultantly, become disconnected during dry periods. Water storages and downstream releases in the eastern catchments of QMDB has resulted in an alteration to in-channel flow variability, by stabilising flows and reducing the magnitudes of flood flows. Reduced flow variability and increased seasonal stability can adversely impact native fish reproduction or migration, favour populations of exotic fish and has been shown to influence aquatic macroinvertebrates, favouring taxa adapted to such conditions (Negus, et al., 2015).

2.1.5 Flow regime and instream connectivity: barriers

The flow regime of the Condamine River basin has been altered from natural flows due to the presence of numerous dams and weirs, and the extraction of water by industry, irrigation and other land uses. Aquatic species have evolved or adapted in line with natural flow regimes, often relying on hydrologic cues for spawning, migration or recruitment. Alterations to natural flows can negatively impact or exclude aquatic species, particularly fish.

Barriers to fish passage, either due to infrastructure or periods of low flow, can prevent fish from migrating to access foraging or breeding areas, and vital drought refugia. For many species the timing of this is key to reproductive success. Refer to Figure 8 for the barriers to fish passage in the Condamine River basin.

2.1.6 Riparian disturbance and riparian weeds

Riparian disturbance including clearing, reduction and fragmentation of riparian vegetation impacts the aquatic and terrestrial ecosystem. Habitat removal, along with decreased bank stability, reduced interception of sediments and other pollutants, increased light penetration and increased abundance and prevalence of weed species, are associated impacts of riparian vegetation disturbance.

The loss of riparian vegetation from pre-European settlement to 2013 due to anthropogenic impacts was determined in the Riparian Forest and Ground Cover Levels report (Clark, Healy, & Tindall, 2015). Clark et al., found that 42% of pre-European riparian vegetation has been cleared in the Condamine River (137,040 ha). The Condamine River catchment area has low riparian connectivity and density in comparison to other catchments in Queensland's Murray-Darling Basin. Further, the proportion of the catchment's riparian area that is endangered is approximately 3% and the proportion that is of concern is approximately 10%.

Refer to Section 10.2.8 for further information on riparian levels and recommended targets to contribute to maintaining and improving ecosystem health.

Although introduced riparian flora was not identified as a priority threat by the Q-catchments program in the Condamine, Maranoa and Balonne River basin, riparian weeds, including Weeds of National Significance (WONS), have been identified in these basins. However, introduced riparian flora was identified as a priority threat in the Lower Balonne section of the basin. Table 4 displays the riparian floral weed species identified in the Condamine, Maranoa and Balonne River basin (including Lower Balonne).

Table 4: Riparian weeds identified in the Condamine River basin (Negus, et al., 2015) (derived from Southern Downs Regional Council).

Species	Condamine, Maranoa and Balonne
African boxthorn (*Lycium ferocissimum*)*	✓
Annual ragweed (*Ambrosia artemisiifolia*)	✓
Blackberry (*Rubus fruticosus* sp. *aggregate*)*	✓
Bridal creeper (*Asparagus asparagoides*)*	✓
Chilean needle grass (*Nassella neesiana*)*	✓
Cholla cactus – devils rope pear (*Cylindropuntia imbricate*)	✓
Firethorn (*Pyracantha* spp.)	✓
Fireweed (*Senecio madagascariensis*)*	✓
Groundsel (*Baccharis halimifolia*)	✓
Harrisia cactus (*Eriocereus* spp. Inc. *E. martini*)	✓
Honey locust tree (*Gleditsia triacanthos*)	✓
Lantana (*Lantana camara*)*	✓
Lippia (*Phyla canescens*)	✓
Mexican poppy (*Argemone mexicana*)	✓
Mother-of-millions (*Bryophyllum delagoense* syn. *B tubiflorum*)	✓
Noogoora burr (*Xanthium pungens*)	✓
Parkinsonia (*Parkinsonia aculeate*)*	✓
Parthenium (*Parthenium hysterophorus*)*	✓
Prickly acacia (*A. nilotica* subspecies *indica*)*	✓
Prickly pear/Opuntioid cacti (*Opuntia* spp.)*.	✓
Privets (*Ligustrum lucidum* & *L*. *sinense*)	✓
Saffron thistle (*Carthamus lanatus)*	✓
Serrated tussock (*N*. *trichotoma*)*, Mexican feather grass (*N*. *tenuissima*), weedy sporobolus or rat's tail grasses, Parramatta grass, (*S*. *africanus*) giant Parramatta grass, (*S*. *fertilis*) giant rat's tail grass (*S.pyramidalis* and *S*. *natalensis*)	✓
St John's wort (*Hypericum perforatum*)	✓
Thornapples (*Datura* spp.)	✓

Species	Condamine, Maranoa and Balonne
Tiger pear (*O. aurantiaca*)	✓
Velvet tree pear (*O. tomentose*)	✓
Willows (*Salix* spp.)*	✓

*Weeds of National Significance (WONS).

2.1.7 Water Quality

2.1.7.1 Surface water

The surface water quality of the Condamine River basin was assessed during the development of water quality targets for these basins (Refer to Appendix 1—Refining water quality targets for fresh water-dependent ecosystems to reflect local conditions). A comparison of surface water quality across the basin area[4] is displayed in the below figures.

Figure 12 shows the average concentration of total nitrogen and total phosphorus across the catchments. Mid Condamine has the greatest average concentration of total nitrogen (1541µg/L) and total phosphorus (881µg/L), followed by Lower Condamine (1249µg/L) (351µg/L) and Upper Condamine (788µg/L) (154µg/L). Nutrient concentrations are typically elevated throughout the whole Condamine catchment area, aside from the rivers in the headwaters of the Condamine system including Condamine River at Warwick, Emu Creek at Emu Vale, Swan Creek at Swanfels, and Spring Creek at Killarney.

Figure 13 shows the average turbidity (NTU) across the catchments. Mid Condamine has the greatest average turbidity levels out of the three catchment areas (199NTU), followed by Lower Condamine (183NTU) and Upper Condamine (43NTU). As with nutrients, it is expected that the headwaters of the Condamine system will have lower concentrations of turbidity than the more impacted areas.

Figure 14 displays the average electrical conductivity (µS/cm) across the catchments. Mid Condamine, again, has the greatest average electrical conductivity out of the three catchment areas (672µS/cm), followed by Lower Condamine (437µS/cm) and Upper Condamine (43µS/cm). The water types within the Mid Condamine catchment area, Central Condamine, Oakey Creek and Middle Condamine River, have the highest recorded concentrations of EC in the Condamine River basin. These elevated concentrations have occurred during periods of low or no flow.

[4] The three water quality zones are an amalgamation of several water types (refer to Figure 29) as such: Upper Condamine (Emu Creek, South-Eastern Condamine, Southern Condamine and Upper Condamine River); Mid Condamine (Oakey Creek, Central Condamine, Kumbarilla Ridge and Middle Condamine River); and Lower Condamine (North-Western Condamine, Dogwood Creek, Undulla Creek and Lower Condamine River).

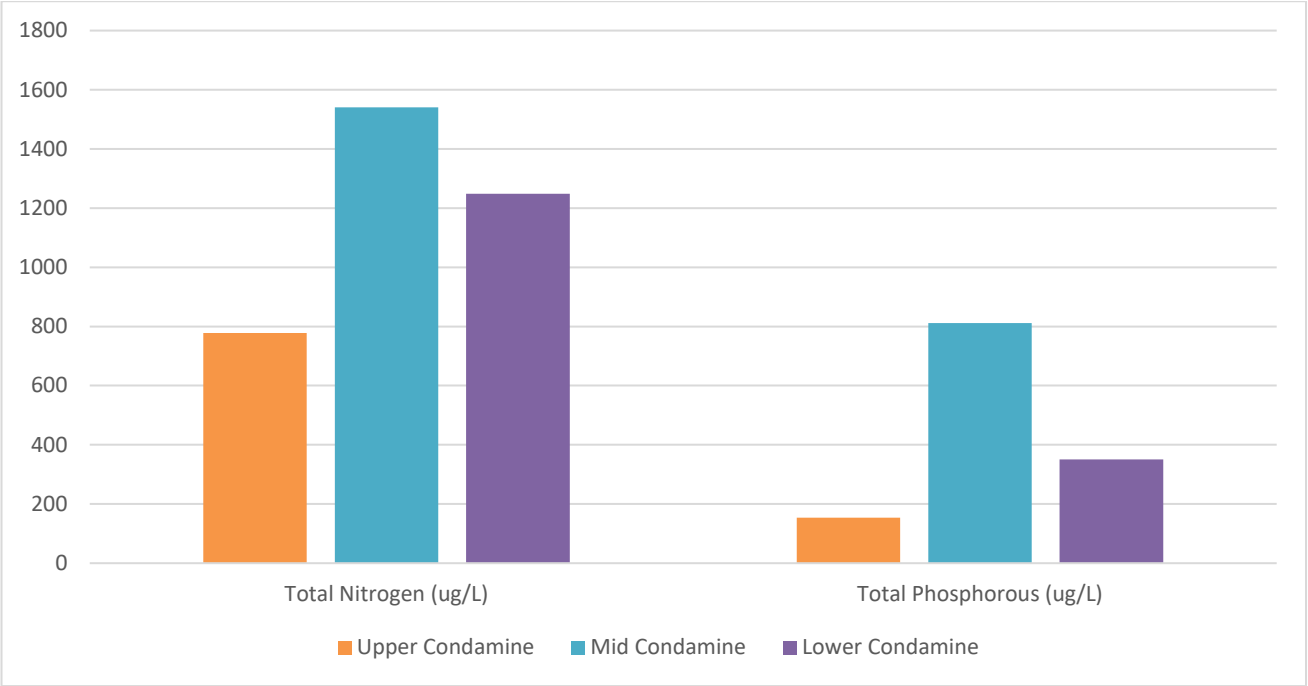

Figure 12: Comparison of average total nitrogen and total phosphorus concentrations (µg/L) in the Condamine River basin.

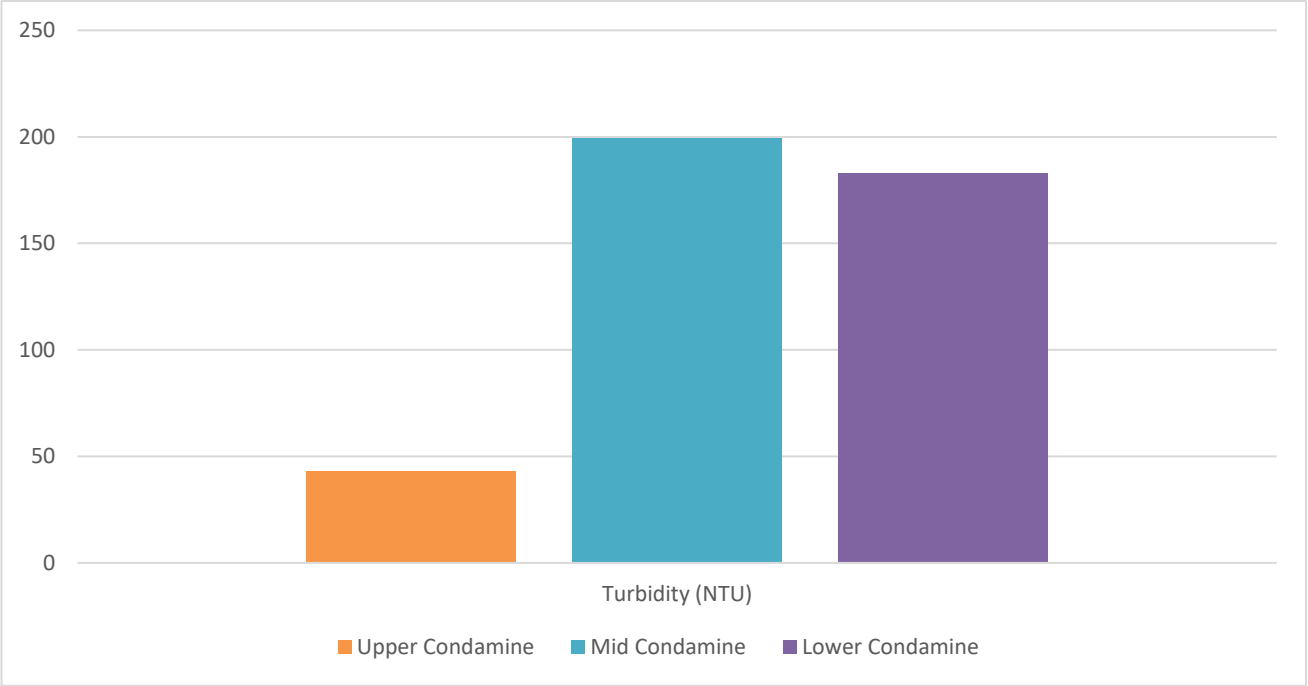

Figure 13: Comparison of average turbidity (NTU) in the Condamine River basin.

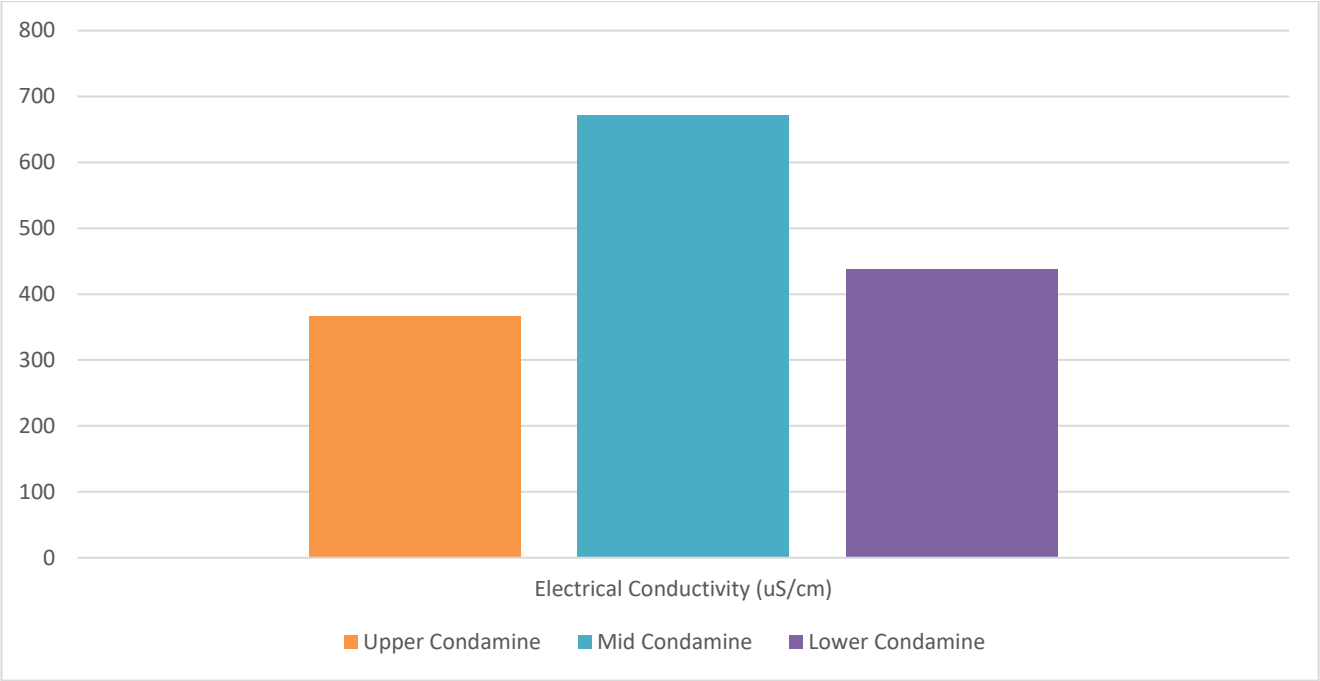

Figure 14: Comparison of average electrical conductivity concentration (µS/cm) in the Condamine River basin.

Further, the eWater Source Water Quality Model for the Queensland Murray-Darling Basin (Davidson, 2018) shows the proportion of total nitrogen and total phosphorus being contributed to stream from each land use in the Condamine River basin (Table 5). This information is useful for determining where investment in land management will be most effective in reducing nutrient export to stream.

Table 5: Proportion of total nitrogen and total phosphorus from exported tonnes per hectare, contributed to stream by land use in the Condamine River basin (Davidson, 2018).

Land use	Condamine	
	TN (%)	TP (%)
Conservation	8	9
Cropping	17	22
Grazing	18	20
Forestry	7	8
Horticulture	4	6
Intensive animal industry	13	7
Mining	4	2
Other	6	6
Rural residential	9	3
Urban	9	1
Waste treatment	2	2
Water	2	4

2.1.7.2 Groundwater

Groundwater quality was analysed during the development of water quality targets for the groundwaters of QMDB. For further information on methods, refer to Regional groundwater chemistry zones: Queensland Murray-Darling Basin (McNeil et. al., (2017)).

McNeil et al., (2017) found that the sub-artesian groundwaters of Condamine reflect two of the dominant surface water types in the region. The first of these has a chemistry consistent with the Palaeozoic or basaltic geology of the Condamine headwaters with evenly proportioned cations. The second is likely related to the Cenozoic alluvium or underlying Walloon Coal measures and is a moderately saline sodium chloride type which is relatively high in magnesium. These two water types are fairly consistent to a depth of 30m, although the proportion and salinity of the sodium/magnesium chloride type increases with depth. In some areas, mostly 60m in depth or more, the sub-artesian waters are consistent with the majority of most artesian water in the QMDB and are the moderately saline sodium bicarbonate type. The artesian waters are highly saline in parts - dominated by sodium chloride - mainly along the extension of the Kumbarilla Ridge. This is likely related to the depth of aquifers or other basement features.

Refer to section 7 for further information about potential risks to water quality over the life of the plan in the Condamine River basin. Refer to section 8 for information on management responses to address risks to water quality in the Condamine River basin.

2.1.8 State of the Environment

The Queensland Government is responsible for reporting on the environmental performance of the State of Queensland. This reporting occurs on a biennial frequency with the report structured around four themes – biodiversity, heritage, pollution and climate.

Refer to the Queensland Government webpage for more information about the SoE reporting https://www.stateoftheenvironment.des.qld.gov.au/.

2.2 Extent

The extent and distribution of freshwater wetlands is the most important indicator of the state of wetland resources in Queensland, as any loss will mean that the services provided by that wetland will be diminished. Different wetland systems provide different values to society. These values can vary throughout the State and can be affected by changes in extent.

Freshwater wetlands include:

Riverine wetlands: Systems that are contained within a channel (e.g. river, creek or waterway) and their associated streamside vegetation (WetlandInfo, 2013c).

Lacustrine wetlands (lakes): Systems that are dominated by open water. Although lakes may have fringing vegetation, the majority of the wetland area is open water. Lacustrine systems in Queensland, particularly in arid and semi-arid areas, are highly variable. Some are known to dry out and to support species adapted to these conditions, while others stay wet for long periods and provide a refuge for many species during dry times (WetlandInfo, 2013d).

Palustrine wetlands: Systems traditionally considered as a wetland. They are vegetated, non-riverine or non-channel systems and include billabongs, swamps, bogs, springs, soaks etc. They have more than 30% emergent vegetation and are an important part of the landscape, providing habitat and breeding areas for a wide variety of species (WetlandInfo, 2013e).

The table below specifies the area of freshwater wetlands (by system) in the Condamine River basin.

Table 6: Wetland area by system (2013): Condamine River basin

System	Area (km^2)	Wetlands area (%)	Total area (%)
Artificial and highly modified	152.4	47.2	0.5
Lacustrine	5.2	1.6	0.0
Palustrine	39.2	12.1	0.1
Riverine	126.4	39.1	0.4
Total	**323.2**	**100.0**	**1.1**

Note: Areas are approximate and calculated using the GDA94/Australian Albers projection. Areas may change over time as mapping approaches improve. Totals may not match the sum of individually displayed figures due to the rounding of displayed figures.

Source: Condamine River drainage sub-basin — facts and maps, WetlandInfo, Department of Environment and Heritage Protection, Queensland, viewed 15 January 2018, <https://wetlandinfo.ehp.qld.gov.au/wetlands/facts-maps/sub-basin-condamine-river/>.

Wetlands can also be described by type of habitat that occurs within the system. The tables below specifies the wetland area by habitat for the plan area. Refer to the Queensland Wetland*Info* website for conceptual models that describe each habitat type in terms of its hydrology, geomorphology, fauna and flora.

Table 7: Wetland area by habitat (2013): Condamine River basin

Habitat	Area (km^2)	Wetlands area %	Total area (%)
Coastal and sub-coastal non-floodplain tree swamp—*Melaleuca* spp. and *Eucalyptus* spp.	6.6	2.0	0.0
Coastal and sub-coastal non-floodplain grass sedge and herb swamp	1.7	0.5	0.0
Coastal and sub-coastal floodplain tree swamp—*Melaleuca* spp. and	10.2	3.2	0.0

Habitat	Area (km^2)	Wetlands area %	Total area (%)
Eucalyptus spp.			
Coastal and sub-coastal floodplain grass, sedge, herb swamp	20.8	6.4	0.1
Coastal and sub-coastal floodplain lake	0.4	0.1	0.0
Coastal and sub-coastal non-floodplain soil lake	4.7	1.5	0.0
Artificial and highly modified wetlands (dams, ring tanks, irrigation channels)	150.0	46.4	0.5
(modified natural) Coastal and sub-coastal non-floodplain tree swamp—*Melaleuca* spp. and *Eucalyptus* spp.	0.1	0.0	0.0
(modified natural) Coastal and sub-coastal floodplain tree swamp—*Melaleuca* spp. and *Eucalyptus* spp.	0.4	0.1	0.0
(modified natural) Coastal and sub-coastal floodplain grass, sedge, herb swamp	1.9	0.6	0.0
(modified natural) Coastal and sub-coastal non-floodplain soil lake	0.1	0.0	0.0
Riverine	126.4	39.1	0.4
Total	**323.2**	**100.0**	**1.1**

Note 1: Areas are approximate and calculated using the GDA94/Australian Albers projection. Areas may change over time as mapping approaches improve. Totals may not match the sum of individually displayed figures due to the rounding of displayed figures.

Note 2: The drainage boundary for the Condamine River sub-basin varies slightly to the Condamine River spatial area covered in this plan. Refer to Wetland*Info* – Condamine drainage sub-basin for boundary layers.

Source: Condamine River drainage sub-basin — facts and maps, WetlandInfo, Department of Environment and Heritage Protection, Queensland, viewed 15 January 2018, <https://wetlandinfo.ehp.qld.gov.au/wetlands/facts-maps/sub-basin-condamine-river/>.

The loss of wetland extent in Queensland is affected primarily by drainage, clearing or levelling in lowland parts of catchments due to intensive agriculture and urbanisation. Wetland extent can also be impacted by upland activities such as dam construction altering the hydrology of downstream wetlands. The greatest losses have occurred in the palustrine and riverine systems. At a state-wide scale, an estimated 94% of pre-clear extent of freshwater wetland remains (DEHP, 2017). Estimated historical loss of wetlands is unevenly distributed across drainage divisions and catchments with:

- 84% remaining in the Queensland Murray-Darling division
- 50% remaining in the North East Coast (non-Great Barrier Reef (GBR)) division
- 80% remaining in the North East Coast—GBR division
- close to 100% remaining in the other divisions (including the Bulloo drainage basin).

Of the three freshwater wetland systems (lacustrine, palustrine, riverine) in Queensland, one of the greatest ongoing losses has occurred in palustrine and riverine systems in the Queensland Murray-Darling drainage division. Within this division, historical loss of freshwater wetland extent is unevenly distributed. The Macintyre, Weir and the Dumaresq have less than, or equal to, 50% remaining. Historical loss of palustrine wetlands in the Moonie, Macintyre and Weir catchments has resulted in less than 25% remaining (DEHP, 2017).

Net rate of loss of wetlands in the Queensland Murray-Darling drainage division over the 2001-05, 2005-09 and 2009-13 periods has decreased from a rate of over 1500 hectares (ha) to 291ha (2009-13)—a rate of 72ha per year. Most of this loss is due to broad acre land clearing of riverine and palustrine wetlands, primarily in the Warrego drainage basin (DEHP, 2017).

There are 40,901ha of freshwater wetlands within protected areas in the Queensland Murray-Darling drainage division. This amounts to 9% of the total 432,603ha of freshwater wetlands in the division and 0.7% across the state. The majority (78%) of freshwater wetlands that are in protected areas are contained within national parks. The rest are mostly within nature refuges (19%). Both lacustrine and palustrine wetlands are reasonably well represented in protected areas, at 14% and 11% respectively, however only 1% of riverine wetlands are contained within protected areas (DEHP, 2017). The tables below specify the change in wetland extent by system and habitat.

Table 8: Wetland extent change by system: Condamine River drainage sub-basin

System	2013 area (km^2)	2009 area (km^2)	2005 area (km^2)	2001 area (km^2)	2013/pre-clear (%)
Artificial and highly modified	152.4	148.0	140.5	132.8	n/a
Lacustrine	5.2	5.2	5.2	5.1	89.1
Palustrine	39.2	39.2	39.2	39.1	38.1
Riverine	126.4	126.4	126.6	126.9	54.1
Total	**323.2**	**318.9**	**311.5**	**303.8**	**55.9**

Note 1: Areas are approximate and calculated using the GDA94/Australian Albers projection. Areas may change over time as mapping approaches improve. Totals may not match the sum of individually displayed figures due to the rounding of displayed figures.

Note 2: The drainage boundary for the Condamine River sub-basin varies slightly to the Condamine River spatial area covered in this plan. Refer to Wetland*Info* – Condamine drainage sub-basin for boundary layers.

Source: Condamine River drainage sub-basin — facts and maps, WetlandInfo, Department of Environment and Heritage Protection, Queensland, viewed 15 January 2018, <https://wetlandinfo.ehp.qld.gov.au/wetlands/facts-maps/sub-basin-condamine-river/>.

Table 9: Wetland extent change by habitat: Condamine River drainage sub-basin

Habitat	2013 area (km^2)	2009 area (km^2)	2005 area (km^2)	2001 area (km^2)
Coastal and sub-coastal non-floodplain tree swamp—*Melaleuca* spp. and *Eucalyptus* spp.	6.6	6.6	6.6	6.6
Coastal and sub-coastal non-floodplain grass sedge and herb swamp	1.7	1.7	1.7	1.6
Coastal and sub-coastal floodplain tree swamp—*Melaleuca* spp. and *Eucalyptus* spp.	10.2	10.2	10.2	10.2
Coastal and sub-coastal floodplain grass, sedge, herb swamp	20.8	20.8	20.8	20.7
Coastal and sub-coastal floodplain lake	0.4	0.4	0.4	0.4
Coastal and sub-coastal non-floodplain soil lake	4.7	4.7	4.7	4.6
Artificial and highly modified wetlands (dams, ring tanks, irrigation channels)	150.0	145.6	138.1	130.5
(modified natural) Coastal and sub-coastal non-floodplain tree swamp—*Melaleuca* spp. and *Eucalyptus* spp.	0.1	0.1	0.1	0.1
(modified natural) Coastal and sub-coastal floodplain tree swamp—*Melaleuca* spp. and	0.4	0.4	0.4	0.4

Habitat	2013 area (km^2)	2009 area (km^2)	2005 area (km^2)	2001 area (km^2)
Eucalyptus spp.				
(modified natural) Coastal and sub-coastal floodplain grass, sedge, herb swamp	1.9	1.9	1.9	1.9
(modified natural) Coastal and sub-coastal non-floodplain soil lake	0.1	0.1	0.0	0.0
Riverine	126.4	126.4	126.6	126.9
Total	**323.2**	**318.9**	**311.5**	**303.8**

Note 1: Areas are approximate and calculated using the GDA94/Australian Albers projection. Areas may change over time as mapping approaches improve. Totals may not match the sum of individually displayed figures due to the rounding of displayed figures.

Note 2: The drainage boundary for the Condamine River sub-basin varies slightly to the Condamine River spatial area covered in this plan. Refer to Wetland*Info* – Condamine drainage sub-basin for boundary layers.

Source: Condamine River drainage sub-basin — facts and maps, WetlandInfo, Department of Environment and Heritage Protection, Queensland, viewed 15 January 2018, <https://wetlandinfo.ehp.qld.gov.au/wetlands/facts-maps/sub-basin-condamine-river/>.

SECTION 3: OBJECTIVES AND OUTCOMES FOR WATER RESOURCES

3 Objectives and outcomes for water resources

The objectives and outcomes for water resources[5] are stated below. Specific objectives and outcomes apply to the waters of the Murray-Darling Basin as a whole and the waters of the Condamine River basin. The relevant section numbers are listed for objectives and outcomes derived from the Basin Plan.

3.1 Objectives and outcomes for Murray-Darling Basin water resources (whole system)

The following objectives and outcomes apply to the Condamine River basin due to its connectivity with the Murray-Darling Basin system.

3.1.1 Objectives and outcome to contribute to the achievement of the Murray-Darling Basin Plan

The relevant objectives for **water quality** are:

a. to give effect to relevant international agreements through the integrated management of Basin water resources
b. to establish a sustainable and long-term adaptive management framework for Basin water resources, that takes into account the broader management of natural resources in the Murray-Darling Basin
c. to optimise social, economic and environmental outcomes arising from the use of water resources.

(Reflects Basin Plan Section 5.02, 1a-c)

The outcome for the Basin Plan as a whole is a healthy and working Murray-Darling Basin that includes:

a. communities with sufficient and reliable water supplies that are fit for a range of intended purposes, including domestic, recreational and cultural use
b. productive and resilient water-dependent industries, and communities with confidence in their long-term future
c. healthy and resilient ecosystems with rivers and creeks regularly connected to their floodplains and ultimately, the ocean.

(Reflects Basin Plan Section 5.02, 2a-c)

3.1.2 Objectives and outcome in relation to environmental outcomes

The objectives in relation to environmental outcomes are, within the context of a working Murray-Darling Basin:

a. to protect and restore water-dependent ecosystems of the Murray-Darling Basin
b. to protect and restore the ecosystem functions of water-dependent ecosystems
c. to ensure that water-dependent ecosystems are resilient to climate change and other risks and threats.

(Reflects Basin Plan Section 5.03, 1a-c)

The outcome in relation to objectives (a) to (c) is the restoration and protection of water-dependent ecosystems and ecosystem functions in the Murray-Darling Basin with strengthened resilience to a changing climate.

(Reflects Basin Plan Section 5.03, 2)

[5] Reflects the terminology used in the Basin Plan. 'Objectives and outcomes for water resources' are equivalent to 'Management Goals' under the National Water Quality Management Strategy. The EPP Water provides for the development of Management Goals that are long-term management objectives used to assess whether corresponding Environmental Values are being maintained. Management Goals for aquatic ecosystems reflect the management intent described in Section 14 of the EPP Water.

3.1.3 Objective and outcome in relation to water quality and salinity

The objective in relation to water quality and salinity is to maintain appropriate water quality, including salinity levels, for environmental, social, cultural and economic activity in the Condamine River basin.

The outcome in relation to water quality and salinity is that water resources in the Condamine River basin remain fit for purpose.

(Reflects Basin Plan Section 5.04, 1-2)

3.2 Objectives and outcomes for the Condamine River basin

The following objectives and outcomes apply to the Condamine River basin.

3.2.1 Objective to maintain good levels of water quality

If the value of a water quality indicator (for example, salinity, nutrients, pH, turbidity etc.) is at a level that is better than the target value for water quality (set out in section 10 of this report), the objective is to maintain that level.

(Reflects Basin Plan Section 9.08)

3.2.2 Objective to maintain the extent of natural wetlands and riparian forested areas

The objective is to maintain and, where possible, enhance the extent of natural wetlands (palustrine, lacustrine and riverine) and riparian forested areas across the Condamine River basin.

3.2.3 Objective for declared Ramsar wetlands aquatic ecosystems

The Condamine River basin does not contain any Ramsar wetlands at time of print.

If wetlands of international significance are declared in the future, the objective is that the quality of water is sufficient to maintain the ecological character of the wetlands.

(Reflects Basin Plan Section 9.04, 1)

3.2.4 Objective for aquatic ecosystems other than declared Ramsar wetlands

The objective is that the quality of water is sufficient:

a. to protect and restore the ecosystems
b. to protect and restore the ecosystem functions of the ecosystems
c. to ensure that the ecosystems are resilient to climate change and other risks and threats.

(Reflects Basin Plan Section 9.04, 2a-c)

3.2.5 Objective and outcome for Aboriginal cultural, spiritual and ceremonial values and uses of water

The objective is to ensure the suitability of water to support the identified cultural, ceremonial and spiritual values and uses of waters across the Queensland Murray-Darling Basin.

The outcome is that Queensland Murray-Darling Basin water resources remain fit for purpose in relation to cultural, spiritual and ceremonial values and uses of water.

(Reflects Basin Plan Section 10.52, 1a-b)

3.2.6 Objectives for raw water for treatment for human consumption

The objectives for raw water treatment for human consumption are:

a. to minimise the risk that the quality of raw water taken for treatment for human consumption results in adverse human health effects
b. to maintain the palatability rating of water taken for treatment for human consumption at the level of good as set out in the Australian Drinking Water Guidelines
c. to minimise the risk that the quality of raw water taken for treatment for human consumption results in the odour of drinking water being offensive to consumers.

(Reflects Basin Plan Section 9.05, a-c)

3.2.7 Objective for irrigation water

The objective for irrigation water is that the quality of surface water, when used in accordance with the best irrigation and crop management practices and principles of ecologically sustainable development, does not result in crop yield loss or soil degradation.

Soil degradation means reduced permeability and soil structure breakdown caused by the level of sodium in the irrigation water, and is assessed using the sodium adsorption ratio[6].

(Reflects Basin Plan Section 9.06)

3.2.8 Objective for recreational water quality

The objective for recreational water quality is to achieve a low risk to human health from water quality threats posed by exposure through ingestion, inhalation or contact during recreational use of QMDB water resources.

(Reflects Basin Plan Section 9.07)

3.2.9 Objective for waters under the *Environmental Protection (Water) Policy 2009*

It is the management intent for waters[7] that the decision to release waste water or contaminants to the waters must ensure the following for:

- high ecological value (HEV) waters—the measures for the indicators for all EVs are maintained
- slightly disturbed (SD) waters—the measures for the slightly modified physical or chemical indicators are progressively improved to achieve the water quality objectives (targets) for HEV waters
- moderately disturbed (MD) waters, if the measures for indicators of the EVs:
  - achieve the water quality objectives— the measures for the indicators are maintained at levels that achieve the water quality objectives (targets) for the water
  - do not achieve the water quality objectives (targets) for the water—the measures for indicators of the EVs are improved to achieve the water quality objectives (targets) for the water.

Refer to Section 6 of this plan for further details.

[6] See Chapter 11 – Salinity Management Handbook (DNR, 1997); or Figure 4.2.1 of Chapter 4 of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

[7] Refer to Section 14 of the EPP Water.

SECTION 4: CONSULTATION AND ENGAGEMENT

4 Consultation and engagement

Consultation requirements for the WQM Plan are specified under section 10.32(4)(d) and 10.35 of the Basin Plan and relate to the connectivity of water resources with New South Wales. Section 4 provides information in support of these consultation requirements.

The development of the HWMP for the Condamine River basin involved ongoing consultation in accordance with the requirements of the EPP Water and the Basin Plan. Consultation on individual components of this draft HWMP occurred throughout 2016 and 2017 and is detailed below. Following this, a draft version of the HWMP was released online for community and stakeholder consultation from April 2018 to June 2018.

Engagement with stakeholders and the community was encouraged through a range of mediums, including local print media, mail-outs, emails, natural resource management websites, meetings and workshops. The consultation was open to all interested stakeholders, including community members, participants from local, state and federal governments, natural resource management groups, local Aboriginal Nations, industry groups and environmental groups.

The stakeholder and community-based discussions indicated that water is a key regional asset, whether above or below ground. The major variances in discussion amongst the groups were the different uses and outcomes, the allocations to various sectors and the potential threats to the quantity and quality of both above ground or underground water supplies.

4.1 Water Quality Technical Panel

Throughout the development of the HWMP for the Condamine River basin, the Water Quality Technical Panel was consulted on matters where skilled expertise or technical input was required. The panel was comprised of technical staff from Queensland Government departments, the former-Condamine Alliance and external water quality experts, and utilised a range of State and Commonwealth information resources.

The Water Quality Technical Panel initially met to divide the Condamine River basin into sub-regions through GIS mapping, to enable more targeted discussions and establishment of environmental values at stakeholder and community workshops. The panel further met to discuss the development of water quality targets based on local data to protect environmental values.

The panel was also consulted during the initial risk assessment conducted in 2013 and again in 2016-17 when the risk assessment for the Condamine was refined.

4.2 Consultation – Environmental values

Environmental values (EVs) for the Condamine River basin were established through a consultative process conducted by various agencies between early 2000 and 2017.

In 2002, the Condamine Balonne Water Committee began the process of identifying EVs for the waters of the Condamine River basin, and found that "*most respondents want water quality that supports all environmental values in all catchments"* (CBWC, 2002).

In 2007, the former-Condamine Alliance contracted Natural Solutions (2008) to conduct workshops with key stakeholders to identify EVs over 20 sub-catchments across the Condamine region. This project also proposed some innovative ideas for the development of water quality targets (water quality objectives).

In 2012, the former-Condamine Alliance (CA) re-established this work to support the development of the HWMPs for the Condamine River basin. CA collected the values and uses of surface and groundwater as informed by stakeholders or stakeholder groups, including local governments, environmental groups, individual community members, Traditional Owner groups, industry bodies, Queensland Government and the Murray-Darling Basin Authority. During this process, CA, with the Water Quality Technical Panel and using work previously undertaken in the catchment (Condamine Alliance, 2012), divided the Condamine catchments into sub-regions, to enable more targeted discussions around how stakeholders value and use water in these sub-regions. The EVs identified during the process employed by CA have been considered, and are included in this HWMP.

In 2016, the Queensland Government further refined the EVs that were identified for groundwater. Groundwater aquifer zones were established to allow for the development of locally relevant water quality objectives. This process included identifying EVs for each groundwater aquifer using bore records. The Water Quality Technical Panel were consulted to ensure the approach taken to identify groundwater EVs was accurate and representative.

Feedback from Aboriginal Nations during the refinement of the groundwater EV method confirmed that the Cultural, Spiritual and Ceremonial EV should be identified for all groundwater aquifers.

In March 2017, the draft EVs were released for a three month public consultation period via print media, email, and website. The material was made available, and in many cases presented, to 51 stakeholder groups, including Local State and Federal governments, Northern Basin Aboriginal Nations, SunWater, Arrow Energy, former-QMDC and Condamine Balonne Water Committee. Submissions received during the consultation period included the following common suggestions:

- *Include an appendix in the guidelines with location details of identified High Ecological Value and Slightly Disturbed Aquatic Ecosystems*
    - An appendix is included in this HWMP with locations of the persistent waterholes which are High Ecological Value. Spatial information on High Ecological Value and Slightly Disturbed Aquatic Ecosystems will be available via QSpatial, as per below.

- *Spatial information layer on identified High Ecological Value and Slightly Disturbed Aquatic Ecosystems (and extent of Water Type Zone boundaries) be made available on Qld Globe and to NRM bodies*
    - This layer will be published on QSpatial once the EVs and WQOs have been recommended for inclusion under Schedule 1 of EPP Water.

In the April 2018 submissions period, additional feedback was received regarding the environmental values mapping included in the draft HWMPs. The feedback received during each consultation process has resulted in the final set of EVs presented in Table 10 and shown in Figure 16 to Figure 24 of this HWMP.

The economic and social impacts of protecting environmental values are considered through consultation, as well as through a socioeconomic report commissioned by the Queensland Government (Marsden Jacob Associates, 2017). At the completion of consultation and consideration of all submissions, finalised environmental values and water quality objectives (water quality target values) will be subsequently recommended for inclusion under Schedule 1 of the EPP Water[8]. Under the EPP Water, environmental values and associated water quality objectives (water quality target values) inform statutory and non-statutory water quality management planning and decision-making.

4.3 Consultation – Water quality objectives

Consultation with relevant local stakeholders occurred throughout the development of the water quality objectives[9] (WQOs) for the Condamine River basin. In March 2017, the draft WQOs were released for a three month public consultation period via print media, email, and publishing on the Queensland Government website. The material was made available, and in many cases presented, to 51 stakeholder groups, including local, state and federal governments, Northern Basin Aboriginal Nations, SunWater, Arrow Energy, CA and Condamine Balonne Water Committee. This consultation period allowed stakeholders to provide comment on the draft local water quality objectives which are developed to protect the draft environmental values for each sub-catchment.

This consultation provided the community with an update of progress towards the Condamine River basin HWMP and an opportunity to provide feedback on the draft environmental values, WQOs, levels of aquatic ecosystem protection and sub-regional mapping.

Following the consultation period, communication was maintained with several stakeholder groups who indicated they possessed additional water quality data that would assist the department to further refine the WQOs and increase the relevance of the values to their local area. Submissions were received on the draft WQO material during and after the consultation period, and common feedback included:

- *Implement event monitoring programs including end of system monitoring and a number of nested monitoring sequences to improve understanding of pollutant sources and sinks through the catchment systems*
- *Maintain existing ambient monitoring programs*
- *Consideration should be given to coupling water quality guidelines and associated monitoring and modelling with broader environmental accounts and socioeconomic indicators.*

[8] If the environmental values and associated water quality objectives are not listed in schedule 1 of the EPP Water, the environmental values are stated under section 6 (2) of the EPP Water and the water quality objectives are the set of water quality guidelines for all indicators that protect all the environmental values for the water.

[9] This terminology is sourced from EPP Water. Under Basin Plan, water quality objectives are termed ‘water quality targets’.

This consultation also provided the community with an update of progress towards the Condamine River basin HWMP and an opportunity to provide feedback on the draft environmental values, levels of aquatic ecosystem protection and sub-regional mapping.

In April 2018, the department invited submissions on the draft HWMP for the plan area, which contained the environmental values and water quality objectives. The department encouraged any additional data to be submitted by stakeholders in a format that would enable the refinement of the WQOs.

4.4 Consultation – Risk assessment

An initial risk assessment workshop to assess the risk of water quality degradation in the Condamine River basin was conducted in March 2013. The workshop was comprised of the Water Quality Technical Panel and included local on-ground expertise from representatives from the former-Department of Natural Resources and Mines (DNRM) and staff from former-Condamine Alliance.

The scores from the initial risk assessment were revisited in October 2016 and an additional workshop was held with the Water Quality Technical Panel to update the risk scores. Following update to the risk scores, further consultation occurred between staff from the Queensland Government as well as between DES and former-Condamine Alliance. The following feedback is an example of what was received from this consultation:

- *Risks identified and risk scores look to be accurate, noting that localised risks could occur but due to the spatial scale of the assessment units, these risks could be overlooked.*
    - This was addressed by identifying hotspots within each assessment area.

Following the internal workshops, joint external workshops were held with former-DNRM to present the draft risk assessment material to key stakeholders. The joint external workshop for the Condamine risk assessment was held in Toowoomba on the 28th November 2016. Fourteen participants attended the workshop, including representatives from Qld Farmers Federation, Western Downs Regional council, Gowrie Oakey Irrigators, former-Queensland Murray-Darling Committee, former-Condamine Alliance, Cotton Australia, WWF, SunWater, and Transport and Main Roads.

The risk assessment contributes to the requirements of a Water Quality Management Plan under Chapter 10, Part 7 of the Basin Plan and will be included in the Commonwealth Water Resource Plan package to be submitted to the Murray-Darling Basin Authority for accreditation under the Basin Plan.

4.5 Consultation – Aboriginal Nations

The Department of Environment and Science would like to acknowledge and pay respect to the past and present Traditional Owners of the region and their Nations, and thank the representatives of the Aboriginal communities, including the Elders, who provided their knowledge of natural resource management throughout the consultation process. It is recognised that there are values and protocols of men's and women's business that relate to water which are culturally sensitive and were not discussed openly through consultation. It is acknowledged that only the commonly known places and stories can be discussed openly. It is also understood that places and stories can hold different cultural values and significance between each Aboriginal Nation.

Consideration of Aboriginal social, cultural and economic values and uses has been a key part of the consultation process for the development of the HWMP. The term 'Aboriginal water values' is used to describe the relationship between Aboriginal and Torres Strait Islander peoples and water and the importance of water and water dependent resources. Their relationship with water is intrinsic in nature, with water not only being fundamental for survival, but an indivisible, interwoven and central element of cultural and spiritual life (Constable & Love, 2015).

The consultation process, and how the consultation process fits into water planning, is described in detail in the Water Connections Report (DNRME, 2019) – but has been summarised below for the purposes of the HWMP. The Queensland Government aimed to consult with as many Traditional Owners as possible from Aboriginal Nations in the Border Rivers, Moonie, Condamine and Maranoa-Balonne river basins. The Department of Environment and Science worked closely with the Department of Natural Resources, Mines and Energy to align the consultation process for the development of the water plans and HWMPs for Queensland Murray-Darling Basin catchments.

It is important to note that Aboriginal Nation areas do not align with water plan areas or state borders and there are multiple Aboriginal Nations within the Condamine River basin. Aboriginal Nations of the Murray–Darling Basin (for both surface water and groundwater) are listed on maps produced by the Murray–Darling Basin Authority and representatives of the Aboriginal Nations (MDBA, 2018a & MDBA, 2018b). The Aboriginal Nations involved in the consultation process included:

- Barunggam
- Bidjara

- Bigambul
- Euahlayi
- Giabel
- Githabul
- Gomeroi (Kamilaroi)
- Gunggari
- Guwamu (Kooma)
- Jarowair
- Kambuwal
- Mandandanji
- Wakka Wakka.

Note: Murrawarri Nation representatives have indicated to the Queensland Government that their traditional lands do not extend far into Queensland, and therefore they do not need to be part of the engagement.

The consultation process started in August 2016 with a joint workshop held in Boggabilla between the Northern Basin Aboriginal Nations Delegates from the Nations in the catchment areas. The workshop outlined options for the Aboriginal Nation Delegates to consider how they wished to be engaged. From August 2016 to August 2017, people from the Aboriginal Nations across the plan area were engaged through a series of workshops on a Nation by Nation basis. In addition to the Nation workshops, individual Traditional Owners from each basin area were also consulted and input sought.

The consultation process aimed to identify values and uses of water, risks to the values and uses of water, objectives and outcomes desired for the water, and opportunities to strengthen the protection of Aboriginal values and uses, for consideration in both the Condamine River basin HWMP and Queensland Water Plan for the Condamine-Balonne plan area. During consultation, careful consideration was given towards ensuring this information was documented in participant's own words.

Discussions with participants in the consultation workshops and meetings raised a number of risks related to:

- Aboriginal values and uses arising from the use and management of water resources; and
- that insufficient water is available, or water is not suitable, to maintain social, cultural, Aboriginal and other public benefit values.

The risks raised at the workshops and during discussions were largely consequential risks that have occurred as a result of insufficient water available for the environment, water being of a quality unsuitable for use or the poor health of water-dependent ecosystems. In the discussions, Aboriginal people often relayed the risks in the form of stories about impacts to important social, spiritual and cultural aspects related to land and water. Participants also drew comparisons between the current state of the river systems and how they remembered using and valuing the river systems when they were children or from stories passed on from earlier generations.

Following on from the consultation process described above, in April 2018 the draft version of the Healthy Waters Management Plan for the Condamine River basin was made available to Traditional Owners through the Department of Environment and Science website as well as through the former-Condamine Alliance website. People from Aboriginal Nations across the plan area were then met with again during May and June of 2018 to discuss the draft plans and review the way in which their values and uses of water were included. Overall, 180 submissions on the water plans and HWMPs were received from the Aboriginal community. The Department of Environment and Science reviewed submissions related to water quality that were received, to address through the HWMP where possible.

Section 9 of the HWMP presents Aboriginal people's values and uses addressed under a healthy waters management plan, which relates to water quality matters.

4.6 Consultation – Climate variability

The impacts of a changing climate are already being experienced in Queensland. These changes pose a threat to the state's economy, communities and environment. Due to this, climate change and the impacts of climate change on water quality have been considered in this HWMP.

In 2017, the former Department of Environment and Heritage Protection (DEHP) prepared a response to ensure Queensland is equipped to understand, adapt and transition under a changing climate. The Queensland Climate Change Response outlines the commitments and actions the Queensland Government will take to transition to a low carbon, clean growth economy and adapt to the impacts of a changing climate. The Queensland Climate Change Response includes two key strategies: Queensland Climate Transition Strategy; and Queensland Climate Adaptation Strategy. The commitments and actions listed in these strategies inform the measures to address risks resultant of climate change.

Further information about Queensland's approach to understand, adapt and transition under a changing climate can be found at the Queensland Government website: https://www.qld.gov.au/environment/climate/response.

4.7 Consultation – New South Wales Government

Under the Basin Plan, consultation with the New South Wales Government on the WQM Plan (and accompanying HWMP) must be undertaken by the Queensland Department of Environment and Science to consider any cross-border impacts that may result from managing water quality in these basins. In particular, the following must be considered:

- the impact of Queensland proposed alternative water quality target values on the ability of New South Wales to meet water quality targets;
- the impact of Queensland measures on the ability of New South Wales to meet water quality targets; and
- any adverse impacts measures may have on New South Wales water resources.

The Condamine River basin does not connect directly with New South Wales (NSW) water resources. As such, components of the draft HWMPs for the Queensland Border Rivers-Moonie and Maranoa and Balonne River basins were presented to water quality representatives from the New South Wales Department of Primary Industries (DPI) on 30 June 2017 and 23 January 2018. The department briefed DPI on the following components of these HWMPs:

- 30 June 2017
    - A summary of risks to water quality identified by the department in the Border Rivers, Moonie River and Lower Balonne River basins. These risks were compared to the risks to water quality identified in the risk assessment conducted by DPI. Inconsistencies between the two risk assessments were highlighted and investigated.
- 23 January 2018
    - An updated summary of risks to water quality by the department in the Border Rivers, Moonie River and Lower Balonne River basins was provided to DPI for comparison to the risks to water quality identified by DPI.
    - The methods used to develop the proposed alternative water quality target values for surface and groundwater.

Feedback provided to the department from NSW Department of Primary Industries (DPI) during the development of the Warrego, Paroo, Bulloo and Nebine Healthy Waters Management Plan (Department of Environment and Heritage Protection, 2016) has been considered in the development of the Condamine HWMP. This is to ensure a consistent approach is maintained with the other HWMPs under development in the QMDB. The following suggestions have been incorporated into this HWMP:

- Include water quality data from NSW catchments in the development of proposed alternative water quality target values
- Include text boxes throughout the document to assist the reader to understand how the HWMP for the Maranoa and Balonne River basin contributes to meeting the requirements of a Water Quality Management Plan under the Basin Plan.

A final version of the HWMPs was provided to the New South Wales Government for their response following consideration of the Basin Plan requirements. On 12th February 2019, the New South Wales Department of Industry (Water) indicated their support for the Queensland Condamine-Balonne Water Quality Management Plan.

SECTION 5: SOCIAL, ECONOMIC, CULTURAL AND ENVIRONMENTAL VALUES AND USES

5 Social, economic, cultural and environmental values and uses

The social, economic, cultural and environmental values and uses of water for the Condamine River basin were established through the environmental values framework under the EPP Water. Environmental values (EVs) reflect the ways in which water is valued and used in a catchment area. Setting environmental values through community and stakeholder consultation reflects how a local region values and uses water. Under the EPP Water, and as depicted by Figure 15, EVs include:

- aquatic ecosystem[10]
- cultural and spiritual values (modified to 'cultural, spiritual and ceremonial values' for the purposes of this HWMP at the request of Traditional Owners)
- agriculture (including irrigation, stock and domestic)
- aquaculture
- human consumption of aquatic foods
- drinking water (suitable for treatment before supply as drinking water[11])
- industrial use; and
- recreation (primary, secondary and visual/aesthetic).

Initially, for the purpose of establishing environmental values for the surface waters of the Condamine River basin, sub-catchments were defined within each basin. The creation of sub-catchments enables locally relevant discussion around how water is valued and used by stakeholders and the community. The surface water sub-catchments were generated from Queensland Government, public domain information and community consultation and were developed on the basis of:

a. likely geological influences on soil type and water quality
b. recognition of existing defined sub-regional natural resource management planning areas.

The environmental values that apply to each surface water sub-catchment were determined through stakeholder and community consultation, and were further refined by technical input from Queensland Government staff (Refer to Section 4). To simplify the final EVs mapping, the sub-catchments were aligned, where possible, with the water types which were developed through the water quality objective development. A description of water types in the Condamine River basin is provided in in Appendix 2—Description of water types in the Condamine River basin.

To enable the accurate and comprehensive depiction of environmental values that apply to groundwater, groundwater aquifer units and sub-aquifer chemistry zones were defined for QMDB (McNeil, Raymond, Bennett, & McGregor, 2017). Groundwater chemistry data was analysed to identify zones of similar water chemistry. The EVs for each zone of similar water chemistry (sub-aquifer chemistry zones) were initially determined by reviewing the bore installation records, which are held within the Queensland Government Water Entitlements Registration Database. The bore installation records detail how the groundwater for each bore will be used, thus informing how the water is valued. Consultation with the Water Quality Technical Panel was conducted to ensure the approach taken to identify groundwater EVs is accurate and representative (Refer to Section 4).

At the completion of consultation and consideration of all submissions, finalised environmental values and water quality objectives (water quality target values) will be subsequently recommended for inclusion under Schedule 1 of the EPP Water[12]. Under the EPP Water, environmental values and associated water quality objectives (water quality target values) inform statutory and non-statutory water quality management planning and decision-making.

[10] The Australian and New Zealand Water Quality Guidelines (ANZECC/ARMCANZ – as updated) and the EPP Water outline how aquatic ecosystems can be subdivided into different levels of protection, depending on condition. The EPP Water recognises four possible levels of ecosystem condition and corresponding management intent; namely high ecological value (effectively unmodified) systems; slightly disturbed, moderately disturbed and highly disturbed systems. Section 14 of the EPP Water states the management intent for waters subject to an activity that involves the release of wastewater or contaminants to waters.

