

Minister's Performance Assessment Report

Water Plan (Fitzroy Basin) 2011

December 2018

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Minister's Performance Assessment Report, Water Plan (Fitzroy Basin) 2011, Department of Natural Resources, Mines and Energy, 2018

Minister's forward

I am pleased to publish this report, which provides an overview of the effectiveness of the Water Plan (Fitzroy Basin) 2011 implementation to date.

The Fitzroy Basin water plan area has diverse geographic and environmental features and supports agriculture, industrial activities and a number of large community centres. While existing water infrastructure is crucial to support the continued reliability of water supply, new infrastructure including Rookwood Weir will provide for further growth in the agricultural and industrial sectors.

Existing information indicates the implementation of the plan has been effective in achieving many of the plan outcomes. Key achievements in implementing the plan include:

- reduction of the total volume of entitlement in the Callide Valley alluvium to improve long-term sustainability
- grants of unsupplemented groundwater allocations in the Lower Callide groundwater sub-area
- grants of unsupplemented surface water allocations from water licences in the Dawson Valley, Theresa Retreat and Comet water management areas.

The community has indicated that access to unallocated water and trade within the plan area needs to be more flexible. There is also some further scientific work required to better understand the ecological connectivity within the river system, groundwater and surface water interaction and groundwater-dependent ecosystems.

With the progression of the new Rookwood Weir, a targeted amendment to the plan will be needed over the next two to three year period to incorporate new water supply infrastructure.

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

Hon Dr Anthony Lynham MP

Minister for Natural Resources Mines and Energy

Executive summary

Under the *Water Act 2000* (the Water Act), a report on each plan must be prepared at least every five years to assess the effectiveness of the plan and its implementation. The Water Regulation 2016 (Water Regulation) states the matters to be addressed.

This report provides an assessment of the performance of the Water Plan (Fitzroy Basin) 2011 (the plan) against these matters. **Table 1** provides a summary of the report in addressing these matters.

Existing information indicates the implementation of the plan has been effective in achieving many of the plan outcomes. However, a number of medium and high-level risks have been identified, including:

- Ability of the plan to support flexible and diverse water supply arrangements. Stakeholders are seeking more products to facilitate growth of enterprises.
- Conversion of area-based licences. There are a number of area-based water licences without volumetric limits in unsupplemented watercourses of the plan area.
- Efficient use of water. For the plan to encourage continuous improvement in the efficient use of water, the trading framework requires optimisation and further water measurement, e.g. water metering. 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.
- Demand for new water. There is demand for water in the Upper Dawson and Lower Dawson subcatchment areas, including for unallocated water. In the Don and Dee Rivers and Alma Creek water management area (WMA), water sharing rules have not been completed which poses risks to water availability particularly in dry years.
- Natural variability of flows to support aquatic ecosystems. Approved and proposed infrastructure could present risks to the natural variability of flows that support aquatic ecosystems. Proposals for new infrastructure will need to ensure that construction and operation meet the outcomes of the plan.
- Ecosystem connectivity. Lateral and longitudinal movement of aquatic fauna is impeded by barriers such as bunds, levees, weirs, and non-operational fishways. Targeted research would improve knowledge of the critical flow thresholds enabling aquatic fauna to pass these barriers to inform the next Minister's report.
- Maintaining connected resources and groundwater dependent ecosystems. The plan and water management protocol detail rules and strategies to protect groundwater-surface water interactions. For instance, the plan recognises connected water resources in the Callide and Isaac Connors catchments but not in other groundwater management areas (GMAs). More knowledge would assist in understanding groundwater dependent ecosystems and connected surface and groundwater resources across the plan area.
- Protection of flows for flow spawning fish. While strategies are in place for protecting flows for fish spawning, targeted monitoring would confirm that the environmental flow objectives and strategies are achieving the intended plan outcomes.
- Flows required to maintain coastal wetlands. Medium and high flows in the lower Fitzroy catchment are impeded by temporary floodplain barriers such as ponded pasture bunds and

flood levees that reduce the frequency of key flushing events. While management of these temporary barriers are outside the scope of the plan, the plan does include strategies for maintaining flows, such as the first post winter flow strategy and environmental flow objectives.

