



Aquatic Conservation Assessment

**Riverine and non-riverine wetlands of the
Queensland Fitzroy Great Barrier Reef
Connecting Catchments**

Summary Report, Version 2.1

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Version history

Version	Type	Release Date	Description
1.1	Riverine	2009	Aquatic Conservation Assessment using AquaBAMM for the riverine wetlands of the Great Barrier Reef catchments.
1.3	Non-riverine	2012	Aquatic Conservation Assessments, using AquaBAMM for the non-riverine wetlands of the Great Barrier Reef catchments.
2.1	Riverine and non-riverine	2026	Aquatic Conservation Assessment using AquaBAMM for the riverine and non-riverine wetlands of the Queensland Fitzroy Great Barrier Reef Connecting Catchments.

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This report should be read in conjunction with the accompanying expert panel report:

DETSI. 2026. Aquatic Conservation Assessment using AquaBAMM: Riverine and non-riverine wetlands of the Queensland Fitzroy Great Barrier Reef Connecting Catchments: Flora, Fauna and Ecology Expert Panel Report, Version 2.1. Brisbane: Department of the Environment, Tourism, Science and Innovation Government.

Glossary

ACA	Aquatic Conservation Assessment
AquaBAMM	Aquatic Biodiversity Assessment and Mapping Method
APFD	Annual Proportional Flow Deviation
ASFB	Australian Society for Fish Biology
AUSRIVAS	Australian River Assessment System
BONN	Bonn Convention on the Conservation of Migratory Species
CAMBA	China-Australia Migratory Bird Agreement
CIM	Criterion, Indicator and Measure (used in AquaBAMM)
DIWA	Directory of Important Wetlands in Australia
DETSI	Department of the Environment, Tourism, Science and Innovation
EPBC	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FGBRCC	Fitzroy Great Barrier Reef Connecting Catchments
GBRCC	Great Barrier Reef Connecting Catchments
JAMBA	Japan-Australia Migratory Bird Agreement
NCA	<i>Nature Conservation Act 1992</i>
NR	non-riverine
QHFD	Queensland Historical Fauna Database
R	riverine
Ramsar	Ramsar Convention on Wetlands
RE	regional ecosystem
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
SIGNAL2	Stream Invertebrate Grade Number – Average Level
SOR	State of the Rivers report
WWF	World Wildlife Fund

Introduction

The Department of the Environment, Tourism, Science and Innovation (DETSI) has undertaken a review and update of the freshwater Aquatic Conservation Assessments (ACA) for catchments in the Fitzroy and Mackay/Whitsunday region. The current combined assessments are titled – Queensland Fitzroy Great Barrier Reef Connecting Catchments Aquatic Conservation Assessments (FGBRCC ACA) version 2.1. Expert panels, held in Rockhampton in May 2024, assessed the flora, fauna and ecology values of the study areas. See Attachment A – An Aquatic Conservation Assessment; Riverine and non-riverine wetlands of the Queensland Fitzroy Great Barrier Reef Connecting Catchments: Flora, Fauna and Ecology Expert Panel Report, Version 2.1. for more information regarding the expert panel process and results.

The Aquatic Biodiversity Assessment and Mapping Methodology (AquaBAMM) was developed in 2006 to provide a robust and repeatable method for assessing the biological and ecological values of Queensland's wetlands (Clayton et al. 2006). It does not assess social, cultural, economic or tenure values.

The AquaBAMM method uses a comprehensive set of criteria founded upon a large body of national and international literature. Criteria are combined to assign an overall biodiversity value (AquaScore) to each wetland or spatial unit assessed. The criteria, each of which have a variable number of indicators and measures, include Naturalness Aquatic, Naturalness Catchment, Diversity and Richness, Threatened Species and Ecosystems, Priority Species and Ecosystems, Special Features, Connectivity and Representativeness. Assessment measures are populated with data from a range of sources including expert opinion elicited during structured expert panel workshops. The product of applying the AquaBAMM is an Aquatic Conservation Assessment (ACA) for a particular study area (a drainage catchment).

Well-documented conservation values for aquatic ecosystems are an important input to natural resource management and regulatory decision-making processes including regional planning, development assessment and tenure negotiations such as those related to protected area estates. ACAs provide a powerful decision support tool that can be easily interrogated to support these decisions, policy and regulatory development and implementation. For example, ACA results can have applications in:

- Determining priorities for protection, regulation or rehabilitation of wetlands and other aquatic ecosystems.
- On-ground investment in wetlands and other aquatic ecosystems.
- Contributing to impact assessment of large-scale development (e.g. dams).
- Water resource and strategic regional planning processes.
- Providing input to broader social and economic evaluation and prioritisation processes.

At its most basic level this product is an inventory of the biological and ecological conservation values associated with freshwater wetlands within Queensland. It is up to the end user to carefully gauge suitability for their intended purpose, giving due diligence to the caveats and constraints discussed in the section Caveats, limitations and recommendations.

This report summarises the methods and results for the Aquatic Conservation Assessments completed for the Fitzroy Great Barrier Reef Connecting Catchments. Freshwater riverine and non-riverine systems have been assessed.

This report should be read in conjunction with the accompanying expert panel report – *An Aquatic Conservation Assessment for the riverine and non-riverine wetlands of the Queensland Fitzroy Great Barrier Reef Connecting Catchments: Flora, Fauna and Ecology Expert Panel Report, Version 2.1*. Department of the Environment, Tourism, Science and Innovation, Queensland Government.

Queensland Fitzroy Great Barrier Reef Connecting Catchments study regions

This Aquatic Conservation Assessment covers 18 drainage catchments including the Boyne, Calliope, Curtis Island, Comet, Dawson, Fitzroy, Isaac, Mackenzie, Nogoa, O'Connell, Pioneer, Plane, Proserpine, Shoalwater, Styx, Waterpark, Whitsunday Island and Fitzroy Other Islands (Figure 1).

The Fitzroy GBRCC combined study areas are located in the largest eastward flowing system in Australia. From waterfalls and cascades in the rainforests of the Whitsunday coast, to the meandering floodplain streams of the Fitzroy study area, it is a vast and varied area. The region holds Ramsar listed wetlands, iconic sandstone gorges in the Carnarvon Ranges, perched lakes in the upper Comet study area and world-recognised wetland complexes such as the Goorganga Plains. Its waterways eventually drain to the coastal waters of the southern Great Barrier Reef Marine Park.

The climate of the region ranges from tropical in the north to subtropical in the south. Rainfall is seasonal with a pronounced wet season from December to March though total rainfall can vary dramatically from year to year. For instance, between 1976 and 2008, wet season flow to the mouth of the Fitzroy varied from approximately 0.35 million megalitres to 22.9 million megalitres. Much of the aquatic ecology of the area is driven by boom-and-bust cycles.

Much of the region has been cleared, predominantly for cattle grazing on natural pastures. Extensive cropping and intensive cultivation of sugar cane are also widespread in coastal catchments. Mining, industrial activities and urban development occur throughout the catchment. The catchment includes the Port of Gladstone, which is Queensland's largest multi-commodity port and is located within one of Australia's best natural deep-water harbours, and many associated industrial activities. While some catchments are highly modified and some rivers are heavily regulated by dams, weirs and irrigation development, the area includes two catchments that are surrounded by protected areas (Waterpark Creek and Repulse Creek).

Further information on Fitzroy catchments is available in the ['Walking the Landscape' catchment stories](#).

Boyne study area

The Boyne catchment covers an area to the south of Gladstone and includes the townships of Nagoorin, Ubobo, Boyne Island, Tannum Sands and Benaraby. The Boyne River and its tributaries are the major streams in the area. The Boyne is highly regulated by the large Awoonga Dam that supplies water to Gladstone and to the power station on Callide Creek in the Dawson catchment to the west. The headwaters of the Boyne drain from Kroombit Tops, Castletower, Bulburin and Dawes National Parks and these upper reaches are surrounded by high ecological value (HEV) habitat.

Calliope study area

The Calliope catchment is located to the north and west of Gladstone. It includes the Calliope and its tributaries and some smaller waterways including Alma, Larcom and Neil creeks. The Calliope River is one of the few east coast rivers that are not regulated by a dam or weir and good ecological connectivity is maintained from its source to its estuary. Its freshwater reaches are relatively natural. However, its estuary flows through major industrial sites around the Port of Gladstone including a power station that releases cooling water into its lower reaches.

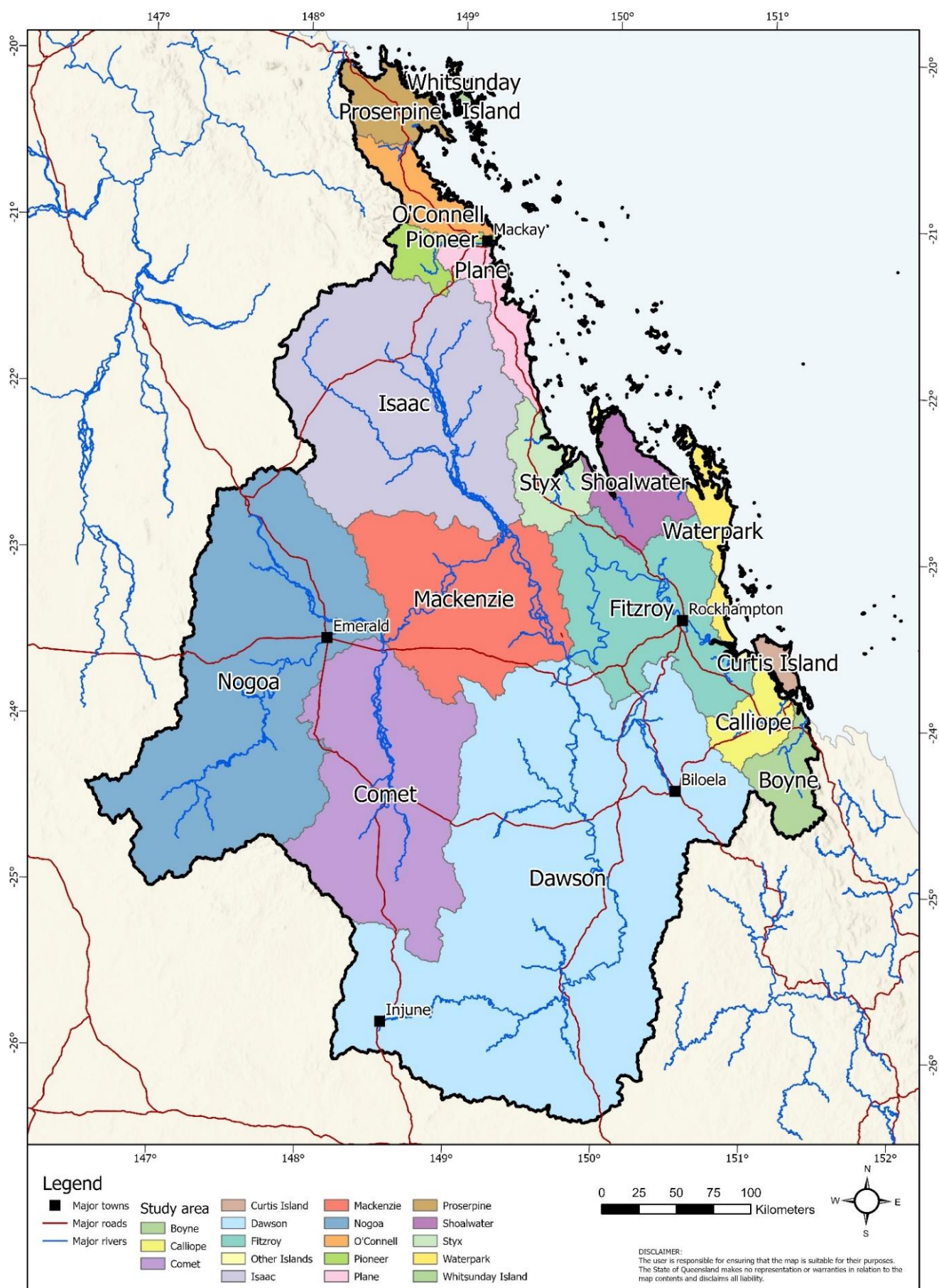


Figure 1 Study areas of the Queensland Fitzroy Great Barrier Reef Connecting Catchments Aquatic Conservation Assessment v2.1

Most of the catchment's freshwaters are surrounded by grazing lands. Townships within the catchment include Gladstone, Calliope and Mount Larcom. The Calliope catchment includes three national parks – Dan Dan, Kroombit Tops and Rundle Range. The catchment also includes the Calliope Conservation Park, Rundle Range Resource Reserve and several state forests.

The geological nature of Calliope catchment does not allow for the development of major inland (palustrine) wetlands, although significant wetland developments occur in the coastal areas (estuarine), near Curtis Island. The wetlands and creeks of the catchment provide habitat for many aquatic species, including plants, fish, freshwater turtles, frogs and migratory birds. Estuarine areas also support important plants.

Comet study area

The Comet catchment is located west of the Great Dividing Range largely to the south and east of Emerald. The major river system is the Comet and its tributaries such as Orion and Humboldt creeks.

This catchment originates in the Carnarvon and Expedition Ranges and flows across a relatively flat floodplain into the Mackenzie River. Several large, perched lakes including Lake Nugga Nugga occur in its headwaters. The catchment is flatter and the streams less steep than others in the Fitzroy region.

The catchment has levees and water harvesting infrastructure and the Comet Weir is found near its confluence with the Mackenzie. The major industry of the catchment is grazing but significant coal mines and cropping also occur. Townships include Rolleston, Springsure and Comet.

Curtis Island study area

The Curtis Island catchment contains few freshwater streams but has significant non-riverine wetlands with good connectivity to estuarine systems. Most of the catchment's wetlands are surrounded by grazing lands or are within the Curtis Island National Park and Curtis Island Conservation Park.

Dawson study area

The Dawson catchment is the largest of the Fitzroy GBRCC catchments. Its sources include the Carnarvon Range to the south, the Expedition Range and Blackdown Tableland to the west and the Kroombit and Mount Morgan ranges to the east. The Dawson has several major tributaries including the Don and Dee rivers, Callide, Mimosa, Palm Tree, Juandah, Eurombah and Injune creeks, and joins the Mackenzie River to form the Fitzroy.

The Dawson Valley tends to be relatively flat and the river frequently splits into anabranches and oxbow lakes in some places. The river intersects sandstone gorges, notably the Nathan Gorge near Taroom and has complex groundwater links that produce unusual mound springs (boggomosses) holding unique plant communities.

Townships within the sub-catchment include Injune, Wandoan, Taroom, Theodore, Moura, Baralaba, Biloela, Mount Morgan and Duaringa. There is extensive grazing throughout the catchment as well as small areas of irrigated and dry-land cropping. There are several large coal mines and coal seam methane gas production is a significant and growing land use in the area that impacts on water flows.

The Dawson catchment has dams and weirs including the Glebe, Orange Creek, Gylanda, Theodore, Moura and Neville Hewitt weirs on the Dawson and Kroombit and Callide dams on the Callide Creek system. There are also dams on the Dee River near Mount Morgan to provide water for the township and others to contain contaminated water runoff from the Mount Morgan Mine tailings. Water is also flood harvested from the Dawson into off stream storage at Moura. Water is also pumped over the range from the Awoonga Dam on the Boyne River into Callide Dam. Most of the flows in the Dawson occur in summer but its southern catchments may also receive significant winter rains in some years.

Fitzroy study area

The Fitzroy catchment receives its waters from the Mackenzie and Dawson rivers. It also receives significant inflows from Marlborough, Neerkol and Alligator creeks. The area also includes smaller Fitzroy delta streams including Raglan Creek.

More than half of the catchment has been cleared. Grazing is a major land use, and cropping, horticulture, mining and quarrying occur throughout the catchment. The catchment contributes significant sediment to the Great Barrier Reef as a result of human impacts.

The Fitzroy River estuary flows through the city of Rockhampton and the townships of Marlborough, Yaamba, Westwood, Bajool and Raglan. There are industrial developments close to the river including two large meatworks and the Stanwell Power Station. The Fitzroy is highly regulated as a result of upstream dams and weirs. Eden Bann Weir and the Fitzroy Barrage prevent tidal saltwater from moving upstream and supply water to Rockhampton, Stanwell Power Station and the Capricorn Coast region.

The catchment holds the Goodedulla and Mount Archer national parks and parts of the Fitzroy River Fish Habitat Area. The catchment also includes conservation areas, nature refuges, and several large off stream wetlands through the Fitzroy Delta including Woolwash, Yeppen, Frogmore, Crescent, Nankin, Serpentine and Gracemere lagoons.

Isaac study area

The Isaac catchment is located west of the Great Dividing Range roughly west of Sarina and St Lawrence, out to Dysart and Moranbah. The headwaters of the Isaac and Connors Rivers originate in the Clarke-Connors Ranges to the west of Mackay and are important wilderness areas and climate refugia for many aquatic and terrestrial species. The tributaries of the Connors River originate in the Connors Range which is relatively wetter and cooler than the broader region, providing essential refugia within an increasingly hot and arid coastal zone between the Wet Tropics and southeast Queensland rainforests. The Clark-Connors Range is habitat for the threatened yellow-bellied glider (*Petaurus australis*), a number of endemic frogs and charismatic leaf-tailed gecko (*Phyllurus nepthys*).

The lower Isaac and Connors Rivers become split into complex multi-channels and anabranches that can become separated lagoons during the dry season. This catchment provides most of the flow reaching the Fitzroy Estuary.

Grazing and coal mining are the predominant land uses within the catchment. Townships in the catchment include Nebo, Moranbah and Dysart. This catchment is currently less regulated than any of the other Fitzroy catchments with only small dams occurring in the upper Isaac River including Burton Gorge Dam. Large quantities of water are pumped from the Burdekin catchment into this catchment to supply the needs of coal mining.

National Parks within the area include Dipperu National Park, Junee National Park and Homevale National Park. There are also several State Forests that mostly occur within the east of the catchment.

Mackenzie study area

The Mackenzie catchment receives flows from the Nogoia, Comet and Isaac rivers. The catchment extends downstream to the confluence with the Dawson River after which it becomes the Fitzroy. Most of the upper catchment flows through a single channel. However, at the confluence with the Isaac River the river has several large floodplain waterholes such as Lake Mary that may become river channels during floods.

Townships in the catchment include Middlemount, Blackwater and Dingo. Grazing is the predominant land use in the catchment, but coal mining and cropping are also important land uses. The catchment is highly regulated with flows being controlled through Bingegang, Bedford and Tartarus weirs as well as several water harvesting operations.

Nogoa study area

The Nogoa catchment is located west of the Great Dividing Range largely to the west of Emerald. Townships in the catchment include Emerald, Rubyvale, Sapphire, Clermont and Capella. The major river system is the Nogoa and its tributaries such as Theresa and Crinum creeks.

This catchment originates between Carnarvon Range and Clermont and shares its origins with the Burdekin, Burnett and Murray Darling systems. It is totally landlocked and flows into the Mackenzie River system. Grazing is the predominant land use in the catchment but there are a significant number of coal mines, and cropping is important in the Emerald irrigation area. The catchment is highly regulated downstream of the large Fairbairn Dam near Emerald and flows are regulated by several weirs and the Theresa Creek Dam.

O'Connell study area

The O'Connell catchment is located to the south of Proserpine and north of Mackay. This catchment comprises small coastal catchments including the Andromache and O'Connell rivers and several smaller creeks including Murray, Constant, Reliance and Blackrock creeks.

The major land uses of the area include cattle grazing, cane growing, forestry, and urban (residential). Townships and rural residential areas in the catchment include Bloomsbury, Midge Point, Calen, Kuttatubul and Seaforth with Bucasia and Blacks Beach (Northern Beaches). Numerous barriers affect fish passage in the O'Connell catchment and a number of fishways assist in improving fish passage past barriers.

The O'Connell catchment has a tropical climate with a pronounced wet season between December and March. The streams tend to be relatively short and fast flowing from rainforest headwaters in Eungella National Park and Cathu State Forest across a highly modified coastal plain extensively developed for sugar cane growing. There are few wetlands along the major watercourses inland, but the coastal sediments and geology support low-lying coastal swamps and estuarine wetland.

Pioneer study area

The Pioneer catchment falls within the Mackay Regional Council area. This catchment includes the Pioneer River and its tributaries such as Cattle, Teemburra, and Silver creeks.

Most of the headwaters of the Pioneer rise in the national parks of the Clark Range, such as the Eungella National Park, or state forest (including Crediton State Forest) and then flow across a highly modified coastal plain through the city of Mackay. The Clark Range has the largest area of wet sclerophyll forest within the region and a huge suite of endemic flora and fauna including the threatened yellow-bellied glider.

Townships in the area include Mackay, Marian, Mirani and Pinnacle. The major land uses of the area include cane growing, cattle grazing, forestry (including plantations), and urban. The Pioneer River is highly regulated with a major dam (Teemburra Dam) and a series of weirs (Marian, Mirani and Dumbleton). Water is also diverted through a series of creeks to be utilised in the Pioneer Valley Water Supply Scheme and also pumped to the nearby Kinchant Dam which is the major storage for the Eton Irrigation Scheme in the Plane Creek catchment.

The Proserpine catchment has a tropical climate with a pronounced wet season between December and March.

Plane study area

The Plane catchment is located to the south of Mackay and consists of several coastal subcatchments. The main waterways are Sandy, Alligator, Plane and Rocky Dam creeks together with many smaller waterways, including Bakers, Louisa and Cape creeks in the north and Marion, West Hill, Carmila and Flagg Rock creeks in the south.

The Plane catchment has a tropical climate with a pronounced wet season between December and March. The streams tend to be relatively short and fast flowing from rainforest headwaters. In the north they flow across a highly modified coastal plain extensively developed for sugar cane growing.

Southern streams largely rise in state forests such as the West Hill and Kelvin State Forest. Cape Palmerston National Park is found on the coast within the catchment.

Townships within the catchment include Sarina, Koumala, Carmila and Clairview. The northern streams form part of the Eton Water Supply Scheme supplying water for irrigated cane growing. Water from the Pioneer River is flood harvested and transferred into these streams in part through the large offstream storage Kinchant Dam. Plane Creek has a series of small weirs regulating its flows. Streams in the southern parts of the catchment tend to be less regulated and modified.

Proserpine study area

The Proserpine catchment is located on the coast to the south of Bowen and north of Mackay. The catchment consists of the Proserpine River and smaller areas such as Gregory River, Whitsunday Coastal Creeks, Eden Lassie Creek, and Goorganga Plains.

Streams in the area tend to be short and fast flowing usually with headwaters in rainforest. Goorganga Plains holds world-recognised wetlands, though these have been impacted by hyphenachne and barriers to fish passage that block life-cycle dependent migrations for important fish species. Repulse Creek (in Whitsunday Coastal Creeks subcatchment) is one of few streams in Queensland almost entirely enclosed in protected area (predominantly Conway National Park).

Cane growing and cattle grazing are the main land uses. Townships in the area include Proserpine, Airlie Beach, Dingo Beach and Midge Point. The Proserpine River is highly regulated with a major storage (Lake Proserpine/Peter Faust Dam) in its headwaters. Water is released from this dam through a series of stream diversions to facilitate irrigated sugar cane growing.

The Proserpine catchment has a tropical climate with a pronounced wet season between December and March.

Shoalwater study area

The Shoalwater catchment is located to the north of Rockhampton and south of Mackay. It is largely bounded by the western coast of Shoalwater Bay and the shores of Stanage Bay. It includes the small streams flowing into Stanage Bay such as Herbert and Wadallah creeks, and the settlement of Stanage Bay. It represents a transitional zone between the steep fast streams to the north and the long slow-flowing streams of the Fitzroy Basin. Streams are less steep and slower flowing than those further north.

There are extensive non-riverine wetlands in the vicinity of the Torilla Plains and Glen Prairie to the east and west of Stanage Bay. The extensive levees to stop saltwater intrusion have modified the local water regime, and consequently a number of estuarine wetlands have become extensive freshwater palustrine areas.

The Shoalwater catchment has a tropical to subtropical climate with a pronounced wet season between December and March.

Styx study area

The Styx catchment is located on the coast, to the north of Rockhampton and south of Mackay. The major streams in this small catchment are the Styx River and St Lawrence Creek.

The Styx catchment has a tropical climate with a pronounced wet season between December and March. It represents a transitional zone between the steep fast streams to the north and the long slow-flowing streams of the Fitzroy Basin. Streams are less steep and slower flowing than those further north. The highly dispersive soils of the area make the streams naturally turbid.

Cattle grazing is the major land use in the catchment, with some horticulture and plantation forestry in the north. Locations within the catchment include St Lawrence and Ogmoo. St Lawrence Creek is regulated by a small weir.

Waterpark study area

The Waterpark catchment is located to the north-east of Rockhampton. The northern section from the mouth of Waterpark Creek is one of the least disturbed catchment areas in Queensland with infrequent use in relatively small areas. It holds the Ramsar-listed Shoalwater and Corio Bays Area wetlands and declared Fish Habitat Areas. It is closely managed as part of the Shoalwater Bay Military Training Area, the Byfield National Park and Byfield State Forest with limited access and largely natural remnant vegetation.

The largest stream in the area is Waterpark Creek, which rises from sand dunes in the north and flows south and then east into Corio Bay almost exclusively through protected areas. Its water quality and source from within sand dunes makes it unique within the Fitzroy study area. Within Shoalwater Bay, there are several small streams including Shoalwater Creek and a large wetland complex (Dismal Swamp) but no large rivers. Creeks further south such as Coorooman Creek have more disturbed catchments. The acid wallum wetlands of the Dismal Swamp area are very unusual within the central Fitzroy area. The region holds an unusual mix of tropical, sub-tropical and temperate species. The extensive freshwater peat swamps are rare within the bioregion and in Australia.

The area includes the townships of Yeppoon, Emu Park and Keppel Sands.

Whitsunday Island study area

Though the Whitsundays includes over 90 islands from Bowen to Repulse Islands in the south, this study area only refers to the main Whitsunday Island. All the other islands are included as part of the 'Fitzroy Other Islands study area'.

Whitsunday Island is a national park and has international protection under the Great Barrier Reef World Heritage Area. It has only one palustrine wetland on the southern western end of the island, though there are numerous ephemeral riverine wetlands.

Fitzroy Other Islands study area

There are over 750 islands within this study area that stretch all the way down the coast and include the Whitsunday Island group, the Cumberland Islands, the Northumberland Islands and the Great Keppel Islands. Curtis Island and Whitsunday Island have their own individual study areas.

The Islands have a variety of flora and fauna communities including rainforests, melaleuca and eucalypt swamp forests and grasslands. There are 68 palustrine wetlands scattered on the islands that support a variety of species including the Proserpine rock-wallaby and buff-breasted paradise-kingfisher.

Methods and implementation

AquaBAMM

The Queensland Fitzroy Great Barrier Reef Connecting Catchments Aquatic Conservation Assessments were undertaken using AquaBAMM (Clayton et al 2006). The method has been updated since its development including minor changes to the AquaBAMM tool and revisions to the filter table.

Spatial units

The conservation values of riverine and non-riverine wetlands are calculated and attributed to spatial units. This section describes the spatial units used for each riverine and non-riverine assessment.

Riverine spatial units

Riverine spatial units have been defined by considering hydrological patterns and processes in the landscape. They are generally of a size that balances reporting needs with data availability and can be determined in several ways, including modelling.

In the associated mapping products, riverine assessment values are presented in spatial units which are fine scale riverine catchments. End users can apply any results from this analysis to the riverine wetlands (or drainage lines) within the spatial unit. Riverine wetlands are known as all wetlands and deepwater habitats within a channel (Qld Herbarium and Biodiversity Science definition adapted from Cowardin et. a. 1979). Channels can be natural or artificially created, periodically or continuously contain moving water, or be connected to two bodies of standing water (Langbein and Iseri 1960).

The riverine spatial units were based on those used for the GBR riverine ACA v1.1. Please refer to the summary reports (Inglis and Howell 2009) associated with these assessments for a detailed description of how the spatial units were generated. Minor adjustments were made for the current assessment to align the spatial units with new study area linework (see section Updates to framework datasets).

The FGBRCC riverine assessments included 1,952 riverine spatial units (Table 1). The minimum size for a spatial unit is 0.02 ha which is one of the islands within the Fitzroy Other Islands. The maximum size for a spatial unit is 151,063 ha in Shoalwater study area. The average size of the spatial units is 8,507 ha.

Non-Riverine spatial units

The non-riverine spatial units are based on Queensland Wetland Mapping Version 6.0 – Wetland Areas (2019). Linework and attribute descriptions of Queensland Wetland Mapping are developed from satellite derived waterbody and Regional Ecosystem Mapping (Neldner et al. 2020) using the Wetland Mapping and Classification Methodology (DES 2023).

The Queensland Wetland Mapping is mapped at a scale of 1:100,000 with a positional accuracy of ± 100 metres, except for areas along the east coast that may be mapped at a scale of 1:50,000 with a positional accuracy of ± 50 metres. Wetlands smaller than 1 hectare are not delineated in the Wetland Mapping.

The non-riverine assessments included 14,602 spatial units derived from palustrine and lacustrine (defined by the Queensland Herbarium and Biodiversity Science which is adapted from Cowardin et. a. 1979) wetland waterbodies that have a dominant (>50%) wet regional ecosystem present. All wetlands were assessed as part of this FGBRCC assessment, including hydromodification categories:

- Natural: 'H1'
- Slightly modified: 'H2-M1', 'H2-M1-a', 'H2-M1-b', 'H2-M2', 'H2-M2-a', 'H2-M2-b', 'H2-M2-c', 'H2-M2-d', 'H2-M9', 'H2-M9-a', 'H2-M9-b', 'H2-M9-c', 'H2-M10', 'H2-M10-a', 'H2-M10-c', 'H2-

M11', 'H2-M11-a', 'H2-M11-b', 'H2-M11-d', 'H2-M12', 'H2-M12-a', 'H2-M12-b', 'H2-M12-c', 'H2-M12-d'

- Highly modified: 'H2-M1-e', 'H2-M5', 'H2-M6', 'H2-M6-a', 'H2-M6-b', 'H2-M6-f', 'H2-M7', 'H2-M11-c', 'H2-M13'
- Artificial: 'H3-C1', 'H3-C1-a', 'H3-C1-b', 'H3-C4', 'H3-C5', 'H3-C5-a', 'H3-C5-b'.

Please refer to the mapping data field details in the Queensland Wetland Mapping Classification Database (DESI 2024) for more information on hydrological modifiers.

The intent of an ACA is to provide an inventory and prioritisation of freshwater wetland ecological values. Artificial wetlands, especially relatively large ones may hold some ecological value (e.g. species habitat). Expert panels may, in a very small number of instances, consider an artificial wetland as having sufficient ecological value to identify as a special feature. Artificial wetlands have been included in this ACA for the purpose of ecological comprehensiveness. The values assigned to artificial wetlands are meant to serve primarily as an ecological inventory. Their inclusion is not meant to imply any policy, protective or legislative requirements.

The minimum size for a non-riverine spatial unit within the FGBRCC ACA is 0.1 ha in Isaac River study area and the maximum size is 18,097 ha in Shoalwater study area. The average size for the spatial units is 13.6 ha.

Table 1 Study areas of the Fitzroy Great Barrier Reef Connecting Catchments Aquatic Conservation Assessment

ACA study areas or catchments	Study area code	Catchment area (ha)	Number of riverine spatial units	Number of non-riverine spatial units	Total area of non-riverine spatial units (ha)
Boyne	bo	249,301	69	83	6,336
Calliope	ca	224,863	64	134	1,127
Curtis Island	ci	57,804	18	48	788
Comet	ct	1,727,489	118	1,340	14,792
Dawson	dn	5,068,741	195	3,614	24,818
Fitzroy	fi	1,143,110	94	1,197	28,028
Fitzroy Other Islands	ig	72,616	754	68	624
Isaac	is	2,232,467	174	1,779	12,821
Mackenzie	ma	1,305,897	69	1,521	10,409
Nogoa	no	2,770,589	154	1,709	25,536
O'Connell	oc	238,873	55	573	2,244
Pioneer	pi	157,452	39	87	2,217
Plane	pl	254,423	50	971	11,065
Proserpine	pr	250,002	59	418	14,047
Shoalwater	sh	359,579	14	228	21,852
Styx	st	301,068	9	233	9,609
Waterpark	wa	182,282	16	598	12,219
Whitsunday Island	wi	10,687	1	1	16

Assessment parameters

The criteria, indicators, and measures (CIM) implemented for each FGBRCC ACA are outlined in Table 2. An overview of each criteria and the types of ecological values that are being captured, are outlined in Appendix I – Criteria definitions.

These CIM lists were developed from the default list of criteria, indicators and measures provided by Clayton et al. (2006). The default CIM list provides a starter set for consideration when setting up the assessment parameters for a new ACA, and additional CIM continue to be added to this list to meet end user needs or as new datasets become available.

Each ACA can have a bespoke combination of assessment parameters and are based on a different sets of source datasets. A description of how each measure was implemented for both the riverine and non-riverine assessment is outlined in the tables contained in Appendix II – Measure implementation table.