[11] For drinking water guidelines that apply to water after it has been treated or is to be used for drinking—see the Australian Drinking Water Guidelines developed by the National Health and Medical Research Council.

[12] If the environmental values and associated water quality objectives are not listed in schedule 1 of the EPP Water, the environmental values are stated under section 6 (2) of the EPP Water and the water quality objectives are the set of water quality guidelines for all indicators that protect all the environmental values for the water.

The environmental values that apply to the surface and groundwater of the Condamine River basin are presented in Table 10 and mapped for each surface water sub-catchment and groundwater sub-aquifer chemistry zone in Figure 16 to Figure 24.

Figure 15: Environmental values icons and definitions under EPP Water (used in Figure 16 to Figure 24).

5.1 Socioeconomic assessment for the protection of environmental values

EPP Water section 12(b) states that the economic and social impacts of protecting environmental values must be considered prior to recommending the environmental values for inclusion in Schedule 1 of EPP Water. The former Department of Environment and Heritage Protection commissioned Marsden Jacob Associates to assess the value of protecting and enhancing environmental values and water quality in QMDB. This work forms the socioeconomic report for the protection of environmental values in the Queensland Murray-Darling and Bulloo Basins (Marsden Jacob Associates, 2017).

> **"When the condition of the aquatic ecosystem declines, important ecosystem functions and services also decline, affecting key sectors such as tourism, agriculture, fishing and recreation and threatening critical assets such as the unique wetlands of the region."** (Marsden Jacob Associates, 2017)

Benefits to the community, region and State from maintaining environmental values and water quality in QMDB as a whole, and in the Condamine River basin more specifically, were identified in the socioeconomic assessment. Key findings were that the aquatic ecosystem, ecosystem functions and services in QMDB directly contribute to the social and economic wellbeing of the community, region and State. Benefits from maintaining environmental values and water quality include:

- maintaining a regionally significant and developing tourism sector in QMDB which generates $952 million per annum
    - Water quality of rivers, streams and wetlands underpins the tourism sector and outdoor recreation opportunities for all residents and visitors.
- providing recreation, boating and other aesthetic benefits to the community
    - Water based recreational activities in QMDB is valued at approximately $128 million per annum.
- ensuring a sustainable recreational fishing sector
    - Valued at $104 million per annum and further enhances recreational and eco-tourism opportunities.
- providing biological support and physical protection for biodiversity, fisheries and ecosystems
    - Community willingness to pay to protect the 1.3 million hectares of wetlands in QMDB is estimated to be $1.9 billion.
- ensuring the agricultural sector is sustainable
    - Land and water resources of suitable quality are critical to a sustainable agriculture sector
    - Agriculture production in Condamine River basin was worth approximately $1,315 million in 2015.
    - In QMDB as a whole, agricultural production is worth $3,162 million.

The full socioeconomic report can be viewed on the Queensland Government website: https://environment.des.qld.gov.au/water/policy/pdf/qmdb-socioeconomic-report.pdf.

5.2 Environmental values for the Condamine River Basin

Table 10: Environmental values for the Condamine River basin surface waters and groundwaters.

Notes:

1. Refer to the accompanying maps (Figure 16 to Figure 24), as indicated in the table, for the sub-catchments and sub-aquifers where environmental values apply.
2. ✓ means the environmental value is selected for protection. Blank indicates that the environmental value is not selected for protection.
3. Refer to Section 10 for the water quality target values that apply to protect the environmental values in Table 10.

Condamine River Basin	Environmental Values[1–3]											
	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual recreation	Drinking water	Industrial use	Cultural, spiritual and ceremonial values
Water												
SURFACE FRESH WATERS (rivers, creeks, streams) (Figure 16)												
Ashall Creek	✓	✓	✓	✓					✓		✓	✓
Braemar and Kogan Creeks	✓	✓	✓	✓					✓	✓	✓	✓
Central Condamine River	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Condamine River North Branch	✓	✓	✓						✓	✓	✓	✓
Condamine River North	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Condamine River Basin	Environmental Values[1–3]											
	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual recreation	Drinking water	Industrial use	Cultural, spiritual and ceremonial values
Water												
Condamine River South Branch	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
Condamine River South	✓	✓	✓	✓		✓	✓		✓			✓
Cooby Dam	✓		✓	✓		✓		✓	✓	✓	✓	✓
Dalrymple and Glengallan Creeks	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Headwaters	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
Hodgson Creek	✓	✓	✓	✓		✓			✓			✓
Jandowae and Upper Charleys Creeks	✓	✓	✓	✓		✓			✓	✓	✓	✓
Jimbour Creek	✓	✓	✓	✓					✓	✓		✓
Kings Creek	✓	✓	✓	✓		✓			✓	✓	✓	✓
Lake Broadwater	✓		✓				✓	✓	✓		✓	✓
Leslie Dam	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Sandy Creek	✓	✓	✓	✓					✓			✓

Condamine River Basin	Environmental Values[1–3]											
	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual recreation	Drinking water	Industrial use	Cultural, spiritual and ceremonial values
Water												
Six Mile Creek and Thane Creek	✓	✓		✓		✓			✓	✓	✓	✓
Upper Myall Creek	✓	✓	✓	✓		✓			✓			✓
Upper Oakey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Wieambilla and Wambo Creeks	✓	✓	✓	✓		✓			✓		✓	✓
Wilkie Creek	✓	✓	✓	✓					✓		✓	✓
GROUNDWATERS												
Alluvial Zones (Figure 17)												
Central Condamine	✓	✓	✓	✓	✓					✓	✓	✓
Hodgson	✓	✓	✓	✓						✓	✓	✓
Lower Condamine	✓	✓	✓	✓	✓					✓		✓
Myall	✓	✓	✓	✓						✓	✓	✓

Condamine River Basin	Environmental Values[1–3]											
	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual recreation	Drinking water	Industrial use	Cultural, spiritual and ceremonial values
Water												
North Branch	✓	✓	✓	✓						✓	✓	✓
Northwest Condamine	✓	✓	✓	✓	✓					✓	✓	✓
Oakey	✓	✓	✓	✓	✓					✓	✓	✓
Southern Condamine	✓	✓	✓	✓						✓	✓	✓
Wooloowins	✓	✓	✓	✓	✓					✓	✓	✓
Fractured Rock Zones (Figure 18)												
Border Rivers Headwaters	✓	✓	✓	✓						✓		✓
Lower Condamine basalts	✓	✓	✓	✓						✓	✓	✓
New England Granite	✓	✓	✓	✓						✓	✓	✓
Toowoomba region basalts	✓	✓	✓	✓	✓					✓	✓	✓
Upper Condamine basalts	✓	✓	✓	✓	✓					✓	✓	✓

Condamine River Basin	Environmental Values[1–3]											
	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual recreation	Drinking water	Industrial use	Cultural, spiritual and ceremonial values
Water												
Sediments Overlying the GAB Zones (Figure 19)												
Tertiary sediments	✓		✓	✓								✓
Weathered alluvium	✓	✓	✓	✓	✓					✓	✓	✓
Upper GAB Zones (Figure 20)												
Probable Upper Cretaceous	✓	✓	✓	✓						✓		✓
Mid GAB Aquifer Zones (Figure 21)												
Eastern Cretaceous Outcrop	✓		✓	✓						✓	✓	✓
Southeast Kumbarilla	✓	✓	✓	✓	✓					✓		✓
Lower GAB Zones (Figure 22)												
Central Surat Springbok area	✓	✓	✓	✓	✓					✓		✓
Eastern Springbok Outcrop	✓		✓	✓						✓		✓

Condamine River Basin	Environmental Values[1–3]											
	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual recreation	Drinking water	Industrial use	Cultural, spiritual and ceremonial values
Water												
North East Walloons	✓	✓	✓	✓	✓					✓	✓	✓
Saline Southeastern Hutton Outcrop	✓	✓	✓	✓						✓		✓
Southeastern Hutton Outcrop	✓	✓	✓	✓						✓	✓	✓
South East Walloons	✓	✓	✓	✓	✓					✓	✓	✓
Basal GAB Zones (Figure 23)												
Eastern Central area	✓	✓	✓	✓						✓	✓	✓
Northeastern Evergreen Outcrop	✓	✓	✓	✓						✓		✓
Southeastern Evergreen	✓	✓	✓	✓						✓	✓	✓
Earlier Basins Partially Underlying the GAB Zones (Figure 24)												

Condamine River Basin	Environmental Values[1–3]											
	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual recreation	Drinking water	Industrial use	Cultural, spiritual and ceremonial values
Water												
Bowen Basin	✓			✓								✓

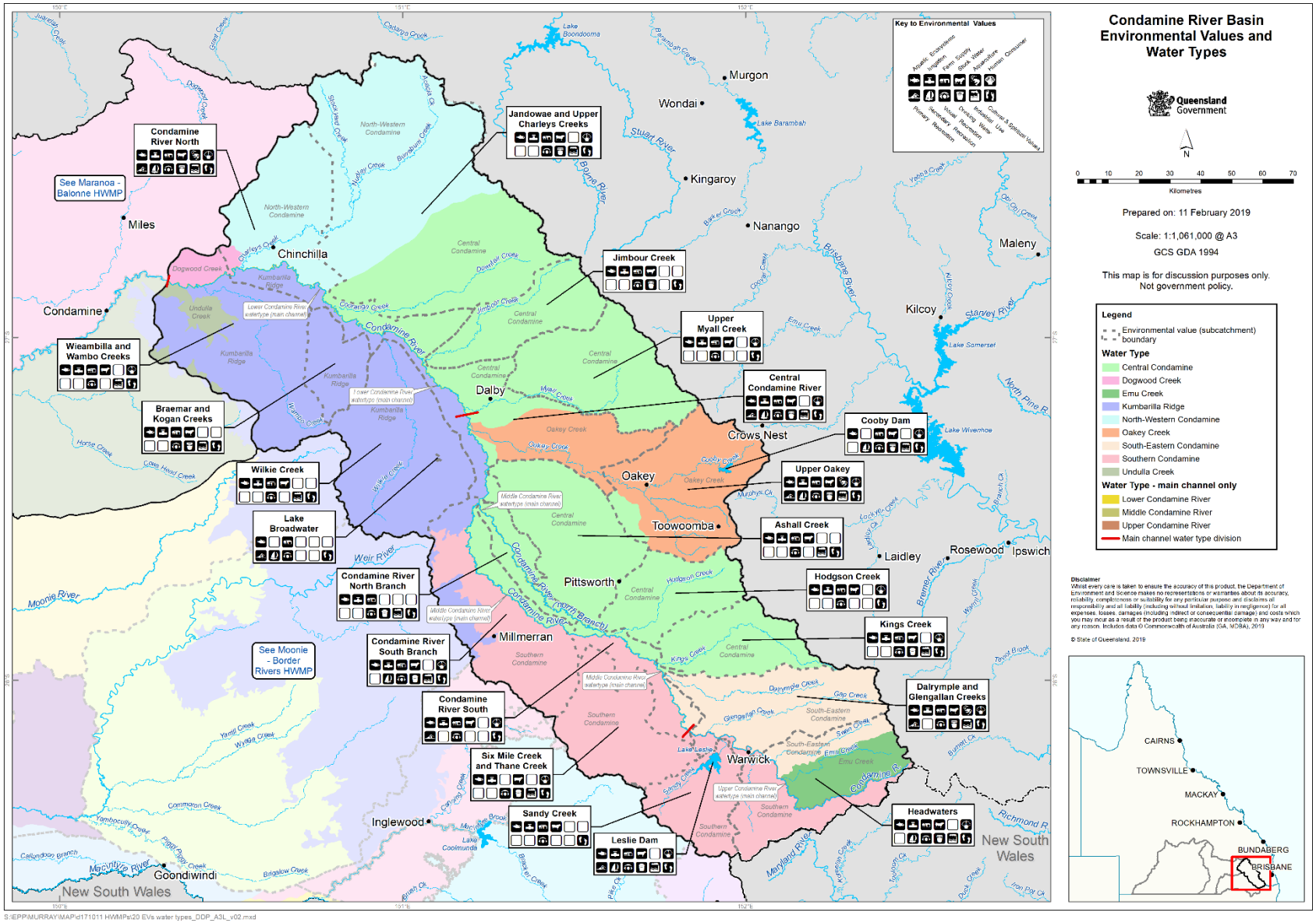

Figure 16: Environmental values that apply to the surface waters in each sub-catchment within the Condamine River basin.

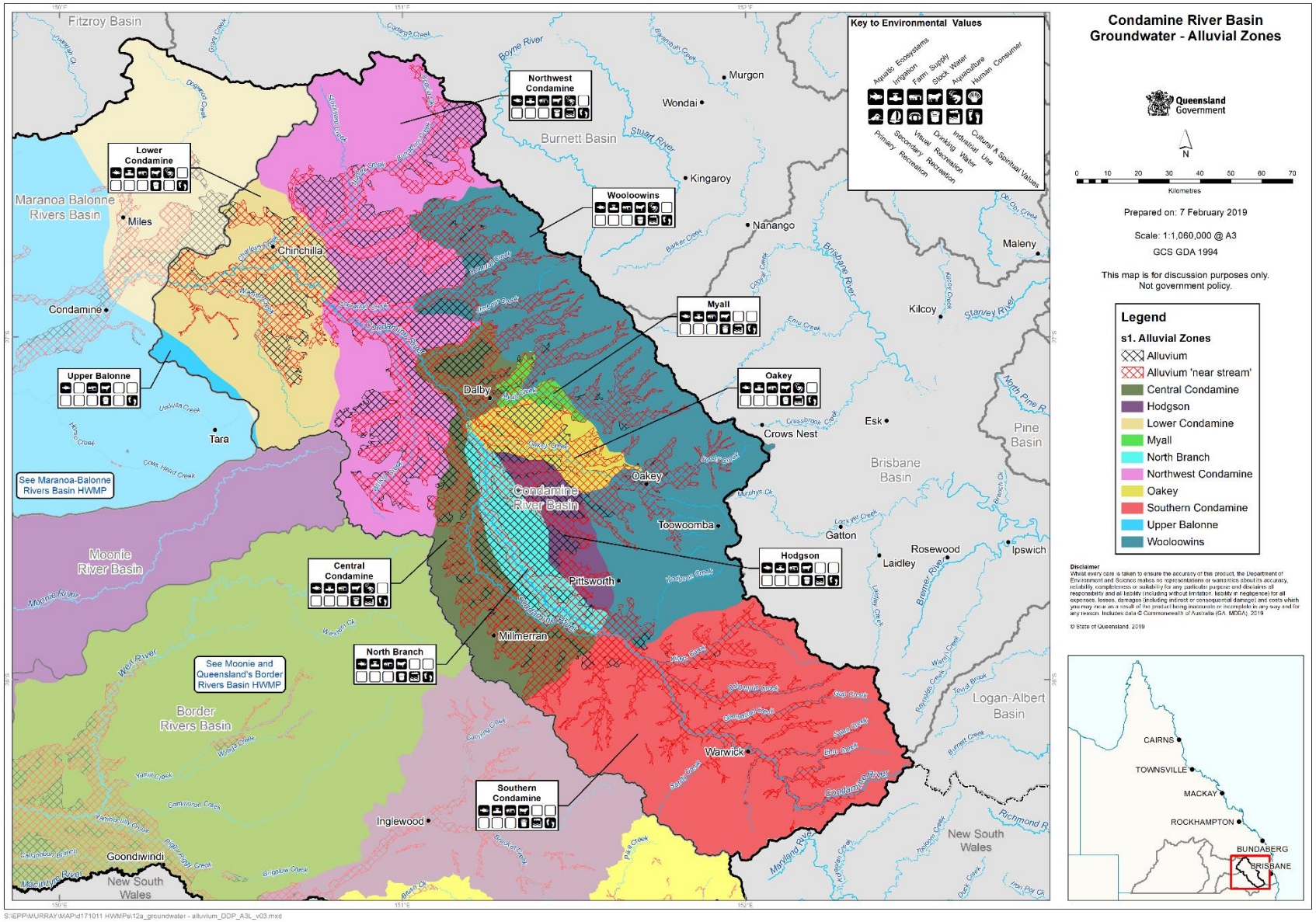

Figure 17: Environmental values that apply to the Alluvial aquifer zones within the groundwaters of Condamine River basin.

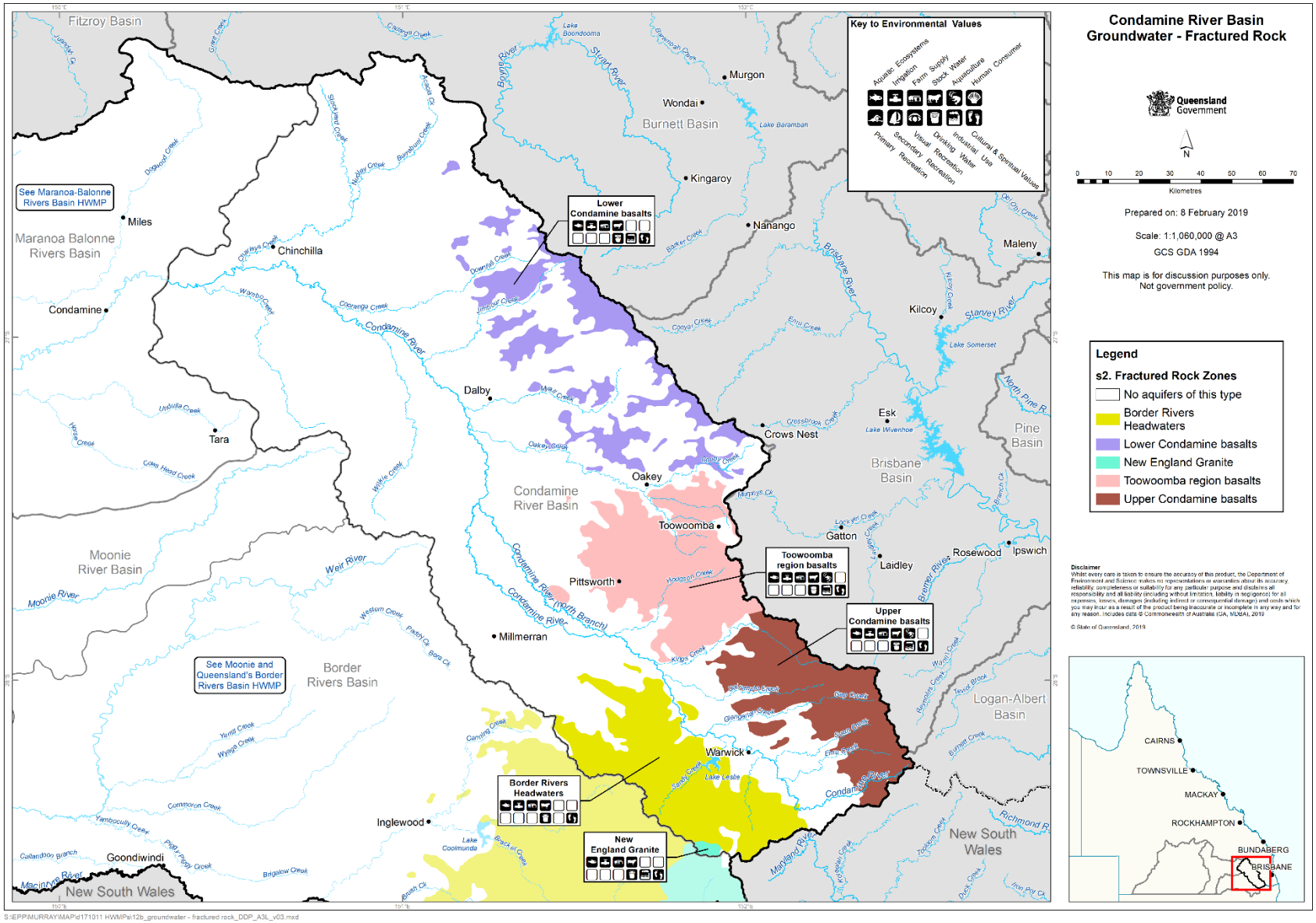

Figure 18: Environmental values that apply to the Fractured Rock aquifer zones within the groundwaters of Condamine River basin.

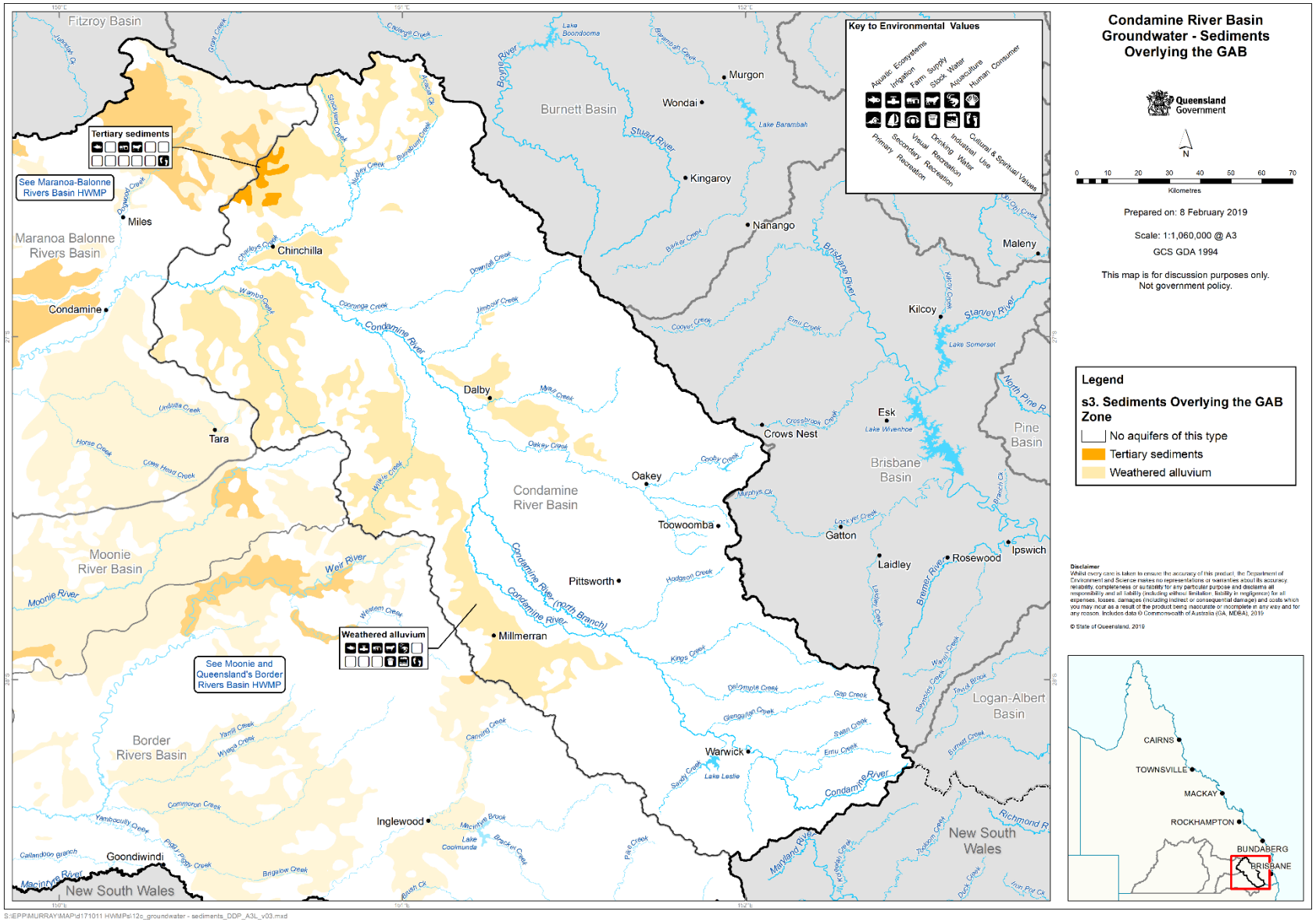

Figure 19: Environmental values that apply to the sediments overlying the GAB aquifer zones within the groundwaters of Condamine River basin.

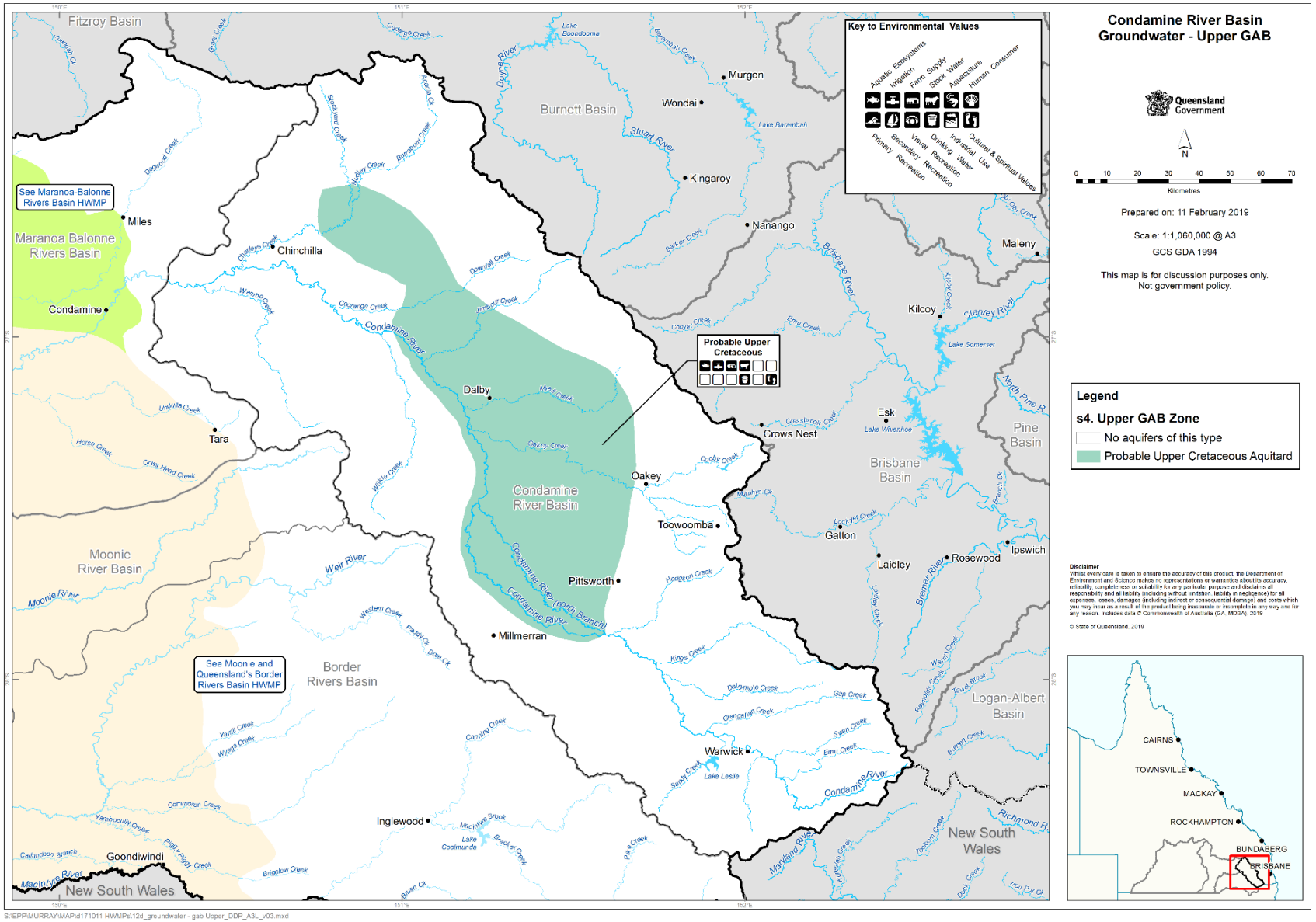

Figure 20: Environmental values that apply to the Upper GAB aquifer zones within the groundwaters of Condamine River basin.

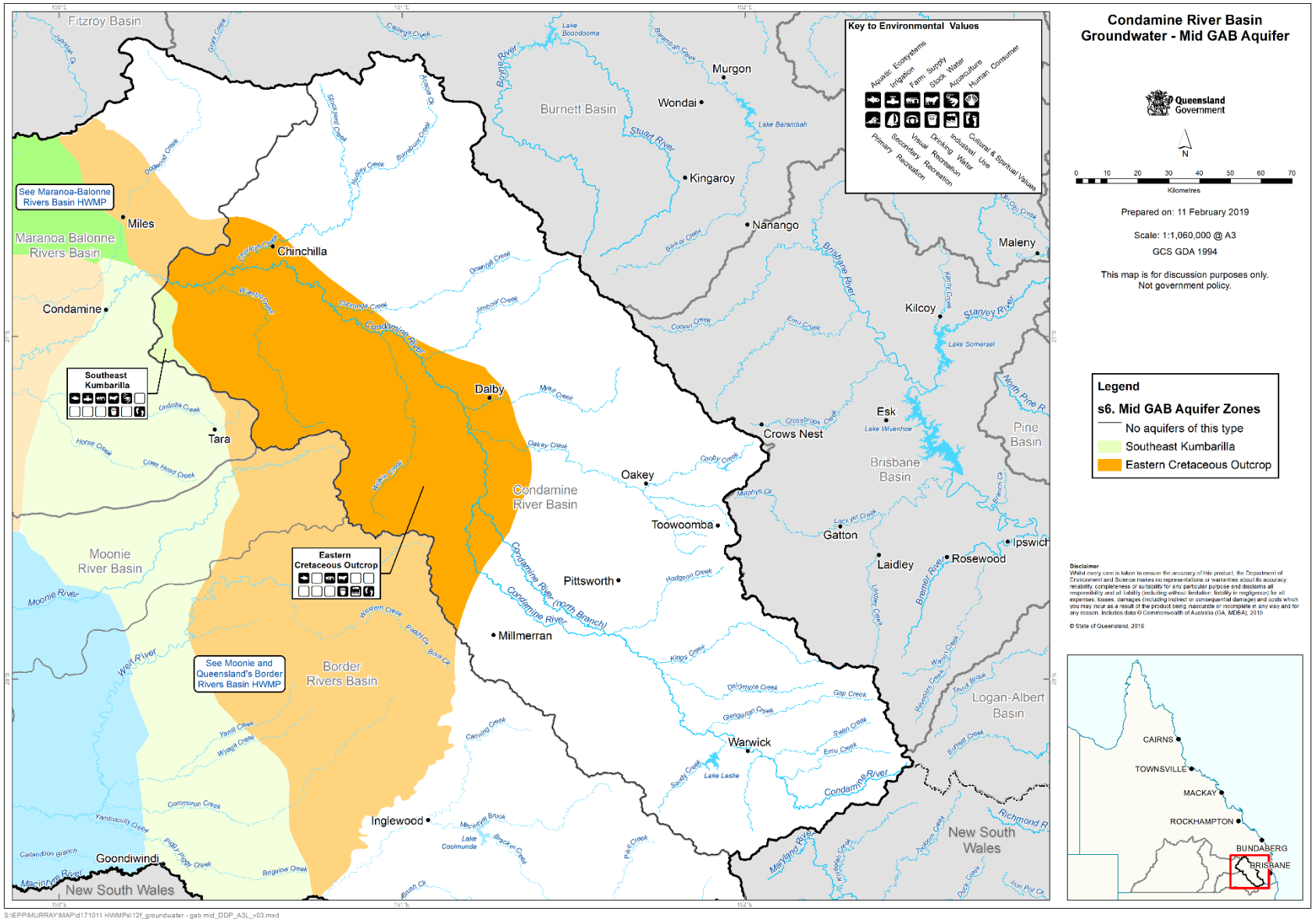

Figure 21: Environmental values that apply to the Mid GAB aquifer zones within the groundwaters of Condamine River basin.

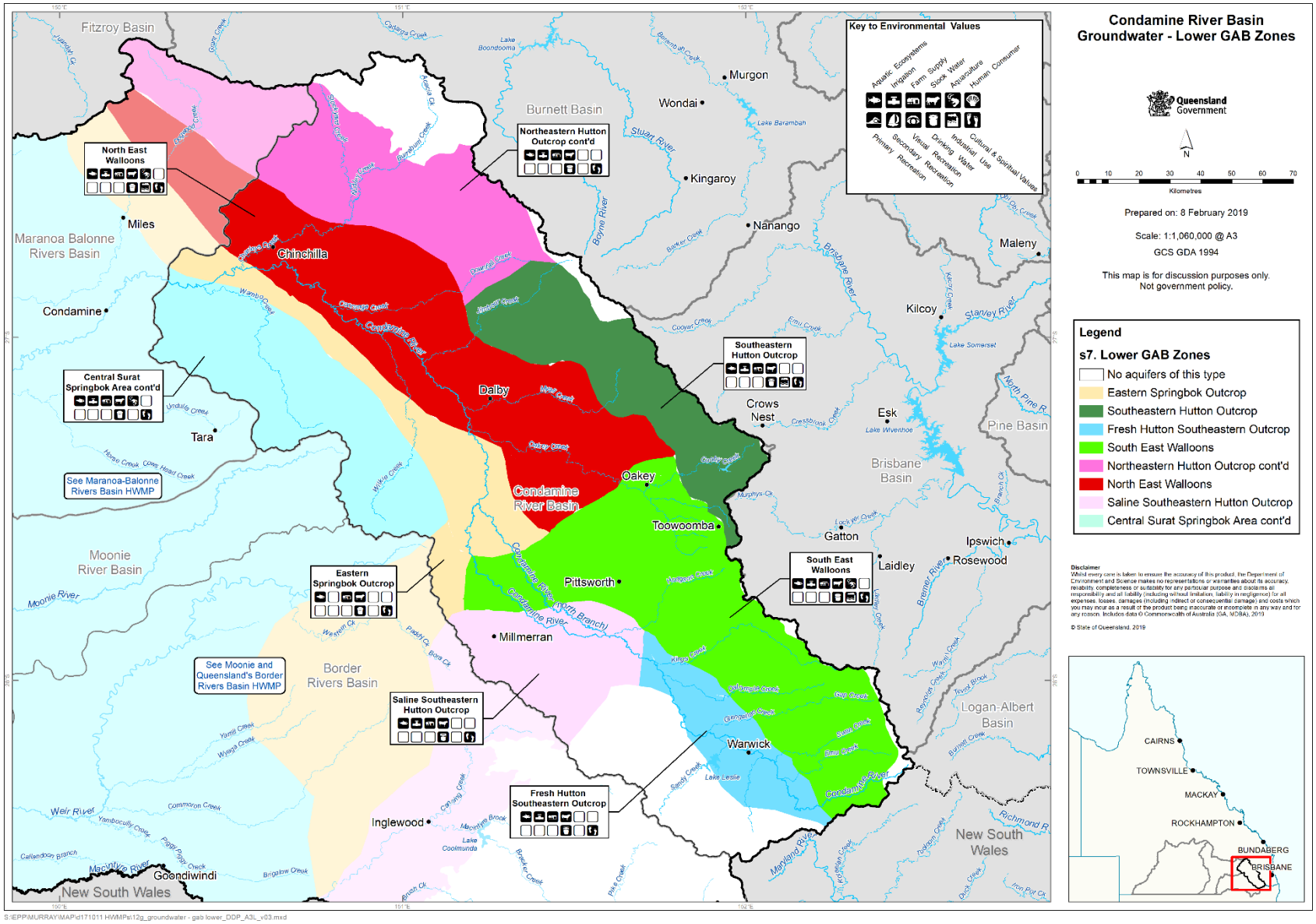

Figure 22: Environmental values that apply to the Lower GAB aquifer zones within the groundwaters of Condamine River basin.

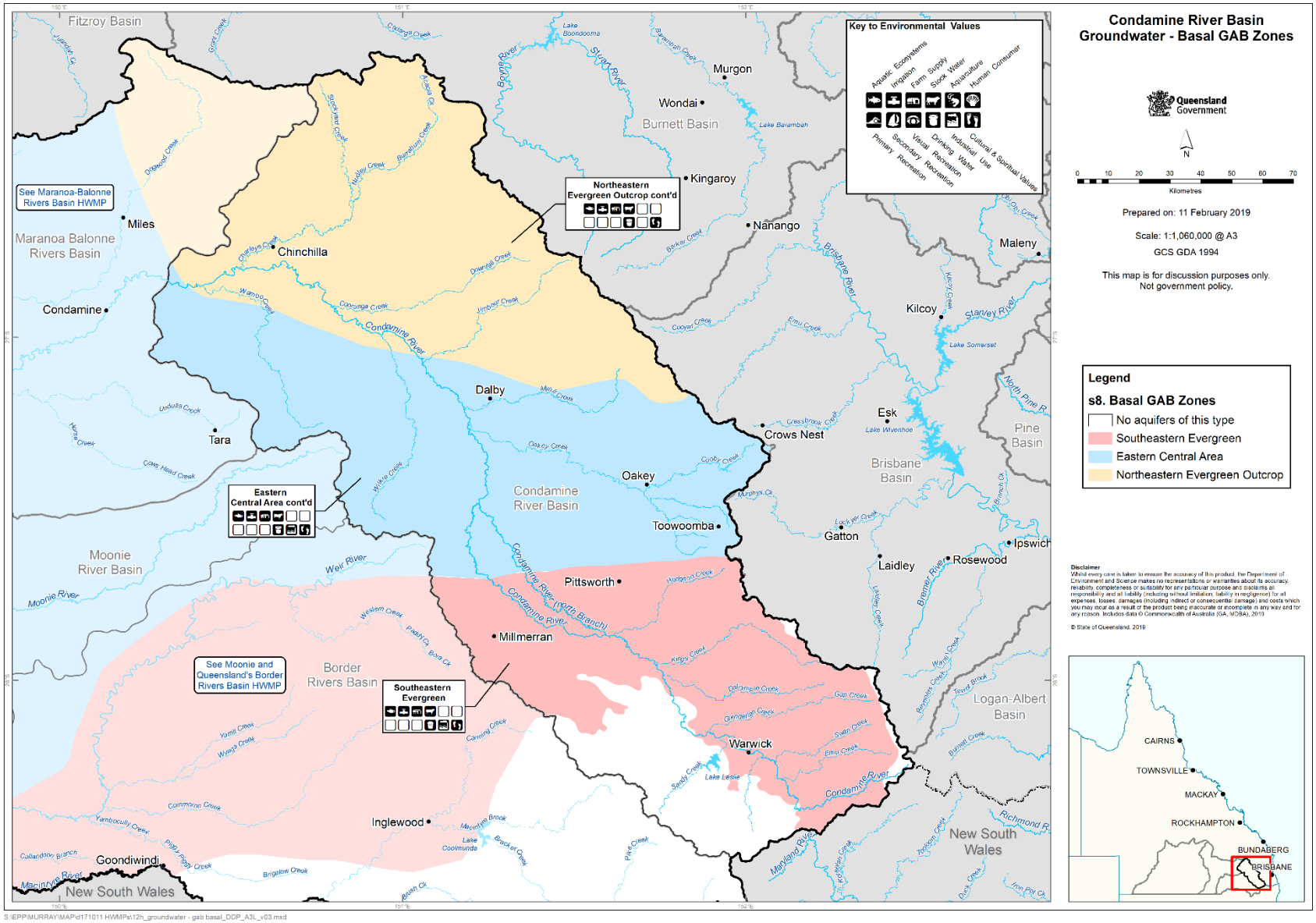

Figure 23: Environmental values that apply to the Basal GAB aquifer zones within the groundwaters of Condamine River basin.

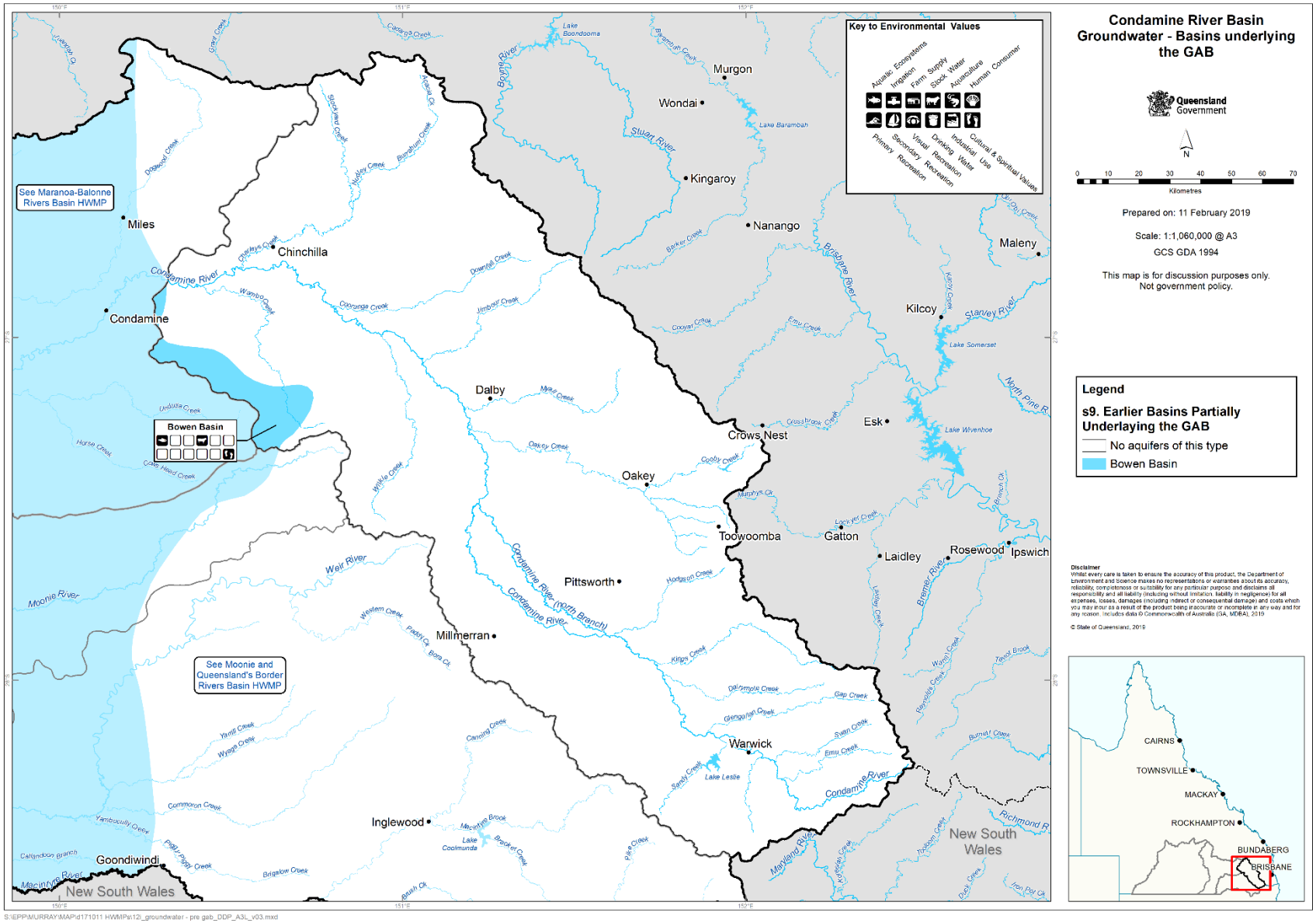

Figure 24: Environmental values that apply to the Earlier Basins Partially Underlying the GAB aquifer zones within the groundwaters of Condamine River basin.

SECTION 6: LEVELS OF AQUATIC ECOSYSTEM PROTECTION

6 Levels of aquatic ecosystem protection

For the aquatic ecosystem environmental value, the EPP Water identifies four levels of protection according to the current condition of waters. The four levels of protection are high ecological value, slightly disturbed, moderately disturbed and highly disturbed (Table 11). Each level of protection is assigned a specific management intent under the EPP Water, as described in section 6.4 of this report.

Table 11: Levels of aquatic ecosystem protection

Ecosystem condition	Definition
Level 1 High ecological value (HEV) ecosystems	Waters in which the biological integrity of the water is effectively unmodified or highly valued.
Level 2 Slightly disturbed ecosystems	Waters that have the biological integrity of high ecological value waters with slightly modified physical or chemical indicators but effectively unmodified biological indicators.
Level 3 Moderately disturbed ecosystems	Waters in which the biological integrity of the water is adversely affected by human activity to a relatively small but measurable degree.
Level 4 Highly disturbed ecosystems	Waters that are significantly degraded by human activity and have lower ecological value than high ecological value waters or slightly or moderately disturbed waters.

Source: EPP Water, Schedule 2.

The designation of levels of aquatic ecosystem condition and the subsequent management intent for waters across Queensland is initially determined by a rules-based approach. This is described in Environmental Protection Policy (Water) Mapping procedural guide (Department of Environment and Science, 2018). This approach is used to develop draft for consultation mapping, which is then refined to consider local water quality data, regional studies and local consultation information. Priority aquatic ecosystems are assigned as either High Ecological Value aquatic ecosystems or Slightly Disturbed aquatic ecosystems based on their condition.

6.1 High Ecological Value and Slightly Disturbed Aquatic Ecosystems

High ecological value and slightly disturbed aquatic ecosystems are presented in Figure 25. The High Ecological Value and Slightly Disturbed waters designations apply only to the waters within the identified boundaries.

The information and datasets considered in the identification and mapping of High Ecological Value waters included:

- protected estates (primarily national parks);
- Wetlands of High Ecological Significance;
- the list of persistent waterholes considered as critical refugia, tabulated at Appendix 4— Persistent Waterholes in the Condamine River basin (Department of Science, Information Technology and Innovation, 2017);
- Great artesian basin (GAB) springs in the ground dependent ecosystems (GDE) register of the QLD GAB and Other Regional Aquifers water management protocol;
- Matters of National Environmental Significance;
- Matters of State Environmental Significance;
- NRM supporting documents (Condamine Alliance); and
- stakeholder consultation and expert opinion through the Water Quality Technical Panel.

The information and datasets for the Slightly Disturbed waters mapping included:

- nature refuges and state forests;
- conservation parks;
- Coordinated Conservation Areas; and
- stakeholder consultation and expert opinion through the Water Quality Technical Panel.

6.2 Moderately Disturbed Aquatic Ecosystems

All other areas of the Condamine River basin that are not identified as High Ecological Value, Slightly Disturbed or Highly Disturbed Aquatic Ecosystems are classed as Moderately Disturbed waters. This is the most common level of protection.

6.3 Highly Disturbed Aquatic Ecosystems

Areas classed as Highly Disturbed are not typically assigned until after local water quality data, regional studies and local information local information have been considered and clearly identify a more heavily degraded condition for particular waters.

Highly Disturbed waters have not been identified in the Condamine River basin.

6.4 Management intent under the EPP Water

Section 14 of the EPP Water states how waters in the different levels of protection described above should be managed. These matters must be considered when decisions are being made about the release of waste water into receiving waters.

For the matters to be complied with for environmental management decisions, including consideration of the management intent, refer to the Environmental Protection Regulation 2008 (as updated), section 51.

Table 12: Management intent under the EPP Water for levels of aquatic ecosystem protection

Level of protection	Management intent
High ecological value (HEV) waters	The measures for the indicators for all Environmental Values are maintained i.e. maintain water quality objectives (target values) for HEV waters.
Slightly disturbed waters	The measures for the slightly modified physical or chemical indicators are progressively improved to achieve the water quality objectives (target values) for HEV waters.
Moderately disturbed waters	If the measures for indicators of the environmental values achieve the water quality objectives (target values) for the water—the measures for the indicators are maintained at levels that achieve the water quality objectives (target values) for the water, or If the measures for indicators of the environmental values do not achieve the water quality objectives (target values) for the water—the measures for indicators of the environmental values are improved to achieve the water quality objectives (target values) for the water.
Highly disturbed waters	The measures for the indicators of all environmental values are progressively improved to achieve the water quality objectives (target values) for the water.

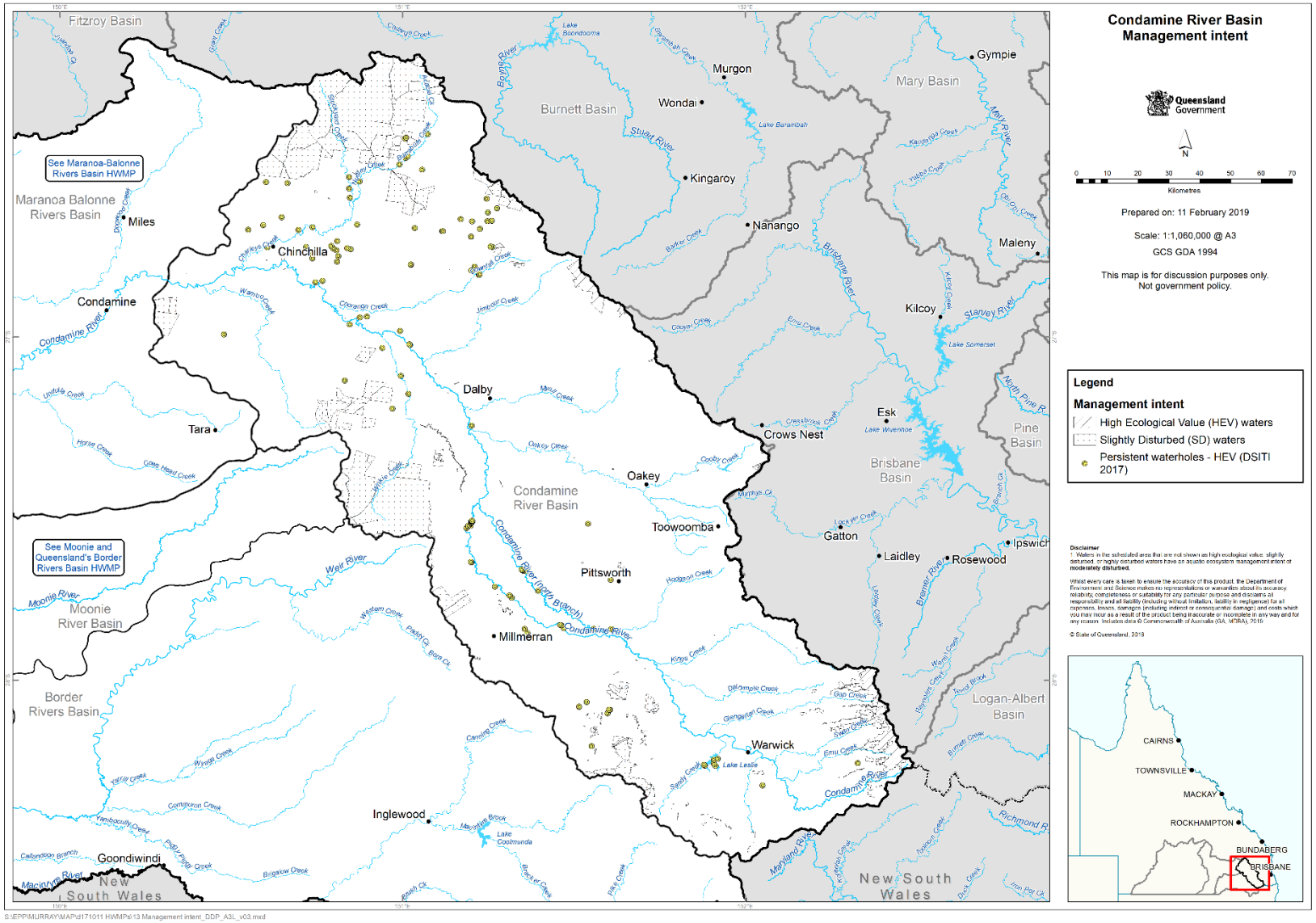

Figure 25: High Ecological Value and Slightly Disturbed waters. Persistent waterholes are High Ecological Value waters (refer to Appendix 4 for a list of the waterholes).

SECTION 7: KEY CAUSES OF WATER QUALITY DEGRADATION AND RISK ASSESSMENT OF WATER BEING OF A QUALITY UNSUITABLE FOR USE

7 Key causes, or likely causes, of water quality degradation and risk assessment of water being of a quality unsuitable for use

The Basin Plan specifies that a WQM Plan must identify the causes, or likely causes, of water quality degradation in the water resource plan area having regard to the key causes of water quality degradation identified in the Basin Plan (Part 2 of Chapter 9 and Schedule 10) under Section 10.30 for surface waters and Section 10.35A for groundwater.

Section 10.41 of the Basin Plan specifies that a water resource plan must be prepared having regard to current and future risks to the condition and continued availability of the water resources of the water resource plan area. Risks include those arising from elevated levels of salinity or other types of water quality degradation.

The key causes, or likely causes, of water quality degradation specific to the Condamine River basin surface waters and groundwater, have been identified through assessment of the current and future risks to the water quality of Basin water resources.

Table 13 presents the key causes, or likely causes, of water quality degradation and the risk of each cause occurring in the Condamine River basin.

For details of the likelihood and consequence of the key causes, or likely causes, of water quality degradation impacting on water resources in the plan area, refer to the Water Quality Risk Assessment spreadsheet on the following website: https://environment.des.qld.gov.au/water/policy/murray-darling-bulloo-evs.html.

A water quality risk assessment was completed in accordance with the requirements of section 10.41 of the Basin Plan. The risk assessment assessed the current and future risks to the condition, or continued availability, of Basin water resources as a result of water being of a quality unsuitable for use. For the purposes of the risk assessment, 'use' included:

- cultural, spiritual and ceremonial
- aquatic ecosystem
- agriculture (including irrigation, stock and domestic)
- consumption of aquatic food (aquaculture and human consumption of aquatic foods)
- drinking water
- industrial use
- recreation (primary, secondary and visual/aesthetic).

The risk assessment was based on the 'Key causes of water quality degradation' derived from Part 2 of Chapter 9 and Schedule 10 of the Basin Plan and identified for the Condamine River basin surface waters and groundwater (see Table 13). During consultation, it was considered necessary to include in the risk assessment issues of local significance that indirectly impact water quality, including pest flora and fauna and climate change. These risks were informed by the Queensland Government Q-catchments Program (Negus, et al., 2015) and other sources as listed in Table 13. Risks to Aboriginal values and uses are displayed and discussed in Section 9 of the HWMP.