- Protection of flows for estuarine function under climate change. Flow management rules are in place to protect existing water entitlements and ecological values, however there is potential for flow regime variability and increased stress due to climate change.
- Consideration of cultural water needs. A need has been identified for further engagement with Aboriginal peoples and Torres Strait Islanders to better understand current and emerging cultural water needs in the plan area.

The plan is due to expire in September 2022. Prior to this, a targeted amendment is likely in order to incorporate the new Rookwood Weir. DNRME is in the preplanning phase of project scoping with SunWater to ensure the amendment would align with SunWater's final assessment and construction milestones. Any targeted amendment will be undertaken in close consultation with the catchment community. A targeted amendment may present an opportunity to also address other identified issues in the report.

Table 1 – Summary of the performance assessment for 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 <i>Water Act 2000</i> .	See section 3			
Effectiveness of the implementation of the plan in achieving the plan outcomes	The plan continues to provide for economic, social, and environmental outcomes. Previous reports prepared about the plan did not highlight any significant issues with the implementation of the plan. There was, however, insufficient information available to assess the outcome relating to water-related cultural values in the plan area. Further engagement with Aboriginal peoples and Torres Strait Islanders is proposed to inform the next Minister's report. There remain a number of area-based entitlements in the plan area that have no volumetric limit.	See 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.	See section 5			
Summary of research and monitoring findings	DNRME reviewed a number of research and monitoring programs across the catchment. Further work would assist in preparing management rules for new infrastructure projects such as Rookwood Weir. Other gaps in knowledge for specific plan ecological outcomes and assets, as well as for testing environmental flow objectives, have been identified and form the basis of proposed monitoring projects.	See 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.	See section 7			
Summary of identified risks to the plan outcomes	A risk assessment process has identified any risks to the plan outcomes.	See section 8 and 9			
Summary of non-compliances under a water entitlement or other authorisation in the plan area	There have been a number of minor reported non-compliance issues concerning water use in the plan area. These have been investigated and resolved.	See section 10			
Overall status and recommendation for plan	The plan is due to expire in September 2022. It is proposed that, in the meantime, a targeted amendment is completed to incorporate the new Rookwood Weir. This amendment presents an opportunity to address other identified issues.				
	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 water 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) what amendments, if any, 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, with an emphasis on progress since the previous report was prepared in 2013.

2. Plan area

The Water Plan (Fitzroy Basin) 2011 area covers approximately 142 600 square kilometres. The plan area has a tropical to subtropical, semi-humid climate. Rainfall and temperature for the plan area is highly variable and irregular. The majority of rain falls in the north-east part of the catchment, and on average is over 1000 millimetres per annum, with the south west sections receiving the least, approximately 500 millimetres per annum.

The plan area is known for its geographic breadth and environmental diversity. Mining, agriculture, industry and urban supplies are supported by the plan.

The plan area has been heavily developed with water resource infrastructure and includes five water supply schemes. **Figure 1**, **Figure 2** and **Figure 3** show the water supply schemes, water management areas, and the groundwater management areas respectively.

The Water (Fitzroy Basin) Plan 2011 is a second-generation plan that commenced on 9 December 2011. The plan manages supplemented and unsupplemented water, including water in a watercourse, lake or spring, overland flow (OLF) water and groundwater.

The Queensland government committed to the construction of Rookwood Weir and recently confirmed that SunWater will be the proponent for the project. Once constructed, Rookwood Weir will have the ability to supply 76,000 ML per annum of water for the region – a resource that will underpin agricultural growth and supply industrial and urban water throughout Gladstone and the Capricorn Coast. The plan already provides a reserve of unallocated water to support the project.



