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Department of Natural Resources, Mines and Energy

Minister's Performance Assessment Report

Water Plan (Boyne River Basin) 2013

May 2019

Queensland Government

This publication has been compiled by Water Policy and Water Services (Central/South Region), Department of Natural Resources, Mines and Energy.

Minister's foreword

I am pleased to publish this report on the effectiveness of the implementation of the Water Plan (Boyne River Basin) 2013 (the plan).

Located in Queensland's central coast region the Boyne River supports irrigation and livestock agriculture and is critical to support water use for industrial and residential water supplies in Gladstone. The plan also supports environmental, fisheries and tourism values in the downstream fresh and estuarine environments, including the Great Barrier Reef World Heritage Area.

The plans' outcomes have been implemented through a number of key achievements. Water licences across the plan area have been better specified as volumetric entitlements, giving entitlement holders certainty in their entitlement. There is also some flexibility for water licences to be seasonally traded in the reach downstream of Awoonga Dam, giving greater flexibility to water users and promoting agricultural development.

During the life of the plan, new release rules have been implemented for Awoonga Dam to improve downstream environmental flows and security for water users.

The future connection between Awoonga Dam with the proposed Rookwood Weir, via a 115 kilometre pipeline, is also supported by the Boyne water plan which provides an avenue for additional water security and further development opportunities for the Gladstone region. The pipeline is part of a long term strategy for the Gladstone Area Water Board.

To date the plan's strategies have been effective in advancing the sustainable management of Boyne River Basins water resources. Potential risks to water users and the environment have been assessed as low, and there are no expected adverse impacts on water entitlement holders or natural ecosystems in the plan area before the next plan evaluation in 2023.

Monitoring will continue to identity and evaluate potential emerging risks ensuring the plan continues to meet its outcomes. Any identified risks that can't be dealt with under the current plan can be reviewed or amended at any time.

I encourage anyone with an interest in the management of water resources in the plan area to read this report.

Hon Dr Anthony Lynham MP

Minister for Natural Resources, Mines and Energy

Executive summary

This report provides an assessment of the effectiveness of the Water Plan (Boyne River Basin) 2013 (the plan) and its implementation over the past five years against the criteria outlined in the *Water Act 2000.* Table 1 provides a concise summary of the assessment.

The assessment highlights the following matters:

- The strategies in the plan are continuing to achieve the plan outcomes and are fit for purpose.
- The outcomes in the plan are advancing the sustainable management of Queensland's water resources and no significant risks were identified.
- Some emerging risks were identified:
    - Water trading: The plan provides for a limited water market through seasonal assignment of water licences. There appears to be limited demand for additional water in the plan area. Should demand for water increase, the market will need more flexible mechanisms in the plan to facilitate trade.
    - Groundwater: Take of groundwater is not licensed and there is potential to extract water using bores from groundwater adjacent to the watercourse, which may impact on surface water availability. Currently this is considered low risk. The Department of Natural Resources, Mines and Energy (department) will continue to monitor bore construction along the watercourse and evaluate the associated potential risks.
    - Mann's Weir: Mann's Weir has been reconfigured within the past five years. Monitoring will be undertaken to assess the effectiveness of current low flow releases in maintaining connectivity through the system.
    - Rookwood Weir: The future connection with the proposed Rookwood Weir will provide additional security for the Awoonga Water Supply Scheme and further development opportunities for the Gladstone region.
- A need has been identified for further engagement with Aboriginal peoples and Torres Strait Islanders to better understand and report on their economic aspirations and cultural values.

Table 1 – Summary of the performance assessment of the plan

Matters to be addressed	Comment	Section of report	Status
Effectiveness of the plan in advancing the sustainable management of Queensland's water resources	Social, environmental and economic assessments indicate that the plan is achieving the purposes of the *Water Act 2000.*	Section 3	
Effectiveness of the implementation of the plan in achieving the plan outcomes	The risk assessment and monitoring show that the plan's implementation is meeting the outcomes. However, there was insufficient information available to assess the outcome relating to water-related cultural values in the plan area. Previous reports prepared about the plan did not highlight any significant issues with plan implementation.	Section 4	
Summary of water usage and entitlements including those taken or interfered with under statutory authorisations	Water users have access to water taken under a water entitlement or under a statutory authorisation through the Water Act (e.g. low risk or prescribed activities such as stock and domestic use). DNRME is currently completing a review of the non-urban water metering policy as part of the response to the Independent Audit of non-urban water measurement and compliance.	Section 5	
Summary of research and monitoring findings.	DNRME and the Gladstone Area Water Board (GAWB) have conducted ecological and water monitoring in the water supply scheme area.	Section 6	
Summary of amendments to the plan since its commencement	Since the plan implementation, a number of amendments have been made in order to improve its effectiveness such as improving the release rules from Awoonga Dam and specifying maximum rate of take and daily volumetric limits for licences.	Section 7	
Summary of identified risks to the plan outcomes	A risk assessment process has not identified any risks to the plan outcomes.	Section 8 and 9	
Summary of non-compliances under a water entitlement or other authorisation in the plan area	There have been two relatively minor instances of non-compliance relating to overuse of water entitlements within the plan area in the past five water years. These have been dealt with in accordance with the standard departmental compliance response procedures and there were no impacts on plan outcomes.	Section 10	
Overall status and recommendation for plan	The plan is performing well and based on this evaluation it is recommended that it is appropriate for the plan to continue. In the meantime, monitoring and implementation of the plan will continue and the plan will be re-evaluated, prior to its expiry.	-	

	Completed		On track / no issues		Some minor issues
	Some major issues		Not achieved		Insufficient information available

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1 Purpose of the report

The Water Act (section 49) requires the Minister to prepare reports for each plan. This ensures the implementation and effectiveness of each plan is regularly reviewed and evaluated as part of an adaptive management cycle of planning, implementation, monitoring and reporting.

The Water Regulation requires these reports to be prepared at five-year intervals and that they address a range of matters relevant to the ongoing sustainable management of Queensland's water resources, including:

a) whether the plan is advancing the sustainable management of Queensland's water resources

b) an assessment of the effectiveness of the implementation of the plan in achieving the plan's outcomes

c) information on water use and authorisations in the plan area, including—

   i. water entitlements

   ii. water taken or interfered with under statutory authorisations

d) a summary of the findings of research and monitoring for the plan

e) any identified risks to the plan's outcomes

f) an outline of any amendments, that have been made to the plan since its commencement

g) any noncompliance under a water entitlement or other authorisation in the plan area.

This report provides an overview of the above and evaluates the implementation of the water plan to date.

2 Plan area

The Boyne River Basin water plan is a second-generation plan that commenced in December 2013. The plan:

- regulates the take and interference of surface water
- allows for the take of groundwater and overland flow water
- provides for water allocations, water licences and seasonal water assignment.

The plan area covers approximately 2600 km^2 and is bound by Many Peaks Range to the east, Dawes Range to the south, Calliope Range to the south-west and Boyne Range to the west. The terrain is relatively steep with heights ranging from 600 to 850 metres above sea level.

The climate of the plan area is sub-tropical with warm to hot summers and mild dry winters. The average annual rainfall in the basin ranges between 800 and 1000 millimetres, most of which occurs between December to March. A number of ecologically important areas and protected areas both within and adjacent to the plan area include the Coral Sea, Great Barrier Reef World Heritage Area, Dugong Protection Areas, Boyne Island Conservation Park and various national parks and state forests.

The major regional population centre associated with the plan area is Gladstone, which is economically significant at both a state and a national level due to its metals-processing industries, power generation and port facilities, which all use water sourced from Awoonga Dam in the plan area. In addition to industrial and urban water use, water is also sourced from the Boyne River and its tributaries for small-scale agriculture and livestock production. Tourism and fishing (recreational and commercial) are also important to the plan area's economy.

The plan area covers the single catchment of the Boyne River system and its tributaries. These include Ridler, Degalgil, Marble and Diglum creeks that drain to Gladstone Harbour and the Great Barrier Reef. **Figure 1** shows the plan area including the Awoonga Water Supply Scheme and the water management area (subcatchment A). The plan also manages unsupplemented water upstream of Awoonga Dam (subcatchment B). Awoonga dam is the only major water storage in the plan area and is located on the Boyne River. It has a storage volume of approximately 777 000 megalitres (ML) and is owned and operated by the Gladstone Area Water Board (GAWB).

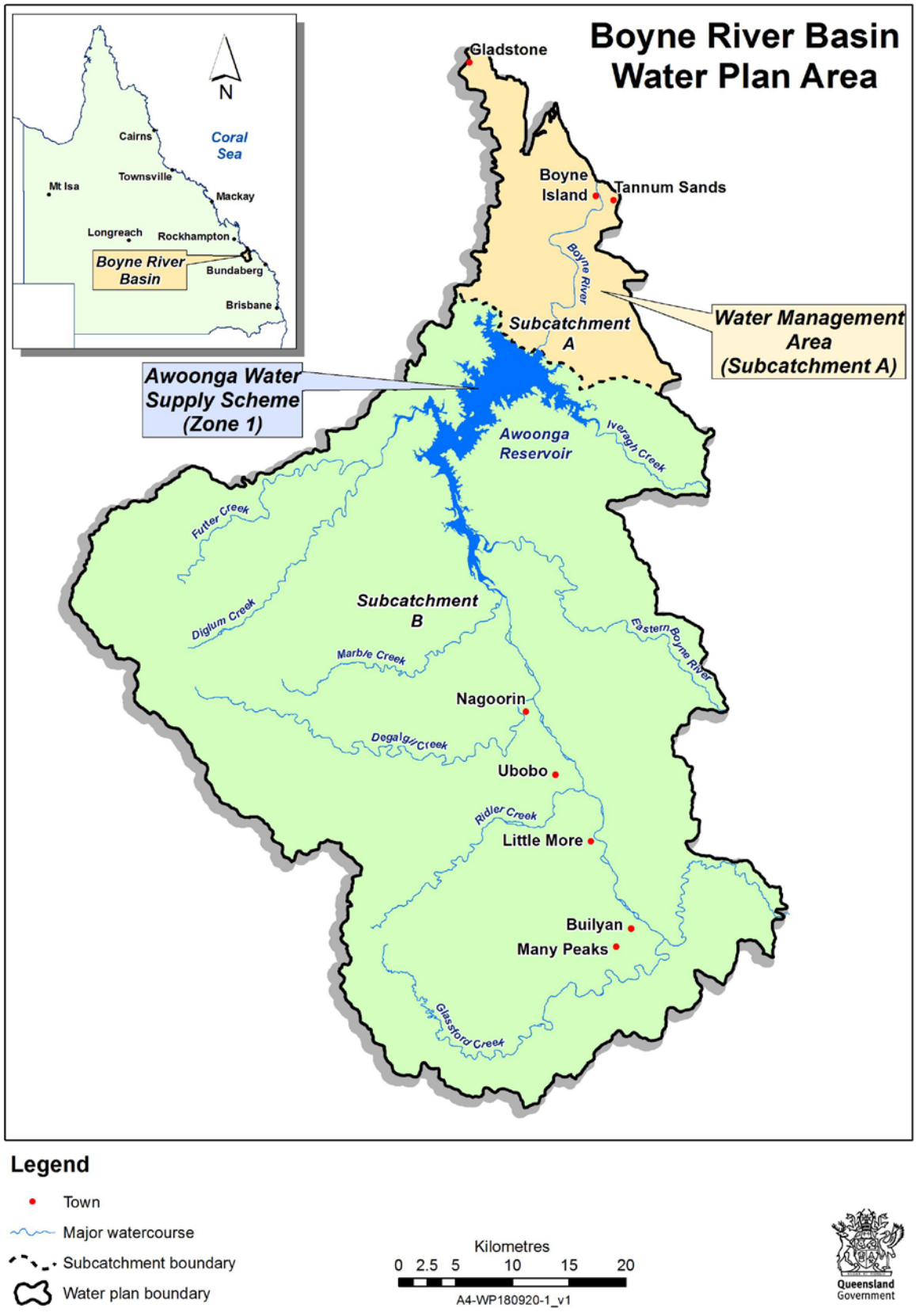

Figure 1 – Map of Boyne River Basin water plan area

3 How the plan advances the sustainable management of Queensland's water resources

This section discusses how the water plan advances sustainable management of Queensland water resources by incorporating the principles of ecologically sustainable development. The plan establishes a system for the allocation and use of water resources in the Boyne River Basin for the economic, physical and social wellbeing of the people of Queensland.