7.1 Risk assessment process

The environmental values and water quality targets at Section 5 and Section 10 of this HWMP take precedent to ANZG 2018 (previously ANZECC) guidelines, with exception of pesticides, heavy metals and other toxicant contaminants where ANZG 2018 guidelines continue to apply.

The risk assessment methodology is detailed in Appendix 3—Condamine-Balonne, Moonie and Queensland Border Rivers Water Quality Risk Assessment Methodology of this report, and is consistent with the AS/NZS ISO 31000:2009 Risk Management—Principles and Guidelines. It is also consistent with the National Water Initiative Policy Guidelines for Water Planning and Management—Risk Assessment Module developed by the former-Department of Sustainability, Environment, Water, Population and Communities.

The spatial scale of the surface water assessment was based on groupings of several water type zones. The surface water risk assessment units for the Condamine River basin include, North-Western, South-Western, Southern Condamine, South-Eastern and Central Condamine (Figure 26).

The spatial scale of the groundwater assessment was based on the groundwater Sustainable Diversion Limit (SDL) resource units identified by the Murray-Darling Basin Authority. Refer to the Murray-Darling Basin Authority website for further information on Sustainable Diversion Limit resource units in the Murray-Darling Basin.

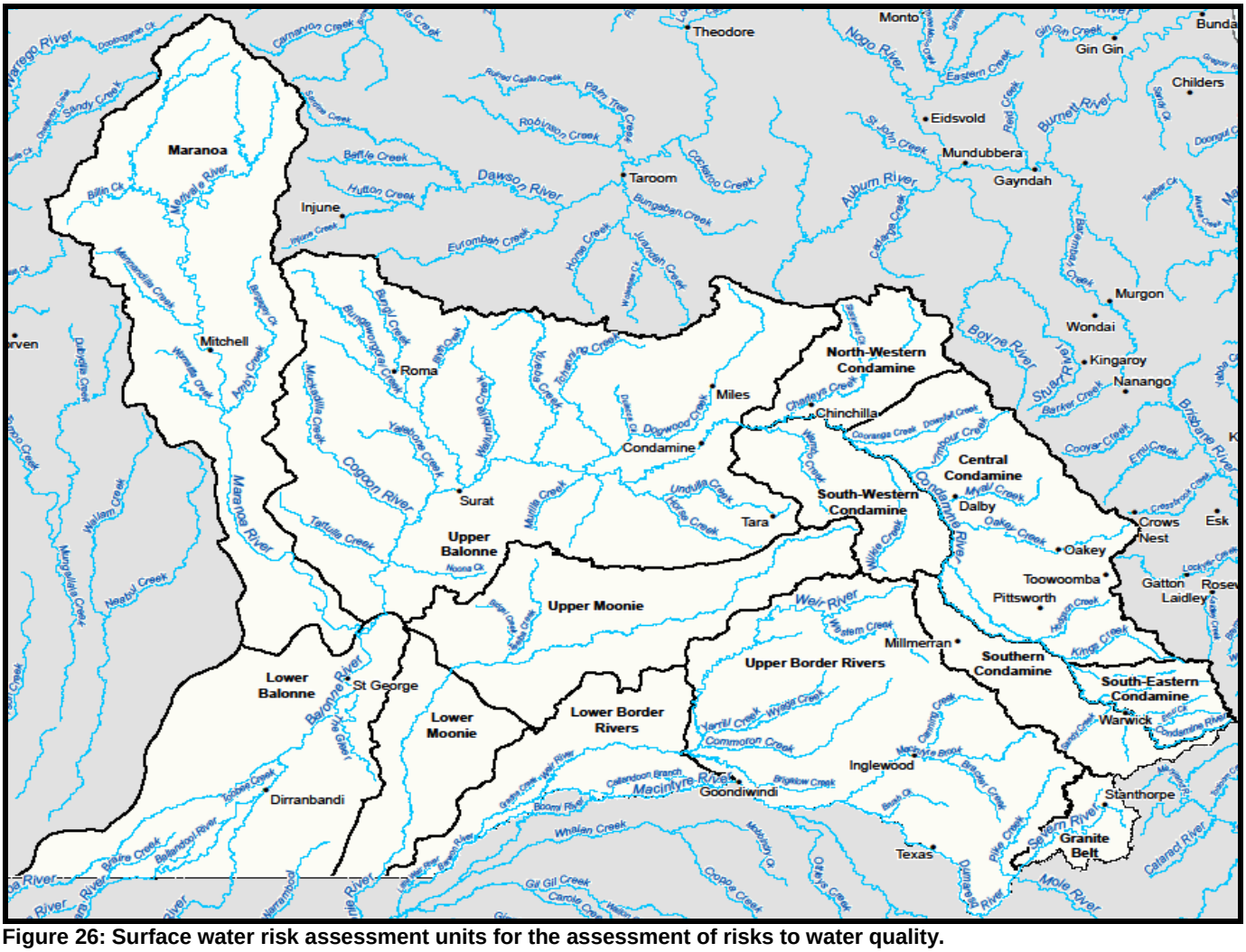

Figure 26: Surface water risk assessment units for the assessment of risks to water quality.

7.2 Risk assessment workshops

The initial risk assessment workshop for Condamine was conducted in March 2013. The workshop was comprised of the Water Quality Technical Panel (Refer to section 4.1) and included local on-ground expertise from former Department of Natural Resources and Mines (DNRM) staff as well as staff from the former-Condamine Alliance. The scores from the initial risk assessment were revisited in October 2016 and an additional workshop was held with the Water Quality Technical Panel to update the risk scores. Further consultation occurred between staff from the Queensland Government and comments included:

- *Risks identified and risk scores look to be accurate, noting that localised risks could occur but due to the spatial scale of the assessment units, these risks could be overlooked.*
    - This was addressed by identifying hotspots within each assessment area.
- *The spatial areas used in the Condamine assessment are appropriate to assess the variation in water quality and land use throughout the Condamine basin.*
- *The risk of elevated Suspended Solids and Nutrients in Southern Condamine as low is supported due to land use (mostly grazing and dryland cropping).*
- *The catchment areas: Hodgson creek, Dalrymple Creek and Emu Creek should be merged to form a South-East assessment area based on land use and geology.*
    - This was addressed as per map above.

Following the internal workshops, joint external workshops were held with former-DNRM to present the draft risk assessment material to key stakeholders. For more information refer to section 4.4 which summarises the risk assessment consultation.

7.3 Risk assessment results

A water quality risk assessment was conducted to identify the potential key types of water quality degradation that could occur in the Condamine River basin.

It is important to note that just because a risk was highlighted through the assessment, does not mean the set of circumstances is currently present for the risk to materialise. The factors contributing to the potential risk are summarised in Table 13. The risks that were identified included:

- elevated levels of salinity as potential medium risk in the South-Eastern Condamine, North-Western, Central (with a hotspot at Hodgson Creek), Southern, and South-Western Condamine;
- elevated levels of suspended matter as a potential medium risk in surface waters of the North-Western and South-Western Condamine.
- elevated levels of nutrients as a potential medium risk in the surface waters of the South-Western Condamine (including a hotspot at Condamine River gauging station 422336A), North-Western and Central Condamine. A potential medium risk was also identified for the ground waters of Mt Tyson within the Upper Condamine Basalts (GS65) and of the Upper Condamine Basalts (GS65) SDL resource unit;
- elevated levels of cyanobacteria cell counts or biovolume and toxins and odour compounds as a potential high risk in surface waters of the North-Western and South-Western Condamine;
- water temperature outside of natural ranges as a potential high risk in surface waters of the North-Western Condamine downstream of Chinchilla Weir and in the Southern Condamine downstream of Leslie reservoir if stratification occurs;
- dissolved oxygen outside natural (ambient) ranges as a potential high risk in surface waters of the North-Western Condamine downstream of Chinchilla Weir and in the Southern Condamine downstream of Leslie reservoir if stratification occurs;
- elevated levels of pesticides and other contaminants as a potential medium risk in surface waters of the Central and South-Western Condamine between Dalby and Condamine and in groundwaters of the Upper Condamine Basalts (GS65) SDL resource unit;
- elevated pathogen counts as a potential medium risk in surface waters of the Central Condamine and groundwaters of the Upper Condamine Basalts (GS65) SDL resource unit, with a hotspot at Highfields due to peri-urban development;
- degradation of aquatic habitat connectivity and condition within and between water-dependent ecosystems and the degradation of riparian extent, connectivity and condition as a medium risk throughout the Condamine basin;
- climate change as a high risk in the Condamine, Balonne and Maranoa; and
- pest fauna (aquatic) as a high risk in the Condamine, Balonne and Maranoa.

The results of the water quality risk assessment for the Condamine River basin are summarised in Table 13.

Table 13: Key causes, or likely causes, of water quality degradation and the risk of each cause occurring in the Condamine River basin.

The causes of water quality degradation are reflective of the risk assessment results. A Risk Register Code is listed for all medium or higher risks and relates to the full water quality risk assessment, available online as supporting information to the HWMP for the Condamine River basin.

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of Risk	Justification
Key causes, or likely causes, of water quality degradation identified from Schedule 10 of the Basin Plan					
Surface water LM52	Elevated levels of salinity	The process of mobilisation of salt stores in the landscape and geological redisposition to salinity development, including by: (a) the following processes and activities relating to water flow or water management: (i) saline groundwater and surface water discharges into surface water systems	South-Western Condamine	Medium	Analysis of water quality data for the South-Western catchments has shown that the ANZECC aquatic ecosystem guideline will possibly be exceeded. The expert panel has attributed this to cumulative impacts of land clearing, irrigation, infrastructure construction and exposing sodic and saline soils. It should also be noted that CSG water is discharged to stream in this assessment unit, although CSG discharge is managed already under the *Environmental Protection Regulation 2008* and salinity targets must be met under licensing. The uncertainty is low for this risk as the water quality technical panel informed the likelihood of occurrence and the water quality data for electrical conductivity is a reliable sample size (N=221).
Surface water LM29			Central Condamine Hotspot: Hodgson Creek	Medium	Analysis of water quality data for the South-Western catchments has shown that the ANZECC aquatic ecosystem guideline will possibly be exceeded. The data analysis also shows that the ANZECC irrigation guideline will possibly be exceeded. The expert panel has attributed this to concentrated irrigation adjacent to Oakey Creek, Condamine River and Kings Creek as well as grazing land use which is prevalent in majority of the assessment unit. The data has also indicated that the sewage treatment plant (STP) on Oakey Creek discharges to surface waters. However, point source releases are a regulated activity managed under the

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of Risk	Justification
					Environmental Protection Act 1994.
		(ii) increased deep drainage below irrigated agricultural land displacing saline groundwater to surface water systems	All surface and groundwater units	Low	Across the assessment units for Condamine, the technical panel determined that this cause of water quality degradation was either rare or unlikely to occur. This risk could become present with an increase in irrigation throughout the catchments.
Surface water LM29		(iii) saline surface and shallow groundwater drainage from irrigated agricultural land into surface water systems	Central Condamine	Medium	Analysis of water quality data for the South-Western catchments has shown that the ANZECC aquatic ecosystem guideline will possibly be exceeded. The data analysis also shows that the ANZECC irrigation guideline will possibly be exceeded. The expert panel has attributed this to concentrated irrigation adjacent to Oakey Creek, Condamine River and Kings Creek as well as grazing land use which is prevalent in majority of the assessment unit.
		(iv) irrigation at high salinity risk locations without adequate drainage management; Example: Locations where there is a high risk of recharge to groundwater resulting in saline discharges to surface waters	All surface and groundwater units	Low	Across the assessment units for Condamine, the technical panel determined that this cause of water quality degradation was either rare or unlikely to occur. This risk could become present with an increase in irrigation throughout the catchments.
		(v) de-watering of saline groundwater which mobilises salt into surface water systems	All surface and groundwater units	Low	Across the assessment units for Condamine, the technical panel determined that this cause of water quality degradation was either rare or unlikely to occur. This risk could become present with an increase in irrigation throughout the catchments.
		(vi) reduction in stream flows, limiting the dilution of salinity.	All surface and groundwater units	Low	Across the assessment units for Condamine, this cause of water quality degradation was determined as either rare or unlikely to occur. DNRME have assessed the risk of reduced flow and have found

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of Risk	Justification
					the risk is low. It should be noted that reduced flows could result under a changing climate. DNRME have assessed the risk of climate change resulting in reduced flows and have found the risk is low. This is based on modelling wet/median/dry scenarios. It should also be noted that the modelling has a low level of precision (high uncertainty). The uncertainty is medium for this risk due to the uncertainty surrounding the flow conditions under climate change.
Surface water LM12		(b) land management practices involving the replacement of deep-rooted vegetation with shallow-rooted crops and pastures, resulting in increased rainfall recharge displacing saline groundwater to surface water systems	South-Eastern Condamine	Medium	As the current EC for these catchments is relatively low, the aquatic ecosystem is likely to be moderately impacted if elevated EC concentrations occur. The expert panel has identified that the soils in these catchments have a moderate salt storing capacity. When mobilised, the ions sorbed to the sediment are transported to stream. The expert panel identified land use practices as contributors to saline surface waters in South-Eastern and Southern Condamine, including grazing, dryland and irrigated cropping. The uncertainty is low for this risk as the water quality technical panel informed the likelihood of occurrence and the water quality data for electrical conductivity is a reliable sample size (South-eastern: N=481; Southern: N=745).
Surface water LM51			Southern Condamine	Medium	
Surface water LM49			North-Western Condamine	Medium	Analysis of water quality data for the North-Western has shown that the ANZECC aquatic ecosystem guideline will possibly be exceeded. The expert panel identified land use practices as contributors to saline surface waters in North-Western, including grazing, dryland and irrigated cropping. As the current EC for this catchment is relatively low, the aquatic ecosystem is likely to be moderately impacted if elevated EC concentrations

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of Risk	Justification
					occur. The uncertainty is low for this risk as the water quality technical panel informed the likelihood of occurrence and the water quality data for electrical conductivity is a reliable sample size (N=570).
		(2) The use of groundwater for irrigation purposes at locations where highly saline upper aquifer water drains to the lower aquifer.	All surface and groundwater units	Low	Across the assessment units for Condamine, the technical panel determined that this cause of water quality degradation was either rare or unlikely to occur in the aquifers present in the region.
		(3) With respect to soil degradation, the use of water with a high ratio of sodium to calcium and magnesium for irrigation.	All surface and groundwater units	Low	Across the assessment units for Condamine, the technical panel determined that this cause of water quality degradation was either rare or unlikely to occur. This risk could become present with an increase in irrigation throughout the catchments.
Surface water LM53	Elevated levels of suspended matter	Sediments entering Basin water resources, which is contributed to by: (a) the following land management practices: (i) inappropriate frequency, timing and location of cultivation; Example: Cultivation taking place at times of the year when the risk of erosion is high (e.g. during the high rainfall season), excessive frequency of cultivation, and cultivation of steep slopes	South-Western Condamine	Medium	The analysis of water quality data for the North-Western and South-Western catchment areas shows that the ANZECC aquatic ecosystem guideline for turbidity will possibly be exceeded. QMDB Source Water Quality model (Davidson, 2018) shows that in the Condamine, 13% of total suspended solids (tonnes/ha) is contributed to stream from cropping. The uncertainty for this risk is low as the expert panel, the QMDB Source Water Quality Model and the water quality data support this risk level and is a reliable sample size (N=191).

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of Risk	Justification
Surface water LM50 LM53		(ii) overgrazing of catchments and grazing of riverbanks and floodplains; Example: The riparian zone along watercourses kept in permanent vegetation can effectively mitigate the movement of sediment within farmlands and from farmlands	South-Western Condamine North-Western Condamine	Medium	The analysis of water quality data for the North-Western and South-Western catchment areas shows that the ANZECC aquatic ecosystem guideline for turbidity will possibly be exceeded. QMDB Source Water Quality model (Davidson, 2018) shows that in the Condamine, 27% of total suspended solids (tonnes/ha) is contributed to stream from grazing. The uncertainty for this risk is low as the expert panel, the QMDB Source Water Quality Model and the water quality data support this risk level and is a reliable sample size (N=462).
Surface water LM50		(iii) poor soil conservation practices; Example: Practices that fail to use management strategies that prevent soil erosion, acidification, salinisation or other chemical soil contamination, or fail to adopt proven soil conservation technologies such as the construction of contour banks	North-Western Condamine	Medium	The analysis of water quality data for the North-Western and South-Western catchment areas shows that the ANZECC aquatic ecosystem guideline for turbidity will possibly be exceeded. The expert panel have identified cumulative impacts from CSG expansion and agriculture as contributing factors to this level of risk. The uncertainty for this risk is low as local expert knowledge and land use maps (Qld Globe) support the data analysis. Data is a reliable sample size (N=462) Sodic soils have been identified in South-Western catchment which is exacerbated by earthworks in the region. The uncertainty for this risk is low as local expert knowledge and land use maps (Qld Globe) support the data analysis. Data is a reliable sample size (N=191).
Surface water LM53			South-Western Condamine	Medium	

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of Risk	Justification
		(iv) practices that over the long-term cause decline of stream morphology, leading to near stream processes of gully erosion, side wall cut and head migration.	All surface and groundwater units	Low	Across the assessment units for Condamine, this cause of water quality degradation was determined as either rare or unlikely to occur. However, it should be noted that the expert panel identified the lack of riparian fencing as a contributing factor to stream bank erosion and gully development. Further, QMDB Source Water Quality model (Davidson, 2018) shows that in the Condamine, 66% of total suspended solids is contributed to stream from streambank and 19% from gully sources. The uncertainty for this risk is medium as the water quality data sample size was sufficient to suggest low risk, however expert opinion and QMDB Source Water Quality model suggest that practices causing gully erosion may be present.
		(b) the following water management practices: (i) rapid drawdown of water within a surface water resource; Example: Rapid drawdown of water in a dam (ii) the volume or manner of release of water, resulting in back or bed erosion.	All surface and groundwater units	Low	Across the assessment units for Condamine, this cause of water quality degradation was determined as either rare or unlikely to occur. Although Leslie Dam does release water periodically, impacts from this activity resulting in increased turbidity and/or suspended solids have not been identified and are managed under the water planning process.
		(c) wave wash (for example, that caused by speedboats).	All surface and groundwater units	Low	Across the assessment units for Condamine, this cause of water quality degradation was determined as either rare or unlikely to occur. The expert panel did not identify this cause as a risk.
Surface water LM48	Elevated levels of nutrients	Nutrients entering Basin water resources through both point and diffuse sources. The key sources of nutrients are: (a) soil and organic matter (b) animal waste (c) fertilisers	North-Western Condamine	Medium	The analysis of data from this catchment area has identified that the NHMRC recreation guideline for total phosphorus is likely to be exceeded (NHMRC, 2008). The expert panel has identified land use, such as irrigated and dryland cropping, as contributors of nutrients to stream. This risk is also linked to the high concentration of suspended matter in this catchment.

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of Risk	Justification
		(d) sewage and industrial discharges (e) nutrients from water storages released as a result of storage management practices.			Certain nutrients sorb to sediments and are transported to stream when sediments are mobilised.
Surface water LM27 LM28			Central Condamine	Medium	The analysis of data from this catchment area has identified that the Basin Plan C2 target application zone for total phosphorus will possibly be exceeded. The data analysis also indicates that the NHMRC recreation guideline for total phosphorus is likely to be exceeded (NHMRC, 2008). The expert panel have identified land use as contributors to this risk which includes, large proportion of irrigated and dryland cropping, sewage treatment plants within catchment, feedlots, urban centres and aging septic systems. QMDB Source Water Quality model (Davidson, 2018) shows that in the Condamine, 17%% of total nitrogen and 22% of total phosphorus (tonnes/ha) is contributed to stream from cropping; 18%.of total nitrogen and 20% of total phosphorus (tonnes/ha) is contributed to stream from grazing; 13% of total nitrogen and 17% of total phosphorus (tonnes/ha) is contributed to stream from intensive animal industries. Note that regulated activities are managed under the Environmental Protection Act 1994. The uncertainty for this risk is low as the expert panel, the QMDB Source Water Quality Model and the water quality data support this risk level.
Surface water LM16			South-Western Condamine - Condamine River Gauging Station 422336A	Medium	Total nitrogen and total phosphorus concentrations will be addressed by the water quality targets developed for these waters. This risk is also linked to the high concentration of suspended matter in this catchment. Certain nutrients sorb to sediments and are transported to stream when sediments are mobilised.

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of Risk	Justification
Groundwater LM6			Upper Condamine Basalts (GS65)	Medium	Expert panel assessment indicates that based on first principles a risk could potentially occur. The Upper Condamine Basalts are a cyclic system, if there is increasing urbanisation or intensive agricultural development, the resource unit has the potential to have elevated levels of nutrients. There has been an intensification of land use around Toowoomba supplying produce to overseas markets. In particular, Wyreema, Clifton and Westbrook region have the drivers for higher nutrients. However, the levels of nutrients in the groundwater resource unit will depend on the rate at which the organic material breaks over time or through flushing from recharge events.
Groundwater LM2			Upper Condamine Basalts (GS65) - Hotspot at Mt Tyson	Medium	Total nitrogen and total phosphorus concentrations will be addressed by the water quality targets developed for these waters, including local hotspots. Due to the cyclic nature and high transmissivity of the system (recharge/discharge) - the Upper Condamine Basalts are susceptible to nutrients if intensive land use increases. However, levels of nutrients in the groundwater resource unit will depend on the rate at which the organic material breaks over time or through flushing from recharge events.
Surface water LM10	Elevated levels of cyanobacteria cell counts or biovolume and toxins and odour compounds	The interaction of the following factors: (a) a water body with little or no flow (b) stratification in the water body	North-Western Condamine	High	Nutrient concentrations in the North-Western and South-Western Condamine indicates the potential for elevated levels of cyanobacteria. This potential is increased by the extensive clearing of riparian vegetation in the Condamine, exposing

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of Risk	Justification
Surface water LM15		(c) sunlight (d) the availability of phosphorus and nitrogen in the water (e) seeding from up-stream (although cyanobacteria blooms may occur without this factor).	South-Western Condamine	High	the system to direct sunlight. The Queensland Harmful Algal Bloom Response Plan identifies roles and responsibilities of government agencies in the event of a harmful algal bloom. The uncertainty for this risk is medium in both North-Western and South-Western Condamine, as the data analysis used chlorophyll-a as a surrogate for cyanobacteria (Microcystins). Despite this, the data sample size is reliable (North-Western: N=221; South-Western: N=113).
Surface water WM11	Water temperature outside natural ranges	(1) The key cause of water temperature of Basin water resources below natural ranges is the release of stored water from below the thermocline from large water storages in spring, summer and autumn. (2) The key causes of water temperature of Basin water resources above natural ranges are the following: (a) the release of stored water from large water storages in winter	North-Western Condamine downstream of Chinchilla Weir	High	Leslie Reservoir and Chinchilla Weir have been identified as a high risk of thermal alteration due to stratification (Department of Natural Resources and Mines, 2017). The management of water storages is addressed through the water planning process. Note that these structures do not contain a multi-level off-take. The uncertainty for this risk is low as the current available literature supports the high risk of stratification in these reservoirs. This risk was also identified by the technical panel during the internal risk assessment.
Surface water WM14			Southern Condamine downstream of Leslie Reservoir	High	
		(b) the removal of shading riparian vegetation	All surface and groundwater units	Low	Across the assessment units for Condamine, the technical panel determined that this cause of water quality degradation was either rare or unlikely to occur. Despite 40% of pre-European riparian vegetation having been removed, data analysis showed water temperatures rarely exceeded ANZECC uplands aquatic ecosystem guideline.
		(c) reduced flow.	All surface and groundwater units	Low	Across the assessment units for Condamine, the technical panel determined that this cause of water quality degradation was either rare or unlikely to occur. DNRME have assessed the risk of reduced

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of Risk	Justification
					flow and have found the risk is low. It should be noted that reduced flows could result under a changing climate or with an increase in irrigation throughout the catchments. DNRME have assessed the risk of climate change resulting in reduced flows and have found the risk is low. This is based on modelling wet/median/dry scenarios. It should also be noted that the modelling has a low level of precision (high uncertainty). The uncertainty is medium for this risk due to the uncertainty surrounding the flow conditions under climate change.
	Dissolved oxygen outside natural ranges	(1) Micro-organisms consuming organic matter and depleting oxygen at a rate faster than it can be replenished. Example: This can arise when there is a discharge from sewage treatment plants or there is flushing of natural organic material from the floodplain.	All surface and groundwater units	Low	Across the assessment units for Condamine, the technical panel determined that this cause of water quality degradation was either rare or unlikely to occur. The risk of occurrence could increase in future if flows are reduced, or if the combination of reduced flows and removal of shading riparian vegetation occurs.
Surface water WM13		(2) Bottom release from, or overturn within, a stratified water storage.	Southern Condamine-Hotspot: Downstream Leslie reservoir North-Western-Hotspot: Downstream of Chinchilla Weir	High	Based on the potential for Leslie Reservoir and Chinchilla Weir to experience thermal stratification (Department of Natural Resources and Mines, 2017), and the lack of multi-level off-takes, the risk of released water having dissolved oxygen levels outside of natural ranges is high. The management of water storages is addressed through the water planning process. The uncertainty of this risk is medium as the literature review component of this risk assessment informed the likelihood, however the water quality data for temperature is lacking for this catchment.
		(3) Eutrophication leading to excessive plant growth causing high diurnal variations in dissolved oxygen levels, both above and below natural ranges.	All surface and groundwater units	Low	Across the assessment units for the Condamine this cause of water quality degradation was determined as either rare or unlikely to occur. The Queensland Harmful Algal Bloom Response Plan identifies roles and responsibilities of

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of Risk	Justification
					government agencies in the event of a harmful algal bloom. In the event of a fish kill, the type of response implemented will be dependent on the likely cause for concern, e.g. low dissolved oxygen, disease, etc. The Queensland Government will coordinate involvement across agencies depending on the nature of the event.
Surface water LM1	Elevated levels of pesticides and other contaminants	Poor management practices including the following: (a) pesticide spray drift (b) allowing pesticides or other contaminants into surface water runoff (c) allowing pesticides or other contaminants to leach into groundwater (d) allowing erosion of contaminated soil (e) inappropriate disposal of pesticides (f) inappropriate disposal and management of industrial and other waste (including from mining and coal-seam gas extraction).	Hotspot-Condamine River-Dalby to Condamine (Central Condamine and South-Western Condamine)	Medium	The expert panel identified potential drivers are present for elevated levels of pesticides in Central Condamine and South-Western Condamine, specifically between Dalby and Condamine. Grazing is the predominant land use in this system and irrigated and dryland cropping is concentrated in close proximity to waterways.
Groundwater LM7			Upper Condamine Basalts (GS65)	Medium	The Upper Condamine Basalts is a cyclic groundwater system with fast recharge rates. The DRASTIC hazard assessment (vulnerability score) has been conducted and shows the basalts have a high susceptibility of contamination from land. Elevated levels of pesticides, heavy metals or other toxic contaminants is possible if urban and rural development intensifies, however water quality impacts are managed under the Environmental Protection Act 1994.
	pH outside natural ranges	(1) The exposure to the air of soils containing iron sulphide minerals. Note: When iron sulphide minerals are exposed to air natural oxidation processes can result in the release of acid, which can be flushed into Basin water resources. (2) Agricultural practices that lead to the acidification of soils.	All surface and groundwater units	Low	The uncertainty for this risk is low as the literature review and the expert panel did not indicate acid sulphate soils as being present. Further research to investigate the presence of potential acid sulphate soils would be beneficial.

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of Risk	Justification
		(3) Eutrophication leading to excessive plant growth causing high diurnal variation in pH.	All surface and groundwater units	Low	Although elevated nutrients have been identified in North-Western, Central, Condamine River and Upper Condamine Basalts (GS65), it is not considered likely that pH will be impacted.
Surface water LM31 LM32 LM33 LM34	Elevated pathogen counts	Pathogens entering Basin water resources through both point and diffuse sources. The key sources of pathogens are: (a) human and animal waste (b) sewage discharges.	Central Condamine	Medium	The expert panel identified elevated pathogen counts as possible in Central Condamine. This is due to the types of land use in the region. The risk of pathogens is also linked to sediments as pathogens can sorb to soil particles and can be transported to stream. It should be noted that although potential drivers for this risk were identified, no data was available to inform the risk.
Groundwater LM8			Upper Condamine Basalts (GS65) – Hotspot: Highfields	Medium	The Upper Condamine Basalts have a high susceptibility to contamination from land. The expert panel identified elevated pathogen counts as possible in this resource unit. This is due to the types of land use in the region associated with peri-urban development. It should be noted that although potential drivers for this risk were identified, no data was available to inform the risk.
Additional key causes, or likely causes, of water quality degradation identified through consultation					

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of Risk	Justification
	Degradation of aquatic habitat, riparian extent/connectivity, riparian condition	Removal of riparian vegetation. Overgrazing of catchments and grazing of riverbanks and floodplains. Practices that over the long-term cause decline of stream morphology, leading to near stream processes of gully erosion, side wall cut and head migration. The implementation of poor management practices leading to elevated levels of pesticides and other contaminants. Unmanaged fire risk leading to wildfires, destruction of riparian vegetation.	Condamine River basin	Medium	Condamine River has lost approximately 42% of pre-European riparian vegetation (Clark, Healy, & Tindall, 2015). The Condamine River catchment area has low riparian connectivity and density compared to other rivers in Queensland's Murray-Darling Basin. Further, the proportion of the catchment's riparian area that is endangered is approximately 3% and the proportion that is of concern is approximately 10%. The removal or fragmentation of riparian vegetation increases the risk of pollutant transport to stream, reduces bank stability and can increase the amount of direct sunlight the stream receives.
	Climate change	The appropriate actions are not taken to reduce Greenhouse Gas emissions, increase carbon capture and promote adaptation. Rainfall variability and associated changes to river flows and to the frequency and extremity of droughts and floods. Changes to flood frequency and duration may impact vegetation, reducing river shading and the contribution of organic matter to stream. This will impact fish species, particularly the cold-water tolerant species (Balcombe, et al., 2011), as stream water temperature will increase and food and habitat availability will decrease. Drought refugia may dry out faster due to increased evapotranspiration and changes to flood frequency and duration (Balcombe, et al., 2011).	Condamine, Balonne and Maranoa River basin	High	Former-Condamine Alliance identified the risk of climate change and associated impacts to natural resources, as high. The NRM Plan (Condamine Alliance, 2016) identifies the inability to adjust to and mitigate the magnitude of the shift in climate change as the contributing factor to this risk level. The Q-catchments report for QMDB (Negus, et al., 2015) assessed the risk of climate change on aquatic ecosystems in the Condamine, Balonne and Maranoa River basin, as high. A changing climate is likely to impact the water resources and freshwater ecosystems of the QMDB (Negus, et al., 2015). Rainfall variability is likely to increase with current climate modelling predicting that rainfall during winter and spring will decrease and the frequency of intense downpours will increase (State of Queensland, 2017). It is likely that this will be associated with changes to river flows and to the frequency and extremity of droughts and floods.

Risk Register code	Type of water quality degradation	Key causes, or likely causes, of water quality degradation for that type	Applicable assessment unit	Level of Risk	Justification
					Climate change is predicted to impact fish species, particularly the cold-water tolerant species (Balcombe, et al., 2011). Changes to flood frequency and duration may impact vegetation (river red gums - *Eucalyptus camaldulensis* for example), reducing river shading and reducing the contribution of organic matter to stream. This will impact fish species as stream water temperature will increase and food and habitat availability will decrease. Drought refugia may dry out faster under current climate predictions due to increased evapotranspiration and changes to flood frequency and duration (Balcombe, et al., 2011).
	Pest fauna—Aquatic	Predation of native species. Competition with native fish populations for food, habitat and spawning locations. Increase in suspended sediment and nutrients. (Negus et al., 2012a-d).	Condamine, Balonne and Maranoa River basin	High	Of the 12 species of instream pest fauna present in the Murray-Darling Basin (Lintermans, 2007), five fish species and one amphibian are known to occur, or have a real potential to occur in the Condamine, Balonne and Maranoa basins. The presence of instream pest fauna generally results in a decline in the populations and communities of native flora and fauna (Negus, et al., 2015). This is due to the increased predation and competition with native species. Pest fish are introduced into the ecosystem in a number of ways including, dumping of unwanted fish to waterways, the use of pest fish as bait, and stocking of fish in dams and impoundments.

SECTION 8: MANAGEMENT RESPONSES

8 Management responses

Section 10.33 of the Basin Plan that a WQM Plan must specify measures to be undertaken in, or in relation to, the surface water resources of the water resource plan area that contribute to the achievement of objectives. Similarly, Section 10.35C of the Basin Plan specifies that regard must be had to whether it is desirable for the WQM Plan to include rules or measures that support the maintenance of water quality within groundwater SDL resource units, based on consideration of a number of matters specified in the Basin Plan.

A measure is recommended for accreditation in a WQM Plan for Queensland Murray-Darling Basin catchments if the:

- **level of risk is medium, high or very high;**
- **relevant water quality and salinity target values are identified in the HWMP;**
- **measure is an action within the scope of the *Water Act 2007* and Queensland *Water Act 2000*;**
- **measures are fit-for-purpose and cost effective.**

As a result of these criteria, the land management measures listed in a HWMP are not flow-related accredited measures for the purposes of the Basin Plan. However, in order to encapsulate the overall framework for the management of water quality in the Queensland Murray-Darling Basin, the WQM Plan under the Basin Plan recognises that the land management measures, listed in Section 8, contribute to improving water quality in the Condamine River basin.

The management responses presented in this section have been developed to address the risks identified in Section 7 of this report and contribute to the achievement of objectives and outcomes for water resources specified in Section 3. The management responses included in the tables below address risks to water quality in the Condamine River basin identified as being at a medium or higher level of risk. Risks identified as at a low level, and the accompanying management responses to maintain low risk scores, are included in these tables.

Existing projects being conducted across Queensland Murray-Darling Basin may inform future management responses and updates to this document. The implementation of future projects will be dependent on the allocation of funding and resources for natural resource management actions.

The extent and cost of the management responses is guided by the level of risk assigned to the type of water quality degradation the management response seeks to address. Management responses should also be fit-for-purpose and collaborative to increase cost efficiency.

The overarching NRM program “Regional Coordination and Evaluation” is relevant to the management of all risks. This project supports essential functions that assist to effectively deliver NRM outcomes including: design and on-going improvement of monitoring, evaluation, reporting and improvement (MERI) processes; development of shared evaluation and monitoring frameworks; analysis and interpretation of critical resource condition and spatial data; improving knowledge management systems; upskilling staff; engaging key stakeholders & developing partnerships; and, developing key strategies to ensure efficiencies and continuous improvement of project delivery. The Southern Queensland NRM project is delivered under the Queensland Government Natural Resources Investment Program 2018-2022.

The success of the management responses provided in this section will be assessed against the water quality target values specified in Section 10 of this report, where funded monitoring programs are available. The management responses have been designed to maintain and/or improve water quality to achieve these water quality targets.

8.1 Management responses to address risks and contribute to the achievement of objectives

8.1.1 Risk factor: Elevated levels of salinity

Risk level	
South-Eastern Condamine	High
Central Condamine (Hotspot: Hodgson Creek)	Medium
North-Western Condamine	Medium
Southern Condamine	Medium
South-Western Condamine	Medium
All other surface waters and groundwaters	Low

Table 14: Management responses to address risks from elevated levels of salinity

Key causes, or likely causes, of water quality degradation to be addressed by measures	Management responses to address risks and contribute to the achievement of objectives
Saline groundwater and surface water discharges into surface water systems. De-watering of saline groundwater which mobilises salt into surface water systems Land management practices involving the replacement of deep-rooted vegetation with shallow-rooted crops and pastures. The use of groundwater for irrigation purposes at locations where highly saline upper aquifer water drains to the lower aquifer.	**Basin Salinity Management 2030** The Queensland Government will implement Basin Salinity Management 2030, in accordance with Schedule B of Schedule 1 of the Commonwealth *Water Act 2007* (and as revised) – for the purposes of long-term salinity planning and management. **Environmental Authorities under the *Environmental Protection Act 1994*** Environmentally relevant activities (ERAs) require an environmental authority under the *Environmental Protection Act 1994* to be issued before any activity can begin. ERAs are industrial or intensive agricultural activities with the potential to release contaminants into the environment. They include a wide range of activities such as aquaculture, sewage treatment, cattle feedlotting, mining and coal seam gas extraction. Environmental authorities include conditions requiring developments to conduct activities in an environmentally responsible manner and reduce or avoid potential environmental impacts. Where the proposed environmentally relevant activity involves salinity being generated, applicants are encouraged to develop a detailed management strategy. The strategy should demonstrate that the environmentally relevant activity will be managed to minimise the impacts on the environment.

Key causes, or likely causes, of water quality degradation to be addressed by measures	Management responses to address risks and contribute to the achievement of objectives
	Environmental Values and Water Quality Objectives under the Environmental Protection (Water) Policy 2009 The risk of salinity is reduced by maintaining ground cover in sodic soil areas and through native vegetation management, such as maintaining/improving deep rooted vegetation. Water quality objectives to protect environmental values in the plan area include the following targets for wetland extent, ground cover in grazing lands and riparian vegetation: • Target for wetland extent: No reduction in the extent of natural wetlands (palustrine, lacustrine and riverine) from 2013 baseline levels. • Target for ground cover in grazing lands: Maintain a ground cover level of >70%. • Targets for riparian areas: (1) No reduction in forested riparian areas from 2013 baseline levels; (2) No reduction in riparian forest connectivity from 2013 baseline levels; (3) In non-forested areas, maintain riparian ground cover in each catchment at a level that minimises soil erosion by water. Water quality objectives for electrical conductivity have also been established for the various water types in the plan area, which complement the end-of-valley salinity targets under Schedule B of Schedule 1 of the Commonwealth *Water Act 2007* (and as revised). Water quality objectives will be recommended for inclusion under Schedule 1 of the Environmental Protection (Water) Policy 2009 to inform statutory and non-statutory planning and decision-making. **Protecting and enhancing key soil, water and vegetation assets of southern inland Queensland** A Southern Queensland NRM project delivered under the Queensland Government Natural Resources Investment Program 2018-2022. This project seeks to improve 12,500ha for soil health and stability, 12,000ha of native vegetation, and 2,400ha of riparian and wetland areas through land managers adopting improved management practices Southern Queensland NRM will partner with community and Landcare groups, regional councils, Government agencies, Traditional Owner groups, and research and development organisations to enhance the delivery of the project. **Future proofing agricultural lands** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project will address declining native vegetation and soil carbon in the South West Queensland, Condamine, and Maranoa Balonne and Border Rivers through building the adaptive capacity of producers to adopt best practice natural resource management to improve the condition of native vegetation, biodiversity and soils. This will enhance the resilience of the region to climate change. **Raising the profile of natural grasslands on the Darling Downs** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23.This project will implement recommended management actions to address the key threatening processes of clearing, inappropriate grazing regime, mechanical disturbance, weed invasion, herbicide use and dryland salinity on Natural grasslands on the Darling Downs, which are a Critically Endangered Threatened Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999*. The management actions will include reinvigorating Traditional Knowledge about native grasslands; fire management; grazing management; weed management; converting cropping land to pasture; propagating native plants for use in site rehabilitation; and undertaking salinity control measures. **Regional Agricultural Landcare Facilitator (RALF)** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) –

Key causes, or likely causes, of water quality degradation to be addressed by measures	Management responses to address risks and contribute to the achievement of objectives
	Regional Land Partnerships Program 2018-23. This project builds on the strong, established partnerships across the South West Queensland, Condamine, and Maranoa Balonne and Border rivers management units. The Regional Agriculture Landcare Facilitators will support the development and delivery of agriculture projects and initiatives by proactively engaging with agricultural industries, landholder groups, Landcare Groups and other key stakeholders to: facilitate information exchange; provide linkages to technical experts; support local and regional agricultural events; facilitate innovative agricultural practice demonstrations; assist with accessing grants for sustainable agriculture activities; and, facilitate connections with a range of programs that align to the NLP2 Regional Land Partnership objectives. **Grazing BMP** Promote uptake of the industry-led, voluntary Grazing BMP program by graziers in the plan area. The Grazing BMP initiative is supported by Queensland Government, Fitzroy Basin Association, AgForce and a range of other delivery partners. The Grazing BMP modules include Soil Health, Grazing Land Management, People and Business, Animal Production and Animal Health and Welfare. Website: https://www.bmpgrazing.com.au/ **myBMP – Cotton** Promote uptake of myBMP, the voluntary farm and environmental management program that ensures cotton is produced to industry best practice. myBMP is supported by Cotton Australia through funding from the Australian Government's National Landcare Programme and the Cotton Research Development Corporation. myBMP comprises 10 modules including Sustainable Natural Landscape (for managing vegetation and riparian assets on farm), Soil Health (for maintaining and/or improving soil quality and fertility), Pesticide Management (including storage and use) and Water Management (addresses water quality, efficiency of storage and distribution for both dryland and irrigated farming practices). Website: https://www.mybmp.com.au/home.aspx **Hort360** Promote uptake of Hort360, a voluntary BMP program for horticultural enterprises. The program is supported by Growcom and the Queensland Government. The Hort360 program comprises 14 modules, including irrigation, runoff, soil, biodiversity, climate and pesticide management. Website: https://www.hort360.com.au/

8.1.2 Risk factor: Elevated levels of suspended matter—including deposited sediment

Risk level	
North-Western Condamine	Medium
South-Western Condamine	Medium
All other surface waters	Low
Not applicable to groundwater.	

Table 15: Management responses to address risks from elevated levels of suspended matter—including deposited sediment

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	Land Restoration Fund A $500 million fund that will directly support land based carbon reduction projects. This fund will support rehabilitation and revegetation of public and private land (including grazing land), protection of native forests and removal of pest and weed species. The carbon farming projects will have a number of co-benefits, such as restoring ecosystems and degraded land which will contribute to the reduction of sediment inputs to stream.
Inappropriate frequency, timing and location of cultivation; Example: Cultivation taking place at times of the year when the risk of erosion is high (e.g. during the high rainfall season), excessive frequency of cultivation, and cultivation of steep slopes.	**Protecting and enhancing key soil, water and vegetation assets of southern inland Queensland** A Southern Queensland NRM project delivered under the Queensland Government Natural Resources Investment Program 2018-2022. This project seeks to improve 12,500ha for soil health and stability, 12,000ha of native vegetation, and 2,400ha of riparian and wetland areas through land managers adopting improved management practices Southern Queensland NRM will partner with community and Landcare groups, regional councils, Government agencies, Traditional Owner groups, and research and development organisations to enhance the delivery of the project.
Overgrazing of catchments and grazing of riverbanks and floodplains; Example: The riparian zone along watercourses kept in permanent vegetation can effectively mitigate the movement of sediment within farmlands and from farmlands.	**Future proofing agricultural lands** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project will address declining native vegetation and soil carbon in the South West Queensland, Condamine, and Maranoa Balonne and Border Rivers through building the adaptive capacity of producers to adopt best practice natural resource management to improve the condition of native vegetation, biodiversity and soils. This will enhance the resilience of the region to climate change.
Poor soil conservation practices; Example: Practices that fail to use management strategies that prevent soil erosion, acidification, salinisation or other chemical soil contamination, or fail to adopt proven soil conservation technologies such as the construction of contour banks. Practices that over the long-term cause decline of stream morphology, leading to near stream processes of gully erosion, side wall cut and head migration.	**Raising the profile of natural grasslands on the Darling Downs** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23.This project will implement recommended management actions to address the key threatening processes of clearing, inappropriate grazing regime, mechanical disturbance, weed invasion, herbicide use and dryland salinity on Natural grasslands on the Darling Downs, which are a Critically Endangered Threatened Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999*. The management actions will include reinvigorating Traditional Knowledge about native grasslands; fire management; grazing management; weed management; converting cropping land to pasture; propagating native plants for use in site rehabilitation; and undertaking salinity control measures. **Regional Agricultural Landcare Facilitator (RALF)** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project builds on the strong, established partnerships across the South West Queensland, Condamine, and Maranoa Balonne and Border rivers management units. The Regional Agriculture Landcare Facilitators will support the development and delivery of agriculture projects and initiatives by proactively engaging with agricultural industries, landholder groups, Landcare Groups and other key stakeholders to: facilitate information exchange; provide linkages to technical experts; support local and regional agricultural events; facilitate innovative agricultural practice demonstrations; assist with accessing grants for sustainable agriculture activities;

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	and, facilitate connections with a range of programs that align to the NLP2 Regional Land Partnership objectives. **Grazing BMP** Promote uptake of the industry-led, voluntary Grazing BMP program by graziers in the plan area. The Grazing BMP initiative is supported by Queensland Government, Fitzroy Basin Association, AgForce and a range of other delivery partners. The Grazing BMP modules include Soil Health, Grazing Land Management, People and Business, Animal Production and Animal Health and Welfare. Website: https://www.bmpgrazing.com.au/ **myBMP – Cotton** Promote uptake of myBMP, the voluntary farm and environmental management program that ensures cotton is produced to industry best practice. myBMP is supported by Cotton Australia through funding from the Australian Government's National Landcare Programme and the Cotton Research Development Corporation. myBMP comprises 10 modules including Sustainable Natural Landscape (for managing vegetation and riparian assets on farm), Soil Health (for maintaining and/or improving soil quality and fertility), Pesticide Management (including storage and use) and Water Management (addresses water quality, efficiency of storage and distribution for both dryland and irrigated farming practices). Website: https://www.mybmp.com.au/home.aspx **Hort360** Promote uptake of Hort360, a voluntary BMP program for horticultural enterprises. The program is supported by Growcom and the Queensland Government. The Hort360 program comprises 14 modules, including irrigation, runoff, soil, biodiversity, climate and pesticide management. Website: https://www.hort360.com.au/ **Environmental Values and Water Quality Objectives under the Environmental Protection (Water) Policy 2009** The risk of suspended matter is reduced through maintaining ground cover and vegetation in riparian zones and the wider landscape. Water quality objectives to protect environmental values in the plan area include the following targets for wetland extent, ground cover in grazing lands and riparian vegetation: • Target for wetland extent: No reduction in the extent of natural wetlands (palustrine, lacustrine and riverine) from 2013 baseline levels. • Target for ground cover in grazing lands: Maintain a ground cover level of >70%. • Targets for riparian areas: (1) No reduction in forested riparian areas from 2013 baseline levels; (2) No reduction in riparian forest connectivity from 2013 baseline levels; (3) In non-forested areas, maintain riparian ground cover in each catchment at a level that minimises soil erosion by water. Water quality objectives for turbidity have also been established for the various water types in the plan area. Water quality objectives will be recommended for inclusion under Schedule 1 of the Environmental Protection (Water) Policy 2009 to inform statutory and non-statutory planning and decision-making. **Store and release code of practice** 'The Code of practice for the release of stored water from privately owned farm storages to receiving waters in the Queensland Murray-Darling Basin' was developed in 2016 to provide guidance to landholders that wish to release water from privately owned farm storages to receiving waters, helping them comply with their general environmental duty under the Environmental Protection Act 1994. The code includes measures to minimise the potential water quality impacts of the

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	release of stored water on the environment. The release of stored water from privately owned farm storages to receiving waters has been an action identified by the Commonwealth Environmental Water Holder to complement water recovery in the northern Murray-Darling Basin. **eWater Source Modelling** Under the Intergovernmental Agreement on Implementing Water Reform in the Murray-Darling Basin and an amended National Partnership Agreement, the Queensland Government received funding to support the development of a water quality model (eWater Source Modelling) for Queensland Murray-Darling Basin catchments. The Source Catchment model enables a greater understanding of the temporal and spatial variability in water quality loads and concentrations across the Condamine-Balonne basins, enabling better prioritisation of management responses. The water quality model assesses total suspended solids, as well as key nutrients. Water quality monitoring has also been conducted to validate and calibrate the model. **Natural Disaster Relief and Recovery Arrangements (NDRRA):** In response to the damage caused by Severe Tropical Cyclone Debbie in 2017, the Australian and Queensland Governments made funding available for impacted individuals, primary producers, small businesses, non-profit organisations and local governments under the Natural Disaster Relief and Recovery Arrangements. The funding package included $35 million for the Environmental Recovery Package. The on-ground works produced through the Environmental Recovery Package will enhance catchment resilience and improve catchment condition through riparian recovery, weed control, soil conservation and gully and streambank stabilisation. **Point Source Water Quality Offsets Policy** The voluntary Point Source Water Quality Offsets Policy offers an alternative investment option for regulated point source operators, including sewage treatment plants, quarries, abattoirs and mine sites, to manage their water emissions under the *Environmental Protection Act 1994*, while improving water quality. Water quality offsets may come from another point source (such as a bubble licence) or the offsets may be achieved through diffuse actions such as bank stabilisation, on farm nutrient runoff reduction and constructed wetlands. Where implemented, these onground actions will contribute to the reduction of sediments to waterways. **State Planning Policy – Water Quality State Interest** The State Planning Policy (SPP) guides local governments in preparing and amending planning schemes to ensure 17 State Interests are considered. The State Interest for Water Quality specifies that the environmental values and quality of Queensland waters are protected and enhanced. Performance outcomes are specified in the SPP for the State Interest: Water Quality to ensure development is planning, designed, constructed and operated to manage stormwater and wastewater in a way that supports the protection of environmental values identified in the Environmental Protection (Water) Policy 2009. The performance outcomes refer to applicable stormwater management design objectives outlined in Tables A and B in Appendix 2 of the SPP. Table A specifies construction phase stormwater management design objectives which apply to all climatic regions in Queensland and aim to minimise the risk of sediment washing off sites and polluting waterways during construction. Table B specifies post-construction phase stormwater management design objectives to address pollutants known to be generated from urban land uses. For the Western Queensland region, post construction phase stormwater management design objectives for total suspended solids, nutrients, gross pollutants and waterway stability management apply to population centres greater than 25,000 persons. In the Condamine River basin,

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	these objectives apply to the city of Toowoomba, as it classifies as a population centre greater than 25,000 persons. **Toolkit measures** In July 2018, the Basin Plan 2012 was amended following the outcomes of the Northern Basin review. In the Northern Basin, a range of 'toolkit measures' will be adopted by the New South Wales and Queensland Governments, with assistance from the Australian Government. The toolkit measures recognise that environmental outcomes can be achieved not only through water recovery, but also through complementary actions to enhance water recovery efforts. The toolkit measures include environmental works and measures to promote fish movement and habitat, as well as cold water pollution control, which aligns with the objectives of the HWMPs.

8.1.3 Risk factor: Elevated levels of nutrients, including phosphorus and nitrogen

Risk level	
South-Western (Hotspot: Condamine River at gauging station 422336A)	High
Upper Condamine Basalts (GS65) (Hotspot: Groundwaters of Mt Tyson)	High
North-Western	Medium
Central Condamine	Medium
Upper Condamine Basalts (GS65)	Medium
All other surface waters and groundwaters	Low

Table 16: Management responses to address risks from elevated levels of nutrients, including phosphorus and nitrogen

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
Nutrients entering Basin water resources through both point and diffuse sources. The key sources of nutrients are: (a) soil and organic matter	**Environmental Authorities under the *Environmental Protection Act 1994*** Environmentally relevant activities (ERAs) require an environmental authority under the *Environmental Protection Act 1994* to be issued before any activity can begin. ERAs are industrial or intensive agricultural activities with the potential to release contaminants, including nutrients, into the environment. They include a wide range of activities such as aquaculture, sewage treatment, cattle feedlotting, mining and coal seam gas extraction. Environmental authorities include

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
(b) animal waste (c) fertilisers (d) sewage and industrial discharges (e) nutrients from water storages released as a result of storage management practices.	conditions requiring developments to conduct activities in an environmentally responsible manner and reduce or avoid potential environmental impacts. **Land Restoration Fund** A $500 million fund that will directly support land based carbon reduction projects. This fund will support rehabilitation and revegetation of public and private land (including grazing land), protection of native forests and removal of pest and weed species. The carbon farming projects will have a number of co-benefits, such as restoring ecosystems and degraded land which will contribute to the reduction of sediment inputs to stream. **Protecting and enhancing key soil, water and vegetation assets of southern inland Queensland** A Southern Queensland NRM project delivered under the Queensland Government Natural Resources Investment Program 2018-2022. This project seeks to improve 12,500ha for soil health and stability, 12,000ha of native vegetation, and 2,400ha of riparian and wetland areas through land managers adopting improved management practices Southern Queensland NRM will partner with community and Landcare groups, regional councils, Government agencies, Traditional Owner groups, and research and development organisations to enhance the delivery of the project. **Future proofing agricultural lands** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project will address declining native vegetation and soil carbon in the South West Queensland, Condamine, and Maranoa Balonne and Border Rivers through building the adaptive capacity of producers to adopt best practice natural resource management to improve the condition of native vegetation, biodiversity and soils. This will enhance the resilience of the region to climate change. **Raising the profile of natural grasslands on the Darling Downs** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23.This project will implement recommended management actions to address the key threatening processes of clearing, inappropriate grazing regime, mechanical disturbance, weed invasion, herbicide use and dryland salinity on Natural grasslands on the Darling Downs, which are a Critically Endangered Threatened Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999*. The management actions will include reinvigorating Traditional Knowledge about native grasslands; fire management; grazing management; weed management; converting cropping land to pasture; propagating native plants for use in site rehabilitation; and undertaking salinity control measures. **Regional Agricultural Landcare Facilitator (RALF)** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project builds on the strong, established partnerships across the South West Queensland, Condamine, and Maranoa Balonne and Border rivers management units. The Regional Agriculture Landcare Facilitators will support the development and delivery of agriculture projects and initiatives by proactively engaging with agricultural industries, landholder groups, Landcare Groups and other key stakeholders to: facilitate information exchange; provide linkages to technical experts; support local and regional agricultural events; facilitate innovative agricultural practice demonstrations; assist with accessing grants for sustainable agriculture activities; and, facilitate connections with a range of programs that align to the NLP2 Regional Land Partnership objectives.