Table 2 Criterion, Indicator, Measure list used for the Queensland Fitzroy Great Barrier Reef Aquatic Conservation Assessments

Criteria and Indicators	Measures	Riverine	Non-riverine
1. Naturalness aquatic			
1.1 Exotic flora/fauna	1.1.1 Presence of 'alien' fish species within the wetland	Y	Y
	1.1.2 Presence of exotic aquatic and semi-aquatic plants within the wetland	Y	Y
	1.1.3 Presence of exotic invertebrate fauna within the wetland	Y	Y
	1.1.4 Presence of feral/exotic vertebrate fauna (other than fish) within the wetland	Y	Y
1.3 Habitat features modification	1.3.4 Presence/absence of dams/weirs within the wetland	Y	
	1.3.5 Inundation by dams/weirs (% of waterway length within the wetland)	Y	
	1.3.7 % area of remnant wetland relative to preclear extent for each spatial unit	Y	Y
1.4 Hydrological modification	1.4.5 Hydrological disturbance/modification of the wetland (e.g. as determined through DETSI wetland mapping and classification)		Y
2. Naturalness catchment			
2.1 Exotic flora/fauna	2.1.1 Presence of exotic terrestrial plants in the assessment unit	Y	Y
2.2 Riparian disturbance	2.2.1 % area remnant vegetation relative to preclear extent within buffered riverine wetland or watercourses	Y	
	2.2.2 Total number of REs relative to preclear number of REs within buffered riverine wetland or watercourses	Y	
	2.2.5 % area of remnant vegetation relative to pre-clear extent within buffered non-riverine wetland: 500m buffer for		Y

Criteria and Indicators	Measures	Riverine	Non-riverine
	wetlands $\geq$ 8Ha, 200m buffer for smaller wetlands		
	2.2.9 % woody cover within the waterway corridor	Y	Y
2.3 Catchment disturbance	2.3.4 % "settlement" land-use area (i.e. towns, cities, etc)	Y	Y
	2.3.12 Potential land use pressures on water quality within a subsection.	Y	Y
	2.3.13 Potential load of anthropogenic fine sediments within a subsection.	Y	Y
2.4 Flow Modifications	2.4.1 Farm storage (overland flow harvesting, floodplain ring tanks, gully dams) calculated by surface area	Y	Y
	2.4.7 Potential land use pressures on changes to natural flow water regime within a subsection.	Y	Y
3. Diversity and richness			
3.1 Species	3.1.1 Richness of native amphibians (riverine wetland breeders)	Y	
	3.1.2 Richness of native fish	Y	Y
	3.1.3 Richness of native wetland dependent reptiles	Y	Y
	3.1.4 Richness of native waterbirds	Y	Y
	3.1.5 Richness of native aquatic plants	Y	Y
	3.1.6 Richness of native amphibians (non-riverine wetland breeders)		Y
	3.1.7 Richness of native wetland dependent mammals	Y	Y
3.2 Communities/assemblages	3.2.2 Richness of REs along riverine wetlands or watercourses within a specified buffer distance	Y	
3.3 Habitat	3.3.2 Richness of wetland types within the local catchment (e.g. sub-section)	Y	Y
	3.3.3 Richness of wetland types within the sub-catchment	Y	Y
4. Threatened species and ecosystems			
4.1 Species	4.1.1 Presence of rare or threatened aquatic ecosystem dependent fauna species – NCA, EPBC	Y	Y
	4.1.2 Presence of rare or threatened aquatic ecosystem dependent flora species – NCA, EPBC	Y	Y
4.2 Communities/assemblages	4.2.1 Conservation status of wetland Regional Ecosystems – Herbarium biodiversity status, NCA, EPBC	Y	Y
5. Priority species and ecosystems			
5.1 Species	5.1.1 Presence of aquatic ecosystem dependent 'priority' fauna species	Y	Y

Criteria and Indicators	Measures	Riverine	Non-riverine
	(expert panel list/discussion or other lists such as ASFB, WWF)		
	5.1.2 Presence of aquatic ecosystem dependent 'priority' flora species	Y	Y
	5.1.3 Habitat for, or presence of, migratory species (expert panel list/discussion and/or JAMBA / CAMBA agreement lists and/or Bonn Convention)	Y	Y
	5.1.4 Habitat for significant numbers of waterbirds	Y	Y
5.2 Ecosystems	5.2.1 Presence of 'priority' aquatic ecosystem	Y	Y
6. Special features			
6.1 Geomorphic features	6.1.1 Presence of distinct, unique or special geomorphic features	Y	Y
6.2 Ecological processes	6.2.1 Presence of (or requirement for) distinct, unique or special ecological processes	Y	Y
6.3 Habitat	6.3.1 Presence of distinct, unique or special habitat (including habitat that functions as refugia or other critical purpose)	Y	Y
	6.3.2 Significant wetlands identified by an accepted method such as Ramsar, Australian Directory of Important Wetlands, Regional Coastal Management Planning, World Heritage Areas, etc.	Y	Y
	6.3.3 Ecologically significant wetlands identified through expert opinion and/or documented study	Y	Y
	6.3.4 Areas important as refugia from the predicted effects of climate change (e.g. source of species re-population)	Y	Y
6.4 Hydrological	6.4.1 Presence of distinct, unique or special hydrological regimes (e.g. Spring fed stream, ephemeral stream, boggomoss)	Y	Y
7. Connectivity			
7.1 Significant species or populations	7.1.1 The contribution (upstream or downstream) of the spatial unit to the maintenance of significant species or populations.	Y	
	7.1.2 Migratory or routine 'passage' of fish and other fully aquatic species (upstream, lateral or downstream movement) within the spatial unit.	Y	
	7.1.4 Instream fragmentation due to anthropogenic barriers within a sub-catchment, based on an acknowledged metric.	Y	

Criteria and Indicators	Measures	Riverine	Non-riverine
	7.1.5 Feasibility of terrestrial or aquatic movement for amphibian biological connectivity.	Y	Y
7.2 Groundwater dependent ecosystems	7.2.1 The contribution (upstream or downstream) of the spatial unit to the maintenance of groundwater ecosystems with significant biodiversity values (e.g. karsts, cave streams, artesian springs)	Y	Y
7.3 Floodplain and wetland ecosystems	7.3.2 Extent to which the wetland retains critical ecological and hydrological connectivity, where it should exist, with floodplains, rivers, groundwater, etc.	Y	Y
7.4 Terrestrial ecosystems	7.4.2 Terrestrial natural area connectivity within a subsection based on an acknowledged metric.	Y	Y
7.5 Estuarine and marine ecosystems	7.5.1 The contribution of the spatial unit to the maintenance of estuarine and marine ecosystems with significant biodiversity values.	Y	Y
	7.5.2 Extent to which the wetland retains critical ecological and hydrological connectivity, where it should exist in marine or estuarine areas.	Y	
8. Representativeness			
8.1 Wetland protection	8.1.1 The percent area of each wetland type within Protected Areas.		Y
8.2 Wetland uniqueness	8.2.1 The relative abundance of the wetland management group to which the wetland type belongs within the catchment or study area (management groups ranked least common to most common)		Y
	8.2.2 The relative abundance of the wetland management group to which the wetland type belongs within the sub-catchment or estuarine/marine zone (management groups ranked least common to most common)		Y
	8.2.3 The size of each wetland type relative to others of its wetland management group within the catchment or study area		Y
	8.2.4 The size of each wetland type relative to others of its wetland management group within a sub-catchment (or estuarine zone)		Y
	8.2.5 Wetland type representative of the study area – identified by expert opinion	Y	Y

Criteria and Indicators	Measures	Riverine	Non-riverine
	8.2.6 The size of each wetland type relative to others of its type within the catchment or study area		Y

Wetland management groups

The Queensland Wetlands Program identifies attributes addressing characteristics of lacustrine and palustrine wetlands at increasingly specific scales (continental, ecosystem, landscape, and local). These attributes can be used to develop wetland typologies aimed at classifying wetlands into types or groups useful for wetland management, monitoring and regulation.

Through expert consultation, and an iterative process of reality checking with the mapping, a series of wetland habitat types has been developed that are broad enough to cover Queensland, while allowing the identification and grouping of key wetland ecological and physical processes across the broad climatic zones of Queensland (DES 2023). As wetlands are spatially and temporally diverse, this typology also allows wetland habitat types which may be found within an individual wetland to be combined (e.g. a lacustrine waterbody may have a palustrine fringe). Wetland habitat types are subsequently called wetland management groups for the purposes of an Aquatic Conservation Assessment. Wetland management groups are used for AquaBAMM Measures 8.2.1, 8.2.2, 8.2.3 and 8.2.4.

Standardising and weighting measures

Some attributes or measures are known to contribute more strongly to the overall conservation value of a wetland compared to others. Values for each measure are standardised and weighted to provide a common scale for comparison between measures that reflect the differing ecological or biodiversity contribution of each.

Measure data used in an ACA comes from a range of sources and data types (for example continuous, presence/absence, or categorical). To standardise the data, a procedure called thresholding is used to convert the data to a common scale so it can be compared with other datasets. Seven different types thresholding are used depending on the type and distribution of the measure data (e.g. raster percentage index grids or vector points with count values). These are listed in Table 3.

Thresholding involves applying rules to assign a threshold score of 1 (Low), 2 (Medium), 3 (High), or 4 (Very High) to each spatial unit for each measure. The threshold type Continuous Descending (Negative) applies similar rules to calculate the 1 to 4 threshold scores. However, the final scores are ranged from -4 (Low), -3 (Medium), -2 (High) and -1 (Very High).

Table 3 Threshold types used in AquaBAMM

Threshold type	Type of data	Scores
Categorical	Discrete data, mostly used by expert panel members to rate a wetland based on a particular measure.	Scores range from 1 (Low), 2 (Medium), 3 (High), or 4 (Very High).
Continuous Ascending	Continuous data values that may be counts or percentages increasing in conservation value the higher the data value. The data is split into groups either by quartiles, quantiles or Jenks natural breaks.	Scores range from 1 (Low), 2 (Medium), 3 (High), or 4 (Very High).

Threshold type	Type of data	Scores
Continuous Descending	Continuous data values that may be counts or percentages decreasing in conservation value the higher the data value. The data is split into groups either by quartiles, quantiles or Jenks natural breaks.	Scores range from 1 (Low), 2 (Medium), 3 (High), or 4 (Very High).
Continuous Descending (Negative)	Continuous data values that may be counts or percentages decreasing in conservation value the higher the data value. The data is split into groups either by quartiles, quantiles or Jenks natural breaks.	Scores range from -4 (Low), -3 (Medium), -2 (High), or -1 (Very High).
Presence Positive	Presence of data values greater than 0 have a Very High conservation value compared to a data value of 0 (Low conservation value) or the absence of data.	Scores are either 1 (Low), 4 (Very High) or No Data.
Presence Negative	Presence of data values greater than 0 have a Low conservation value compared to a data value of 0 (Very High conservation value) or the absence of data.	Scores are either -1 (Low), 4 (Very High) or No Data.

The threshold type of Presence (Positive) gives scores based on a presence/absence analysis. If a data value is present and greater than zero, then a score of 4 (Very High) is given. If the data value is equal to zero then the score is 1 (Low) and if the data value is absent then the score is 0 (no data). For Presence (Negative), the scores are -1 (Low) for a data value greater than zero, 4 (Very High) for a data value that equals zero and 0 (no data) for the absence of any data value.

Measure scores of -999 are used for spatial units that have been assessed (e.g. expert panel members assessing wetlands as special features) but not given a value for a particular measure. Using a value of -999 ensures the measure is considered as having data when calculating a spatial unit's dependability score. Dependability is a metric of how many measures were able to be evaluated for a given spatial unit.

Measure scores of No Data indicate there is no data available to evaluate the measure for a particular spatial unit. Measures with No Data lower a spatial unit's dependability score.

Not all measures are applied to all spatial units. For example, highly modified and artificial wetlands are not suitable for inclusion in the assessment of representativeness and were excluded from Measures 8.1.1, 8.2.1, 8.2.2, 8.2.3, 8.2.4 and 8.2.6. Also, the Threatened Species and Priority Species Measures (4.1.1, 4.1.2, 5.1.1, 5.1.2 and 5.1.3) exclude artificial wetlands as their conservation values are continually being eroded by anthropogenic processes.

After standardising the measure data, each set of measures within a certain indicator are mathematically combined to create a score. Part of the process uses a weighting against each measure. Weightings range between 1 and 10 (10 being the highest) and are based on the following rules:

- At least one measure within each indicator must be weighted 10 which is the highest weighting.

- Other measures within each indicator were weighted compared to the weighting of 10 assigned in the first step.
- It was okay to have different measures with the same weight (i.e. all measures could be weighted 10).
- Some indicators only had one measure and had already been given a weighting of 10.
- Measures shouldn't be weighted down because of the quality or lack of data for that measure.
- High weightings are given to measures that provide more worth or importance to the conservation of a wetland.

Normally expert panel members are asked to weight the measures within each indicator at the expert panel workshops. Weights from all respondents are then averaged and reviewed with particular attention to averages having a high variance.

The measure weights used for the FGBRCC assessments were based on the average weights derived from the workshops held for Southeast Queensland (2015), Lake Eyre and Bulloo Basins (2016), Eastern Gulf of Carpentaria (2018) and Southern Gulf Catchments (2020). If no measures within an indicator received a weight of 10, then the weights for all measures within the indicator were adjusted relative to each other to ensure that at least one measure had a weight of 10. For example, if an indicator had three measures with average scores of 9.5, 9.0 and 8.0, the adjusted weights were 10, 9.5 and 8.5 (i.e. 0.5 was added to the weights of all three measures). This is done because at least one measure within each indicator must have a weight of 10.

New measures added to this assessment that were not used in previous assessments were given a weighting of 10. They were identified to provide a better conservation value and of high importance than those within the same indicator.

The riverine and non-riverine measure weights are outlined in Appendix III – Indicator ranks and measure weights.

Ranking indicators to calculate criteria scores

Indicators are then mathematically combined to create a criterion score. This process uses a ranking system based on the value or importance of the indicator to the criteria being measured. Rank values are based on the following rules:

- At least one indicator within each criterion must be ranked 1 which is the highest ranking.
- The other indicators are ranked (within each criterion) relative to the ranking of 1 assigned in the first step.
- It is possible to have different indicators with the same ranking (i.e. all indicators may be weighted 1).
- An indicator should not be ranked down because of the quality or lack of data for that indicator.
- High rank values are given to indicators that provide the most worth or importance to the conservation of a wetland.

A rank of 1 signifies the highest (most important) contribution. Similar to the measure weights, an indicator rank given to each indicator within a criterion was based on the ranks derived by the expert panel workshops for Southeast Queensland (2015), Lake Eyre and Bulloo Basins (2016), Eastern Gulf of Carpentaria (2018) and Southern Gulf Catchments (2020).

For each panel workshop, ranks from all respondents were reviewed and the common rank assigned to each indicator. Where two or more ranks were most common, we used the highest rank for the indicator. For example, if an indicator was ranked 1, 1, 2, 2, 3 by five different expert panel members, we gave the indicator a rank of 1.

Indicator 7.4 Terrestrial ecosystems is a new indicator for this assessment (not used in previous assessments) and was given a ranking of 1.

The riverine and non-riverine indicator ranks are outlined in Appendix III – Indicator ranks and measure weights.

Assessing criteria scores to create an overall AquaScore

AquaBAMM uses a criterion decision matrix (known as the filter table) that provides an ordered series of decisions that determine the final overall score for each spatial unit (See Appendix IV – Riverine filter table and Appendix V – Non-riverine filter table).

Each decision contains a unique combination of criteria ratings and associated final AquaScore. These decisions are essentially several ‘if-then’ statements and are tested in sequence for each spatial unit. An AquaScore is assigned immediately when a match is achieved between the criterion rating combination of the decision and that of the spatial unit. This filtering table technique has previously been used successfully in the Biodiversity Assessment and Mapping Methodology (EHP 2014).

It is important to note that, unlike previous steps through the AquaBAMM tool, the AquaScore may be one of five categories (i.e. Very High, High, Medium, Low and Very Low). This increased level of discrimination at the AquaScore level provides for a more useful conservation assessment tool and enables more informed management decisions.

Dependability and data richness

The dependability score provides an indication of the availability of data for each spatial unit. Criterion ratings and AquaScores should be interpreted in conjunction with the corresponding dependability scores, as these provide an overall indication of the amount of data available for each spatial unit.

Dependability scores are a proportional value ranging from 0 to 1 and represents the number of measures with data for a spatial unit out of the total number of measures used in the assessment. Dependability is calculated as follows:

$$\text{Dependability} = \frac{\text{No. of measures with data (count)}}{\text{Total no. of measures (count)}}$$

Dependability scores indicate the potential for an AquaScore to change (upgrade or downgrade) with the addition of new data. For example, where sections with Very Low AquaScore values have low dependability, the results should be used cautiously as the AquaScore may be due to a lack of data rather than low ecological value. In the case of missing data, further survey work may add more data which may, or may not, change the AquaScore. Dependability scores can also provide an indication of where additional survey work may be required and which, once completed, may or may not change an AquaScore.

Conservation value (AquaScore) categories

The AquaBAMM calculates an overall aquatic conservation score, called an AquaScore, for each spatial unit within a study area. The AquaScore ratings can be Very High, High, Medium, Low or Very Low and are relative within a study area.

The following descriptions provide a summary of the general characteristics of each AquaScore.

Very High

Wetlands given an AquaScore of Very High generally have very high biodiversity values across all criteria (aquatic naturalness, catchment naturalness, diversity and richness, threatened species, special features, connectivity, representativeness), or Very High representativeness values in combination with Very High aquatic naturalness, catchment naturalness or threatened species values. They may also be wetlands nominated by an expert panel as containing very important special or

unique features from a flora, fauna and/or ecological perspective regardless of the values across the other criterion.

High

Wetlands given an AquaScore of High are mainly those that have Very High aquatic naturalness or representativeness values in combination with High or Very High values for rare and threatened species or diversity and richness. Combinations of Very High or High values among most criteria may also result in a High AquaScore. They may also be wetlands nominated by an expert panel as containing important special or unique features from a flora, fauna and/or ecological perspective regardless of the values across the other criterion.

Medium

Wetlands given an AquaScore of Medium generally have combinations of High and Medium rating across the various AquaBAMM criteria.

Low

Wetlands given an AquaScore of Low generally have limited aquatic and catchment naturalness values and generally varied combinations of Medium and Low values across the criteria. These wetlands do not contain special or unique features.

Very Low

Wetlands given an AquaScore of Very Low generally have Low naturalness (as indicated in Criteria 1 and 2) and lack any other known significant values. They may also be wetlands that are largely data deficient across the AquaBAMM measures. These wetlands do not contain special or unique features.

Updates and differences from GBR ACA riverine version 1.1 and non-riverine version 1.3

With each successive ACA, there are refinements to input datasets and methodology implementation. Each ACA uses the most up-to-date data available at the time the assessment is undertaken. These updates can alter the individual spatial units AquaBAMM scores for each Criterion and overall AquaScore.

The previous versions (riverine 1.1 and non-riverine 1.3) of the GBR ACAs were released in 2009 and 2011 respectively. While the general methodology of AquaBAMM has remains unchanged, input datasets have been updated, and some elements of the methodology have been refined. This makes any direct comparison to the previous version difficult. Some of these updates for the FGBRCC ACA v2.1 include:

- The QLD wetland mapping v2.0 was utilised for GBR non-riverine v1.3 and only the natural (H1) or slightly modified (H2M1, H2M2, H2M3, H2M5) wetlands were included. While for the FGBRCC v2.1, the QLD wetland mapping v6.0 was utilised, and all dominant wetlands were included irrespective of hydrological modifications. The hydrological modifications have also been updated and refined.
- Refinements to the filter table is an ongoing process in which there is potential for each assessment to produce a unique combination of criteria ratings, that on a rare occasion, may not be captured at the right level in the filter table. For the current filter tables see Appendix IV – Riverine filter table and Appendix V – Non-riverine filter table.
- Additional species records from survey work.
- There has been a considerable refinement of the flora and fauna Wetland Indicator Species Lists (WIS), which helps guide species inclusion.
- There have been changes in NCA species status for some Threatened and Near-threatened species. This is an ongoing process undertaken by the Species Technical Committee, coordinated by DETSI.

- The water mouse (*Xeromys myoides*) core habitat model has been incorporated into Criteria 3 and 4 (Diversity and richness and Threatened species respectively) measure calculations as a presence record. Further habitat models are being developed and will be incorporated into future ACAs to support the species sighting record dataset.
- The Department of Agriculture and Fisheries (DAF) pest and weed distribution survey datasets have been incorporated in the pest species Measures for Criteria 1 and 2. This has allowed for a more broadscale landscape occurrence and distribution analysis to support the existing sighting record datasets.
- The weights and ranks for measures and indicators have been reviewed and updated. With the completion of ACAs statewide, there is comprehensive information on weights and ranks, as provided by expert panels. The decision was made to utilise the overall average weight/rank score for each measure and indicator respectively as it was not possible to undertake this process with the v2.1 expert panels due to time constraints.
- The FGBRCC v2.1 expert panel reports include reviewed and updated special features. Additional special features defined at the expert panel workshops have been added to the current assessment.
- There were many differences between assessments in the measures utilised (see Appendix VI – Criterion, indicator, measure list comparison between FGBRCC v2.1 and previous versions). FGBRCC v2.1 only utilised measures that had available and current datasets for the entire assessment area. It is recognised that datasets may have been missed or that we are not yet aware of. In addition to updated data, new indices were calculated that utilised new published methodologies. These include the CAFI index, natural area connectivity, wetland connectivity for small amphibians, land use pressures and the Paddock 2 Reef fine sediment modelling.
- A new threshold scale was introduced for the pest species Measures, which ranged between -4 (Low) to -1 (Very High). The data values are thresholded into four groups using Jenks natural breaks. The previous GBR versions used a presence/absence method where if there was one or more species present, the spatial unit scored a 1 (Low).

Major differences that can affect the proportions (% of spatial units) of scores for each criteria and AquaScore are set out below.

- Framework datasets, (bounding area, study area and sub catchments) have been updated to match a point of truth framework (see Updates to framework datasets). This affected the size and shape of spatial units that align along these boundaries.
- FGBRCC v2.1 has included H3 (artificial) wetlands. There are 6,343 artificial wetlands which comprise 43% of total wetland proportion (14,602). Table 4 lists the number and percentage of artificial wetlands for each study area. While artificial wetlands are recognised as having some potential ecological value, they are not included in all measures (for further details see section 0 and the implementation tables in Appendix II – Measure implementation table).

Table 4 Number of wetlands and artificial wetlands in each study area

Study area	Number of wetlands	Number of artificial wetlands	Percent of wetlands that are artificial
Boyne	83	53	64 %
Calliope	134	62	46 %
Curtis Island	48	8	16 %
Comet	1,340	715	53 %
Dawson	3,614	1,611	45 %

Study area	Number of wetlands	Number of artificial wetlands	Percent of wetlands that are artificial
Fitzroy	1,197	395	33 %
Fitzroy Other Islands	68	8	12 %
Isaac	1,779	911	51 %
Mackenzie	1,521	813	53 %
Nogoa	1,709	926	54 %
O'Connell	573	259	45 %
Pioneer	87	35	40 %
Plane	971	180	19 %
Proserpine	418	101	24 %
Shoalwater	228	116	51 %
Styx	233	102	44 %
Waterpark	598	48	8 %
Whitsunday Island	1	0	0 %

Updates to framework datasets

A review of the framework datasets was completed in 2021 to provide a contextual reference for ACAs in relation to other data sources and projects that work with drainage basins. The ACA framework datasets include:

- ACA Boundary – outlines a collection of study areas that are assessed at the same time with the same expert panel members.
- Study Area – a drainage catchment that an ACA assessment is completed for where results are relative within the catchment area.
- Subcatchments – a smaller drainage catchment that is used by some measures to calculate a landscape or catchment scale data value.

Spatial data was obtained from the Department of Resources (2021) which is the authoritative point of truth for river drainage mapping in Queensland. The spatial data includes the spatial extent and name for drainage divisions and drainage basins as defined by the Australian Water Resources Management Committee (WRMC). It also includes river basins which were compiled by determining watersheds based on 1:100,000 topographic contours. Each of the three data layers have boundaries that are aligned to and nested within each other.

The GBRCC framework bounding areas were determined by the drainage divisions that best aligned with the Natural Resource Management regional boundaries and cut at the Queensland border. Nested within this bounding area layer are the study areas and sub-catchments. These were determined by the Drainage Basins and River Basins linework that best aligned with the original ACAs.

Results and discussion

Riverine overall results

ACAs were conducted for the riverine spatial units within each study area. Figure 2 and Figure 3 show the riverine AquaScores, dependability scores and criteria ratings for each riverine spatial unit. AquaScores range between Very High to Very Low, and criteria scores range from Very High to Low.

For each study area, Table 5 lists the top 3 most common filter table decisions that identified the final AquaScore.

Key findings

- All study areas have wetlands with AquaScores from Very High to Very Low. This variation in wetland value arises from a range of factors, from the presence of special features, the number of pest species recorded within the area, to the prevalence of anthropogenic influences on water quality and in-stream connectivity.
- A few study areas are dominated by Very High and High AquaScores. These include Shoalwater, Waterpark, Styx, Curtis Island, Whitsunday Island and Fitzroy Other Islands. These study areas contain large national parks, conservation areas or areas of relatively intact ecosystems.
- Fitzroy Other Islands and Whitsunday Island are part of the Great Barrier Reef Marine Park World Heritage Area and so are given a Very High ranking for Measure 6.3.2 (Significant wetlands identified by an accepted method such as Ramsar, Australian Directory of Important Wetlands, Regional Coastal Management Planning, World Heritage Areas) under Criterion 6 (C6 Special Features), which results in a Very High AquaScore.
- Very few spatial units are rated High or greater for aquatic naturalness (C1) with nearly 80% rated as Medium and Low. Within each study region, 50% and 70% of spatial units have a rating of High for catchment naturalness (C2).
- Most study areas have a Low rating for aquatic naturalness (C1) due to the number of pest species found within the regions and the very high number of anthropogenic barriers. Instream barriers included dams, weirs and road culverts. Though the C1 metrics considered the fauna 'passability' of each barrier, the number of barriers within the region (particularly in the western study areas) limits the ability of aquatic organisms to travel through aquatic networks.
- Catchment naturalness (C2) is highly influenced by whether or not native vegetation (remnant) is retained in riparian zones along creeks and rivers. Many spatial units within each of the study areas had Medium to Low ratings due to the influences of agricultural and mining land uses on overland water quality and flow.
- Higher diversity and richness of species (C3) are found within areas or catchments with limited agriculture or mining activities. However, these ratings may in part be a reflection of higher survey effort in more natural areas such as national parks.
- The bias in survey effort and available species records is also reflected in Criterion 4 and Criterion 5 (C4 Threatened species and ecosystems and C5 Priority species and ecosystems respectively), where many spatial units within the agricultural and mining regions are either ranked as Low or have No Data.
- Species records data for macroinvertebrates was particularly sparse meaning the Criterion 3 'richness of macroinvertebrates' measure could not be used. Some ACAs have used maximum richness scores derived from higher-level macroinvertebrates studies undertaken using recognised survey and analysis methods (for example those used by Conrick & Cockayne 2000, Chessman 2002, and Healthy Waterways 2014). These methods estimate macroinvertebrate diversity at the broad taxonomic group level (e.g. sub-family,

family, order or class) and can provide suitable representations of macroinvertebrate richness. This type of data was not available for the FGBRCC study areas and would improve the dependability of Criterion 3 results.

- For Criterion 6 (C6 Special features), all but one decision were given ratings of High or Very High by the expert panel. The one exception was Mimosa Creek within the Dawson study area which was identified by the expert panel as having a Medium rating in their special feature decision. This decision is Mimosa Creek (dn_r_fa_01) and can be found in Table 21 of the expert panel report (DETSI 2026).
- The Connectivity (C7) rating considers a mix of expert panel decisions, terrestrial natural area connections, in-stream connections and pathway connections between wetlands for small amphibians. Landscapes within most of the study areas are dominated by agriculture and mining. Very little natural vegetation remains, and many in-stream barriers have been constructed, resulting in Low ratings for connectivity. These areas are particularly prevalent in the Comet, Dawson, Isaac and Fitzroy study areas.
- No spatial units were identified by the expert panel to be representative (C8) of riverine wetlands for any of the study areas.
- Data limitations and variations within study areas are visible in the Dependability scores. However, it appears that all study areas are data rich and similar amounts of data are available throughout the region. Input source data is now available at statewide levels and new measures utilize this landscape scale mapping for catchment naturalness, connectivity and pest species calculations.
- The Fitzroy Other Islands study areas has lower dependability scores, reflecting limited aquatic data was available for these islands. Few of the islands have freshwater riverine wetlands and most of these would be ephemeral, filling only during wet periods. All the islands have relatively natural landscapes of either vegetation, rocky outcrops or cleared from historical grazing on some of the larger islands. Criteria ratings for this study area should be considered with caution due to data limitations.
- Filter table decisions (Assessing criteria scores to create an overall AquaScore) identify the overall AquaScore for a spatial unit. The top three filter table decisions for the riverine results, vary for each study area (Table 5). However, decision 24 is the most common and gives an overall AquaScore of Medium. The decision indicates that threatened species and ecosystems (C4) are rated Very High or High among the spatial units with varying scores of High or Medium for the other criteria.
- The second most common decision is decision 4. This decision indicates that the spatial unit has been nominated by an expert panel as containing very important special and unique features for flora, fauna or ecological values and given a rating of Very High for Criterion 6 (special features). The overall AquaScore is Very High regardless of other criteria values.

Table 5 Top three filter table decisions for riverine results by study area.