Figure 1 – Water supply schemes within the Fitzroy Basin water plan area



Figure 2 – Map of water management areas in the Fitzroy Basin water plan area

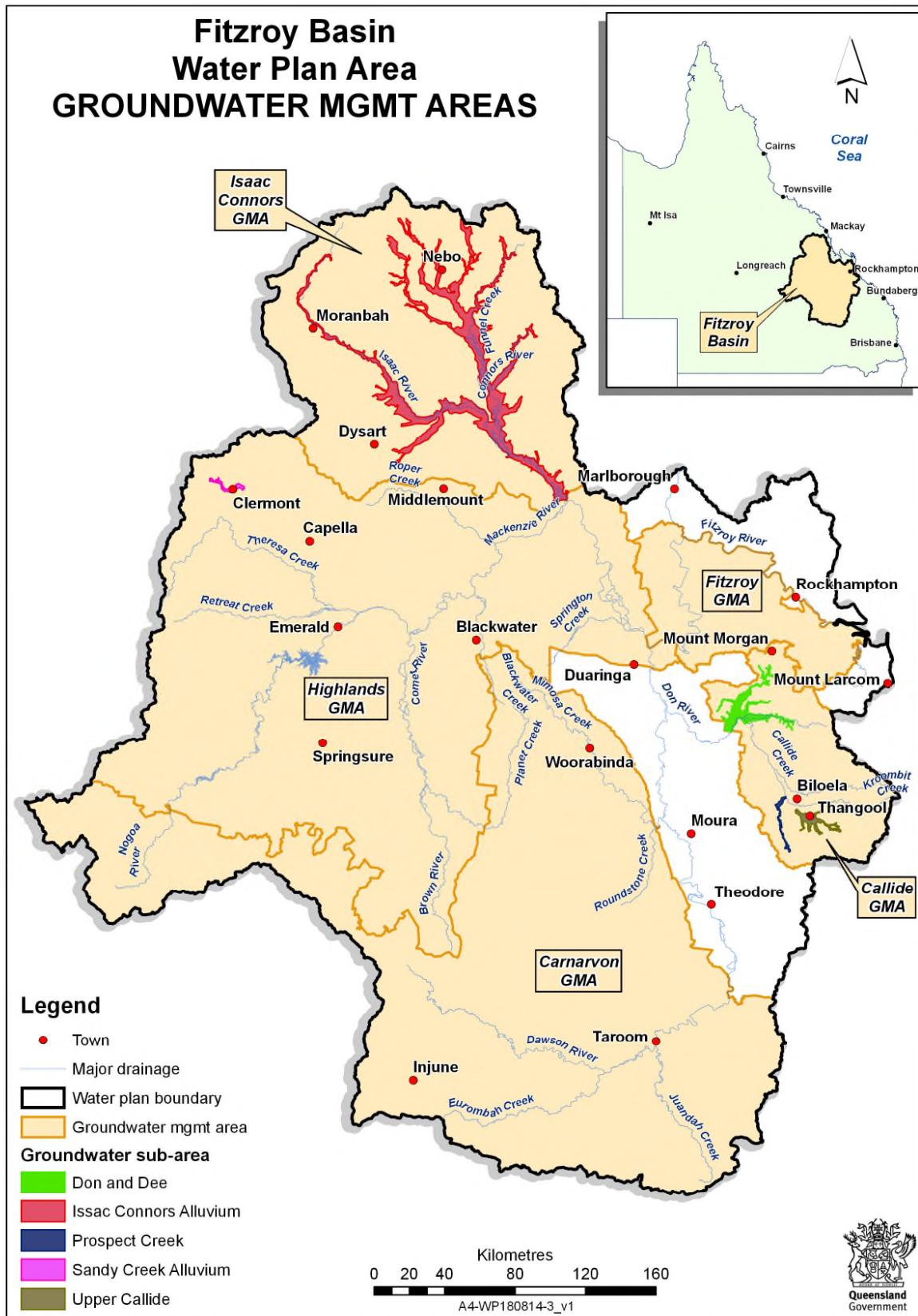


Figure 3 – Map of groundwater management areas in the Fitzroy Basin water plan area