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	Grazing BMP Promote uptake of the industry-led, voluntary Grazing BMP program by graziers in the plan area. The Grazing BMP initiative is supported by Queensland Government, Fitzroy Basin Association, AgForce and a range of other delivery partners. The Grazing BMP modules include Soil Health, Grazing Land Management, People and Business, Animal Production and Animal Health and Welfare. Website: https://www.bmpgrazing.com.au/ **myBMP – Cotton** Promote uptake of myBMP, the voluntary farm and environmental management program that ensures cotton is produced to industry best practice. myBMP is supported by Cotton Australia through funding from the Australian Government's National Landcare Programme and the Cotton Research Development Corporation. myBMP comprises 10 modules including Sustainable Natural Landscape (for managing vegetation and riparian assets on farm), Soil Health (for maintaining and/or improving soil quality and fertility), Pesticide Management (including storage and use) and Water Management (addresses water quality, efficiency of storage and distribution for both dryland and irrigated farming practices). Website: https://www.mybmp.com.au/home.aspx **Hort360** Promote uptake of Hort360, a voluntary BMP program for horticultural enterprises. The program is supported by Growcom and the Queensland Government. The Hort360 program comprises 14 modules, including irrigation, runoff, soil, biodiversity, climate and pesticide management. Website: https://www.hort360.com.au/ **Environmental Values and Water Quality Objectives under the Environmental Protection (Water) Policy 2009** Maintaining ground cover and vegetation in riparian zones and the wider landscape can assist in preventing nutrients from flowing to waterways. Water quality objectives to protect environmental values in the plan area include the following targets for wetland extent, ground cover in grazing lands and riparian vegetation: • Target for wetland extent: No reduction in the extent of natural wetlands (palustrine, lacustrine and riverine) from 2013 baseline levels. • Target for ground cover in grazing lands: Maintain a ground cover level of >70%. • Targets for riparian areas: (1) No reduction in forested riparian areas from 2013 baseline levels; (2) No reduction in riparian forest connectivity from 2013 baseline levels; (3) In non-forested areas, maintain riparian ground cover in each catchment at a level that minimises soil erosion by water. Water quality objectives for nutrients, including total nitrogen and total phosphorus, have also been established for the various water types in the plan area. Water quality objectives will be recommended for inclusion under Schedule 1 under the Environmental Protection (Water) Policy 2009 to inform statutory and non-statutory planning and decision-making. It is important to notice that while wetlands and riparian areas can be effective in water quality improvement, caution should be taken when relying solely on natural and near natural wetlands for this purpose as it may come at the expense of the other ecosystem services that they provide. Other water quality treatments are available and must be considered when aiming to prevent toxicants from reaching natural waterways. **Store and release code of practice** 'The Code of practice for the release of stored water from privately owned farm storages to receiving waters in the Queensland Murray-Darling Basin' was developed in 2016 to provide guidance to landholders that wish to release water

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	from privately owned farm storages to receiving waters, helping them comply with their general environmental duty under the Environmental Protection Act 1994. The code includes measures to minimise the potential water quality impacts of the release of stored water on the environment. The release of stored water from privately owned farm storages to receiving waters has been an action identified by the Commonwealth Environmental Water Holder to complement water recovery in the northern Murray-Darling Basin. **eWater Source Modelling** Under the Intergovernmental Agreement on Implementing Water Reform in the Murray-Darling Basin and an amended National Partnership Agreement, the Queensland Government received funding to support the development of a water quality model (eWater Source Modelling) for Queensland Murray-Darling Basin catchments. The Source Catchment model enables a greater understanding of the temporal and spatial variability in water quality loads and concentrations across the Border Rivers-Moonie basins, enabling better prioritisation of management responses. The water quality model assesses total suspended solids, as well as key nutrients. Water quality monitoring has also been conducted to validate and calibrate the model. **Natural Disaster Relief and Recovery Arrangements (NDRRA):** In response to the damage caused by Severe Tropical Cyclone Debbie in 2017, the Australian and Queensland Governments made funding available for impacted individuals, primary producers, small businesses, non-profit organisations and local governments under the Natural Disaster Relief and Recovery Arrangements. The funding package included $35 million for the Environmental Recovery Package. The on-ground works produced through the Environmental Recovery Package will enhance catchment resilience and improve catchment condition through riparian recovery, weed control, soil conservation and gully and streambank stabilisation. **Point Source Water Quality Offsets Policy** The voluntary Point Source Water Quality Offsets Policy offers an alternative investment option for regulated point source operators, including sewage treatment plants, quarries, abattoirs and mine sites, to manage their water emissions under the *Environmental Protection Act 1994*, while improving water quality. Water quality offsets may come from another point source (such as a bubble licence) or the offsets may be achieved through diffuse actions such as bank stabilisation, on farm nutrient runoff reduction and constructed wetlands. Where implemented, these onground actions will contribute to the reduction of sediments to waterways. **State Planning Policy – Water Quality State Interest** The State Planning Policy (SPP) guides local governments in preparing and amending planning schemes to ensure 17 State Interests are considered. The State Interest for Water Quality specifies that the environmental values and quality of Queensland waters are protected and enhanced. Performance outcomes are specified in the SPP for the State Interest: Water Quality to ensure development is planning, designed, constructed and operated to manage stormwater and wastewater in a way that supports the protection of environmental values identified in the Environmental Protection (Water) Policy 2009. The performance outcomes refer to applicable stormwater management design objectives outlined in Tables A and B in Appendix 2 of the SPP. Table A specifies construction phase stormwater management design objectives which apply to all climatic regions in Queensland and aim to minimise the risk of sediment washing off sites and polluting waterways during construction. Table B specifies post-construction phase stormwater management design objectives to address pollutants known to be generated from urban land uses. For the Western Queensland region, post construction phase stormwater management design objectives for total suspended solids, nutrients, gross pollutants and

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	waterway stability management apply to population centres greater than 25,000 persons. In the Condamine River basin, these objectives apply to the city of Toowoomba, as it classifies as a population centre greater than 25,000 persons.

8.1.4 Risk Factor: Elevated cyanobacteria cell counts or biovolume, toxins and odour compounds

Risk level	
South-Western	High
North-Western	High
All other surface waters and groundwaters	Low

Table 17: Management responses to address elevated cyanobacteria cell counts or biovolume, toxins and odour compounds

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
The interaction of the following factors: (a) a water body with little or no flow (b) stratification in the water body (c) sunlight (d) the availability of phosphorus and nitrogen in the water (e) seeding from up-stream (although cyanobacteria blooms may occur without this factor).	**Queensland Harmful Algal Bloom Response Plan** Seasonal incidents of harmful algal blooms can occur throughout Queensland. This response plan, developed in 2014 (and updated), identifies the appropriate response agency to deal with a harmful algal bloom incident or enquiry. The response plan ensures a coordinated response to address the issue and minimise the risk of harmful algal blooms to humans, livestock and wildlife. The Queensland Harmful Algal Bloom Response Plan is supported by the Queensland Harmful Algal Bloom operational procedures. To address phosphorus and nitrogen in the water, the following management responses apply: **Environmental Authorities under the *Environmental Protection Act 1994*** Environmentally relevant activities (ERAs) require an environmental authority under the *Environmental Protection Act 1994* to be issued before any activity can begin. ERAs are industrial or intensive agricultural activities with the potential to release contaminants, including nutrients, into the environment. They include a wide range of activities such as aquaculture, sewage treatment, cattle feedlotting, mining and coal seam gas extraction. Environmental authorities include conditions requiring developments to conduct activities in an environmentally responsible manner and reduce or avoid potential environmental impacts. **Land Restoration Fund** A $500 million fund that will directly support land based carbon reduction projects. This fund will support rehabilitation and

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	revegetation of public and private land (including grazing land), protection of native forests and removal of pest and weed species. The carbon farming projects will have a number of co-benefits, such as restoring ecosystems and degraded land which will contribute to the reduction of sediment inputs to stream. **Protecting and enhancing key soil, water and vegetation assets of southern inland Queensland** A Southern Queensland NRM project delivered under the Queensland Government Natural Resources Investment Program 2018-2022. This project seeks to improve 12,500ha for soil health and stability, 12,000ha of native vegetation, and 2,400ha of riparian and wetland areas through land managers adopting improved management practices Southern Queensland NRM will partner with community and Landcare groups, regional councils, Government agencies, Traditional Owner groups, and research and development organisations to enhance the delivery of the project. **Future proofing agricultural lands** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project will address declining native vegetation and soil carbon in the South West Queensland, Condamine, and Maranoa Balonne and Border Rivers through building the adaptive capacity of producers to adopt best practice natural resource management to improve the condition of native vegetation, biodiversity and soils. This will enhance the resilience of the region to climate change. **Raising the profile of natural grasslands on the Darling Downs** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23.This project will implement recommended management actions to address the key threatening processes of clearing, inappropriate grazing regime, mechanical disturbance, weed invasion, herbicide use and dryland salinity on Natural grasslands on the Darling Downs, which are a Critically Endangered Threatened Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999*. The management actions will include reinvigorating Traditional Knowledge about native grasslands; fire management; grazing management; weed management; converting cropping land to pasture; propagating native plants for use in site rehabilitation; and undertaking salinity control measures. **Regional Agricultural Landcare Facilitator (RALF)** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project builds on the strong, established partnerships across the South West Queensland, Condamine, and Maranoa Balonne and Border rivers management units. The Regional Agriculture Landcare Facilitators will support the development and delivery of agriculture projects and initiatives by proactively engaging with agricultural industries, landholder groups, Landcare Groups and other key stakeholders to: facilitate information exchange; provide linkages to technical experts; support local and regional agricultural events; facilitate innovative agricultural practice demonstrations; assist with accessing grants for sustainable agriculture activities; and, facilitate connections with a range of programs that align to the NLP2 Regional Land Partnership objectives. **Grazing BMP** Promote uptake of the industry-led, voluntary Grazing BMP program by graziers in the plan area. The Grazing BMP initiative is supported by Queensland Government, Fitzroy Basin Association, AgForce and a range of other delivery partners. The Grazing BMP modules include Soil Health, Grazing Land Management, People and Business, Animal

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	Production and Animal Health and Welfare. Website: https://www.bmpgrazing.com.au/ **myBMP – Cotton** Promote uptake of myBMP, the voluntary farm and environmental management program that ensures cotton is produced to industry best practice. myBMP is supported by Cotton Australia through funding from the Australian Government's National Landcare Programme and the Cotton Research Development Corporation. myBMP comprises 10 modules including Sustainable Natural Landscape (for managing vegetation and riparian assets on farm), Soil Health (for maintaining and/or improving soil quality and fertility), Pesticide Management (including storage and use) and Water Management (addresses water quality, efficiency of storage and distribution for both dryland and irrigated farming practices). Website: https://www.mybmp.com.au/home.aspx **Hort360** Promote uptake of Hort360, a voluntary BMP program for horticultural enterprises. The program is supported by Growcom and the Queensland Government. The Hort360 program comprises 14 modules, including irrigation, runoff, soil, biodiversity, climate and pesticide management. Website: https://www.hort360.com.au/ **Environmental Values and Water Quality Objectives under the Environmental Protection (Water) Policy 2009** Maintaining ground cover and vegetation in riparian zones and the wider landscape can assist in preventing nutrients from flowing to waterways. Water quality objectives to protect environmental values in the plan area include the following targets for wetland extent, ground cover in grazing lands and riparian vegetation: • Target for wetland extent: No reduction in the extent of natural wetlands (palustrine, lacustrine and riverine) from 2013 baseline levels. • Target for ground cover in grazing lands: Maintain a ground cover level of >70%. • Targets for riparian areas: (1) No reduction in forested riparian areas from 2013 baseline levels; (2) No reduction in riparian forest connectivity from 2013 baseline levels; (3) In non-forested areas, maintain riparian ground cover in each catchment at a level that minimises soil erosion by water. Water quality objectives for nutrients, including total nitrogen and total phosphorus, have also been established for the various water types in the plan area. Water quality objectives will be recommended for inclusion under Schedule 1 under the Environmental Protection (Water) Policy 2009 to inform statutory and non-statutory planning and decision-making. It is important to notice that while wetlands and riparian areas can be effective in water quality improvement, caution should be taken when relying solely on natural and near natural wetlands for this purpose as it may come at the expense of the other ecosystem services that they provide. Other water quality treatments are available and must be considered when aiming to prevent toxicants from reaching natural waterways. **Store and release code of practice** 'The Code of practice for the release of stored water from privately owned farm storages to receiving waters in the Queensland Murray-Darling Basin' was developed in 2016 to provide guidance to landholders that wish to release water from privately owned farm storages to receiving waters, helping them comply with their general environmental duty under the Environmental Protection Act 1994. The code includes measures to minimise the potential water quality impacts of the release of stored water on the environment. The release of stored water from privately owned farm storages to receiving waters has been an action identified by the Commonwealth Environmental Water Holder to complement water recovery in

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	the northern Murray-Darling Basin. **eWater Source Modelling** Under the Intergovernmental Agreement on Implementing Water Reform in the Murray-Darling Basin and an amended National Partnership Agreement, the Queensland Government received funding to support the development of a water quality model (eWater Source Modelling) for Queensland Murray-Darling Basin catchments. The Source Catchment model enables a greater understanding of the temporal and spatial variability in water quality loads and concentrations across the Border Rivers-Moonie basins, enabling better prioritisation of management responses. The water quality model assesses total suspended solids, as well as key nutrients. Water quality monitoring has also been conducted to validate and calibrate the model. **Natural Disaster Relief and Recovery Arrangements (NDRRA):** In response to the damage caused by Severe Tropical Cyclone Debbie in 2017, the Australian and Queensland Governments made funding available for impacted individuals, primary producers, small businesses, non-profit organisations and local governments under the Natural Disaster Relief and Recovery Arrangements. The funding package included $35 million for the Environmental Recovery Package. The on-ground works produced through the Environmental Recovery Package will enhance catchment resilience and improve catchment condition through riparian recovery, weed control, soil conservation and gully and streambank stabilisation. **Point Source Water Quality Offsets Policy** The voluntary Point Source Water Quality Offsets Policy offers an alternative investment option for regulated point source operators, including sewage treatment plants, quarries, abattoirs and mine sites, to manage their water emissions under the *Environmental Protection Act 1994*, while improving water quality. Water quality offsets may come from another point source (such as a bubble licence) or the offsets may be achieved through diffuse actions such as bank stabilisation, on farm nutrient runoff reduction and constructed wetlands. Where implemented, these onground actions will contribute to the reduction of sediments to waterways. **State Planning Policy – Water Quality State Interest** The State Planning Policy (SPP) guides local governments in preparing and amending planning schemes to ensure 17 State Interests are considered. The State Interest for Water Quality specifies that the environmental values and quality of Queensland waters are protected and enhanced. Performance outcomes are specified in the SPP for the State Interest: Water Quality to ensure development is planning, designed, constructed and operated to manage stormwater and wastewater in a way that supports the protection of environmental values identified in the Environmental Protection (Water) Policy 2009. The performance outcomes refer to applicable stormwater management design objectives outlined in Tables A and B in Appendix 2 of the SPP. Table A specifies construction phase stormwater management design objectives which apply to all climatic regions in Queensland and aim to minimise the risk of sediment washing off sites and polluting waterways during construction. Table B specifies post-construction phase stormwater management design objectives to address pollutants known to be generated from urban land uses. For the Western Queensland region, post construction phase stormwater management design objectives for total suspended solids, nutrients, gross pollutants and waterway stability management apply to population centres greater than 25,000 persons. In the Condamine River basin, these objectives apply to the city of Toowoomba, as it classifies as a population centre greater than 25,000 persons.

8.1.5 Risk factor: Water temperature outside natural ranges

Risk level	
North-Western Condamine downstream of Chinchilla Weir	High
Southern Condamine downstream of Leslie Reservoir	High
All other surface and groundwaters	Low

Table 18: Management responses to address risks from water temperature outside natural ranges

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
The release of stored water from below the thermocline from large water storages in spring, summer and autumn. The release of stored water from large water storages in winter The removal of shading riparian vegetation Reduced flow.	**Water planning framework under the Water Act 2000** The Water Act 2000 enables provisions to be included on Resource Operation Licences regarding operating rules to minimise impacts to ecosystems. The Water Act 2000 also provides for outcomes, measures, objectives and indicators to be developed for the respective plan area under a Water Plan. The release of water from storages is managed by conditions on each Resource Operations Licence (ROL) under the Water Act 2000. These ROL conditions are implemented by the Resource Operations Licence Holder e.g. SunWater. To address the risk of water temperature outside natural ranges due to the removal of shading riparian vegetation, the following management responses apply: **Land Restoration Fund** A $500 million fund that will directly support land based carbon reduction projects. This fund will support rehabilitation and revegetation of public and private land (including grazing land), protection of native forests and removal of pest and weed species. The carbon farming projects will have a number of co-benefits, such as restoring ecosystems and degraded land which will contribute to the reduction of sediment inputs to stream. **Protecting and enhancing key soil, water and vegetation assets of southern inland Queensland** A Southern Queensland NRM project delivered under the Queensland Government Natural Resources Investment Program 2018-2022. This project seeks to improve 12,500ha for soil health and stability, 12,000ha of native vegetation, and 2,400ha of riparian and wetland areas through land managers adopting improved management practices Southern Queensland NRM will partner with community and Landcare groups, regional councils, Government agencies, Traditional Owner groups, and research and development organisations to enhance the delivery of the project. **Future proofing agricultural lands** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project will address declining native vegetation and soil carbon in the South West Queensland, Condamine, and Maranoa Balonne and Border Rivers through building the adaptive capacity of producers to adopt best practice natural resource management to improve the condition of native vegetation, biodiversity

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	and soils. This will enhance the resilience of the region to climate change. **Raising the profile of natural grasslands on the Darling Downs** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23.This project will implement recommended management actions to address the key threatening processes of clearing, inappropriate grazing regime, mechanical disturbance, weed invasion, herbicide use and dryland salinity on Natural grasslands on the Darling Downs, which are a Critically Endangered Threatened Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999*. The management actions will include reinvigorating Traditional Knowledge about native grasslands; fire management; grazing management; weed management; converting cropping land to pasture; propagating native plants for use in site rehabilitation; and undertaking salinity control measures. **Environmental Values and Water Quality Objectives under the Environmental Protection (Water) Policy 2009** Maintaining ground cover and vegetation in riparian zones and the wider landscape can assist in preventing nutrients from flowing to waterways. Water quality objectives to protect environmental values in the plan area include the following targets for wetland extent, ground cover in grazing lands and riparian vegetation: • Target for wetland extent: No reduction in the extent of natural wetlands (palustrine, lacustrine and riverine) from 2013 baseline levels. • Target for ground cover in grazing lands: Maintain a ground cover level of >70%. • Targets for riparian areas: (1) No reduction in forested riparian areas from 2013 baseline levels; (2) No reduction in riparian forest connectivity from 2013 baseline levels; (3) In non-forested areas, maintain riparian ground cover in each catchment at a level that minimises soil erosion by water. Water quality objectives will be recommended for inclusion under Schedule 1 of the Environmental Protection (Water) Policy 2009 to inform statutory and non-statutory planning and decision-making. **Store and release code of practice** 'The Code of practice for the release of stored water from privately owned farm storages to receiving waters in the Queensland Murray-Darling Basin' was developed in 2016 to provide guidance to landholders that wish to release water from privately owned farm storages to receiving waters, helping them comply with their general environmental duty under the Environmental Protection Act 1994. The code includes measures to minimise the potential water quality impacts of the release of stored water on the environment. The release of stored water from privately owned farm storages to receiving waters has been an action identified by the Commonwealth Environmental Water Holder to complement water recovery in the northern Murray-Darling Basin. **Toolkit measures** In July 2018, the Basin Plan 2012 was amended following the outcomes of the Northern Basin review. In the Northern Basin, a range of 'toolkit measures' will be adopted by the New South Wales and Queensland Governments, with assistance from the Australian Government. The toolkit measures recognise that environmental outcomes can be achieved not only through water recovery, but also through complementary actions to enhance water recovery efforts. The toolkit measures include environmental works and measures to promote fish movement and habitat, as well as cold water pollution control, which aligns with the objectives of the HWMPs.

8.1.6 Risk factor: Dissolved oxygen outside natural ranges

Risk level	
North-Western Condamine downstream of Chinchilla Weir	High
Southern Condamine downstream of Leslie Reservoir	High
All other surface waters	Low
Not applicable to groundwater.	

Table 19: Management responses to address dissolved oxygen outside natural ranges

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
Micro-organisms consuming organic matter and depleting oxygen at a rate faster than it can be replenished. Example: This can arise when there is a discharge from sewage treatment plants or the flushing of natural organic material from the floodplain. Bottom release from, or overturn within, a stratified water storage. Eutrophication leading to excessive plant growth causing high diurnal variations in dissolved oxygen levels, both above and below natural ranges.	**Water planning framework under the Water Act 2000** The Water Act 2000 enables provisions to be included on Resource Operation Licences regarding operating rules to minimise impacts to ecosystems. The Water Act 2000 also provides for outcomes, measures, objectives and indicators to be developed for the respective plan area under a Water Plan. The release of water from storages is managed by conditions on each Resource Operations Licence (ROL) under the Water Act 2000. These ROL conditions are implemented by the Resource Operations Licence Holder e.g. SunWater. To address the risk of dissolved oxygen outside natural ranges due to eutrophication, the following management responses apply: **Environmental Authorities under the *Environmental Protection Act 1994*** Environmentally relevant activities (ERAs) require an environmental authority under the *Environmental Protection Act 1994* to be issued before any activity can begin. ERAs are industrial or intensive agricultural activities with the potential to release contaminants, including nutrients, into the environment. They include a wide range of activities such as aquaculture, sewage treatment, cattle feedlotting, mining and coal seam gas extraction. Environmental authorities include conditions requiring developments to conduct activities in an environmentally responsible manner and reduce or avoid potential environmental impacts. **Land Restoration Fund** A $500 million fund that will directly support land based carbon reduction projects. This fund will support rehabilitation and revegetation of public and private land (including grazing land), protection of native forests and removal of pest and weed species. The carbon farming projects will have a number of co-benefits, such as restoring ecosystems and degraded land which will contribute to the reduction of sediment inputs to stream.

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	Protecting and enhancing key soil, water and vegetation assets of southern inland Queensland A Southern Queensland NRM project delivered under the Queensland Government Natural Resources Investment Program 2018-2022. This project seeks to improve 12,500ha for soil health and stability, 12,000ha of native vegetation, and 2,400ha of riparian and wetland areas through land managers adopting improved management practices Southern Queensland NRM will partner with community and Landcare groups, regional councils, Government agencies, Traditional Owner groups, and research and development organisations to enhance the delivery of the project. **Future proofing agricultural lands** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project will address declining native vegetation and soil carbon in the South West Queensland, Condamine, and Maranoa Balonne and Border Rivers through building the adaptive capacity of producers to adopt best practice natural resource management to improve the condition of native vegetation, biodiversity and soils. This will enhance the resilience of the region to climate change. **Raising the profile of natural grasslands on the Darling Downs** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23.This project will implement recommended management actions to address the key threatening processes of clearing, inappropriate grazing regime, mechanical disturbance, weed invasion, herbicide use and dryland salinity on Natural grasslands on the Darling Downs, which are a Critically Endangered Threatened Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999*. The management actions will include reinvigorating Traditional Knowledge about native grasslands; fire management; grazing management; weed management; converting cropping land to pasture; propagating native plants for use in site rehabilitation; and undertaking salinity control measures. **Regional Agricultural Landcare Facilitator (RALF)** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project builds on the strong, established partnerships across the South West Queensland, Condamine, and Maranoa Balonne and Border rivers management units. The Regional Agriculture Landcare Facilitators will support the development and delivery of agriculture projects and initiatives by proactively engaging with agricultural industries, landholder groups, Landcare Groups and other key stakeholders to: facilitate information exchange; provide linkages to technical experts; support local and regional agricultural events; facilitate innovative agricultural practice demonstrations; assist with accessing grants for sustainable agriculture activities; and, facilitate connections with a range of programs that align to the NLP2 Regional Land Partnership objectives. **Grazing BMP** Promote uptake of the industry-led, voluntary Grazing BMP program by graziers in the plan area. The Grazing BMP initiative is supported by Queensland Government, Fitzroy Basin Association, AgForce and a range of other delivery partners. The Grazing BMP modules include Soil Health, Grazing Land Management, People and Business, Animal Production and Animal Health and Welfare. Website: https://www.bmpgrazing.com.au/ **myBMP – Cotton** Promote uptake of myBMP, the voluntary farm and environmental management program that ensures cotton is produced

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	to industry best practice. myBMP is supported by Cotton Australia through funding from the Australian Government's National Landcare Programme and the Cotton Research Development Corporation. myBMP comprises 10 modules including Sustainable Natural Landscape (for managing vegetation and riparian assets on farm), Soil Health (for maintaining and/or improving soil quality and fertility), Pesticide Management (including storage and use) and Water Management (addresses water quality, efficiency of storage and distribution for both dryland and irrigated farming practices). Website: https://www.mybmp.com.au/home.aspx **Hort360** Promote uptake of Hort360, a voluntary BMP program for horticultural enterprises. The program is supported by Growcom and the Queensland Government. The Hort360 program comprises 14 modules, including irrigation, runoff, soil, biodiversity, climate and pesticide management. Website: https://www.hort360.com.au/ **Environmental Values and Water Quality Objectives under the Environmental Protection (Water) Policy 2009** Maintaining ground cover and vegetation in riparian zones and the wider landscape can assist in preventing nutrients from flowing to waterways. Water quality objectives to protect environmental values in the plan area include the following targets for wetland extent, ground cover in grazing lands and riparian vegetation: • Target for wetland extent: No reduction in the extent of natural wetlands (palustrine, lacustrine and riverine) from 2013 baseline levels. • Target for ground cover in grazing lands: Maintain a ground cover level of >70%. • Targets for riparian areas: (1) No reduction in forested riparian areas from 2013 baseline levels; (2) No reduction in riparian forest connectivity from 2013 baseline levels; (3) In non-forested areas, maintain riparian ground cover in each catchment at a level that minimises soil erosion by water. Water quality objectives for nutrients, including total nitrogen and total phosphorus, have also been established for the various water types in the plan area. Water quality objectives will be recommended for inclusion under Schedule 1 of the Environmental Protection (Water) Policy 2009 to inform statutory and non-statutory planning and decision-making. **Store and release code of practice** 'The Code of practice for the release of stored water from privately owned farm storages to receiving waters in the Queensland Murray-Darling Basin' was developed in 2016 to provide guidance to landholders that wish to release water from privately owned farm storages to receiving waters, helping them comply with their general environmental duty under the Environmental Protection Act 1994. The code includes measures to minimise the potential water quality impacts of the release of stored water on the environment. The release of stored water from privately owned farm storages to receiving waters has been an action identified by the Commonwealth Environmental Water Holder to complement water recovery in the northern Murray-Darling Basin. **eWater Source Modelling** Under the Intergovernmental Agreement on Implementing Water Reform in the Murray-Darling Basin and an amended National Partnership Agreement, the Queensland Government received funding to support the development of a water quality model (eWater Source Modelling) for Queensland Murray-Darling Basin catchments. The Source Catchment model enables a greater understanding of the temporal and spatial variability in water quality loads and concentrations across the Border Rivers-Moonie basins, enabling better prioritisation of management responses. The water quality model

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	assesses total suspended solids, as well as key nutrients. Water quality monitoring has also been conducted to validate and calibrate the model. **Natural Disaster Relief and Recovery Arrangements (NDRRA)** In response to the damage caused by Severe Tropical Cyclone Debbie in 2017, the Australian and Queensland Governments made funding available for impacted individuals, primary producers, small businesses, non-profit organisations and local governments under the Natural Disaster Relief and Recovery Arrangements. The funding package included $35 million for the Environmental Recovery Package. The on-ground works produced through the Environmental Recovery Package will enhance catchment resilience and improve catchment condition through riparian recovery, weed control, soil conservation and gully and streambank stabilisation. **Point Source Water Quality Offsets Policy** The voluntary Point Source Water Quality Offsets Policy offers an alternative investment option for regulated point source operators, including sewage treatment plants, quarries, abattoirs and mine sites, to manage their water emissions under the *Environmental Protection Act 1994*, while improving water quality. Water quality offsets may come from another point source (such as a bubble licence) or the offsets may be achieved through diffuse actions such as bank stabilisation, on farm nutrient runoff reduction and constructed wetlands. Where implemented, these onground actions will contribute to the reduction of sediments to waterways. **State Planning Policy – Water Quality State Interest** The State Planning Policy (SPP) guides local governments in preparing and amending planning schemes to ensure 17 State Interests are considered. The State Interest for Water Quality specifies that the environmental values and quality of Queensland waters are protected and enhanced. Performance outcomes are specified in the SPP for the State Interest: Water Quality to ensure development is planning, designed, constructed and operated to manage stormwater and wastewater in a way that supports the protection of environmental values identified in the Environmental Protection (Water) Policy 2009. The performance outcomes refer to applicable stormwater management design objectives outlined in Tables A and B in Appendix 2 of the SPP. Table A specifies construction phase stormwater management design objectives which apply to all climatic regions in Queensland and aim to minimise the risk of sediment washing off sites and polluting waterways during construction. Table B specifies post-construction phase stormwater management design objectives to address pollutants known to be generated from urban land uses. For the Western Queensland region, post construction phase stormwater management design objectives for total suspended solids, nutrients, gross pollutants and waterway stability management apply to population centres greater than 25,000 persons. In the Condamine River basin, these objectives apply to the city of Toowoomba, as it classifies as a population centre greater than 25,000 persons. **Toolkit measures** In July 2018, the Basin Plan 2012 was amended following the outcomes of the Northern Basin review. In the Northern Basin, a range of 'toolkit measures' will be adopted by the New South Wales and Queensland Governments, with assistance from the Australian Government. The toolkit measures recognise that environmental outcomes can be achieved not only through water recovery, but also through complementary actions to enhance water recovery efforts. The toolkit measures include environmental works and measures to promote fish movement and habitat, as well as cold water pollution control, which aligns with the objectives of the HWMPs.

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives

8.1.7 Risk Factor: Elevated levels of pesticides, heavy metals and other toxic contaminants

Risk level	
Central Condamine (Hotspot between Dalby and Condamine)	High
South-Western Condamine (Hotspot between Dalby and Condamine)	High
Upper Condamine Basalts (GS65)	Medium
All other surface waters and groundwaters	Low

Table 20: Management responses to address risks from elevated levels of pesticides, heavy metals and other toxic contaminants

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
Poor management practices including the following: (a) pesticide spray drift (b) allowing pesticides or other contaminants into surface water runoff (c) allowing pesticides or other contaminants to leach into groundwater (d) allowing erosion of contaminated soil (e) inappropriate disposal of pesticides (f) inappropriate disposal and management of industrial and other waste (including from mining and coal-seam gas extraction).	**Environmental Values and Water Quality Objectives under the Environmental Protection (Water) Policy 2009** Maintaining ground cover and vegetation in riparian zones and the wider landscape can assist in preventing nutrients from flowing to waterways. Water quality objectives to protect environmental values in the plan area include the following targets for wetland extent, ground cover in grazing lands and riparian vegetation: • Target for wetland extent: No reduction in the extent of natural wetlands (palustrine, lacustrine and riverine) from 2013 baseline levels. • Target for ground cover in grazing lands: Maintain a ground cover level of >70%. • Targets for riparian areas: (1) No reduction in forested riparian areas from 2013 baseline levels; (2) No reduction in riparian forest connectivity from 2013 baseline levels; (3) In non-forested areas, maintain riparian ground cover in each catchment at a level that minimises soil erosion by water. Water quality objectives for toxicants, including pesticides and heavy metals, have also been established for the various water types in the plan area. Water quality objectives will be recommended for inclusion under Schedule 1 of the Environmental Protection (Water) Policy 2009 to inform statutory and non-statutory planning and decision-making. It is important to notice that while wetlands and riparian areas can be effective in water quality improvement, caution should be taken when relying solely on natural and near natural wetlands for this purpose as it may come at the expense of the other ecosystem services that they provide. Other water quality treatments are available and must be considered when aiming to prevent toxicants from reaching natural waterways. **Store and release code of practice** 'The Code of practice for the release of stored water from privately owned farm storages to receiving waters in the Queensland

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	Murray-Darling Basin' was developed in 2016 to provide guidance to landholders that wish to release water from privately owned farm storages to receiving waters, helping them comply with their general environmental duty under the Environmental Protection Act 1994. The code includes measures to minimise the potential water quality impacts of the release of stored water on the environment. The release of stored water from privately owned farm storages to receiving waters has been an action identified by the Commonwealth Environmental Water Holder to complement water recovery in the northern Murray-Darling Basin. **Regional Agricultural Landcare Facilitator (RALF)** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project builds on the strong, established partnerships across the South West Queensland, Condamine, and Maranoa Balonne and Border rivers management units. The Regional Agriculture Landcare Facilitators will support the development and delivery of agriculture projects and initiatives by proactively engaging with agricultural industries, landholder groups, Landcare Groups and other key stakeholders to: facilitate information exchange; provide linkages to technical experts; support local and regional agricultural events; facilitate innovative agricultural practice demonstrations; assist with accessing grants for sustainable agriculture activities; and, facilitate connections with a range of programs that align to the NLP2 Regional Land Partnership objectives. **Grazing BMP** Promote uptake of the industry-led, voluntary Grazing BMP program by graziers in the plan area. The Grazing BMP initiative is supported by Queensland Government, Fitzroy Basin Association, AgForce and a range of other delivery partners. The Grazing BMP modules include Soil Health, Grazing Land Management, People and Business, Animal Production and Animal Health and Welfare. Website: https://www.bmpgrazing.com.au/ **myBMP – Cotton** Promote uptake of myBMP, the voluntary farm and environmental management program that ensures cotton is produced to industry best practice. myBMP is supported by Cotton Australia through funding from the Australian Government's National Landcare Programme and the Cotton Research Development Corporation. myBMP comprises 10 modules including Sustainable Natural Landscape (for managing vegetation and riparian assets on farm), Soil Health (for maintaining and/or improving soil quality and fertility), Pesticide Management (including storage and use) and Water Management (addresses water quality, efficiency of storage and distribution for both dryland and irrigated farming practices). Website: https://www.mybmp.com.au/home.aspx **Hort360** Promote uptake of Hort360, a voluntary BMP program for horticultural enterprises. The program is supported by Growcom and the Queensland Government. The Hort360 program comprises 14 modules, including irrigation, runoff, soil, biodiversity, climate and pesticide management. Website: https://www.hort360.com.au/

8.1.8 Risk factor: pH outside natural ranges

Risk level	
All surface waters and groundwaters	Low

Table 21: Management responses to address risks from pH outside natural ranges

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
The exposure to the air of soils containing iron sulphide minerals. Note: When iron sulphide minerals are exposed to air natural oxidation processes can result in the release of acid, which can be flushed into Basin water resources. Agricultural practices that lead to the acidification of soils. Eutrophication leading to excessive plant growth causing high diurnal variation in pH.	**State Planning Policy – Emissions and Hazardous Activities State Interest** The State Planning Policy (SPP) guides local governments in preparing and amending planning schemes to ensure 17 State Interests are considered. The State Interest for Emissions and Hazardous Activities seeks to minimise the disturbance to acid sulfate soils to reduce risks posed to the natural and built environments from the release of acid and metal contaminants. **Regional Agricultural Landcare Facilitator (RALF)** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project builds on the strong, established partnerships across the South West Queensland, Condamine, and Maranoa Balonne and Border rivers management units. The Regional Agriculture Landcare Facilitators will support the development and delivery of agriculture projects and initiatives by proactively engaging with agricultural industries, landholder groups, Landcare Groups and other key stakeholders to: facilitate information exchange; provide linkages to technical experts; support local and regional agricultural events; facilitate innovative agricultural practice demonstrations; assist with accessing grants for sustainable agriculture activities; and, facilitate connections with a range of programs that align to the NLP2 Regional Land Partnership objectives. **Grazing BMP** Promote uptake of the industry-led, voluntary Grazing BMP program by graziers in the plan area. The Grazing BMP initiative is supported by Queensland Government, Fitzroy Basin Association, AgForce and a range of other delivery partners. The Grazing BMP modules include Soil Health, Grazing Land Management, People and Business, Animal Production and Animal Health and Welfare. Website: https://www.bmpgrazing.com.au/ **myBMP – Cotton** Promote uptake of myBMP, the voluntary farm and environmental management program that ensures cotton is produced to industry best practice. myBMP is supported by Cotton Australia through funding from the Australian Government's National Landcare Programme and the Cotton Research Development Corporation. myBMP comprises 10 modules including Sustainable Natural Landscape (for managing vegetation and riparian assets on farm), Soil Health (for maintaining and/or improving soil quality and fertility), Pesticide Management (including storage and use) and Water Management (addresses water quality, efficiency of storage and distribution for both dryland and irrigated farming practices). Website: https://www.mybmp.com.au/home.aspx

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	Hort360 Promote uptake of Hort360, a voluntary BMP program for horticultural enterprises. The program is supported by Growcom and the Queensland Government. The Hort360 program comprises 14 modules, including irrigation, runoff, soil, biodiversity, climate and pesticide management. Website: https://www.hort360.com.au/

8.1.9 Risk factor: Elevated pathogen counts

Risk level	
Central Condamine	Medium
Upper Condamine Basalts (GS65) (Hotspot at Highfields)	Medium
All other surface waters and groundwaters	Low

Table 22: Management responses to address risks from elevated pathogen counts

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
Pathogens entering water through both point and diffuse sources. The key sources of pathogens include animal and human waste and sewage discharges.	**Environmental Authorities under the *Environmental Protection Act 1994*** Environmentally relevant activities (ERAs) require an environmental authority under the *Environmental Protection Act 1994* to be issued before any activity can begin. ERAs are industrial or intensive agricultural activities with the potential to release contaminants, including pathogens, into the environment. They include a wide range of activities such as aquaculture, sewage treatment, cattle feedlotting, mining and coal seam gas extraction. Environmental authorities include conditions requiring developments to conduct activities in an environmentally responsible manner and reduce or avoid potential environmental impacts. **Regional Agricultural Landcare Facilitator (RALF)** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project builds on the strong, established partnerships across the South West Queensland, Condamine, and Maranoa Balonne and Border rivers management units. The Regional Agriculture Landcare Facilitators will support the development and delivery of agriculture projects and initiatives by proactively engaging with agricultural industries, landholder groups, Landcare Groups and other key stakeholders to: facilitate information exchange; provide linkages to technical experts; support local and regional agricultural events; facilitate innovative agricultural practice

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	demonstrations; assist with accessing grants for sustainable agriculture activities; and, facilitate connections with a range of programs that align to the NLP2 Regional Land Partnership objectives. **Grazing BMP** Promote uptake of the Grazing BMP program by graziers in the plan area. The voluntary and industry-led Grazing BMP program provides graziers across Queensland with the opportunity to improve productivity and reduce soil run-off to waterways through the identification of improved practices. The Grazing BMP program is available to graziers online via the following website: https://www.bmpgrazing.com.au.

8.1.10 Risk factor: Degradation of aquatic habitat, riparian extent/connectivity, riparian condition

Risk level	
Condamine River basin	Medium
Not applicable to groundwater.	

Table 23: Management responses to address the degradation of aquatic habitat, riparian extent/connectivity, and riparian condition

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
Removal of riparian vegetation. Overgrazing of catchments and grazing of riverbanks and floodplains. Practices that over the long-term cause decline of stream morphology, leading to near stream processes of gully erosion, side wall cut and head migration. The implementation of poor management practices leading to elevated levels of pesticides and other contaminants. Unmanaged fire risk leading to wildfires, destruction of riparian vegetation.	**Environmental Values and Water Quality Objectives under the Environmental Protection (Water) Policy 2009** Maintaining ground cover and vegetation in riparian zones and the wider landscape can assist in preventing nutrients from flowing to waterways. Water quality objectives to protect environmental values in the plan area include the following targets for wetland extent, ground cover in grazing lands and riparian vegetation: • Target for wetland extent: No reduction in the extent of natural wetlands (palustrine, lacustrine and riverine) from 2013 baseline levels. • Target for ground cover in grazing lands: Maintain a ground cover level of >70%. • Targets for riparian areas: (1) No reduction in forested riparian areas from 2013 baseline levels; (2) No reduction in riparian forest connectivity from 2013 baseline levels; (3) In non-forested areas, maintain riparian ground cover in each catchment at a level that minimises soil erosion by water. In addition, persistent waterholes have been identified and assigned high ecological value management intent due to their importance as refugial habitats in 'boom and bust' landscapes. Water quality objectives, and accompanying mapping displaying management intent, will be recommended for inclusion under Schedule 1 of the Environmental Protection (Water) Policy 2009 to inform statutory and non-statutory planning and decision-making.

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	Land Restoration Fund A $500 million fund that will directly support land based carbon reduction projects. This fund will support rehabilitation and revegetation of public and private land (including grazing land), protection of native forests and removal of pest and weed species. The carbon farming projects will have a number of co-benefits, such as restoring ecosystems and degraded land which will contribute to the reduction of sediment inputs to stream. **Protecting and enhancing key soil, water and vegetation assets of southern inland Queensland** A Southern Queensland NRM project delivered under the Queensland Government Natural Resources Investment Program 2018-2022. This project seeks to improve 12,500ha for soil health and stability, 12,000ha of native vegetation, and 2,400ha of riparian and wetland areas through land managers adopting improved management practices Southern Queensland NRM will partner with community and Landcare groups, regional councils, Government agencies, Traditional Owner groups, and research and development organisations to enhance the delivery of the project. **Future proofing agricultural lands** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project will address declining native vegetation and soil carbon in the South West Queensland, Condamine, and Maranoa Balonne and Border Rivers through building the adaptive capacity of producers to adopt best practice natural resource management to improve the condition of native vegetation, biodiversity and soils. This will enhance the resilience of the region to climate change. **Raising the profile of natural grasslands on the Darling Downs** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23.This project will implement recommended management actions to address the key threatening processes of clearing, inappropriate grazing regime, mechanical disturbance, weed invasion, herbicide use and dryland salinity on Natural grasslands on the Darling Downs, which are a Critically Endangered Threatened Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999*. The management actions will include reinvigorating Traditional Knowledge about native grasslands; fire management; grazing management; weed management; converting cropping land to pasture; propagating native plants for use in site rehabilitation; and undertaking salinity control measures. **Regional Agricultural Landcare Facilitator (RALF)** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project builds on the strong, established partnerships across the South West Queensland, Condamine, and Maranoa Balonne and Border rivers management units. The Regional Agriculture Landcare Facilitators will support the development and delivery of agriculture projects and initiatives by proactively engaging with agricultural industries, landholder groups, Landcare Groups and other key stakeholders to: facilitate information exchange; provide linkages to technical experts; support local and regional agricultural events; facilitate innovative agricultural practice demonstrations; assist with accessing grants for sustainable agriculture activities; and, facilitate connections with a range of programs that align to the NLP2 Regional Land Partnership objectives. **Grazing BMP** Promote uptake of the industry-led, voluntary Grazing BMP program by graziers in the plan area. The Grazing BMP initiative

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
	is supported by Queensland Government, Fitzroy Basin Association, AgForce and a range of other delivery partners. The Grazing BMP modules include Soil Health, Grazing Land Management, People and Business, Animal Production and Animal Health and Welfare. Website: https://www.bmpgrazing.com.au/ **myBMP – Cotton** Promote uptake of myBMP, the voluntary farm and environmental management program that ensures cotton is produced to industry best practice. myBMP is supported by Cotton Australia through funding from the Australian Government's National Landcare Programme and the Cotton Research Development Corporation. myBMP comprises 10 modules including Sustainable Natural Landscape (for managing vegetation and riparian assets on farm), Soil Health (for maintaining and/or improving soil quality and fertility), Pesticide Management (including storage and use) and Water Management (addresses water quality, efficiency of storage and distribution for both dryland and irrigated farming practices). Website: https://www.mybmp.com.au/home.aspx **Hort360** Promote uptake of Hort360, a voluntary BMP program for horticultural enterprises. The program is supported by Growcom and the Queensland Government. The Hort360 program comprises 14 modules, including irrigation, runoff, soil, biodiversity, climate and pesticide management. Website: https://www.hort360.com.au/ **Aerial Survey of wetlands and waterbirds in Queensland** Under the Intergovernmental Agreement on Implementing Water Reform in the Murray-Darling Basin and an amended National Partnership Agreement, the Queensland Government received funding to support the 'Aerial Survey of wetlands and waterbirds in Queensland' from 2014-2017. This project surveys 2,697,000 km^2 of eastern Australia and can monitor changes in the distribution and abundance of 50 waterbird species, including threatened species, and the health of rivers and wetlands. The survey is a powerful tool to observe changes in Ramsar wetland condition as well as other global and international conservation agreements. The survey can also detect potential long term changes through implementation of the Basin Plan. The aerial surveys are conducted by the University of New South Wales. Refer to https://www.ecosystem.unsw.edu.au/content/rivers-and-wetlands/waterbirds/eastern-australian-waterbird-survey for more information. **Fire management** Actively manage fire risk to mitigate risk of wildfires, which can lead to destruction of riparian vegetation, high levels of erosion, and declines in water quality. This could be delivered through NRM bodies, local governments, landholder education, and ranger programs. **Toolkit measures** In July 2018, the Basin Plan 2012 was amended following the outcomes of the Northern Basin review. In the Northern Basin, a range of 'toolkit measures' will be adopted by the New South Wales and Queensland Governments, with assistance from the Australian Government. The toolkit measures recognise that environmental outcomes can be achieved not only through water recovery, but also through complementary actions to enhance water recovery efforts. The toolkit measures include environmental works and measures to promote fish movement and habitat, as well as cold water pollution control, which aligns with the objectives of the HWMPs.

8.1.11 Risk factor: Climate change

Risk level	
Condamine, Balonne and Maranoa River basin[13]	High

Table 24: Management responses to address risks from climate change

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives [14]
The appropriate actions are not taken to reduce Greenhouse Gas emissions, increase carbon capture and promote adaptation. Rainfall variability and associated changes to river flows and to the frequency and extremity of droughts and floods. Changes to flood frequency and duration may impact vegetation, reducing river shading and the contribution of organic matter to stream. This will impact fish species, particularly the cold-water tolerant species (Balcombe, et al., 2011), as stream water temperature will increase and food and habitat availability will decrease. Drought refugia may dry out faster due to increased evapotranspiration and changes to flood frequency	The Queensland Government is working closely with business and industry, local councils and regional communities to understand the impacts of climate change, and to guide the state to adapt and transition under a changing climate. The following initiatives have been funded by Queensland Government and directly relate to water and land management: • **Land Restoration Fund**: A $500 million fund that will directly support land based carbon reduction projects. This fund will support rehabilitation and revegetation of public and private land (including grazing land), protection of native forests and removal of pest and weed species. • **CarbonPlus fund**: An $8.4 million project that will support and expand the carbon farming industry. The project has two parts: (1) equip Queensland Indigenous communities to participate in the carbon market and ensure the cultural, social and environmental co-benefits of Aboriginal carbon farming projects are recognised and appropriately valued. The Aboriginal Carbon Fund was engaged to undertake this component of the project. (2) the purchase of carbon credits to offset the Queensland Government's vehicle emissions from 2017-18 to 2018-19, with credits from Indigenous carbon projects being prioritised. In addition to the above, the current initiatives employed by the Queensland Government to understand, adapt and transition under a changing climate are not limited to water and land management initiatives, but instead include projects that encourage a whole-of-sector response (Refer to https://www.qld.gov.au/environment/climate/response for more information). These include:

[13] This risk level was determined under the Queensland Government Q-catchments Program (Q-catchments Program) which assessed the condition of the aquatic ecosystem in the eastern portion of Queensland's Murray-Darling basin (Negus, et al., 2015). The Q-catchments Program combined Condamine, Balonne and Maranoa basins into a single assessment and as such, the combined basin area is reflected for Risk factor: Climate Change.

[14] As the strategies to mitigate climate change are not restricted to a basin level, but require local, national and international initiatives, the measures presented here are not restricted to those within the Condamine River basin.

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives [14]
and duration (Balcombe, et al., 2011).	• **Transition to a zero carbon economy**: A strategy to ensure Queensland is positioned to take advantage of the opportunities as the world economy transitions to reduce pollution and adopt low carbon alternatives. • **1 million solar rooftops**: Supporting the deployment of solar PV on the rooftops of businesses, community buildings and commercial or industrial sites including on public housing and schools under the Advancing Clean Energy Schools program: http://education.qld.gov.au/facilities/solar/energy.html. • **Solar150**: The initiative, in conjunction with the large-scale solar PV competitive funding round conducted by the Australian Renewable Energy Agency (ARENA), will help support the development of large-scale solar energy projects in Queensland. • **Green Bonds**: Proceeds from QTC Green Bonds are to be used to fund qualifying green projects and assets for the State of Queensland. The proceeds are allocated to specific projects that support Queensland's transition to a low-carbon and climate resilient economy. So far, the qualifying green projects include rail links, cycleways and solar farms. • **Queensland Climate Resilient Councils**: a five year program working with Queensland local governments to strengthen internal council decision-making processes to respond to climate change (http://qcrc.lgaq.asn.au/). • **Biofutures**: The Advance Queensland's Biofutures 10-Year Roadmap and Action Plan has a vision for a $1 billion sustainable (including low carbon) and export-oriented industrial biotechnology and bioproducts sector: https://advance.qld.gov.au/our-vision/roadmaps/biofutures.aspx. The majority of Queensland-based vegetation management projects under the Australian Government's Emissions Reduction Fund are located in the Murray-Darling Basin [http://www.cleanenergyregulator.gov.au/maps/Pages/erf-projects/index.html]. These projects are actively contributing to reducing greenhouse gas emission and improved land management outcomes consistent with Australia's international climate change targets. <u>Future activities:</u> • Transitioning to a low carbon energy sector: Working with industry and the community to transition to an efficient, affordable and fair clean energy system, including: setting a 50% Renewable Energy Target by 2030 to drive jobs, investment, and cut carbon pollution; unlocking North Queensland's renewable energy potential; and supporting an additional 400 megawatts of new large-scale renewable capacity. • Continue to work collaboratively with land holders to consider, mitigate and adapt to climate change. **Protecting and enhancing key soil, water and vegetation assets of southern inland Queensland** A Southern Queensland NRM project delivered under the Queensland Government Natural Resources Investment Program 2018-2022. This project seeks to improve 12,500ha for soil health and stability, 12,000ha of native vegetation, and 2,400ha of riparian and wetland areas through land managers adopting improved management practices Southern Queensland NRM will partner with community and Landcare groups, regional councils, Government agencies, Traditional Owner groups, and research and development organisations to enhance the delivery of the project. **Future proofing agricultural lands** A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project will address declining native vegetation and soil carbon in the South West Queensland, Condamine, and Maranoa Balonne and Border Rivers through building the adaptive capacity of producers to adopt best practice natural resource management to improve the condition of native vegetation, biodiversity and soils. This will enhance the resilience of the region to climate change.

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives [14]
	Raising the profile of natural grasslands on the Darling Downs A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23.This project will implement recommended management actions to address the key threatening processes of clearing, inappropriate grazing regime, mechanical disturbance, weed invasion, herbicide use and dryland salinity on Natural grasslands on the Darling Downs, which are a Critically Endangered Threatened Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999*. The management actions will include reinvigorating Traditional Knowledge about native grasslands; fire management; grazing management; weed management; converting cropping land to pasture; propagating native plants for use in site rehabilitation; and undertaking salinity control measures.

8.1.12 Risk factor: Pest fauna—Aquatic

Risk level	
Condamine, Balonne and Maranoa River basins[15]	High
Not applicable to groundwater.	

Table 25: Management responses to address risks from aquatic pest fauna

Key causes, or likely causes, of water quality degradation to be addressed	Management responses to address risks and contribute to the achievement of objectives
Predation of native species. Competition with native fish populations for food, habitat and spawning locations. Increase in suspended sediment and nutrients.	**National Carp Control Plan** A $15-million planning process, on behalf of the Australian Government, to lead a large program of research and consultation to identify a smart, safe, effective and integrated suite of measures to control carp impacts. Consultation has occurred with Queensland stakeholders including, Northern Basin Aboriginal Nations, fishing groups, NRM bodies and

[15] This risk level was determined under the Queensland Government Q-catchments Program (Q-catchments Program) which assessed the condition of the aquatic ecosystem in the eastern portion of Queensland's Murray-Darling basin (Negus, et al., 2015). The Q-catchments Program combined Condamine, Balonne and Maranoa basins into a single assessment and as such, combined basin area is reflected for Risk factor: Pest fauna - Aquatic.

(Negus et al., 2012a-d).	community members. Further information can be found at http://www.carp.gov.au/. **Carp busting events** Fishing competitions that target carp are held throughout the catchment. Although it is recognised that these events are unlikely to have a significant impact on carp population numbers (except in closed systems), the educational opportunity that these events provide to the wider community about the detrimental impacts of pest fish are valuable. **Pest management plans**[16]: Goondiwindi Regional Council, Balonne Regional Council, Western Downs Regional Council, Toowoomba Regional Council, and Southern Downs Regional Council. Pest management plans recognise the need to control pest species in the catchment through partnership with all levels of government, natural resource management bodies and community. **Barriers to fish passage** Mitigate existing barriers to fish passage, where possible. Options for the installation of fishways include the relevant Natural Resource Management body for the region or through the toolkit measures to complement environmental water recovery in the Northern Murray-Darling Basin under the Basin Plan – in consultation with Traditional Owners.

[16] Pest management plans include plans from adjacent Local Government areas as it is recognised that addressing pest species in the Border Rivers and Moonie is not limited to local government boundaries.

SECTION 9: ABORIGINAL PEOPLE'S VALUES AND USES OF WATER ADDRESSED UNDER A HEALTHY WATERS MANAGEMENT PLAN

9 Aboriginal people's values and uses of water addressed under a healthy waters management plan

Section 10.52 of the Basin Plan outlines the process to identify objectives and outcomes based on Indigenous values and uses.