In particular, the plan provides outcomes and strategies to advance the sustainable management of ecosystems, water quality, water-dependent ecological processes and biological diversity associated with watercourses, lakes and springs. For a more detailed summary of the linkages between plan outcomes, strategies and rules see **appendix A: Assessment of plan outcomes.**

3.1. Ecologically sustainable development

The plan was developed based on a long-term hydrologic model to better understand patterns of water use and availability for both consumptive and non-consumptive purposes. The hydrological model is also used to assess the consistency of future water management decisions made under the plan against the stated environmental flow objectives, and ensure plan outcomes are met.

Targeted monitoring and research has improved our understanding and management of environmental flow requirements for aquatic species.

When granting unallocated water for future development, the plan provides for environmental flows to maintain the ecological integrity of the river system, with specific ecological outcomes for particular areas, as well as limitations on the additional take of water from lakes.

The plan also includes outcomes and strategies that aim to encourage the efficient use of water while ensuring the security of supply for towns and other water users.

3.2. Allocation and use of water resources for economic, physical and social well-being of the people of Queensland

The plan has outcomes that provide a framework for the allocation and use of water resources in the plan area for the economic, physical and social wellbeing of the people of Queensland.

Implementation of the plan's strategies have provided certainty for water users to promote economic development. This was done by amending licences in 2013 to improve their specifications and by defining volumes of unallocated water (general, strategic and strategic infrastructure reserves) for future development. These strategies support population and industry growth, and aesthetic and recreational values.

3.3. Sustain the health of ecosystems

The plan contains ecological outcomes for the plan area. These outcomes aim to support the ongoing protection of ecological assets and their habitats. The outcomes include provisions such as maintenance of a flow regime for fresh water to the Boyne River estuary, to waterholes such as the Nagoorin waterhole and for the movement and recruitment of barramundi, sea mullet and banana prawn growth.

Meeting these outcomes is ensured through implementing the strategies relating to the environmental flow objectives and better specification of water entitlements, for example stating an annual volume and other conditions that limit the extraction of water.

3.4. Recognise the interests of Aboriginal peoples and Torres Strait Islanders

The recent amendment to the Water Act recognises the importance of water resources to Aboriginal peoples and Torres Strait Islanders, including their strong spiritual connection to water. The plan contains one outcome relating to the maintenance of flows that support cultural values in the plan area, including the cultural values of the traditional owners in the plan area. Additionally, the chief executive, when granting licences from unallocated water, must consider the cultural values of the Aboriginal peoples and Torres Strait Islanders of the plan area.

Through the assessment of plan outcomes, the department has identified a need for further engagement with Aboriginal peoples and Torres Strait Islanders to better understand current and emerging cultural water needs in the plan area. To support the preparation of the next Minister's report, the department is proposing to:

- re-engage with Aboriginal peoples and Torres Strait Islanders, continue the conversation and undertake further engagement
- improve understanding of cultural values and uses of water
- record the engagement process
- incorporate this information into the next Minister's report on the plan.

3.5. Enable water resources to be obtained through fair, transparent, orderly processes

The plan allows for water use without a water entitlement for stock and domestic purposes or for prescribed activities under the Water Act (see **appendix C: Water taken or interfered with under statutory authorisations**). All other use requires a water entitlement (such as a water licence).

The plan provides reserves of unallocated water for strategic water infrastructure, strategic and general purposes. There is 19 000ML available in the strategic water infrastructure reserve for a future raising of Awoonga Dam. In the strategic reserve there is 500ML available in the plan area upstream of Awoonga Dam and in the general reserve, there is 338ML available in subcatchment A and 1000ML in subcatchment B (see f**igure 1** and t**able 7**). The plan and the Water Regulation provide the framework for fair and transparent release of this reserved water. The plan limits the grant of water licences from the strategic and general reserves by requiring conditions on licences relating to the flow rate in a watercourse.

3.6. Build confidence regarding availability, security and value of water entitlements and authorisations

The plan states economic, social and ecological outcomes. These outcomes aim to provide, protect and improve access to available water resources for water entitlements and other authorisations to take or interfere with water. The plan includes improvements on the previous plan such as an upgrade to the release rules at Awoonga Dam and, where applicable, the amendment of water licences to state a maximum rate of take and daily volumetric limits. The plan's defined volumes of unallocated water for future development provide certainty and security for current water users, while also making water available to support towns, communities and industrial and agricultural growth.

3.7. Promote efficient use of water through water markets, allocation, risk assessments and community education

The plan established seasonal water assignment for water licence holders. This mechanism allows for the seasonal purchase or sale of water among water licence holders and creates a water market. The plan has an outcome related to encouraging continual improvement in the efficient use of water. The foundation for encouraging the efficient use of water has been established by the plan through better specification of water entitlements to include maximum rates of take and volumetric limits.

In addition, the efficiency of existing and proposed water use practices is a consideration in granting water entitlements from the unallocated water reserves. When the State sells unallocated water, a price is set encouraging the recognition of water as a valuable resource, and promoting its highest value and efficient use.

3.8. Facilitate community involvement in planning for the management and allocation of water

Community involvement is ensured through consultation processes for water planning initiatives. Community consultation and support were integral to the development and finalisation of the water plan and water management protocol (protocol)[1].

4 Assessment of the effectiveness of the implementation of the plan in achieving the plan's outcomes

The department monitors the implementation of each plan to make sure it is achieving its outcomes. The plan's outcomes were implemented by the release of the Boyne River Basin Resource Operations Plan (now the protocol) in December 2016, as well as through the delivery of a number of other specific actions required by the plan. The plan's strategies were effectively implemented through:

- the requirement of water licences to take or interfere with water
- making unallocated water available
- an upgrade to the release rules at Awoonga Dam
- the amendment of water licences to state a maximum rate of take and daily volumetric limits.

Specific ecological outcomes in the plan were implemented by the inclusion of environmental management strategies for water supply infrastructure requiring environmental flow releases and waterhole management.

The plan is performing well based on the evaluation in this report. For more information, see **appendix A: Assessment of plan outcomes**, **table 2** and **table 3**.

[1] The Boyne River Basin water resource plan and resource operations plan (ROP) were transitioned into a water plan and water management protocol under amended Water Act provisions that took effect in December 2016. For clarity, the reference to the protocol has been utilised throughout this document. More information is available in **appendix F: Plan amendments and milestones**.

5 Information on water use and authorisations in the plan area

5.1. Information on water use under water entitlements

Water users have access to water taken under a water entitlement (e.g. water licence) or under a statutory authorisation through the Water Act (e.g. low risk or prescribed activities such as stock and domestic use). Unallocated water is reserved and can be made available for future use with consideration to public interest and welfare, protecting existing entitlements and the environment.

There are 28 unsupplemented surface water licences in the Boyne plan area. There is a concentration of licence holders immediately downstream of Awoonga dam, and the remaining licences are located sporadically in the upper catchment.

The downstream licence holders generally produces a variety of high value tree crops, however they are relatively small in nature with properties less than 100 ha. Upstream use is for supplementing fodder and other small crops.

GAWB hold two water allocations in the plan area, both from Awoonga Dam. GAWB enters into commercial supply contracts with end users (industry and urban supplies around Gladstone). Water use information for these allocations is available in GAWB's annual reports, however it has remained relatively constant in the plan's lifecycle. For details, see **table 5**.

The department is reviewing the current non-urban water meter policy and standard as part of the Queensland Government's response to the Independent Audit of Queensland Non-urban Water Measurement and Compliance which was released in June 2018. The review is seeking to address a number of key matters raised by the audit including the effectiveness of the meter validation process, the need for meter accuracy testing and a maintenance oversight regime. We will provide recommendations to government in 2019 in relation to a new water measurement policy and standard which will support improvements or enhancements to water measurement, including metering across Queensland. We will adopt a risk-based approach to implementation of a new water measurement policy.

5.1.1. Announced allocation

The Awoonga Water Supply Scheme Operations Manual states that allocation for high priority water must be 100 per cent.

There are no announced allocation provisions for unsupplemented water licences.

5.1.2. Entitlements granted from unallocated water reserves

There have been no unallocated water releases in this plan's lifecycle.

5.1.3. Water trading

There are no permanent water trading provisions in the plan. Seasonal water assignment is provided for in the area immediately downstream of Awoonga Dam, however there has been only minimal uptake of this mechanism in the past, and there have been no trades of this type in the last five years.

5.1.4. Water use

Supplemented use is fairly constant, using around 59 – 65 per cent of the total volume available (**table 5**). Unsupplemented water use has been fairly low. The 2013 and 2014 years saw the highest use, with 20% of the total nominal entitlement available, and the average use being 14 per cent (**table 6**).

5.2. Water taken or interfered with under statutory authorisations

The take of water under statutory authorisations is provided for by the Water Act. This take is typically not measured, with the exception of water use by constructing authorities for road construction purposes. This makes an accurate quantitative assessment difficult. However, by identifying broad trends in consumptive water use behaviour, it is possible to estimate the risk that these statutory authorisations may pose to the availability of water for existing water users and the environment. A summary of this assessment relating to the activities under sections 93 to 103 of the *Water Act 2000* is available in **appendix C: Water taken or interfered with under statutory authorisations**. The assessment is based on the best available information at time of publication.

The take of water by constructing authorities for road construction purposes is recorded and assessed by the department, with conditions imposed (when required) to manage any possible detrimental effects.

The department considers that the volumes of statutory authorisation take across the plan area are small and are unlikely to detrimentally affect existing water users' access to water, or the environment.