Study area	First top filter table decision	% of spatial units	Second top filter table decision	% of spatial units	Third top filter table decision	% of spatial units	Total % of spatial units
Boyne	23a	23%	4	22%	24	22%	67%
Calliope	24	28%	4	23%	38	13%	64%
Curtis Island	4	100%					100%
Comet	24	51%	38	14%	28	11%	73%

Study area	First top filter table decision	% of spatial units	Second top filter table decision	% of spatial units	Third top filter table decision	% of spatial units	Total % of spatial units
Dawson	24	53%	4	19%	38	9%	81%
Fitzroy	4	40%	24	34%	38	7%	82%
Fitzroy Other islands	4	99%					99%
Isaac	24	51%	4	16%	13	6%	72%
Mackenzie	24	58%	4	16	38	7%	81%
Nogoa	24	49%	4	10%	38	6%	66%
O'Connell	24	32%	4	24%	25	11%	67%
Pioneer	24	38%	4	15%	25	10%	63%
Plane	24	30%	38	18%	22	14%	62%
Proserpine	24	32%	4	24%	28	14%	70%
Shoalwater	4	36%	22	36%	23a	14%	86%
Styx	4	44%	23a	22%			66%
Waterpark	4	56%	22	25%			81%
Whitsunday Island	4	100%					100%

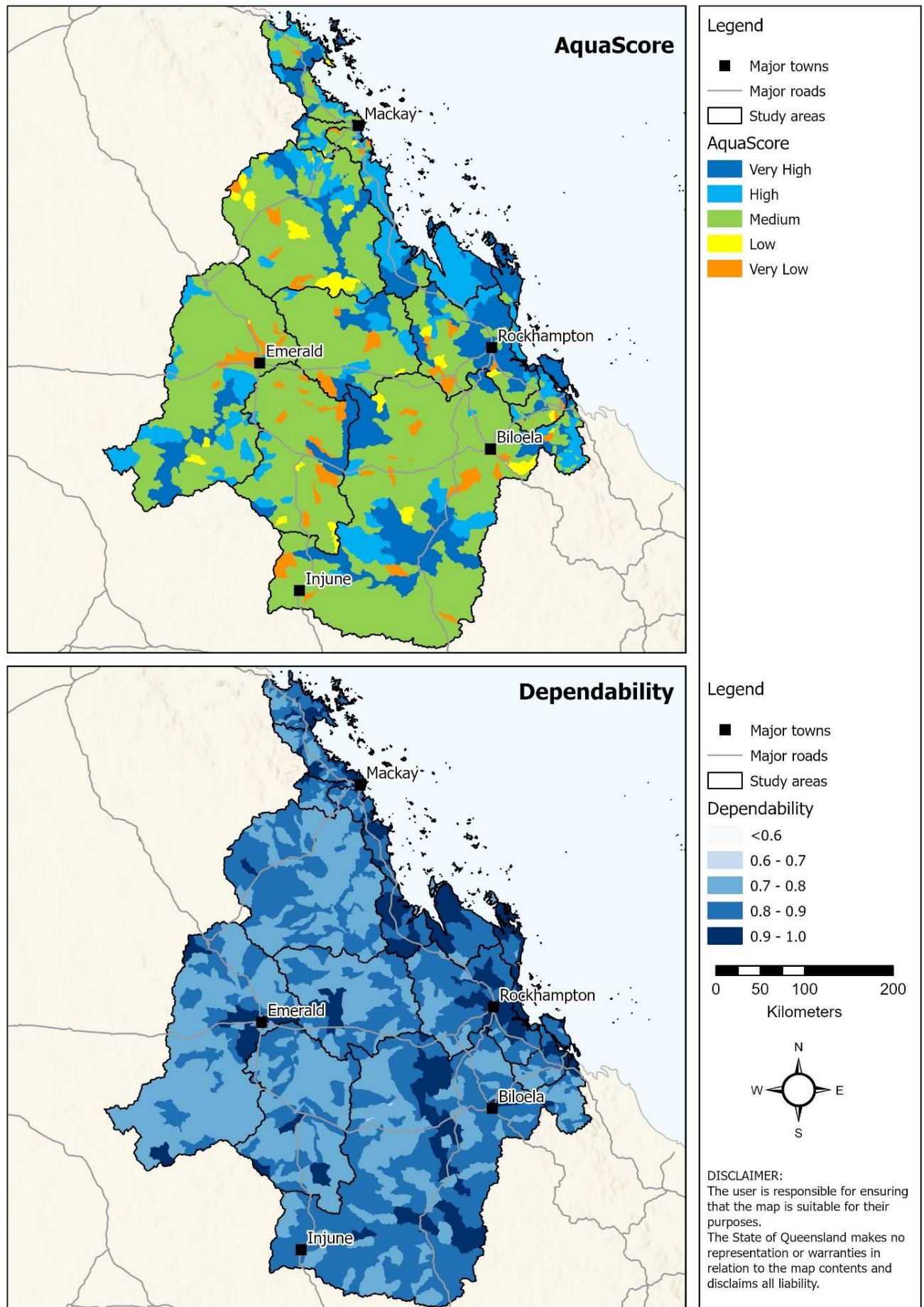


Figure 2 AquaScore and Dependability by riverine spatial unit

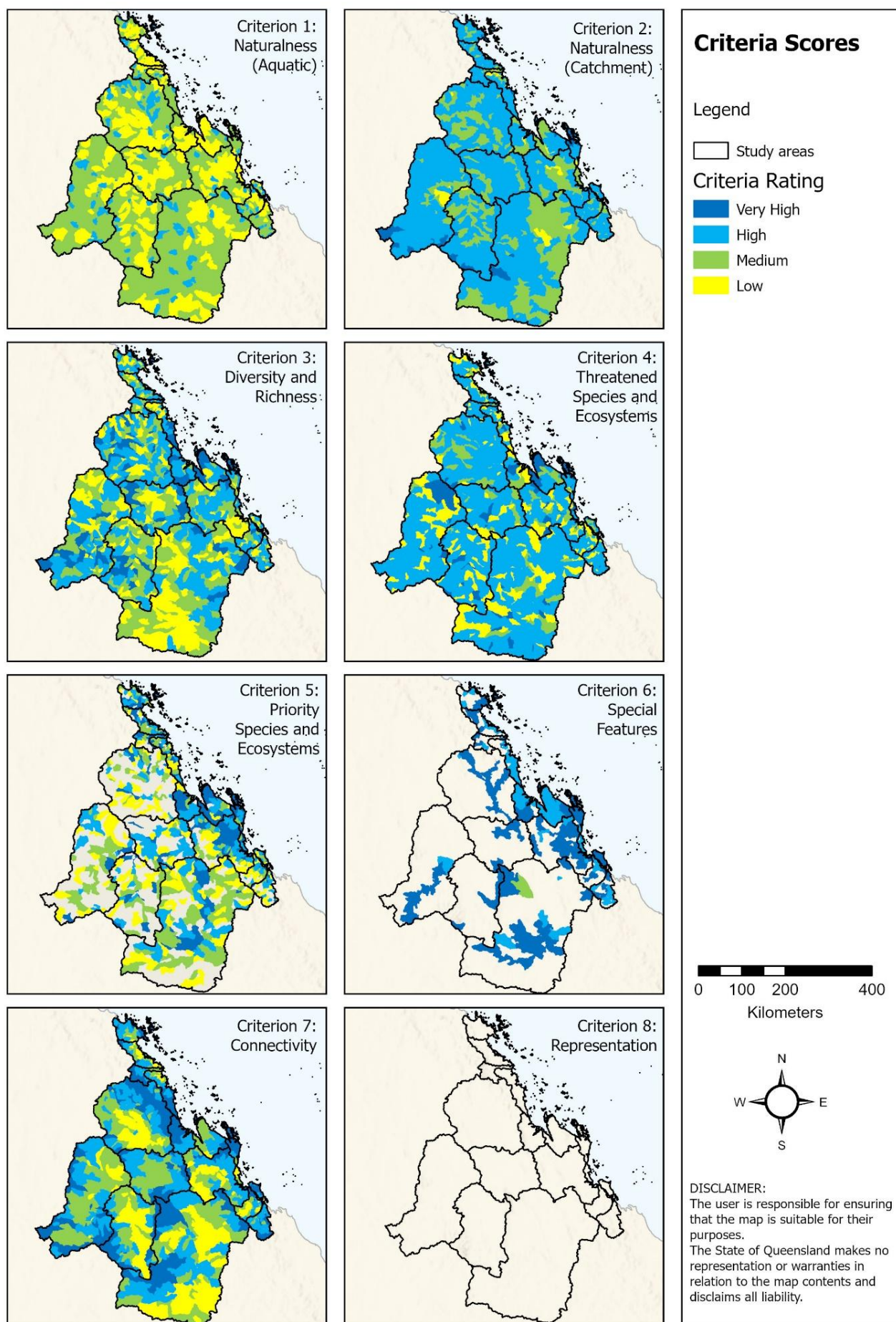


Figure 3 Ratings for Criterion 1 to 8 by riverine spatial unit

Non-riverine overall results

Aquatic Conservation Assessments were conducted for the non-riverine spatial units within each study area. Figure 4 and Figure 5 show the non-riverine AquaScores, dependability scores and criteria ratings for each non-riverine spatial unit.

For each study area, Table 6 lists the top 3 most common filter table decisions that identified the final AquaScore.

Key findings

- This assessment of the non-riverine wetlands included artificial wetlands as identified by the Queensland Wetland Mapping. This accounted for 43% (6,343 artificial in a total of 14,602) of all the non-riverine wetlands within FGBRCC area. The proportion of artificial wetlands in each study area is listed in Table 4.
- Several study areas that have relatively large wetlands by area. For example, 25% of wetlands in Boyne have a Very High AquaScore. These wetlands cover approximately 87% of the total wetland area within the catchment. The biggest wetland in Boyne is Awoonga Reservoir which covers 66% of the total wetland area. Other study areas where the highest scores are dominated by a few large wetlands include:
 - Comet. 12% of wetlands cover 27% of the total wetland area with a Very High AquaScore. The biggest wetland is Nuga Nuga wetland on the Brown River.
 - Nogoa. 5% of wetlands cover 69% of the total wetland area with a High AquaScore. The biggest wetland is Lake Maraboon which covers 65% of the total wetland area.
 - Proserpine. 41% of wetlands cover 54% of the total wetland area with a Very High AquaScore. The biggest wetland complex is the Goorganga Plain which covers 52% of the area. Lake Proserpine also covers a large area (28% of the total wetland area) and has a Medium AquaScore. Within the catchment 16% of the wetlands with a Medium AquaScore cover 32% of the total wetland area.
 - Shoalwater. 16% of wetlands cover 86% of the total wetland area with a Very High AquaScore. The biggest wetland complex is Torilla Plain which covers 85% of the total wetland area.
- While Criterion 1 ratings for wetlands in the region range between Very High to Low, only a few small wetlands that sit adjacent to the Isaac River are rated as Very High. Pests are widespread throughout this landscape including those that directly affect wetlands, and this brings down Criterion 1 ratings. This is the first ACA where Department of Agriculture and Fisheries (DAF) pest and weed distribution survey data has been incorporated into the measure calculations, and this dataset improves the accuracy and spatial coverage of pest information.
- The higher diversity and richness (C3) scores within the catchments appear to follow the major river lines like Dawson River, Mackenzie River, Nuga River and the Isaac River.
- One limitation for the calculation of Criterion 3 (C3 diversity and richness) is that a single species richness value is applied to all wetlands that fall within that subsection unit. An example of this are the artificial wetlands within the Dysart coal mine. Some wetlands that sit just outside of the mining cut record high numbers of waterbirds and amphibians relative to other subsection units within the study area. However, these high numbers are also applied to the wetlands that sit directly inside the mining cut where amphibians are not likely to occur. This methodology is suitable for natural landscapes as fauna move between connected neighbouring wetlands on a regular basis but causes erroneous results in a highly impacted landscape as fauna would probably not readily move into an open cut coal mine.
- Another limitation of species sightings records is the number of records that can be captured in the field and the ability to reach all locations for all taxa groups. This is

especially noticeable in Criterion 4 (C4 threatened species and ecosystems) where dependability scores are relatively low. Fewer surveys are available in landscapes dominated by agricultural and mining (which tend to be in national parks and along roads), so rankings for this criterion should be interpreted with caution.

- Landscapes dominated by agriculture within the western study areas (Dawson, Comet, Nogoa, Mackenzie and Isaac) have been cleared of the natural terrestrial vegetation over many years. This lack of terrestrial vegetation reduces the overall connectivity within the landscape (C7 connectivity) and increases potential hazards (C2 catchment naturalness) running into the wetlands. These hazards include potential pollutants, sediments and exotic species.
- Species records data for macroinvertebrates was particularly sparse meaning the Criterion 3 (richness of macroinvertebrates) measure could not be used. Some ACAs have used maximum richness scores derived from higher-level macroinvertebrates studies undertaken using recognised survey and analysis methods (e.g. such as those used by Conrick & Cockayne 2000, Chessman 2002, and Healthy Waterways 2014). These methods estimate macroinvertebrate diversity at the broad taxonomic group level (e.g. sub-family, family, order or class) and can provide suitable representations of macroinvertebrate richness. This type of data would improve the Criterion 3 results but was not available for the FGBRCC study areas.
- The Connectivity score (C7) is dominated by two main broad landscape measures. These are 7.1.5 (feasibility of terrestrial or aquatic movement for amphibian biological connectivity) and 7.4.2 (Terrestrial natural area connectivity within a buffered area, based on an acknowledged metric). The higher scores for Measure 7.4.2 correspond to the patterns of remnant vegetation within the landscape. Measure 7.1.5 highlights the wetlands that are less connected to suitable small amphibian habitats. Overall, well connected wetlands follow major drainage lines and cluster groups. Isolated wetlands (especially artificial agricultural dams) have Low connectivity due to their lack of surrounding natural vegetation and distance (over 70m) to wetter and more protected (cover from predators) areas of the landscape.
- A good example of a wetland cluster group that has scored Very High for connectivity (C7) are the wetlands along Palm Tree Creek and Tualka Creek in the Dawson study area. They have also been recognised as a special feature (dn_nr_ec_01, dn_nr_fl_02, dn_nr_fa_01) for its high diversity of species, extensive *Eleocharis* swamps and its series of shallow lakes and streams.
- Filter table decisions (Assessing criteria scores to create an overall AquaScore) identify the overall AquaScore for a spatial unit. The top three filter table decisions for the riverine results, vary for each study area (Table 6). However, decision 1000 is the most common decision and gives an overall AquaScore of Low. The decision identifies spatial units where many criteria have No Data and there are a mixture of High to Low ratings for any Criterion. This is mostly common for the artificial wetlands.
- Another top filter table decision is decision 5, which indicates that the spatial unit has been nominated by an expert panel as containing very important special and unique features for flora, fauna or ecological values and given a rating of Very High for Criterion 6 (special features). The overall AquaScore is Very High regardless of other criteria values.

Table 6 Top three filter table decisions for non-riverine results by study area.

Study area	First top filter table decision	% of spatial units	Second top filter table decision	% of spatial units	Third top filter table decision	% of spatial units	Total % of spatial units
Boyne	5	25%	1000	23%	28	22%	70%
Calliope	1000	27%	15a	15%	5	13%	55%
Curtis Island	5	83%	28	15%			98%
Comet	1000	42%	28	21%	19	16%	79%
Dawson	1000	34%	28	21%	19	13%	68%
Fitzroy	5	38%	1000	24%	28	13%	75%
Fitzroy Other Islands	5	82%	27	6%			88%
Isaac	1000	32%	28	19%	19	12%	63%
Mackenzie	1000	36%	28	22%	19	11%	69%
Nogoa	1000	42%	28	26%	30e	5%	73%
O'Connell	1000	28%	28	16%	15a	9%	53%
Pioneer	1000	26%	19	20%	28	13%	59%
Plane	15a	18%	5	18%	1000	15%	51%
Proserpine	5	40%	1000	19%	28	13%	72%
Shoalwater	1000	39%	15a	13%	19	12%	64%
Styx	1000	31%	15a	21%	10a	9%	61%
Waterpark	5	45%	27	20%	15a	16%	81%
Whitsunday Island	5	100%					100%

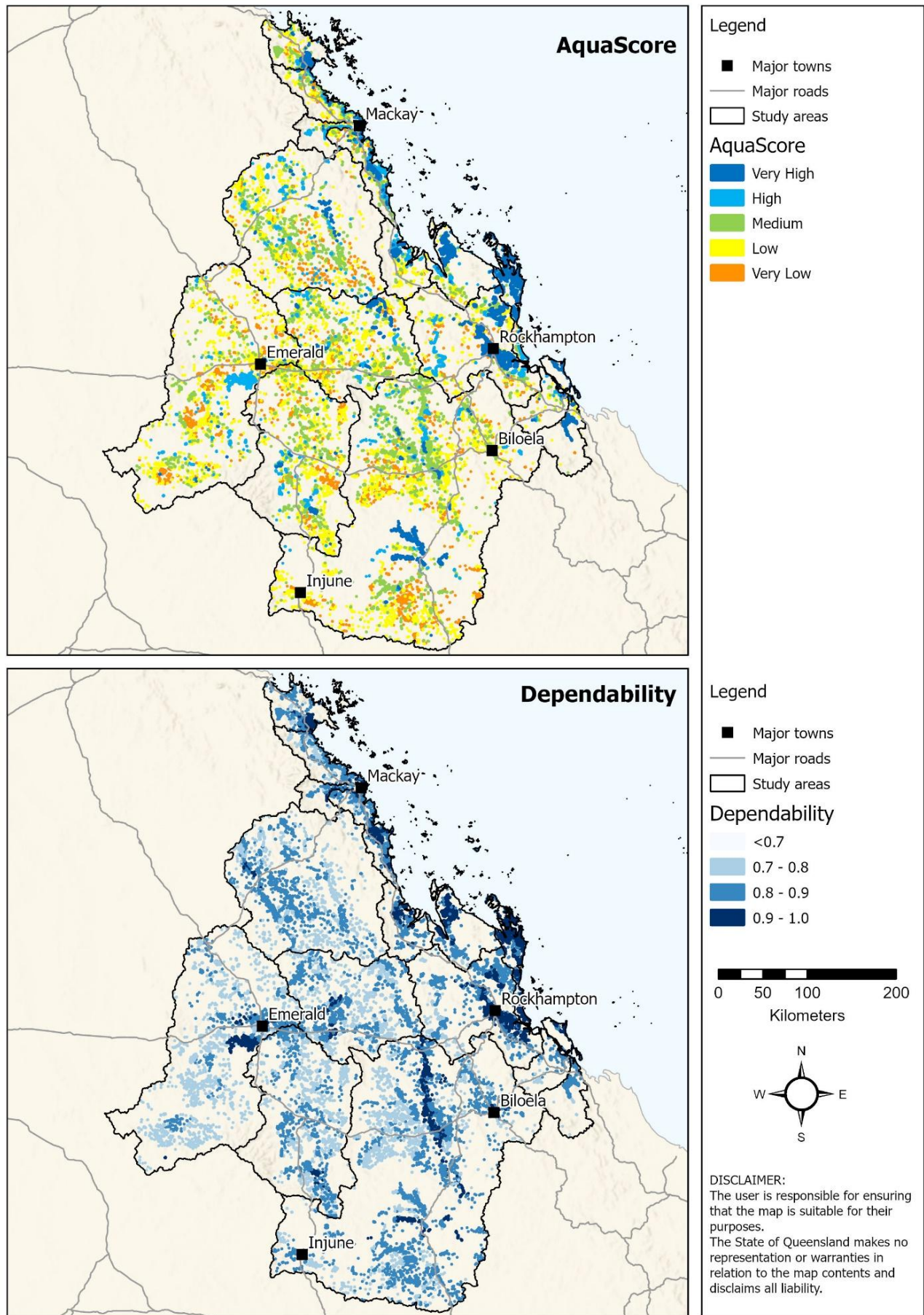
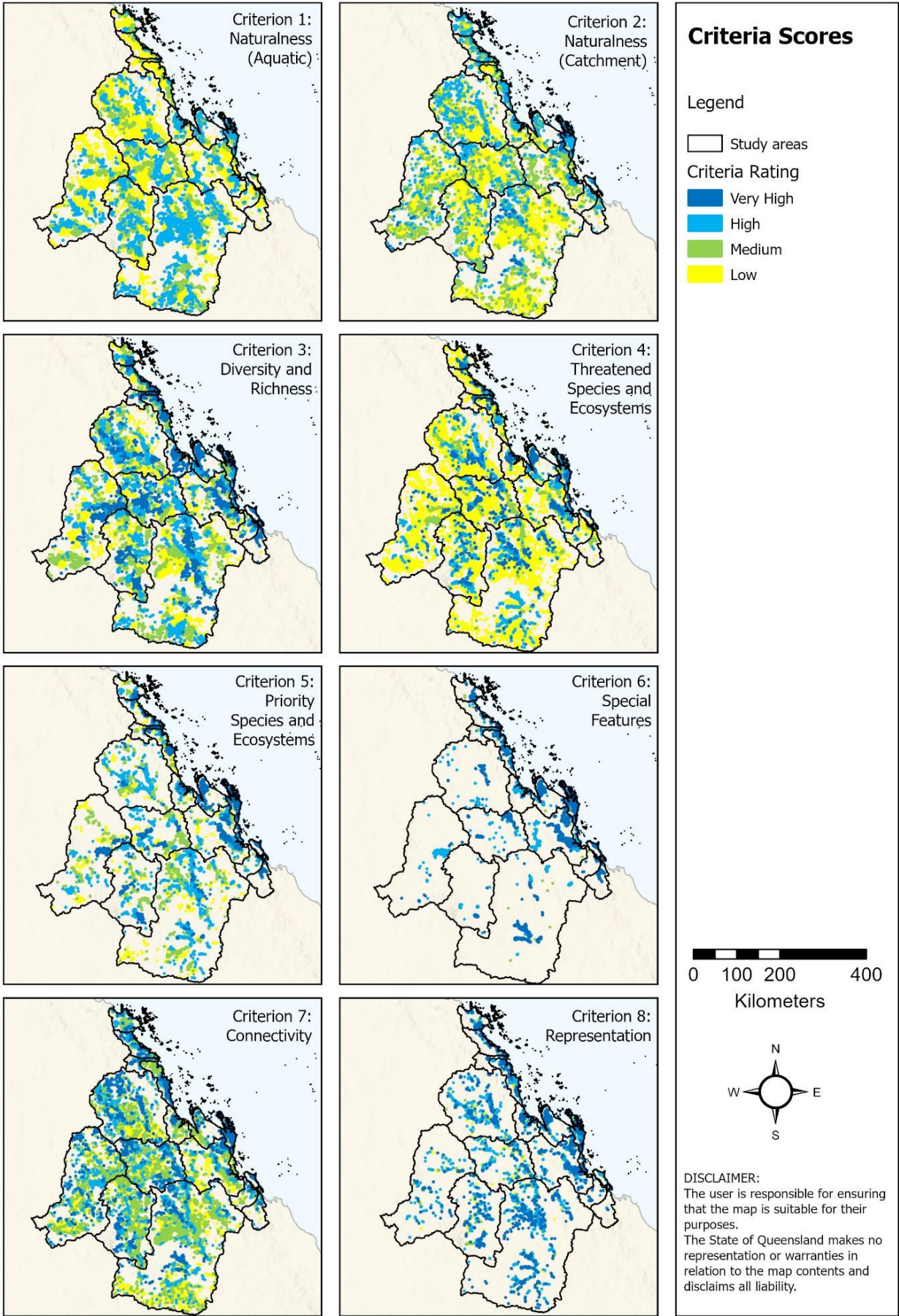


Figure 4 AquaScore and Dependability by non-riverine spatial unit



Study area results

The figures below for each study area provide summary statistics of the AquaScores, criteria scores and dependability scores by study area and include a count of the area and number of wetlands within each rating. AquaScores range between Very High to Very Low, and criteria scores range from Very High to Low. Dependability scores range between 0 and 1 with a 2 standard deviation error bar.

Boyne study area

Figure 6 shows over 50% of the riverine wetlands within the Boyne study area have ratings of High or Very High for Criteria 2, 4, 6 and 7 (naturalness catchment, threatened species and ecosystems, special features and connectivity respectively). Criterion 1 (naturalness aquatic) is rated Medium for over 70% of the riverine wetlands, which is due to the number and spread of exotic flora and fauna within the region.

Awoonga Reservoir covers over 4,000 ha in area which is about 66% of the total area covered by the non-riverine wetlands within the study area (Figure 7). The reservoir has a Very High rating for Criteria 3, 5 and 6 (diversity and richness, priority species and ecosystems and special features respectively), due to being a permanent water source for many species, especially birdlife, and adjoins the Castle Tower National Park.

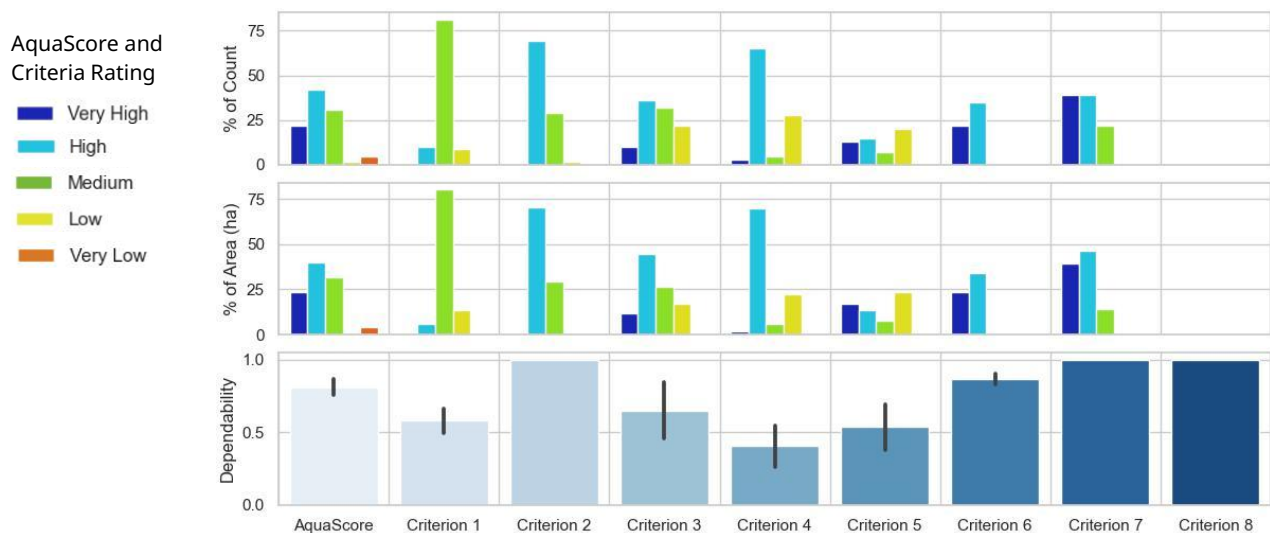


Figure 6 Ratings and average dependability of riverine spatial units for the Boyne Study Area

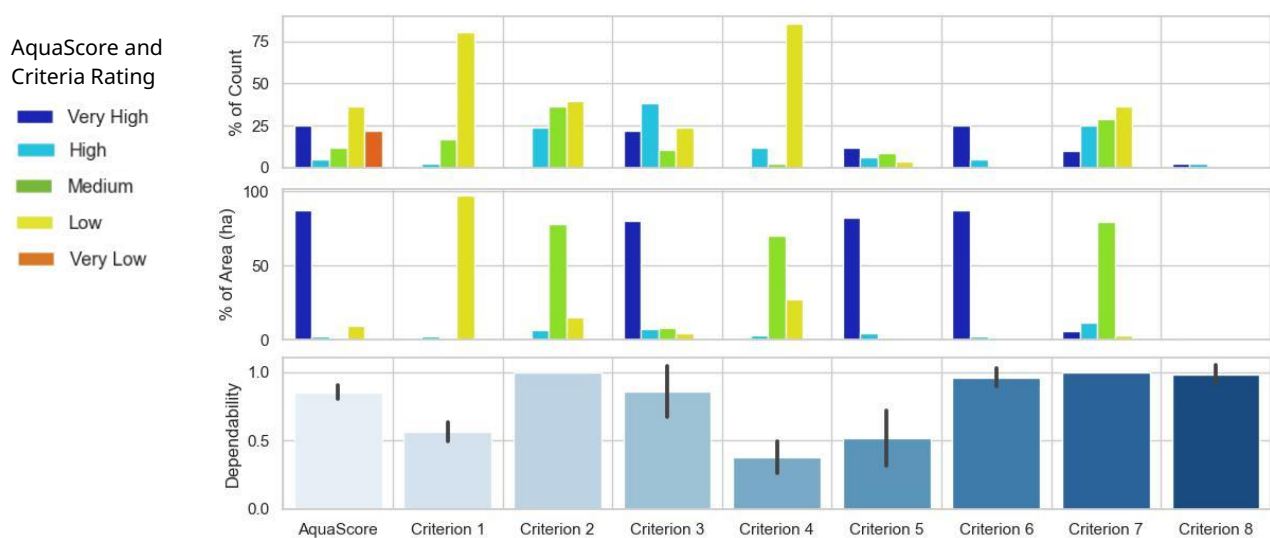


Figure 7. Ratings and average dependability of non-riverine spatial units for the Boyne Study Area

Calliope study area

Figure 8 shows 60% of wetlands within the Calliope study area have a rating of Medium for Criterion 1 (naturalness aquatic), which is due to the number and spread of exotic flora and fauna species. Criterion 2 (naturalness catchment) is rated High for over 60% of the wetlands. Connectivity (C7) and priority species and ecosystems (C5) are relatively low for this study area, with about 50% of the wetlands rating Medium, Low or No Data.

Figure 9 shows about 70% of the non-riverine wetlands have a Low rating for Criterion 1 (naturalness aquatic). This includes the 46% artificial wetlands (Measure 1.4.5) and the large reduction in remnant wetland extent relative to pre-European extent (Measure 1.3.7). About 40% of non-riverine wetlands have a Very High rating for diversity and richness (C3), which occur mostly along the coastal zones near Curtis Island.

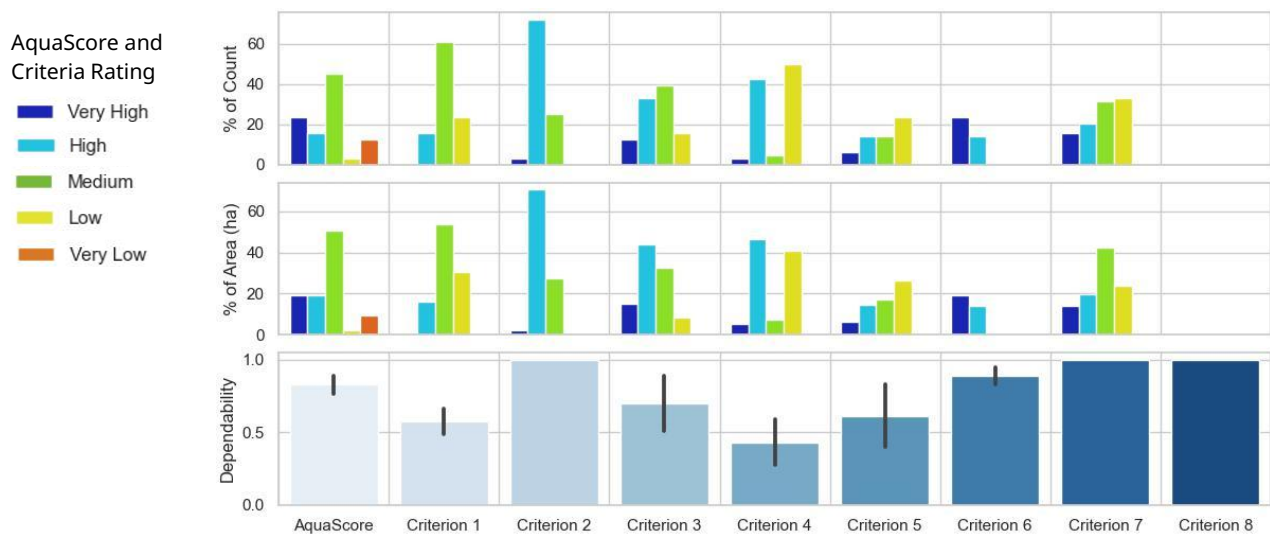


Figure 8 Ratings and average dependability of riverine spatial units for the Calliope Study Area

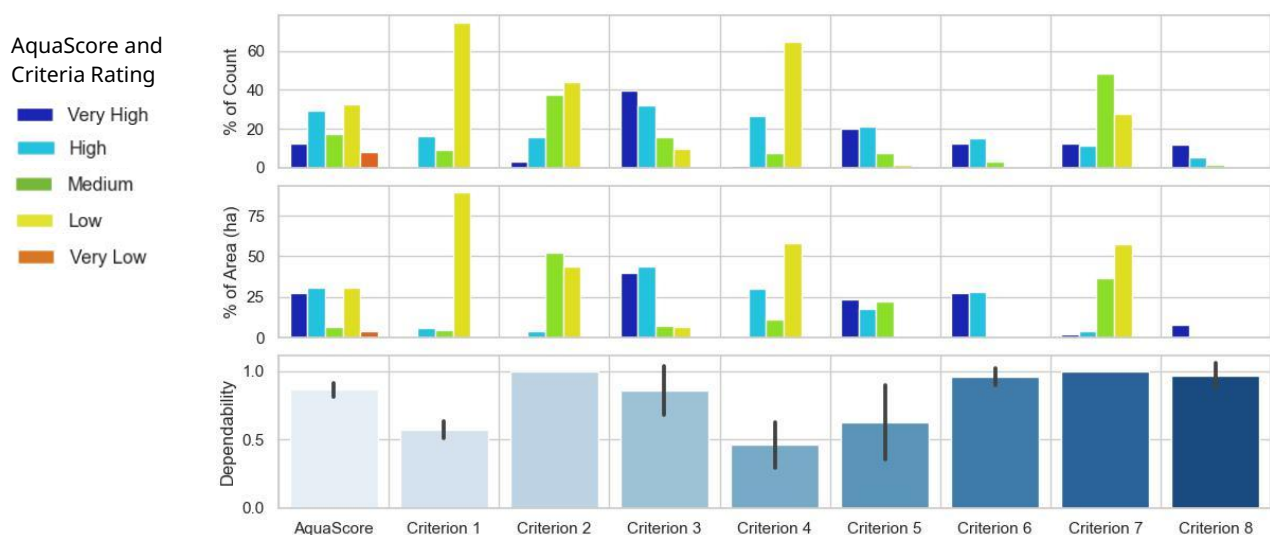


Figure 9. Ratings and average dependability of non-riverine spatial units for the Calliope Study Area

Curtis Island study area

Curtis Island is rated Very High for the riverine wetlands AquaScores (Figure 10) due to the Very High ratings for Criteria 6 and 7 (special features and connectivity respectively). Much of the island remains relatively natural in terrestrial vegetation with few to no instream barriers and valued as habitat for waterbirds.

The non-riverine wetlands (Figure 11) are also rated Very High for Criteria 6 and 7, as well as Criteria 3 and 5 (diversity and richness and priority species and ecosystems respectively). The non-riverine wetlands are essential habitat for many species that require connection to estuarine ecosystems.