Section 9.5 of the Healthy Waters Management Plan for the Condamine River basin outlines opportunities to strengthen the protection of Aboriginal values and uses of water that are relevant to the content of a HWMP. The values and uses of water resources and the risks to these values and uses (Refer to Section 9.2 and Section 9.4) were identified through a consultation process led by the Department of Natural Resources, Mines and Energy and DES, with Nations within the eastern catchments of QMDB and the Northern Basin Aboriginal Nations (NBAN) (Refer to section 4.5). This consultation process also identified the objectives and outcomes that Aboriginal people within the eastern catchments of QMDB want to achieve for the water resources of the plan area (See Section 9.3). The content below has been informed by the Water Connections Report (DNRME, 2019). The identification of objectives and outcomes for water resources enables the values and uses to be protected and enhanced by water resource planning, particularly those relating to water quality and land management, which can be addressed under the *Environmental Protection (Water) Policy 2009* through the Condamine River Basin HWMP.

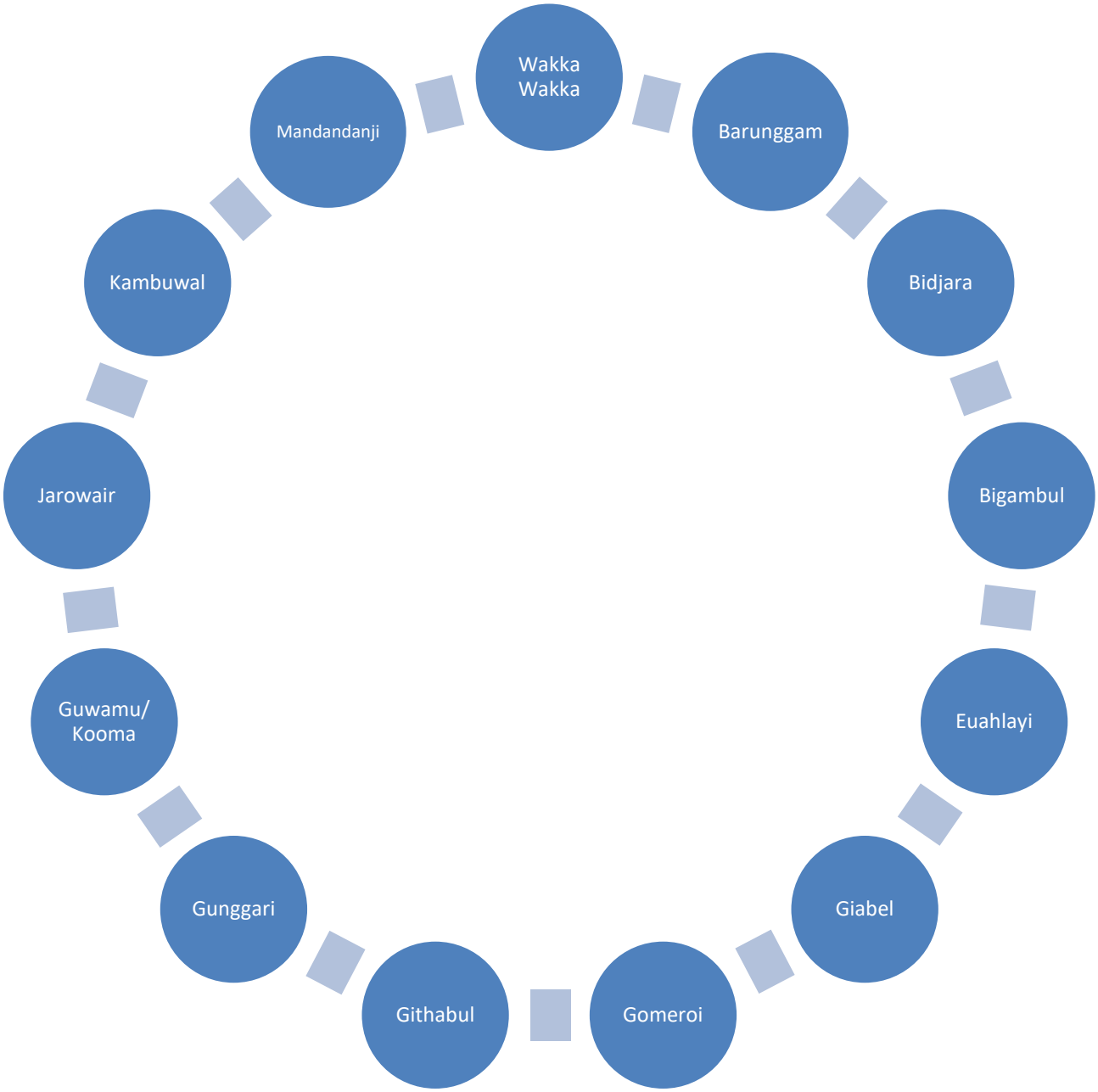

Figure 27 Aboriginal Nations consulted in the Border Rivers, Moonie, Condamine, and Maranoa-Balonne.

9.1 Background

Aboriginal peoples[17] in Australia have frequently expressed the desire for better inclusion in the management of land and water resources. Aboriginal relationships with water are holistic, combining land, water, culture, society and economy. Water underpins social, spiritual and economic well-being, is inseparable from the land, and the relationship of Aboriginal peoples with waters, lands and their resources is crucial to cultural well-being and resilience (Human Rights Commission, 2008). It is worth emphasising the sense of responsibility that Aboriginal peoples feel for their land and water, to look after it as their ancestors have done for tens of thousands of years. This interest entails an inherent cultural responsibility to look after water, and presents an incredible source of knowledge and opportunity for involvement for water resource planning.

The Queensland Government is now working to improve Aboriginal involvement in water resource planning in the Queensland Murray-Darling Basin through the Basin Plan, which details the ways in which water planning authorities must consult with relevant Aboriginal organisations in relation to the requirements of section 10.52: Objectives and outcomes based on Indigenous values and uses. This work has been summarised in the Water Connections Report (DNRME, 2019).

The Aboriginal values and uses of water that can be protected and enhanced by a HWMP are those that are related to water quality. Good water quality supports all human uses and is fundamental to plants, animals and healthy aquatic ecosystems. Fishing, for example, relies on healthy ecosystems to support healthy fish in good numbers. For some Nations, specific species of fish, such as Yellowbelly (Golden perch), hold deep spiritual importance as a totem animal and is seen as a family member[18].

The HWMP can support cultural and spiritual values by protecting water quality through the water quality objectives (refer to Section 10). The water quality objectives are designed to protect aquatic ecosystems of a certain condition (Highly Disturbed, Moderately Disturbed, Slightly Disturbed, and High Ecological Value). As other project outcomes come to light and are more clearly defined, for example the bioregional assessments (Constable & Love, 2015) and the Cultural Flows project (Section 9.4.1), it may be possible to develop water quality objectives that are specific to protecting cultural, spiritual and ceremonial values and uses.

Limitations

It is important to point out that while every effort has been made to speak to as many Traditional Owners as possible, the information obtained from the consultation process is not exhaustive, and there will be further values and uses and risks associated with these that have not been identified here. This provides a representation of the values and uses and associated risks identified by the Aboriginal Nations who engaged in the consultation process, consistent with those included in the Water Connections Report (DNRME, 2019). In addition, it is important to note the complexity of the holistic nature of Aboriginal perspectives of the landscape, for example, stories of Aboriginal people often focus on the creation of the whole landscape, not just individual rivers or elements of the landscape. Interconnected water sources are believed to have the same spiritual energy, forming part of the same ‘site’, in some cases in a similar way to groundwater connectivity, but also through waterways forming dreaming tracks and songlines (Australian Government, 2017). It is important to acknowledge that these values and uses remain the Intellectual Property of Traditional Owners, and this as well as the complexity of Aboriginal perspectives and culture is another reason it is imperative to involve Aboriginal people directly in water resource management, as they are the best people to speak for their land and water and it is their right.

9.2 Aboriginal people’s values and uses of water from consultation

As Aboriginal Nation boundaries are independent of water planning boundaries, the information contained in this section of the Condamine River Basin HWMP may have some overlap with information from Nations that are also represented in the Maranoa and Balonne HWMP, and/or the Queensland Border Rivers and Moonie River Basins HWMP.

[17] In this chapter, the term *Indigenous* is used where quoting the Basin Plan and where used in other existing legislation or literature. *Aboriginal* or *Aboriginal peoples* will be used in this report in the context of Aboriginal people consulted with in the Murray-Darling basin, noting the great diversity of Aboriginal Nations and cultures.

[18] Not only because they are, but because knowing them and their distribution and behaviour in great detail give subtle information on changes in the landscape which can be very significant, even life-saving when living in the bush.

The Traditional Owners of the Condamine basins described the way in which water is valued and used across the plan area, as described in Figure 28.

Figure 28 Aboriginal values and uses of water, and interrelated aspects of culture.

Water is a foundational element that runs through almost all aspects of Aboriginal culture, as described in the figure above. Clean water is essential for survival, ensures the survival of plants and animals needed for traditional diet and medicine. Scarred and carved trees that are large and old are likely to have very deep roots that tap into groundwater. Middens, for example those that are comprised of mollusc shells, often are situated near waterways due to the source of the materials, and are therefore susceptible to erosion from nearby creeks or rivers.

9.3 Aboriginal objectives and outcomes from consultation

The objectives and outcomes in this section were informed by the consultation process conducted by Queensland Government with the Traditional Owners of the Condamine, Maranoa, Balonne, Moonie and Border Rivers basins, as described in section 4.5. The objectives and outcomes aim to protect Aboriginal cultural, spiritual and ceremonial values and uses of water.

Table 26 Aboriginal objectives and outcomes from consultation

Objectives of water resource management as identified by Nations	Desired outcomes of water resource management as identified by Nations
Bigger populations and better health of animals and plants Better balance in how water is shared between users and environment Better sharing of water between users and Aboriginal peoples More economic opportunities for the ownership, use and trade of water entitlements More natural flows and connectivity down the system Improved water quality Protected riparian zones, floodplains, waterways, springs, animals, plants, waterholes and cultural sites for future generations Improved access to waterways More involvement of Aboriginal peoples in decision making and management of waterways Improved and continuous consultation and participation in water planning process Improved capacity building and education of Aboriginal peoples and government Better integration of traditional knowledge and western science	A healthy system that supports populations of animals and plants Clean, connected and flowing rivers, creeks, lakes, floodplains, wetlands and springs Aboriginal peoples can use waterways for cultural, social, environmental, spiritual and economic purposes Stronger connection to Country Waterways are being accessed for swimming, fishing, storytelling, family gatherings, education A seat at the table for decisions on how water is managed and shared Aboriginal peoples have the capacity and are fully informed about water planning Traditional ecological knowledge is used as part of water planning process

9.4 Risks to Aboriginal people's values and uses identified through consultation

Following the documentation of how Traditional Owners of the Condamine River Basin value and use water resources, the risks that threaten the continued availability of these values and uses were discussed. The risks raised at the workshops and during discussions were often relayed in the form of stories about impacts to important social, spiritual and cultural aspects of land and water. Participants also drew comparisons between the current state of the system and how they remembered using and valuing the system when they were children or from stories passed on from earlier generations. The common risks raised during the workshops were risks that are linked to insufficient water available for the environment, water being of a quality unsuitable for use, and the poor health of water-dependent ecosystems.

Many of the risks raised by Aboriginal peoples and Traditional Owners are related to the use and management of water resources, as well as from land use and other non-water related activities. Although some of the risks to values and uses identified by local Aboriginal peoples cannot be addressed specifically by the HWMP, they are included in this HWMP in order to understand the full range of issues affecting water related values and uses in the basin. The full list of risks and the factors contributing to the risks are displayed in Table 27.

Table 27 Risks and causes of risks to Aboriginal values and uses as identified during consultation with individual Aboriginal Nations

Risk to Aboriginal peoples values and uses	Factors contributing to risk
Risk to all Aboriginal peoples values and uses (Climate change and associated extreme weather events)	Climate change: increasing rainfall variability and associated changes to river flows and to the frequency and extremity of droughts and floods and associated water quality.
	Changes to flood frequency/duration may impact vegetation, reducing river shading and organic matter inputs. Increased temperatures and reduced food and habitat will impact native fish and other aquatic species.
	Drought refugia may dry out faster, impacting aquatic ecosystems and water availability.
Risk to continued availability of water resources for Aboriginal people (Reduced and altered flow from increases in take from watercourse and changing climate and rainfall patterns)	Flood and overland flow harvesting, dam operations, stock and domestic take, pumping from refugial waterholes, extraction of groundwater.
	Land clearing around the ranges that affects the rainfall on floodplains to the west and reducing inflows.
Risk to use of water resources for cultural, spiritual and ceremonial activities of Aboriginal peoples (Lack of access to waterways)	Lack of access to waterways
Risk to sense of obligation to care for Country (Lack of a role or responsibilities in managing and decision-making around water resources)	Lack of representation on committees, lack of recognition, lack of employment opportunities in government and other decision making bodies, lack of capacity, and lack of influence over decision making on land and water management.
Risk to water being of a quality unsuitable for use by Aboriginal people (Turbidity, nutrients and pesticides and other contaminants)	Erosion from stock, clearing of riparian vegetation, siltation behind infrastructure, land management activities, feral pigs, vehicle use, mining and motorboats causing wave wash.
	Erosion from stock, clearing of riparian vegetation, nutrient inputs promoting algal blooms, land management activities, mining, blueberry farms, sewage leaks
	Mining and farming activities and practices
Risk to health and wellbeing of Aboriginal people	Removal or decline of one animal or plant species affects the whole system and other species. Impact of weeds and pest species, such as carp and azolla. Algal blooms. Water pumps installed

Risk to Aboriginal peoples values and uses	Factors contributing to risk
(Declining aquatic ecosystems)	without screens.
Risk to degradation of important cultural sites (destruction and degradation of important cultural sites, such as burial grounds and scar trees)	Mismanagement of land and waterways, Council activities, farming and mining practices and motorboats.

9.5 Opportunities to strengthen the protection of Aboriginal values and uses of water under the HWMP

The opportunities to strengthen the protection of Aboriginal peoples' values and uses of water are linked to Basin Plan section 10.52(3). These opportunities are identified to be consistent with the objectives and outcomes (Section 9.4) identified during consultation with the Aboriginal Nations.

Aboriginal Waterways Assessments

Aboriginal Waterways Assessments (AWAs) are an in-field assessment of stream health from the perspective of Traditional Owners, and are a key initiative to increase the participation of Traditional Owners in natural resource and waterway management. They provide a tool for Aboriginal communities to consistently measure and prioritise river and wetland health so that they are better placed to negotiate for their Country's water needs.

AWAs were adapted from a Māori-originated water assessment tool by the Northern Basin Aboriginal Nations, Murray Lower Darling Rivers Indigenous Nations and the Murray-Darling Basin Authority Aboriginal Partnerships team.

The Queensland Government, with contribution from the MDBA, is funding six AWAs in the Condamine, Border Rivers, Moonie, Balonne and Warrego River basins. The AWAs are being conducted throughout 2018/19 and are being jointly delivered by the Northern Basin Aboriginal Nations and the former-NRM bodies, QMDC and Condamine Alliance (which are currently transitioning to Southern Queensland NRM). Additionally, DES, DNRME and MDBA are providing in-kind support to assist the Queensland AWA projects.

AWAs also align with the principles for engaging Indigenous peoples in water planning and management as stated in Section 1.3 of the *Module to the National Water Initiative (NWI) Policy Guidelines for Water Planning and Management: Engaging Indigenous Peoples in Water Planning and Management* (Australian Government, 2017):

"Investing in capacity building exercises for Indigenous peoples to develop their skills in water planning and management practices, and reciprocal knowledge transfer from Indigenous peoples to water planners." In addition the AWAs can facilitate intended active and informed participation of Indigenous people as stated in Section 10.53 (1) (e) of Basin Plan.

Under the HWMP, the Queensland Government will continue to seek to identify opportunities for further AWAs in the QMDB. With the approval of the Aboriginal Nation that conducted an AWA, the HWMPS can be amended to include main findings of the AWAs.

Queensland Indigenous Land and Sea Rangers

Queensland Indigenous Land and Sea Rangers

The Queensland Indigenous Land and Sea Ranger program currently provides funding for over 100 Indigenous land and sea rangers across Queensland, most of whom are Traditional Owners of the land on which they work. The Queensland Government, through the Department of Environment and Science, funds local Indigenous host organisations to employ the land and sea rangers. Traditional Owners and local communities have ownership of the work programs for their rangers, including fire and feral animal management, fencing of wetlands, land restoration, and conservation of rock art sites. Many of these practices assist in improving water quality, as well as preventing wildfires, reducing carbon emissions and improving biodiversity.

There are limited Queensland Indigenous Land and Sea ranger positions in the Condamine River Basin of the Queensland Murray Darling basin – only through the Bunya Peoples' Aboriginal Corporation in the Bunya Mountains. An expansion of the ranger program in the Condamine River Basin represents a significant opportunity to support current efforts to deal with pest management and a range of other risks to Aboriginal values and uses, while providing additional employment to Traditional Owners to support them looking after their Country, as discussed in Sections 9 and 9.4.

Rangers are critical to future land and water management throughout the Murray-Darling Basin. Identified

Aboriginal ranger positions on Country, managed through native title bodies, Aboriginal corporations or through NBAN, was a pressing need highlighted by many participants during the consultation with Aboriginal Nations. This consultation indicated that the rangers must be trained by Traditional Elders. Rangers could fulfil functions such as, but not limited to, the following:

- land and water care and management;
- pest management;
- fire management;
- locally appropriate revegetation;
- monitoring and reporting potential issues of non-compliance;
- monitoring of water quality and ecosystem health; and
- Cultural heritage protection.

Identified Aboriginal ranger positions could also take responsibility for identifying issues regarding cultural heritage and the care of managing and maintaining these locations.

Under the HWMP, the Queensland Government will continue to seek to identify opportunities to expand the Queensland Indigenous Land and Sea Ranger program in the Condamine River Basin.

Looking after Country Grant Program

The Looking after Country Grant program is a Queensland-based initiative that was formerly known as the Queensland Indigenous Land and Sea Grant Program. If successful following an application process, Aboriginal and Torres Strait Islander groups are provided with grants of up to $75,000 for projects on-Country, aimed at conserving environmental and cultural resources and values.

The program encourages collaborative projects that may address (but are not limited to) the following:

- cultural heritage site management
- protected species monitoring and conservation
- habitat restoration
- feral animal and weed management
- fire management
- erosion control
- the development and implementation of country management plans.

The application process for the Looking after Country Grant program is outlined on the following website: https://www.qld.gov.au/environment/plants-animals/conservation/community/land-sea-rangers/grants-program.

The Looking after Country Grant program aligns with many of the responses received during the Aboriginal community consultation seeking opportunities for better involvement in natural resource management activities.

Environmental values and water quality objectives under the Environmental Protection (Water) Policy 2009

The Queensland Government schedules environmental values and water quality objectives under the Environmental Protection (Water) Policy 2009 (EPP Water) to inform statutory and non-statutory planning and decision-making. This framework seeks to protect and maintain water quality within Queensland's waterways and groundwater aquifers. The environmental values and water quality objectives are informed by community consultation. Through the process of engaging with Aboriginal Nations, the following was determined for consideration for inclusion under Schedule 1 of the EPP Water:

- Cultural, spiritual and ceremonial environmental values apply to all surface water and groundwater in the Queensland Murray–Darling Basin, and this has been included on the relevant mapping.
- Default water quality objectives apply for the protection of the cultural, spiritual and ceremonial environmental values. In future, water quality objectives that are specific to cultural flows or developed by an Aboriginal nation may be available to update relevant documents accordingly.
- Persistent waterholes in the Queensland Murray–Darling Basin have been mapped and assigned the highest level of protection (high ecological value) under the Environmental Protection (Water) Policy 2009.
- Maintaining healthy riparian vegetation zones which reduce run-off and erosion was identified as important through consultation. Water quality objectives to protect environmental values in the plan area include targets for wetland extent, ground cover in grazing lands and riparian vegetation.

Environmental values support Aboriginal values and uses of water, and these values and uses of water will continue to be reflected in healthy waters management plans moving forward.

Queensland Carbon Plus Fund

In December 2016, the Queensland Government announced an $8.4 million project that will support and expand the carbon farming industry and create jobs for Traditional Owners. The project has two parts:

1. equip Queensland Aboriginal nations to participate in the carbon market and ensure the cultural, social and environmental co-benefits of Aboriginal carbon farming projects are recognised and appropriately valued. The Aboriginal Carbon Fund was engaged to undertake this component of the project
2. the purchase of carbon credits to offset the Queensland Government's fleet vehicle emissions from 2017–18 to 2018–19, with credits from Aboriginal carbon projects being prioritised.

Refer to this link for more information: https://www.qld.gov.au/environment/climate/climate-change/carbon-farming

Supporting Indigenous Participation

A Southern Queensland NRM project delivered under the Australian Government National Landcare Program (Phase 2) – Regional Land Partnerships Program 2018-23. This project will support engagement and involvement of Aboriginal Australians in the planning and implementation natural resource management initiatives. Aboriginal Australians have been the custodians of Southern Queensland for at least 40,000 years and have looked after the natural assets and landscapes of the region successfully for thousands of generations. Southern Queensland NRM will engender a strong culture of learning, respect and inclusion of Traditional Owner groups. Involvement will be underpinned by a Reconciliation Action Plan and an Indigenous Participation Plan.

Healthy Waters Management Plan: management responses

Section 8 of the Healthy Waters Management Plans identifies management responses to address risks and contribute to the achievement of objectives. These actions will help to address water quality and aquatic ecosystem concerns captured in the consultation with Aboriginal nations, such as reducing sediment and nutrients entering water through streambank stabilisation and improving the health of riparian zones.

Great Artesian Basin – Environmental values and water quality objectives

Participants at the Aboriginal Nations' consultation identified that the Great Artesian Basin is of great cultural and spiritual significance to Aboriginal people, and is important for maintaining the health of aquatic ecosystems. There were concerns expressed over mining and coal seam gas operations in terms of the potential threat to the Great Artesian Basin, including over-extraction, pollution/contamination, and reduced aquifer recharge.

The environmental values and water quality objectives for groundwater established for the Queensland Murray–Darling Basin region include the Great Artesian Basin aquifers. The cultural, spiritual and ceremonial environmental value applies to all groundwater, based on the results of consultation with Aboriginal nations. Environmental values and water quality objectives will be recommended for inclusion under Schedule 1 of the Environmental Protection (Water) Policy 2009 and will subsequently inform planning and decision-making related to mining and coal seam gas development.

9.6 Recommendations broader than the HWMP

A range of comments and submissions received through consultation related to important issues that were broader than the HWMP. The Water Connections Report (DNRME, 2019) has summarised these issues and provides a response to each. The Queensland Government recognises the importance of following up these issues with the relevant agencies.

SECTION 10: WATER QUALITY TARGET VALUES

10 Water quality target values

Water quality target values[19] are quantitative measures of water quality indicators that protect a stated environmental value (Refer to section 5 of this report). The targets can be concentrations, loads or a biological measure, e.g. macroinvertebrate diversity. Where there are multiple water quality target values for a particular indicator to protect different environmental values at a location, the most stringent water quality target value applies.

Section 10.32 of the Basin Plan specifies that a WQM Plan is to identify surface water quality target values for fresh water-dependent ecosystems, irrigation water and water used for recreational purposes. Section 10.35B specifies that a WQM Plan must also identify the groundwater quality target values for the plan area for these purposes. Default water quality target values are provided in the Basin Plan (Chapter 9 and Schedule 11) for these matters. Subsections 10.32 (3) and (4) enables the WQM Plan to specify alternative surface water quality target values if they are developed in accordance with stated requirements. Similarly, subsection 10.35B (3) enables the WQM Plan to specify alternative groundwater quality target values if they are consistent with stated water quality objectives.

Where available, alternative local water quality targets to those specified in Chapter 9 and Schedule 11 of the Basin Plan have been included in Section 10 of the HWMP for the Condamine River basin for both surface water and groundwater. The application of the default Basin Plan water quality targets is considered inappropriate where local water quality target values have been developed. The default Basin Plan targets under Chapter 9 and Schedule 11 were developed for a broad spatial scale that does not reflect the variation in water types across the Condamine River basin (Refer to the waters types in Figure 29 and Appendix 2—Description of water types in the Condamine River basin). Where local water quality data was available, local water quality target values were developed for surface water types, under high and base flow conditions, and for groundwater aquifer zones. Further information on the development of alternative water quality target values is provided in Appendix 1—Refining water quality targets for fresh water-dependent ecosystems to reflect local conditions.

Refer to the following sections of the Healthy Waters Management Plan for the water quality target values for accreditation under section 10.32 of the Basin Plan for surface water. Note: There are no Ramsar Wetlands currently identified in the plan area.

Fresh water-dependent ecosystems (other than Declared Ramsar wetlands)

- **Section 10.2.1: Water quality targets for fresh water-dependent ecosystems (moderately disturbed aquatic ecosystems) Table 28 for the Condamine River basin surface waters;**

Irrigation water

- **As there are no irrigation infrastructure operators in the plan area (as defined under the Water Act 2007), irrigation water quality target values for accreditation do not apply. While not accredited under the Basin Plan, Section 10.3.1, Table 46 provision (1) for the Condamine River basin is recognised to provide targets for irrigation water in the plan area for the purposes of Queensland water quality planning and management.**

Water used for recreation

- **Section 10.3.5: Water quality targets for the protection of the Primary, Secondary and Visual Recreation Environmental Values Table 60, provision (1) - Suitability for primary, secondary and visual recreation.**

Refer to the following sections of the Healthy Waters Management Plan for the water quality target values for accreditation under section 10.35B of the Basin Plan for groundwater:

Fresh water-dependent ecosystems (other than Declared Ramsar wetlands)

Section 10.2.6: Water quality targets to protect aquatic ecosystem environmental values for groundwater aquifer zones in the Condamine River basin specified in Table 31, Table 32, Table 33 and

- **Table 38 Table 38;**

Irrigation water

- **As there are no irrigation infrastructure operators in the plan area (as defined under the Water Act 2007), irrigation water quality target values for accreditation do not apply. While not accredited under the Basin Plan, Section 10.3.1, Table 46 provision (1) for the Condamine River basin is recognised to provide targets for irrigation water in the plan area for the purposes of Queensland water quality planning and management.**

[19] 'Water quality target values' under the Basin Plan are equivalent to 'Water Quality Objectives' under the EPP Water.

Water used for recreation

- **Section 10.3.5: Water quality targets for the protection of the Primary, Secondary and Visual Recreation Environmental Values Table 60, provision (1) - Suitability for primary, secondary and visual recreation.**

10.1 Targets for managing water flows

Water quality in relation to the management of water flows in the Condamine River basin is addressed through the Department of Natural Resources, Mines and Energy water planning framework. Refer to the Department of Natural Resources, Mines and Energy —Water Management website for further information.

10.2 Water quality targets for the protection of the Aquatic Ecosystem Environmental Value

The water quality targets in this section apply where the Aquatic Ecosystem Environmental Value has been identified in the Condamine River basin (Refer to section 5 of this report).

10.2.1 Water quality targets for fresh water-dependent ecosystems (moderately disturbed aquatic ecosystems)

Section 10.32 (2)(a) of the Basin Plan requires a WQM Plan to identify water quality targets for fresh water-dependent ecosystems other than declared Ramsar wetlands. Section 10.35B (2)(a) specifies that a WQM Plan must also identify the groundwater quality target values for the plan area for these purposes.

Under the Healthy Waters Management Plan, water quality targets for the protection of the Aquatic Ecosystem Environmental Value were developed for each water type[20] in the Condamine River basin, for low and high flow conditions, based on local data. A sub-set of these water quality targets are relevant to meeting the requirements of section 10.32 (2)(a) of the Basin Plan for fresh water-dependent ecosystems other than declared Ramsar wetlands. The water quality target values for accreditation under section 10.32 (2)(a) of the Basin Plan are the water quality target values in:

Fresh water-dependent ecosystems (other than Declared Ramsar wetlands)

- **Section 10.2.1: Water quality targets for fresh water-dependent ecosystems (moderately disturbed aquatic ecosystems) Table 28 for the Condamine River basin surface waters;**

While not accredited under the Basin Plan, the water quality target values for additional indicators in Table 29, which were developed under the Queensland legislative water quality framework (see Appendix 1), are recognised to support the accredited water quality target values to protect and restore water-dependent ecosystems.

Water quality targets were also developed for aquifers in the plan area based on local groundwater data. The water quality target values for accreditation under section 10.35B (2)(a) of the Basin Plan for groundwater are:

Fresh water-dependent ecosystems (other than Declared Ramsar wetlands)

- **Section 10.2.6: Water quality targets to protect aquatic ecosystem environmental values for groundwater aquifer zones in the Condamine River basin specified in Table 31, Table 32, Table 33 and Table 38;**

While not accredited under the Basin Plan, the water quality target values in Table 34 to Table 37, which were developed under the Queensland legislative water quality framework (see Appendix 1—Refining water quality targets for fresh water-dependent ecosystems to reflect local conditions), are recognised to support the accredited water quality target values to protect and restore water-dependent ecosystems.

Note: The Condamine River basin does not currently contain declared Ramsar wetlands.

Local water quality targets for fresh water-dependent ecosystems were developed for each water type identified in Figure 29. A description of water types in the Condamine River basin is provided in Appendix 2—Description of water types in the Condamine River basin. Where local data was unavailable, the regional water quality targets for fresh water-dependent ecosystems listed in Schedule 11 of the Basin Plan apply. The relevant target application zone for the Condamine River basin is B1 (Condamine, and Warrego valleys; Upland Zone) – Other water dependent ecosystems[21] (also portrayed on Figure 29).

NOTE: The purpose of the targets provided in this section is to assist those involved in managing water resources to ensure that moderately disturbed aquatic ecosystems are adequately protected (Refer to Section 6: Levels of aquatic ecosystem protection). The local water quality targets presented below are applicable to low flow conditions and high flow conditions when sufficient data was available. Additional water quality monitoring and modelling is required to derive additional local water quality target values for other flow scenarios.

[20] Water types for the Condamine River basin are mapped in Figure 29 and are described in Appendix 2.

[21] Refer to the Murray-Darling Basin Authority website for spatial information on Water Quality Zones.

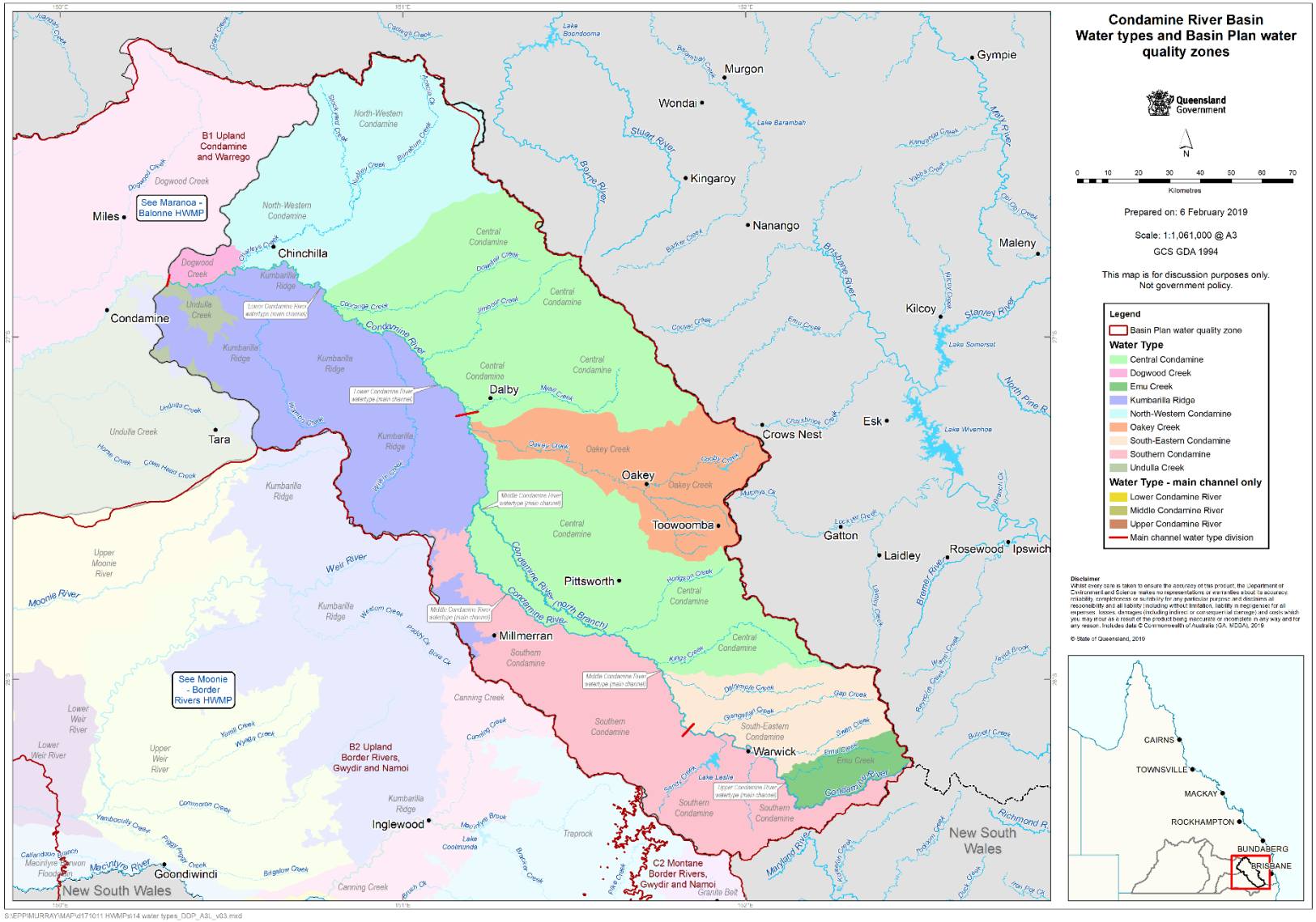

Figure 29: Water types in the Condamine River basin where local water quality target values for fresh water-dependent ecosystems apply (Refer to Table 28 and Table 29). See Appendix 2 for a description of each water type.

Table 28: Water quality target values for Moderately Disturbed waters of the Condamine River basin under low and high flow conditions[22]. Refer to Figure 29 for the map of water types.

Water type	Management intent/ level of protection	**Table 28: CONDAMINE RIVER BASIN SURFACE WATERS– accreditable water quality target values** **Notes:** **1.** Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated. **2.** ID: Insufficient data to develop a target value. **3.** Sources: s1: Local Data; s2: Basin Plan Schedule 11 target value for B1 (Condamine and Warrego valleys; Upland zone)—Other water-dependent ecosystems.								
		Turbidity (NTU) (Annual median)	**Total Phosphorus** (µg/L) (Annual median)	**Total Nitrogen** (µg/L) (Annual median)	**Dissolved Oxygen** (Annual median within the range)		**pH** (Annual median within the range)	**Salinity** (End-of-valley targets) (Median)	**Temperature** (Monthly median within the range)	**Pesticides, heavy metals and other toxic contaminants**
					mg/L	% sat.				
CENTRAL CONDAMINE catchment waters	**Low flow**									
	Moderately Disturbed	25 (s1)	170 (s1)	860 (s1)	ID	60-110% (s2)	7.4-8.3 (s1)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High flow									
	Moderately Disturbed	220 (s1)	950 (s1)	2200 (s1)	ID	60-110% (s2)	7.0-7.6 (s1)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
EMU CREEK catchment	**Low flow**									

[22] Water quality target values in Table 28 are accreditable water quality target values for fresh water-dependent ecosystems (other than declared Ramsar wetlands) under section 10.32 of the Basin Plan.

Water type	Management intent/ level of protection	**Table 28: CONDAMINE RIVER BASIN SURFACE WATERS– accreditable water quality target values** **Notes:** **1.** Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated. **2.** ID: Insufficient data to develop a target value. **3.** Sources: s1: Local Data; s2: Basin Plan Schedule 11 target value for B1 (Condamine and Warrego valleys; Upland zone)—Other water-dependent ecosystems.								
		Turbidity (NTU) (Annual median)	**Total Phosphorus** (µg/L) (Annual median)	**Total Nitrogen** (µg/L) (Annual median)	**Dissolved Oxygen** (Annual median within the range)		**pH** (Annual median within the range)	**Salinity** (End-of-valley targets) (Median)	**Temperature** (Monthly median within the range)	**Pesticides, heavy metals and other toxic contaminants**
					mg/L	% sat.				
waters	Moderately Disturbed	5 (s1)	65 (s1)	370 (s1)	ID	60-110% (s2)	7.6-8.2 (s1)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High flow									
	Moderately Disturbed	10 (s1)	140 (s1)	380 (s1)	ID	60-110% (s2)	7.5-8.0 (s1)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
KUMBARILLA RIDGE catchment waters	**Low flow**									
	Moderately Disturbed	110 (s1)	170 (s1)	860 (s1)	ID	60-110% (s2)	6.8-7.6 (s1)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High flow									
	Moderately Disturbed	270 (s2)	450 (s2)	2000 (s2)	ID	60-110% (s2)	7.0-8.5 (s2)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
LOWER CONDAMINE	**Low flow**									

Water type	Management intent/ level of protection	**Table 28: CONDAMINE RIVER BASIN SURFACE WATERS– accreditable water quality target values** **Notes:** **1.** Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated. **2.** ID: Insufficient data to develop a target value. **3.** Sources: s1: Local Data; s2: Basin Plan Schedule 11 target value for B1 (Condamine and Warrego valleys; Upland zone)—Other water-dependent ecosystems.								
		Turbidity (NTU) (Annual median)	**Total Phosphorus** (µg/L) (Annual median)	**Total Nitrogen** (µg/L) (Annual median)	**Dissolved Oxygen** (Annual median within the range)		**pH** (Annual median within the range)	**Salinity** (End-of-valley targets) (Median)	**Temperature** (Monthly median within the range)	**Pesticides, heavy metals and other toxic contaminants**
					mg/L	% sat.				
catchment waters	Moderately Disturbed	35 (s1)	210 (s1)	890 (s1)	ID	60-110% (s2)	7.4-8.1 (s1)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High flow									
	Moderately Disturbed	390 (s1)	640 (s1)	1750 (s1)	ID	60-110% (s2)	7.1-7.6 (s1)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
MIDDLE CONDAMINE catchment waters	**Low flow**									
	Moderately Disturbed	25 (s1)	140 (s1)	740 (s1)	ID	60-110% (s2)	7.5-8.1 (s1)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High flow									
	Moderately Disturbed	165 (s1)	470 (s1)	1210 (s1)	ID	60-110% (s2)	7.2-7.8 (s1)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
NORTH WESTERN	**Low flow**									

Water type	Management intent/ level of protection	**Table 28: CONDAMINE RIVER BASIN SURFACE WATERS– accreditable water quality target values** **Notes:** **1.** Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated. **2.** ID: Insufficient data to develop a target value. **3.** Sources: s1: Local Data; s2: Basin Plan Schedule 11 target value for B1 (Condamine and Warrego valleys; Upland zone)—Other water-dependent ecosystems.								
		Turbidity (NTU) (Annual median)	**Total Phosphorus** (µg/L) (Annual median)	**Total Nitrogen** (µg/L) (Annual median)	**Dissolved Oxygen** (Annual median within the range)		**pH** (Annual median within the range)	**Salinity** (End-of-valley targets) (Median)	**Temperature** (Monthly median within the range)	**Pesticides, heavy metals and other toxic contaminants**
					mg/L	% sat.				
catchment waters	Moderately Disturbed	80 (s1)	140 (s1)	1150 (s1)	ID	60-110% (s2)	7.0-7.4 (s1)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High flow									
	Moderately Disturbed	140 (s1)	130 (s1)	ID	ID	60-110% (s2)	7.0-8.5 (s2)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
OAKEY CREEK catchment waters	**Low flow**									
	Moderately Disturbed	13 (s1)	110 (s1)	1000 (s1)	ID	60-110% (s2)	7.7-8.3 (s1)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High flow									
	Moderately Disturbed	55 (s1)	340 (s1)	1280 (s1)	ID	60-110% (s2)	7.4-8.1 (s1)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
SOUTH-EASTERN	**Low flow**									

Water type	Management intent/ level of protection	**Table 28: CONDAMINE RIVER BASIN SURFACE WATERS– accreditable water quality target values** **Notes:** **1.** Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated. **2.** ID: Insufficient data to develop a target value. **3.** Sources: s1: Local Data; s2: Basin Plan Schedule 11 target value for B1 (Condamine and Warrego valleys; Upland zone)—Other water-dependent ecosystems.								
		Turbidity (NTU) (Annual median)	**Total Phosphorus** (µg/L) (Annual median)	**Total Nitrogen** (µg/L) (Annual median)	**Dissolved Oxygen** (Annual median within the range)		**pH** (Annual median within the range)	**Salinity** (End-of-valley targets) (Median)	**Temperature** (Monthly median within the range)	**Pesticides, heavy metals and other toxic contaminants**
					mg/L	% sat.				
catchment waters	Moderately Disturbed	8 (s1)	110 (s1)	270 (s1)	ID	60-110% (s2)	7.7-8.3 (s1)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High flow									
	Moderately Disturbed	25 (s1)	200 (s1)	460 (s1)	ID	60-110% (s2)	7.5-8.1 (s1)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
SOUTHERN CONDAMINE catchment waters	**Low flow**									
	Moderately Disturbed	9 (s1)	45 (s1)	590 (s1)	ID	60-110% (s2)	7.2-7.9 (s1)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High flow									
	Moderately Disturbed	25 (s1)	60 (s1)	830 (s1)	ID	60-110% (s2)	7.0-7.6 (s1)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
SOUTHERN CONDAMINE –	**No Flow Separations Applied**									

Water type	Management intent/ level of protection	**Table 28: CONDAMINE RIVER BASIN SURFACE WATERS– accreditable water quality target values** **Notes:** **1.** Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated. **2.** ID: Insufficient data to develop a target value. **3.** Sources: s1: Local Data; s2: Basin Plan Schedule 11 target value for B1 (Condamine and Warrego valleys; Upland zone)—Other water-dependent ecosystems.								
		Turbidity (NTU) (Annual median)	**Total Phosphorus** (µg/L) (Annual median)	**Total Nitrogen** (µg/L) (Annual median)	**Dissolved Oxygen** (Annual median within the range)		**pH** (Annual median within the range)	**Salinity** (End-of-valley targets) (Median)	**Temperature** (Monthly median within the range)	**Pesticides, heavy metals and other toxic contaminants**
					mg/L	% sat.				
LESLIE DAM	Moderately Disturbed	4 (s1)	40 (s1)	590 (s1)	ID	60-110% (s2)	7.3-8.1 (s1)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
UPPER CONDAMINE catchment waters	**Low flow**									
	Moderately Disturbed	7 (s1)	75 (s1)	400 (s1)	ID	60-110% (s2)	7.5-8.0 (s1)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High flow									
	Moderately Disturbed	50 (s1)	210 (s1)	1050 (s1)	ID	60-110% (s2)	7.1-7.7 (s1)	Not applicable	Between the 20th and 80th percentiles of natural monthly water temperature. (s2)	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.

Table 29: Additional water quality target values for Moderately Disturbed surface waters of the Condamine River basins under low and high flow conditions[23]. Refer to Figure 29 for the map of water types.

Water type	Management intent/ level of protection	Table 29: CONDAMINE RIVER BASIN SURFACE WATERS– additional water quality target values **Notes:** **1.** Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated. **2.** ID: Insufficient data to develop a target value. **3.** Sources: s1: Local Data.							
		Electrical Conductivity (µS/cm)	**Total Suspended Solids (mg/L)**	**Alkalinity (mg/L as $CaCO_3$)**	**Oxidised N (µg-N/L)**	**Ammonium N (µg-N/L)**	**Filterable Reactive P (µg-P/L)**	**Sulphate as SO_4 (mg/L)**	**Chlorophyll-a (µg/L)**
CENTRAL CONDAMINE catchment waters	Moderately Disturbed	**Low flow**							
		890 (s1)	25 (s1)	350 (s1)	4 (s1)	4 (s1)	20 (s1)	5 (s1)	9 (s1)
		High flow							
		290 (s1)	130 (s1)	100 (s1)	480 (s1)	ID	500 (s1)	4 (s1)	4 (s1)
EMU CREEK catchment waters	Moderately Disturbed	**Low flow**							
		470 (s1)	9 (s1)	140 (s1)	35 (s1)	5 (s1)	25 (s1)	5 (s1)	ID

[23] While not accreditable under the Basin Plan, water quality target values in Table 29 are recognised to support the accreditable water quality target values in Table 28 to protect and restore fresh water-dependent ecosystems.

Water type	Management intent/ level of protection	**Table 29: CONDAMINE RIVER BASIN SURFACE WATERS– additional water quality target values** **Notes:** **1.** Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated. **2.** ID: Insufficient data to develop a target value. **3.** Sources: s1: Local Data.							
		Electrical Conductivity (µS/cm)	**Total Suspended Solids (mg/L)**	**Alkalinity (mg/L as $CaCO_3$)**	**Oxidised N (µg-N/L)**	**Ammonium N (µg-N/L)**	**Filterable Reactive P (µg-P/L)**	**Sulphate as SO_4 (mg/L)**	**Chlorophyll-a (µg/L)**
		High flow							
		180 (s1)	10 (s1)	60 (s1)	ID	ID	ID	2 (s1)	ID
KUMBARILLA RIDGE catchment waters	Moderately Disturbed	**Low flow**							
		170 (s1)	ID	35 (s1)	4 (s1)	4 (s1)	20 (s1)	3 (s1)	9 (s1)
		High flow							
		ID	ID	ID	ID	ID	ID	ID	ID
LOWER CONDAMINE catchment waters	Moderately Disturbed	**Low flow**							
		360 (s1)	25 (s1)	100 (s1)	4 (s1)	8 (s1)	80 (s1)	5 (s1)	14 (s1)
		High flow							
		180 (s1)	390 (s1)	70 (s1)	370 (s1)	25 (s1)	210 (s1)	3 (s1)	6 (s1)
MIDDLE CONDAMINE catchment waters	Moderately Disturbed	**Low flow**							
		320 (s1)	20 (s1)	95 (s1)	3 (s1)	6 (s1)	50 (s1)	4 (s1)	10 (s1)

Water type	Management intent/ level of protection	**Table 29: CONDAMINE RIVER BASIN SURFACE WATERS– additional water quality target values** **Notes:** **1.** Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated. **2.** ID: Insufficient data to develop a target value. **3.** Sources: s1: Local Data.							
		Electrical Conductivity (µS/cm)	**Total Suspended Solids (mg/L)**	**Alkalinity (mg/L as $CaCO_3$)**	**Oxidised N (µg-N/L)**	**Ammonium N (µg-N/L)**	**Filterable Reactive P (µg-P/L)**	**Sulphate as SO_4 (mg/L)**	**Chlorophyll-a (µg/L)**
		High flow							
		240 (s1)	140 (s1)	75 (s1)	120 (s1)	20 (s1)	180 (s1)	3 (s1)	7 (s1)
NORTH WESTERN catchment waters	Moderately Disturbed	**Low flow**							
		115 (s1)	30 (s1)	35 (s1)	2 (s1)	9 (s1)	20 (s1)	2 (s1)	17 (s1)
		High flow							
		75 (s1)	ID	ID	ID	ID	ID	ID	ID
OAKEY CREEK catchment waters	Moderately Disturbed	**Low flow**							
		510 (s1)	14 (s1)	125 (s1)	5 (s1)	10 (s1)	45 (s1)	7 (s1)	5 (s1)
		High flow							
		380 (s1)	65 (s1)	85 (s1)	ID	ID	90 (s1)	7 (s1)	ID

Water type	Management intent/ level of protection	**Table 29: CONDAMINE RIVER BASIN SURFACE WATERS– additional water quality target values** **Notes:** **1.** Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated. **2.** ID: Insufficient data to develop a target value. **3.** Sources: s1: Local Data.							
		Electrical Conductivity (µS/cm)	**Total Suspended Solids (mg/L)**	**Alkalinity (mg/L as $CaCO_3$)**	**Oxidised N (µg-N/L)**	**Ammonium N (µg-N/L)**	**Filterable Reactive P (µg-P/L)**	**Sulphate as SO_4 (mg/L)**	**Chlorophyll-a (µg/L)**
SOUTH EASTERN catchment waters	Moderately Disturbed	**Low flow**							
		440 (s1)	10 (s1)	185 (s1)	4 (s1)	4 (s1)	50 (s1)	2 (s1)	5 (s1)
		High flow							
		190 (s1)	18 (s1)	70 (s1)	80 (s1)	13 (s1)	90 (s1)	2 (s1)	ID
SOUTHERN CONDAMINE catchment waters	Moderately Disturbed	**Low flow**							
		170 (s1)	8 (s1)	45 (s1)	3 (s1)	6 (s1)	15 (s1)	3 (s1)	5 (s1)
		High flow							
		160 (s1)	17 (s1)	35 (s1)	ID	ID	20 (s1)	2 (s1)	ID
SOUTHERN CONDAMINE – LESLIE DAM	Moderately Disturbed	**No Flow Separation Applied**							
		320 (s1)	8 (s1)	50 (s1)	120 (s1)	20 (s1)	7 (s1)	5 (s1)	6 (s1)

Water type	Management intent/ level of protection	**Table 29: CONDAMINE RIVER BASIN SURFACE WATERS– additional water quality target values** **Notes:** **1.** Water quality targets for indicators are shown as single values to be achieved by annual median of test data, unless otherwise indicated. **2.** ID: Insufficient data to develop a target value. **3.** Sources: s1: Local Data.							
		Electrical Conductivity (µS/cm)	**Total Suspended Solids (mg/L)**	**Alkalinity (mg/L as $CaCO_3$)**	**Oxidised N (µg-N/L)**	**Ammonium N (µg-N/L)**	**Filterable Reactive P (µg-P/L)**	**Sulphate as SO_4 (mg/L)**	**Chlorophyll-a (µg/L)**
UPPER CONDAMINE catchment waters	Moderately Disturbed	**Low flow**							
		275 (s1)	10 s1)	75 (s1)	18 (s1)	8 (s1)	35 (s1)	3 (s1)	6 (s1)
		High flow							
		170 (s1)	50 (s1)	50 (s1)	140 (s1)	16 (s1)	80 (s1)	3 (s1)	5 (s1)

10.2.2 Water quality targets for declared Ramsar wetlands

As a Ramsar Convention signatory, Australia is expected to describe and maintain the ecological character of each of its current 65 Ramsar sites. An ecological character description (ECD) is a rigorously prepared assessment of the ecosystem components, processes and benefits/services of a site. The trigger levels contained in the ECD provide the benchmark against which ecological changes at the site are assessed for significance.

Section 10.32 (2)(a) of the Basin Plan requires a WQM Plan to identify water quality targets for fresh water-dependent ecosystems that are declared Ramsar wetlands.

The Condamine River basin does not currently contain any declared Ramsar wetlands. If, following publication of this document, sites within the Condamine River basin are declared as Ramsar wetlands, locally relevant water quality target values for low and high flow conditions should be developed for these sites to ensure no deterioration of the water quality range occurs over time.

10.2.3 Water quality targets for lakes other than declared Ramsar wetlands

Lakes in dryland regions are diverse in their natural water conditions and biology. Local investigations of the natural range of water quality in all stages of inundation and drying are necessary to develop local water quality target values.

To protect the aquatic ecosystem values of lakes, they should be protected against threats of secondary salinity, sedimentation and disrupted hydrologic regime. Thus, there should be no change from historic hydrologic regime (i.e. no change in flow frequency, intensity required to inundate the lake), and loads of salt and sediments from upstream catchments should be managed in accordance with the management intent for the waters (Refer to section 6.4) and consistent with the Basin Salinity Management Strategy 2030.

As additional data becomes available, it is recommended that water quality targets are developed for lakes throughout the Condamine River basin.

10.2.4 Water quality targets for Slightly Disturbed waters

The water quality target values for pesticides, heavy metals and other toxic contaminants for Slightly Disturbed waters in the Condamine River basin are that the values in ANZECC Guidelines (as updated), for the protection of 99% of species must not be exceeded.

The water quality target values for Slightly Disturbed waters in the Condamine River basin for all other indicators are as follows:

1. if the measures for indicators achieve the water quality target values for High Ecological Value waters (section 10.2.5) in the Condamine River basin, maintain the water quality to this standard (i.e. maintain the 20th, 50th and 80th percentile values for each indicator); and
2. if the measures for indicators do not achieve the water quality target values for High Ecological Value waters (section 10.2.5) in the Condamine River basin, progressively improve the water quality at the site towards achieving the High Ecological Value water quality target values for each indicator.

Refer to section 6.4 for a description of the management intent under the EPP Water for Slightly Disturbed waters in the Condamine River basin.

The Slightly Disturbed waters are mapped at Figure 25.

10.2.5 Water quality targets for High Ecological Value waters

The water quality targets for pesticides, heavy metals and other toxic contaminants for High Ecological Value waters is that the values in ANZECC Guidelines (as updated), for the protection of 99% of species must not be exceeded.

The water quality target for High Ecological Value waters in the Condamine River basin for all other indicators is to maintain the existing water quality distribution (i.e. maintain the 20th, 50th and 80th percentile values for each indicator). Refer to the Queensland Water Quality Guidelines 2009 (section 4) for appropriate procedures to derive sub-regional water quality guidelines.

Refer to section 6.4 for a description of the management intent under the EPP Water for High Ecological Value waters in the Condamine River basin. The High Ecological Value waters are mapped at Figure 25

10.2.5.1 Persistent waterholes

Persistent waterholes, as mapped at Figure 25 and listed at Appendix 4— Persistent Waterholes in the Condamine River basin, are important for their outstanding natural values in dryland river systems. In dryland regions, many rivers stop flowing for extended periods of time and become disconnected waterholes and wetlands. The waterholes are critical refugia for aquatic organisms, such as fish, turtles and invertebrates. Persistent waterholes also support birds, plants, other reptiles and amphibians.