6 Summary of research and monitoring findings for the water plan

The water planning framework is supported by water monitoring activities that include water quantity and quality of surface freshwater and underground water systems across Queensland. Together with targeted ecological monitoring for water plans, this information is vital for continued improvement of water planning.

The Environmental Flows Assessment Program (EFAP) undertakes ecological monitoring to assist in assessing the ecological performance of each water plan in meeting its stated ecological outcomes. Ecological assets with critical links to flow that represent the plan ecological outcomes, and the various aspects of the flow regime are selected as indicators of the broader ecosystem for monitoring.

The department has conducted a review of the level of underground water resource development within low-risk aquifers of the plan area, which is summarised in section 6.4.

In addition, we have conducted a review of overland flow (OLF) development in the plan area, which is summarised in section 6.5. OLF is water that flows over land after rainfall, or rises to the surface naturally from underground. It is an important source of water in rural communities and provides water to watercourses where it sustains critical environmental processes. OLF is captured using water storage infrastructure, typically dams located in gullies, and it is currently not regulated under the plan.

6.1. Summary of ecological monitoring

The majority of relevant ecological monitoring to plan outcomes has been conducted by GAWB and the department.

GAWB have an Aquatic Ecosystem Monitoring Plan (AEMP) that has conducted ecological monitoring in the Boyne River since 2004. GAWB use contractors to conduct the monitoring and reporting of this information to the department as a way to assess the effectiveness of the environmental management rules. Some of this information is summarised in **appendix D: Ecological monitoring**, sections 6.2 and 6.3. GAWB conducts

monitoring of aquatic habitat, macroinvertebrates, fish, and water quality as well as bank stability. This work is related to each of the ecological outcomes in the plan and the operations of Awoonga Dam, with sampling occurring both upstream and downstream of Awoonga Dam as well as within the dam.

The monitoring has highlighted the effectiveness of the high overtopping flows in maintaining the river ecosystem downstream. Trigger flow releases cause mild resetting of the river channel to minimise encroachment of aquatic macrophytes. Base flows provide connectivity for aquatic organisms and maintain water quality.

EFAP monitoring has centred on measuring the effectiveness of the trigger flows in providing brackish conditions in the estuary as well as measuring the level of fish passage provided by base flows. The trigger flows in 2014 and 2016 both produced temporary brackish conditions in the estuary, however these flow releases were also associated with local rainfall making definitive assessment difficult. The baseflows currently are based on a minimum monthly release and provide limited connectivity for fish species to migrate between freshwater and estuary only on the larger tides. Further details can be found in **Appendix D: Ecological monitoring**.

6.2. Summary of resource operations licence holder monitoring

The resource operations licence (ROL) holder is required to monitor and report on water quantity, water levels and impacts of storage operation on natural ecosystems. A summary of water level and dam release information, overtopping flows, base flow release volumes and water level information at Pikes Crossing supplied by GAWB can be seen in **figure 2**. The effect of these releases on downstream ecosystems is discussed in **appendix D: Ecological monitoring**.

The water supply scheme located in the plan area is considered to operate in compliance with the requirements of the licence. GAWB conducted regular monitoring of water levels, releases, blue green algae levels, erosion and fish stranding throughout the five-year period. Monitoring occurs in both within the dam and the upstream and downstream extents of the scheme.

High rainfall from Ex-Tropical Cyclones Marcia and Debbie into Awoonga Dam resulted in discharge over the spillway in 2015 and 2017. Fish strandings and GAWB management actions were reported in both instances by the ROL holder after these events. Refer to **appendix E: Operational reporting by ROL holders** for more details.

Frequent reviews of ROL reporting data is expected to continue. The department has been in consultation with GAWB for improvements to the reporting of volumes released and the timing of trigger flow releases including reporting on when no trigger flows have occurred.

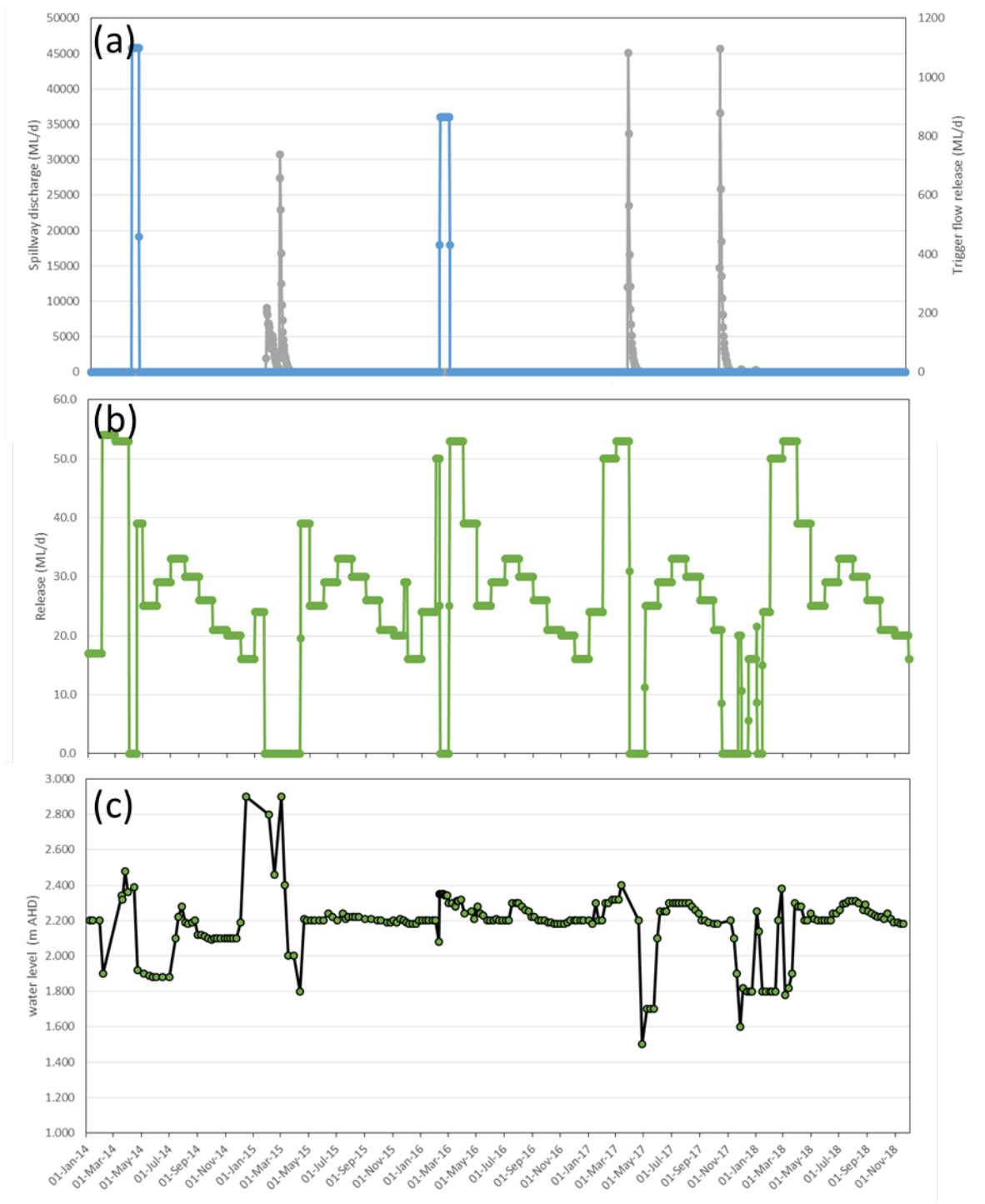

Figure 2 – ROL holder monitoring data highlighting (a) overtopping flows (grey) and trigger flows (blue) from Awoonga Dam (b) baseflow releases and (c) water levels at Pikes Crossing

6.3. Summary of existing environmental management rules

The department's EFAP monitoring has been focused on monitoring the effectiveness of trigger flow and baseflow releases downstream of Awoonga Dam. Fish monitoring in the low flow channel at Mann's Weir on larger tides has revealed that tides greater than 4.52 meters Australian Height Datum (mAHD) are capable of allowing upstream fish passage for a variety of species. Ten species of fish were recorded moving through the low flow channel including barramundi and sea mullet. Only larger tides greater than 4.52 mAHD were capable of drowning out the larger steps in the low flow channel to allow fish passage (f**igure 3**). The department will work with the ROL holder to investigate potential alterations to baseflow to improve fish passage on the large tides in the future.

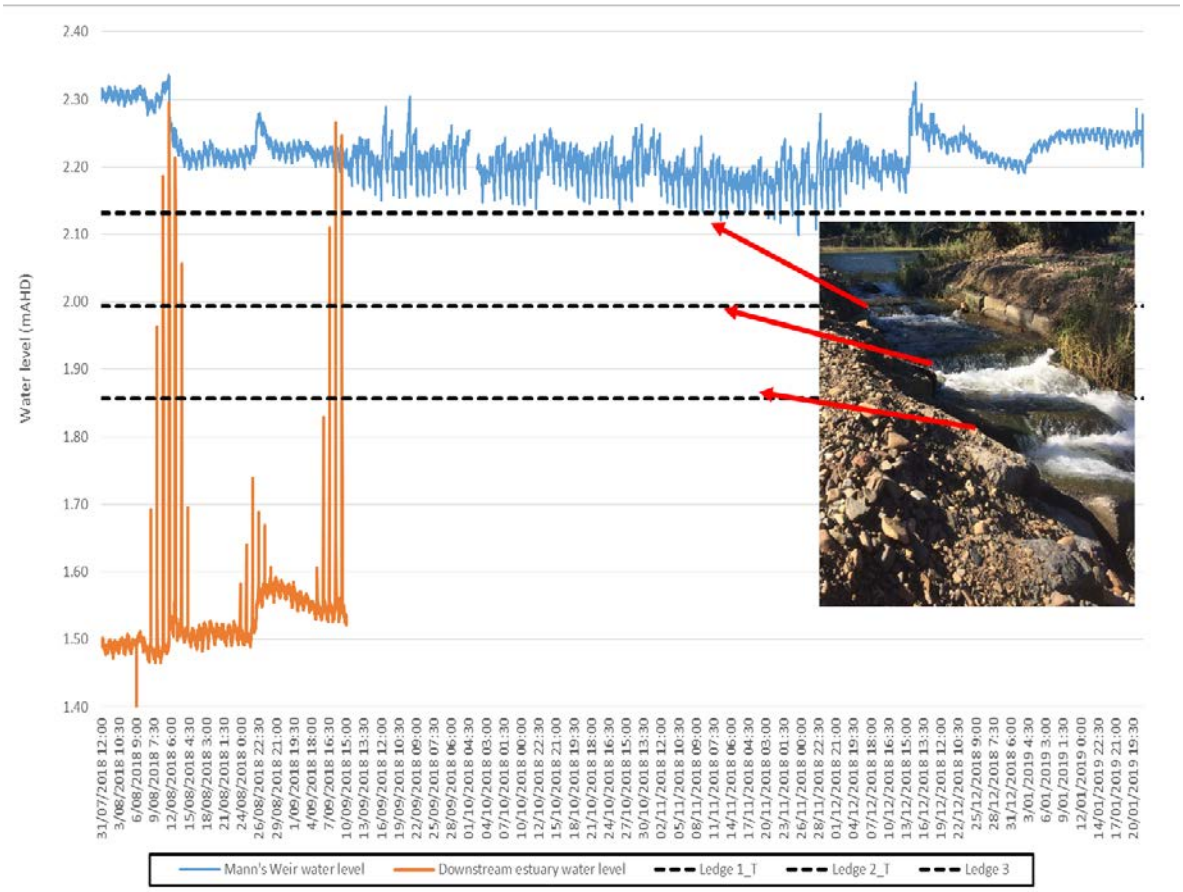

Figure 3 – Monitoring the level of fish passage possible during various tide cycles at Mann's Weir. The horizontal lines represent the height of the vertical drops within the low flow channel.