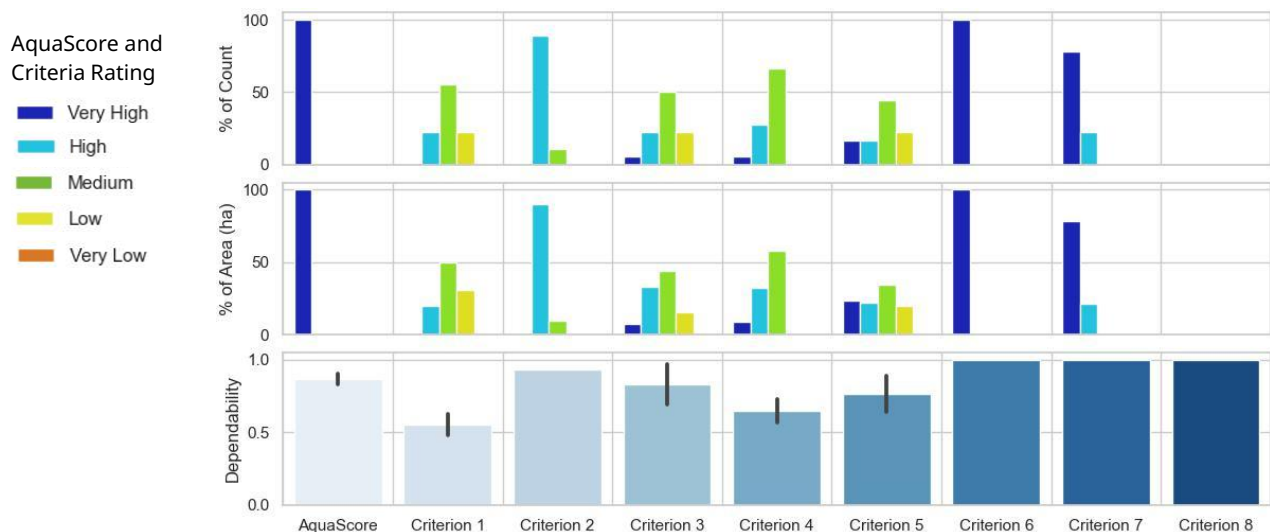


Figure 10 Ratings and average dependability of riverine spatial units for the Curtis Island Study Area

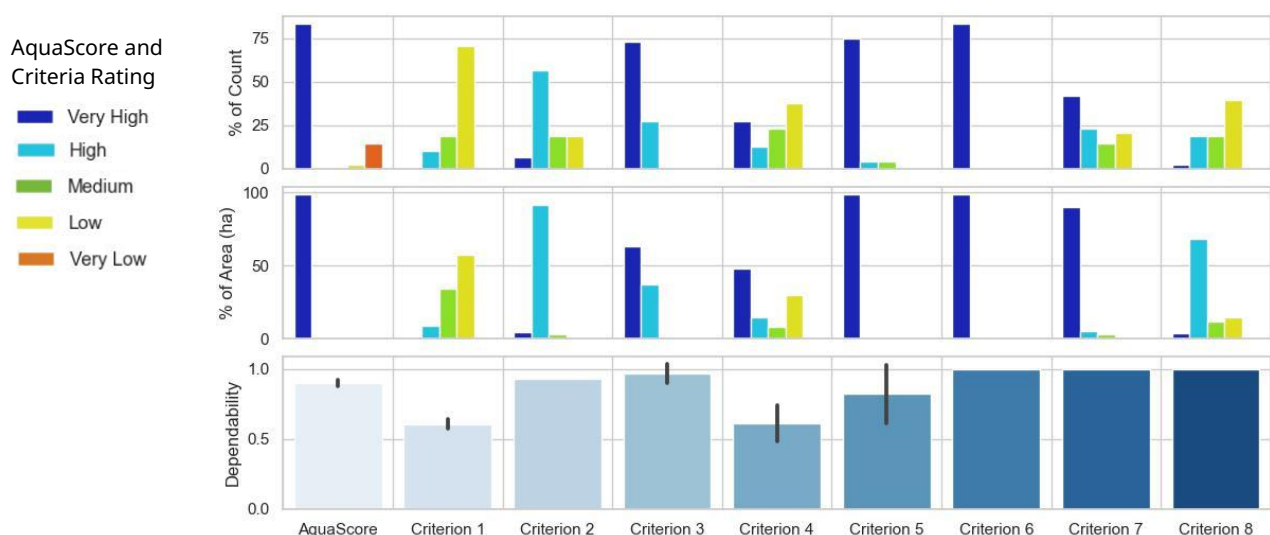


Figure 11. Ratings and average dependability of non-riverine spatial units for the Curtis Island Study Area

Comet study area

The Comet study area is dominated by agriculture with Blackdown Tableland national park bounding the eastern edge and Carnarvon George national park in the west. These national parks support the High ratings for Criterion 4 (threatened species and ecosystems) for about 50% of the wetlands (Figure 12). On average, Criterion 3 (diversity and richness) is lower with over 50% of the wetlands rating Medium or Low due to the influence of agriculture within the region.

The non-riverine wetlands includes several large perched lakes in the headwaters of the catchment, including Lake Nugga Nugga. These lakes are rated Very High for Criteria 6 and 7 (connectivity and representativeness respectively) (Figure 13). The size of the lakes is notable in percentage of area (ha) that the wetlands cover relative to their count (about 30% Very High ratings for C7 compared to about 10% for count). The non-riverine wetlands with a Low rating for C7, are significantly less in % of area compared to their % of count.

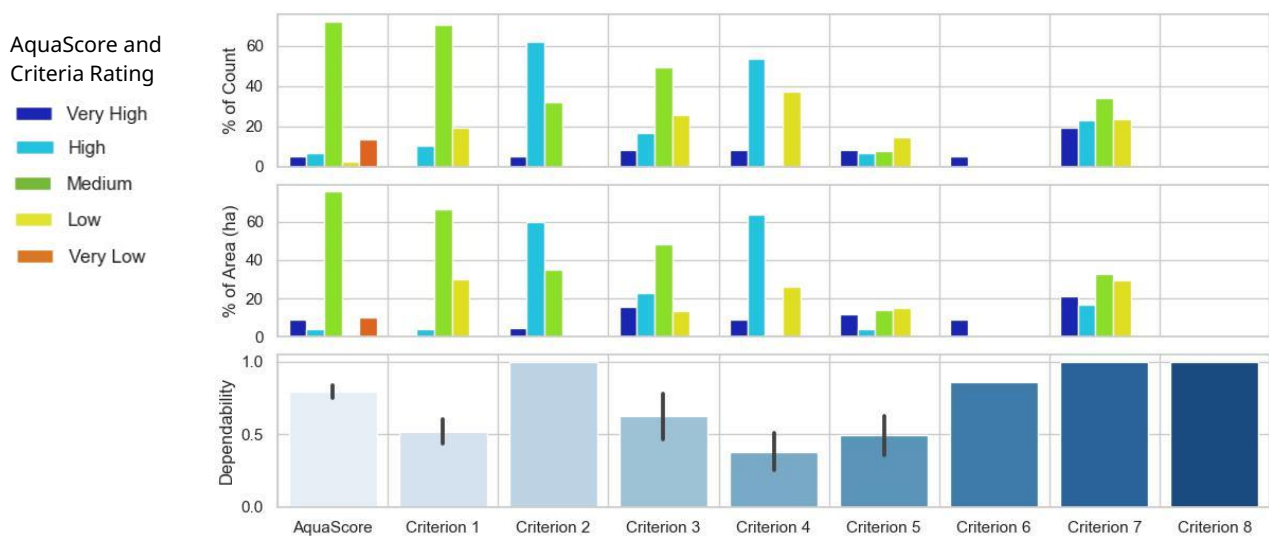


Figure 12 Ratings and average dependability of riverine spatial units for the Comet Study Area

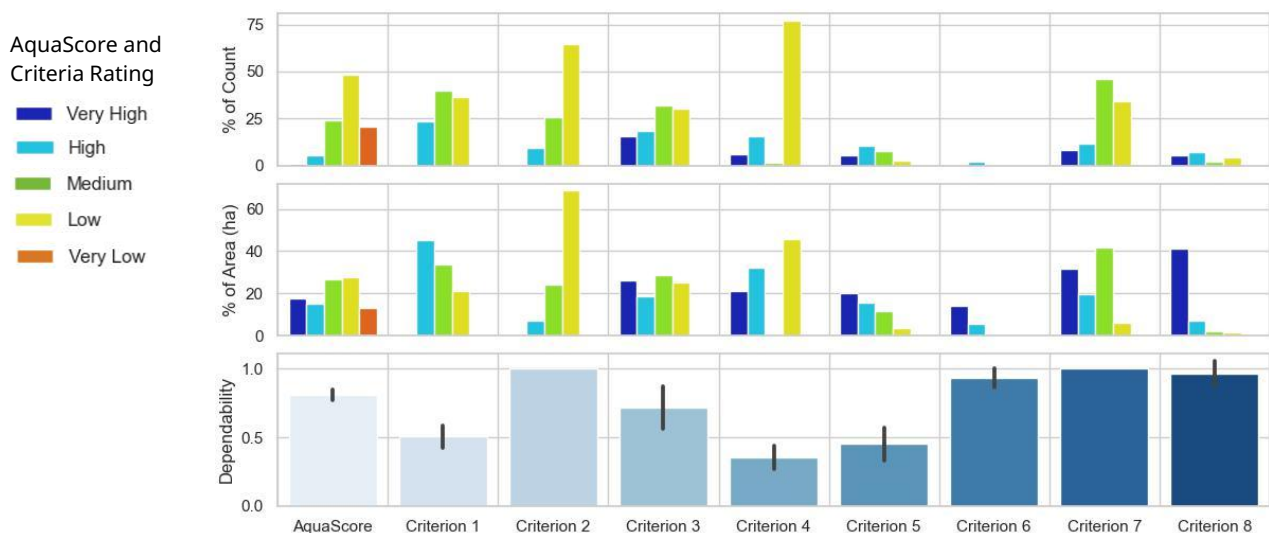


Figure 13. Ratings and average dependability of non-riverine spatial units for the Comet Study Area

Dawson study area

The Dawson study area is dominated by agriculture with Blackdown Tableland national park in the west and a number of state forests and forest reserves through the centre. The national park and forested areas support the High ratings for Criterion 4 (threatened species and ecosystems) for about 60% of the riverine wetlands (Figure 14). On average, Criterion 3 (diversity and richness) is lower with about 60% of the riverine wetlands rating Medium or Low due to the influence of agriculture within the region.

Over 60% of non-riverine wetlands are rated Low for Criteria 2 and 4 (naturalness catchment) (Figure 15). One contributing factor to the high percentage is that about 45% of the wetlands are artificial and Criterion 4 measures are not applicable, resulting in the Low rating. The other contributing factor is the limited spatial spread of threatened species records within the dataset. Most of the records are collected within the Dawson River, with other records located in Blackdown Tableland and Kroombit Tops National Parks where there are no non-riverine wetlands located.

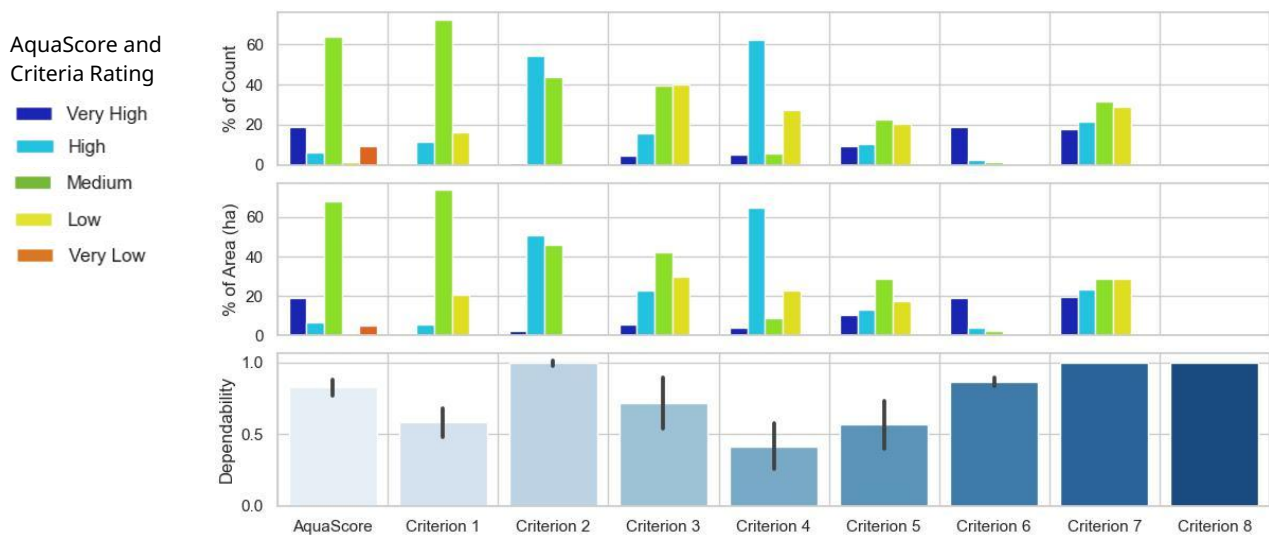


Figure 14 Ratings and average dependability of riverine spatial units for the Dawson Study Area

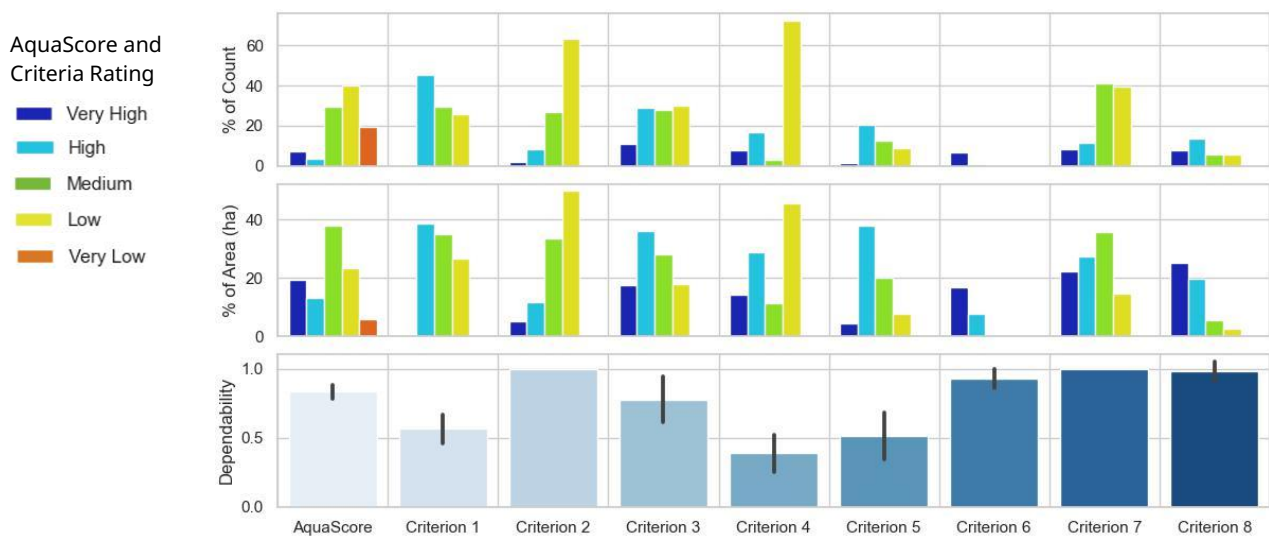


Figure 15. Ratings and average dependability of non-riverine spatial units for the Dawson Study Area

Fitzroy study area

The Fitzroy study area supports a relatively large floodplain and delta region which is important habitat for many species and is identified by the expert panel as a special feature and priority ecosystem for waterbirds. One priority ecosystem that occurs within the region is black ironbox (*Eucalyptus raveretiana*) which is important for riparian zones.

About 40% of riverine wetlands within the region are rated High or Very High for Criteria 4, 5 and 6 (threatened species and ecosystems, priority species and ecosystems and special features respectively) (Figure 16). Criterion 3 (diversity and richness) is also rated Very High for about 20% of non-riverine wetlands (Figure 17).

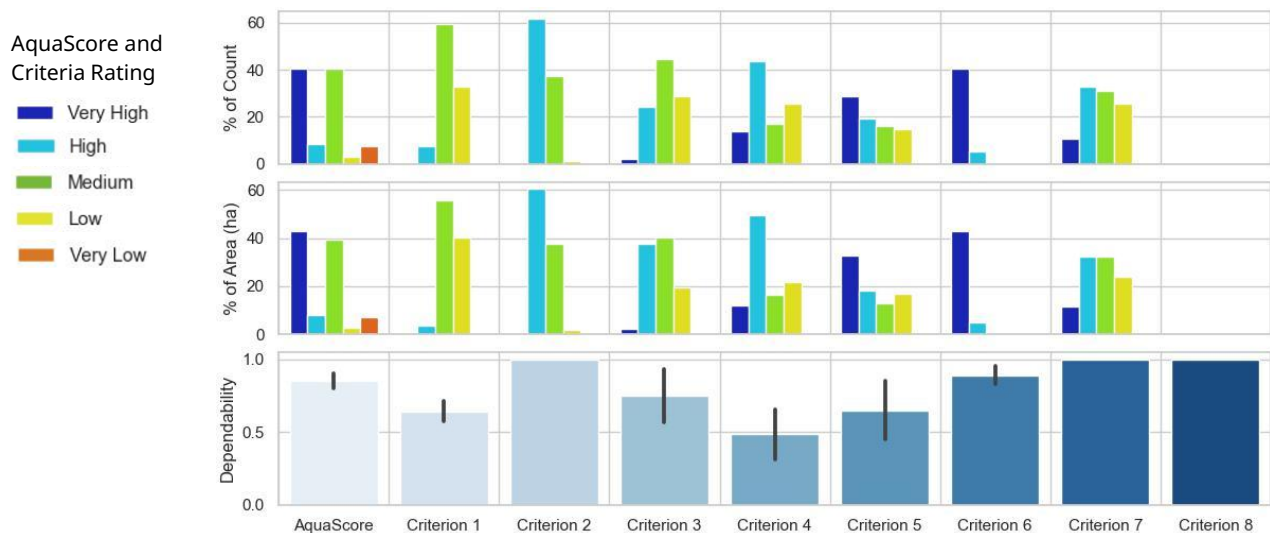


Figure 16 Ratings and average dependability of riverine spatial units for the Fitzroy Study Area

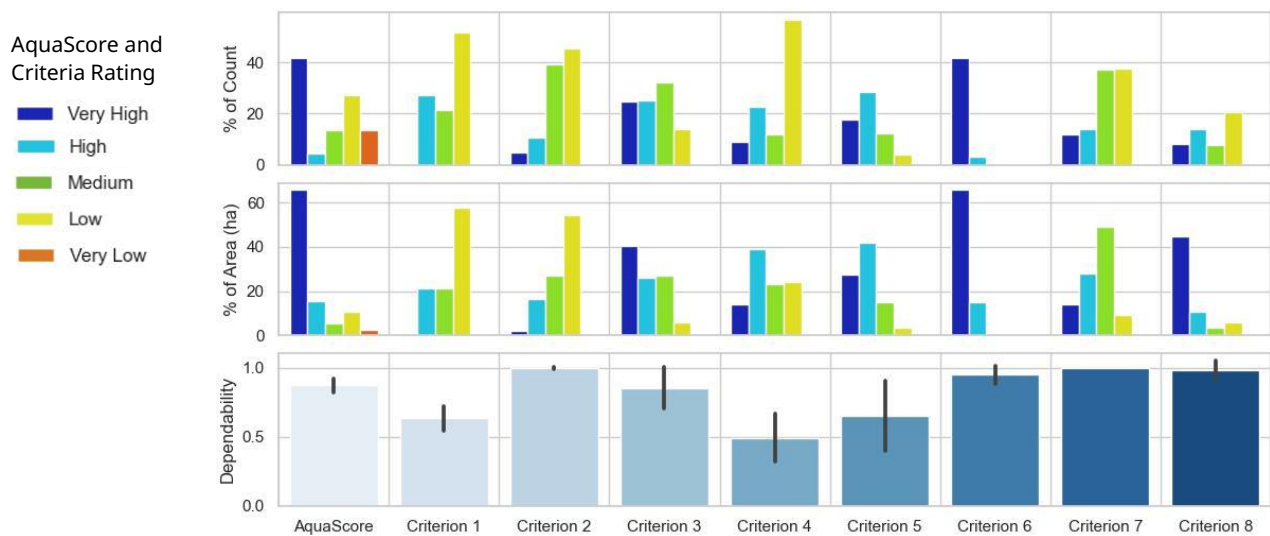


Figure 17. Ratings and average dependability of non-riverine spatial units for the Fitzroy Study Area

Fitzroy Other Islands study area

Figure 18 and Figure 19 shows that all the outlying islands are part of the Great Barrier Reef Marine Park and the wetlands for both riverine and non-riverine are rated Very High for Criterion 6 (special features). There are also little to no records of threatened species or ecosystems present on the islands, as indicated by the riverine wetland Low ratings for Criterion 4, though there are a few identified within the non-riverine wetlands.

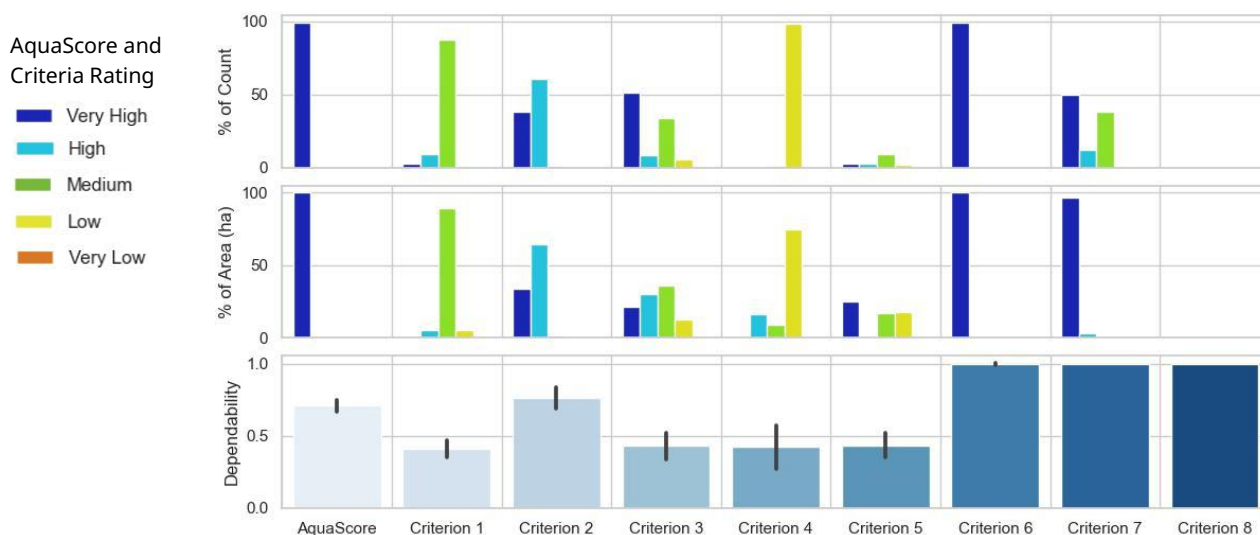


Figure 18 Ratings and average dependability of riverine spatial units for the Fitzroy Other Islands Study Area

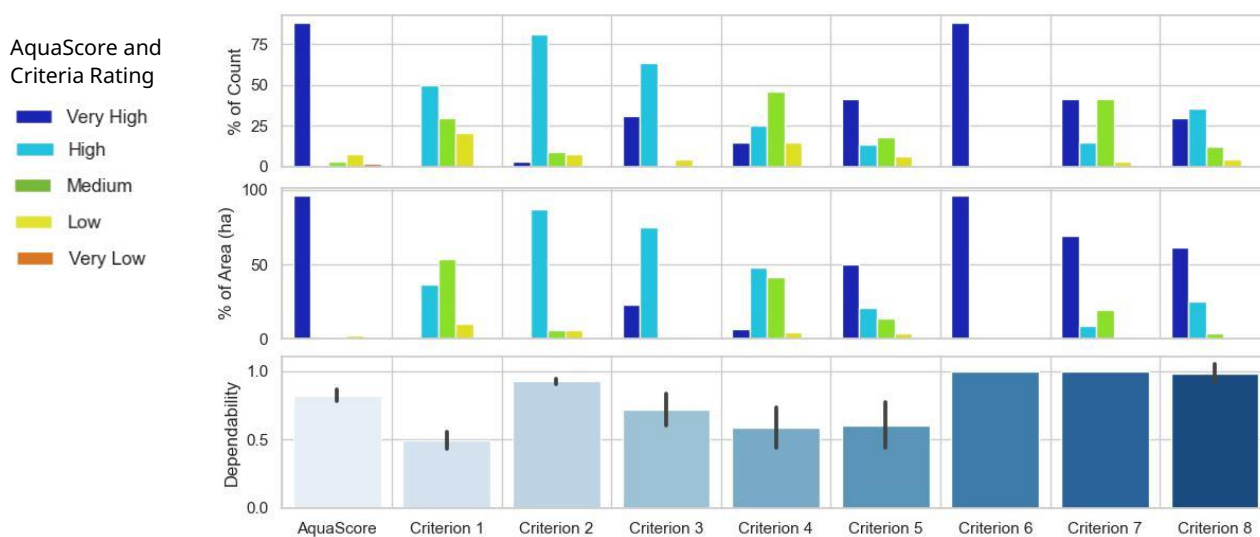


Figure 19. Ratings and average dependability of non-riverine spatial units for the Fitzroy Other Islands Study Area

Isaac study area

The Clark-Connors Range runs down the eastern side of the Isaac study area and is habitat for a number of wetland dependent species including the freshwater snake (*Tropidonophis mairii*) and the platypus (*Ornithorhynchus anatinus*). Other parts of the study area support the ornamental snake (*Denisonia maculata*) and the Fitzroy River turtle (*Rheodytes leukops*). These species are reflected in the High ratings for Criteria 3 and 4 (diversity and richness and threatened species and ecosystems respectively) (Figure 20).

Connectivity (C7) is relatively high for about 40% of the riverine and non-riverine wetlands (Figure 20 and Figure 21). This is due to the Isaac and Connors Rivers that split into multi-channels and anabranches and fill separate lagoons during flood events. The channels have well vegetated riparian zones and few anthropogenic barriers controlling water flow, allowing for a higher connectivity between wetlands especially within the lowland areas.

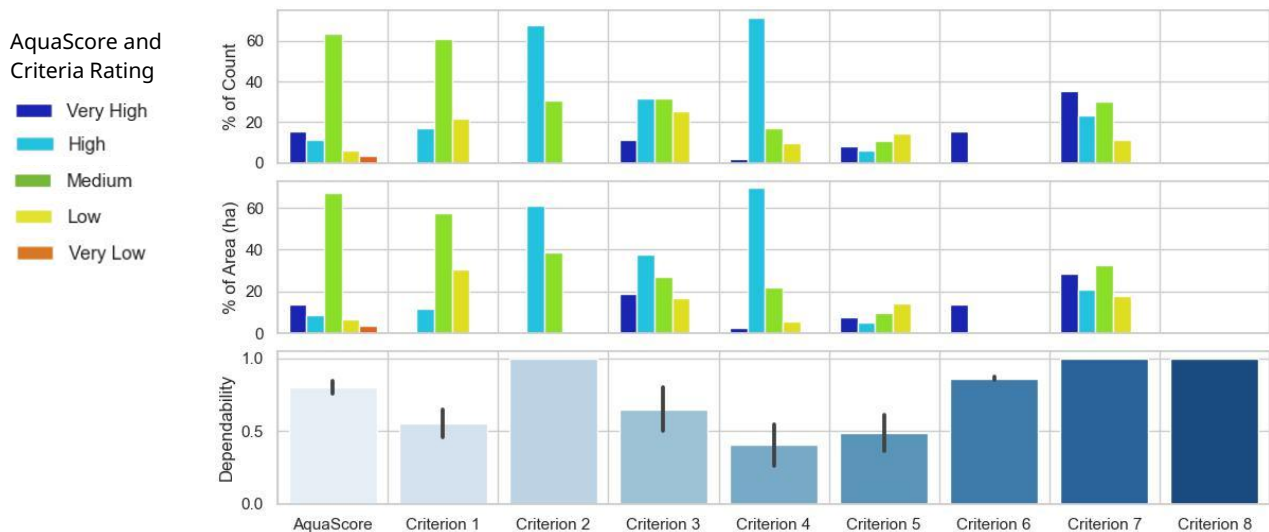


Figure 20 Ratings and average dependability of riverine spatial units for the Isaac Study Area

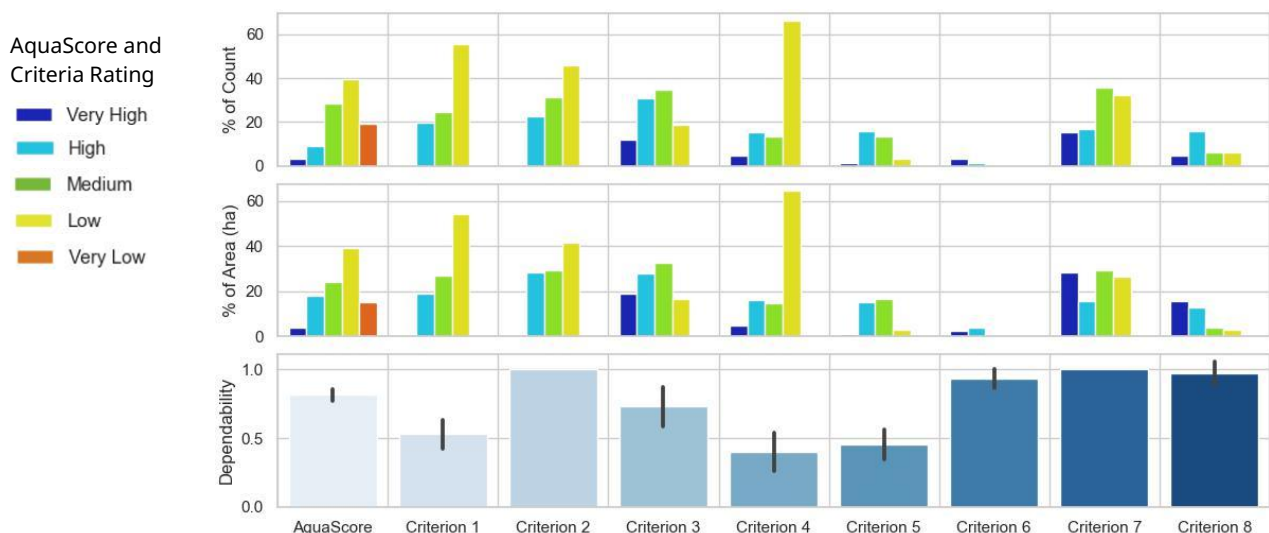


Figure 21. Ratings and average dependability of non-riverine spatial units for the Isaac Study Area

Mackenzie study area

Relative with the Mackenzie study area, over 50% of the riverine wetlands have recorded a threatened species or ecosystem (C4) (Figure 22). These include the white-throated snapping turtle (*Elseya albagula*) in the Mackenzie River and the tusked frog (*Adelotus brevis*) in the Blackdown Tableland National Park. Though the catchment has been heavily cleared for agriculture, the riparian vegetation along most of the river channels remains woody within the measured buffered distance (Indicator 2.2 riparian disturbance). This raises the rating of Criterion 2 (naturalness catchment) where over 70% of the wetlands have receive a rating of High.

There are several weirs controlling the flow of Mackenzie River including Bedford, Binegang, and Tartrus weirs. These create lacustrine wetlands that provide a source of permanent water within the dry landscape and have a diversity of species. They have been identified by the expert panel as special or unique habitats (C6 special features) for refugia (Figure 23).

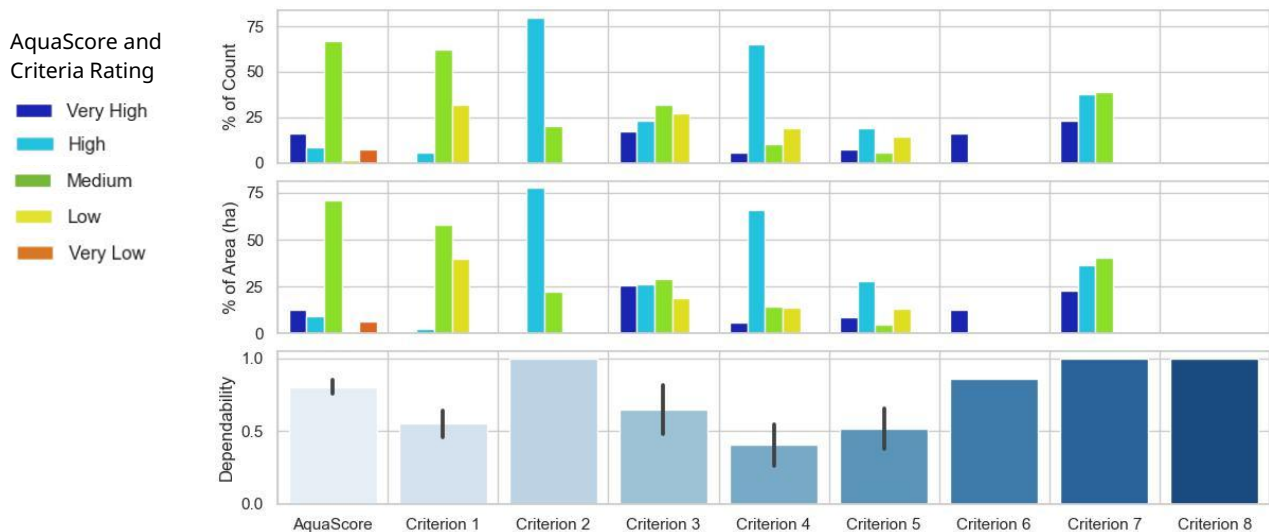


Figure 22 Ratings and average dependability of riverine spatial units for the Mackenzie Study Area

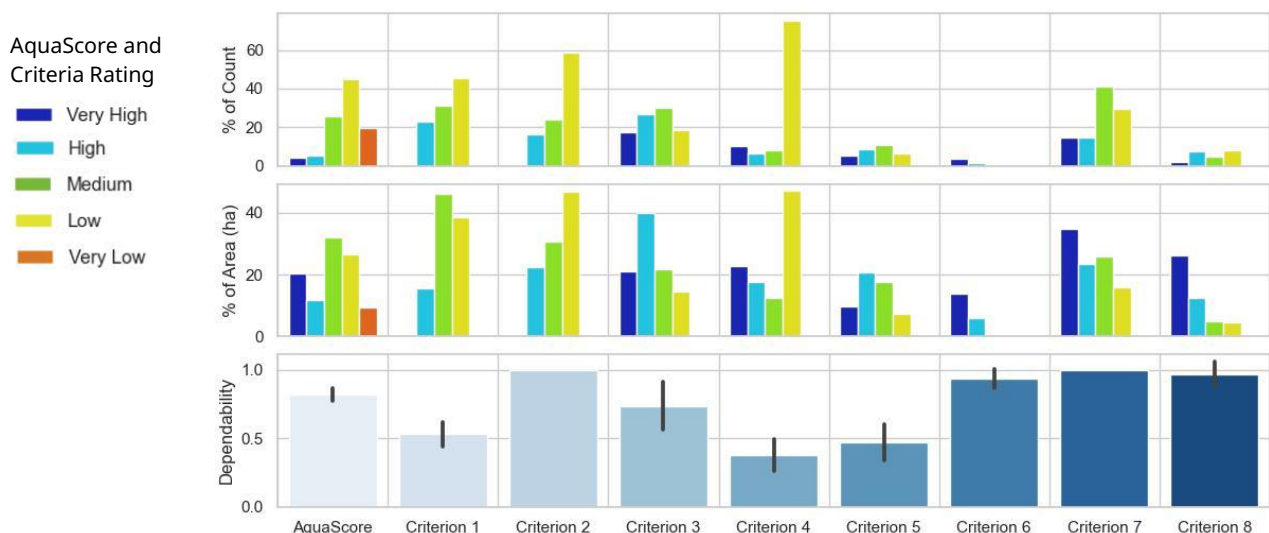


Figure 23. Ratings and average dependability of non-riverine spatial units for the Mackenzie Study Area

Nogoa study area

Lake Maraboon (Fairbairn Dam) on the Nogoa River has been identified by the expert panel as having special and unique features (C6 special features) for refugia and a source of permanent water supporting a diversity of species. Figure 25 identifies Lake Maraboon through the larger percentage of area (ha) values compared to the percentage of count values for the High AquaScore rating (60% of area), the Very High Criteria 3 and 5 ratings (diversity and richness and priority species and ecosystems respectively) and the High Criteria 6 and 7 ratings (special features and connectivity respectively).