Due to the variable nature of rainfall in the Queensland Murray-Darling Basin, the refugial waterholes along the river systems in the region represent the only permanent aquatic habitat during extended periods of low or no flow and are critical components of a functioning 'source and sink' system for aquatic organisms in semi-arid landscapes.

Waterholes experience variable patterns of connection and disconnection. This is a fundamental driver of ecological processes in dryland riverine environments, vital for dispersal and survival of diverse populations of biota. Waterholes require careful management, both individually and as an integrated system of waterholes along the length of rivers and channels.

Waterhole persistence is associated with active channel-forming processes (to provide deep waterhole habitat for biota) and bankfull discharge[24]. In-channel flows, or flow pulses, are important for connecting waterholes and improving water quality (Sheldon, 2010). As a result, the water quality of waterholes in the Queensland Murray-Darling Basin will be largely influenced by the strategies for water resource development implemented through water planning instruments. It is recommended water resource development maintains the hydrological variability of waterholes and prevents extreme levels of water abstraction (Sheldon, 2010).

As the permanent waterholes mapped in Figure 25 are classified as High Ecological Value waters, refer to Section 10.2.5 for the water quality target values that apply. Additionally:

1. riparian vegetation surrounding identified waterholes should be maintained or, as necessary over time, restored; and
2. disturbance to beds and banks of waterholes should be minimised where possible to reduce sedimentation through offstream watering of stock.

[24] Bankfull discharge is the point at which water overflows onto a floodplain.

10.2.6 Water quality targets to protect groundwater aquatic ecosystem environmental values

Section 10.35B (2)(a) specifies that a WQM Plan must identify water quality target values for groundwater fresh-water dependent ecosystems in the plan area.

The water quality parameters shown in Schedule 11 of Basin Plan are not applicable to groundwater as the majority of the parameters listed are not appropriate in gauging groundwater quality. Further, the target application zones shown in Schedule 11 do not allow for the complexities of groundwater aquifer systems and accompanying water quality variability to be represented. Thus, alternative water quality target values for accreditation under section 10.35B (3) of the Basin Plan have been developed for groundwater of the Condamine River basin.

The water quality target values for accreditation under section 10.35B (2)(a) of the Basin Plan for groundwater are:

Fresh water-dependent ecosystems (other than Declared Ramsar wetlands)

- **Section 10.2.6: Water quality targets to protect aquatic ecosystem environmental values for groundwater aquifer zones in the Condamine River basin specified in Table 31, Table 32, Table 33 and Table 38.**

The groundwater aquifer zones are displayed in Figure 17 to Figure 24.

While not accredited under the Basin Plan, the water quality target values in Table 34 to Table 37, which were developed under the Queensland legislative water quality framework (see Appendix 1), are recognised to support the accredited water quality target values to protect and restore water-dependent ecosystems.

This section lists the water quality targets for various groundwater types to protect the aquatic ecosystem environmental values stated for the groundwaters of the Condamine River basin (Refer to Section 5).

Water quality targets for groundwaters of QMDB have been determined following the identification of aquifer types, which are based on the clustering of zones of similar water chemistry (McNeil, Raymond, Bennett, & McGregor, 2017). Sub-aquifer chemistry zones were further defined within each aquifer to allow development of water quality targets that are representative of local groundwater conditions. Following the derivation of sub-aquifer chemistry zones, the groundwater quality data was used to calculate a range of percentiles for several water quality parameters including, major ions, pH and electrical conductivity. The percentiles are used to form the water quality targets which are based on over 7700 sub-artesian and 4200 artesian water quality samples collected from 6600 bores within QMDB since the mid-1960s. For a full description of the methods used to develop the groundwater water quality targets for QMDB, refer to Regional groundwater chemistry zones: Queensland Murray-Darling Basin, 2017.

The water quality targets for the groundwaters of Condamine River basin are displayed in Table 31 to Table 38. It is important to note that the spatial extent of groundwater aquifer zones are not restricted to the spatial extent of surface water basins. Where groundwaters interact with surface waters, groundwater quality should not compromise identified environmental values and water quality targets for those waters. The ANZECC Guidelines (as updated) recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value. Thus, the management intent for groundwater is to maintain the existing water quality distribution (20th, 50th and 80th percentiles). Moreover, the ANZECC Guidelines (as updated) trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded. The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

10.2.6.1 Groundwater aquifer zones in the Condamine River basin

The groundwater aquifer zones in the Condamine River basin and the groundwater chemistry zones within each aquifer are shown in Figure 17 to Figure 24. The groundwater chemistry zones listed below are arranged under eight aquifer types (McNeil, Raymond, Bennett, & McGregor, 2017):

Aquifer Zone	Sub-aquifer chemistry zone
s1. Alluvial Zones	Southern Condamine Central Condamine North Branch Hodgson Oakey Myall Northwest Condamine Lower Condamine Wooloowins
s2. Fractured Rock	Upper Condamine basalts Toowoomba region basalts Lower Condamine basalts Border Rivers Headwaters New England region basalts
s3. Sediments above the GAB	Weathered alluvium Tertiary sediments
s4. Upper GAB	Probable Upper Cretaceous
s6. Mid GAB aquifers	Southeast Kumbarilla Eastern Cretaceous Outcrop
s7. Lower GAB	Eastern Springbok Outcrop Southeastern Hutton Outcrop Fresh Hutton Southeastern Outcrop South East Walloons Northwestern Hutton Outcrop North East Walloons Saline Southeastern Hutton Outcrop Central Surat Springbok Area
s8. Basal GAB	Southeastern Evergreen Eastern Central Area Northeastern Evergreen Outcrop
s9. Earlier Basins Partially Underlying the GAB the GAB	Bowen Basin

The Groundwater Aquifer Zones that intersect the Groundwater Sustainable Diversion Limit resource units identified under the Basin Plan are identified in Table 30.

Table 30: The groundwater aquifer zones in the Condamine River basin that intersect the Groundwater Sustainable Diversion Limit resource units under the Basin Plan (refer to Figure 9).

	Groundwater Aquifer zones							
Groundwater SDL resource unit	**s1— Alluvial zones**	**s2—Fractured Rock zones**	**s3—Sediments Overlying the GAB zones**	**s4—Upper GAB zones**	**s6—Mid GAB Aquifer zones**	**s7—Lower GAB zones**	**s8—Basal GAB zones**	**s9— Earlier Basins Partially Underlying the GAB the GAB**
Condamine Fractured Rock (GS53)		✓				✓		
Queensland Murray-Darling Basin: deep (GS56)	✓		✓	✓	✓	✓	✓	✓
Upper Condamine Alluvium (Central Condamine Alluvium) (GS64a)	✓		✓	✓	✓	✓	✓	
Upper Condamine Alluvium (Tributaries) (GS64b)	✓		✓	✓	✓	✓	✓	
Upper Condamine Basalts (GS65)		✓	✓	✓		✓	✓	

Table 31: Water quality targets to protect the aquatic ecosystem environmental value for Alluvial groundwater aquifer zones in the Condamine River basin (refer to Figure 17).

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S1.Alluvial																												
1 - Southern Condamine	20th	44	22	36	17	27	27	281	49	56	18	0.5	0	0.00	0	680	217	7.5	245.0	28.0	0.10	0.005	0.000	0.005	0.010	1.00	0.000	0.000
	50th	78	33	55	27	49	36	428	69	103	29	4.7	1	1.00	0	990	350	7.9	365.0	36.0	0.20	0.010	0.010	0.005	0.015	1.80	0.207	0.033
	80th	156	51	84	36	80	47	592	81	245	47	15.0	2	8.50	1	1480	522	8.2	500.0	44.0	0.25	0.050	0.293	0.010	0.015	3.80	1.804	0.225
1 - Southern Condamine near stream	20th	43	21	38	17	28	27	291	50	54	17	0.5	0	0.00	0	689	228	7.5	254.0	28.0	0.10	0.005	0.000	0.005	0.010	1.00	0.000	0.000
	50th	75	32	56	28	50	36	433	71	97	28	4.2	1	0.90	0	981	353	7.9	373.0	36.0	0.20	0.010	0.010	0.005	0.015	1.70	0.196	0.033
	80th	150	49	84	36	77	47	589	82	225	46	13.0	2	8.00	1	1400	508	8.2	499.0	44.0	0.24	0.040	0.309	0.011	0.015	3.60	1.739	0.229
2 - Central Condamine	20th	85	54	19	7	13	12	239	24	70	28	5.0	1	0.20	0	603	110	7.4	200.0	27.0	0.10	0.005	0.005	0.005	0.015	3.20	0.043	0.000
	50th	213	71	34	12	24	16	382	54	170	40	22.0	4	0.50	0	1160	183	7.9	321.0	33.0	0.16	0.010	0.010	0.005	0.015	7.30	0.109	0.033
	80th	535	80	61	23	54	25	465	69	739	72	84.7	7	2.00	0	2800	364	8.3	390.0	40.0	0.30	0.050	0.050	0.010	0.015	12.80	0.435	0.154
2 - Central Condamine near stream	20th	63	42	18	8	14	13	210	42	64	27	4.2	1	0.25	0	580	107	7.3	173.9	24.0	0.10	0.005	0.005	0.005	0.015	2.10	0.053	0.000
	50th	134	64	32	16	23	20	352	61	120	37	12.5	3	0.50	0	890	179	7.9	291.0	32.0	0.15	0.010	0.010	0.005	0.015	4.50	0.109	0.033
	80th	316	78	50	28	36	29	445	71	285	57	58.0	7	2.50	0	1675	264	8.3	375.0	38.0	0.30	0.103	0.150	0.010	0.015	10.15	0.543	0.163
3 - North Branch	20th	83	46	27	15	17	17	280	59	54	20	4.0	1	0.00	0	660	146	7.5	240.0	28.0	0.10	0.005	0.005	0.005	0.015	2.50	0.000	0.000
	50th	105	55	37	21	26	23	380	71	80	26	9.6	2	0.50	0	805	203	7.9	320.0	36.0	0.10	0.010	0.010	0.005	0.015	3.30	0.109	0.033
	80th	158	66	52	28	34	28	451	77	136	38	26.0	5	1.00	0	1050	256	8.3	376.0	40.0	0.20	0.030	0.010	0.010	0.015	4.90	0.217	0.098
3 - North Branch near stream	20th	66	40	26	18	15	17	235	60	51	21	2.2	1	0.00	0	603	134	7.5	201.5	27.0	0.10	0.005	0.004	0.001	0.010	2.10	0.020	0.000
	50th	92	53	36	24	20	22	332	72	70	27	5.6	2	0.50	0	720	175	7.9	277.0	34.0	0.10	0.010	0.010	0.005	0.015	3.00	0.109	0.098
	80th	123	63	64	32	33	28	432	78	119	39	12.0	3	1.20	0	987	264	8.2	364.0	40.0	0.25	0.030	0.010	0.005	0.015	4.00	0.241	0.154
4 - Hodgson	20th	381	65	31	5	47	15	353	9	400	47	65.8	6	0.50	0	1927	295	7.4	307.2	20.0	0.15	0.005	0.005	0.005	0.015	8.10	0.109	0.000
	50th	617	73	59	8	83	20	458	25	818	66	198.5	9	1.80	0	3575	479	7.8	392.5	27.5	0.20	0.010	0.010	0.005	0.015	13.10	0.391	0.000
	80th	1176	79	107	11	181	24	567	41	1890	80	440.7	15	5.00	0	7049	918	8.3	518.6	32.1	0.50	0.050	0.050	0.020	0.035	18.60	1.087	0.065
5 - Oakey	20th	313	71	23	5	31	11	358	15	279	41	33.5	3	0.50	0	1800	198	7.6	300.5	24.0	0.10	0.005	0.000	0.005	0.015	9.31	0.109	0.000
	50th	490	77	38	7	50	16	450	28	631	65	86.0	6	1.25	0	2750	304	8.0	375.0	29.0	0.20	0.010	0.010	0.005	0.015	12.90	0.304	0.000

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S1.Alluvial																												
	80th	782	83	79	9	96	20	600	52	1201	79	165.0	9	3.97	0	4400	586	8.4	515.5	35.0	0.40	0.050	0.020	0.005	0.015	16.49	1.017	0.033
5 - Oakey near stream	20th	228	68	19	5	22	10	360	23	217	46	20.6	2	0.06	0	1150	149	7.5	298.6	25.1	0.10	0.000	0.000	0.002	0.015	7.57	0.013	0.000
	50th	380	76	37	8	49	16	455	31	550	61	74.5	7	1.33	0	2378	301	8.0	379.5	32.0	0.20	0.010	0.005	0.005	0.015	10.87	0.288	0.016
	80th	620	84	59	14	68	20	511	46	757	71	143.7	10	3.00	0	3410	394	8.3	443.0	37.0	0.30	0.067	0.020	0.005	0.015	15.42	0.652	0.033
6 - Myall	20th	265	67	30	6	34	11	382	23	305	49	15.7	2	0.23	0	1629	215	7.5	330.0	24.0	0.10	0.000	0.005	ID	ID	7.28	0.109	ID
	50th	359	72	44	10	45	18	454	35	472	62	42.8	4	0.60	0	2150	294	8.0	382.0	28.0	0.20	0.020	0.020	ID	ID	9.40	0.207	ID
	80th	593	81	63	13	66	22	560	47	791	72	73.4	6	4.00	0	3150	427	8.4	468.3	32.0	0.40	0.031	0.070	ID	ID	14.32	0.957	ID
6 - Myall near stream	20th	403	72	31	5	34	10	352	19	407	55	39.3	3	0.00	0	1970	213	7.5	318.2	22.3	0.18	0.000	0.000	ID	ID	10.94	0.083	ID
	50th	570	79	41	8	45	13	459	24	784	71	60.0	5	0.50	0	3080	269	8.0	385.0	27.8	0.30	0.020	0.020	ID	ID	13.70	0.109	ID
	80th	814	84	74	11	87	17	619	44	1213	75	117.1	6	3.41	0	3995	527	8.5	555.2	32.7	0.40	0.033	0.070	ID	ID	16.58	0.865	ID
7 - Northwest Condamine	20th	489	65	34	5	35	11	332	8	577	60	36.5	2	0.10	0	2400	274	7.4	309.1	25.0	0.20	0.005	0.009	0.005	0.015	9.90	0.020	0.000
	50th	830	76	82	9	92	16	462	15	1380	80	120.0	5	1.30	0	4740	582	7.8	394.5	37.0	0.40	0.020	0.050	0.010	0.030	15.30	0.283	0.000
	80th	1549	81	180	17	208	21	575	33	3079	88	180.5	7	5.00	0	9200	1260	8.2	487.7	49.0	0.60	0.070	0.243	0.025	0.075	19.99	1.176	0.033
7 - Northwest Condamine near stream	20th	258	53	20	5	19	10	255	6	195	43	8.0	1	0.48	0	1380	135	7.3	221.0	18.6	0.23	ID	ID	ID	ID	5.03	0.103	ID
	50th	544	77	42	8	41	16	477	24	680	71	19.5	2	5.55	0	2600	321	7.9	405.0	26.0	0.53	ID	ID	ID	ID	11.94	1.207	ID
	80th	1795	84	145	22	196	27	554	55	3432	90	216.3	4	11.20	1	11050	1093	8.3	509.0	49.6	0.83	ID	ID	ID	ID	22.95	2.435	ID
8 - Lower Condamine	20th	110	65	9	3	10	8	152	7	96	45	9.9	2	0.10	0	625	65	7.3	133.0	13.0	0.15	0.005	0.000	ID	ID	4.70	0.028	ID
	50th	586	79	40	7	37	14	330	17	608	77	54.5	5	0.50	0	2700	256	7.8	276.0	33.0	0.30	0.100	0.040	ID	ID	18.10	0.109	ID
	80th	1889	87	130	14	164	21	616	44	2930	87	220.5	8	4.01	0	9910	997	8.2	511.5	57.3	0.80	0.630	0.295	ID	ID	28.70	0.274	ID
8 - Lower Condamine near stream	20th	74	61	10	4	10	8	136	5	77	45	13.7	3	0.11	0	563	77	7.2	116.0	13.0	0.10	0.019	0.000	ID	ID	4.00	0.020	ID
	50th	320	74	38	8	31	16	307	18	450	73	58.5	5	0.50	0	1950	230	7.8	256.5	30.0	0.30	0.100	0.053	ID	ID	13.25	0.087	ID
	80th	1926	86	128	16	185	22	464	47	3300	88	228.7	9	4.46	1	10440	1094	8.1	398.0	61.0	0.70	0.960	0.295	ID	ID	28.12	0.191	ID
9 - Wooloowins	20th	134	38	37	10	43	19	275	20	255	49	6.6	1	0.50	0	1400	297	7.5	238.8	28.0	0.19	0.005	0.000	0.005	0.010	2.80	0.109	0.000
	50th	250	51	72	17	76	30	405	33	470	64	14.0	1	2.20	0	2047	495	7.9	340.0	36.0	0.27	0.020	0.010	0.005	0.015	5.00	0.478	0.000
	80th	413	68	125	26	120	38	574	48	881	77	39.0	3	6.60	1	3000	780	8.2	481.0	44.0	0.40	0.050	0.020	0.013	0.015	8.55	1.174	0.033

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S1.Alluvial																												
9 - Wooloowins near stream	20th	155	38	37	9	51	23	240	17	299	53	7.8	1	0.50	0	1350	328	7.6	203.0	28.0	0.18	0.003	0.000	0.005	0.015	3.00	0.109	0.000
	50th	262	48	82	18	99	32	391	27	600	70	15.0	1	2.30	0	2270	634	7.9	326.5	36.0	0.25	0.020	0.010	0.005	0.015	4.80	0.500	0.000
	80th	399	65	146	27	145	37	570	44	1023	81	33.0	3	6.60	0	3456	921	8.2	475.7	43.0	0.40	0.070	0.020	0.010	0.015	7.80	1.304	0.033

Table 32: Water quality targets to protect the aquatic ecosystem environmental value for Fractured Rock groundwater aquifer zones in the Condamine River basin (refer to Figure 18).

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S2. Fractured Rock																												
1 - Upper Condamine Basalts	20th	50	18	22	10	21	21	317	57	49	16	0.0	0	0.00	0	687	151	7.6	263.5	23.0	0.10	0.000	0.000	0.005	0.000	1.00	0.000	0.000
	50th	76	27	47	20	70	48	513	71	99	26	3.3	1	3.55	0	1040	417	7.9	426.0	35.0	0.20	0.020	0.010	0.020	0.010	1.50	0.543	0.000
	80th	114	62	72	28	115	60	651	82	205	40	9.6	2	25.00	3	1493	635	8.3	540.0	45.1	0.30	0.100	0.010	0.065	0.035	4.76	5.000	0.087
2 - Toowoomba Region Basalts	20th	66	22	16	10	7	8	180	32	88	32	3.4	1	0.50	0	660	85	7.5	150.0	20.0	0.10	0.000	0.000	0.005	0.010	1.30	0.087	0.000
	50th	97	35	52	21	59	40	350	49	184	47	10.0	2	5.00	1	1200	390	7.9	291.0	34.0	0.20	0.020	0.010	0.005	0.015	2.20	1.054	0.000
	80th	147	79	100	29	116	53	530	64	356	63	22.0	4	33.00	4	1750	708	8.2	443.0	47.0	0.30	0.050	0.020	0.025	0.015	6.20	7.391	0.000
3 - Lower Condamine Basalts	20th	92	34	18	9	14	11	257	30	100	30	6.0	1	0.10	0	790	114	7.6	220.0	30.0	0.20	0.000	0.000	0.000	0.000	2.10	0.000	0.000
	50th	158	49	55	19	56	30	445	49	220	47	14.4	2	1.00	0	1400	380	7.9	376.0	48.0	0.30	0.010	0.010	0.003	0.018	3.80	0.130	0.000
	80th	308	79	105	28	102	42	592	66	596	67	35.6	5	16.90	1	2568	643	8.3	494.5	60.0	0.50	0.050	0.020	0.040	0.030	8.19	3.793	0.000
6 - Border Rivers Headwaters	20th	75	42	17	9	13	16	164	19	92	42	9.1	2	0.00	0	648	104	7.0	138.8	20.1	0.20	0.000	0.000	0.007	0.003	2.60	0.000	ID
	50th	189	57	67	20	45	22	351	37	305	56	36.0	6	1.00	0	1550	366	7.7	294.5	30.0	0.33	0.010	0.020	0.039	0.015	4.40	0.109	ID
	80th	437	70	127	27	115	30	602	51	1033	72	145.2	11	9.10	1	4212	772	8.2	497.1	39.9	0.59	0.093	0.086	0.097	0.019	7.84	0.652	ID
8 - New England Granite	20th	32	44	6	10	3	9	20	5	30	34	3.2	1	0.21	0	273	45	6.6	16.0	33.9	0.20	0.003	0.010	0.030	0.010	1.80	0.034	ID
	50th	65	64	23	18	9	14	74	37	78	51	12.0	4	1.00	0	600	106	7.1	60.5	52.0	1.36	0.010	0.110	0.925	0.015	3.10	0.217	ID
	80th	173	78	48	39	25	21	175	53	321	85	25.4	11	13.30	4	1225	244	7.7	146.0	65.7	3.00	0.125	0.663	2.583	0.043	6.12	4.489	ID

Table 33: Water quality targets to protect the aquatic ecosystem environmental value for sediments overlying the GAB groundwater aquifer zones in the Condamine River basin (refer to Figure 19).

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S3. Sediments overlying GAB																												
1 - Weathered Alluvium	20th	168	67	13	5	8	7	73	1	144	47	36.3	6	0.00	0	624	71	7.0	78.6	45.0	0.13	0.000	0.000	0.008	0.000	8.10	0.000	0.000
	50th	666	76	82	10	73	13	197	10	982	77	281.7	12	2.40	0	2690	569	7.6	199.7	57.0	0.40	0.000	0.010	0.050	0.015	19.45	0.011	0.000
	80th	4418	87	592	15	550	19	384	40	8590	86	1600.0	16	12.50	0	22710	3706	7.9	333.3	80.0	0.80	0.120	0.184	0.190	0.035	30.10	2.717	0.000
1 - Weathered Alluvium near stream	20th	104	63	7	4	4	2	156	5	75	33	15.1	5	0.00	0	525	27	7.2	134.6	18.3	0.15	0.000	0.000	0.017	0.000	4.65	0.130	ID
	50th	289	74	24	10	10	13	256	49	180	40	76.0	11	2.40	0	1269	102	7.7	210.0	70.0	0.30	0.000	0.010	0.040	0.015	11.50	1.930	ID
	80th	1368	92	170	22	149	20	388	58	2398	83	504.5	15	7.20	1	6400	1000	8.3	321.0	86.0	0.52	0.044	0.043	0.210	0.017	28.32	0.000	ID
3 - Tertiary Sediments	20th	395	81	3	1	0	0	0	4	195	34	0.0	0	ID	ID	0	9	ID	136.1	ID	ID	ID	ID	ID	ID	ID	ID	ID
	50th	432	97	15	2	4	2	212	26	520	74	1.8	0	ID	ID	1575	58	ID	207.5	ID	ID	ID	ID	ID	ID	ID	ID	ID
	80th	3058	99	50	8	6	11	682	63	4712	96	34.9	5	ID	ID	2180	203	ID	609.0	ID	ID	ID	ID	ID	ID	ID	ID	ID

Table 34: Water quality targets to protect the aquatic ecosystem environmental value for Upper GAB groundwater aquifer zones in the Condamine River basin (refer to Figure 20).

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S4. Upper GAB																												
6 - Probable Upper Cretaceous Aquitard	20th	201	69	20	6	20	9	161	7	342	64	17.7	3	ID	ID	1260	130	7.8	135.7	ID	0.20	ID	ID	ID	ID	9.61	ID	ID
	50th	655	76	79	8	77	14	342	13	913	82	60.0	4	ID	ID	3150	520	8.0	300.0	ID	0.35	ID	ID	ID	ID	13.63	ID	ID
	80th	1559	83	149	12	195	23	547	32	3061	89	155.5	5	ID	ID	8900	1417	8.2	449.0	ID	0.50	ID	ID	ID	ID	19.76	ID	ID

Table 35: Water quality targets to protect the aquatic ecosystem environmental value for Mid GAB groundwater aquifer zones in the Condamine River basin (refer to Figure 21).

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S6. Mid GAB Aquifers																												
3 - Eastern Cretaceous Outcrop	20th	162	82	4	1	1	0	105	6	85	32	0.5	0	0.05	0	771	14	7.3	100.0	13.7	0.10	0.000	0.000	0.005	0.010	12.49	0.021	0.000
	50th	395	93	10	3	4	2	293	30	337	64	8.0	1	0.50	0	1650	47	8.0	263.0	17.0	0.39	0.070	0.010	0.010	0.015	28.30	0.109	0.000
	80th	1167	98	74	9	22	7	644	66	1780	89	95.1	6	1.89	0	3870	267	8.5	571.0	33.3	0.65	0.809	0.182	0.110	0.015	49.27	0.285	0.065
11- South-east Kumbarilla	20th	315	98	2	0	0	0	459	60	72	13	0.0	0	0.00	0	1173	6	8.0	506.0	13.0	0.55	0.005	0.000	0.000	0.000	38.10	0.000	0.000
	50th	417	99	3	1	1	0	720	80	120	19	2.0	0	0.50	0	1600	10	8.4	660.0	15.0	1.50	0.020	0.010	0.005	0.015	56.30	0.109	0.000
	80th	530	99	4	1	2	1	969	86	260	39	9.1	1	1.30	0	2050	19	8.6	864.6	19.0	3.20	0.130	0.010	0.017	0.015	71.65	0.283	0.033

Table 36: Water quality targets to protect the aquatic ecosystem environmental value for Lower GAB groundwater aquifer zones in the Condamine River basin (refer to Figure 22).

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S7. Lower GAB																												
1 - Central Surat Springbok Area (continues as Fitzroy River basin Zone 1)	20th	235	96	2	1	0	0	346	48	80	19	0.5	0	0.00	0	1042	6	7.9	316.7	14.0	0.40	0.000	0.000	0.000	0.003	27.76	0.000	0.000
	50th	319	99	3	1	1	0	540	71	125	26	10.0	2	0.50	0	1300	12	8.3	472.5	18.0	0.70	0.010	0.005	0.005	0.015	45.00	0.109	0.000
	80th	546	99	10	2	4	2	749	79	407	50	33.6	5	1.20	0	2100	40	8.6	661.0	28.1	1.80	0.165	0.015	0.010	0.020	64.00	0.261	0.000
2 - Eastern Springbok Outcrop	20th	243	79	5	1	2	1	198	7	183	41	0.7	0	0.00	0	963	19	7.5	194.3	13.0	0.19	0.005	0.000	0.005	0.001	14.75	0.000	0.000
	50th	677	91	20	3	11	4	345	26	737	70	8.0	1	0.70	0	2925	96	8.0	308.5	18.0	0.30	0.050	0.010	0.010	0.015	28.97	0.152	0.000
	80th	1830	98	89	10	83	12	838	58	2970	90	47.6	3	2.50	0	9021	612	8.4	795.2	52.1	1.75	0.891	0.097	0.049	0.030	56.49	0.543	0.016
3 - Fresh Hutton South-eastern Outcrop	20th	175	54	25	6	24	10	325	15	231	38	6.9	1	0.10	0	1400	185	7.7	275.4	16.0	0.16	0.000	0.000	ID	ID	4.61	0.022	0.000
	50th	361	65	59	14	57	22	504	40	412	57	24.8	2	1.50	0	2150	380	8.0	420.0	24.5	0.30	0.010	0.010	ID	ID	8.10	0.326	0.000
	80th	591	77	124	20	90	28	668	59	957	81	50.1	4	26.50	2	3790	676	8.3	568.0	37.0	0.47	0.059	0.051	ID	ID	13.39	5.761	0.029
4 - North East Walloons	20th	339	61	12	2	6	2	249	7	334	48	4.0	0	0.00	0	1650	58	7.5	230.0	12.0	0.20	0.005	0.005	0.005	0.010	9.05	0.000	0.000
	50th	750	82	53	8	41	9	390	20	968	76	35.8	2	1.00	0	3500	308	8.0	344.5	15.0	0.40	0.020	0.020	0.020	0.015	17.69	0.217	0.000
	80th	1554	96	155	18	134	21	615	47	2931	91	134.0	6	5.00	0	9015	864	8.4	539.5	27.9	0.80	0.100	0.087	0.043	0.033	48.99	1.087	0.033
5 – North-eastern Hutton Outcrop (continues as Fitzroy River basin Zone 5)	20th	421	76	7	1	1	0	64	8	468	67	0.0	0	0.00	0	2000	26	7.5	149.5	11.7	0.10	0.000	0.000	0.004	0.000	11.61	0.000	0.000
	50th	674	93	24	3	8	2	243	16	923	80	19.0	1	0.50	0	3050	119	7.9	236.0	15.0	0.30	0.020	0.025	0.020	0.010	35.63	0.109	0.000
	80th	1250	98	81	8	75	13	522	27	1882	91	85.1	5	3.19	0	5670	532	8.4	482.0	41.2	0.66	0.120	0.110	0.135	0.015	53.71	0.693	0.016
8 - Saline South-eastern Hutton Outcrop	20th	212	66	19	3	10	3	201	6	262	54	2.7	0	0.00	0	1308	100	7.4	168.3	13.0	0.20	0.000	0.000	0.010	0.000	6.50	0.000	0.000
	50th	564	79	54	9	33	12	379	24	760	73	27.0	2	0.50	0	2865	260	7.9	320.0	19.0	0.40	0.010	0.015	0.030	0.010	15.30	0.109	0.000
	80th	1475	92	138	18	123	19	629	41	2482	89	151.2	6	4.30	0	7068	706	8.2	520.9	39.0	0.90	0.235	0.108	0.170	0.024	28.67	1.413	0.023
9 - South East Walloons	20th	121	41	9	4	4	3	300	30	101	27	3.4	1	0.00	0	880	45	7.7	250.5	12.0	0.10	0.000	0.000	0.000	0.000	2.90	0.000	0.000
	50th	225	72	39	12	27	14	455	52	236	45	13.0	2	1.00	0	1500	222	8.0	390.0	17.0	0.27	0.010	0.010	0.010	0.010	8.10	0.217	0.000

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S7. Lower GAB																												
	80th	425	93	89	23	89	34	662	71	560	65	46.2	4	6.00	0	2550	566	8.4	562.0	29.5	0.50	0.060	0.020	0.148	0.025	17.89	1.324	0.033
10 – South-eastern Hutton Outcrop	20th	140	41	26	9	14	9	227	15	165	41	8.6	1	0.00	0	1111	142	7.4	190.0	13.0	0.10	0.000	0.000	0.000	0.000	3.14	0.000	0.000
	50th	260	58	65	17	48	23	410	34	380	62	20.0	2	0.70	0	1817	391	7.8	346.0	20.0	0.30	0.020	0.010	0.008	0.013	5.88	0.152	0.000
	80th	507	77	140	26	145	38	581	56	1053	81	53.7	4	3.66	0	3895	959	8.2	485.0	30.0	0.50	0.090	0.080	0.048	0.020	10.34	0.796	0.031

Table 37: Water quality targets to protect the aquatic ecosystem environmental value for Basal GAB groundwater aquifer zones in the Condamine River basin (refer to Figure 23).

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S8. Basal GAB																												
2 - Eastern Central Area (merged with Fitzroy River basin zone '5 Eastern Central Area')	20th	87	92	2	1	0	0	150	57	36	17	0.0	0	0.00	0	185	6	7.5	162.2	14.0	0.15	0.000	0.000	ID	ID	8.48	0.000	0.000
	50th	255	97	3	2	1	1	420	72	99	26	5.0	2	0.25	0	1040	11	8.2	347.0	19.0	0.53	0.008	0.010	ID	ID	27.56	0.054	0.000
	80th	342	99	8	5	5	4	674	82	165	37	29.6	5	1.00	0	1463	33	8.6	569.6	26.0	2.20	0.180	0.030	ID	ID	48.45	0.217	0.016
3 - Northeastern Evergreen	20th	175	77	6	1	1	1	126	8	130	28	0.5	0	0.00	0	1225	33	7.3	150.0	14.0	0.37	0.020	0.010	ID	ID	10.69	0.000	ID

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S8. Basal GAB																												
Outcrop (merged with Fitzroy River basin zone '2 South Eastern Evergreen Outcrop')	50th	629	91	17	4	7	2	377	34	542	66	8.4	1	0.80	0	2950	85	7.8	342.5	17.0	0.70	0.070	0.025	ID	ID	19.08	0.174	ID
	80th	1386	98	106	14	70	8	576	66	1499	89	28.0	3	3.00	0	5465	595	8.4	487.7	20.0	1.40	0.755	0.051	ID	ID	60.08	0.652	ID
4 - Southeastern Evergreen	20th	157	60	10	3	5	3	200	14	161	36	1.3	0	0.00	0	920	42	7.4	172.2	14.0	0.20	0.000	0.000	0.005	0.000	5.62	0.000	ID
	50th	380	76	40	11	29	13	452	34	480	62	21.0	3	0.50	0	2300	230	7.9	380.0	26.0	0.30	0.010	0.020	0.020	0.008	10.29	0.109	ID
	80th	724	94	123	17	89	23	605	62	964	82	70.2	5	3.00	0	3634	675	8.2	532.5	42.0	0.95	0.072	0.187	0.100	0.020	25.88	0.652	ID

Table 38: Water quality targets to protect the aquatic ecosystem environmental value for Earlier Basins Partially Underlying the GAB groundwater aquifer zones in the Condamine River basin (refer to Figure 24).

The ANZECC Guidelines (ANZECC/ARMCANZ, 2000) **recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.**

The management intent is to maintain the existing water quality distribution (20th, 50th and 80th percentiles).

ANZECC Guidelines (ANZECC/ARMCANZ, 2000) trigger values for freshwater for pesticides, heavy metals and other toxic contaminants that protect 99% of species must not be exceeded.

The target for temperature specified in Schedule 11 of the Basin Plan applies to all aquifer zones. The specified target is: monthly median temperature within the range between the 20%ile and 80%ile of natural monthly water temperature.

ID: Insufficient data

Zone	%ile	Na		Ca		Mg		HCO_3		Cl		SO_4		NO_3		EC	Hard	pH	Alk	SiO_2	F	Fe	Mn	Zn	Cu	SAR	TN	TP
		mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	mg/L	mg/L
S9. Earlier Basins Partially Underlying the GAB																												
1 - Bowen Basin (merged with Fitzroy River basin zone '8 Lower Bowen')	20th	51	96	2	0	0	0	113	56	14	9	0.0	0	0.00	0	218	5	7.4	105.0	13.0	0.20	0.000	0.000	0.005	0.001	89.57	0.000	0.000
	50th	440	99	2	1	1	0	685	78	109	19	0.0	0	0.00	0	1700	7	8.3	611.0	17.0	1.65	0.040	0.005	0.005	0.001	50.82	0.000	0.000
	80th	853	99	5	3	1	1	1217	90	316	42	2.9	1	0.50	0	3001	19	8.6	1080.9	22.0	5.46	0.150	0.010	0.010	0.015	109.14	0.109	0.000

Notes:

1. Abbreviations: Na: Sodium, Ca: Calcium, Mg: Magnesium, HCO_3: Bicarbonate, Cl: Chloride, SO_4: Sulfate, NO_3: Nitrate, EC: Electrical conductivity, Hard: hardness, Alk: alkalinity, SiO_2: Silica, F: Fluoride, Fe: Iron, Mn: Manganese, Zn: Zinc, Cu: Copper, SAR: Sodium adsorption ratio, TN: total nitrogen, TP: total phosphorus, mg/L: milligrams per Litre, µS/cm: microsiemens/centimetre

2. Percentiles are provided in most cells where samples are available for a particular indicator. The Queensland Water Quality Guidelines (section 4) contains information on recommended minimum sample size when deriving percentiles for use in deriving water quality guidelines. For this table, where less than 8 samples were available, cell shows insufficient data ('id'); where 8–20 samples were available, 50_{th} percentile values are provided (in bold). Where greater than 20 samples were available, the full percentile ranges are provided. The intent is to maintain current water quality (20_{th}, 50_{th} and 80_{th} percentile ranges) where water quality is in natural condition. Where there is evidence of anthropogenic disturbance in groundwater quality, a long term goal to improve water quality may be established and reflected by adoption of an alternative (e.g. 40_{th} percentile) value.

3. Na, Ca and other ion % columns: The percentages of major cations (Na, Ca and Mg) were evaluated for each sample, as were the major anions (Cl, HCO_3, SO_4 and NO_3). Then the ion % columns were compiled by calculating the percentiles of these percentages independently of each other. For instance, in Alluvium zone 1 – Southern Condamine, the 50th percentile of Na is 35, while the 20th–80th percentile range is 23–52. This means that half of the samples contain at least 35% of dissolved Na, with the balance being made up of Ca and Mg in any proportions. Because of this, the sum of the 50th percentiles in Alluvium zone 1 – Southern Condamine is near to 100%, with Ca contributing 27% and Mg contributing 35%. However, the 20th and 80th percentiles of each of the major cations are based on ranges of that cation, and add up to less or more than 100% respectively.

4. Low TP values (e.g. recordings of zero) may be due to concentrations below detection limits. Concentrations of TP are usually low in Queensland groundwaters, because most of the phosphorus binds to particles in the soil and unsaturated zone, restricting its movement to the aquifer (Holman et al. 2008).

5. Refer to accompanying figures (maps) for locations of chemistry zone. In some locations (mainly within the alluvial aquifer class) a chemistry zone is identified by entire zone and the 'near stream' (within 1.5km of stream channel) component of the zone, where near stream water quality characteristics may be different from overall zone. Percentiles are provided in each case. Overall zone includes near stream and other areas. Near stream zone is shown on large scale plans accompanying this report, available on the department's website.

10.2.7 Target for wetland extent

As identified in Section 2.2 of this report, the extent and distribution of freshwater wetlands is the most important indicator of the state of wetland resources in Queensland, as any loss will mean that the services provided by that wetland will be diminished.

Target 1: No reduction in the extent of natural wetlands (palustrine, lacustrine and riverine) from 2013 baseline levels.

The indicators are:

- Wetland area by system (2013): Whole of plan area
- Wetland area by system (2013): Water resource plan basins

Refer to Table 6 and Table 7 of this report for a description of these indicators.

10.2.8 Riparian targets and catchment ground cover

The following recommendations are aimed at NRM bodies, with specific focus on aquatic ecosystem health.

10.2.8.1 Riparian health

Riparian zones are recognised as an important component of riverine ecosystems. Healthy riparian zones contain varying proportions of both forest and ground cover vegetation. This vegetation helps to stabilize banks and reduce erosion, provides a filtering mechanism for catchment run-off, provides habitat for various aquatic related species and provides shading, which reduces temperature extremes in waterbodies. Maintaining healthy riparian zones is therefore important to overall ecosystem health. Due to these factors, riparian targets have been included in the HWMP for the Condamine River basins.

Details of ground cover mapping in the Queensland Murray Darling Basin can be found in the Riparian vegetation levels in the Queensland Murray-Darling Basin and Bulloo catchments for 2013 (Clark, Healy, & Tindall, 2015) and the Queensland Murray-Darling Basin Ground Cover 2015 reports (van den Berg, Trevithick, & Tindall, 2015). Mapping of riparian areas is done using satellite imagery with a pixel resolution of 30 m. For the purposes of these reports, the riparian area is defined as the area within 100 metres either side of a (mapped) stream or riverine wetland, and two forms of riparian area are considered—forested and non-forested. These are defined as follows:

Forested: Areas where tree crown cover is >~20%

Non-forested: Areas where tree crown cover is <~20%

In wetter coastal areas, riparian areas would naturally be 100% forested. However, in the drier western catchments considered in this document, extensive reaches of the riparian zones may be naturally non-forested.

See Riparian Vegetation Levels in the Queensland Murray-Darling Basin and Bulloo Catchment for 2013 (Clark, Healy, & Tindall, 2015) for further information.

10.2.8.2 Indicators for forested riparian areas

Indicator 1—Total forested riparian area: This is the total forested riparian area measured in each catchment in 2013. The target is that there should be no further net loss of the existing (2013) forested area.

Indicator 2—Normalised Patch Density (NPD): Establishes the number of riparian forest patches per kilometre of stream network and provides a measure of the linear connectivity of riparian forest along the stream network. This measure is normalised to account for the different proportion of each catchment's riparian area that is forested. A low NPD score is assigned to catchments with a highly connected riparian forest. Conversely, a high NPD score indicates there is lower connectivity between riparian forest patches in a catchment. The target is to have no increase from existing (2013) NPD scores.

Indicator 3—Patch Size and Connectivity Index (PSCI): The PSCI analyses the size of riparian forest patches and the distance between them. As vegetation extent is increased, the PSCI value will also increase. This indicates that riparian forest patches have become larger and more connected at the landscape scale. Alternatively, as patches either become smaller or the distance between them increases, the PSCI value will decrease. This indicates a loss of connectivity at the landscape scale. A value of 100 indicates fully connected riparian forests while a value of 0 indicates no connectivity. The target is to have no decline in existing (2013) PSCI scores.

10.2.8.3 Indicators for non-forested riparian areas

In the non-forested areas, satellite imagery is able to assess the density of ground cover vegetation (grasses, small shrubs, general plant litter). The standardised method is to assess three categories of ground cover density:

- >70% ground cover
- 30 to 70% ground cover
- <30% ground cover

Non-forested riparian areas are classified in good condition if ground cover is >70%.

Indicator 4—Riparian area with ground cover >70%: This is the total non-forested riparian area with >70% cover as measured in each catchment in 2013. The objective is that there should be no further net loss of the existing area with >70% cover. It is recognised that riparian ground cover varies significantly with rainfall and so the objective will need to be assessed over a range of seasons.

10.2.8.4 Riparian targets

Due to the natural occurrence of non-forested riparian areas in these catchments, and also the variation in proportions of natural forested/non-forested riparian areas between catchments, the targets are tailored to each catchment. The overall aim is to maintain existing riparian quality as measured by the indicators described above.

Riparian targets, and corresponding indicators, are specified in Table 39 to Table 41.

Table 39: Total forested riparian area target and supporting indicator

Target 1: No reduction in forested riparian areas from 2013 baseline levels.	
	Indicator 1—Total forested riparian area (ha) in 2013.
Condamine	150,279

Note: Targets are based on the Queensland drainage sub-basins layer on the SIR spatial database, which differs slightly to the water resource plan boundaries for the plan area.

Source: Riparian vegetation levels in the Queensland Murray-Darling Basin and Bulloo catchment for 2013 (Clark, Healy, & Tindall, 2015)

Table 40: Riparian connectivity target and supporting indicators

Target 2: No reduction in riparian forest connectivity from 2013 baseline levels.		
	Indicator 2—No increase in the Normalised Patch Density (NPD) value for each major catchment.	Indicator 3—No reduction in the Patch Size and Connectivity Index (PSCI) value for each major catchment.
Condamine	38.0	52.8

Note: Targets are based on the Queensland drainage sub-basins layer on the SIR spatial database, which differs slightly to the water resource plan boundaries for the plan area.

Source: Riparian vegetation levels in the Queensland Murray-Darling Basin and Bulloo catchment for 2013 (Clark, Healy, & Tindall, 2015)

Table 41: Riparian ground cover target and supporting indicator

Target 3: In non-forested areas, maintain riparian ground cover in each catchment at a level that minimises soil erosion by water.	
	Indicator 4—No reduction from 2013 baseline levels in the area of non-forested riparian ground cover that has more than 70% coverage (ha) in each major catchment.
Condamine	97,117

Note: Targets are based on the Queensland drainage sub-basins layer on the SIR spatial database, which differs slightly to the water resource plan boundaries for the plan area.

Source: Riparian vegetation levels in the Queensland Murray-Darling Basin and Bulloo catchment for 2013 (Clark, Healy, & Tindall, 2015)

10.2.8.5 Ground cover in grazing lands

The Queensland Murray-Darling Basin Ground Cover Report—2015 (van den Berg, Trevithick, & Tindall, 2015) established a baseline for ground cover in grazing lands by calculating a 28-year long-term mean and seasonal changes in ground cover during 2015. The study was limited to reporting areas, defined by a grazing land-use with foliage projection cover of less than 60% (which is the method limit for 'fractional ground cover'). Within the reporting area for each of the 11 defined catchments, the mean (average) level of ground cover in each season was calculated for 2015, and compared to the corresponding 28-year mean. The report also calculated the area with less than 70% ground cover, as independent studies have indicated that a ground cover level of at least 70% is required to minimise erosion by water (van den Berg, Trevithick, & Tindall, 2015).

Ground cover is defined as the vegetation (living and dead), biological crusts and stone that are in contact with the soil surface. Ground cover levels are the result of complex interactions between landscape function (soil type, topography and vegetation dynamics), climate and land management. Some areas maintain naturally higher levels of ground cover due to factors such as high soil fertility and consistently high annual rainfall. The impacts of grazing land management practices on ground cover levels in these areas may be minimal due to the resilience of the land to respond to pressures. In areas where rainfall is less reliable and soils are less fertile, ground cover levels can vary greatly and the influence of grazing land management practices on ground cover levels and the species composition of the ground cover can be more pronounced.

Target 1: Maintain 90% of catchment with a ground cover level of >70% in the late dry season.

It is important to note that the influences of rainfall and grazing pressure can be particularly evident in Queensland Murray-Darling Basin (QMDB) catchments where a strong east to west rainfall gradient exists, the impacts of drought can be prolonged and rainfall can be highly variable in space and time. Some parts of the QMDB (e.g. Paroo and Bulloo catchments) also have soils of lower fertility and low mean annual rainfall. Ground levels in these areas are naturally lower than eastern QMDB catchments and will therefore rarely attain levels of 90% of the catchment with ground cover above 70 percent.

The Queensland Murray-Darling Basin Ground Cover Report—2015 (van den Berg, Trevithick, & Tindall, 2015) set the ground cover results in the context of climatic conditions. Rainfall was below average in 2015 for all catchments within the QMDB, with large parts of western Queensland drought declared during mid-late 2013 and 2014. Generally drier conditions across the QMDB area led to reductions in ground cover levels. The effects of high rainfall in 2010 and 2011 were observed for all catchments, with significant increases in ground cover levels and subsequent reduction in the area with ground cover below 70 percent.

Table 42 characterises the level of ground cover in the grazing lands of each drainage basin in 2015. The values in each table can be used as a baseline to track increases or decreases in ground cover through time, while working towards the target of >70% ground cover. Maintaining and/or improving ground cover levels in grazing lands from 2015, with consideration to soil type, topography, vegetation dynamics, climate and land management, would have multiple benefits to the Condamine River basin. Ground cover is a key component of many soil processes including infiltration, runoff and surface erosion. It is particularly important to try to maintain ground cover during dry periods or periods of unreliable rainfall to minimise loss of water, soil, and nutrients when rainfall eventually occurs. This will also maximise the pasture response to rainfall. Implementation of appropriate and sustainable land management practices, particularly careful management of grazing pressure, can help to maintain or improve ground cover and improve the stability and resilience of the grazing system.

See Queensland Murray-Darling Basin Ground Cover Report—2015 (van den Berg, Trevithick, & Tindall, 2015) for further information.

Condamine

Mean rainfall for 2015 in the Condamine catchment was 511 millimetres, 114 mm below the long term mean of 625 mm. The preceding year was also below the mean with 550 mm.

The proportion of grazing lands greater than 70 per cent fluctuated significantly in 2015 across all season, being highest during the winter season, at 91 per cent and lowest in spring at 69 per cent. The Condamine catchment had relatively high mean cover across all seasons for 2015, with the lowest occurring in spring, at 74 per cent. The Condamine also has a high long-term (28-year) mean ground cover. Despite the generally high levels of mean ground cover, the Condamine did not quite meet the target.

Table 42: A summary of ground cover in the Condamine River basin per season

	Area of reporting region with greater than 70% ground cover averaged over previous 28 years (%)	Area of reporting region with greater than 70% ground cover in 2015 (%)	28-year mean ground cover (%)	2015 mean ground cover (%)
Summer	82	83	81	81
Autumn	89	89	86	86
Winter	91	91	85	85
Spring	79	69	79	74

Note: This assessment is based on the Queensland drainage sub-basins layer on the SIR spatial database, which differs slightly to the water resource plan boundaries for the plan area.

Source: Queensland Murray-Darling Basin Ground Cover Report—2015 (Van den berg et al., 2015)

10.2.9 Targets for freshwater macroinvertebrates

Freshwater macroinvertebrates are organisms without a backbone that are able to be seen with the naked eye and are found in freshwater environments (Negus, Steward, & Blessing, 2013). Freshwater macroinvertebrates are diverse, common and widespread throughout many aquatic ecosystems and are easily sampled. Different taxa groups react differentially to varied stressors in the environment. These varied responses allow for a range of indices, such as salinity index, to be calculated from each sample of macroinvertebrates collected. These indices can then provide an integrated measure of stream condition.

Negus et al. (2013) recommends that targeted macroinvertebrate sampling is conducted for the Condamine River basin to allow the development of locally relevant macroinvertebrate guidelines. It is recommended that sampling occur in waters of high ecological value (HEV) as well as slightly disturbed (SD) to moderately disturbed (MD) waters to allow development of targets for the different levels of protection under EPP Water.

10.2.10 Targets for freshwater fish

Fish are an important component of the fauna of Australian river systems and can be used as indicators of ecosystem health (Kennard, Harch, Arthington, Mackay, & Pusey, 2001). For example, fish have been used as an indicator of ecosystem health in the Murray-Darling Basin (Hutchinson, 2014) (MDBC, 2008) and also in south east Queensland (EHMP, 2006). Ecosystem health is indicated by developing fish metrics, which are a tool to score the composition of fish fauna in a given system. Once developed, scores may be compared against an expected or average condition derived from existing data sets or expert opinion.

Hutchinson (2014) used fish data from various surveys conducted in the Condamine-Balonne system between 1995 and 2014 to determine fish species occurrence frequencies (proportion of capture from multiple surveys, across multiple sites), the mean native species richness and the mean non-native species richness of the system. This information can be used to provide a baseline against which to compare the catch rates of individual species over a series of sites, or over a period of time, to determine if catch rates are near to what is expected or above or below what might be expected.

Due to the size of the Condamine-Balonne system in the study, the catchment area was divided into sections. These sections are (Refer to Figure 30):

A. from the headwaters (near Killarney), including adjoining tributaries, to the Murray Bridge.
B. from Murray Bridge to the north and south Condamine River anabranch bifurcation (near Cecil Plains).
C. from the anabranch bifurcation (near Cecil Plains) to immediately downstream of Dogwood Creek,
D. from immediately downstream of Dogwood Creek to the NSW boarder, including distributaries and adjoining tributaries (including the Maranoa River).

Table 43, Table 44 and Table 45 display the targets for freshwater fish for the relevant catchment sections based on the occurrence frequency of native and non-native species, mean native species richness and the mean non-native species richness.
For the purposes of the Condamine River basin HWMP, only findings from catchment sections A, B and C above are displayed in Table 43, Table 44 and Table 45.

Hutchinson (2014) recommends a survey method for the Condamine-Balonne system which includes a site size between 300m and 2km in length, noting that when surveying in dry years a site may consist of several sections of pools with dry areas in between; a fish sampling method involving electrofishing, combined with fine meshed fyke nets (as this is most likely to detect the largest range of species with the least impact on the sampled fish); fish captured in standard electrofishing and fyke shots should have a sub-sample of up to 20 fish from each species measured per shot. Survey methods used to develop fish metrics can be found in full in the report ‘Fish assemblages as indicators of ecosystem health in the Condamine-Balonne River system’ (Hutchinson, 2014).

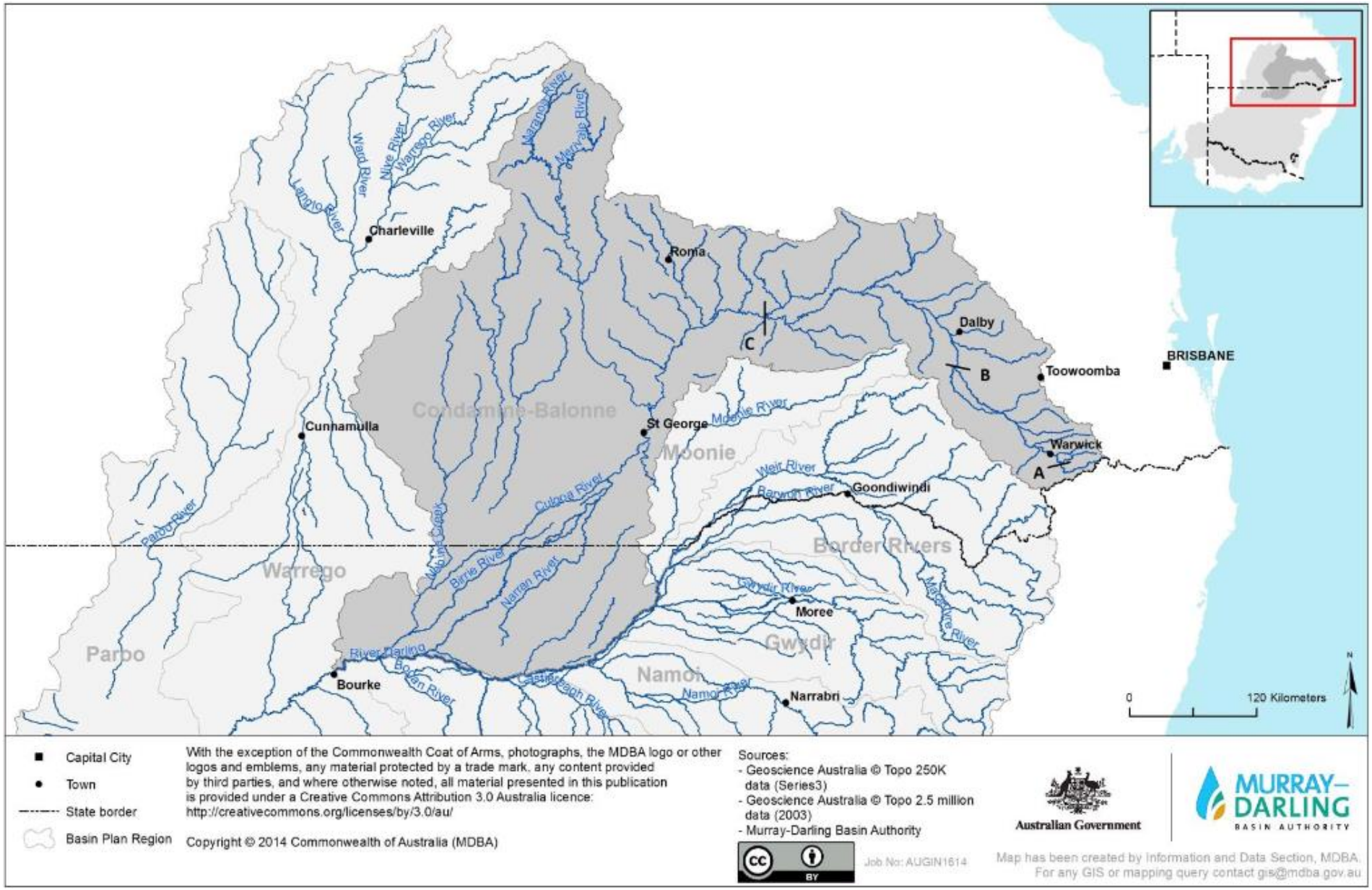

Figure 30: The area surveyed and the different catchment sections for the Condamine-Balonne fish assemblages survey (Hutchinson, 2014).