The horizontal lines relate to steps/ledges in the low flow channel that need to be drowned out by the tides to allow fish to pass. Only when the downstream tides in August and September (orange lines) were higher than the upper step (upper dashed line) was fish passage possible. This also required baseflow to provide hydraulic connection between upstream and downstream.

An assessment of trigger flows revealed that trigger flows were released in 2014 and 2016 (f**igure 4**). These trigger flows provided brackish conditions for a length at least halfway down the estuary (8.6 km AMTD) for short periods. Overtopping flows in 2015 and 2017 (two flows) provided brackish conditions for longer and further down into the estuary (**figure 2**). Such releases are important for providing broad scale movement of fish past Mann's Weir as well as providing the brackish conditions in the estuary that favour the growth of juvenile species such as banana prawns and provide suitable salinities for seedling river mangroves.

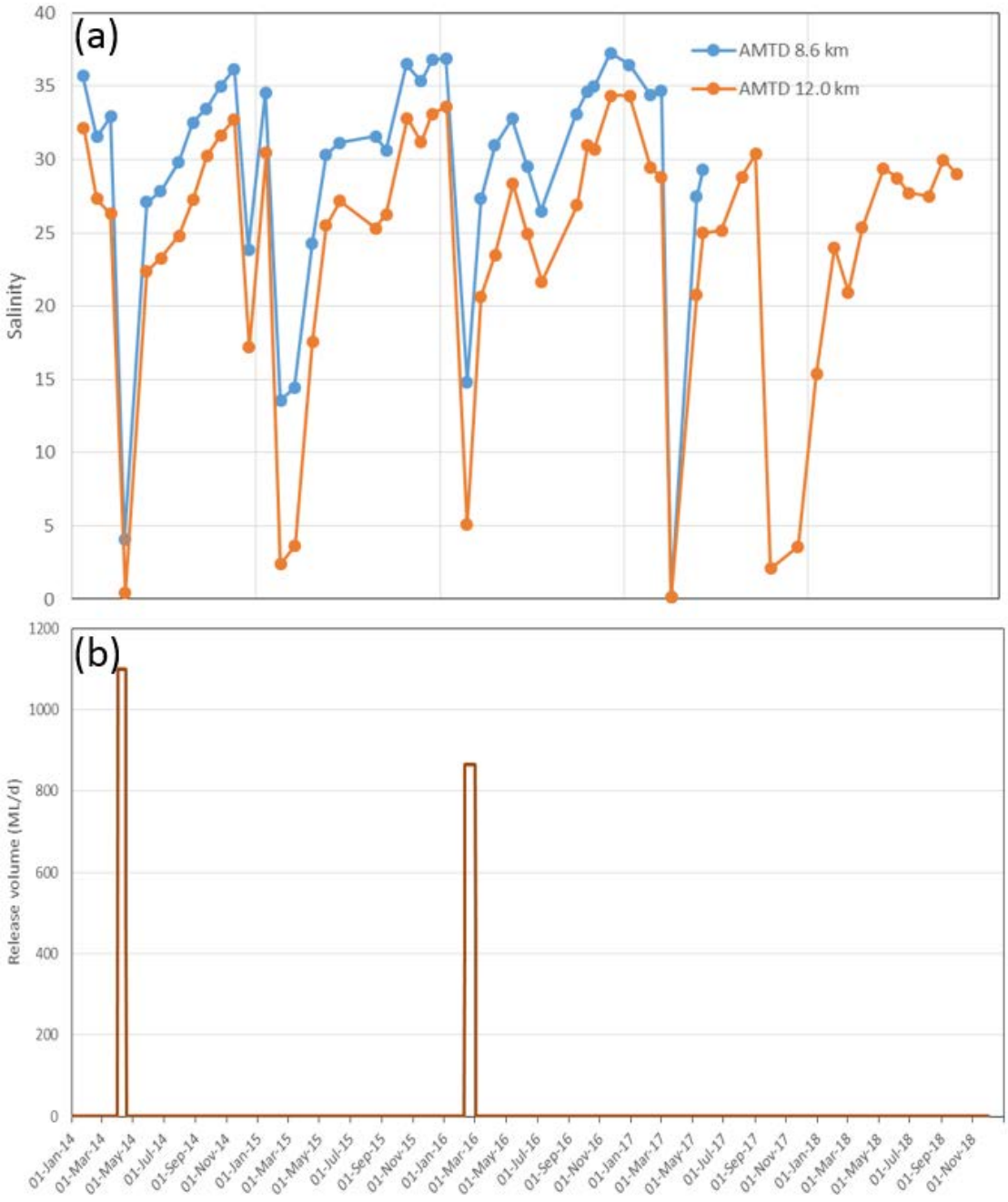

Figure 4 – Salinity measurements conducted at two sites in the Boyne estuary (a) supplied by the Department of Environment and Science. The associated trigger flows (b) that caused reductions in salinity in the estuary.

6.4. Assessment of low risk aquifers

There have been 90 bores installed within the last five years, 13 of these are monitoring bores and the remaining 77 have small diameter casing indicating use as stock and domestic bores. Many of these are replacement bores for previously existing bores. This indicates that growth and demand for groundwater in the plan area is low.

6.5. Assessment of OLF development

There is a small number of overland flow developments within the Boyne Basin with the majority being for stock and domestic or ornamental purposes. Analysis indicates that there are very few new OLF developments within the last five years.

6.6. Social and economic assessment

The plan supports growth in population and industries and aims to maintain flows that support water-related economic values in the plan area. It provides this through unallocated water releases and the establishment of a water market. Volumes of unallocated water are shown in **appendix B: Water entitlements**, **table 7**.

The basis of the statistics used in this section is the Australian Bureau of Statistics (ABS) census data (ABS 2016) using relevant Statistical Areas - level 2 (SA2s). For the purpose of the report the conglomerate of SA2s chosen to represent the plan area are Boyne Island – Tannum Sands, Gladstone, Gladstone Hinterland, South Trees and Telina – Toolooa.

6.6.1. Population information

As at 30 June 2017, the estimated population for the Boyne water plan area was 34 780. The growth rate was 0.5% for the last five years well below the Queensland average of 1.5 per cent. Population growth rates throughout the plan area are variable with the highest being 1.6% t in the TelinaTooloola area with negative growth being in the Gladstone area of -1.0 per cent. The population projection to 2041 in the region is estimated to increase to 41 500 persons or by 0.7 per cent over 25 years.

6.6.2. Employment by industry

The top three industries in the Boyne region are:

- manufacturing (14.7%)
- construction (11.5%)
- retail trade (9.2%).

The percentage of employment in the Agriculture, Forestry and Fishing sector is 1.9% with the Queensland average being 2.8 per cent.

Water use in the plan area is used for grazing and agriculture, town water supplies and industry.

6.6.3. Australian Bureau of Statistics) farm surveys

The value for agricultural commodities in the plan region[2] for the 201516 financial year was estimated at $19 million, being an increase of $10 million from 201011. The reserves of unallocated water available across the plan area can partially facilitate further expansion and diversification of agriculture.

6.6.4. Water trading and water prices

In the last five year period there has been no water trading, seasonal water assignments or unallocated water made available.

For more information, visit the Water markets and trading[3] website.

[2]A set of Statistical Area Level 2 ABS datasets were used as a proxy for the plan area.
[3] www.business.qld.gov.au/industries/mining-energy-water/water/water-markets/market-information#water-sales

6.7. Climate assessment

A review of the climatic conditions for the plan area was undertaken to determine if there has been a significant change that affects the plan's ability to provide consumptive and non-consumptive water use for the remaining life of the plan. Two preliminary assessments were carried out by the Department of Environment and Science to determine any:

- variations in the climatic conditions since 2011 compared with the period used for hydrological modelling for the plan (1890–2011)
- impacts of potential climate change based on climate projection scenario to the year 2030.

6.7.1. Recent climate variation

The purpose of this assessment was to determine any significant variation in the recent climatic conditions that could affect the plan's ability to provide for consumptive and non-consumptive use for the remaining life of the plan. The rainfall and evaporation data recorded from July 2011 to June 2015 based on the data provided by the Gladstone Area Water Board (GAWB) was compared to the historical data used in the hydrological modelling for the plan, from 1 January 1890 to 30 June 2011 (121 years).

The data recorded at the Boyne River at Nagoorin (133006A) was chosen for the comparison as it is representative of the catchment and it is of interest for the water security of the region. The annual streamflow at the Boyne River at Nagoorin since 2011 is within the range of the historical data as shown by the green dots (new data) being distributed amongst the historical data (blue dots) (**figure 5**).

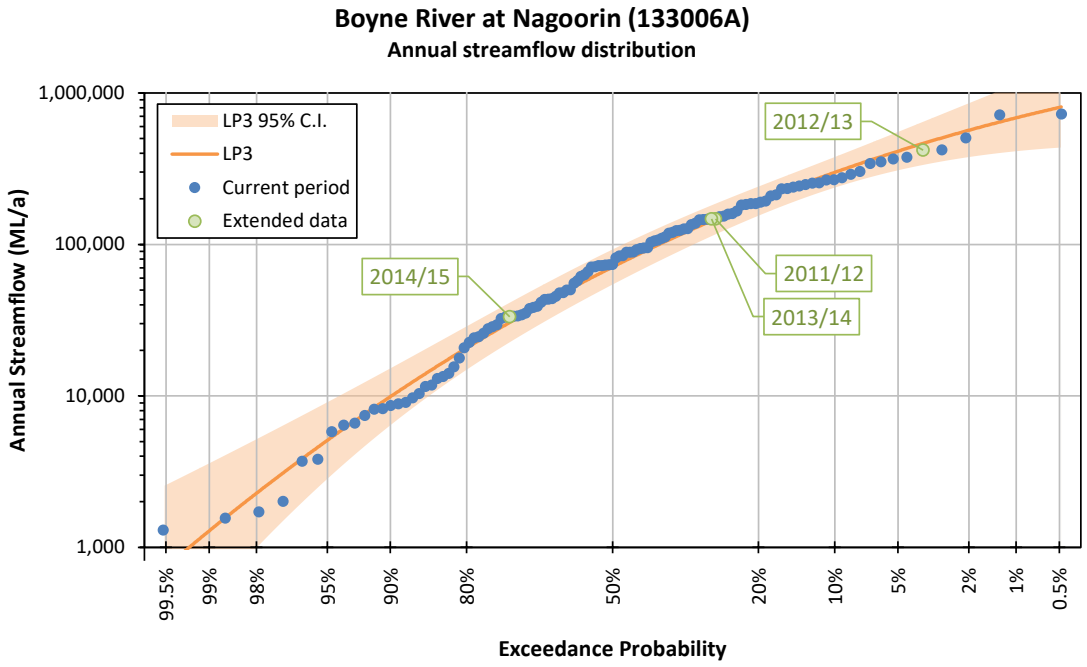

Figure 5 – Distribution of annual streamflow at Boyne River at Nagoorin (GS 133006A)

Of the four years of data, three of those are greater than the median (50 per cent) and one below. In general, this suggests that the recent rainfall since July 2011 does not pose a risk to the plan's ability to provide for consumptive and non-consumptive use.