Though predominantly cleared for grazing in the south and cropping in the north, there are a diversity of species throughout the catchment. Figure 24 shows over 50% of riverine wetlands have a High rating for Criterion 4 (threatened species and ecosystems). Endangered species include the Australian painted-snipe (*Rostratula australis*).

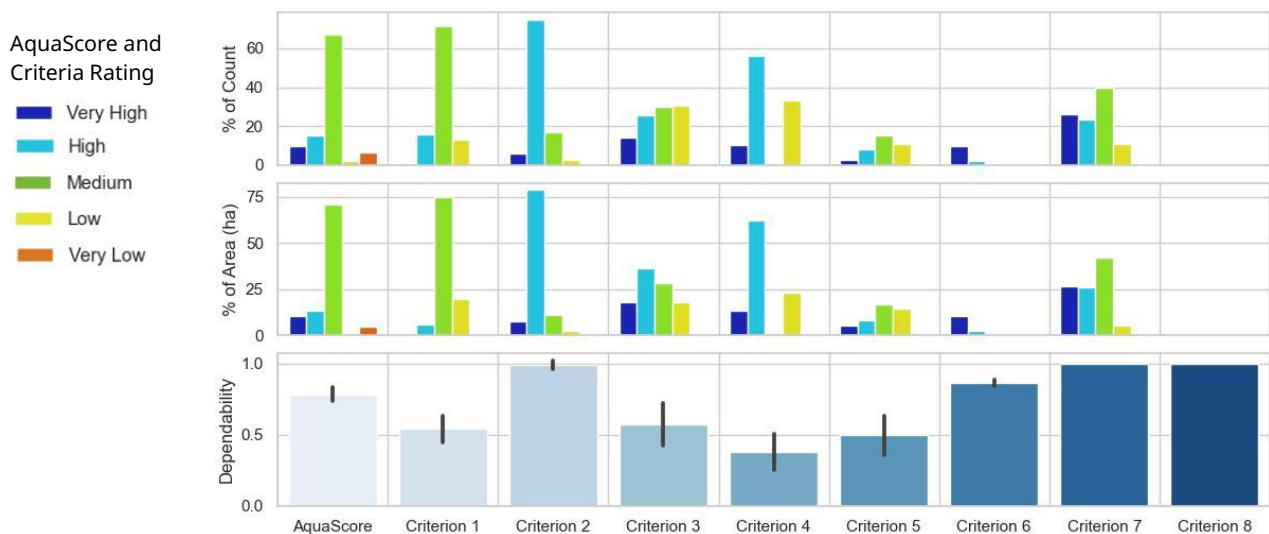


Figure 24 Ratings and average dependability of riverine spatial units for the Nogoa Study Area

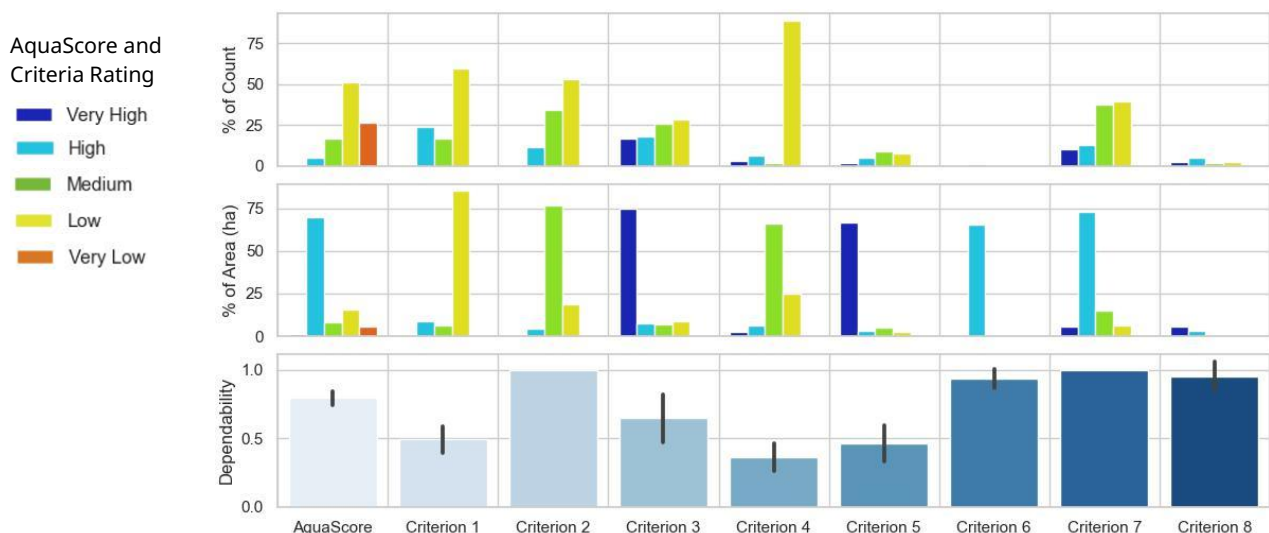


Figure 25. Ratings and average dependability of non-riverine spatial units for the Nogoa Study Area

O'Connell study area

The O'Connell catchment riverine wetlands support a high diversity of threatened and priority species with a rating of High for Criterion 4 and Very High for Criterion 5 (C4 threatened species and ecosystems and C5 priority species and ecosystems) (Figure 26). The headwaters of streams derive from the Eungella National Park and Cathu State Forest before passing through a highly modified landscape for cropping purposes (mostly sugar cane). Riparian vegetation along the major tributaries contributes to the connectivity ratings for both riverine and non-riverine wetlands (Figure 26 and Figure 27). However, many of the lower order streams (riverine) and the artificial and highly modified non-riverine wetlands lack a riparian zone which is essential for supporting breeding habitats and connections between wetlands.

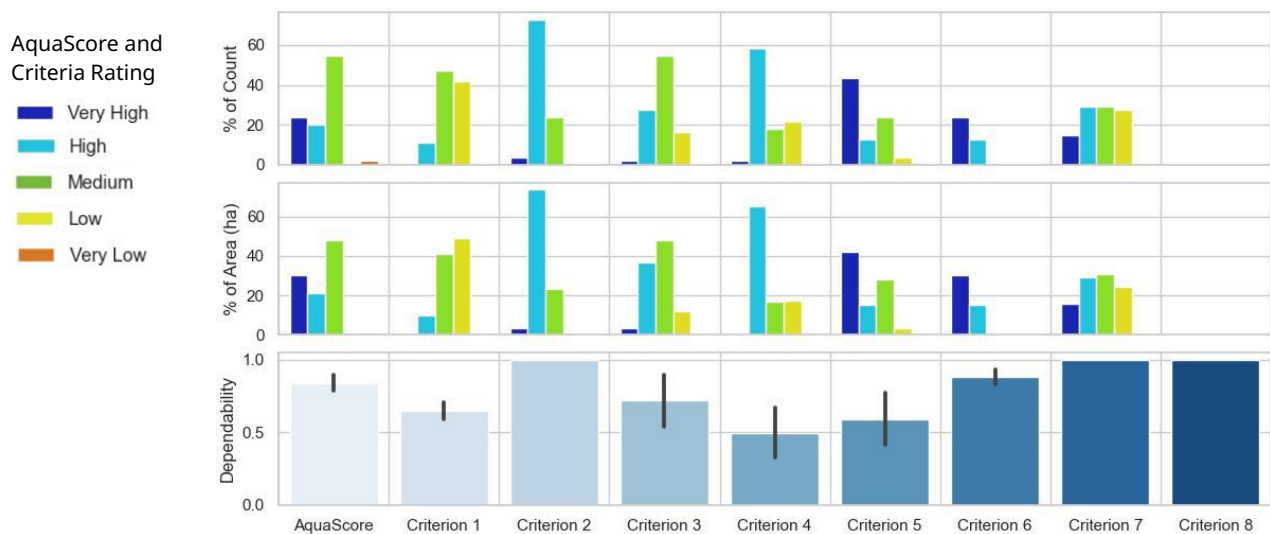


Figure 26 Ratings and average dependability of riverine spatial units for the O'Connell Study Area

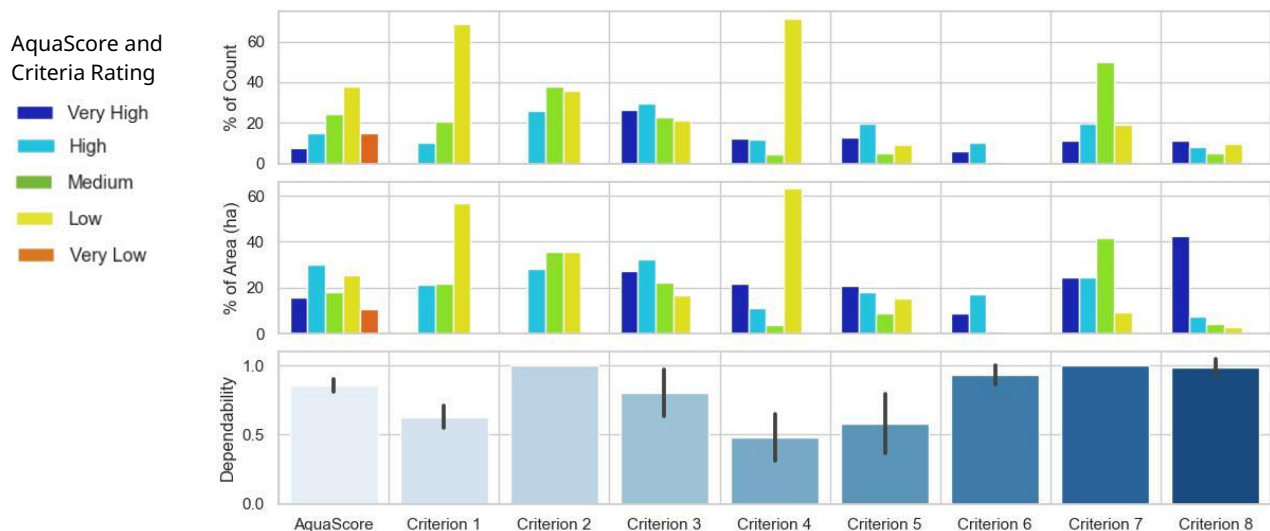


Figure 27. Ratings and average dependability of non-riverine spatial units for the O'Connell Study Area

Pioneer study area

The headwaters of the Pioneer catchment originate from Eungella National Park in the north and state forests in the south including Cridton State Forest and Ben Mohr State Forest. Many endangered and priority species are abundant within these regions as can be seen in Figure 28 with about 60% of riverine wetlands rating High for C4 (threatened species and ecosystems) and about 40% rating Very High for C5 (priority species and ecosystems).

The Pioneer River is regulated by the Dumbleton Weir near Walkerston and the Teemburra Dam regulates Teemburra Creek which eventually drains into the Pioneer River. Both are lacustrine non-riverine wetlands and have Very High ratings for species diversity and richness (C3) (Figure 29).

Riverine wetlands in the upper reaches of the catchment are well connected (C7 connectivity) with few in-stream barriers and natural remnant vegetation. This reflects the Very High ratings for over 50% of the riverine wetlands for Criterion 7 (connectivity) (Figure 28).

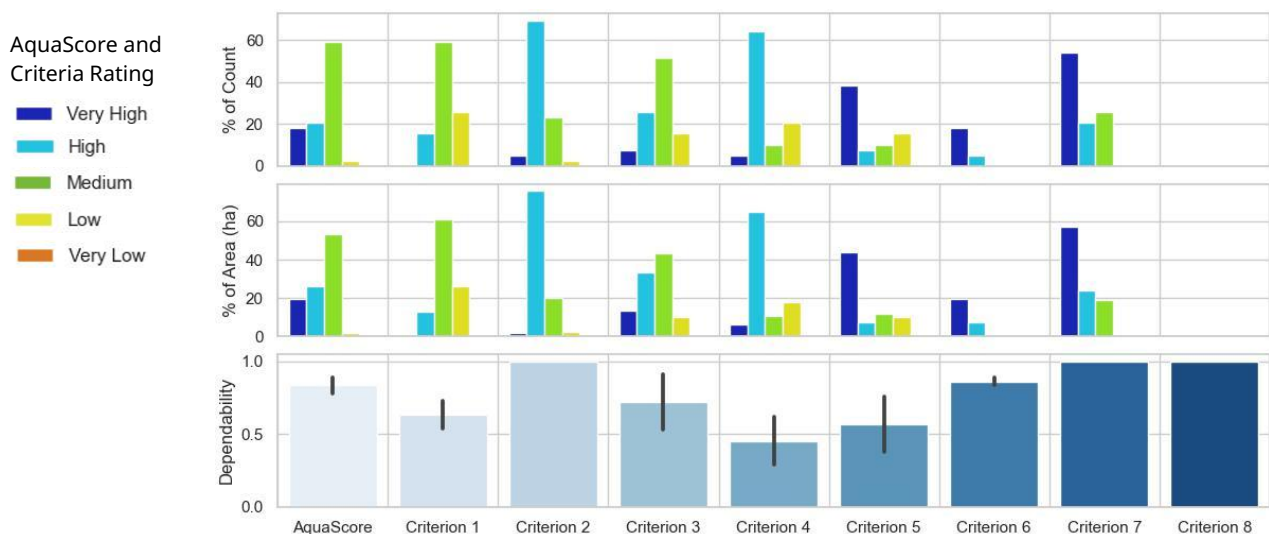


Figure 28 Ratings and average dependability of riverine spatial units for the Pioneer Study Area

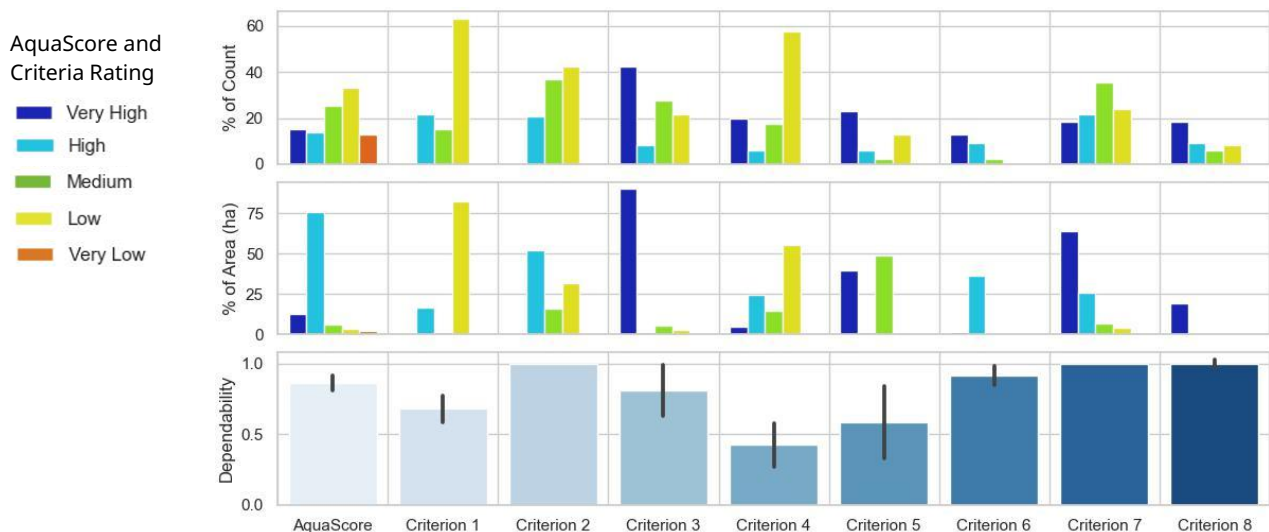


Figure 29. Ratings and average dependability of non-riverine spatial units for the Pioneer Study Area

Plane study area

There are many palustrine coastal wetlands in the Plane catchment which support a variety of species and ecosystems including the restricted regional ecosystem 8.2.11 (*Melaleuca* spp. in dune swales) and habitat for diadromous fish and waterbirds. Another significant habitat identified by the expert panel is the artificial non-riverine wetland known as Kinchant Dam, as it supports an abundance of waterbirds. These significant habitats are reflected in the Very High ratings for Criterion 5 (priority species and ecosystems) in Figure 31.

The riverine wetlands also support important priority ecosystems like regional ecosystem 8.2.11, 8.3.4 (freshwater wetlands with forbland vegetation) and 11.3.27 (freshwater wetlands with woodland vegetation) which are reflected in the Very High ratings for Criterion 5 in Figure 30.

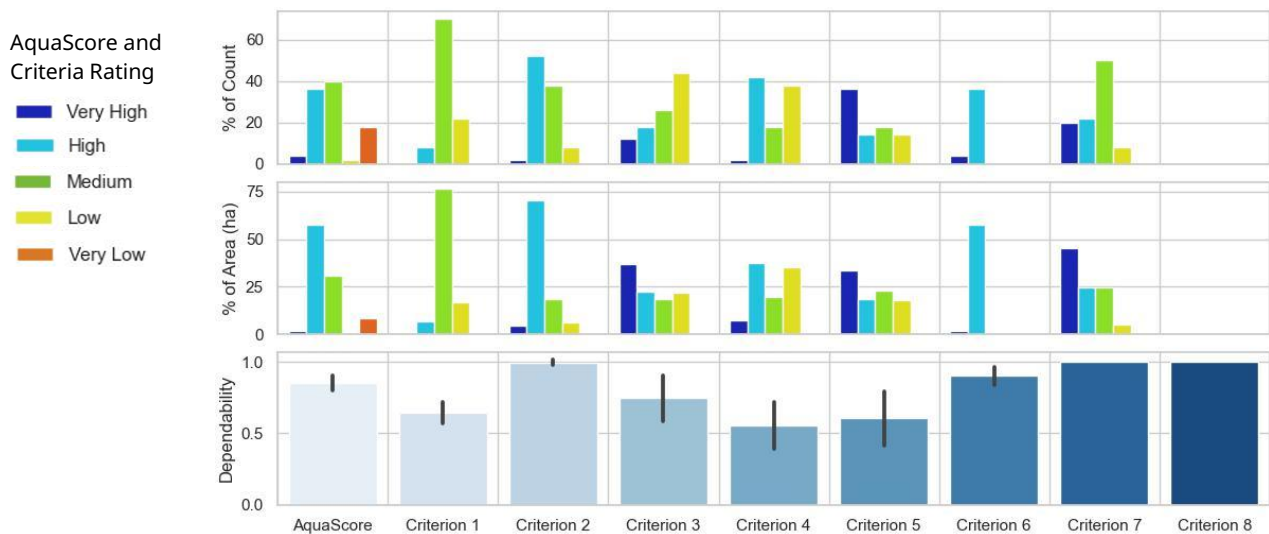


Figure 30 Ratings and average dependability of riverine spatial units for the Plane Study Area

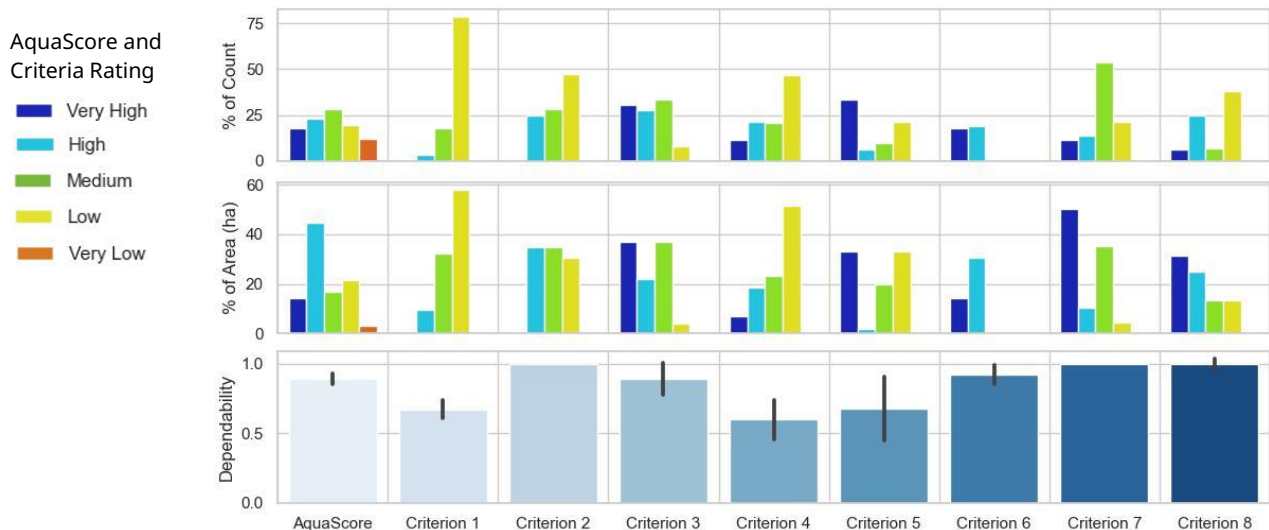


Figure 31. Ratings and average dependability of non-riverine spatial units for the Plane Study Area

Proserpine study area

The Goorganga Plains is a significant palustrine ecosystem that many creeks drain into and occurs south of Proserpine River. It supports an abundance of waterbirds and is listed on the Directory of Important Wetlands in Australia (DIWA). The area supports both riverine and non-riverine wetlands and is reflected in the Very High ratings for Criterion 5 (priority species and ecosystems) in Figure 32 and Figure 33.

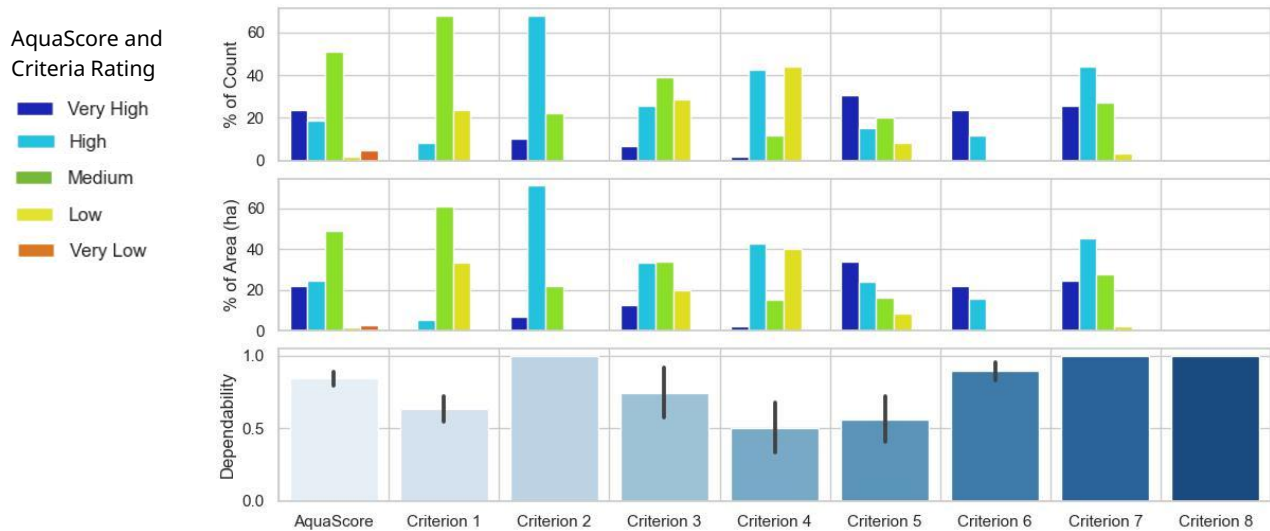


Figure 32 Ratings and average dependability of riverine spatial units for the Proserpine Study Area

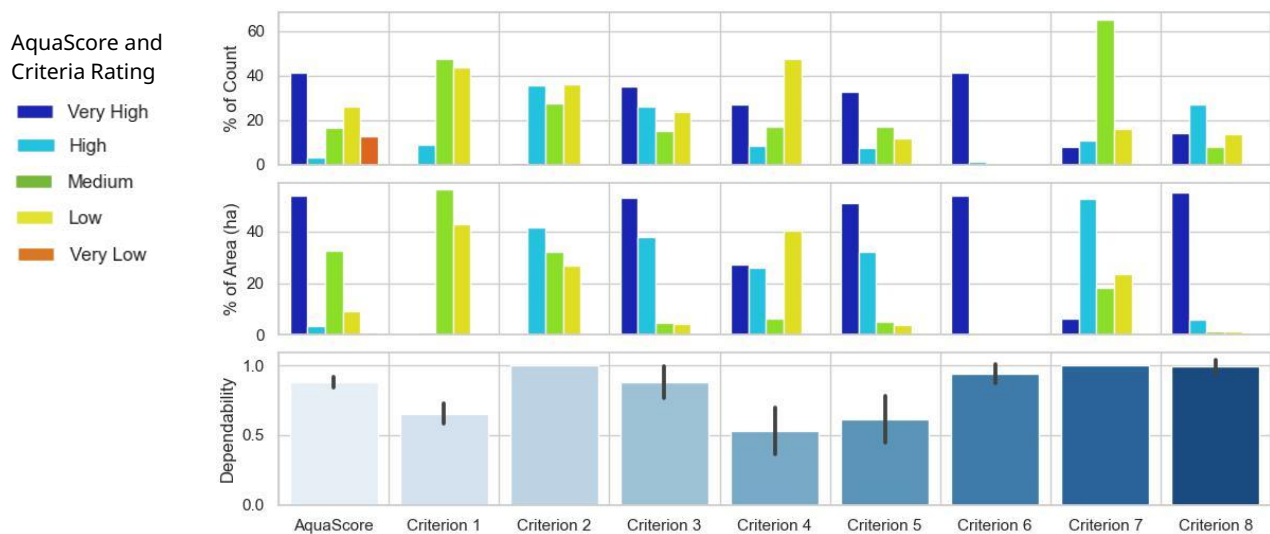


Figure 33 Ratings and average dependability of non-riverine spatial units for the Proserpine Study Area

Shoalwater study area

The Shoalwater catchment is relatively natural with much of the area retaining its remnant vegetation with large coastal wetland habitats supporting an abundance of species and ecosystems including the endangered yellow chat (Dawson) (*Epthianura crocea macgregori*). The abundance of species is reflected in the Very High and High ratings for Criteria 3, 4 and 5 (species diversity and richness, threatened species and ecosystems and priority species and ecosystems respectively) for both riverine wetlands (Figure 34) and non-riverine wetlands (Figure 35).

The non-riverine wetlands of Glen Prairie have been modified by barriers that stop the intrusion of saltwater, so the wetlands are now exclusively freshwater palustrine areas. This supports significant reed beds for waterbirds.

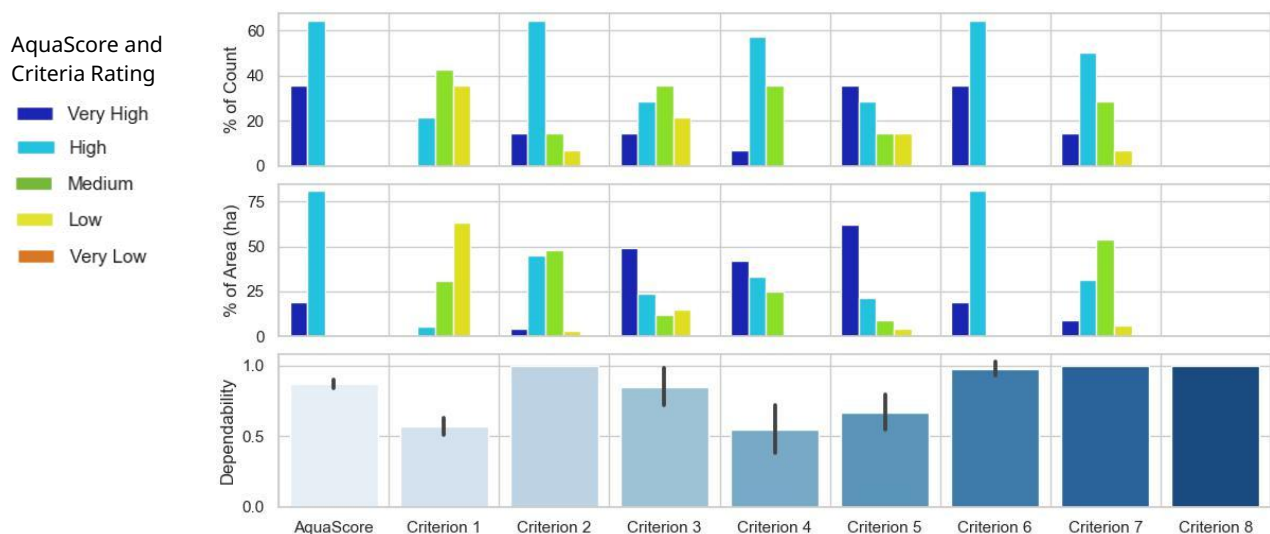


Figure 34 Ratings and average dependability of riverine spatial units for the Shoalwater Study Area

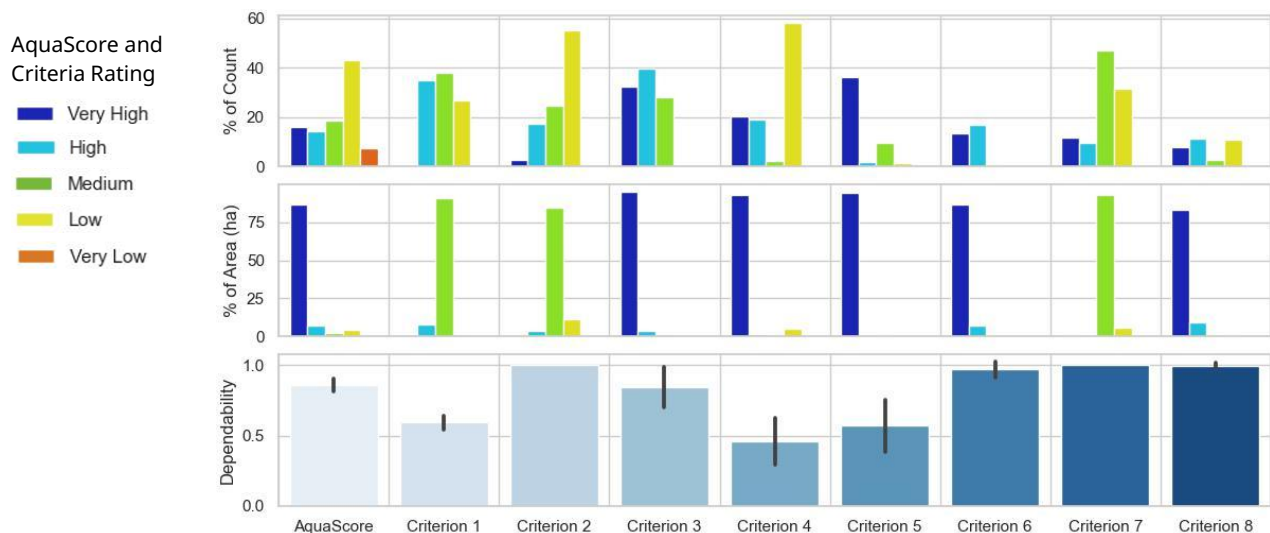


Figure 35. Ratings and average dependability of non-riverine spatial units for the Shoalwater Study Area

Styx study area

The headwaters of the riverine wetlands in the Styx catchment, originate in the higher altitudes of Glencoe State Forest, Mount Buffalo State Forest and Bukkulla Conservation Park before running through grazing land and then into coastal palustrine wetlands. Riparian vegetation is maintained along river channels with few in-stream barriers. This is reflected in the Very High and High ratings for Criterion 7 (connectivity) for all of the riverine wetlands (Figure 36).

The non-riverine coastal wetlands are important habitats for birdlife, especially the yellow chat (Dawson) (*Epthianura crocea macgregori*) and is reflected in the Very High ratings for Criteria 3 and 4 (species diversity and richness and threatened species and ecosystems respectively) (Figure 37).