Table 43: Derived frequency of native and non-native species fish capture and mean native and mean non-native species richness in section A of the Condamine-Balonne system (Hutchinson, 2014).

Target 1: **Maintain or improve occurrence frequency**		
Species	Derived frequency of occurrence	
	Main river (electrofishing and fykes)	Tributary (electrofishing only)
Murray cod (*Maccullochella peelii*)	0.11	0
Spangled perch (*Leiopotherapon unicolor*)	0.11	0
Freshwater catfish (*Tandanus tandanus*)	0.67	0
Carp gudgeon spp. (*Hypseleotris* spp.)	1.00	0.06
Purple spotted gudgeon (*Mogurnda adspersa*)	0	0.06
Murray-Darling rainbow (*Melanotaenia fluviatilis*)	0.11	0
Australian smelt (*Retropinna semoni*)	0.67	0
Mountain galaxias (*Galaxias olidus*)	1.00	0.59
River blackfish (*Gadopsis marmoratus*)	0.11	0.59
Mean native species richness	**3.33**	**1.22**
Target 2: Maintain or decrease occurrence frequency		
Goldfish (*Carassius auratus*)	0.67	0
Mosquitofish (*Gambusia holbrooki*)	0	0.06
Rainbow trout (*Oncorhynchus mykiss*)	0	0.12
Mean non-native species richness	**0.67**	**0.17**

Table 44: Derived frequency of native and non-native species fish capture and mean native and mean non-native species richness in section B of the Condamine-Balonne system (Hutchinson, 2014).

Target 1: **Maintain or improve occurrence frequency**		
Species	Derived frequency of occurrence	
	Main river	Tributary
Golden perch (*Macquaria ambigua*)	0.67	0.38
Murray cod (*Maccullochella peelii*)	0.33	0.13*
Silver perch (*Bidyanus bidyanus*)	0.08*	0

Target 1: **Maintain or improve occurrence frequency**		
Species	Derived frequency of occurrence	
	Main river	Tributary
Spangled perch (*Leiopotherapon unicolor*)	0.54	0.38
Bony bream (*Nematalosa erebi*)	1.00	0.75
Freshwater catfish (*Tandanus tandanus*)	0.15*	0.50
Hyrtl's tandan (*Neosilurus hyrtlii*)	0.33	0
Carp gudgeon spp. (*Hypseleotris* spp.)	1.00	0.63
Dwarf flathead gudgeon (*Philypnodon macrostomus*)	0.08*	0.13*
Purple spotted gudgeon (*Mogurnda adspersa*)	0	0.25*
Unspecked hardyhead (*Craterocephalus stercusmuscarum fulvus*)	0.38	0.38
Murray-Darling rainbowfish (*Melanotaenia fluviatilis*)	0.54	0.50
Australian smelt (*Retropinna semoni*)	0.38	0.75
Olive perchlet (*Ambassis agassizii*)	0.33	0.38
Mountain galaxias (*Galaxias olidus*)	0	0.13*
Mean native species richness	**7.67**	**6.88**
Target 2: Maintain or decrease occurrence frequency		
Carp (*Cyprinus carpio*)	0.33	0.75
Goldfish (*Carassius auratus*)	0.67	0.63
Mosquitofish (*Gambusia holbrooki*)	0.33	0.50
Pearl cichlid (*Geophagus brasiliensis*)	0.08	0
Mean non-native species richness	**2.07**	**1.62**

Notes:

* Indicates a rare species for that part of the catchment.

Table 45: Derived frequency of native and non-native species fish capture and mean native and mean non-native

species richness in section C of the Condamine-Balonne system (Hutchinson, 2014).

Target 1: **Maintain or improve occurrence frequency**			
Species	Derived frequency of occurrence		
	Main river	Tributary	Lagoon
Golden perch (*Macquaria ambigua*)	0.91	0.60	0.54
Murray cod (*Maccullochella peelii*)	0.29*	0.27*	0.08*
Silver perch (*Bidyanus bidyanus*)	0.03*	0.03*	0
Spangled perch (*Leiopotherapon unicolor*)	0.82	0.85	0.92
Bony bream (*Nematalosa erebi*)	1.00	0.78	0.92
Freshwater catfish (*Tandanus tandanus*)	0.15*	0.40	0.23*
Hyrtl's tandan (*Neosilurus hyrtlii*)	0.28*	0.53	0.38
Rendahl's tandan (*Porochilus rendahli*)	0	0.05*	0.15*
Carp gudgeon spp. (*Hypseleotris* spp.)	1.00	0.95	0.92
Dwarf flathead gudgeon (*Philypnodon macrostomus*)	0.58	0	0.08*
Purple spotted gudgeon (*Mogurnda adspersa*)	0	0.03*	0
Unspecked hardyhead (*Craterocephalus stercusmuscarum fulvus*)	0.15*	0.55	0.23*
Murray-Darling rainbowfish (*Melanotaenia fluviatilis*)	0.56	0.82	0.15*
Australian smelt (*Retropinna semoni*)	0.74	0.60	0.23*
Olive perchlet (*Ambassis agassizii*)	0.26*	0.52	0.46
Mean native species richness	**6.65**	**6.78**	**5.31**
Target 2: Maintain or decrease occurrence frequency			
Carp (*Cyprinus carpio*)	0.65	0.70	0.53
Goldfish (*Carassius auratus*)	0.68	0.75	0.84
Mosquitofish (*Gambusia holbrooki*)	0.94	0.93	0.77
Mean non-native species richness	**2.26**	**2.38**	**1.90**

Notes:

* Indicates a rare species for that part of the catchment.

10.3 Water quality targets for the protection of human use environmental values

These water quality targets apply where the following Human Use Environmental Values have been identified in the Condamine River basin (Refer to Section 5 of this report). Where more than one EV applies to a given water (for example aquatic ecosystem and recreational use), the adoption of the most stringent water quality target for each water quality indicator will then protect all identified EVs. The water quality targets in this section are, unless otherwise specified, based on national water quality guidelines, including the ANZECC Guidelines (as updated), the National Health and Medical Research Council Guidelines for managing risks in recreational water, the Food Standards Australia New Zealand (FSANZ, 2007 & updates), and the Australian Drinking Water Guidelines (NHMRC, 2011, as amended). Where national guidelines are the source for the stated water quality targets, it is recommended that users refer directly to the sources to obtain comprehensive listings of all indicators and up-to-date information.

10.3.1 Water quality targets for the protection of primary industry environmental values

Section 10.32 (2)(b) and 10.35B (2)(b) of the Basin Plan requires a WQM Plan to identify water quality targets for irrigation water. The target values for irrigation water are set out in Section 9.17 of the Basin Plan. Section 10.34 of the Basin Plan requires a WQM Plan to identify the locations of targets for irrigation water. As per Section 9.17 of the Basin Plan, the target values apply at sites in the Murray-Darling Basin where water is extracted by an irrigation infrastructure operator for the purpose of irrigation.

Irrigation infrastructure operators are defined under Section 7 (4) of the Water Act 2007. Based on this definition, there are no sites in the Condamine River basin that qualify as an irrigation infrastructure operator for the purposes of Basin Plan Section 9.17, 10.32 (2)(b), 10.34 and 10.35 (2)(b).

While not accredited under the Basin Plan, Table 46 provision (1) for the Condamine River basin is recognised to provide targets for irrigation water in the plan area for the purposes of Queensland water quality planning and management.

Table 46: Suitability of water supply for irrigation: Water quality targets

WATER QUALITY TARGET VALUES FOR IRRIGATION		
Environmental Value	Water type/area	Water quality targets to protect Environmental Value
Suitability for irrigation 	All surface waters and groundwaters	**For the Condamine River basin**: ANZECC Guidelines (as updated) targets for pathogens and metals are provided in: 1. 2. Table 47 and Table 48. For all other indicators, such as major ions and herbicides refer to the ANZECC Guidelines (as updated).

Table 47: Suitability of water supply for irrigation: Water quality targets for thermotolerant (faecal) coliforms in irrigation waters used for food and non-food crops[1]

Intended use	Median values of thermotolerant coliforms (colony forming units–cfu) [2]
Raw human food crops in direct contact with irrigation water (e.g. via sprays, irrigation of salad vegetables)	<10 cfu/100mL
Raw human food crops not in direct contact with irrigation water (edible product separated from contact with water, e.g. by peel, use of trickle irrigation); or crops sold to consumers cooked or processed	<1000 cfu/100mL
Pasture and fodder for dairy animals (without withholding period)	<100 cfu/100mL
Pasture and fodder for dairy animals (with withholding period of five days)	<1000 cfu/100mL
Pasture and fodder (for grazing animals except pigs and dairy animals, i.e. cattle, sheep and goats)	<1000 cfu/100mL
Silviculture, turf, cotton, etc. (restricted public access)	<10 000 cfu/100mL

Notes:

1. Adapted from ANZECC (ANZECC/ARMCANZ, 2000) and ADWG (NHMRC, 2011, as amended).

2. Refer to ANZECC (ANZECC/ARMCANZ, 2000), Volume 1, Section 4.2.3.3 for advice on testing protocols.

Source: ANZECC (ANZECC/ARMCANZ, 2000), Volume 1, Section 4.2.3.3 and Table 4.2.2.

Table 48: Suitability of water supply for irrigation: Water quality targets for heavy metals and metalloids in agricultural irrigation water[1]—long-term trigger value (LTV), short-term trigger value (STV) and soil cumulative contamination loading limit (CCL)

Element	Soil cumulative contaminant loading limit (CCL) [2] (kg/ha)	Long-term trigger value (LTV) in irrigation water (up to 100 years) (mg/L)	Short-term trigger value (STV) in irrigation water (up to 20 years) (mg/L)
Aluminium	ND[2]	5	20
Arsenic	20	0.1	2.0
Beryllium	ND	0.1	0.5
Boron	ND	0.5	Refer to ANZECC (ANZECC/ARMCANZ, 2000), Vol 3, Table 9.2.18
Cadmium	2	0.01	0.05
Chromium	ND	0.1	1
Cobalt	ND	0.05	0.1
Copper	140	0.2	5
Fluoride	ND	1	2
Iron	ND	0.2	10
Lead	260	2	5
Lithium	ND	2.5 (0.075 for citrus crops)	2.5 (0.075 for citrus crops)
Manganese	ND	0.2	10
Mercury	2	0.002	0.002
Molybdenum	ND	0.01	0.05
Nickel	85	0.2	2
Selenium	10	0.02	0.05
Uranium	ND	0.01	0.1
Vanadium	ND	0.1	0.5
Zinc	300	2	5

Notes:

1. Concentrations in irrigation water should be less than the trigger values. Trigger values should only be used in conjunction with information on each individual element and the potential for off-site transport of contaminants (refer ANZECC (ANZECC/ARMCANZ, 2000), Volume 3, Section 9.2.5).

2. ND = Not determined; insufficient background data to calculate CCL.

Source: ANZECC (ANZECC/ARMCANZ, 2000), Volume 1, Section 4.2.6 and Table 4.2.10.

Table 49: Suitability of water supply for stock watering: Water quality targets

WATER QUALITY TARGET VALUES FOR STOCK WATERING		
Environmental Value	Water type/area	Water quality targets to protect Environmental Value
Suitability for stock watering 	All surface waters and groundwaters	Water quality targets as per ANZECC (ANZECC/ARMCANZ, 2000), including median faecal coliforms <100 organisms per 100 mL. Water quality targets for total dissolved solids and metals are provided in Table 50 **Table** 50 and Table 51, based on ANZECC (ANZECC/ARMCANZ, 2000). For other water quality targets, such as cyanobacteria and pathogens, see ANZECC (ANZECC/ARMCANZ, 2000).

Table 50: Suitability of water supply for stock watering: Water quality targets for tolerances of livestock to total dissolved solids (salinity) in drinking water[1]

Livestock	Total dissolved solids (TDS) (mg/L)		
	No adverse effects on animals expected.	Animals may have initial reluctance to drink or there may be some scouring, but stock should adapt without loss of production.	Loss of production and a decline in animal condition and health would be expected. Stock may tolerate these levels for short periods if introduced gradually.
Beef cattle	0–4000	4000–5000	5000–10 000
Dairy cattle	0–2500	2500–4000	4000–7000
Sheep	0–5000	5000–10 000	10 000–13 000[2]
Horses	0–4000	4000–6000	6000–7000
Pigs	0–4000	4000–6000	6000–8000
Poultry	0–2000	2000–3000	3000–4000

Notes:

1. From ANZECC (ANZECC/ARMCANZ, 2000).

2. Sheep on lush green feed may tolerate up to 13 000 mg/L TDS without loss of condition or production.

Source: ANZECC (ANZECC/ARMCANZ, 2000), Volume 1, Section 4.3.3.5 and Table 4.3.1.

Table 51: Suitability of water supply for stock watering: Water quality targets (low risk trigger values) for heavy metals and metalloids in livestock drinking water

Metal or metalloid	Trigger value (low risk)[1,2] (mg/L)
Aluminium	5
Arsenic	0.5 (up to 5[3])
Beryllium	ND

Metal or metalloid	Trigger value (low risk)[1,2] (mg/L)
Boron	5
Cadmium	0.01
Chromium	1
Cobalt	1
Copper	0.4 (sheep), 1 (cattle), 5 (pigs), 5 (poultry)
Fluoride	2
Iron	Not sufficiently toxic
Lead	0.1
Manganese	Not sufficiently toxic
Mercury	0.002
Molybdenum	0.15
Nickel	1
Selenium	0.02
Uranium	0.2
Vanadium	ND
Zinc	20

Notes:

1. Higher concentrations may be tolerated in some situations (further details provided in ANZECC (ANZECC/ARMCANZ, 2000), Volume 3, Section 9.3.5).

2. ND = not determined, insufficient background data to calculate.

3. May be tolerated if not provided as a food additive and natural levels in the diet are low.

Source: ANZECC (ANZECC/ARMCANZ, 2000), Volume 1, Section 4.3.4 and Table 4.3.2.

Table 52: Suitability of water supply for farm supply/use: Water quality targets

WATER QUALITY TARGET VALUES FOR FARM SUPPLY/USE		
Environmental Value	Water type/area	Water quality targets to protect Environmental Value
Suitability for farm supply/use 	All surface waters and groundwaters	Targets as per: • ANZECC guidelines (ANZECC/ARMCANZ, 2000)

Table 53: Protection of the human consumer: Water quality targets

WATER QUALITY TARGET VALUES FOR HUMAN CONSUMER		
Environmental Value	Water type/area	Water quality targets to protect Environmental Value
Protection of the human consumer 	All surface waters and groundwaters	Targets as per: • ANZECC guidelines (ANZECC/ARMCANZ, 2000) • Australia New Zealand Food Standards Code, Food Standards Australia New Zealand (FSANZ, 2007 & updates).

Table 54: Suitability of water supply for aquaculture: Water quality targets

WATER QUALITY TARGET VALUES FOR AQUACULTURE		
Environmental Value	Water type/area	Water quality targets to protect Environmental Value
Suitability for aquaculture 	All surface waters and groundwaters	Targets as per: • Table 55 of this report • ANZECC guidelines (ANZECC/ARMCANZ, 2000) • Australia New Zealand Food Standards Code, Food Standards Australia New Zealand (FSANZ, 2007 & updates)

Table 55: Water quality targets for aquaculture (optimal growth of particular species in freshwater)

WATER QUALITY TARGET VALUES FOR PRIMARY AQUACULTURE						
Water parameter	**Barramundi**	**Eel**	**Silver perch**	**Jade perch**	**Sleepy cod**	**Redclaw**
Dissolved oxygen	4–9mg/L	>3mg/L	>4mg/L	>3mg/L	>4.0mg/L	>4.0mg/L
Temperature ˚C	26–32	23–28	23–28	23–28	22–31	23–31
pH	7.5–8.5	7.0–8.5	6.5–9	6.5–9	7.0–8.5	7.0–8.5
Ammonia (TAN, Total ammonia-nitrogen)		<1.0mg/L			<1.0mg/L	<1.0mg/L
Ammonia (NH_3, un-ionised form)*pH dependent	<0.46mg/L	<0.1mg/L	<0.1mg/L	<0.1mg/L	<0.1mg/L	<0.1mg/L
Nitrate (NO_3)			<100mg/L			
Nitrite (NO_2)	<1.5mg/L	<1.0mg/L	<0.1mg/L		<1.0mg/L	<1.0mg/L
Salinity (extended periods)	0–35ppt		<5ppt	<5ppt		<4ppt
Salinity bath	0–35ppt		5–10ppt for 1 hour		max. 20ppt for 1 hour	
Hardness ($CaCO_3$)			>50 mg/L	>50 mg/L	>40mg/L	>40mg/L
Alkalinity	>20mg/L		100–400 ppm	100–400 ppm	>40mg/L	>40mg/L
Chlorine	<0.04mg/L				<0.04mg/L	
Hydrogen sulphide	0–0.3mg/L				0–0.3mg/L	
Iron	<0.1mg/L		<0.5mg/L	<0.5mg/L	<0.1mg/L	<0.1mg/L
Spawning temperature °C	Marine		23–28	23–28	>24 for more than 3 days	

Source: Department of Primary Industries and Fisheries: Water Quality in Aquaculture—DPI Notes April 2004.

10.3.2 Water quality targets for the protection of the drinking water environmental value

These water quality targets apply where the Drinking Water Environmental Value has been identified in the Condamine River basin (Refer to Section 5 of this report).

Table 56: Suitability of drinking water supply: Water quality targets

WATER QUALITY TARGET VALUES FOR DRINKING WATER		
Environmental Value	Water type/area	Water quality targets to protect Environmental Value
Suitability for drinking water supply 	All surface waters and groundwaters	Targets as per: • Table 57- Local water quality targets for drinking water supply. • The Australian Drinking Water Guidelines (2011, as amended) provides a framework for the quality of raw water for treatment for human consumption. For water quality after treatment or at point of use refer to legislation and guidelines, including: • Australian Drinking Water Guidelines (2011, as amended) • *Public Health Act 2005* and Regulation • *Water Fluoridation Act 2008* and Regulation • *Water Supply (Safety and Reliability) Act 2008*, including any approved drinking water management plan under the Act.

Table 57: Suitability of raw drinking water supply: Water quality targets for drinking water supply in the vicinity of off-takes, including groundwater, before treatment

This table outlines the water quality targets for water **before treatment**, unless otherwise stated (e.g. Australian Drinking Water Guidelines (ADWG)). For water quality after treatment or at the point of use, refer to relevant legislation and guidelines, including *Public Health Act 2005* and Regulation, *Water Supply (Safety and Reliability) Act 2008* and Regulation, including any approved drinking water management plan under the Act, *Water Fluoridation Act 2008* and Regulation, and the Australian Drinking Water Guidelines (National Health and Medical Research Council, 2011, as amended).

Indicator	Water quality target
Giardia	0 cysts (Queensland Water Supply Regulator) If *Giardia* is detected in drinking water then the health authorities should be notified immediately and an investigation of the likely source of contamination undertaken (ADWG, 2011, as amended).
Cryptosporidium	0 cysts (Queensland Water Supply Regulator) If *Cryptosporidium* is detected in drinking water then the health authorities should be notified immediately and an investigation of the likely source of contamination undertaken (ADWG, 2011, as amended).
E. coli	<100 cfu/100mL Treatment plants with effective barriers and disinfection are designed to address faecal contamination. *E. coli* or thermotolerant coliforms should not be present in any 100 mL sample of (treated) drinking water (ADWG, 2011, as amended).
Blue-green algae (cyanobacteria)	<2000 cells/mL
Algal toxin	ADWG (2011, as amended) health guideline: <1.3 µg/L Microcystin
pH	6.5-8.0

Indicator	Water quality target
Sulphate	ADWG (2011, as amended) health guideline: <500 mg/L
Dissolved oxygen	60-110 % saturation
Pesticides	Raw supplies: With good land and water quality management practices, pesticides should not be detected in source waters used for drinking water supplies (NHMRC 2011, Section 6.3.2, and Pesticide factsheets). Refer to the ADWG ((National Health and Medical Research Council, 2011, as amended) for specific human health related guideline values. Treated drinking water: Advanced treatment processes can aid in removal of pesticides from water supplies. Refer to the ADWG (National Health and Medical Research Council, 2011, as amended) for specific human health related guideline values.
Other indicators (including physico-chemical indicators)	Refer to ADWG (National Health and Medical Research Council, 2011, as amended).

10.3.3 Water quality targets for the protection of the cultural, spiritual and ceremonial environmental value

These water quality targets apply where the Cultural, Spiritual and Ceremonial Environmental Value has been identified in the Condamine River basin (Refer to Section 5 of this report).

Table 58: Protection of cultural, spiritual and ceremonial values: Water quality targets

WATER QUALITY TARGET VALUES FOR CULTURAL, SPIRITUAL AND CEREMONIAL VALUES		
Environmental Value	Water type/area	Water quality targets to protect Environmental Value
Protection of cultural, spiritual and ceremonial values 	All surface waters and groundwaters	Protect or restore cultural, spiritual and ceremonial values consistent with approved policies and plans. Aboriginal Waterways Assessments may provide information to support the cultural, spiritual and ceremonial value.

10.3.4 Water quality targets for the protection of the industry environmental value

These water quality targets apply where the Industry Environmental Value has been identified in the Condamine River basin (Refer to Section 5 of this report).

Table 59: Suitability for industrial use: Water quality targets

WATER QUALITY TARGET VALUES FOR INDUSTRY		
Environmental Value	Water type/area	Water quality targets to protect Environmental Value
Suitability for industrial use 	All surface waters and groundwaters	Water quality requirements for industry vary within and between industries. The ANZECC guidelines (ANZECC/ARMCANZ, 2000) do not provide targets to protect industries, and indicate that industrial water quality requirements need to be considered on a case-by-case basis. This environmental value is usually protected by other values, such as the aquatic ecosystem environmental value.

10.3.5 Water quality targets for the protection of the primary, secondary and visual recreation environmental values

The following water quality targets apply where the following recreational environmental values have been identified in the Condamine River basin (Refer to Section 5 of this report).

Section 10.32 (2)(c) of the Basin Plan requires a WQM Plan to identify water quality targets for recreational purposes for surface waters and 10.35B (2)(c) for groundwaters.

The Healthy Waters Management Plan fulfils this requirement by specifying that the water quality targets for water used for recreational purposes includes the values for cyanobacteria cell counts or biovolume as set out in Chapter 6 of the Guidelines for Managing Risks in Recreational Water (NHMRC, 2008).

The water quality target values for accreditation under section 10.32 (2)(c) and 10.35B (2)(c) of the Basin Plan are the water quality target values in Table 60, provision (1) for primary, secondary and visual recreation. The accredited water quality target values apply in the Condamine River basin.

While not accredited under the Basin Plan, Table 60, provision (2) for primary, secondary and visual recreation is recognised to support the accredited water quality target values for recreational purposes.

Table 60: Suitability for primary, secondary and visual recreation: Water quality targets

WATER QUALITY TARGET VALUES FOR RECREATION		
Environmental Value	**Water type/area**	**Water quality targets to protect Environmental Value**
Suitability for primary contact recreation 	All surface waters and groundwaters	1. Cyanobacteria and algae targets as per Chapter 6 of the Guidelines for Managing Risks in Recreational Water (NHMRC, 2008), including: • Recreational water bodies should not contain: ○ Level 1[1]: ≥ 10 µg/L total microcystins; or ≥ 50 000 cells/mL toxic *Microcystis aeruginosa*; or biovolume equivalent of ≥ 4 mm^3/L for the combined total of all cyanobacteria where a known toxin producer is dominant in the total biovolume; or ○ Level 2[1]: ≥ 10 mm^3/L for total biovolume of all cyanobacterial material where known toxins are not present; or ○ cyanobacterial scums consistently present. Further details are contained in (NHMRC, 2008) and Table 61. 2. All other targets for fresh waters as per the Guidelines for Managing Risks in Recreational Water (NHMRC, 2008), including: • water free of physical (floating and submerged) hazards[25] • temperature range: 16–34°C • pH range: 6.5–8.5 • DO: >80% • faecal contamination: designated recreational waters are protected against direct contamination with fresh faecal material, particularly of human or domesticated animal origin. Two principal components are required for assessing faecal contamination: ○ assessment of evidence for the likely influence of faecal material ○ counts of suitable faecal indicator bacteria (usually enterococci) These two components are combined to produce an overall microbial classification of the recreational water body.

[25] Where permanent hazards exist appropriate warning signs should be clearly displayed.

WATER QUALITY TARGET VALUES FOR RECREATION		
Environmental Value	**Water type/area**	**Water quality targets to protect Environmental Value**
		• avoiding exposure to freshwater free-living microorganisms (e.g. the protozoan *Naegleria fowleri* in warm fresh waters) • waters contaminated with chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreational purposes.
Suitability for secondary contact recreation 	All surface waters and groundwaters	1. Cyanobacteria and algae targets as per Chapter 6 of the Guidelines for Managing Risks in Recreational Water (NHMRC, 2008). Refer to the cyanobacteria and algae targets for primary recreation NHMRC (2008) and Table 61 for further detail. 2. All other targets for fresh waters as per the Guidelines for Managing Risks in Recreational Water (NHMRC, 2008).
Suitability for visual recreation 	All surface waters and groundwaters	1. Cyanobacteria and algae targets as per Chapter 6 of the Guidelines for Managing Risks in Recreational Water (NHMRC, 2008). Refer to the cyanobacteria and algae targets for primary recreation, NHMRC (2008) and Table 61 for further detail. 2. All other targets for fresh waters as per the Guidelines for Managing Risks in Recreational Water (NHMRC, 2008), including: • recreational water bodies should be aesthetically acceptable to recreational users. The water should be free from visible materials that may settle to form objectionable deposits; floating debris, oil, scum and other matter; substances producing objectionable colour, odour, taste or turbidity; and substances and conditions that produce undesirable aquatic life.

Notes:

1. Level 1 recognises the probability of adverse health effects from ingestion of known toxins, in this case based on the toxicity of microcystins. Level 2 covers circumstances in which there are very high cell densities of cyanobacterial material, irrespective of the presence of toxicity or known toxins. Increased cyanobacterial densities increase the likelihood of non-specific adverse health outcomes, principally respiratory, irritation and allergy symptoms (NHMRC, 2008; 8).

Table 61: Recreational waters: Alert levels and corresponding actions for management of cyanobacteria

When cyanobacteria are present in large numbers they can present a significant hazard, particularly to primary contact users of waters. Monitoring/action requirements relative to cyanobacteria 'alert' levels are summarised below, and are explained more fully in the Guidelines for Managing Risks in Recreational Water (NHMRC, 2008). Further details on the process to determine suitability of waters for recreation, relative to historical cyanobacterial levels and susceptibility to cyanobacterial contamination, are contained in Section 6 of the NHMRC guidelines (2008).

Green level surveillance mode[1]	**Amber level alert mode[1]**	**Red level action mode[1]**
Fresh waters		
≥ 500 to <5000 cells/mL *M. aeruginosa* or biovolume equivalent of >0.04 to <0.4 mm^3/L for the combined total of all cyanobacteria.	≥ 5000 to <50 000 cells/mL *M. aeruginosa* or biovolume equivalent of ≥0.4 to <4 mm^3/L for the combined total of all cyanobacteria where a known toxin producer is dominant in the total biovolume[2]. or[3] ≥0.4 to <10 mm^3/L for the combined total of all cyanobacteria where known toxin producers are not present.	Level 1 guideline[4]: ≥ 10 µg/L total microcystins. or ≥ 50 000 cells/mL toxic *M. aeruginosa* or biovolume equivalent of ≥ 4 mm^3/L for the combined total of all cyanobacteria where a known toxin producer is dominant in the total biovolume. or[3] Level 2 guideline[4]:

Green level surveillance mode[1]	Amber level alert mode[1]	Red level action mode[1]
Fresh waters		
		≥ 10 mm^3/L for total biovolume of all cyanobacterial material where known toxins are not present. or cyanobacterial scums are consistently present[5].

Notes:

1. Recommended actions at different alert levels are outlined below (based on NHMRC, 2008, Table 6.6—Fresh waters).
    a. **Green:** Regular monitoring. Weekly sampling and cell counts at representative locations in the water body where known toxigenic species are present (i.e. *Microcystis aeruginosa*, *Anabaena circinalis*, *Cylindrospermopsis raciborskii*, *Aphanizomenon ovalisporum*, *Nodularia spumigena*); or fortnightly for other types including regular visual inspection of water surface for scums.
    b. **Amber:** Notify agencies as appropriate. Increase sampling frequency to twice weekly at representative locations in the water body where toxigenic species (above) are dominant within the alert level definition (i.e. total biovolume) to establish population growth and spatial variability in the water body. Monitor weekly or fortnightly where other types are dominant. Make regular visual inspections of water surface for scums. Decide on requirement for toxicity assessment or toxin monitoring.
    c. **Red:** Continue monitoring as for (amber) alert mode. Immediately notify health authorities for advice on health risk. ('In action mode the local authority and health authorities warn the public of the existence of potential health risks; for example, through the media and the erection of signs by the local authority.' NHMRC, 2008; 114). Make toxicity assessment or toxin measurement of water if this has not already been done. Health authorities warn of risk to public health (i.e. the authorities make a health risk assessment considering toxin monitoring data, sample type and variability).
2. The definition of 'dominant' is where the known toxin producer comprises 75% or more of the total biovolume of cyanobacteria in a representative sample.
3. This applies where high cell densities or scums of 'non-toxic' cyanobacteria are present i.e. where the cyanobacterial population has been tested and shown not to contain known toxins (microcystin, nodularian, cylindrospermopsin or saxitoxins).
4. Health risks and levels: Level 1 is developed to protect against short-term health effects of exposure to cyanobacterial toxins ingested during recreational activity, whereas the Level 2 applies to the circumstance where there is a probability of increased likelihood of non-specific adverse health outcomes, principally respiratory, irritation and allergy symptoms, from exposure to very high cell densities of cyanobacterial material irrespective of the presence of toxicity or known toxins (NHMRC, 2008; 114).
5. This refers to the situation where scums occur at the recreation site each day when conditions are calm, particularly in the morning. Note that it is not likely that scums are always present and visible when there is a high population as the cells may mix down with wind and turbulence and then reform later when conditions become stable.

Source: Summarised from NHMRC (2008) Guideline for Managing Risks in Recreational Water (Tables 6.2 and 6.6).

10.4 Salinity targets for the purposes of long-term salinity planning and management

Table 62: Queensland Basin Salinity Management Strategy End-of-Valley Salinity Targets

WATER QUALITY TARGET VALUES FOR LONG-TERM SALINITY PLANNING AND MANAGEMENT									
Valley	Baseline as at 1 Jan 2000			End-of-Valley targets (as absolute value)			Valley reporting site	AWRC Site Number	Map EoV Site ID
	Salinity (EC µS/cm)		Salt Load (t/yr)	Salinity (EC µS/cm)		Salt Load (t/yr)			
	Median (50%ile)	Peak (80%ile)	Mean	Median (50%ile)	Peak (80%ile)	Mean			
Queensland									
Condamine-Balonne	170	210	4,200	170	210	4,200	Ballandool R @ Hebel-Bollon Rd	422207A	83
	170	210	5,000	170	210	5,000	Bokhara R @ Hebel	422209A	82
	150	280	6,500	150	280	6,500	Briarie Ck @ Wollerbilla-Hebel Rd	422211A	84
	170	210	29,000	170	210	29,000	Culgoa R @ Brenda[1]	422015[1]	85
	160	210	10,000	160	210	10,000	Narran R @ New Angledool[1]	422030[1]	81

Notes:

1. These sites are operated by NSW on behalf of Queensland.

Source: Appendix 1 of Schedule B to the Murray-Darling Basin Agreement (Schedule 1 of the Water Act 2007). Version 15 June 2010, and as amended.

SECTION 11: MONITORING, DATA MANAGEMENT, EVALUATION AND REPORTING

11 Monitoring, data management, reporting and governance

11.1 Monitoring

Monitoring should be designed in accordance with the EPP Water Monitoring and Sampling Manual 2018. The principles in section 13.04 of the Basin Plan (listed below in The Queensland Government will continue to monitor water quality through both the Surface Water Ambient Network and Groundwater Ambient Network. End-of-Valley monitoring is also conducted as part of Queensland's responsibilities under Basin Salinity Management 2030, with data derived from gauging station sites in both Queensland and New South Wales. Continuous and field-based water quality monitoring to support the calibration of the QMDB water quality model has also been conducted in the QMDB, supported by the Intergovernmental Agreement on Implementing Water Reform in the Murray-Darling Basin and an amended National Partnership Agreement. Local short-term water quality monitoring programs are also conducted in the QMDB where funded opportunities arise. These are often implemented by natural resource management groups, community groups or other local stakeholders.

Some activities in Queensland have approval under the *Environmental Protection Act 1994* to release water to the environment. These point sources releases are monitored by the approval holder for various water quality parameters and release volumes. The approval holders can also undertake monitoring of the surrounding environment.

It is an aim of the healthy waters management plan over the life of the plan to identify opportunities for a Report Card for the QMDB region, similar to South East Queensland and the Great Barrier Reef.

Table 63) should also be implemented when conducting monitoring and evaluation in the plan area. These principles apply to all Queensland Murray-Darling Basins, including the Bulloo drainage basin. This ensures consistency in monitoring practices across the Queensland portion of the Murray-Darling Basin, as well as across the Murray-Darling Basin.

The Queensland Government will continue to monitor water quality through both the Surface Water Ambient Network and Groundwater Ambient Network. End-of-Valley monitoring is also conducted as part of Queensland's responsibilities under Basin Salinity Management 2030, with data derived from gauging station sites in both Queensland and New South Wales. Continuous and field-based water quality monitoring to support the calibration of the QMDB water quality model has also been conducted in the QMDB, supported by the Intergovernmental Agreement on Implementing Water Reform in the Murray-Darling Basin and an amended National Partnership Agreement. Local short-term water quality monitoring programs are also conducted in the QMDB where funded opportunities arise. These are often implemented by natural resource management groups, community groups or other local stakeholders.

Some activities in Queensland have approval under the *Environmental Protection Act 1994* to release water to the environment. These point sources releases are monitored by the approval holder for various water quality parameters and release volumes. The approval holders can also undertake monitoring of the surrounding environment.

It is an aim of the healthy waters management plan over the life of the plan to identify opportunities for a Report Card for the QMDB region, similar to South East Queensland and the Great Barrier Reef.

Table 63: Principles to be applied in monitoring and evaluating the effectiveness of the Basin Plan (section 13.04 Basin Plan)

Principle	Description
Principles 1-2	Not applicable to the Queensland Government or other state agencies.
Principle 3	Commonwealth agencies and Basin States should report against matters in a manner which reflects the degree to which they are responsible for those matters.
Principle 4	Monitoring and evaluation should be undertaken within the conceptual framework of program logic. Note: Program logic is a mechanism that helps to determine when and what to evaluate so that resources can be used effectively and efficiently: see the Australian Government's NRM MERI Framework.
Principle 5	Monitoring and evaluation findings, including in respect of progress towards meeting targets and trends in the condition and availability of the Basin water resources, should enable decision-makers to use adaptive management.

Principle	Description
Principle 6	Monitoring and evaluation should harness the monitoring capabilities of existing Basin State and Commonwealth programs (including jointly funded programs), provided that the programs are consistent with the principles in this Part, with a view to aligning and improving these programs over time. Note: For example, water information provided by Basin States to the Bureau of Meteorology under Part 7 of the Water Act 2007 may be used, where possible, for monitoring and evaluation to avoid duplication in the sourcing of that information.
Principle 7	The best available knowledge (including scientific, local and cultural knowledge), evidence and analysis should be used where practicable to ensure credibility, transparency and usefulness of monitoring and evaluation findings.
Principle 8	Basin States and the Commonwealth should collaborate on the technical and operational elements of monitoring and evaluation in order to build engagement and ownership.
Principle 9	A risk-based approach should be used for investment in monitoring and evaluation.
Principle 10	Monitoring and reporting should be timely, efficient, cost-effective and consistent, and should supply the information needed for evaluation.
Principle 11	To the extent possible, there should be open access to information collected or used in, or generated by, monitoring and evaluation.

11.2 Data management and reporting

Data management and reporting should be consistent with the following:

1. Data should be stored with sufficient identifiers and metadata associated with the data to ensure its integrity.
2. A common, secure and accessible platform for archiving (storing and retrieval) and displaying water quality information is required.
3. Reporting should be specifically linked to management responses and outcomes.
4. Integration of reporting and linking to related reports should be considered, where possible.
5. Reporting should address progress against actions, performance indicators and timelines. Reporting should also address the outcomes of any review processes undertaken and any updates or improvements made to the plan.
6. Reporting should be web based, where possible.
7. Decision support models should be utilised, if available, to assist with evaluating progress and possible management intervention scenarios.

11.3 Governance

A collaborative partnership between the Queensland Government and the relevant NRM group for the Queensland Murray-Darling Basin region is the recommended approach for the delivery of the Condamine River Basin HWMP. Resources and implementation of the various management responses to address risks and contribute to the achievement of objectives for water resources will involve Commonwealth and State governments, key stakeholders including industry, commerce, landholders, science providers, environment groups and Traditional Owner groups and the broader community.

SECTION 12: DICTIONARY

12 Dictionary

ADWG means the Australian Drinking Water Guidelines (NHMRC, 2011, as amended), prepared by the National Health and Medical Research Council (NHMRC) in collaboration with the Natural Resource Management Ministerial Council (NRMMC).

ANZECC means the Australian and New Zealand Environment and Conservation Council.

ANZECC Guidelines mean the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (recently updated to become ANZG, 2018), prepared by the Australian and New Zealand Environment and Conservation Council (ANZECC) and the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ).

Aquatic ecosystems (defined in the AWQG) comprise the animals, plants and micro-organisms that live in water, and the physical and chemical environment and climatic regime in which they interact. It is predominantly the physical components (e.g. light, temperature, mixing, flow, habitat) and chemical components (e.g. organic and inorganic carbon, oxygen, nutrients) of an ecosystem that determine what lives and breeds in it, and therefore the structure of the food web. Biological interactions (e.g. grazing and predation) can also play a part in structuring many aquatic ecosystems.

ARMCANZ means the Agriculture and Resource Management Council of Australia and New Zealand.

AWQG means the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (October 2000), prepared by the Australian and New Zealand Environment and Conservation Council (ANZECC) and the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ).

Basin Plan means the *Basin Plan 2012*, prepared under the Commonwealth *Water Act 2007*.

Ecological health (defined in the AWQG) means the 'health' or 'condition' of an ecosystem. It is the ability of an ecosystem to support and maintain key ecological processes and organisms so that their species compositions, diversity and functional organisations are as comparable as possible to those occurring in natural habitats within a region (also termed ecological integrity).

Environmental values (EVs) for water are the qualities of water that make it suitable for supporting aquatic ecosystems and human water uses. These EVs need to be protected from the effects of habitat alteration, waste releases, contaminated runoff and changed flows to ensure healthy aquatic ecosystems and waterways that are safe for community use. Particular waters may have different EVs. EVs for a specified region are listed in schedule 1 of the EPP Water.

EPP Water is the Environmental Protection (Water) Policy 2009.

Level of protection for a water (aquatic ecosystem EV) means the level of aquatic ecosystem condition specified in Table 11 of this document that the corresponding WQOs for that water are intended to achieve (refer to management intent definition below for further information).

Management intent (aquatic ecosystem EV) is defined in s. 14 of the EPP (Water). It is the management intent for the waters that the decision to release waste water or contaminant to the waters must ensure the following:

- for high ecological value (HEV) waters—the measures for the indicators are maintained
- for slightly disturbed (SD) waters—the measures for the slightly modified physical or chemical indicators are progressively improved to achieve the water quality objectives for high ecological value water
- for moderately disturbed (MD) waters:
    - if the measures for indicators of the EVs achieve the water quality objectives for the water—the measures for the indicators are maintained at levels that achieve the water quality objectives for the water, or
    - if the measures for indicators of the EVs do not achieve the water quality objectives for the water—the measures for indicators of the EVs are improved to achieve the water quality objectives for the water
- for highly disturbed (HD) waters—the measures for the indicators of all environmental values are progressively improved to achieve the water quality objectives for the water.

QWQG means the Queensland Water Quality Guidelines.

Queensland waters (as defined in *Acts Interpretation Act 1954*): means all waters that are a) within the limits of the state; or b) coastal waters of the state.

Toxicant (defined in the AWQG) means a chemical capable of producing an adverse response (effect) in a biological system at concentrations that might be encountered in the environment, seriously injuring structure or function or producing death. Examples include pesticides, heavy metals and biotoxins.

Water quality guidelines (defined in the EPP (Water)) are numerical concentration levels or statements for indicators that protect a stated environmental value. Under the EVs setting process contained in the EPP (Water), water quality guidelines are used as an input to the development of WQOs.

Water quality indicator (for an EV) means a property that is able to be measured or decided in a quantitative way. Examples of water quality indicators include physical indicators (e.g. temperature), chemical indicators (e.g. nitrogen, phosphorus, metals), and biological indicators (e.g. macroinvertebrates, seagrass, fish).

Water quality objectives (WQOs) are long-term goals for water quality management. They are numerical concentration levels or narrative statements of indicators established for receiving waters to support and protect the designated EVs for those waters. Water quality objectives are not individual point source emission objectives, but the receiving water quality objectives. They are based on scientific criteria or water quality guidelines but may be modified by other inputs (e.g. social, cultural and economic). Examples of WQOs include:

- total phosphorus concentration less than 20 micrograms per litre (µg/L)
- chlorophyll a concentration less than 1 µg/L
- dissolved oxygen between 95% and 105% saturation
- family richness of macroinvertebrates greater than 12 families
- exotic individuals of fish less than five per cent.

Water type means groupings of waters with similar characteristics. Water types can include fresh waters (lowland, upland, lakes/reservoirs), wetlands and groundwaters.

SECTION 13: REFERENCED SOURCES

13 Referenced sources

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SECTION 14: APPENDICES

14 Appendices

Appendix 1—Refining water quality targets for fresh water-dependent ecosystems to reflect local conditions

The need to refine water quality targets to reflect local conditions

Under s9.16 and Schedule 11 of the Basin Plan, the water quality target values for fresh water-dependent ecosystems are inappropriate and the target application zones are not relevant to developing local measures that address the causes of water quality degradation. The target application zones are not relevant at a spatial scale that recognises the different Queensland Murray-Darling Basin water types, mapped at sub-catchment level (Refer to Figure 29).

The adoption of the same water quality target values for key indicators across approximately 60% of the Queensland Murray-Darling Basin in Schedule 11 of the Basin Plan is inappropriate for the respective water resource plan areas. Most of the water quality target values in Schedule 11 are less stringent than local water quality target values and for key water–dependent ecosystem indicators, such as suspended solids, the water quality target values are unrealistically low. Further, the majority of the water quality indicators and subsequent target values in Schedule 11 are not applicable to groundwater. Consequently, the Schedule 11 water quality target values are neither environmentally nor economically appropriate. The default application of water quality target values would be inconsistent with s5.02 (1) (d) of the Basin Plan—by failing to optimise social, economic or environmental outcomes in the national (or local community or state) interest.

Under the water quality framework of the ANZECC guidelines (as updated) and the EPP Water, local water quality targets hold higher precedence over regional, state or national targets. Local water quality targets for fresh water-dependent ecosystems are critical for appropriate economic and environmental management, as the direct application of default regional, state or national water quality targets often do not reflect local water types or water quality characteristics. This results in water quality targets, particularly for physico-chemical indicators, that potentially offer insufficient protection for the local aquatic ecosystem or impose excessive constraints on stakeholders to manage water quality to an inappropriate standard for the local area.

The ANZECC guidelines emphasise the need to tailor water quality targets to local conditions:

“It is not possible to develop a universal set of specific guidelines that apply equally to the very wide range of ecosystem types or production systems, in varying degrees of health, in Australia and New Zealand. Environmental factors can reduce or increase the effects of physical and chemical parameters at a site and these factors can vary considerably across the two countries. A framework is provided that allows the user to move beyond single-number, necessarily conservative values, to guidelines that can be refined according to local environmental conditions — that is, to developing site-specific guidelines. This is a key message of the Water Quality Guidelines….”

“This can produce values more appropriate to a particular water resource. Although tailoring guidelines to local conditions requires more work in some cases, it results in much more realistic management goals. It therefore has the potential to reduce costs for industry.” (ANZECC/ARMCANZ, 2000; Introduction to the guidelines, 8 - 9)

The ANZECC guidelines refer to four large regions of Australia (Figure A), and derive ‘default’ water quality guidelines for water types in each region. The split between the ‘Tropical’ region and the southern regions is the Tropic of Capricorn.

The Queensland Murray-Darling Basin drainage basins (416-Border Rivers, 417-Moonie, 422 Balonne-Condamine, 423-Warrego and 424-Paroo) and the Bulloo (011) fall within the ANZECC ‘South-east Australia’ region, which includes waters in New South Wales, Victoria and Tasmania.

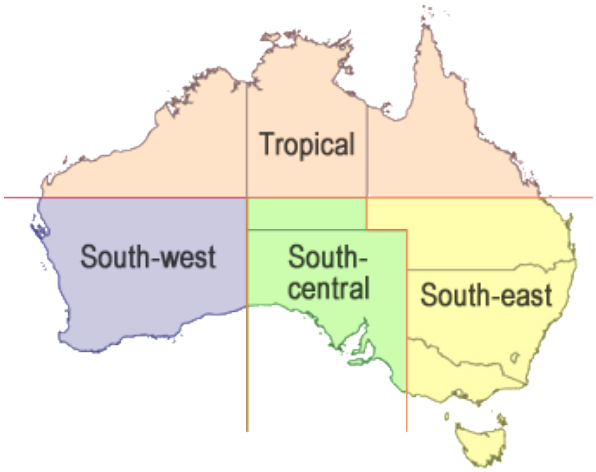

Figure A: ANZECC water type regions

The ANZECC guidelines state:

"The default trigger values in the present guidelines were derived from ecosystem data for unmodified or slightly-modified ecosystems supplied by state agencies. However, the choice of these reference systems was not based on any objective biological criteria. This lack of specificity may have resulted in inclusion of reference systems of varying quality, and further emphasises that the default trigger values should only be used until site- or ecosystem-specific values can be generated."

The water quality targets for fresh-water dependent ecosystems stated in Schedule 11 of the Basin Plan can be considered as 'default' regional trigger values, in the absence of local water quality targets. Refining the regional water quality targets for fresh-water dependent ecosystems stated in Schedule 11 of the Basin Plan based on local water quality data provides the best opportunity to achieve objectives and outcomes for water quality in the QMDB. Thus, where the water quality targets for fresh water-dependent ecosystems differ from those specified in the Basin Plan, they will be as effective in achieving consistency with the objectives described in the table below.

Procedure

Local water quality targets for fresh water-dependent ecosystems (surface water) were derived based on the procedure outlined for 'Physical and chemical stressors' in section 3.3 of the ANZECC guidelines. The purpose of establishing local water quality targets from this section of the ANZECC guidelines is to ensure that the slightly to moderately disturbed ecosystems of QMDB are adequately protected (Refer to Section 6).

The procedure for determining groundwater quality target values is described briefly in sub-section 10.2.6 of this report, and in full in Regional groundwater chemistry zones: Queensland Murray-Darling Basin (McNeil, Raymond, Bennett, & McGregor, 2017).

Data sources

Best available data was sourced from a variety of databases for the development of water quality target values, as described below.

Surface water

Section 3.3 of the ANZECC Guidelines describes the sources of information for use when deriving water quality targets for physical and chemical stressors:

1. biological and ecological effects data
2. reference system data
3. predictive modelling
4. professional judgement.

The following local data and information sources were used to refine the water quality targets for fresh water-dependent ecosystems stated in Schedule 11 of the Basin Plan:

- Department of Natural Resources, Mines and Energy water quality and quantity monitoring data (Hydstra project database)
- Sustainable Rivers Audit monitoring data from the Murray-Darling Basin Authority
- Condamine Catchment Management Association
- Condamine Balonne Monitoring and Information
- Queensland Murray-Darling Committee data
- Smart Rivers data
- Published journal articles and data.

The refined water quality targets were prepared in conjunction with professional advice from the Water Quality Technical Panel. Data from approximately 850 water quality sampling occasions, conducted in the plan area between 1952 and 2017, was used in the analysis.

In the absence of local data for indicators, the regional targets specified in Schedule 11 of the Basin Plan apply. Table 64 displays the metadata summary for surface water quality targets for all water types of the Condamine River basin.

Groundwater

Data was sourced from the Groundwater Database managed by the Queensland Department of Natural Resources, Mines and Energy. In the Queensland Murray-Darling Basin, there are more than 7,700 sub-artesian and 4,200 artesian water quality samples, supplemented by over 2,500 groundwater level measurements from around 6600 bores, mostly since the mid-1960s.

Site selection

Refer to Figure 31 for the surface water sites with available data that was analysed to derive alternative water quality targets for fresh water-dependent ecosystems in the Condamine River basin.

Refer to Figure 32 for the groundwater bores with available chemistry data that was analysed to develop groundwater quality targets for the Condamine River basin.

Data quality

Nutrient samples taken before 1995 were excluded from analyses due to inconsistencies with current sampling and laboratory procedures. Extreme or questionable data was inspected in finer detail, e.g. comparing the sampling dates with meteorological data, comparison with other variables, potential typographical errors, data reported in different units. Obvious errors were excluded, unless the data could be rationalized (e.g. EC recorded in mS/cm instead of µS/cm).

Consultation

Draft water quality target values were developed in consultation with the local government, natural resource management groups, industry groups, the Northern Basin Aboriginal Nations, the New South Wales Government and the community, based on participation at meetings held between March 2017 and January 2018.

Further information

For further information, refer to the Department of Environment and Science website: https://environment.des.qld.gov.au/water/policy/.

Table 64: Metadata summary for surface water quality targets in the Condamine River basin.