The recorded water level data for Awoonga Dam is shown in **figure 6.** Stage 1 was completed in 1984 (30 mAHD) and Stage 2 (40 mAHD) in 2002. The dam level was reasonably high over the extended period of record from 2011 and spilled on a few occasions.

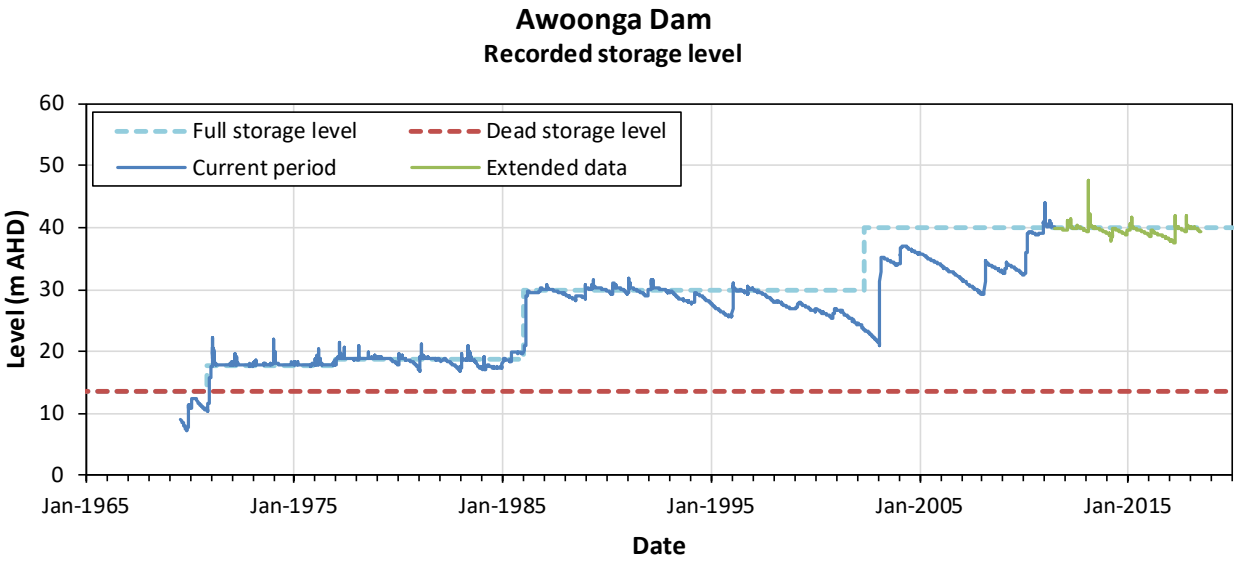

Figure 6 – Recorded water level data at Awoonga Dam (source: GAWB)

6.7.2. Climate change projections

A range of Global Circulation Models (GCMs) were used in the assessment. The results consider the Representative Concentration Pathway (RCP) 8.5 emission scenario. This scenario is commonly used for climate change prediction work and corresponds to a business-as-usual scenario, which follows current emission trends. Rainfall and evaporation data were sourced at the long-term gauge at Ubobo Store (39091).

6.7.2.1 Evaporation

The monthly variation in the potential evaporation predicted for the years through to 2030 is shown in **figure 7.** The GCMs predicted an increase in the median evaporation derived from the GCMs (shown by red line) for all months to varying degrees as compared to the historical evaporation (indicated by black reference line). Increased evaporation will increase losses from farm storages, aligns to greater crop water use and may cause water users to use additional water from surface water. Increases in evaporation may reduce the persistence time of waterholes that are used for refugia by stream biota.

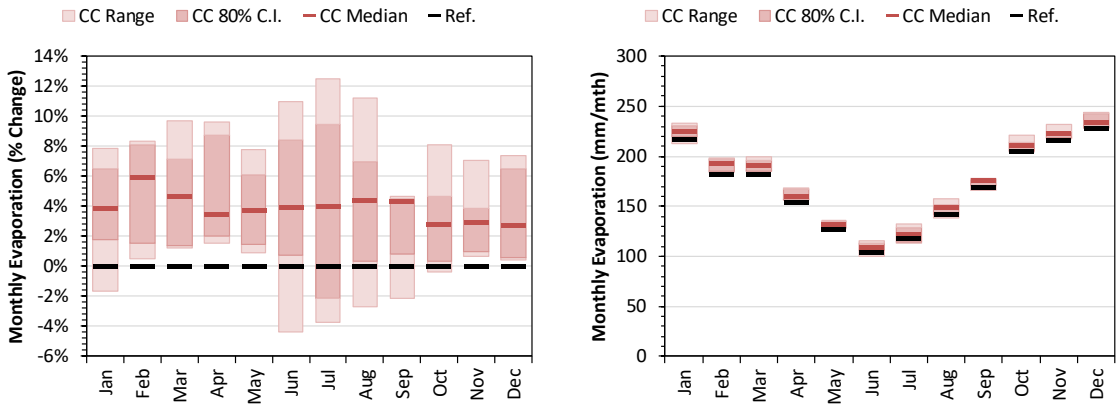

Figure 7 – Monthly potential evaporation projection for RCP 8.5 scenario to the year 2030

6.7.2.2 Rainfall

The monthly variation in the rainfall predicted by the GCMs for the period until 2030 is shown in **figure 8**. For the period to 2030, the median rainfall (red line) expected indicates lower rainfalls for most of the months (except April, May and December) as compared to the historical rainfall (black reference line). However, there are still broad confidence limits around the median rainfall estimates indicating some uncertainties in the projections. Changes in rainfall patterns (including intensity) can affect the volume of water that can be captured by the dam and groundwater recharge. Likewise, on land, changes to rainfall pattern can affect what crops might be grown and resultant pressures on water resources.

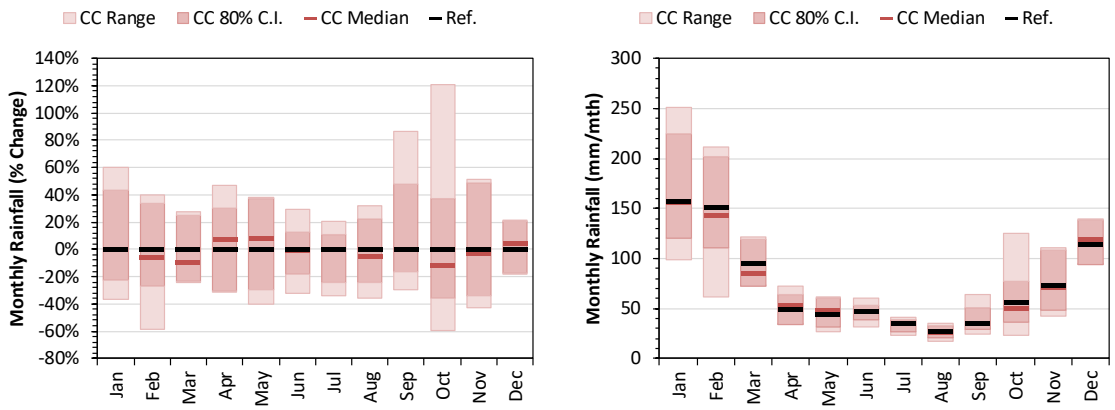

Figure 8 – Monthly rainfall projection for RCP 8.5 scenario to the year 2030

7 Plan amendments and previous reports

7.1. Plan amendments and milestones

Following the release of the water plan a number of amendments have been made to reflect administrative changes relating to the Water Act. The main amending act was the *Water Reform and Other Legislation Amendment Act 2014 (WROLA 2014).* These amendments and other planning milestones are shown in are shown since commencement of the plan in **figure 9**.

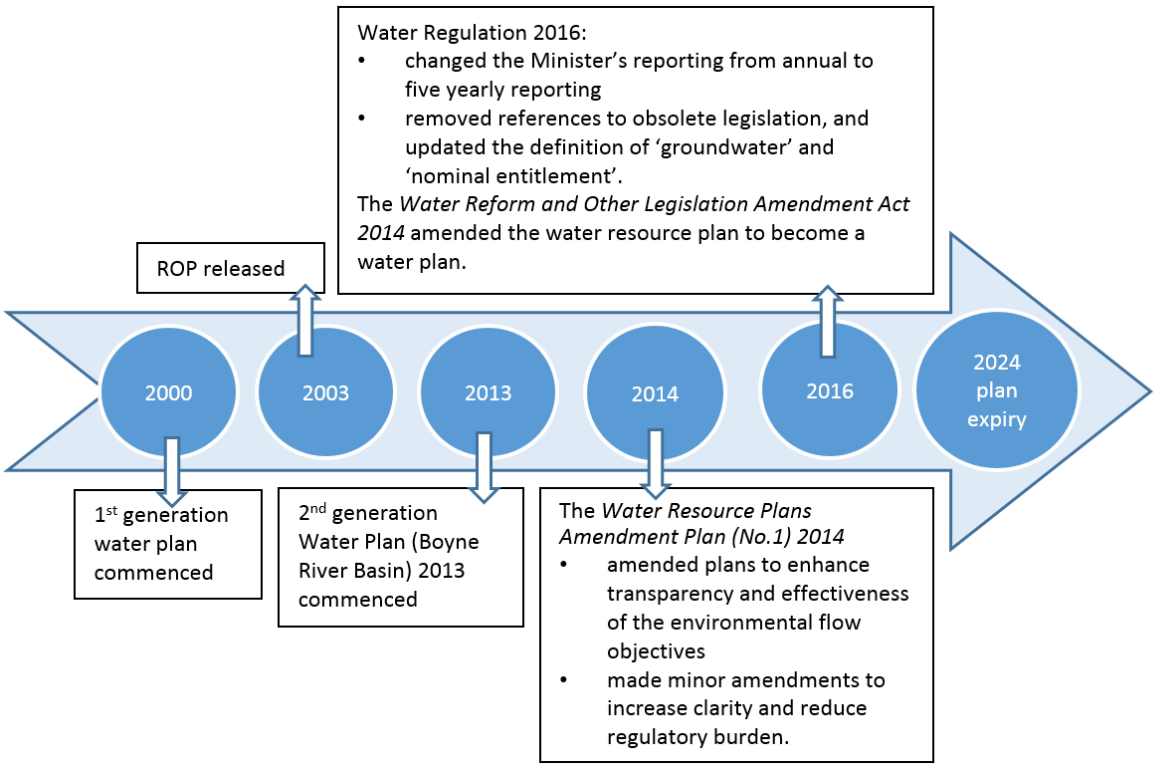

Figure 9 – Water planning milestones for the Boyne River Basin water plan

Amendments to the Water Act and the Water Regulation commenced on 6 December 2016. These amendments change the way water planning is delivered across the state, including the planning documents. These new or expanded water planning documents which replace the previous water resource plans and resource operations plans provide greater flexibility to amend operational documents and allow water service providers to manage their schemes more efficiently and effective.