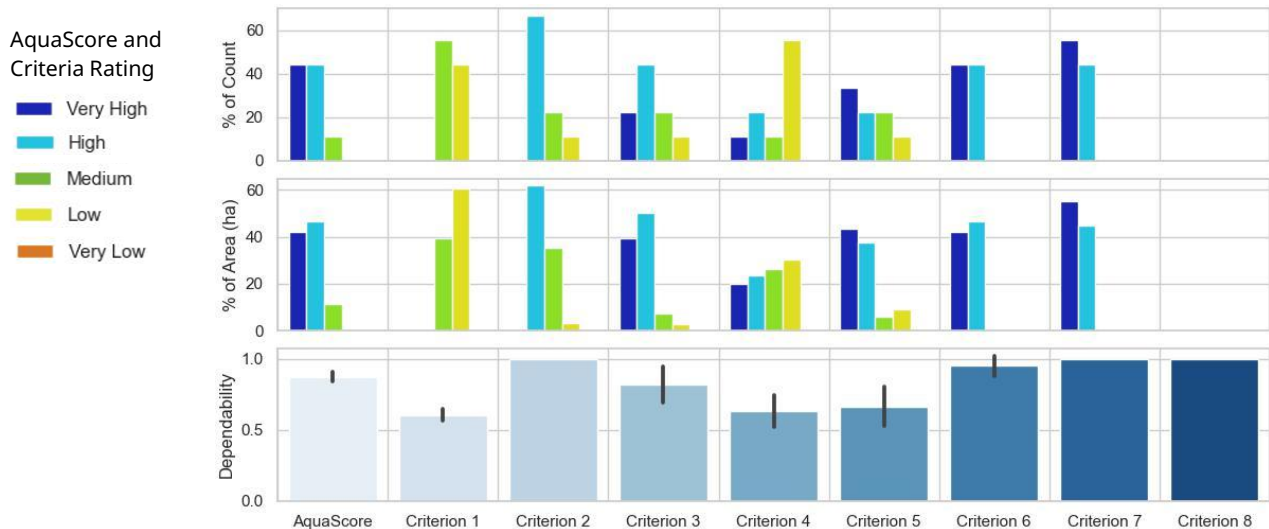


Figure 36 Ratings and average dependability of riverine spatial units for the Styx Study Area

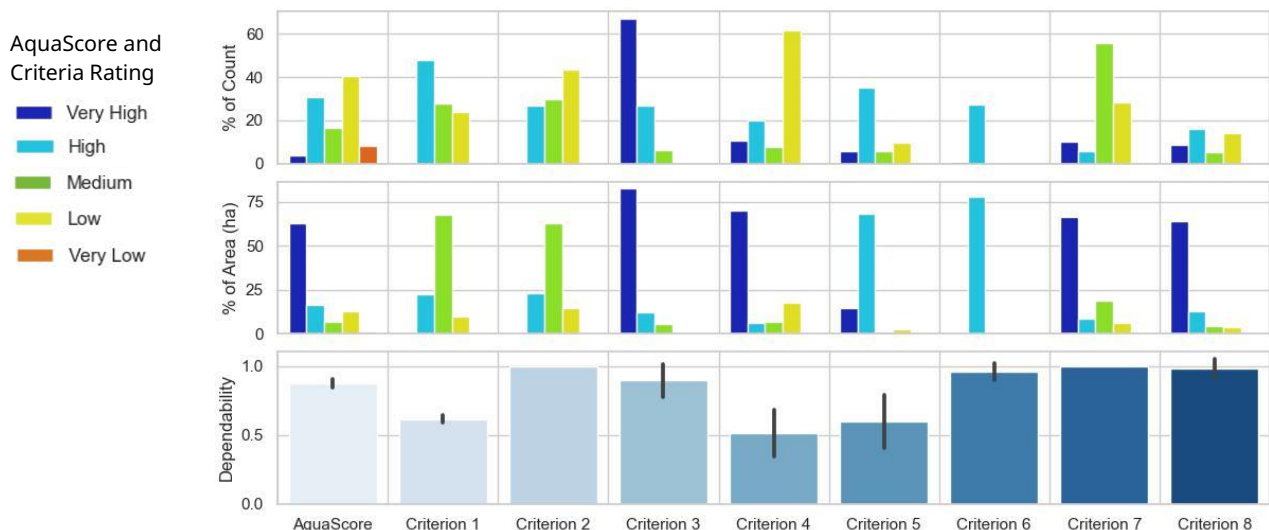


Figure 37. Ratings and average dependability of non-riverine spatial units for the Styx Study Area

Waterpark study area

Much of the Waterpark catchment is reserved for the Shoalwater Bay Training Area and remains largely vegetated with little anthropogenic disturbance. Figure 38 and Figure 39 show Very High and High ratings for all criteria.

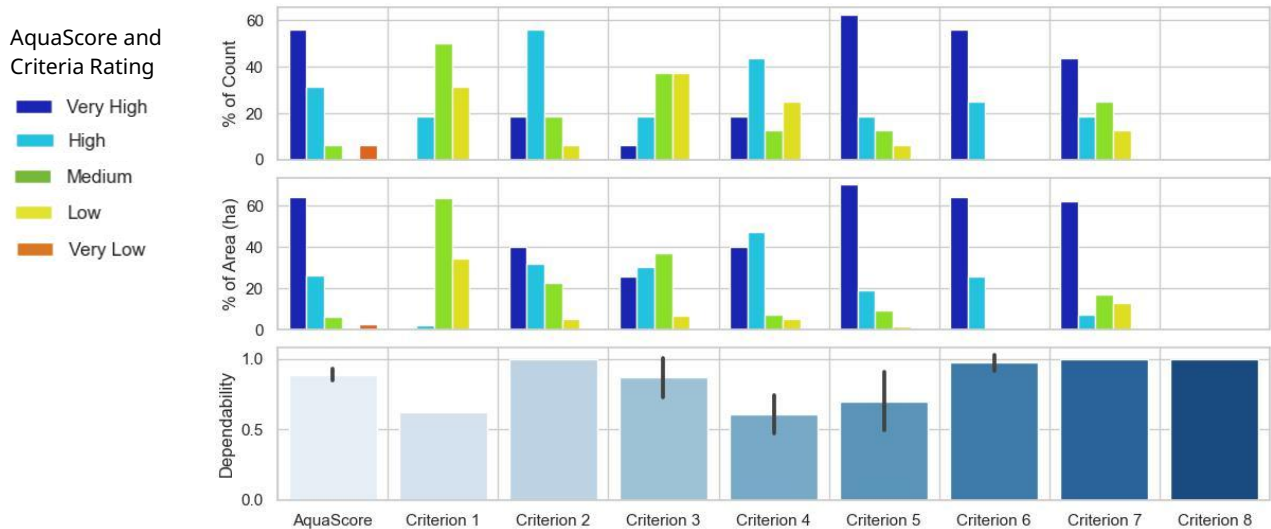


Figure 38 Ratings and average dependability of riverine spatial units for the Waterpark Study Area

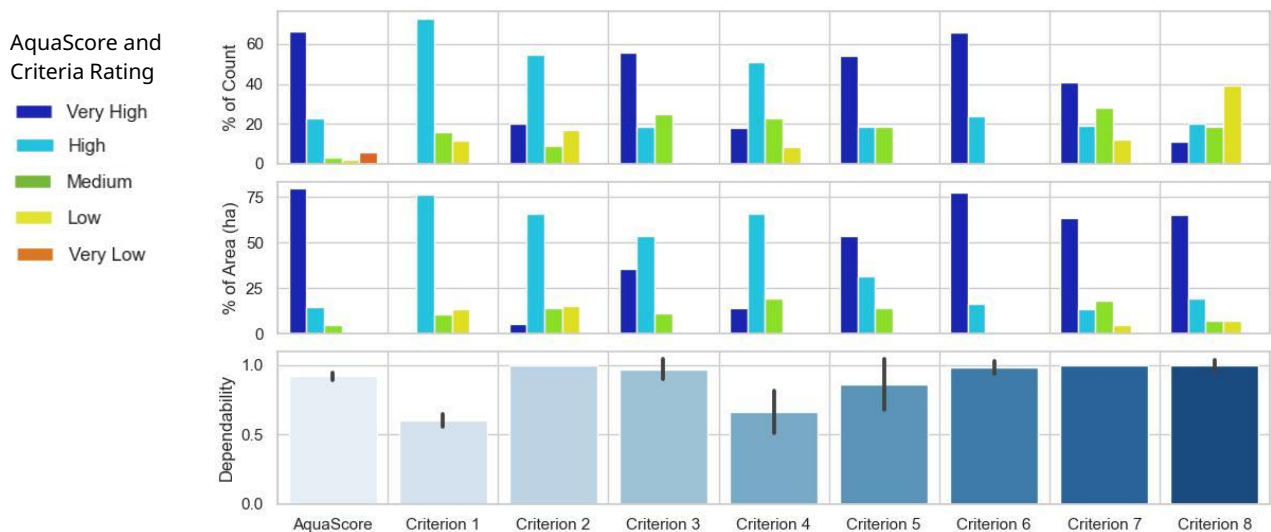


Figure 39. Ratings and average dependability of non-riverine spatial units for the Waterpark Study Area

Whitsunday Island study area

Whitsunday Island is a national park and part of the Great Barrier Reef World Heritage Area. This reflects the Very High and High ratings for all criteria for the single riverine and single non-riverine wetlands in Figure 40 and Figure 41. Some exotic species are found on the island as well as some anthropogenic landuses, which decrease the ratings for the riverine Criteria 1 and 2 (naturalness aquatic and naturalness catchment respectively) from Very High to High.

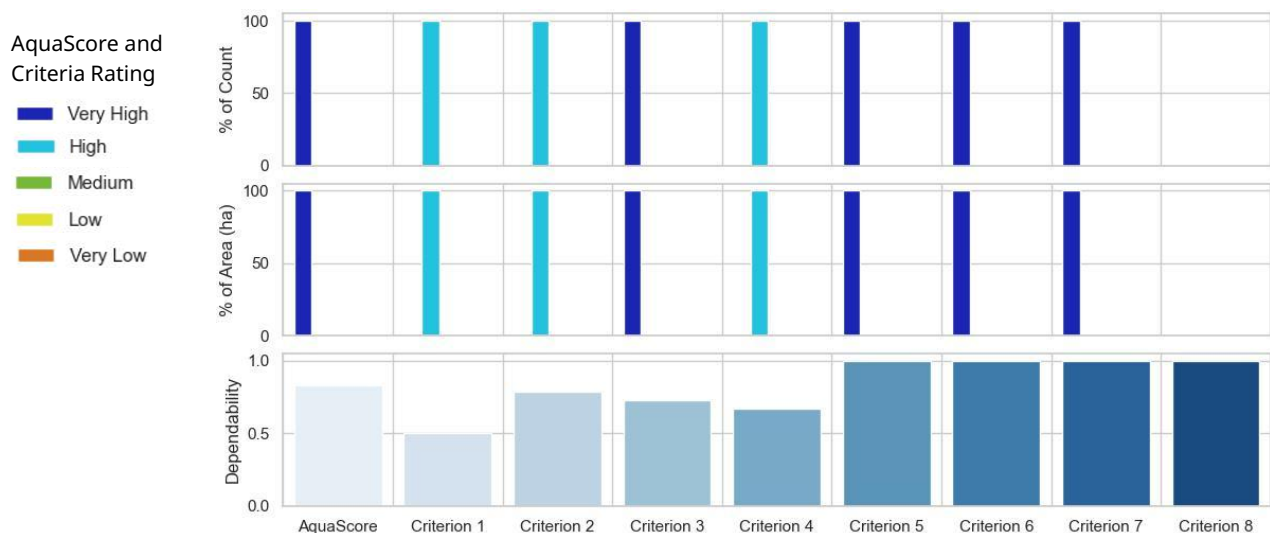


Figure 40 Ratings and average dependability of riverine spatial units for the Whitsunday Island Study Area

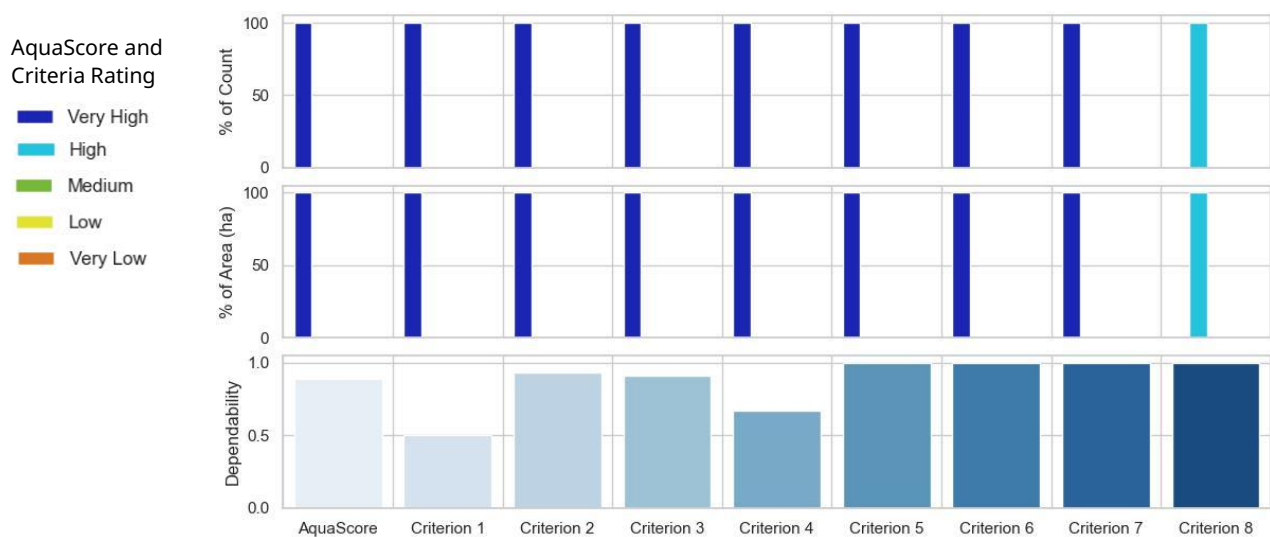


Figure 41. Ratings and average dependability of non-riverine spatial units for the Whitsunday Island Study Area

Ground-truthing

Ground-truthing by field observations is important to identify potential anomalies in assessment results or data implementation. It is an important step in any ACA and it precedes method adjustments and corrections prior to a final run of the AquaBAMM assessment tool.

The lack of available time meant that traveling into the field was unable to be undertaken for this assessment. Instead, high-resolution satellite imagery, aerial photography and other on-line ancillary data sources (including Queensland Globe, Google Earth imagery and photographs) provided a valuable resource to visually review individual wetlands and their surroundings.

While visually interpreting the high-resolution imagery, several validation principles were used to test the validity of the implementation method. These include:

- Inspect spatial units across the range of values from Very Low to Very High. There is a focus on spatial units with Very Low, Low and Very High values as these are considered to have the most influence to reduce the potential of a false negative (type II error) or a false positive (type I error) result.
- Ascertain whether the implementation of Criterion 1 and Criterion 2 needs any adjustment with respect to measure weights and indicator ranks. Some measures or indicators may have an overpowering influence which is not consistent with observation e.g. influence of dams or weirs. This may be due to limitations and availability of relevant base datasets.
- Ascertain whether the size of subsections is adequate to discern variability in criteria (1 and 2) scores or whether values are extrapolated too far an area.
- For non-riverine wetlands reviewed, ascertain if the criteria values and AquaScore are logical as determined by the implementation methodology.
- Inspect wetlands with different levels of hydro-modification (i.e. H1, H2M1, H3 etc.)
- Check where scores or ratings differ markedly between adjacent wetlands.

Field interpretation of ACA results – ecological versus condition assessment

When visually assessing the assessment results there is a strong tendency for observations to be made from a condition or naturalness perspective. Wetland condition or health has been a major focus of aquatic assessment in Australia (such as the nationally agreed protocol of Monitoring River Health Initiative, Index of Stream Condition, Queensland State of the Rivers) (Dunn 2000). However, several authors make a clear distinction between river health and ecological value of a river (Dunn 2000; Bennett et al. 2002; Chessman 2002). Wetland health data may inform assessment of value, and usually does so where data are available, but is not interchangeable with it and the two are not necessarily correlated.

ACAs are primarily focussed on aquatic ecological or conservation value, such that the condition contributes to, but does not solely determine its value. Of the measures used in these assessments, usually less than 10 per cent are related to aquatic, riparian and/or catchment condition. Consequently, when in the field or interpreting high resolution imagery, the successful interpretation of a spatial unit's conservation value is reliant on the observer viewing condition in combination with the other values (seen or unseen).

Examples of wetlands within study areas

The wetlands in the following subsections show different wetlands with their AquaScore and corresponding high-resolution imagery.

Semi-modified wetland in the Nogoa study area

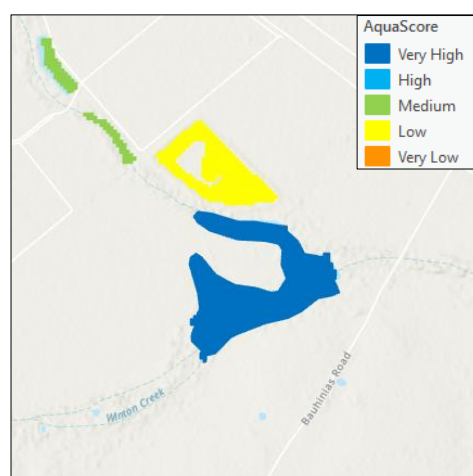
The wetland in Figure 42 and Table 7, sits along Winton Creek in the Nogoa study area. Natural vegetation surrounds most of the wetland with riparian corridor connections to Nogoa River in the north and east. The wetland channel is relatively natural with some anthropogenic bunding (Medium score for C1 aquatic naturalness) retaining a permanent water supply. It has been identified as a special feature with a Very High rating (C6 special features) by the expert panel for the Permanently Wet Wetlands decision (no_nr_ec_01).

Connectivity is maintained via Winton Creek to Nogoa River which then runs into Meckenzie River. All of these channels have reasonably consistent riparian vegetation; however, the surrounding landscape is heavily altered for cropping purposes, reflecting the Medium score for Criterion 7 (C7 connectivity) and the Low score for Criterion 2 (C2 catchment naturalness). The consistent connection of terrestrial vegetation cover along riparian corridors allows for higher species diversity. This is reflected in the Very High scores for Criteria 3 and 5 (C3 diversity and richness and C5 priority species and ecosystems respectively). The riverine ACA analysis for this particular location, has a Medium instream connectivity score, indicating there are a few instream barriers (bunding) within the sub-catchment area.

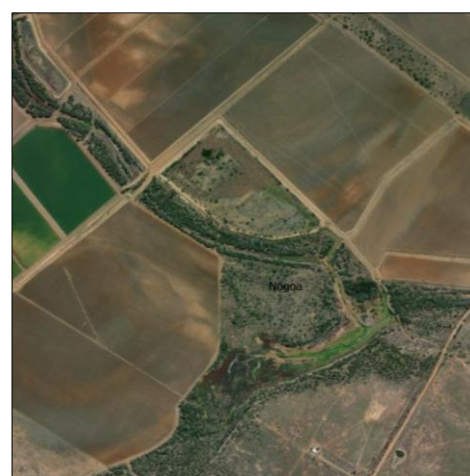
The Criteria scores calculated for this wetland appear to reflect the on-ground observations reasonably well.

Table 7 Semi-modified wetland AquaScore and Criteria scores

Criteria	Score
AquaScore	Very High
Dependability	0.91
C1 Naturalness aquatic	Medium
C2 Naturalness catchment	Low
C3 Diversity and richness	Very High
C4 Threatened species and ecosystems	Medium
C5 Priority species and ecosystems	Very High
C6 Special features	Very High
C7 Connectivity	Medium
C8 Representativeness	No Data



a) AquaScore – Very High



b) High-resolution imagery

Figure 42. Semi-modified wetland showing a) Very High AquaScore conservation value; b) A high-resolution image of the wetland.

Glen Prairie wetlands in the Shoalwater study area.

The Glen Prairie wetlands in Figure 43 and Table 8 are located along the coastline that flows into Broad Sound Bay in the Shoalwater study area. The wetlands score Low for catchment naturalness (C2), and connectivity (C7).

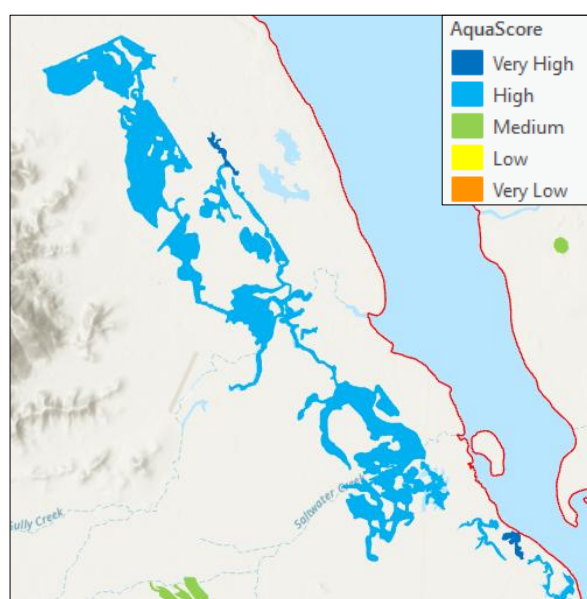
The wetlands have a tidal barrier excluding inflow and outflow from and to the intertidal zone, which allow the wetlands to remain fresh. Though miss-managed through extensive grazing, the expert panel has identified the wetlands as a special feature (C6 special features) with ratings of High for waterbird habitat and regional ecosystems 8.3.4 (forbland) and 11.3.27 (freshwater wetlands).

The wetlands are also important for threatened and priority species and ecosystems within the area, and score Very High for Criterion 4 (C4 threatened species and ecosystems) and Criterion 5 (C5 Priority species and ecosystems).

Overall, the Criteria scores calculated for these wetlands appear to reflect on-ground observations.

Table 8 Glen Prairie wetlands AquaScore and Criteria scores

Criteria	Score
AquaScore	High
Dependability	0.91
C1 Naturalness aquatic	Medium
C2 Naturalness catchment	Low
C3 Diversity and richness	Very High
C4 Threatened species and ecosystems	Very High
C5 Priority species and ecosystems	Very High
C6 Special features	High
C7 Connectivity	Low
C8 Representativeness	High



a) AquaScore – Medium



b) High-resolution imagery

Figure 43. The Glen Prairie wetlands showing a) High AquaScore conservation value; b) A high resolution image of the wetlands.

Riverine wetlands rating Very Low and Medium

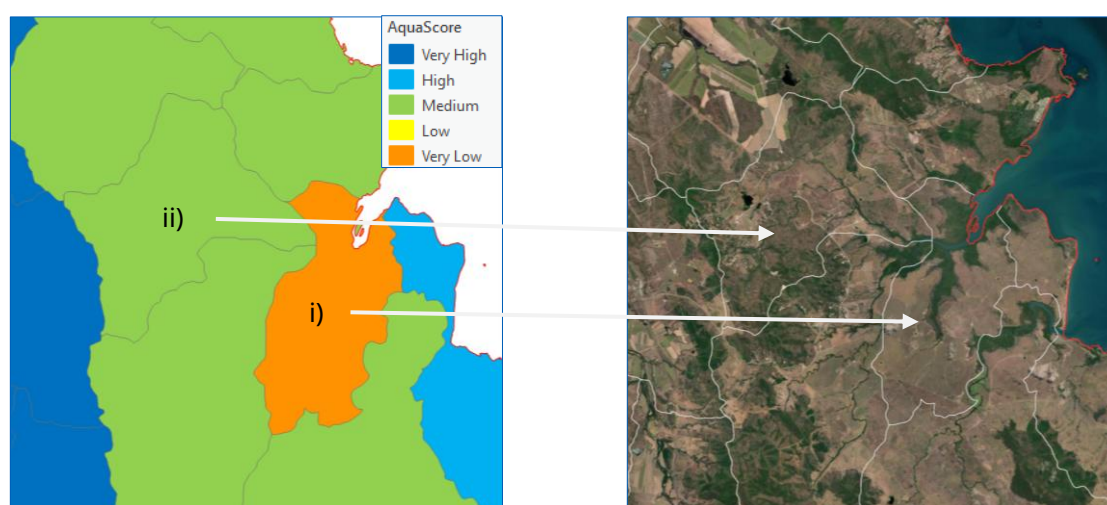
Both riverine wetlands in Table 9 and Figure 44 are connected to the intertidal zone which benefit aquatic organisms like anadromous fish. However, the connection to the intertidal zone is not yet parameterised in ACAs as a landscape estuarine connectivity index and thus not reflected in the AquaScore. It was also not identified within the expert panel workshops through Measure 7.5.2 (Extent to which the wetland retains critical ecological and hydrological connectivity). The freshwater instream (Measure 7.1.4) and terrestrial vegetation (Measure 7.4.2) connections are measured at the landscape scale and reflect the Low and Medium scores for Criterion 7 (C7 connectivity). Wetland ii) appears to contain more natural terrestrial vegetation (Medium for C7) within its landscape compared to wetland i), which appears to be dominated by agricultural (Low for C7).

The number of species records captured for wetland i) is relatively lower than for wetland ii). This is reflected in the lower score for C3 (diversity and richness) and C5 (priority species and ecosystems). Reasons behind this difference could be that the expert panel identified species were not actually captured within wetland i) or the species are not actually present within the area. This limitation needs to be considered when reviewing the scores for management and planning purposes.

Overall, the criteria ratings for these wetlands appear to correspond to on ground observations and data availability (species records and connectivity).

Table 9 Riverine wetlands AquaScore and Criteria scores

Criteria	Score for i)	Score for ii)
AquaScore	Very Low	Medium
Dependability	0.8	0.83
C1 Naturalness aquatic	Medium	Medium
C2 Naturalness catchment	High	High
C3 Diversity and richness	Low	Medium
C4 Threatened species and ecosystems	Low	Low
C5 Priority species and ecosystems	No Data	Low
C6 Special features	No Data	No Data
C7 Connectivity	Low	Medium
C8 Representativeness	No Data	No Data



a) AquaScore – i) Very Low; ii) Medium

b) High-resolution imagery

Figure 44. Riverine wetlands in the O'Connell study area where a) Very Low and Medium AquaScore conservation values and b) a high-resolution image of the wetlands.

Lake Nuga Nuga (rating Very High)

Lake Nuga Nuga wetland in Figure 45 and Table 10 is a very valuable wetland as it has Very High conservation ratings for all criteria except for aquatic and catchment naturalness (C1 and C2 respectively). The lake is surrounded by grazing land that has been cleared of woody vegetation, reflecting the Low rating for Criterion 1. There is a small but important vegetation corridor to the north connecting the lake to Nuga Nuga National Park, but little riparian vegetation surrounds the lake reducing its connection it to other parts of the landscape.

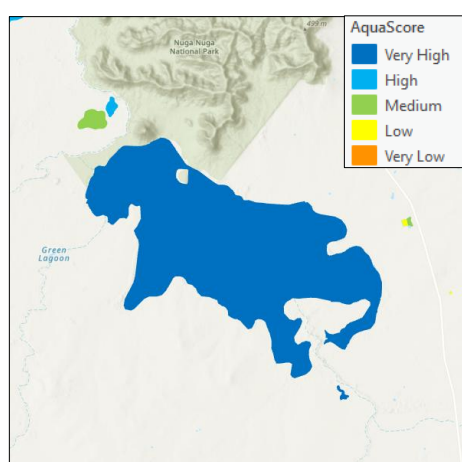
The expert panel identified multiple special feature (C6) and significant habitat (C5) ratings for the lake. These include:

- Lake Nuga Nuga (ct_nr_ec_01) as an ephemeral system that has geomorphic values of interest and habitat for numerous macrophytes and waterbirds.
- Permanently wet wetlands that are natural or semi-modified (ct_nr_ec_03) and provide a permanent source of water in a relatively dry landscape.
- Regional ecosystems 8.3.4 and 11.3.27 (ct_nr_fl_01) that provide habitats with significant values that are under threat from anthropogenic processes and physical alterations.
- Lake Nuga Nuga DIWA (ct_nr_fa_02) for a significant waterbird habitat.

Overall, the criteria ratings for these wetlands appear to correspond to on ground observations and data availability (species records).

Table 10 Lake Nuga Nuga AquaScore and Criteria scores

Criteria	Score
AquaScore	Very High
Dependability	0.94
C1 Naturalness aquatic	High
C2 Naturalness catchment	Low
C3 Diversity and richness	Very High
C4 Threatened species and ecosystems	Very High
C5 Priority species and ecosystems	Very High
C6 Special features	Very High
C7 Connectivity	Very High
C8 Representativeness	Very High



a) AquaScore – Very High



b) High-resolution imagery

Figure 45. Lake Nuga Nuga wetland in the Comet study area is a) Very High AquaScore conservation value and b) a high-resolution image of the wetlands.

Ponded pasture adjacent to the Styx River

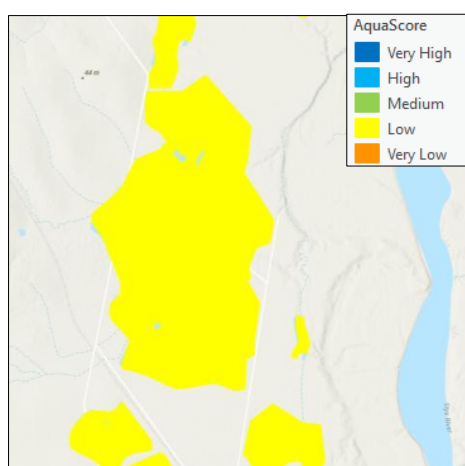
The ponded pastures in Figure 46 and Table 11 are mapped as artificial wetlands. The landscape has been bunded to trap overland flow for pasture growth. This bunding is not reflected in the input data sources used for the analysis of Indicator 1.3 (Habitat feature modification) and so this particular Indicator has a Very High rating which contributes to the High rating for Criterion 1 (C1 Naturalness aquatic). Indicator 1.4 (Hydrological disturbance/modification) is rated Low due to the wetland being classed as artificial and Indicator 1.1 (Exotic flora/fauna) has a Low rating, identifying very few or no exotic pest species recorded within the area. These pest species do not include introduced pasture grasses, as pasture grasses were not identified by the expert panel as significant exotic species that directly affect the condition and conservation values of wetlands.

Criteria 4, 5, 6 and 8 (C4 Threatened species and ecosystems, C5 Priority species and ecosystems, C6 Special features and C8 Representativeness respectively) all have 'No data' for their rating. Artificial wetlands are not given scores for Criteria 4 and 5 and only given a score for Criterion 6 if explicitly identified by the expert panel. For Criterion 8 measures, no data is available for its management group (see section 2.4 on page 23 for further information on management groups).

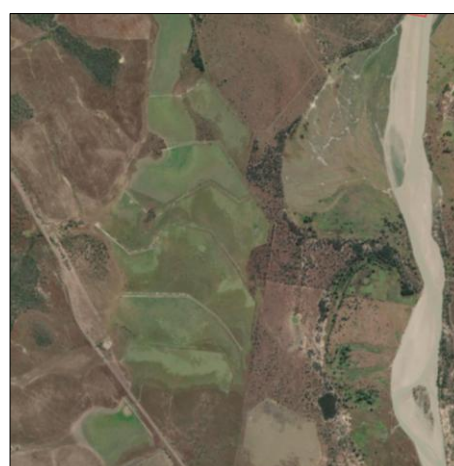
Overall, the criteria ratings for this wetland appear to correspond to on ground observations and data availability (species records).

Table 11 Ponded pastures AquaScore and Criteria scores

Criteria	Score
AquaScore	Low
Dependability	0.85
C1 Naturalness aquatic	High
C2 Naturalness catchment	Low
C3 Diversity and richness	Medium
C4 Threatened species and ecosystems	No data
C5 Priority species and ecosystems	No data
C6 Special features	No data
C7 Connectivity	Medium
C8 Representativeness	No data



a) AquaScore – Low



b) High-resolution imagery

Figure 46. Ponded pastures in the Styx study area is a) Low AquaScore conservation value and b) a high-resolution image of the wetlands.

Caveats, limitations and recommendations

Producing accurate and realistic results in a broadscale analysis such as the ACAs depends on the availability and scale of input datasets and the knowledge held by expert panel members.

One type of data that was unavailable for the current assessment was data from the State of the Rivers program, which featured heavily in early ACAs. Data collection for this program ceased in the early 2000's, was incomplete for the state, and is outdated. To avoid issues of data availability, the AquaBAMM project team are developing a new implementation for Criteria 1 and 2. This new implementation will use contemporary datasets and importantly, datasets that cover the entire state. The intention is to incorporate this new implementation into future ACAs.

Another constraint is that AquaScores can be influenced by high scoring measures within criteria that contain few measures. This was identified as part of an independent sensitivity analysis (Robinson & Lee 2009). Data availability is never equal for all wetlands in a study area. In the same way, expert knowledge is not usually available for every wetland in a study area. Dataset completeness is influenced spatially by research effort and other factors.

The scale at which landscape features are mapped can result in incomplete or imprecise data. Non-riverine wetlands below the minimum mapping scale (i.e. 1:100,000) or polygon threshold size (i.e. 1 Ha) are not mapped as part of the Queensland Wetland Mapping (QWM) and were not assessed as part of the FGBRCC assessments. Furthermore, ACAs only include non-riverine wetland area features from the QWM where palustrine or lacustrine wetlands are dominant, or the sum of subdominant palustrine or lacustrine wetland regional ecosystem area is >50%. Riverine waterbodies, such as instream rock holes, are also often well below the minimum mapping scale of the QWM, though important ecologically. Finer scale mapping of non-riverine wetlands would allow more precise delineation of wetland conservation values particularly special features and connectivity values.