Water type	Flow Condition	Indicators	Sources	Number of samples	Dates (years) of samples
1. North-Western catchment waters	**Low flow** <13.5 cumecs at gauge 422308C – Condamine River at Chinchilla and <1.1 cumecs at gauge 422343A – Charley's Creek at Chinchilla	Total P Chlorophyll-a Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, Condamine Catchment Management Association	18 sample sites, 62 sample dates, N= 11-62 depending on parameter	1993-2016
	High flow >13.5 cumecs at gauge 422308C – Chinchilla and >1.1 cumecs at gauge 422343A – Charley's Creek at Chinchilla	Total P Turbidity Conductivity	Project Sciences database, Condamine Catchment Management Association	4 sample sites, 11 sample dates, N=10-11 depending on parameter	1994-2015
2. South-Western catchment waters	**No flow data – ungauged system**	Insufficient data	Insufficient data	Insufficient data	Insufficient data
3. Kumbarilla Ridge catchment waters	**Low flow** <12.8 cumecs at gauge 422336A – Condamine River at Brigalow	Turbidity pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, Queensland Murray Darling Committee	22 sample sites, 61 sample dates, N= 11-79 depending on parameter	2002-2016
	High flow >12.8 cumecs at gauge 422336A – Condamine River at Brigalow	Insufficient Data	Insufficient data	Insufficient data	Insufficient data
4. Central catchment waters	**Low flow** <0.2 cumecs at gauge 422352A – Hodgson Creek at Balgownie and <0.3 cumecs at gauge 422334A – Kings Creek at Aides Bridge	Ammonia N Oxidised N Total N FRP Total P Chlorophyll-a Turbidity Suspended solids pH Conductivity Sulphate	Surface Water database, Project Sciences database, Condamine Catchment Management Association, New Hope Group	69 sample sites, 494 sample dates, N= 14-721 depending on parameter	1963-2017

Water type	Flow Condition	Indicators	Sources	Number of samples	Dates (years) of samples
		Alkalinity			
	High flow >0.2 cumecs at gauge 422352A – Hodgson Creek at Balgownie and >0.3 cumecs at gauge 422334A – Kings Creek at Aides Bridge	Oxidised N Total N FRP Total P Chlorophyll-a Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, Condamine Catchment Management Association	24 sample sites, 156 sample dates, N= 10-332 depending on parameter	1963-2017
5. Oakey Creek catchment waters	**Low flow** <0.9 cumecs at gauge 422350A – Oakey Creek at Fairview	Ammonia N Oxidised N Total N FRP Total P Chlorophyll-a Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, New Hope Group, RIVERS, Condamine Catchment Management Association	13 sample sites, 111 sample dates, N= 15-147 depending on parameter	2010-2017 (data collected prior to July 2010 not used in analysis due to nutrient impacts)
	High flow >0.9 cumecs at gauge 422350A – Oakey Creek at Fairview	Total N FRP Total P Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, RIVERS, Everyone's Environment Grants (EEG)	4 sample sites, 20 sample dates, N= 18-22 depending on parameter	2010-2017 (data collected prior to July 2010 not used in analysis due to nutrient impacts)
6. Upper Condamine River catchment waters	**Low flow** <3.9 cumecs at gauge 422310C – Condamine River at Warwick	Ammonia N Oxidised N Total N FRP Total P Chlorophyll-a Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, EEG	15 sample sites, 430 sample dates, N= 40-701 depending on parameter	1959-2017
	High flow >3.9 cumecs at gauge 422310C – Condamine River at Warwick	Ammonia N Oxidised N Total N FRP Total P Chlorophyll-a Turbidity Suspended solids pH	Surface Water database, Project Sciences database, EEG	8 sample sites, 77 sample dates, N= 8-102 depending on parameter	1963-2017

Water type	Flow Condition	Indicators	Sources	Number of samples	Dates (years) of samples
		Conductivity Sulphate Alkalinity			
7. Middle Condamine River catchment waters	**Low flow** <7.9 cumecs at gauge 422316A – Condamine River at Cecil Weir and <10.2 cumecs at gauge 422333A – Condamine River at Loudouns Bridge	Ammonia N Oxidised N Total N FRP Total P Chlorophyll-a Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, Condamine Catchment Management Association, EEG	25 sample sites, 560 sample dates, N= 91-841 depending on parameter	1953-2017
	High flow >7.9 cumecs at gauge 422316A – Condamine River at Cecil Weir and >10.2 cumecs at gauge 422333A – Condamine River at Loudouns Bridge	Ammonia N Oxidised N Total N FRP Total P Chlorophyll-a Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, EEG	16 sample sites, 92 sample dates, N= 11-111 depending on parameter	1955-2015
8. Southern catchment waters	**Low flow** <0.1 cumecs at gauge 422338A – Canal Creek at Leyburn and <0.3 cumecs at gauge 422357A –Iron Pot Creek at Sheep Yard (CLOSED)	Total N FRP Total P Chlorophyll-a Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database	32 sample sites, 327 sample dates, N= 22-409 depending on parameter	1963-2017
	High flow >0.1 cumecs at gauge 422338A – Canal Creek at Leyburn and >0.3 cumecs at gauge 422357A –Iron Pot Creek at Sheep Yard (CLOSED)	Total N FRP Total P Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, RIVERS	12 sample sites, 93 sample dates, N= 11-106 depending on parameter	1959-2017

Water type	Flow Condition	Indicators	Sources	Number of samples	Dates (years) of samples
9. Southern catchment waters – Leslie Dam.	**No flow condition separation applied**	Ammonia N Oxidised N FRP Total P Chlorophyll-a Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database	6 sample sites, 145 sample dates, N=91-255 depending on parameter	1967-2001
10. Lower Condamine River catchment waters	**Low flow** <10.2 cumecs at gauge 422333A – Condamine River at Loudouns Bridge	Ammonia N Oxidised N Total N FRP Total P Chlorophyll-a Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, Condamine Catchment Management Association, SunWater, EEG	15 sample sites, 480 sample dates, N= 156-670 depending on parameter	1971-2017
	High flow >10.2 cumecs at gauge 422333A – Condamine River at Loudouns Bridge	Ammonia N Oxidised N Total N FRP Total P Chlorophyll-a Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, SunWater, EEG	11 sample sites, 57 sample dates, N= 11-70 depending on parameter	1973-2017
11. South-Eastern catchment waters	**Low flow** <0.3 cumecs at gauge 422306A – Swan Creek at Swanfels	Ammonia N Oxidised N Total N FRP Total P Chlorophyll-a Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database, Condamine Catchment Management Association	13 sample sites, 312 sample dates, N= 8-344 depending on parameter	1963-2017
	High flow >0.3 cumecs at gauge 422306A – Swan Creek at Swanfels	Ammonia N Oxidised N Total N FRP Total P Turbidity Suspended solids pH	Surface Water database, Project Sciences database	5 sample sites, 47 sample dates, N= 16-51 depending on parameter	1963-2017

Water type	Flow Condition	Indicators	Sources	Number of samples	Dates (years) of samples
		Conductivity Sulphate Alkalinity			
12. Emu Creek catchment waters	**Low flow** <0.6 cumecs at gauge 422313B – Emu Creek at Emu Vale	Ammonia N Oxidised N Total N FRP Total P Turbidity Suspended solids pH Conductivity Sulphate Alkalinity	Surface Water database, Project Sciences database	3 sample sites, 138 sample dates, N= 21-136 depending on parameter	1963-2017
	High flow >0.6 cumecs at gauge 422313B – Emu Creek at Emu Vale	Total N Total P Turbidity Suspended Solids pH Conductivity Sulfate Alkalinity	Surface Water database	3 sample sites, 25 sample dates, N= 12-26 depending on parameter	1963-2017

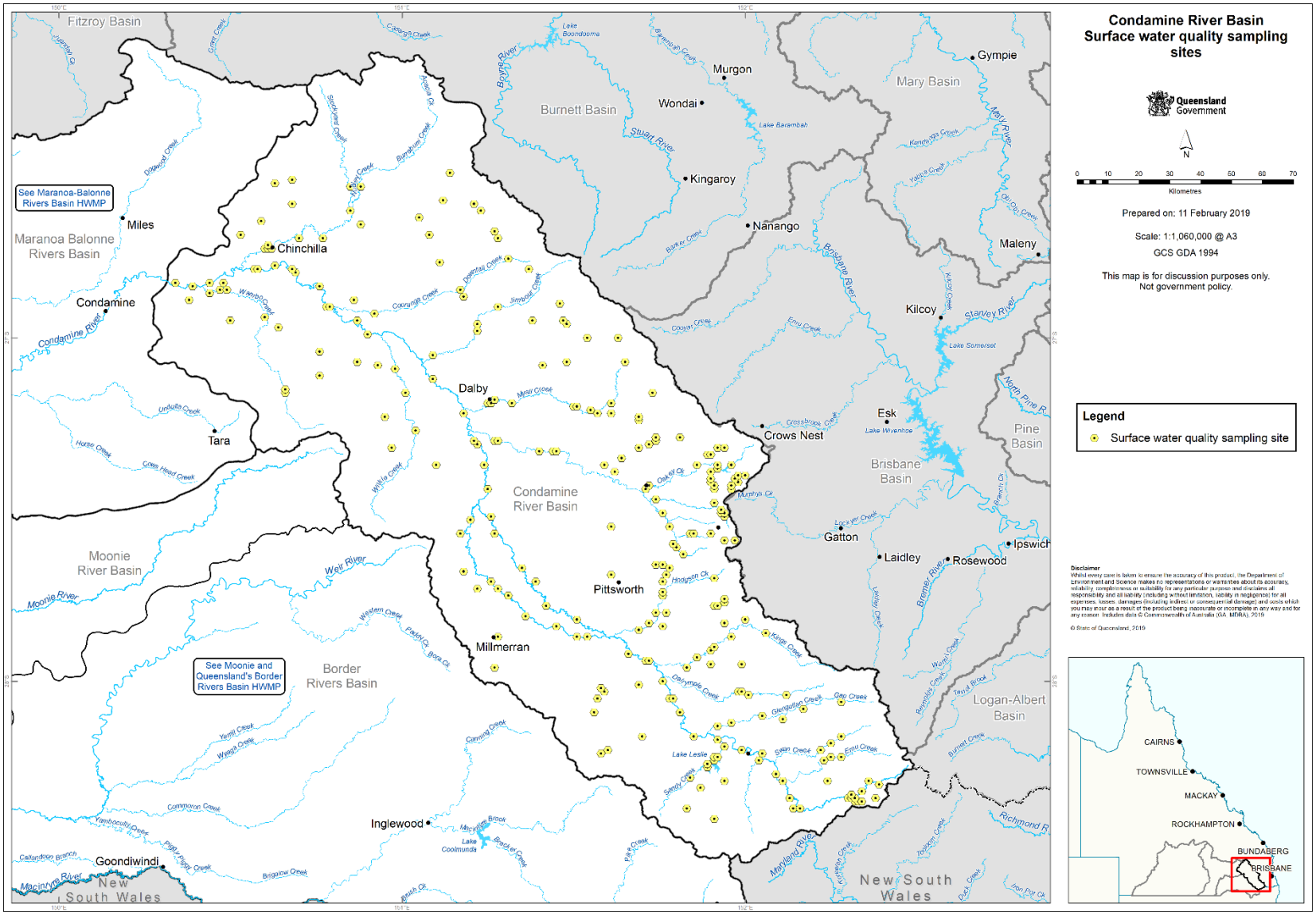

Figure 31: Surface water sample sites in the Condamine River basin.

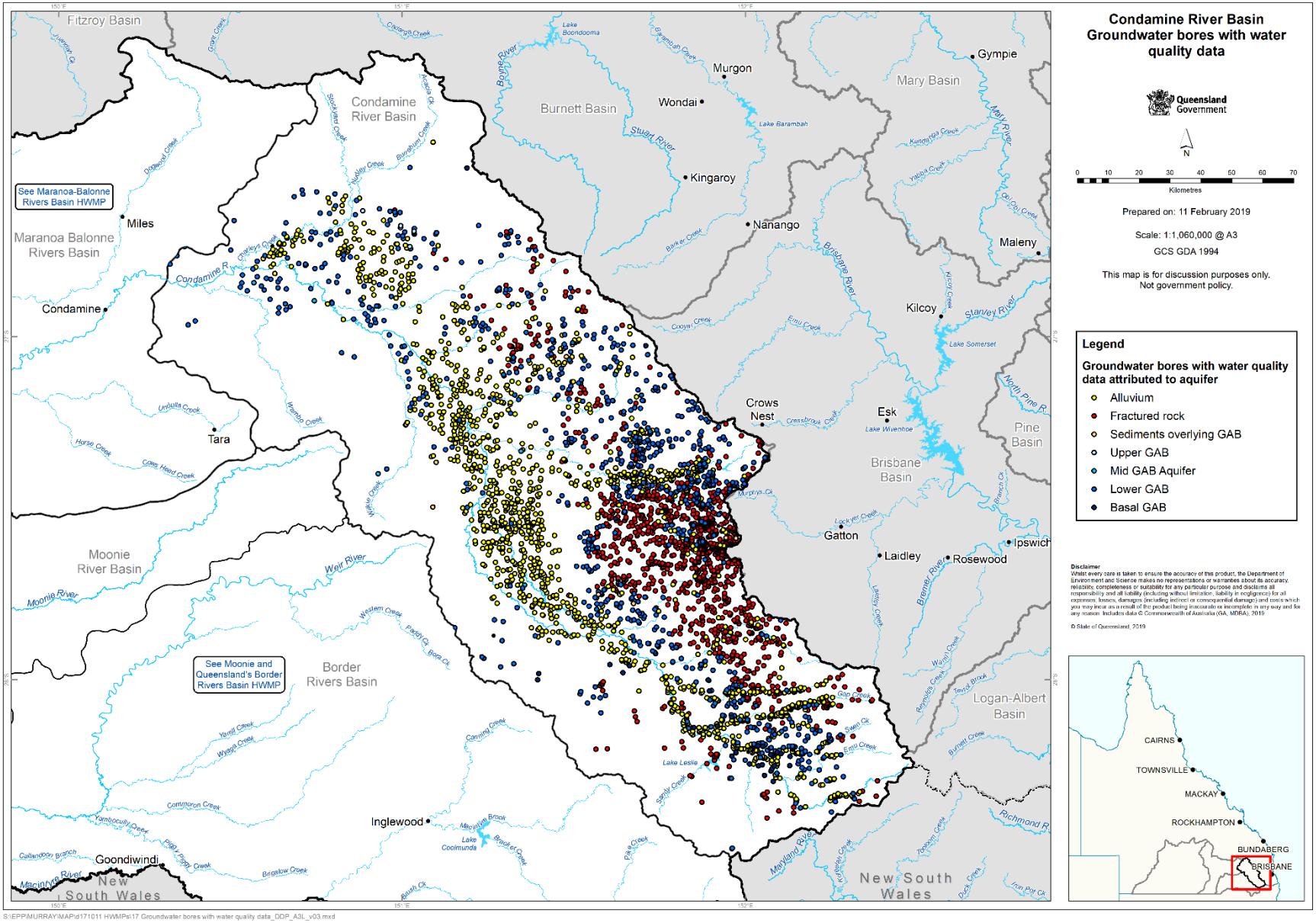

Figure 32: Groundwater bores with available chemistry data in the Condamine River basin.

Appendix 2—Description of water types in the Condamine River basin

The Queensland Water Quality Guidelines 2009 states that the aim of defining water types is to create groupings within which water quality (or biological condition) is sufficiently consistent that a single guideline value can be applied to all waters within each group or water type. Water types are developed through expert opinion of soil type, geology, topography and rainfall. The water types were considered to best represent ecologically relevant spatial areas for key water quality parameters.

The common soil types in the eastern basins of QMDB are as follows (Queensland Government, 2016):

1. Dermosol: Red, brown, yellow, grey or black soils which have loam to clay textures. The potential for erosion is dependent upon the level of slope and ground cover. This soil type is formed in the uplands and alluvia extending from the headwaters above Warwick to Chinchilla at the lower end of the Condamine floodplain.
2. Vertosol: Brown, grey or black soils which crack open when dry. This soil type has very high fertility and a large water-holding capacity, although is prone to sheet erosion if ground cover is not maintained. This soil type is formed in the uplands and alluvia extending from the headwaters above Warwick to Chinchilla at the lower end of the Condamine floodplain.
3. Ferrosols: Well-drained soils with red or yellow-brown colour and clay-loam to clay texture. This soil type is usually associated with previous volcanic activity and is mainly located along the Great Dividing Range. Ferrosols are found in the more weathered zones around Toowoomba.
4. Kandosol: Red, yellow and grey soils which have low fertility and poor water-holding capacity. This soil type produces significant runoff under low vegetation cover, is highly erodible. Stoney Kandosols are predominantly found on steep terrain of granites and metamorphics in the Granite Belt and Traprock regions. Deep Kandosols are expressed in the flatter areas of the basins
5. Sodosol: Texture-contrast soils which are low in nutrients and very vulnerable to erosion (gully and tunnel) and dryland salinity when vegetation is removed.
6. Chromosol: Texture-contrast soils which are not strongly acidic or sodic. They have moderate chemical fertility and water-holding capacity and can be susceptible to soil acidification and soil structure decline. Deep Chromosols are expressed in the flatter areas of the basins
7. Tenosols: Poorly developed, shallow, stony soils which generally have low fertility and low water-holding capacity (highly erodible). This soil type is predominantly found on steep terrain of granites and metamorphics in the Granite Belt and Traprock regions.

The water types for the Condamine River basin are displayed in Figure 29.

The following descriptions of water types in the Condamine River basin were informed by expert opinion from the Water Quality Technical Panel.

Water type	Landscape description
North-Western catchment waters	This area includes Barakula and other state forest areas and the higher quality wetland areas of the Pelican Lagoons and the Gilgai wetlands of Charlies Creek. This area contains significant remnant areas with lower anthropogenic impacts and similar geology and chemistry.
South-Western catchment waters	Tributary systems have differing water chemistry to that of trunk streams.
Kumbarilla Ridge catchment waters	The boundaries of this water type are defined by the extent of the sandstone ridge. The differing geology and slope of this land area to adjacent land areas results in a different chemical signature of these waters.
Central catchment waters	This water type includes the main agricultural areas of the Condamine floodplain from the eastern bank of the Condamine River (and between the River and the North Branch). The nature of the waterways and the anthropogenic impacts across this area are sufficiently similar to aggregate the land areas from Kings Creek to Cooranga Creek, with the exception of the Oakey Creek and Toowoomba area.
Oakey Creek catchment waters	Trunk streams have differing water chemistry to that of tributaries and floodplains. These catchment waters are also heavily influenced by the adjacent land use (sewage treatment plant, urban
Upper Condamine River catchment waters	This includes all main channel water, and excludes the tributaries, which are unlikely to contain the same characteristics that are so heavily influenced by the upstream anthropogenic impacts. The Upper Condamine was split from the Middle Condamine due to differences in electrical conductivity between the two waters.
Middle Condamine River catchment waters	This includes all main channel water, and excludes the tributaries, which are unlikely to contain the same characteristics that are so heavily influenced by the upstream anthropogenic impacts. The Middle Condamine was split from the Lower Condamine due to differences in electrical conductivity between the two waters.
Southern catchment waters	This area includes the granite and traprock landscapes of the upper Condamine. The boundary line has defined as between Clifton and Allora to account for the differences found in the landscapes between the two and the changing nature and intensification of the land use between these two sub-catchment areas.
Lower Condamine River catchment waters	This includes all main channel water, and excludes the tributaries, which are unlikely to contain the same characteristics that are so heavily influenced by the upstream anthropogenic impacts. The Lower Condamine was split from the Middle Condamine due to differences in electrical conductivity between the two waters.
South-Eastern catchment waters	Tributary systems have differing water chemistry to that of trunk streams.
Emu Creek catchment waters	Emu Creek was separated from South-Eastern catchment waters due to a difference in ionic composition under low flow conditions.

Appendix 3—Condamine-Balonne, Moonie and Queensland Border Rivers Water Quality Risk Assessment Methodology

Aim

This document aims to ensure that the risk assessment undertaken for the Healthy Waters Management Plans (HWMPs) for the Queensland Murray-Darling Basin Water Resource Plan (WRP) areas meets the requirements of the Murray-Darling Basin Plan (Basin Plan). The HWMPs fulfil majority of the requirements of a Water Quality Management Plan (WQM Plan) under section 10.29 of the Basin Plan.

This document outlines the methodology to identify, evaluate and treat water quality risks to the current and future condition, and continued availability of the water resources of Queensland Murray-Darling Basin WRP areas.

The full water quality risk assessment for the Condamine River basin (Department of Environment and Science, 2018(b)), can be found at https://www.ehp.qld.gov.au/water/policy/murray-darling-bulloo-evs.html.

Background

Water quality for Queensland waters is managed under the *Environmental Protection Act 1994* and the Environmental Protection (Water) Policy 2009 (EPP Water). This legislation provides the framework for establishing environmental values (EVs), water quality objectives (WQOs) and HWMPs for Queensland waters.

Environmental values reflect the ways in which water is valued and used within a catchment and are displayed in **Figure 1**. The Department of Environment and Science (DES) undertakes a process to identify local environmental values for key regions in Queensland through community and stakeholder consultation. Once the refined set of environmental values has been identified for a region, they are scheduled under the Queensland Environmental Protection (Water) Policy 2009 (EPP Water) (subordinate legislation under the *Environmental Protection Act 1994*) to inform statutory and non-statutory planning and decision-making. This is a key management action for maintaining and improving water quality for Queensland catchments.

The process to identify local environmental values for scheduling under the EPP Water is currently being undertaken across the Queensland Murray-Darling Basin (QMDB) WRP areas. It was conducted by DES, in consultation with the three former-Natural Resource Management groups of the region – Condamine Alliance, Queensland Murray-Darling Committee and South West NRM Ltd – which have now combined to become Southern Queensland NRM. Section 6 of the EPP Water states that in the absence of environmental values included in schedule 1 of the EPP Water, the full list of environmental values applies to a region. As environmental values are yet to be scheduled under the EPP Water for Queensland Murray-Darling Basin catchments, the full set of environmental values were considered for the water quality risk assessment. This means that the likelihood and consequence of water quality degradation on aquatic ecosystems, irrigation, stock watering, recreation and other key values were considered individually in the risk assessment.

Following the identification of EVs, local WQOs for receiving waters are developed for each catchment area, under low and high flow conditions where possible. WQOs set a numerical value for key water quality indicators, setting the benchmark that is required to achieve the protection of the EVs over time. These WQOs are also scheduled under the EPP Water alongside EVs to inform planning and decision-making. Local WQOs have been developed by DES for QMDB WRP areas, in consultation with Department of Natural Resources, Mines and Energy (DNRME) and key stakeholders.

Under section 10.29 of the Basin Plan, a water resource plan is to include a Water Quality Management Plan. The Queensland Government established that the HWMPs developed under the EPP Water will be aligned with the requirements for a Water Quality Management Plan under the Basin Plan.

Figure 1: Environmental values under the Environmental Protection (Water) Policy 2009

Chapter 10, Part 9 of the Basin Plan describes the approaches to addressing risks to water resources to be included in a water resource plan. In accordance with section 10.41(7) of the Basin Plan, the water resource plan must describe the data and methods used to identify and assess risks.

The focus of the risk assessment methodology detailed in this section is on risks to the condition, or continued availability, of Basin water resources arising from water being of a quality unsuitable for use (water quality risk assessment).

Approach

The water quality risk assessment was conducted in line with the approach used by the Department of Natural Resources, Mines and Energy (DNRME) to conduct the Condamine-Balonne - Risk Assessment for the condition and continued availability of the water resources of the water plan area (DNRM, 2017). This approach is consistent with the AS/NZS ISO 31000:2009 Risk Management—Principles and Guidelines. It is also consistent with the National Water Initiative Policy Guidelines for Water Planning and Management—Risk Assessment Module developed by the Department of Sustainability, Environment, Water, Population and Communities. The risk management process follows six steps in a cycle, as detailed below and summarised in **Figure 2**.

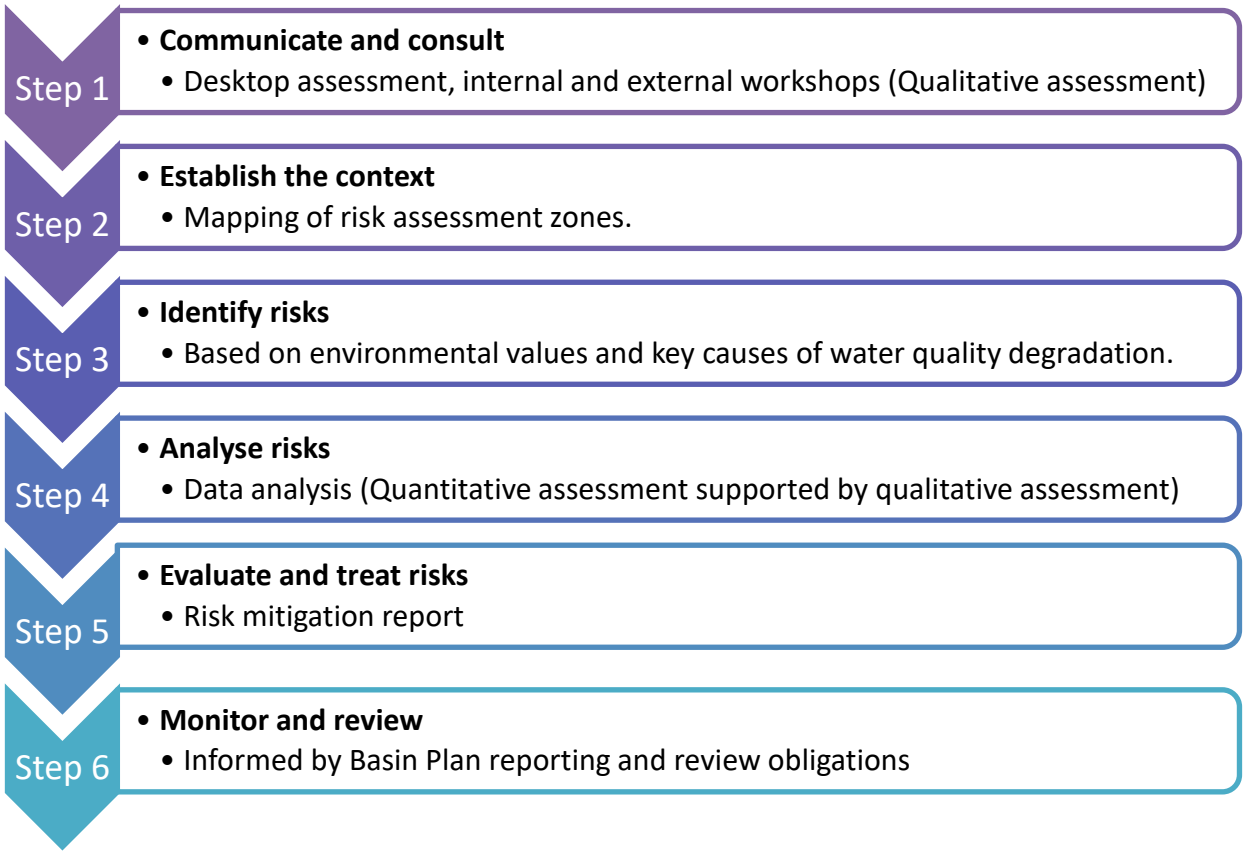

Figure 2: Summary of the approach used for the water quality risk assessment

Step 1: Communicate and consult

The following process was designed to ensure appropriate communication and consultation with internal and external stakeholders—

- Preliminary desktop assessment of known risks and preparation of the risk assessment template.
- Conduct an internal workshop to further identify and analyse risks featuring a panel of experts from across Queensland Government departments, with knowledge of the local area.
- Present outcomes of the risk assessment process to external stakeholders with the Department of Natural Resources, Mines and Energy at a range of workshops across Queensland Murray-Darling Basin catchments.
- Continue to obtain external feedback on the risk assessment through the development of the HWMP.

Step 2: Establish the context

For each Queensland Murray-Darling Basin WRP area, the assessment of surface water quality risks was based on groupings of several water type zones. These zones are displayed in **Figure 3.** This grouping allowed for a more manageable scale of assessment at the risk workshops. The Queensland Water Quality Guidelines 2009 states that the aim of defining water types is to create groupings within which water quality (or biological condition) is sufficiently consistent that a single guideline value can be applied to all waters within each water type. Water types are developed through expert opinion of soil type, geology, topography and rainfall, in addition to water quality data. The assessment of groundwater quality risks was based on the Groundwater and Deep Groundwater SDL resource units published by the Murray-Darling Basin Authority.

Step 3: Identify risks

This step describes risks in terms of what can happen and the impact that can result. Risks were identified based on the 10-year life span of a water resource plan, as defined by the *Water Act 2000* and the Basin Plan.

The water quality risk assessment focussed on risks to the condition, or continued availability, of Basin water resources arising from water being of a quality unsuitable for use. For the purpose of the water quality risk assessment, ‘use’ was taken to mean all the Environmental Values applicable in the plan area (Figure 1). Environmental Values define the uses of water for a region by aquatic ecosystems and for human uses (e.g. drinking water, irrigation, aquaculture, recreation). Thus, the risk assessment assesses the risks to the condition, or continued availability, of Basin water resources arising from water being of a quality unsuitable to protect the Environmental Values in the plan area.

Under section 10.41(2) of the Basin Plan, the risks are to include (where applicable) risks arising from elevated levels of salinity or other types of water quality degradation. The identification of risk factors was informed by the key causes of water quality degradation in Schedule 10 of the Basin Plan. These were included in the water quality risk assessment template.

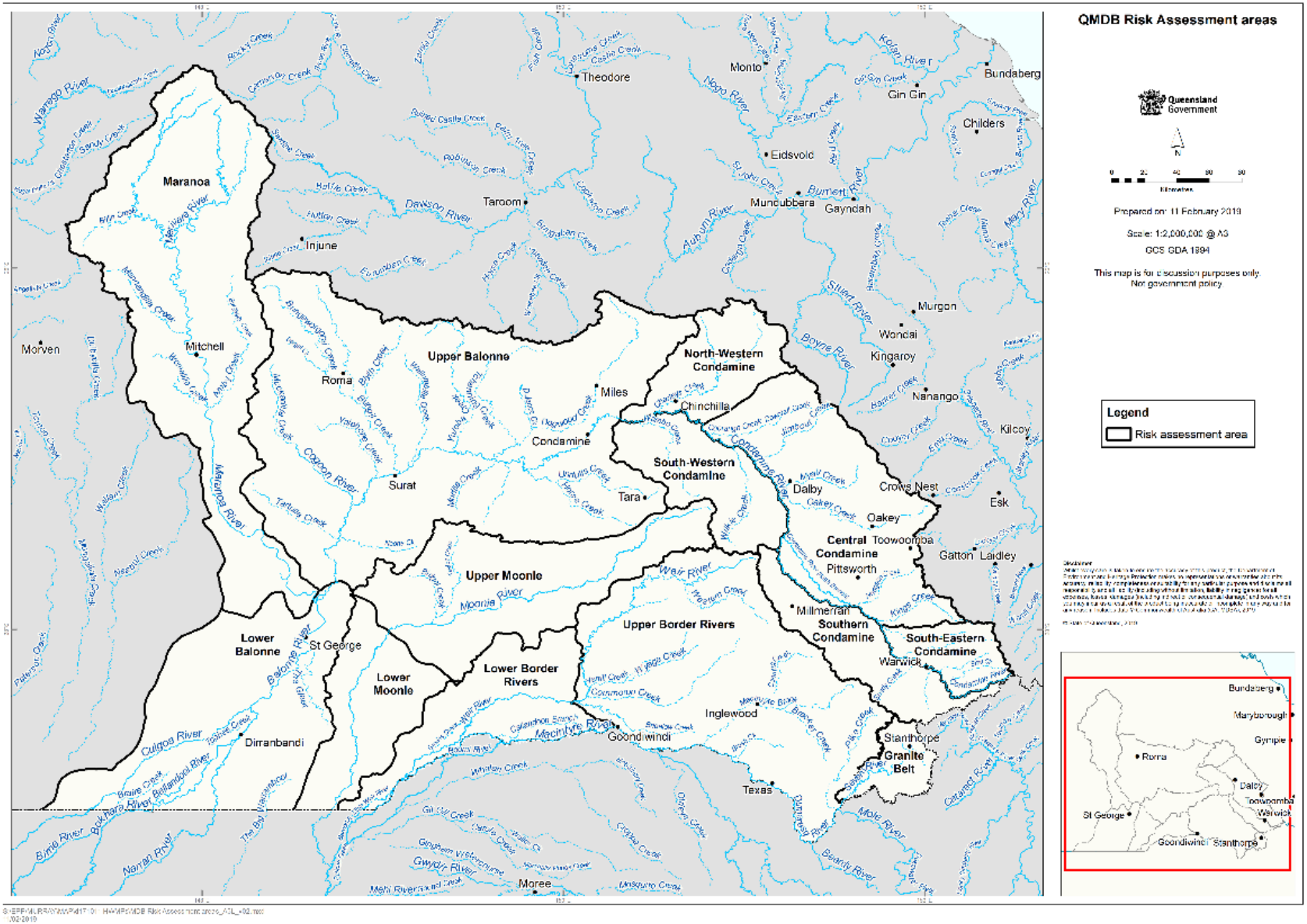

Figure 3: Surface water risk assessment units for the assessment of water quality in QMDB

Step 4: Analyse risks

Each risk must be must be rated in terms of consequences and likelihood to establish the risk level (AS/NZS ISO 31000:2009 Risk Management - Principles and Guidelines). The Basin Plan does not specify detailed requirements for the risk assessment, such as a preferred risk analysis matrix. However, section 10.41(6) states that the level of risk, must be defined using the following categories—

- low
- medium
- high
- if it is considered appropriate, any additional category.

Section 10.42 of the Basin Plan specifies that a water resource plan must describe each risk identified as having a medium or higher risk and the factors that contribute to the risk.

Section 4.04 of the Basin Plan states that the Authority may publish guidelines setting out specific actions that may be taken in relation to the implementation of the strategies listed in subsection 4.03(3) to deal with the risks identified in section 4.02. These guidelines may include a specific risk assessment tool such as a risk analysis matrix; however, no such guidelines are currently available from the Murray-Darling Basin Authority. In the absence of specified guidelines, the existing risk analysis tools implemented by Queensland Government departments for water and aquatic ecosystems were utilised. This ensures consistency between the risk assessment approaches undertaken by DNRME and DES for the purpose of the Basin Plan accreditation package.

Defining consequence

Each consequence was categorised into ecological, economic and social/cultural impacts. Environmental values were grouped under each of these headings, as shown below:

Ecological:	Aquatic ecosystems
Economic:	Irrigation, stock watering, aquaculture, farm use/supply, industry, human consumption and drinking water
Social/cultural:	Cultural and spiritual values, primary recreation, secondary recreation and visual amenity.

Note 1: For a risk to be assigned a given consequence it should reflect the situations described for each of the respective categories. However, where more than one impact category is relevant, the category with the highest consequences was selected in order to determine a single consequence level for the particular risk.

Note 2: Cultural and spiritual values, of water, means its aesthetic, historical, scientific, social or other significance, to the present, past or future generations in the general community. Cultural, spiritual and ceremonial values and uses for people from the Aboriginal Nations of the QMDB are being determined through specific workshops. These workshops will also identify risks to cultural, spiritual and ceremonial values and uses raised by participants of each Nation. This information will be summarised through a separate report.

Refer to **Table 1** for a description of each consequence and its associated impacts.

TABLE 1: **DEFINING CONSEQUENCES**

Consequence	Environmental impacts	Economic impacts	Social/cultural impacts	Score
Insignificant	Impact on aquatic environmental values is negligible/undetectable	Minimal or no financial losses.	Minimal or no impact on cultural and spiritual values, recreational values and amenity.	1
Minor	Minimal detectable impact on environmental value, minor reduction in population size and community structure, change in food resource availability, recovery likely within a short time frame,	Financial loss requiring some reprioritisation and/or restructuring of business.	Minor impact on cultural and spiritual values, recreational values and amenity.	2

Consequence	Environmental impacts	Economic impacts	Social/cultural impacts	Score
Moderate	Obvious and significant impacts on environmental value, change in community structure (loss of sensitive species), moderate habitat disturbance and loss, recovery possible within years.	Significant individual financial loss with minimal community level impact.	Moderate impact on cultural and spiritual values or a vital community resource, recreational values and amenity.	3
Major	Significant spatial and temporal impact on environmental values , changes to long-term recruitment processes possibly leading to local extinction of one or more populations, loss of sensitive species, major changes in food resources and food webs, major habitat loss.	Major financial loss with severe individual and some community level impact.	Major disturbances to significant cultural and spiritual values, recreational values and amenity. Access to resource denied, or vital community resource unavailable, in the medium to long-term.	4
Catastrophic	Extreme and widespread impacts – loss of species, dramatic changes to communities and ecosystem functions, replaced with generalists, exotic biota, and extensive loss of habitat.	Disastrous long-term financial loss with severe individual and community level impact.	Major disturbances to significant cultural and spiritual values, recreational values and amenity. The site or vital community resource permanently affected.	5

Defining likelihood

The likelihood (chance of something happening) table is consistent with the risk assessments conducted by DNRME. **Table 2** identifies the likelihood categories and their definitions.

The risks to water quality were identified by statistical analysis of water quality data for waters of the Condamine-Balonne, Moonie and Queensland Border Rivers. The statistical analysis assessed the likelihood of water in a defined area exceeding the water quality guideline for that use of water. For example, the likelihood that waters in the Upper Balonne exceed the salinity water quality guideline value for aquaculture was determined to inform the likelihood score. This process was conducted for each Environmental Value in each risk assessment spatial unit. Where relevant, EVs of similar type were combined, allowing the assessment of risks to water quality for each environmental value to be streamlined. The EVs that were combined are:

- Recreation:
    - Primary Recreation
    - Secondary Recreation
    - Visual Recreation
- Consumption of aquatic food:
    - Aquaculture
    - Human Consumers of Aquatic Foods
- Agriculture:
    - Irrigation
    - Stock Watering
    - Farm Water Supply

The water quality data was sourced from the Queensland Government's water quality database, as well as from local water quality monitoring programs including those conducted by natural resource management and industry groups. The water quality database is a highly comprehensive historical record of water quality for this area. **Figure 4** displays the amount of data analysed during the assessment of the likelihood of risks occurring for each of the WRP areas, broken down into sources of data. The large quantity of data used in the analysis, which ranged from 1952-2017, shows the rigour behind this risk assessment process. The statistical analysis supported the qualitative information provided by participants at the risk assessment workshops, as well as highlighting additional risks not previously identified.

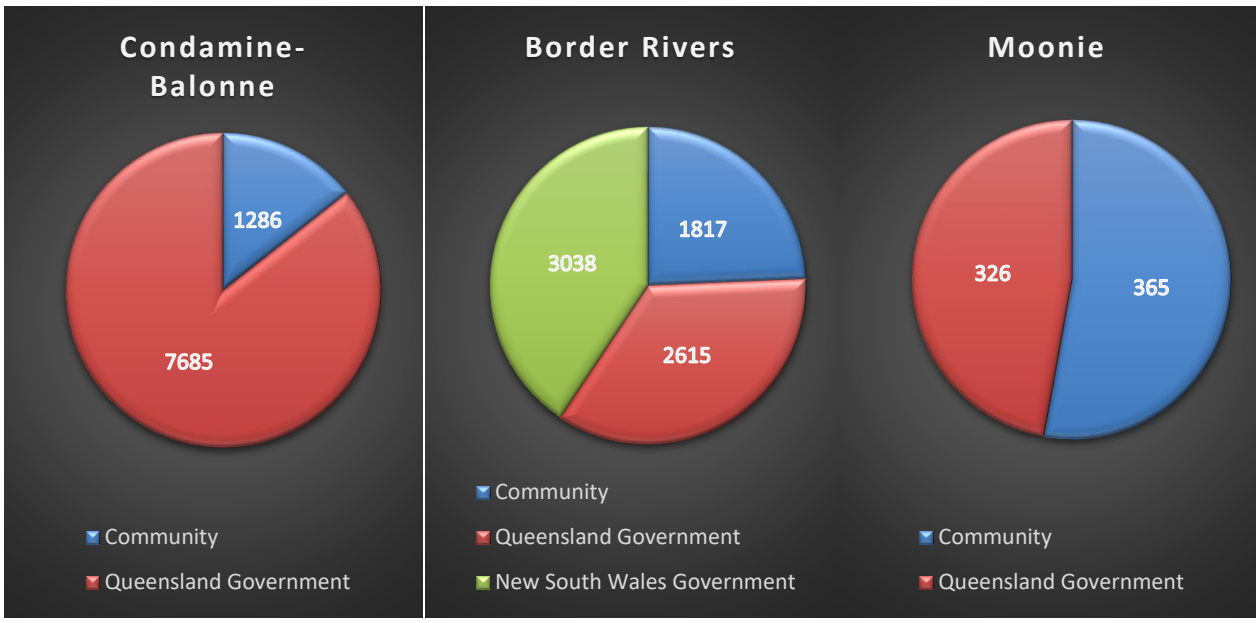

TABLE 2: **LIKELIHOOD TABLE**

Likelihood categories	Definition	Score
Rare	Occurs only in exceptional circumstances (occurrence probability < 15%)	1
Unlikely	Uncommon, could occur but not expected (occurrence probability 15–34%)	2
Possible	Could occur in the assessment area (occurrence probability 35–64%)	3
Likely	Will probably occur in most circumstances (occurrence probability 65–84%)	4
Almost certain	Is expected to occur in most circumstances – will be evident throughout the assessment area (occurrence probability > 85%)	5

Level of risk

The level of risk is determined using the definitions identified in the consequence and likelihood tables and the matrix shown in **Table 3**. The AS/NZS ISO 31000:2009 Risk Management - Principles and Guidelines states the following:

Figure 4: Showing the quantity of data analysed for the assessment of likelihood of risks occurring for the Condamine-Balonne, Border Rivers and Moonie basins, broken down by data source

- consequences may be expressed qualitatively or quantitatively,
- the risk can escalate though knock-on effects
- likelihood can be defined, measured or determined objectively or subjectively, qualitatively or quantitatively and described using general terms or mathematically.

TABLE 3: **CONSEQUENCE AND LIKELIHOOD SCORING**

	Consequence				
Likelihood	Insignificant 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
Rare 1	1	2	3	4	5
Unlikely 2	2	4	6	8	10
Possible 3	3	6	9	12	15
Likely 4	4	8	12	16	20
Almost certain 5	5	10	15	20	25

Based on **Table 3**, the level of risk is categorised into low, medium, high or very high as per the scoring in **Table 4**.

TABLE 4: **LEVEL OF RISK**

Risk ranking	Scores
High	12–25
Medium	8–11
Low	1–7

As per section 10.43 of the Basin Plan, any risk identified as medium or above must be addressed by management strategies within a water resource plan. The exception to this is if it can be explained why the risk cannot be addressed by the water resource plan in a manner commensurate with the level of risk. It is important therefore to clearly explain why a risk would be considered low and therefore tolerable without need for mitigation measures. The following is an explanation of the reasoning behind the 'low' level of risk identified in **Table 4**.

- Any risk that has a consequence of insignificant is considered a low risk because the consequences of the event occurring, irrespective of the likelihood of occurrence, would have undetectable impacts (refer to **Table 1**).
- A risk that has a consequence of minor and a likelihood of possible or less is considered a low risk because even if the event were to occur the consequences of the event are minimal and are recoverable in the short-term. This reasoning also applies to a risk that has a consequence of moderate but a likelihood of unlikely.
- A risk that has a likelihood of rare is ranked as low because it is only likely to occur in exceptional circumstances. The water resource plan accreditation package will include measures to manage extreme events, as required under section 10.51 of the Basin Plan.

Uncertainty rating for level of risk

In accordance with section 10.41(8) of the Basin Plan, the risk assessment must describe any quantified uncertainty in the level of risk attributed to each risk. To do so, an uncertainty score for each risk was assigned as per **Table 5** (based on the approach used by DNRME). Uncertainty scoring was applied to both the likelihood and consequence ranking.

TABLE 5: **UNCERTAINTY SCORES**

Category	Definition	Score
High	Inferred, very little evidence; some information known but not directly relevant to the region	1
Medium	Have some confidence in the score based on local knowledge but this may be limited	2
Low	Adequate high-quality evidence to support scores; process has been documented at a local or regional scale	3

Step 5: Evaluate and treat risks

This step determines which risks require treatment or whether the risk can be tolerated without treatment. Options are identified to treat intolerable risks and ensure the most appropriate treatment/s for reducing the level of risk is implemented.

Section 10.43 of the Basin Plan states that if the level of risk is medium or higher, the water resource plan must either—

- describe a strategy for the management of the water resources of the water resource plan area that will address the risk, in a manner commensurate with the level of risk; or
- explain why the risk cannot be addressed by the water resource plan in a manner commensurate with the level of risk.

In addition, section 10.31 of the Basin Plan applies to the preparation of a Water Quality Management Plan. If any kind of risk (low, medium or high) has been identified in relation to elevated levels of salinity or other types of water quality degradation, the Water Quality Management Plan must explain why measures addressing the risk have or have not been included in the water resource plan.

For the purposes of the accreditation package, the index will direct the reader to the various instruments that make up the water resource plan as defined under section 10.04 of the Basin Plan. The instruments will include measures and strategies to address risks.

Step 6: Monitor and review

Section 10.46 of the Basin Plan states that a water resource plan must specify the monitoring of the water resources of the water resource plan area that will be done to enable the Basin State to fulfil its reporting obligations under section 13.14. There will also be the opportunity for a formal review of water resource plans, including the Water Quality Management Plans, at five (5) and 10 year intervals under the Basin Plan.

Appendix 4— Persistent Waterholes in the Condamine River basin

Source: Persistent Waterhole Classification – Ozius Spatial on behalf of Water Planning Ecology, (former) Department of Science, Information Technology and Innovation, 2017.

Table 65: Persistent waterholes in the Condamine River basin

Basin	Location	Latitude	Longitude
Condamine River	Wildash	-28.30649	152.051
Condamine River	Leslie Dam	-28.24995	151.9135
Condamine River	Leslie Dam	-28.24944	151.8827
Condamine River	Leslie Dam	-28.24698	151.8802
Condamine River	Leslie Dam	-28.24369	151.909
Condamine River	Mount Colliery	-28.24201	152.3292
Condamine River	Leslie Dam	-28.23199	151.9088
Condamine River	Leslie Dam	-28.22902	151.9202
Condamine River	Karara	-28.19245	151.552
Condamine River	Leyburn	-28.09682	151.599
Condamine River	Leyburn	-28.0866	151.606
Condamine River	Leyburn	-28.08636	151.6032
Condamine River	Leyburn	-28.07766	151.5156
Condamine River	Leyburn	-28.07699	151.5157
Condamine River	Leyburn	-28.06368	151.5375
Condamine River	Yandilla	-27.87779	151.3794
Condamine River	Yandilla	-27.87751	151.3788
Condamine River	Yandilla	-27.8775	151.3773
Condamine River	Yandilla	-27.87724	151.3782
Condamine River	Yandilla	-27.86872	151.3674
Condamine River	Yandilla	-27.86708	151.3662
Condamine River	Yandilla	-27.86654	151.3662
Condamine River	Yandilla	-27.86572	151.3659
Condamine River	Yandilla	-27.86299	151.3644
Condamine River	North Branch	-27.85272	151.6132
Condamine River	North Branch	-27.85134	151.6098
Condamine River	Tummaville	-27.85108	151.5588
Condamine River	Yandilla	-27.85098	151.3564
Condamine River	Tummaville	-27.84892	151.4709
Condamine River	Tummaville	-27.84031	151.4644
Condamine River	Tummaville	-27.83947	151.461
Condamine River	Lemontree	-27.7601	151.3188
Condamine River	Lemontree	-27.75326	151.3132
Condamine River	Condamine Plains	-27.75325	151.3125
Condamine River	Brookstead	-27.74016	151.3962
Condamine River	Kurrowah	-27.72782	151.2703
Condamine River	Pittsworth	-27.70807	151.6077
Condamine River	Condamine Plains	-27.68262	151.3611
Condamine River	Brookstead	-27.68145	151.3535

Basin	Location	Latitude	Longitude
Condamine River	Condamine Plains	-27.68039	151.3553
Condamine River	Condamine Plains	-27.68034	151.3513
Condamine River	Condamine Plains	-27.67865	151.3499
Condamine River	Condamine Plains	-27.6776	151.3482
Condamine River	Kurrowah	-27.65682	151.2014
Condamine River	Kurrowah	-27.65572	151.2
Condamine River	Cecil Plains	-27.55713	151.187
Condamine River	Cecil Plains	-27.55109	151.191
Condamine River	Cecil Plains	-27.55064	151.1983
Condamine River	Cecil Plains	-27.55055	151.1917
Condamine River	Evanslea	-27.54448	151.5417
Condamine River	Cecil Plains	-27.54336	151.2006
Condamine River	Cecil Plains	-27.54103	151.202
Condamine River	Cecil Plains	-27.53862	151.2004
Condamine River	Cecil Plains	-27.53797	151.2025
Condamine River	Cecil Plains	-27.5377	151.2031
Condamine River	Cecil Plains	-27.53691	151.2043
Condamine River	Cecil Plains	-27.53527	151.2031
Condamine River	St Ruth	-27.25853	151.2022
Condamine River	Kumbarilla	-27.2088	150.9707
Condamine River	Ranges Bridge	-27.16615	151.0175
Condamine River	Beelbee	-27.12739	150.8315
Condamine River	Macalister	-27.11304	150.9954
Condamine River	Kogan	-27.03238	150.9412
Condamine River	Macalister	-27.0238	151.0221
Condamine River	Macalister	-27.02297	151.0215
Condamine River	Macalister	-27.02133	151.0203
Condamine River	Montrose	-27.01233	150.6952
Condamine River	Wieambilla	-26.99292	150.4792
Condamine River	Warra	-26.9825	150.993
Condamine River	Hopeland	-26.97007	150.645
Condamine River	Brigalow	-26.96338	150.8458
Condamine River	Brigalow	-26.94314	150.8758
Condamine River	Warra	-26.94074	150.8962
Condamine River	Boonarga	-26.84087	150.7462
Condamine River	Hopeland	-26.84018	150.6978
Condamine River	Brigalow	-26.83642	150.7669
Condamine River	Boonarga	-26.83061	150.692
Condamine River	Boonarga	-26.83007	150.692
Condamine River	Boonarga	-26.82335	150.6948
Condamine River	Boonarga	-26.822	150.6952
Condamine River	Boonarga	-26.82092	150.6955
Condamine River	Cooranga	-26.8196	151.2233
Condamine River	Boonarga	-26.8185	150.6962
Condamine River	Boonarga	-26.81814	150.7158

Basin	Location	Latitude	Longitude
Condamine River	Boonarga	-26.81813	150.7126
Condamine River	Cooranga	-26.818	151.2253
Condamine River	Boonarga	-26.81741	150.6962
Condamine River	Hopeland	-26.8159	150.5852
Condamine River	Hopeland	-26.80907	150.6767
Condamine River	Hopeland	-26.80867	150.6744
Condamine River	Boonarga	-26.80675	150.6895
Condamine River	Cooranga	-26.80618	151.2009
Condamine River	Hopeland	-26.80535	150.6298
Condamine River	Boonarga	-26.80458	150.6895
Condamine River	Hopeland	-26.80317	150.5886
Condamine River	Boonarga	-26.80295	150.6889
Condamine River	Hopeland	-26.8021	150.6871
Condamine River	Hopeland	-26.80184	150.6281
Condamine River	Hopeland	-26.80108	150.6255
Condamine River	Chinchilla	-26.80104	150.6231
Condamine River	Crossroads	-26.80075	150.5768
Condamine River	Hopeland	-26.80019	150.5885
Condamine River	Hopeland	-26.79984	150.6483
Condamine River	Hopeland	-26.79917	150.673
Condamine River	Hopeland	-26.79892	150.6745
Condamine River	Boonarga	-26.79713	150.6809
Condamine River	Hopeland	-26.79706	150.6764
Condamine River	Boonarga	-26.79659	150.6809
Condamine River	Jandowae	-26.79534	151.2106
Condamine River	Hopeland	-26.79496	150.6399
Condamine River	Hopeland	-26.79468	150.6313
Condamine River	Chinchilla	-26.7944	150.6628
Condamine River	Chinchilla	-26.79387	150.6635
Condamine River	Chinchilla	-26.79364	150.666
Condamine River	Chinchilla	-26.79313	150.668
Condamine River	Chinchilla	-26.79291	150.6306
Condamine River	Hopeland	-26.79178	150.6686
Condamine River	Chinchilla	-26.79128	150.6222
Condamine River	Hopeland	-26.79096	150.6677
Condamine River	Hopeland	-26.79075	150.6306
Condamine River	Hopeland	-26.78976	150.6286
Condamine River	Tuckerang	-26.78962	151.0245
Condamine River	Chinchilla	-26.78949	150.6445
Condamine River	Hopeland	-26.78917	150.6256
Condamine River	Hopeland	-26.78913	150.6476
Condamine River	Tuckerang	-26.78895	151.025
Condamine River	Chinchilla	-26.78862	150.6246
Condamine River	Hopeland	-26.7853	150.6449
Condamine River	Hopeland	-26.78396	150.6621

Basin	Location	Latitude	Longitude
Condamine River	Chinchilla	-26.78234	150.5898
Condamine River	Hopeland	-26.78193	150.6472
Condamine River	Brigalow	-26.7809	150.8093
Condamine River	Chinchilla	-26.78054	150.6601
Condamine River	Chinchilla	-26.77944	150.6586
Condamine River	Hopeland	-26.77935	150.6532
Condamine River	Hopeland	-26.7791	150.6547
Condamine River	Hopeland	-26.77845	150.6507
Condamine River	Hopeland	-26.77824	150.652
Condamine River	Boonarga	-26.77083	150.7372
Condamine River	Chances Plain	-26.76417	150.8128
Condamine River	Chances Plain	-26.75619	150.7273
Condamine River	Goombi	-26.75316	150.4387
Condamine River	Chances Plain	-26.74757	150.8076
Condamine River	Wychie	-26.74455	150.849
Condamine River	Chances Plain	-26.74214	150.7978
Condamine River	Wychie	-26.74155	150.8388
Condamine River	Chinchilla	-26.73876	150.6058
Condamine River	Jandowae	-26.73792	151.2627
Condamine River	Chances Plain	-26.7375	150.7187
Condamine River	Jandowae	-26.73635	151.2572
Condamine River	Chances Plain	-26.73474	150.7921
Condamine River	Canaga	-26.72075	150.8096
Condamine River	Jandowae	-26.70829	151.2006
Condamine River	Jandowae	-26.70775	151.2003
Condamine River	Jandowae	-26.69203	151.1163
Condamine River	Jandowae	-26.69152	151.1183
Condamine River	Red Hill	-26.68801	150.6964
Condamine River	Baking Board	-26.68758	150.5499
Condamine River	Jandowae	-26.68519	151.2266
Condamine River	Jinghi	-26.68283	151.0365
Condamine River	Burncluith	-26.68054	150.7375
Condamine River	Goombi	-26.67867	150.3913
Condamine River	Baking Board	-26.67425	150.5933
Condamine River	Pelican	-26.67228	150.8682
Condamine River	Diamondy	-26.66338	151.2035
Condamine River	Diamondy	-26.66265	151.2484
Condamine River	Diamondy	-26.66138	151.2607
Condamine River	Jandowae	-26.65686	151.1703
Condamine River	Red Hill	-26.65119	150.6474
Condamine River	Diamondy	-26.63741	151.2497
Condamine River	Diamondy	-26.62524	151.2763
Condamine River	Diamondy	-26.59702	151.2461
Condamine River	Pelican	-26.59434	150.8469
Condamine River	Pelican	-26.5674	150.8442

Basin	Location	Latitude	Longitude
Condamine River	Burncluith	-26.55195	150.6647
Condamine River	Blackswamp	-26.54891	150.6021
Condamine River	Fairyland	-26.54701	150.8747
Condamine River	Fairyland	-26.53411	150.8445
Condamine River	Burra Burri	-26.51225	151.0574
Condamine River	Burra Burri	-26.49753	150.9915
Condamine River	Burra Burri	-26.47856	151.0097
Condamine River	Burra Burri	-26.47377	151.0156
Condamine River	Burra Burri	-26.42208	151.0078
Condamine River	Burra Burri	-26.41938	151.0107
Condamine River	Burra Burri	-26.40904	151.0739