Additionally the Mineral, Water and Other Legislation Amendment Bill 2018 was passed in October 2018. When enacted, new water plans will require the inclusion of plan outcomes for cultural values and climate change.

For more detail, see **appendix F: Plan amendments and milestones.**

7.2. Previous assessments and reports

The last Minister's Report was prepared in 2013. Following this, the reporting frequency changed from annual to five yearly. As the plan was also being reviewed at the same time, the following reports were taken into consideration during the plan review:

Implementation review report: This report indicated that all general outcomes were achieved over the life of the plan. The strategies were suitable even as the Boyne River Basin experienced its worst historical dry period on record (2002–03).

Socioeconomic report: The socioeconomic assessment recommended that the following outcomes be included in the new draft water resource plan: (1) ensure security for existing authorisations, (2) improve specification of entitlements and authorisations, (3) provide for future water requirements whilst taking into account water use efficiency and (4) provide for non-consumptive uses.

Environmental assessment report: Due to the ecological benefits the trigger flow release provides, this report recommended that the intent of this rule be maintained, with minor alterations to the volume, duration and timing of releases. The report also recommended that the base flow release rule be maintained due to its success in mimicking natural events.

In response to these reports, the new draft plans released on 11 June 2013 contained revised water allocation change rules and water sharing rules. The process for release of unallocated water, primarily to Gladstone Area Water Board, was also renewed. The draft plans also included:

- unallocated water reserves for future growth, including 19 000 ML for a potential future raising of Awoonga Dam and over 1800 ML for strategic and general purposes
- provision to access unallocated water reserves prior to infrastructure upgrades under certain conditions
- improved operating and water sharing rules for Awoonga Dam
- provision for seasonal assignment of water licences in subcatchment A
- improved monitoring and reporting requirements for Gladstone Area Water Board (owner/operator of Awoonga Dam)
- support for the continued use of all existing entitlements while amending water licences to have terms that better align with the capacity of existing approved works.

8 Identification of potential risks to the water plan's outcomes

A risk assessment was completed in October 2018 to identify potential risks to the water resource plan's outcomes that could emerge before the plan expires in September 2024. The risk assessment approach used was consistent with the ISO 31000:2018 Risk Management Guideline. This methodology ensures consistent, repeatable and defensible consideration of risks, and that the outcomes of the assessment are documented for future reference.

Potential risks were identified through the consideration of changes in the plan area over the life of the plan. Potential emerging issues were also identified through consideration of future water demands beyond the life of the plan (section 9). Evidence based on data and expert opinion was used to rank the likelihood and consequence of risk from a standardised list of threats, and the risk level and rationale for this ranking was documented (see **appendix A: Assessment of plan outcomes**).

Of the 15 plan outcomes assessed, all plan outcomes were ranked at low risk within the life of the plan. 14 out of the 15 plan outcomes are being achieved, with one plan outcome relating to water-related aesthetic, cultural and recreational values in the plan area is being partially achieved. More detailed information on the results of the risk assessment can be found in **appendix A: Assessment of plan outcomes**.

9 Potential emerging issues

The 2018 risk assessment also investigated potential future risks beyond the life of this plan. No significant threats were identified, however the main emerging issues identified were:

- Water trading: The plan provides for a limited water market through seasonal assignment of water licences but there are no tradeable water allocations. There appears to be limited demand for additional water in the plan area. Should demand for water increase, the market will need more flexible mechanisms in the plan to facilitate trade.
- Take of groundwater: Because groundwater take is not licensed, there is potential to extract water using bores from groundwater adjacent to the watercourse, which may impact on surface water availability. Currently this is considered low risk. We will continue to monitor bore construction along the watercourse for trends.
- Mann's Weir: Mann's Weir has been reconfigured within the past five years. Monitoring will be undertaken to assess the effectiveness of current low flow releases in maintaining connectivity through the system
- The construction of Rookwood Weir will support security for the Awoonga Water Supply scheme and further development of the Gladstone region. When the weir is constructed, it will have the ability to supply 76,000 ML per annum of water for the region, 30 000ML of which is available to underpin agricultural growth and supply industrial and urban water throughout Gladstone. It is intended that this will be facilitated in the future by the construction of a 115km pipeline to connect the Fitzroy River with Awoonga Dam. The pipeline is part of a longer term strategy identified in the Central Queensland Regional Water Supply Strategy (2006) to increase water security across the region.

In addition, knowledge of Aboriginal peoples and Torres Strait Islander economic aspirations and cultural values is limited, and further consultation is required to understand these aspirations and values.

10 Any non-compliance under a water entitlement or other authorisation in the water plan area.

There have been two relatively minor instances of non-compliance relating to overuse of water entitlements within the Boyne River Water Plan Area within the past five water years. **Table 9** in **appendix G: Overview of non-compliance** provides further details on the number and type of non-compliance that has occurred over the five-year period. These have been dealt with in accordance with the standard departmental compliance response procedures.

11 Way forward

This report evaluates the effectiveness of the first five years of implementation of the plan and presents information and assessments that have been used to inform this evaluation. In summary, existing information indicates the implementation of the plan has been effective in achieving almost all of the plan outcomes. Some further monitoring is required to monitor potential emerging risks identified to ensure the plan continues to meet its outcomes.

All plan outcomes were ranked as low risk within the life of the plan and no significant risks were identified. The emerging issues identified in the previous section indicate further monitoring and adaptive management may be required in future to ensure the plan remains fit for purpose. The plan is due to expire in September 2024 and based on this evaluation it is recommended that it is appropriate for the plan to continue. In the meantime, monitoring and implementation of the plan will continue and the plan will be re-evaluated prior to its expiry.

12 References

GAWB, 2014, Boyne River Resource Operations Plan: Annual Report – Water Year July 2013–June 2014.

GAWB, 2015, Boyne River Resource Operations Plan: Annual Report – Water Year July 2014–June 2015.

GHD, 2015, Gladstone Area Water Board: Boyne River ROP AEMP 2014/15 Annual Report.

GHD, 2016, Gladstone Area Water Board: Boyne River ROP AEMP 2015/16 Annual Report.

GHD, 2017, Gladstone Area Water Board: Boyne River ROP AEMP 2016/17 Annual Report.

GHD, 2018, Gladstone Area Water Board: Boyne River ROP AEMP 2017/18 Annual Report.

ISO 31000 (2018) Risk Management Guideline. International Organization for Standardization.

Appendix A: Assessment of plan outcomes

Table 2 – Socioeconomic outcomes

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Rules that provide for outcome	Qualitative risk ranking and preliminary assessment of outcome
10 Economic outcomes			
(a) provision for the use of water entitlements and other authorisations in the plan area;	The plan provides for continued use of all entitlements and authorisations in the plan area. Decisions made under the plan must be consistent with water allocation security objectives stated in the plan.	The protocol outlines rules for amending existing water licences to have volumetric elements. It also allows seasonal water assignment. The protocol also sets out a process for dealing with water licence applications to take water from watercourses, lakes and springs in the plan area.	**Low risk** This outcome is being achieved.
(b) protection of the probability of being able to take water under a water allocation;	The plan provides a framework for specifying water allocations with a defined level of security. Decisions made under the plan about the allocation or management of water in the plan area must be consistent with the water allocation security objectives stated in the plan.	The protocol outlines rules for converting to, amending and granting water allocations. The ROL outlines operating and environmental management rules for the water supply scheme. The protocol sets out water sharing rules (seasonal assignment) for the water management area.	**Low risk** This outcome is being achieved.
(c) availability of water for the following— (i) growth in industries dependent on water resources in the plan area; Examples of growth in industries dependent on water resources in the plan area— • industries located in the Gladstone region that are dependent on water in the plan area • irrigated agriculture industries dependent on water from the Boyne River	The plan provides for unallocated water as strategic, strategic infrastructure and general reserve. The plan provides for stock and domestic take from watercourse water supplies.	The protocol outlines a release process for strategic, strategic infrastructure and general reserve unallocated water and a process for granting water licences and unsupplemented water licences. The Boyne River Basin transitions from ROP to water plan, which contains provisions to be read as the plan, allows for seasonal assignment. Link: https://www.dnrme.qld.gov.au/__data/assets/pdf_file/0014/1064003/boyne-transitions.pdf	**Low risk** This outcome is being achieved.

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Rules that provide for outcome	Qualitative risk ranking and preliminary assessment of outcome
(ii) stock purposes in the plan area;			
(d) the support of flexible and diverse water supply arrangements for water users;	Decisions made under the plan must be consistent with water allocation security objectives stated in the plan.	The protocol outlines the seasonal water assignment for water licences	**Low risk** This outcome is being achieved.
(e) the support of activities stated in the Water Regulation 2016 ,schedule 3;	The plan supports prescribed activity take but limits it to 5ML		**Low risk** This outcome is being achieved.
(f) maintenance of flows that support water-related economic activities in the plan area, including, for example, tourism;	The plan outlines the volumes of unallocated water reserves that may be accessed. The plan requires water licences to be amended to state a volume, purpose, rate of take and any conditions. Environmental flow objectives are used to assess the consistency of water management decisions. The plan outlines limits on watercourse interference.	The protocol outlines a release process for strategic, strategic infrastructure and general reserve unallocated water and a process for granting water. The ROL outlines operating and environmental management rules for the water supply scheme. The protocol sets out water sharing rules (seasonal assignment) for the water management area. The protocol outlines dealing with water licence applications that prevents the increase in the rate of take and total annual volume taken.	**Low risk** This outcome is being achieved.
(g) support of continual improvement in the efficient use of water;	The plan requires water licences to be amended to state a volume, purpose, rate of take and any conditions. Water use efficiency The efficient use of water is also a consideration in dealing with unallocated water.	The ROL outlines operating and environmental management rules for the water supply scheme. The protocol sets out water sharing rules (seasonal assignment) for the water management areas. The protocol outlines dealing with water licence applications that prevents the increase in the rate of take and total annual volume taken.	**Low risk** This outcome is being achieved.
11 Social outcomes			
(1) Each of the following is a social outcome for water in the plan area— (a) increased security for town water supplies that rely on water in the plan	The plan has established water reserves that may be used to provide additional security for town water supplies.		**Low risk** This outcome is being achieved.