The linear nature of many riverine wetlands means they are commonly included as subdominant wetland regional ecosystems within much larger regional ecosystem polygons. For these reasons, riverine wetland areas are generally not as well represented in the QWM as their non-riverine counterparts. To address this, riverine ACAs use fine-scale riverine catchments for spatial units. These fine-scale catchments (subsections) are used to represent specific stream reaches, or groups of reaches, and are synonymous with State of the Rivers subsections or fine-scale sub-catchments of the Australian Hydrological Geospatial Fabric (Geofabric). The implications of this from an ACA perspective are two-fold. Firstly, riverine conservation values calculated as part of an ACA generally only apply to the watercourses within each riverine spatial unit. Secondly, riverine special features may only apply to specific reaches, sections of reaches, or discrete locations (e.g. rockholes) within a riverine spatial unit. Where possible, descriptions of the precise location and extent of riverine special features have been included with the riverine special feature values descriptions and this information can be used to aid interpretation. The availability of finer scale riverine wetland area mapping similar to the non-riverine wetlands would allow more precise delineation of riverine conservation values particular special features and connectivity values.

Whenever lines are drawn on a map from the expert panels or Directory of Important Wetlands for example, there is a possibility that the boundary may not be correct at the scale of the individual subsection. For these types of decisions, the boundary should always be considered at the appropriate scale. The wetlands mapping (QWM) is the fundamental spatial input into this ACA and the positional accuracy of the wetlands mapping is 1:100 000, except for areas along the east coast which are mapped at the 1:50 000 scale.

Cultural values are not specifically taken into consideration during an ACA process, however where noted by the expert panel cultural values were recorded in the special feature descriptions. Experts have highlighted that engagement with Traditional Owners should be undertaken where possible to

assist with identifying ecological values. Unfortunately, resourcing constraints mean that detailed engagement is often limited.

The improvement of data inputs to this type of assessment is ongoing. Input data, especially for more remote areas such as the catchments west of the Great Dividing Range, is often more sparse, dated or limited in spatial extent. Specific examples of where future data enhancements could improve the quality of output of this type of assessment include:

- The use of species habitat suitability models for Criterion 3 diversity and richness, Criterion 4 threatened species, and Criterion 5 priority species measures.
- Integration of new methods for calculating aquatic and catchment naturalness (Criteria 1 and 2) as the current implementation is limited by data availability.
- Development of new methodologies for calculating ecological and physical connectivity (Criterion 7) as previous methods were subjective.
- Finer scale mapping of both riverine and non-riverine wetlands would allow more precise delineation of wetland conservation values particularly special features and connectivity values.
- Future wetlands mapping may consider whether springs have a surface expression and if these should be included in the ACAs depending on their scale.

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Appendix I – Criteria definitions

Naturalness – Aquatic

This Criterion reflects the extent to which a wetland's (riverine or non-riverine) state of naturalness is affected through relevant influencing indicators which include: presence of exotic flora and fauna; presence of aquatic communities; degree of habitat modification and degree of hydrological modification.

Naturalness – Catchment

The naturalness of the broader terrestrial systems of a catchment can have an influence on many wetland characteristics including natural ecological processes e.g. nutrient cycling, riparian vegetation, water chemistry and flow. The indicators utilised to assess this Criterion include: presences of exotic flora and/or fauna; riparian, catchment and flow modification.

Riparian ecosystems (i.e. river bank vegetation) are important components of the landscape for water quality, biodiversity, and the overall health of a catchment. These ecosystems frequently exhibit higher species richness and abundance than surrounding habitats. They act as movement pathways along riparian systems for a number of species, especially birds (Bennet et al 2014). They can also provide critical resources for many species in terms of food, shelter and nesting sites (Lovett & Price 2007). Other important ecosystem services provided by riparian vegetation include the provision of shade, nutrient and debris inputs, bank stabilisation, and water bourn pollution reduction.

Diversity and Richness

Criterion three considers the physical and biological diversity of species and habitats. This Criterion is common to many ecological assessment methods and can include both physical and biological features. It includes such indicators as species richness, riparian ecosystem richness and geomorphological diversity.

Ecosystem diversity refers to the variety of ecosystems within a given place. Landscapes are composed of a mosaic of interconnected ecosystems. For example, the number and size of wetlands ecosystems within an area is an indication of habitat complexity. Habitat complexity has been linked to a variety of ecosystem traits including taxonomic richness and ecosystem resilience.

Threatened Species and Ecosystems

This Criterion evaluates ecological rarity characteristics of a wetland. This includes both species rarity and rarity of communities / assemblages. The communities and assemblages are best represented by regional ecosystems. Species rarity is determined by NCA and EPBC status with Critically Endangered, Endangered, Vulnerable or Near-threatened species being included in the evaluation. Ecosystem rarity is determined by regional ecosystem biodiversity status i.e. Endangered, Of Concern or Not of Concern. Biodiversity status is based on an assessment of the condition of remnant vegetation in addition to the criteria used to determine the class under the *Vegetation Management Act 1999*.

Priority Species and Ecosystems

This Criterion has been restricted to species and ecosystems not currently recognised through the statutes (i.e. NCA, EPBC, VMA) and that are largely identified through expert opinion (not including physical features).

Priority flora and fauna species lists are expert panel derived. These are aquatic, semi-aquatic or riparian species exhibiting one or more of the following traits.

For flora species the traits included:

- It forms significant macrophyte beds (in shallow or deep water).
- It is an important food source.
- It is an important/critical habitat.
- It is implicated in spawning or reproduction for other fauna and/or flora species.
- It is at its distributional limit or is a disjunct population.
- It provides stream bank or bed stabilisation or has soil binding properties.
- It is a small population and subject to threatening processes.

For fauna species the traits include:

- It is endemic to the study area (>75 per cent of its distribution is in the study area/catchment).
- It has experienced a significant reduction in its distribution and has a naturally restricted distribution in the study area/catchment.
- It is a significant disjunct population.
- It is a migratory species (other than birds).
- A significant proportion of the breeding population (>one per cent for waterbirds, >75 per cent for other species) occurs in the waterbody (see Ramsar criterion 6 for waterbirds).
- Limit of species range.

Priority ecosystems include those providing habitat for migratory species or significant water bird habitat.

Special Features

The special features Criterion assimilates information that is not accessible or not in a format that is easily incorporated into the AquaBAMM. Special features are areas identified by flora, fauna and ecology expert panels which exhibit characteristics beyond those identified in other criteria and which the expert panels consider to be of the highest ecological importance. The key themes in the criterion include: geomorphic features, ecological processes, special habitat (including habitat that functions as refugia or other critical purpose), refugia and hydrological regimes.

The attributes used to identify special and unique features are outlined in the Expert Panel Report.

Connectivity

This Criterion identifies connections between and within aquatic ecosystems, including connections to the broader landscape.

Aquatic ecosystem connectivity is the mechanism that propagates environmental processes spatially and temporally.

This Criterion is based on the concept that appropriately connected aquatic ecosystems are more likely to be healthy and resilient, with maximum potential biodiversity and delivery of ecosystem services.

In its broadest meaning it incorporates hydrological processes (quantity and quality, temporal and spatial variability), organism dispersal (barriers) and disturbances from their natural state. It can be bi-directional movements within a stream, uni-directional contribution to a downstream spatial unit or special area, or lateral connectivity to floodplain wetlands or groundwater ecosystems.

Representativeness

This Criterion evaluates the rarity and uniqueness of a wetland type in relation to specific geographic areas and applied primarily to non-riverine assessments. Rarity is determined by the degree of wetland protection with “protected Areas” estate or within an area subject to the *Fisheries Act 1994*, *Coastal Protection and Management Act 1995*, or *Marine Parks Act 2004*. Wetland uniqueness evaluates the relative abundance and size of a wetland or wetland management group/habitat type within geographic areas such as catchment and subcatchment.

The Criterion is underpinned by the CAR (comprehensive, adequate and representative) reserve design principal which aims to protect representative samples of species and ecosystem types from throughout their geographical range. This concept is designed to ensure that reserve systems represent the entire diversity of species, interactions and dependencies inherent to each ecological community.

Appendix II – Measure implementation table

Measure	Description	Implementation	Primary data sets used	Threshold type	NR	R
Criterion 1 Naturalness aquatic						
1.1.1	Presence of 'alien' fish species within the wetland	The expert panel identified exotic fish species dependent on freshwater streams for all or part of their lifecycle. Species survey point records (year ≥ 1950, precision $\leq 2000\text{m}$) were used to count the different exotic species found within a subsection unit. The occurrence, distribution and density values were also drawn from the Department Agriculture and Fisheries Annual Pest and Weed Distribution Surveys from 2008. Values from both records and distribution surveys were normalised between 0 and 1 for each subsection unit. A score of 'No Data' was allocated to any subsection unit that had an absence of data.	DETSI QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel. DAF Annual Pest and Weed Distribution Surveys from 2008.	Continuous Desc (Negative)	Y	Y
1.1.2	Presence of exotic aquatic and semi-aquatic plants within the wetland	The expert panel identified exotic aquatic plant species dependent on freshwater streams for all or part of their lifecycle. Species survey point records (year ≥ 1950, precision $\leq 2000\text{m}$) were used to count the different exotic species found within a subsection unit. The occurrence, distribution and density values were also drawn from the Department Agriculture and Fisheries Annual Pest and Weed Distribution Surveys from 2008. Values from both records and distribution surveys were normalised between 0 and 1 for each subsection unit. A score of 'No Data' was allocated to any subsection unit that had an absence of data.	DETSI databases WildNet, HerbreCs, Corveg and Expert Panel. DAF Annual Pest and Weed Distribution Surveys from 2008.	Continuous Desc (Negative)	Y	Y
1.1.3	Presence of exotic invertebrate fauna within the wetland	The expert panel identified exotic invertebrate fauna species dependent on freshwater streams for all or part of their lifecycle. Species survey point records (year ≥ 1950, precision $\leq 2000\text{m}$) were used to count the different exotic species found within a subsection unit. The occurrence, distribution and density values were also drawn from the Department Agriculture and Fisheries Annual Pest and Weed Distribution Surveys from 2008.	DETSI QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel. DAF Annual Pest and Weed Distribution Surveys from 2008.	Continuous Desc (Negative)	Y	Y

Measure	Description	Implementation	Primary data sets used	Threshold type	NR	R
		Values from both records and distribution surveys were normalised between 0 and 1 for each subsection unit. A score of 'No Data' was allocated to any subsection unit that had an absence of data.				
1.1.4	Presence of feral/exotic vertebrate fauna (other than fish) within the wetland	The expert panel identified exotic vertebrate fauna species dependent on freshwater streams for all or part of their lifecycle. Species survey point records (year ≥ 1950 , precision $\leq 2000\text{m}$) were used to count the different exotic species found within a subsection unit. The occurrence, distribution and density values were also drawn from the Department Agriculture and Fisheries Annual Pest and Weed Distribution Surveys from 2008. Values from both records and distribution surveys were normalised between 0 and 1 for each subsection unit. A score of 'No Data' was allocated to any subsection unit that had an absence of data.	DETSI QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel. DAF Annual Pest and Weed Distribution Surveys from 2008.	Continuous Desc (Negative)	Y	Y
1.3.4	Presence/absence of dams/weirs/biopassages within the wetland	For each subsection unit, each instream dam, weir, culvert or fish biopassage was weighted according to its general aquatic fauna passability and then summed together, generating an overall count. Counts were only taken for stream orders 3 and higher. All known available datasets on barriers were included.	Qld government dataset include: watercourse lines, watercourse areas, road culverts, dams and weirs, water storage points, fish biopassage points, reservoirs, wetlands with barriers.	Continuous Desc		Y
1.3.5	Inundation by dams/weirs (% of waterway length within the wetland)	Dams/weirs/reservoirs were intersected against the watercourses. The proportional length covered by a reservoir was then calculated for each riverine spatial unit.	DR Dams and Weirs coverage; DR watercourses; DESI QLD Wetland Mapping data v6.	Continuous Desc		Y
1.3.7	% area of remnant wetland relative to preclear extent for each spatial unit	Within the riparian extent, wetland polygons are extracted from the preclear regional ecosystems mapping and combined with current unmodified (H1) wetland polygons (excluding estuarine types). This defines the preclear wetland boundary extent.	DETSI Queensland wetland mapping data v6; remnant and preclear regional	Continuous Asc	Y	Y

Measure	Description	Implementation	Primary data sets used	Threshold type	NR	R
		Compare the preclear wetland boundary extent with the current remnant regional ecosystems and the QLD wetland mapping, to identify the overlapping areas that are still remnant and mapped as wetlands. Assessable wetlands with no underlying preclear extent were given a value of 'No Data'.	ecosystem mapping v12, REDD v12.			
1.4.5	Hydrological disturbance/modification of the wetland (e.g. as determined through DETSI wetland mapping and classification)	Score non-riverine spatial units according to their level of Queensland Wetland Mapping hydromodification: 4 = (natural): H1 3 = (semi-modified): H2, H2-M1, H2-M1-a, H2-M1-b, H2-M2, H2-M2-a, H2-M2-b, H2-M2-c, H2-M2-d, H2-M9, H2-M9-a, H2-M9-b, H2-M9-c, H2-M10, H2-M10-a, H2-M10-c, H2-M11, H2-M11-a, H2-M11-b, H2-M11-d, H2-M12, H2-M12-a, H2-M12-b, H2-M12-c, H2-M12-d; 2 = (highly-modified): H2-M1-e, H2-M5, H2-M6, H2-M6-a, H2-M6-b, H2-M6-f, H2-M7, H2-M11-c, H2-M13 1 = (artificial): H3, H3-C1, H3-C1-a, H3-C1-b, H3-C2, H3-C2-a, H3-C2-b, H3-C4, H3-C5, H3-C5-a, H3-C5-b.	DETSI Queensland Wetland Mapping data v6	Categorical	Y	
Criterion 2 Naturalness catchment						
2.1.1	Presence of exotic terrestrial plants in the subsection unit	The expert panel identified exotic terrestrial plant species dependent on freshwater streams for all or part of their lifecycle. Species survey point records (year ≥ 1950 , precision $\leq 2000\text{m}$) were used to count the different exotic species found within a subsection unit. The occurrence, distribution and density values were also drawn from the Department Agriculture and Fisheries Annual Pest and Weed Distribution Surveys from 2008. Values from both records and distribution surveys were normalised between 0 and 1 for each subsection unit. A score of 'No Data' was allocated to any subsection unit that had an absence of data.	Flora species records from DETSI databases WildNet, HerbreCs, Corveg and Expert Panel. DAF Annual Pest and Weed Distribution Surveys from 2008.	Continuous Desc (Negative)	Y	Y
2.2.1	% area remnant vegetation relative to preclear extent within buffered riverine wetland or watercourses	Within the riparian mask for each spatial unit, the percentage of remnant vegetation compared to the pre-clear extent was calculated.	DETSI remnant and preclear Regional Ecosystem Mapping v12.	Continuous Asc		Y

Measure	Description	Implementation	Primary data sets used	Threshold type	NR	R
			River buffers based on DR watercourses			
2.2.2	Total number of remnant regional ecosystems relative to preclear number of REs within buffered riverine wetland or watercourses	Within the riparian mask for each spatial unit, the percentage of current regional ecosystems remaining compared to the pre-clear extent is calculated.	DETSI remnant and preclear Regional Ecosystem Mapping v12. River buffers based on DR watercourses.	Continuous Asc		Y
2.2.5	% area of remnant vegetation relative to preclear extent within buffered non-riverine wetland: 500 m buffer for wetlands $\geq$ 8 ha, 200 m buffer for smaller wetlands	Each non-riverine spatial unit was buffered by 500m for wetlands $\geq$ 8ha and 200m for smaller wetlands. A multi-ring buffer was used as it allowed for the exclusion of the wetland itself from the analysis. The remnant and pre-clear vegetation mapping were then intersected with the area calculated. De-concatenating the RE and PERCENT, the area of each value with a valid RE vegetation code was calculated to gain the total area occupied by RE for pre-clear and remnant. The percentage of remnant to pre-clear was calculated and applied to each non-riverine spatial unit.	DETSI remnant and preclearing Regional Ecosystem Mapping v12; Queensland Wetland Mapping v6	Continuous Asc	Y	
2.2.9	% woody cover within the waterway corridor	Within the riparian mask for each spatial unit, the percentage of remaining woody vegetation was calculated.	River buffers based on DR watercourses; DETSI 2019 woody vegetation extent coverage.	Continuous Asc	Y	Y
2.3.4	% "settlement" land-use area (i.e. towns, cities, etc.)	"Settlement" land-use included (QLUMP secondary categories): manufacturing and industrial, mining, residential, services, transport and communication, utilities, waste treatment and disposal, and channel/aqueduct. These land-use types were allocated a settlement attribute and a percentage of their area was calculated within each spatial unit.	DETSI QLUMP (version GBR 2021).	Continuous Desc	Y	Y

Measure	Description	Implementation	Primary data sets used	Threshold type	NR	R
2.3.12	Potential landuse pressures on water quality within a subsection.	Landuse area (QLUMP mapping) proportions were calculated within a subsection unit which were weighted and then summed. Weights were taken from the landscape hazard assessment, input – direct/indirect pressure category, completed by the Queensland Wetland Mapping Program (DISTIA 2015).	DETSI QLUMP (version GBR 2021).	Continuous Desc	Y	Y
2.3.13	Potential load of anthropogenic fine sediments within a subsection.	Fine sediment load rates were compared to pre-clearing rates provided by Paddock-2-Reef project modelling. Rates were relevant to each landuse category (based on 2019 data) and proportions of each weighted landuse were calculated for subsection units.	DETSI QLUMP (version 2019). Paddock-2-Reef fine sediment load rates.	Continuous Desc	Y	Y
2.4.1	Farm storage (overland flow harvesting, floodplain ring tanks, gully dams) calculated by surface area	Areas were calculated within spatial units for all wetlands from the Qld Wetland Mapping that contained barriers for water storage and NRM reservoirs (rural water storage).	DETSI Queensland Wetland Mapping data v6; NRM Reservoirs	Continuous Desc	Y	Y
2.4.7	Potential landuse pressures on changes to natural flow water regime within a subsection.	Landuse area (QLUMP mapping) proportions were calculated within a subsection unit which were weighted and then summed. Weights were taken from the landscape hazard assessment, changes to the water regime pressure category, completed by the Queensland Wetlands Program (DISTIA 2015).	DETSI QLUMP (version GBR 2021).	Continuous Desc	Y	Y
Criterion 3 Diversity and richness						
3.1.1	Richness of native amphibians (riverine wetland breeders)	The expert panel identified native amphibian (riverine wetland breeders) species dependent on riverine wetlands for all or part of their lifecycle. Species survey point records (year ≥ 1950 , precision $\leq 2000\text{m}$) were used to derive a count of different species found within a subsection unit. A score of 'No Data' was allocated to any subsection unit that had an absence of data.	DETSI QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel.	Continuous Asc		Y
3.1.2	Richness of native fish	The expert panel identified native fish species dependent on riverine wetlands for all or part of their lifecycles. Species survey point records (year ≥ 1950 , precision $\leq 2000\text{m}$) were used to derive a count of different species found within a subsection	DETSI QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel.	Continuous Asc	Y	Y

Measure	Description	Implementation	Primary data sets used	Threshold type	NR	R
		unit. A score of 'No Data' was allocated to any subsection unit that had an absence of data.				
3.1.3	Richness of native wetland dependent reptiles	The expert panel identified native reptiles dependent on riverine wetlands for all or part of their lifecycles. Species survey point records (year ≥ 1950 , precision $\leq 2000\text{m}$) were used to derive a count of different species found within a subsection unit. A score of 'No Data' was allocated to any subsection unit that had an absence of data.	DETSI QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel.	Continuous Asc	Y	Y
3.1.4	Richness of native waterbirds	The expert panel identified native waterbirds dependent on freshwater riverine wetlands for all or part of their lifecycles. Species survey point records (year ≥ 1950 , precision $\leq 2000\text{m}$) were used to derive a count of different species found within a subsection unit. A score of 'No Data' was allocated to any subsection unit that had an absence of data.	DETSI QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel.	Continuous Asc	Y	Y
3.1.5	Richness of native aquatic plants	The expert panel identified aquatic and semi-aquatic plants dependent on riverine wetlands for all or part of their lifecycle. Species survey point records (year ≥ 1950 , precision $\leq 2000\text{m}$) were used to derive a count of different species found within a subsection unit. A score of 'No Data' was allocated to any subsection unit that had an absence of data.	Flora species records from DETSI databases WildNet, Herbrecks, Corveg and Expert Panel.	Continuous Asc	Y	Y
3.1.6	Richness of native amphibians (non-riverine wetland breeders)	The expert panel identified native amphibians (non-riverine wetland breeders) dependent on non-riverine wetlands for all or part of its lifecycles. Species survey point records (year ≥ 1950 , precision $\leq 2000\text{m}$) were used to derive a count of different species found within a subsection unit. A score of 'No Data' was allocated to any subsection unit that had an absence of data.	DETSI Queensland Historical Fauna Database (QHFD), WildNet, and Expert Panel	Continuous Asc	Y	
3.1.7	Richness of native wetland dependent mammals	The expert panel identified native mammal dependent on freshwater streams for all or part of their lifecycles. Species survey point records (year ≥ 1950 , precision $\leq 2000\text{m}$) were used to derive a count of different species found within a subsection	DETSI QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel.	Continuous Asc	Y	Y

Measure	Description	Implementation	Primary data sets used	Threshold type	NR	R
		unit. A score of 'No Data' was allocated to any subsection unit that had an absence of data.				
3.2.2	Richness of REs along riverine wetlands or watercourses within a specified buffer distance	A count of regional ecosystems within the riparian mask was calculated for each riverine spatial unit.	DETSI remnant and preclear regional ecosystem mapping v12. River buffers based on DR watercourses	Continuous Asc		Y
3.3.2	Richness of wetland types within the local catchment (ACA subsection)	The number of different wetland habitat types (based on TYPE_RE field—a concatenation of wetland class, hydro-modifier, water regime, salinity modifier and WETRE fields from the QWM data) was calculated for each subsection unit. This number was then applied to each spatial unit based on its subsection membership. Wetland habitat types were identified only for Natural and Semi-modified non-riverine wetlands. Habitat types with the word "None" in the TYPE_RE are data deficient and were given 'No Data' value. Wetlands less than 1ha were also given a 'No Data' value as they are not valid for this measure.	DETSI Queensland Wetland Mapping data v6, ACA subsections.	Continuous Asc	Y	Y
3.3.3	Richness of wetland types within the sub-catchment	The number of different wetland habitat types (based on TYPE_RE field—a concatenation of wetland class, hydro-modifier, water regime, salinity modifier and WETRE fields from the QWM data) was calculated for each sub-catchment unit. This number was then applied to each spatial unit based on its sub-catchment membership. Wetland habitat types were identified only for Natural and Semi-modified wetlands. Habitat types with the word "None" in the TYPE_RE are data deficient and were given 'No Data' value. Wetlands less than 1ha were also given a 'No Data' value as they are not valid for this measure.	DETSI Queensland Wetland Mapping data v6, River buffers based on DR watercourses.	Continuous Asc	Y	Y

Measure	Description	Implementation	Primary data sets used	Threshold type	NR	R
Criterion 4 Threatened species and ecosystems						
4.1.1	Presence of rare or threatened aquatic ecosystem dependent fauna species — NCA, EPBC	The expert panel identified rare or threatened species dependent on freshwater streams for all or part of their lifecycles and that were also listed in NCA or EPBC. Species survey point records (year ≥ 1950 , precision $\leq 2000\text{m}$) were used to derive a count of different species found within a subsection unit. A score of 'No Data' was allocated to any subsection unit that had an absence of data.	DETSI QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel.	Continuous Asc	Y	Y
4.1.2	Presence of rare or threatened aquatic ecosystem dependent flora species - NCA, EPBC	The expert panel identified rare or threatened species dependent on freshwater streams for all or part of their lifecycles and that were also listed in NCA or EPBC. Species survey point records (year ≥ 1950 , precision $\leq 2000\text{m}$) were used to derive a count of different species found within a subsection unit. A score of 'No Data' was allocated to any subsection unit that had an absence of data.	Flora species records from DETSI databases WildNet, Herbrecks, Corveg and Expert Panel.	Presence (Positive)	Y	Y
4.2.1	Conservation status of wetland Regional Ecosystems — Herbarium biodiversity status, NCA, EPBC	Wetlands were assessed within buffer areas around drainage lines. The following ratings were applied based on the Queensland Herbarium and Biodiversity Science Biodiversity Status and EPBC Status of palustrine and lacustrine regional ecosystems: For biodiversity status: Endangered = 4 Of Concern = 3 No Concern at Present/Least Concern = 2 For EPBC listed communities: Critically Endangered or Endangered = 4 Vulnerable = 3 Other = 2 The highest conservation status for any regional ecosystem in the spatial unit was applied. Spatial units that contained no regional ecosystems of those types received a score of 1.	DETSI Queensland Wetland Mapping data v6, REDD v12. EPBC threatened ecological community list.	Categorical	Y	Y
Criterion 5 Priority species and ecosystems						

Measure	Description	Implementation	Primary data sets used	Threshold type	NR	R
5.1.1	Presence of aquatic ecosystem dependent 'priority' fauna species	The expert panel identified priority species dependent on freshwater wetlands for all or part of their lifecycles. Species survey point records (year ≥ 1950, precision $\leq 2000\text{m}$) were used to derive a count of different species found within a subsection unit. A score of 'No Data' was allocated to any subsection unit that had an absence of data. A conservation value was only given for natural, semi-modified and highly-modified wetlands for the non-riverine assessment. Artificial non-riverine wetlands were given a score of 'No Data'. A conservation value was given to all riverine spatial units where data was present.	DETSI QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel.	Continuous Asc	Y	Y
5.1.2	Presence of aquatic ecosystem dependent 'priority' flora species	The expert panel identified priority species dependent on freshwater wetlands for all or part of their lifecycles. Species survey point records (year ≥ 1950, precision $\leq 2000\text{m}$) were used to derive a count of different species found within a subsection unit. A score of 'No Data' was allocated to any subsection unit that had an absence of data. A conservation value was only given for natural, semi-modified and highly-modified wetlands for the non-riverine assessment. Artificial non-riverine wetlands were given a score of 'No Data'. A conservation value was given to all riverine spatial units where data was present.	Flora species records from DETSI databases WildNet, Herbrecks, Corveg and Expert Panel.	Continuous Asc	Y	Y
5.1.3	Habitat for, or presence of, migratory species	The expert panel identified migratory species dependent on freshwater wetlands for all or part of their lifecycles. Species were also identified from the JAMBA / CAMBA / ROKAMBA agreements or Bonn Convention. Species survey point records (year ≥ 1950, precision $\leq 2000\text{m}$) were used to derive a count of different species found within a subsection unit. A score of 'No Data' was allocated to any subsection unit that had an absence of data. A conservation value was only given for natural, semi-modified and highly-modified wetlands for the non-riverine assessment. Artificial non-riverine wetlands were given a score of 'No Data'. A conservation value was given to all riverine spatial units where data was present.	DETSI QLD Historical Fauna Database (QHFD), WildNet, and Expert Panel.	Continuous Asc	Y	Y

Measure	Description	Implementation	Primary data sets used	Threshold type	NR	R
5.1.4	Habitat for significant numbers of waterbirds	The expert panels identified spatial units that contained notable values associated with waterbirds. They were then given a conservation rating out of 2, 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical	Y	Y
5.2.1	Presence of 'priority' aquatic ecosystem	The expert panels identified spatial units that contained notable values associated with 'priority' aquatic ecosystems (DETSI 2026). They were then given a conservation rating out of 2, 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical	Y	Y
Criterion 6 Special features						
6.1.1	Presence of distinct, unique or special geomorphic features	The expert panels identified spatial units that contained notable values associated with geomorphic features (DETSI 2026). They were then given a conservation rating of 2, 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical	Y	Y
6.2.1	Presence of (or requirement for) distinct, unique or special ecological processes	The expert panels identified spatial units that contained notable values associated with ecological processes (DETSI 2026). They were then given a conservation rating out of 2, 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical	Y	Y
6.3.1	Presence of distinct, unique or special habitat (including habitat that functions as refugia or other critical purpose)	The expert panels identified spatial units that contained notable values associated with habitat (DETSI 2026). They were then given a conservation rating out of 2, 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical	Y	Y
6.3.2	Significant wetlands identified by an accepted method such as Ramsar, Australian Directory of Important Wetlands, Regional Coastal	Spatial units were manually selected based on an interpretation of the criteria for category 4 areas from the Ramsar and World Heritage mapping and category 3 areas from DIWA mapping. They were then given a conservation rating out of 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Ramsar areas. World Heritage Areas. Directory of Important Wetlands (DIWA).	Categorical	Y	Y

Measure	Description	Implementation	Primary data sets used	Threshold type	NR	R
	Management Planning, World Heritage Areas, etc.					
6.3.3	Ecologically significant wetlands identified through expert opinion and/or documented study	The expert panels identified spatial units that contained notable values of significance. They were then given a conservation rating out of 2, 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Documented reports external to the ACA process.	Categorical	Y	Y
6.3.4	Climate change refugia	The expert panels identified spatial units that contained notable values associated with climate change refugia. They were then given a conservation rating out of 2, 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical	Y	Y
6.4.1	Presence of distinct, unique or special hydrological regimes (e.g. Spring fed stream, ephemeral stream, boggomoss).	The expert panels identified spatial units that contained notable values associated with hydrological regimes. They were then given a conservation rating out of 2, 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical	Y	Y
Criterion 7 Connectivity						
7.1.1	The contribution (upstream or downstream) of the spatial unit to the maintenance of significant species or populations.	The expert panels identified spatial units that contributed to maintaining species populations. They were then given a conservation rating of 2, 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999	Expert Panel	Categorical		Y
7.1.2	Migratory or routine 'passage' of fish and other fully aquatic	The expert panels identified spatial units that maintained the routine 'passage' of species. They were then given a conservation rating of 2, 3 or 4.	Expert Panel	Categorical		Y

Measure	Description	Implementation	Primary data sets used	Threshold type	NR	R
	species (upstream, lateral or downstream movement) within a spatial unit.	Spatial units not identified by experts for this measure were given a known absence value of -999				
7.1.4	Instream fragmentation due to anthropogenic barriers within a sub-catchment, based on an acknowledged metric.	The index uses the CAFI (Catchment Area-based Fragmentation Index) methodology for instream connectivity. (Jumani et al 2022) CAFI is calculated based on the Australian Hydrological Geospatial Fabric (Geofabric) units relative within a subcatchment. A barrier passability weighting (between 1 and 0, impassable and fully passable respectively) was added to each catchment area. Dams, weirs and other barriers had a weighting of 1, where pass-ability is assumed to be impossible (during normal flow times). Road culverts constructed prior to 2014 had a weighting of 0.7 and the rest had a weighting of 0.3 (lower pass-ability). This is due to regulations that consider fauna movement during construction. Fish biopassages had a weighting of 0.7, as they were often restricted to certain types of fish and are still impassable for other types of aquatic fauna.	Australian Hydrological Geospatial Fabric v2.1 2012 Qld government dataset include: watercourse lines, watercourse areas, road culverts, dams and weirs, water storage points, fish biopassage points, reservoirs, wetlands with barriers.	Continuous Desc		Y
7.1.5	Feasibility of terrestrial or aquatic movement for amphibian biological connectivity.	The index uses internationally recognised methodologies that incorporates a moving window neighbourhood analysis and cost-distance analysis to identify connected pathways within the landscape between wetland habitats for small amphibians. The analysis looks at each 10m cell location within the landscape, across multiple scales or neighbourhoods (20, 30, 50 and 70m). For each neighbourhood, connectivity is assessed using 3 layers, 1. The presence of habitat, 2. The ability rating for an amphibian to traverse the land and 3. The distance between habitat patches with the least cost (resistance) pathway. The connectivity indexes for all neighbourhoods are combined and then rescaled from 0 – 100.	Multiple Qld government datasets to identify the cost landscape. Includes landuse, barriers, vegetation, floodplains, etc. Qld Wetland Mapping to identify habitats.	Continuous Asc	Y	Y
7.2.1	The contribution (upstream or downstream) of the spatial unit to the	The expert panels identified spatial units that contributed to groundwater ecosystems. They were then given a conservation rating of 2, 3 or 4.	Expert Panel	Categorical	Y	Y