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Rules that provide for outcome	Qualitative risk ranking and preliminary assessment of outcome
area			
(b) availability of water for the following— (i) population growth in towns and communities dependent on water resources in the plan area; (ii) domestic purposes in the plan area;	The plan has established water reserves that may be used to provide additional security for town water supplies. The plan allows for surface water to be taken for stock and domestic purposes. The plan allows for the interference with water for the take of water for domestic purposes.	The protocol outlines a process for dealing with the unallocated water reserves.	**Low risk** This outcome is being achieved.
(c) maintenance of flows that support water-related aesthetic, cultural and recreational values in the plan area, including the cultural values of the traditional owners in the plan area;	The plan establishes interim water sharing and environmental management rules that provide for flows for water-related activities. The plan includes EFOs that aim to provide adequate environmental flows throughout the basin. The plan includes waterhole drawdown rules that may be applied to water entitlements to protect ecological and cultural values.	The ROL contains monitoring and reporting requirements to measure effectiveness of rules in providing for values. The protocol states licence elements that are set to allow for the environment and existing users.	**Low risk** This outcome is being partially achieved. Recreational and aesthetic values are provided for within Awoonga dam, a recreational hotspot. There are no specific cultural water reserves in the plan and insufficient information on aboriginal peoples water needs in the plan area to determine whether water related cultural values are being provided for. **Further engagement with Aboriginal peoples and Torres Strait Islanders is required to better understand current and emerging cultural water needs in the plan area.**
(d) maintenance, to the extent practicable, of the quality of water for human use;	The plan has established water reserves that may be used to provide additional security for town water supplies. The plan includes EFOs that aim to provide adequate environmental flows throughout the basin.	The ROL and operations manual outline operational rules that seek to release water of the best quality. The ROL and operations manual require monitoring of water quality.	**Low risk** This outcome is being achieved.

Table 3 – General ecological outcomes for the plan area

Plan outcome	Plan strategies that provide for outcome	Rules that provide for outcome	Related ecological assets	Summary of monitoring and assessment	Qualitative risk ranking and preliminary assessment of outcome
12 Each of the following is an ecological outcome for water in the plan area—					
(a) the continued capability of a part of the river system to be connected to another, including by maintaining flows that– (i) allow for the movement of native fauna between riverine, floodplain, wetland, estuarine and marine environments; and (ii) support water-related ecosystems; and (iii) support river-forming processes;	The plan identifies performance indicators and provides for the maintenance of flows through EFOs. In addition, the plan outlines pass flow conditions for unallocated water reserves in subcatchment area B. The plan requires monitoring and reporting on plan outcomes.	The protocol outlines: • the process for the granting of unallocated water • seasonal water assignment and water permit rules • monitoring and assessment requirements The resource operations licence outlines: • environmental management rules • monitoring and reporting requirements for the ROL holder	• barramundi • diadromous fish • riffles • stable flow spawning fish guild • waterholes • river-forming processes	ROL holder monitoring has identified sufficient movement of estuarine fish species into the freshwater reaches. River-forming flows have occurred both upstream and downstream of Awoonga Dam since plan commencement. Bank stability surveys have revealed that there were no significant land slumping or erosion downstream of the dam. Overall, aquatic habitat condition was found to be suitable for supporting aquatic ecosystems downstream of the dam. Finally, bank stability throughout the catchment was generally assessed as having moderate to high stability. High flows from both dam overtopping and trigger flow releases have provided brackish conditions in the Boyne River estuary. Overall, fish community analyses were responsive to flow conditions throughout sites and years, demonstrated by changes in the fish communities in both the freshwater and estuarine habitats.	**Low risk** This outcome is being achieved.

Plan outcome	Plan strategies that provide for outcome	Rules that provide for outcome	Related ecological assets	Summary of monitoring and assessment	Qualitative risk ranking and preliminary assessment of outcome
12 Each of the following is an ecological outcome for water in the plan area—					
(b) provision of a flow regime that ensures— (i) maintenance of fresh water to the Boyne River estuary; and (ii) maintenance of waterholes, including the Nagoorin waterhole; and (iii) riffle habitats; and (iv) maintenance of estuarine ecosystem functions, including, for example, flows for the movement and recruitment of barramundi (*Lates calcarifer*) and sea mullet (*Mugil cephalus*) and banana prawn (*Fenneropenaeus merguiensis*) growth;	See above	See above	• barramundi • riffles • banana prawns • estuarine brackish habitat • sea mullet • waterholes	High flows from both dam overtopping and trigger flow releases have provided brackish conditions in the Boyne River estuary. Trigger flow releases were made in both 2014 and 2016 in response to appropriate inflows. ROL holder monitoring has shown that aquatic macroinvertebrates found downstream of the dam are closely associated with the abundance and variety aquatic plants, which in turn are affected by stream flows. A number of marine fish species were captured upstream of Mann's Weir in the freshwater reaches indicating fish passage.	**Low risk** This outcome is being achieved.
(c) minimisation of the impacts of taking water on water-related ecosystems;	See above	See above	• barramundi • diadromous fish • riffles • waterholes • stable flow spawning fish guild	Trigger flow and base flow releases provide connection flows to the estuary for fish species as well as providing mild scouring flows.	**Low risk** This outcome is being achieved.
(d) protection and maintenance of refugia associated with waterholes, lakes and wetlands.	See above	See above	• barramundi • diadromous fish • riffles • waterholes • stable flow spawning fish guild	ROL holder monitoring has demonstrated that baseflow releases from Awoonga Dam provide adequate water quality in downstream pools. Large flood flows provide scouring to remove excessive macrophyte growth.	**Low risk** This outcome is being achieved.

Appendix B: Water entitlements

Table 4 – Water entitlements within the plan area

Entitlement type	Entitlement numbers				Nominal entitlement	
	All	Volumetric	Area	Other[1]	Volume (ML)	Area (ha)
Water Licences	28	26		2	1,334.7	
Supplemented Water Allocations	2	2			78,000	

* The details suppled in this table are correct as of the 16th January 2019. Any changes that occurred after that date will not be reflected in the table.

[1]Entitlements with no volume or area specified, including entitlements to interfere with the flow of water

Table 5 – High priority water use in Awoonga Dam, in terms of volume taken and the percentage of entitlement

Water year	Entitlement (ML)	Volume taken (ML)	Water taken as % of entitlements
2013-14	78 000	50 096.02	64.42
2014-15	78 000	46 397.10	59.48
2015-16	78 000	46 821.33	60.03
2016-17	78 000	51 044.75	65.44
2017-18	78 000	51 767.00	66.37

Table 6 – Unsupplemented surface water use in the plan

Water year	Entitlement (ML)	Volume taken (ML)	Water taken as % of entitlements in metered entitlement areas
2012-13	1334.7	180.669	14%
2013-14	1334.7	264.995	20%
2014-15	1334.7	193.799	15%
2015-16	1334.7	166.83	12%
2016-17	1334.7	195.573	15%
2017-18	1334.7	91.088	7%

Table 7 – Unallocated water reserves within the plan area

Reserve purpose	Initial reserved (ML)	Remaining reserve (ML)
Strategic infrastructure reserve – Raising of Awoonga Dam (45 mAHD)	50 000	19 000*
General reserve – upstream of Awonga Dam	3000	2105
General reserve – downstream of Awonga Dam	800	338
Strategic reserve – Town Water Supply Upstream of Awoonga Dam	200	200

*15 000 ML of unallocated water was released for the raising Awoonga Dam to 40 metres Australian Height Datum (mAHD) in 2003. Note 19 000 ML and not the remaining 35 000 ML was specified in the Boyne River Basin Operations Plan 2003 for further raising to 45 mAHD.

Appendix C: Water taken or interfered with under statutory authorisations

Table 8 – Information on water authorisations in the plan area

Form of take	Catchment information sources
Subdivision 1 – authorisations that may not be limited by water planning instrument	
S93 General authorisations to take water. eg. firefighting, watering travelling stock, contaminated agricultural run-off storages	**No major change in water taken under this general authorisations.** There have been no major increases in take of water for incidences of firefighting or travelling stock. Take of water for contaminated agricultural run-off has seen no significant increase.
S94 General authorisations to interfere with water. eg. OLF, impoundments for state monitoring purposes	**No identified change in interference under this general authorisation**. There are no new gauging stations that interfere with water from a watercourse, lake or spring by impounding for the purpose of collecting monitoring data.
S95 Aboriginal and Torres Strait Islander parties	**No identified change in water take under this general authorisation** There has been no notified increase in the take or interference with water for traditional or cultural activities.
S96 Land owners may take water for stock or domestic purposes	**No impacts identified under this general authorisation** Water use in the plan area is predominately for the irrigation of tree crops and fodder. Stock and domestic water can be taken within the plan area. There have been no reported incidents of significant increases in take for stock or domestic purposes.
S97 Environmental authorities to take or interfere with OLF	**No identified change in water taken under this general authorisation.** Notification for the construction of OLF storages to satisfy an environmental authority or a development permit for carrying out an environmentally relevant activity is required under the *Planning Regulation 2017* and *Water Regulation 2016*. DNRME is not aware of a significant increase in the construction of OLF dams for these purposes through the notification process.
S98 Resource activities that interfere with the flow of water by diversion of a watercourse	**No identified change in water taken under this general authorisation.** DNRME is not aware of an increase in the number of interferences by diversion within the plan area.
S99 Constructing authorities and water service providers	**No impacts identified in water taken under this general authorisation.** Limited volumes of water are required for road and rail construction and maintenance and public amenities. DNRME has record of 108 notifications by 5 constructing authorities within the plan area over the last 5 years.
Subdivision 2 – Authorisations that may be limited by water planning instrument or regulation	
101 Authorisations that may be altered or limited by water planning instrument or regulation.	**No identified change in water taken under this authorisation.** Volumes used under this authority are not known.
102 Authorisations under water plans or regulation	**No impacts identified in water taken under this authorisation.** The plan does not regulate overland flow or groundwater.
103 Authorisations to take water for stock or domestic purposes may be limited	N**o identified change in water taken under these authorities** The plan does not provide any additional rules on how water for stock and domestic is managed.

Appendix D: Ecological monitoring

Gladstone Area Water Board aquatic ecological monitoring program

Gladstne Area Water Board (GAWB) is a registered water authority and service provider for bulk water in the Gladstone region, and also owns and operates Awoonga Dam. Reporting requirements established through the Resource Operations Licence (ROL) led GAWB to implement its aquatic ecological monitoring program (AEMP). Reporting is undertaken on an annual basis focusing on water quality, macroinvertebrate communities, fish communities and habitat assessments at fixed sites in the catchment. Below is a summary of GAWB reporting for each key indicator for the 2014-2018 period.

Water quality

Water quality results for fixed sites across the catchment are generally maintained within relevant Queensland Water Quality Guidelines (QWQG), with limited discrepancies within sites and years. In general, GAWB acknowledges that the main potential impacts of water regulation associated with Awoonga Dam relate to:

- The high trapping efficiency of the dam, particularly in terms of fine sediment (e.g. reduced turbidity downstream of the dam)
- Stratification within the storage and reduced flows below the dam (e.g. reduced dissolved oxygen levels at depth and downstream of the dam)
- Reduced freshwater flows below the dam and increased groundwater contribution to baseflow and evapo-concentration (e.g. increased electrical conductivity downstream of the dam and upstream of Mann's Weir)

Overall however, GAWB found that water quality conditions upstream, within and downstream of Awoonga Dam are capable of meeting the requirements of resident flora and fauna. The base flows provide for adequate water quality downstream of Awoonga Dam.

Macroinvertebrate communities

Macroinvertebrate community data were analysed using a variety of univariate and multivariate techniques and compared against Queensland Water Quality Guidelines and median values derived from historical AEMP results. Results from macroinvertebrate sampling suggests that there have been four distinct changes in the macroinvertebrate community since sampling commenced in 2004. In the period to 2010, the macroinvertebrate community was dominated by pollution-tolerant species as this period coincided with reduced periods of baseflow due to the drought and there were periods of build-up of fine sediments and macrophytes. In both 2008 and 2010, there were trigger flow releases that allowed flushing of habitat and an increase in the taxa more associated with flowing water. Following on from the floods in 2011and 2013 and the subsequent scouring of habitat, diversity of macroinvertebrates was reduced but the community structure was composed more of those species associated with flowing water. Since those floods, the habitat has started to regenerate and diversity of macroinvertebrates has returned.

Fish communities

Fish community data were analysed using a variety of univariate and multivariate techniques focusing on the health, distribution, abundance, diversity and population structure of species across fixed sites within the catchment. In general, fish collected under the AEMP were in good condition. Few

instances of fungal infections were observed though numerous large barramundi were collected downstream of the dam with injuries likely related to coming over the dam wall during flood events.

Overall, fish community analyses were responsive to flow conditions throughout sites and years, summarised by the following principles:

- Fish migrate upstream or downstream following flood cues, for spawning and/or feeding
- Fish abundance varies in freshwater sites as flood conditions passively push fish downstream or stimulate fish to move to more slow flowing areas
- Fish communities in saltwater habitats below Mann's Weir change as high flows reduce salinity and temporal colonisation of less tolerant species
- Fish diversity in freshwater reaches increases after trigger flow events that allow connectivity.

There is a significant difference in the freshwater fish species community from before the 2011 flood and that after the flood. Small bodied freshwater fish species were more abundant prior to the flooding as it is thought that these species are potentially more susceptible to being washed out of freshwater reaches or have become prey for the higher presence of marine and/or stocked predators (such as barramundi from Awoonga Dam) after the floods. Species that migrate between freshwater and marine environments were more prevalent in freshwater reaches after flood or moderate flows due to increased connectivity.

Barramundi within the lower Boyne River are both from natural and stocked populations. Prior to overtopping flows on Awoonga Dam, barramundi abundance in the freshwater reaches was low. Fish sampling in 2014 revealed a barramundi population in freshwater reaches dominated by small fish mostly 400–600 mm (range 417–723 mm) (GHD 2015). These fish potentially originated from spawning from a higher abundance of adult barramundi that came from Awoonga Dam when it overtopped since 2010–11 and subsequently spawned. Fish of this size range in age from three to six years of age (Pusey et al. 2004). In contrast, sampling in 2015 revealed a barramundi size distribution that had two modes (500 mm and 800 mm) and a larger size range (252–1160 mm). This suggests that there is both natural recruitment (through access to the estuary), growth of resident fish as well as an influx of larger fish washed over the spillway from an overtopping flow in February 2015 (GHD 2015). The high flows in March 2017 allowed both connectivity to the estuary to allow recruitment and allowed fish to overtop Awoonga Dam (GHD 2017). The size class of fish in 2017 mirrored that of sampling in 2015 when a similar overtopping event occurred. The size distribution of barramundi in 2017/8 was more similar to that of 2014 suggesting recruitment may have occurred (GHD 2018).

There was a high abundance of sea mullet <100 mm both within and downstream of Mann's Weir in the spring of 2014 suggests that there was recent spawning of adults in the ocean either in 2013 or 2014. The presence of these juvenile fish within the freshwater reach in 2014 and a more uniform size distribution in 2015 suggests that there may have been reduced recruitment to the river in 2015 even though there was connectivity present from an overtopping flow on Awoonga Dam in January/February 2015. There was recruitment of sea mullet into the freshwater reaches in 2017 after overtopping flows in March of that year (GHD 2017). However a more even distribution of sea mullet sizes was evident in sampling in spring 2017 and autumn 2018 (GHD (2018).

GAWB monitoring also identified that without baseflow releases, fish passage was not possible at Mann's Weir at tidal heights of 4.41 m AHD (GHD 2015). Overtopping flows cause scouring of the gravel material at Mann's Weir causing a temporary lowering of water levels until the gravel is re-established, such flows occurred in autumn 2015 as well as autumn and spring 2017.

Aquatic habitat

Assessments of aquatic habitats were developed using the AusRivAS methodology, resulting in overall scores generated for each site, within each year. Bank stability was also assessed at fixed sites to identify active erosion and changes in bank stability over the assessment period. Overall, aquatic habitat condition was found to be suitable for supporting aquatic ecosystems downstream of the dam. Riffle habitat downstream of the dam is found in limited areas due to continually high water levels in Mann's Weir from constant releases. As such, the site chosen for macroinvertebrate sampling has generally been inundated and the biota is more suited to pool habitat. Areas of aggrading and eroding sediment have also been identified, with macrophyte beds stabilizing these depositions in some instances. In general, infilling and scouring processes fluctuate with varying flow conditions experienced downstream of the dam. Long periods without medium to high flows have resulted in extensive macrophyte proliferation, leading to build-up of organic materials and potentially detrimental effects on aquatic fauna from reduced dissolved oxygen levels. Finally, bank stability throughout the catchment was generally assessed as having moderate to high stability. Large flow events and cattle access were identified as the main drivers of reductions in bank stability. Issues with bank stability were also found to be obscured by raised water levels within the dam.

Prior to the trigger flow events in 2008 and 2010, the downstream freshwater reaches of the Boyne River were dominated by both floating and submerged aquatic macrophytes. Trigger flows removed some of this habitat in the deeper sections for a period of 12 months. The large floods and subsequent overtopping events in Awoonga Dam removed all aquatic macrophytes, leaving limited aquatic macrophytes present between 2011 and 2014. Macrophytes have begun to recolonise the shoreline of the freshwater reaches, but is kept restricted to the edges by overtopping flows that have occurred (GHD 2016).

Appendix E: Operational reporting by ROL holders

Incident	Details	Management actions
Monitoring of spillway surface, spillway apron and spillway outlet channel	Dewatering of plunge pool on spillway to assess condition of spillway and scour damage in the spillway outlet channel after heavy rainfall resulted in fish stranding in 2013.	Notification of the possible consequences of the works were notified to the department prior to undertaking works. Gladstone Area Water Board provided an operational report with the implementation of catch and release not possible due to the Rocky and uneven conditions of the pools.
Monitoring of Blue Green Algae levels	Monitoring in 2014 confirmed High Blue Green Algae levels within Lake Awoonga with cell counts above 100,000 cells/ml.	Gladstone Area Water Board provided an operational report and executed the following actions: • Notified affected landowners and stock owners • Continued monitoring recreation sites fortnightly • Issued an alert to regional media • Informed Queensland Health and conduct regular inspection for scum
Monitoring of bank slumping, erosion and fish strandings	High rainfall associated with Ex Tropical Cyclone Marcia, caused scouring occurred at base of spillway. Maintenance of spillway works resulted in fish stranding in 2015.	Gladstone Area Water Board undertook an assessment and provided an operational report. Reasonable efforts were made to minimise fish kill in the deeper pools with the relevant departments informed.
Monitoring of bank slumping, erosion and fish strandings	High rainfall associated with Ex Tropical Cyclone Debbie in 2017 resulted in high inflow to Awoonga Dam and discharge over the spillway. Following the discharge 7 dead barramundi were observed at the baseflow of the release site	Gladstone Area Water Board undertook an assessment and provided an operational report with the Hatchery Manager assessing the fish for signs of external trauma.

Appendix F: Plan amendments and milestones

Effective date	Milestone
14 December 2000	A draft Water Allocation Management Plan prior to the *Water Act 2000* in December 1999 was released. The first generation Water Resource (Boyne River Basin) Plan 2000 was approved by Governor-in-Council.
2003	The plan was transitioned with some amendments under s.57 and s.1044 of the *Water Act 2000* in 2003 – SL No.206.
July 2003	The Boyne River Basin resource operations plan was released.
20 December 2013	Water Plan (Boyne River Basin) 2013 SL No. 301 (previously Water Resource (Boyne River Basin) Plan 2013) This is a second generation plan which manages water in a watercourse, lake and spring. The plan provides for the allocation and sustainable management of water by: • defining the availability of water in the plan area • providing a framework for sustainably managing water and the taking of water • identifying priorities and mechanisms or dealing with future water requirements • providing a framework for establishing water allocations; and • providing a framework for reversing, where practical, degradation in natural ecosystems.
27 June 2014	Water Resource Plans Amendment Plan (No. 1) 2014 SL No. 142 pts 1, 3 The focus of this amendment was to: • amend water resource plans to enhance transparency and effectiveness of the environmental flow objectives; and • make additional non-substantive amendments to water resource plans to increase clarity and reduce regulatory burden while maintaining the intention and effectiveness of the plans.
6 December 2016	*Water Reform and Other Legislation Amendment Act 2014 No. 64* The *Water Reform and Other Legislation Amendment Act 2014* amended the water resource plan to become a water plan.
6 December 2016	Water Regulation 2016 SL No. 216 The Water Regulation 2016 remakes the Water Regulation 2002. To a large extent, the content of the Water Regulation 2002 has been retained. In addition to continuing existing provisions, the Water Regulation 2016 makes the following changes to improve the operation and usability of the provisions: • changed the Minister's reporting from annual to five yearly reporting • structures the provisions in a more logical manner, aligning where possible with revised structure of the *Water Act 2000* following amendments by the *Water Reform and Other Legislation Amendment Act 2014* • incorporates uncommenced amendments from the Water and Other Legislation Amendment Regulation (No. 1) 2014 • contemporises the existing provisions while maintaining the existing policy intent • makes operational amendments relating to prescribe new metered entitlement areas, extend the meter revalidation dates for certain metered entitlement areas and update water bore drillers licencing requirements to more closely reflect the National Uniform Drillers' Licensing System.

Appendix G: Overview of non-compliance

Table 9 – Non-compliance incidents for the plan area

Water year	Number of non-compliances	Type of non-compliance	Outcome
2013-14	0	-	-
2014-15	2	2 overuse	2 advisory letters
2015-16	0	-	-
2016-17	0	-	-
2017-18	0	-	-

[*] *The details suppled in this table are correct as of October 2018. Any changes that occurred after that date will not be reflected in the table.*