Measure	Description	Implementation	Primary data sets used	Threshold type	NR	R
	maintenance of groundwater ecosystems with significant biodiversity values.	Spatial units not identified by experts for this measure were given a known absence value of -999				
7.3.2	Extent to which the wetland retains critical ecological and hydrological connectivity, where it should exist, with floodplains, rivers, groundwater, etc.	The expert panels identified spatial units that retained ecological and hydrological connectivity. They were then given a conservation rating of 2, 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999	Expert Panel	Categorical	Y	Y
7.4.2	Terrestrial natural area connectivity within a subsection based on an acknowledged metric.	The original method (National Connectivity Index) was developed by the Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEE), and has been adapted for this project to include remnant and high value regrowth Regional Ecosystem mapping. The index uses a moving window to assess natural area connectivity at each 100m cell location within the landscape, across multiple scales or neighbourhoods (0.5, 1, 2, 4, 8, 16 and 32km). For each neighbourhood, connectivity is assessed using 3 indexes, 1. The amount of natural area, 2. The amount of core natural area and 3. The distance between natural area patches. The connectivity indexes for all neighbourhoods are combined and then rescaled from 0 – 100.	DETSI Queensland Remnant and Regrowth Regional Ecosystem mapping v12.	Continuous Desc	Y	Y
7.5.1	The contribution of the spatial unit to the maintenance of estuarine and marine ecosystems with significant biodiversity values.	The expert panels identified spatial units that contributed to an estuarine wetland that has a significant contribution to biodiversity values. They were then given a conservation rating of 2, 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999	Expert Panel	Categorical	Y	Y

Measure	Description	Implementation	Primary data sets used	Threshold type	NR	R
7.5.2	Extent to which the wetland retains critical ecological and hydrological connectivity, where it should exist in marine or estuarine areas.	The expert panels identified spatial units that maintained hydrological connectivity to marine or estuarine areas. They were then given a conservation rating of 2, 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999	Expert Panel	Categorical		Y
Criterion 8 Representativeness						
8.1.1	% area of each wetland type within Protected Areas.	Protected area estates and nature refuge data was used to calculate the % area of each wetland habitat type (based on TYPE_RE field—a concatenation of wetland class, water regime, salinity modifier and WETRE fields from the QWM data) located within these protected areas. The minimum % area was used for individual wetlands with more than one wetland habitat type to account for habitats less protected. The calculation was completed only for Natural and Semi-modified wetlands. Highly Modified and Artificial wetlands are not valid for this measure. Spatial units with the word "None" in the TYPE_RE are data deficient and get a score of 'No Data'. All non-valid spatial units were given a score of -999 for this measure.	DETSI Queensland Wetland Mapping data v6, Queensland protected area estate.	Continuous Desc		Y
8.2.1	The relative abundance of the wetland management group to which the wetland type belongs within the catchment or study area (management groups ranked least common to most common)	The frequency of each wetland management group was calculated for the study area. Where a wetland had two or more management groups, the management group with the lowest abundance was assigned to that wetland. The calculation was completed only for Natural and Semi-modified wetlands. Highly Modified and Artificial wetlands are not valid for this measure. All non-valid spatial units were given a score of -999 for this measure.	DETSI Queensland Wetland Mapping data v6, utilising the Habitat Type (HAB) field.	Continuous Desc		Y

Measure	Description	Implementation	Primary data sets used	Threshold type	NR	R
8.2.2	The relative abundance of the wetland management group to which the wetland type belongs within the sub-catchment (management groups ranked least common to most common)	The frequency of each wetland management group was calculated for the sub-catchment. Where a wetland had two or more management groups, the management group with the lowest abundance was assigned to that wetland. The calculation was completed only for Natural and Semi-modified wetlands. Highly Modified and Artificial wetlands are not valid for this measure. All non-valid spatial units were given a score of -999 for this measure.	DETSI Queensland Wetland Mapping data v6, utilising the Habitat Type (HAB) field.	Continuous Desc	Y	
8.2.3	The size of each wetland type relative to others of its wetland management group within the catchment or study area	Each non-riverine spatial unit was ranked (quartiles) by its size relative to other non-riverine spatial units with the same management group within the study area. The calculation was completed only for Natural and Semi-modified wetlands. Highly Modified and Artificial wetlands are not valid for this measure. All non-valid spatial units were given a score of -999 for this measure.	DETSI Queensland Wetland Mapping data v6, utilising the Habitat Type (HAB) field.	Categorical	Y	
8.2.4	The size of each wetland type relative to others of its wetland management group within a sub-catchment.	Each non-riverine spatial unit was ranked (quartiles) by its size relative to other non-riverine spatial units with the same management group within the study area. The calculation was completed only for Natural and Semi-modified wetlands. Highly Modified and Artificial wetlands are not valid for this measure. All non-valid spatial units were given a score of -999 for this measure.	DETSI Queensland Wetland Mapping data v6, utilising the Habitat Type (HAB) field.	Categorical	Y	
8.2.5	Wetland type representative of the study area – identified by expert opinion.	The expert panels identified spatial units that were representative of its type within the study area. They were then given a conservation rating of 2, 3 or 4. Spatial units not identified by experts for this measure were given a known absence value of -999.	Expert Panel	Categorical	Y	Y

Measure	Description	Implementation	Primary data sets used	Threshold type	NR	R
8.2.6	The size of each wetland type relative to others of its type within the catchment or study area.	Based on a concatenation of wetland class, water regime, salinity modifier and WETRE fields from the QWM data [TYPE_RE], the size distribution of each type was derived and grouped into their respective study area. A quartile threshold was then calculated. The maximum threshold was applied to each non-riverine spatial unit based on the types present. The calculation was completed only for Natural and Semi-modified wetlands. Highly Modified and Artificial wetlands are not valid for this measure. Non-riverine spatial units with the word "None" in the TYPE_RE are data deficient and get a score of 'No Data'. All non-valid spatial units were given a score of -999 for this measure.	DETSI Queensland Wetland Mapping data v6.	Categorical	Y	

Appendix III – Indicator ranks and measure weights

The Methods and implementation (page 17) describes how the weights and ranks were determined and how they affect the overall AquaScore and Criterion ranking. The maximum weight for any measure is 10 and is relative to each measure in the same indicator.

The maximum rank for any indicator is 1 and is relative to each indicator in the same criterion. If two indicators within a criterion are ranked 1 - they are considered of equal importance.

Indicator ranks	NR	R	Measure weights	NR	R
1. Naturalness aquatic					
1.1 Exotic flora/fauna	2	2	1.1.1 Presence of 'alien' fish species within the wetland	9.6	9.9
			1.1.2 Presence of exotic aquatic and semi-aquatic plants within the wetland	9.9	10
			1.1.3 Presence of exotic invertebrate fauna within the wetland	9	9.6
			1.1.4 Presence of feral/exotic vertebrate fauna (other than fish) within the wetland	10	9.6
1.3 Habitat features modification	1	1	1.3.4 Presence/absence of dams/weirs/biopassages within the wetland	10	10
			1.3.5 Inundation by dams/weirs (% of waterway length within the wetland)		9.7
			1.3.7 % area of remnant wetland relative to preclear extent within the buffered watercourses		7.7
1.4 Hydrological Modification	2		1.4.5 Hydrological disturbance/modification of the wetland (e.g. as determined through EPA wetland mapping and classification)	10	
2. Naturalness catchment					
2.1 Exotic flora/fauna	3	3	2.1.1 Presence of exotic terrestrial plants in the assessment unit	10	10
2.2 Riparian disturbance	1	2	2.2.1 % area remnant vegetation relative to preclear extent within buffered riverine wetland or watercourses		10
			2.2.2 Total number of REs relative to preclear number of REs within buffered riverine wetland or watercourses		7.9
			2.2.5 % area of remnant vegetation relative to preclear extent within buffered non-riverine wetland: 500m buffer for wetlands >= 8Ha, 200m buffer for smaller wetlands	10	
			2.2.9 % woody cover within the waterway corridor	9	10
2.3 Catchment disturbance	2	2	2.3.4 % "settlement" land-use area (i.e. towns, cities, etc)	8.5	7.8

Indicator ranks	NR	R	Measure weights		NR	R
			2.3.12	Potential landuse pressures on water quality within a subsection.	10	10
			2.3.13	Potential load of anthropogenic fine sediments within a subsection.	10	10
2.4 Flow modification	2	1	2.4.1	Farm storage (overland flow harvesting, floodplain ring tanks, gully dams) calculated by surface area	10	10
			2.4.7	Potential landuse pressures on changes to natural flow water regime within a subsection.	10	10
3. Diversity and richness						
3.1 Species	1	2	3.1.1	Richness of native amphibians (riverine wetland breeders)		9.5
			3.1.2	Richness of native fish	10	10
			3.1.3	Richness of native wetland dependent reptiles	9.1	8.9
			3.1.4	Richness of native waterbirds	9.5	9.3
			3.1.5	Richness of native aquatic plants	9.7	9.3
			3.1.6	Richness of native amphibians (non-riverine wetland breeders)	9.5	
			3.1.7	Richness of native wetland dependent mammals	8.8	8.7
3.2 Communities/assemblages		1	3.2.2	Richness of REs along riverine wetlands or watercourses within a specified buffer distance		10
3.3 Habitat	2	3	3.3.2	Richness of wetland types within the local catchment (e.g. SOR sub-section)	9.3	9
			3.3.3	Richness of wetland types within the sub-catchment	10	10
4. Threatened species and ecosystems						
4.1 Species	1	1	4.1.1	Presence of rare or threatened aquatic ecosystem dependent fauna species – NCAAct, EPBCAct	9.9	9.9
			4.1.2	Presence of rare or threatened aquatic ecosystem dependent flora species - NCAAct, EPBCAct	10	10
4.2 Communities/assemblages	2	2	4.2.1	Conservation status of wetland Regional Ecosystems – Herbarium biodiversity status, NCAAct, EPBCAct	10	10
5. Priority species and ecosystems						
5.1 Species	1	1	5.1.1	Presence of aquatic ecosystem dependent 'priority' fauna species (expert panel list/discussion or other lists such as ASFB, WWF, etc)	9.8	9.8

Indicator ranks	NR	R	Measure weights		NR	R
			5.1.2	Presence of aquatic ecosystem dependent 'priority' flora species	10	10
			5.1.3	Habitat for, or presence of, migratory species (Expert Panel list/discussion and/or JAMBA / CAMBA agreement lists and/or Bonn Convention)	8.9	8.9
			5.1.4	Habitat for significant numbers of waterbirds	8.6	8.7
5.2 Ecosystems	1	1	5.2.1	Presence of 'priority' aquatic ecosystem	10	10
6. Special features						
6.1 Geomorphic features	2	2	6.1.1	Presence of distinct, unique or special geomorphic features	10	10
6.2 Ecological processes	1	1	6.2.1	Presence of (or requirement for) distinct, unique or special ecological processes	10	10
6.3 Habitat	1	1	6.3.1	Presence of distinct, unique or special habitat (including habitat that functions as refugia or other critical purpose)	10	10
			6.3.2	Significant wetlands identified by an accepted method such as Ramsar, Australian Directory of Important Wetlands, Regional Coastal Management Planning, World Heritage Areas, etc.	9.4	9.7
			6.3.3	Ecologically significant wetlands identified through expert opinion and/or documented study	9.6	9.8
			6.3.4	Areas important as refugia from the predicted effects of climate change (eg source of species re-population)	9.5	9.7
6.4 Hydrological	1	1	6.4.1	Presence of distinct, unique or special hydrological regimes (e.g. Spring fed stream, ephemeral stream, boggomoss)	10	10
7. Connectivity						
7.1 Significant species of populations	1	1	7.1.1	The contribution (upstream or downstream) of the spatial unit to the maintenance of significant species or populations.		10
			7.1.2	Migratory or routine 'passage' of fish and other fully aquatic species (upstream, lateral or downstream movement) within the spatial unit.		10
			7.1.4	Instream fragmentation due to anthropogenic barriers within a sub-catchment, based on an acknowledged metric.		10
			7.1.5	Feasibility of terrestrial or aquatic movement for amphibian biological connectivity.	10	10

Indicator ranks	NR	R	Measure weights		NR	R
7.2 Groundwater dependent ecosystems	1	1	7.2.1	The contribution (upstream or downstream) of the spatial unit to the maintenance of groundwater ecosystems with significant biodiversity values (e.g., karsts, cave streams, artesian springs)	10	10
7.3 Floodplain and wetland ecosystems	1	1	7.3.2	Extent to which the wetland retains critical ecological and hydrological connectivity, where it should exist, with floodplains, rivers, groundwater, etc.	10	10
7.4 Terrestrial ecosystems	1	1	7.4.2	Terrestrial natural area connectivity within a subsection based on an acknowledged metric.	10	10
7.5 Estuarine and marine ecosystems	1	1	7.5.1	The contribution of the spatial unit to the maintenance of estuarine and marine ecosystems with significant biodiversity values	10	10
			7.5.2	Extent to which the wetland retains critical ecological and hydrological connectivity, where it should exist in marine or estuarine areas.		10
8. Representativeness						
8.1 Wetland protection	2		8.1.1	The percent area of each wetland type within Protected Areas.	10	
8.2 Wetland uniqueness	1	1	8.2.1	The relative abundance of the wetland management group to which the wetland type belongs within the catchment or study area (management groups ranked least common to most common)	9	
			8.2.2	The relative abundance of the wetland management group to which the wetland type belongs within the subcatchment or estuarine/marine zone (management groups ranked least common to most common)	8.7	
			8.2.3	The size of each wetland type relative to others of its management group within the catchment or study area	8.9	
			8.2.4	The size of each wetland type relative to others of its type within a subcatchment (or estuarine zone)	8.1	
			8.2.5	Wetland type representative of the study area – identified by expert opinion	10	10
			8.2.6	The size of each wetland type relative to others of its type within the catchment or study area	8.5	

Appendix IV – Riverine filter table

The Methods and implementation (page 17) describes how the AquaScore is determined.

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Represen- tativeness	Additional Criteria	AquaScore
0	equal to (No data) and	equal to (No data) and	equal to (No data) and	equal to (No data) and	equal to (No data) and	equal to (No data) and	equal to (No data)			No data
1	equal to (Very High) and	equal to (Very High) and	equal to (Very High) and	equal to (Very High) and	equal to (Very High) and	equal to (Very High) and	equal to (Very High)			Very High
2	equal to (Very High) and			equal to (Very High) and	equal to (Very High) and		equal to (Very High)			Very High
3	equal to (Very High or High)								and number of Criteria with Very High >= 4	Very High
4						equal to (Very High)				Very High
5	equal to (Low) and	equal to (Low) and	equal to (Low) and	equal to (Low) and	equal to (Low) and	equal to (Low) and	equal to (Low)			Very Low
6	equal to (Low) and	equal to (Medium) and	equal to (Low) and	equal to (Low) and	equal to (Low) and	equal to (Low) and	equal to (Low)			Very Low
7	equal to (Very High) and			equal to (Very High)						High
8	equal to (Very High) and				equal to (Very High)					High

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Represen- tativeness	Additional Criteria	AquaScore
9		equal to (Very High) and		equal to (Very High)						High
10			equal to (Very High) and				equal to (Very High)			High
11	equal to (Very High) and	equal to (Very High) and	equal to (Very High)							High
12	equal to (High) and		equal to (Very High)							High
13	equal to (Very High or High) and						equal to (Very High)			High
14			equal to (Very High) and	equal to (Very High) and	equal to (Very High)					High
15					equal to (Very High or High) and		equal to (Very High)			High
18	equal to (High) and	equal to (Very High) and				equal to (High)				High
16		equal to (Very High) and	equal to (Very High) and			equal to (High)				High
19		equal to (Very High) and		equal to (High) and		equal to (High)				High

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Represen- tativeness	Additional Criteria	AquaScore
20		equal to (Very High) and			equal to (High) and	equal to (High)				High
17		equal to (Very High) and				equal to (High)				High
21	equal to (High) and			equal to (High) and	equal to (High)					High
22					equal to (Very High or High) and	equal to (High)				High
23	equal to (Very High or High) and		equal to (High) and	equal to (High)						High
23a						equal to (High)				High
24				equal to (Very High or High)						Medium
25					equal to (Very High or High)					Medium
26			equal to (High) and				equal to (High)			Medium
27	equal to (Very High or High or Medium) and		equal to (Very High or High)							Medium
28	equal to (Very High or High or Medium) and	equal to (Very High or High or Medium) and					equal to (High)			Medium

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Represen- tativeness	Additional Criteria	AquaScore
29			equal to (High) and		equal to (Medium)					Medium
30					equal to (Medium) and		equal to (High)			Medium
36	equal to (Very High or High or Medium) and			equal to (Medium) and	equal to (Medium)					Medium
36a						equal to (Medium)				Medium
37	equal to (Very High or High or Medium) and	equal to (Very High or High or Medium) and	equal to (Very High or High or Medium) and				equal to (Very High or High or Medium)			Medium
37a									and number of Criteria with Very High >= 3	Medium
37b									and number of Criteria with High >= 3	Medium
37c	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High)		and number of Criteria with Very High >= 2	Medium
37d									and number of	Low

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Represen- tativeness	Additional Criteria	AquaScore
									Criteria with Very High >= 2	
37e									and number of Criteria with High >= 2	Low
37f	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High)		and number of Criteria with Very High >= 1	Low
38	not equal to (Very High) and	not equal to (Very High)							and number of Criteria with Low >= 2	Very Low
1000	equal to (Very High or High or Medium or Low or No data) and	equal to (Very High or High or Medium or Low or No data) and	equal to (Very High or High or Medium or Low or No data) and	equal to (Very High or High or Medium or Low or No data) and	equal to (Very High or High or Medium or Low or No data) and	equal to (Very High or High or Medium or Low or No data) and	equal to (Very High or High or Medium or Low or No data)			Low

Appendix V – Non-riverine filter table

The Methods and implementation (page 17) describes how the AquaScore is determined.

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Represent- tiveness	Additional Criteria	AquaScore
0	equal to (No data) and	equal to (No data) and	equal to (No data) and	equal to (No data) and	equal to (No data) and	equal to (No data) and	equal to (No data) and	equal to (No data)		No data
1	equal to (Very High) and	equal to (Very High) and	equal to (Very High) and	equal to (Very High) and	equal to (Very High) and	equal to (Very High) and	equal to (Very High) and	equal to (Very High)		Very High
2	equal to (Very High) and			equal to (Very High) and	equal to (Very High) and			equal to (Very High)		Very High
27	equal to (Very High or High)								and number of Criteria with Very High >= 4	Very High
3	equal to (Very High) and	equal to (Very High) and						equal to (Very High)		Very High
4	equal to (Very High or High or Medium) and	equal to (Very High or High or Medium) and		equal to (Very High) and				equal to (Very High)		Very High
5						equal to (Very High)				Very High
6	equal to (Low) and	equal to (Low) and	equal to (Low) and	equal to (Low) and	equal to (Low) and	equal to (Low) and	equal to (Low) and	equal to (Low)		Very Low

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Represent- tiveness	Additional Criteria	AquaScore
7		equal to (Medium or Low) and	equal to (Low) and	equal to (Low) and	equal to (Low) and	equal to (Low or No data) and	equal to (Low) and	equal to (Medium or Low)		Very Low
8	equal to (Very High) and			equal to (Very High or High) and				equal to (Very High or High)		High
9	equal to (Very High) and				equal to (Very High) and			equal to (High)		High
10	equal to (Very High) and	equal to (Very High) and			equal to (Very High)					High
10a			equal to (Very High) and				equal to (Very High)			High
11			equal to (Very High) and					equal to (Very High)		High
11a	equal to (Very High or High) and						equal to (Very High)			High
12	equal to (Very High) and				equal to (Very High or High) and			equal to (Very High)		High
13	equal to (Very High or High) and	equal to (Very High) and		equal to (Very High or High)						High
14	equal to (High) and	equal to (Very High) and			equal to (Very High)					High

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Represent- tiveness	Additional Criteria	AquaScore
15	equal to (Very High or High) and	equal to (Very High or High) and	equal to (Very High) and					equal to (High)		High
15a						equal to (High)				High
16		equal to (Very High or High) and	equal to (Very High)							Medium
17			equal to (Very High) and					equal to (High)		Medium
18	equal to (Very High or High) and	equal to (Very High or High or Medium) and						equal to (Very High or High)		Medium
19				equal to (Very High or High)						Medium
20					equal to (Very High or High)					Medium
20b			equal to (High) and				equal to (Very High)			Medium
21	equal to (Very High or High or Medium) and	equal to (Very High or High) and				equal to (Medium)				Medium
22		equal to (Very High or High) and	equal to (High) and		equal to (Medium)					Medium

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Represent- tativeness	Additional Criteria	AquaScore
23		equal to (Very High or High) and		equal to (Medium) and		equal to (Medium)				Medium
24	equal to (Very High or High or Medium) and			equal to (Medium) and				equal to (Very High or High or Medium)		Medium
25	equal to (Very High or High or Medium) and	equal to (Very High)								Medium
25a	equal to (Very High or High or Medium) and	equal to (High or Medium) and					equal to (High)			Medium
26	equal to (Very High or High or Medium) and	equal to (High or Medium) and	equal to (Medium) and					equal to (Medium)		Medium
26a						equal to (Medium)				Medium
26c					equal to (Medium) and		equal to (High)			Medium
29									and number of Criteria with High >= 3	Medium
30									and number of Criteria with	Medium

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Represen- tativeness	Additional Criteria	AquaScore
									Medium >= 4	
30a									and number of Criteria with Very High >= 3	Medium
30c	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High)	and number of Criteria with Very High >= 2	Medium
30d									and number of Criteria with Very High >= 2	Low
30e									and number of Criteria with High >= 2	Low
30f	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High) or	equal to (High)	and number of Criteria with Very High >= 1	Low
28									and number of Criteria with Low >= 4	Very Low

Decision	1 Naturalness Aquatic	2 Naturalness Catchment	3 Diversity and Richness	4 Threatened Species and Ecosystems	5 Priority Species and Ecosystems	6 Special Features	7 Connectivity	8 Represen- tativeness	Additional Criteria	AquaScore
1000	equal to (Very High or High or Medium or Low or No data) and	equal to (Very High or High or Medium or Low or No data) and	equal to (Very High or High or Medium or Low or No data) and	equal to (Very High or High or Medium or Low or No data) and	equal to (Very High or High or Medium or Low or No data) and	equal to (Very High or High or Medium or Low or No data) and	equal to (Very High or High or Medium or Low or No data) and	equal to (Very High or High or Medium or Low or No data)		Low

Appendix VI – Criterion, indicator, measure list comparison between FGBRCC v2.1 and previous versions

Criteria and indicators	Measures	Implementation	Riverine – GBR v1.1 2009	Riverine – FGBRCC v2.1	Non-riverine – GBR v1.3 2011	Non-riverine – FGBRCC v2.1
1. Naturalness aquatic						
1.1 Exotic flora/fauna	1.1.1	Presence of 'alien' fish species within the wetland	Y	Y	Y	Y
	1.1.2	Presence of exotic aquatic and semi-aquatic plants within the wetland	Y	Y	Y	Y
	1.1.3	Presence of exotic invertebrate fauna within the wetland	Y	Y	Y	Y
	1.1.4	Presence of feral/exotic vertebrate fauna (other than fish) within the wetland	Y	Y	Y	Y
1.2 Aquatic communities / assemblages	1.2.1	SOR aquatic vegetation condition	Y			
	1.2.2	SIGNAL2 score (max)	Y			
	1.2.3	AUSRIVAS score-edge (min band)	Y			
	1.2.4	AUSRIVAS score-pool (min band)	Y			
	1.2.9	AUSRIVAS score-riffle (min band)	Y			
1.3 Habitat features modification	1.3.1	SOR bank stability	Y			
	1.3.2	SOR bed & bar stability	Y			
	1.3.3	SOR aquatic habitat condition	Y			
	1.3.4	Presence/absence of dams/weirs within the wetland	Y	Y		
	1.3.5	Inundation by dams/weirs (% of waterway length within the wetland)	Y	Y		
	1.3.7	% area of remnant wetland relative to preclear extent for each spatial unit		Y		Y
	1.3.8	Presence of dredging/extraction (including for navigation) and channel modification within the wetland				

Criteria and indicators	Measures	Implementation	Riverine – GBR v1.1 2009	Riverine – FGBRCC v2.1	Non-riverine – GBR v1.3 2011	Non-riverine – FGBRCC v2.1
	1.3.14	Aquatic habitat condition using acknowledged metric	Y			
1.4 Hydrological modification	1.4.1	APFD score-modelled deviation from natural under full development				
	1.4.2	% natural flows-modelled flows remaining relative to predevelopment	Y			
	1.4.3	% no flows-modelled low flows relative to predevelopment				
	1.4.5	Hydrological disturbance/modification of the wetland (e.g. as determined through DETSI wetland mapping and classification)			Y	Y
	1.4.7	WRP (water resource plan) hydraulic habitat	Y			
	1.4.8	High Ecological Value (HEV) Areas	Y			
1.5 Water quality	1.5.10	Water quality index/score – an acknowledged metric calculated considering local, state or national water quality guidelines	Y			
2 Naturalness catchment						
2.1 Exotic flora/fauna	2.1.1	Presence of exotic terrestrial plants in the assessment unit	Y	Y	Y	Y
2.2 Riparian disturbance	2.2.1	% area remnant vegetation relative to preclear extent within buffered riverine wetland or watercourses	Y	Y		
	2.2.2	Total number of REs relative to preclear number of REs within buffered riverine wetland or watercourses	Y	Y		
	2.2.3	SOR reach environs	Y			
	2.2.4	SOR riparian vegetation condition	Y			

Criteria and indicators	Measures	Implementation	Riverine – GBR v1.1 2009	Riverine – FGBRCC v2.1	Non-riverine – GBR v1.3 2011	Non-riverine – FGBRCC v2.1
	2.2.5	% area of remnant vegetation relative to pre-clear extent within buffered non-riverine wetland: 500m buffer for wetlands >= 8Ha, 200m buffer for smaller wetlands			Y	Y
	2.2.9	% woody cover within the waterway corridor		Y		Y
2.3 Catchment disturbance	2.3.1	% "agricultural" land-use area (i.e. cropping and horticulture)	Y		Y	
	2.3.2	% "grazing" land-use area	Y		Y	
	2.3.3	% "vegetation" land-use area (i.e. native veg + regrowth)	Y		Y	
	2.3.4	% "settlement" land-use area (i.e. towns, cities, etc)	Y	Y	Y	Y
	2.3.12	Potential landuse pressures on water quality with a subsection		Y		Y
	2.3.13	Potential load of anthropogenic fine sediments within a subsection		Y		Y
2.4 Flow Modifications	2.4.1	Farm storage (overland flow harvesting, floodplain ring tanks, gully dams) calculated by surface area	Y	Y	Y	Y
	2.4.7	Potential landuse pressures on changes to natural flow water regime within a subsection		Y		Y
3 Diversity and richness						
3.1 Species	3.1.1	Richness of native amphibians (riverine wetland breeders)	Y	Y		
	3.1.2	Richness of native fish	Y	Y	Y	Y

Criteria and indicators	Measures	Implementation	Riverine – GBR v1.1 2009	Riverine – FGBRCC v2.1	Non-riverine – GBR v1.3 2011	Non-riverine – FGBRCC v2.1
	3.1.3	Richness of native wetland dependent reptiles	Y	Y	Y	Y
	3.1.4	Richness of native waterbirds	Y	Y	Y	Y
	3.1.5	Richness of native aquatic plants	Y	Y	Y	Y
	3.1.6	Richness of native amphibians (non-riverine wetland breeders)			Y	Y
	3.1.7	Richness of native wetland dependent mammals	Y	Y	Y	Y
3.2 Communities/ assemblages	3.2.1	Richness of macroinvertebrate taxa	Y		Y	
	3.2.2	Richness of REs along riverine wetlands or watercourses within a specified buffer distance	Y	Y		
3.3 Habitat	3.3.1	SOR channel diversity	Y			
	3.3.2	Richness of wetland types within the local catchment (e.g. sub-section)	Y	Y	Y	Y
	3.3.3	Richness of wetland types within the sub-catchment	Y	Y	Y	Y
3.4 Geomorphology	3.4.1	Richness of geomorphic features	Y			
4 Threatened species and ecosystems						
4.1 Species	4.1.1	Presence of rare or threatened aquatic ecosystem dependent fauna species – NCA, EPBC	Y	Y	Y	Y
	4.1.2	Presence of rare or threatened aquatic ecosystem dependent flora species - NCA, EPBC	Y	Y	Y	Y
4.2 Communities/ assemblages	4.2.1	Conservation status of wetland Regional Ecosystems – Herbarium biodiversity status, NCA, EPBC	Y	Y	Y	Y
5 Priority species and ecosystems						

Criteria and indicators	Measures	Implementation	Riverine – GBR v1.1 2009	Riverine – FGBRCC v2.1	Non-riverine – GBR v1.3 2011	Non-riverine – FGBRCC v2.1
5.1 Species	5.1.1	Presence of aquatic ecosystem dependent 'priority' fauna species (expert panel list/discussion or other lists such as ASFB, WWF, etc)	Y	Y	Y	Y
	5.1.2	Presence of aquatic ecosystem dependent 'priority' flora species	Y	Y	Y	Y
	5.1.3	Habitat for, or presence of, migratory species (expert panel list/discussion and/or JAMBA / CAMBA agreement lists and/or Bonn Convention)	Y	Y	Y	Y
	5.1.4	Habitat for significant numbers of waterbirds	Y	Y	Y	Y
5.2 Ecosystems	5.2.1	Presence of 'priority' aquatic ecosystem	Y	Y	Y	Y
6 Special features						
6.1 Geomorphic features	6.1.1	Presence of distinct, unique or special geomorphic features	Y	Y	Y	Y
6.2 Ecological processes	6.2.1	Presence of (or requirement for) distinct, unique or special ecological processes	Y	Y	Y	Y
6.3 Habitat	6.3.1	Presence of distinct, unique or special habitat (including habitat that functions as refugia or other critical purpose)	Y	Y	Y	Y
	6.3.2	Significant wetlands identified by an accepted method such as Ramsar, Australian Directory of Important Wetlands, Regional Coastal Management Planning, World Heritage Areas, etc.	Y	Y	Y	Y
	6.3.3	Ecologically significant wetlands identified through expert opinion and/or documented study	Y	Y	Y	Y

Criteria and indicators	Measures	Implementation	Riverine – GBR v1.1 2009	Riverine – FGBRCC v2.1	Non-riverine – GBR v1.3 2011	Non-riverine – FGBRCC v2.1
	6.3.4	Areas important as refugia from the predicted effects of climate change (e.g. source of species re-population)		Y		Y
6.4 Hydrological	6.4.1	Presence of distinct, unique or special hydrological regimes (e.g. Spring fed stream, ephemeral stream, boggomoss)	Y	Y	Y	Y
7 Connectivity						
7.1 Significant species or populations	7.1.1	The contribution (upstream or downstream) of the spatial unit to the maintenance of significant species or populations.	Y	Y		
	7.1.2	Migratory or routine 'passage' of fish and other fully aquatic species (upstream, lateral or downstream movement) within the spatial unit.	Y	Y		
	7.1.4	Instream fragmentation due to anthropogenic barriers within a sub-catchment, based on an acknowledged metric		Y		
	7.1.5	Feasibility of terrestrial or aquatic movement for amphibian biological connectivity.		Y		Y
7.2 Groundwater dependent ecosystems	7.2.1	The contribution (upstream or downstream) of the spatial unit to the maintenance of groundwater ecosystems with significant biodiversity values.	Y	Y		Y
7.3 Floodplain and wetland ecosystems	7.3.1	The contribution of the spatial unit to the maintenance of floodplain and wetland ecosystems with significant biodiversity values.	Y			Y

Criteria and indicators	Measures	Implementation	Riverine – GBR v1.1 2009	Riverine – FGBRCC v2.1	Non-riverine – GBR v1.3 2011	Non-riverine – FGBRCC v2.1
	7.3.2	Extent to which the wetland retains critical ecological and hydrological connectivity, where it should exist, with floodplains, rivers, groundwater, etc.		Y		Y
7.4 Terrestrial ecosystems	7.4.2	Terrestrial natural area connectivity within a subsection based on an acknowledged metric		Y		Y
7.5 Estuarine and marine ecosystems	7.5.1	The contribution of the spatial unit to the maintenance of estuarine and marine ecosystems with significant biodiversity values.	Y	Y		Y
	7.5.2	Extent to which the wetland retains critical ecological and hydrological connectivity, where it should exist in marine or estuarine areas.		Y		
8 Representativeness						
8.1 Wetland protection	8.1.1	The percent area of each wetland type within Protected Areas.			Y	Y
	8.1.2	The % area of each wetland type within a coastal/estuarine area subject to the Fisheries Act, Coastal Management Act or marine Parks Act.			Y	
8.2 Wetland uniqueness	8.2.1	The relative abundance of the wetland management group to which the wetland type belongs within the catchment or study area (management groups ranked least common to most common)			Y	Y
	8.2.2	The relative abundance of the wetland management group to which the wetland type belongs within the sub-			Y	Y

Criteria and indicators	Measures	Implementation	Riverine – GBR v1.1 2009	Riverine – FGBRCC v2.1	Non-riverine – GBR v1.3 2011	Non-riverine – FGBRCC v2.1
		catchment or estuarine/marine zone (management groups ranked least common to most common)				
	8.2.3	The size of each wetland type relative to others of its wetland management group within the catchment or study area			Y	Y
	8.2.4	The size of each wetland type relative to others of its wetland management group within a sub-catchment (or estuarine zone)			Y	Y
	8.2.5	Wetland type representative of the study area – identified by expert opinion		Y	Y	Y
	8.2.6	The size of each wetland type relative to others of its type within the catchment or study area			Y	Y

Attachment A

An Aquatic Conservation Assessment; Riverine and non-riverine wetlands of the Queensland Fitzroy Great Barrier Reef Connecting Catchments: Flora, Fauna and Ecology Expert Panel Report, Version 2.1.