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

This section discusses how the 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 Fitzroy 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, springs, aquifers and other natural water systems. 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 long-term hydrological models for surface water and groundwater to better understand patterns of water use, availability and security. The plan includes outcomes that aim to encourage the efficient use of water, whilst protecting the availability of water for all users across all supply schemes. The management of water within the water supply schemes then utilises rules to implement the plan outcomes to ensure the security of supply for towns, mines and other users, as well as providing environmental flows to maintain the ecological integrity of the river systems. Specific ecological outcomes for particular areas, ecological assets and groundwater are also provided in the plan.

Threats to catchment systems from flow changes have been identified and managed using the best available information. Scientific certainty of planning approaches has been improved through targeted monitoring as part of the implementation of the first generation plan up to 2011. Further targeted research to improve understanding of environmental flow requirements for aquatic species is still required over the life of the current plan.

Through understanding social, economic and ecological needs of water, the plan has provided certainty of water entitlements to boost economic growth, whilst enhancing environmental protection by increasing environmental flows provisions in key areas.

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 Fitzroy Basin for the economic, physical and social wellbeing of the people of Queensland. The plan has established water allocations in the supplemented parts of the plan area, providing certainty for water users to promote economic development. The conversion of unsupplemented water entitlements to tradeable water allocations, and the release of unallocated water reserves are items that remain to be implemented.

The plan establishes a framework to ensure security for town water, agricultural and mining supplies and essential services to ensure the well-being of Queenslanders. The security of these supplies are managed through operational rules. The plan also provides for population and industrial growth and has outcomes especially for aesthetic, economic and recreational values in the plan area.

3.3. Sustain the health of ecosystems

The plan contains ecological outcomes for a number of key catchments across the plan area. These ecological outcomes aim to support the ongoing protection of ecological assets and their habitats.

Implementation of these outcomes are ensured through Environmental Flow Objectives (EFOs), environmental management strategies and conditions on Resource Operations Licence's (ROs) and Operations Manuals which govern the water supply schemes. The plan also requires consideration of the health of the ecosystems when decisions are made under the plan; with, for example, specific provisions to protect flows necessary for estuarine ecosystems and groundwater levels for groundwater dependent ecosystems in particular groundwater sub-areas.

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

The plan provides a specific outcome to support water-related cultural values in the plan area, including the values of the traditional owners of the plan area.

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.

A need has been identified for further engagement with Aboriginal peoples and Torres Strait Islanders. This will ensure a better understanding of current and emerging cultural water needs in the plan area. To inform the next Minister's report, DNRME will:

- identify key stakeholders, start the conversation and undertake initial engagement
- identify cultural values and uses of water
- record engagement process and outcomes.

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

The plan provides strategic, strategic infrastructure and general reserves of unallocated water. The plan outcomes together with the Water Regulation provide the framework for fair and transparent release of this reserved water. The plan also provides the foundation for establishing a water market for tradeable water allocations. These water markets are implemented via provisions in the Fitzroy Basin water management protocol. See section 5.1.2 for more information about unallocated water releases.

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

The plan states multiple outcomes, which aim to provide, protect and improve access to available water resources. The plan sets out Water Allocation Security Objectives (WASOs) for supplemented and unsupplemented surface water and for groundwater. WASOs protect the probability of being able to obtain water under a water allocation. In addition, excluding unallocated water volume releases, the plan does not allow a decision on a surface water or groundwater entitlement that would increase the

average volume of water available to be taken in the plan area. This provision ensures the continued use of existing water entitlements.

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

The plan has a specific outcome that encourages the efficient use of water. The foundation for an effective and efficient water market has been established by the plan, through the provision of a tradeable market for water allocations. The operational rules by which the market operates is governed by the protocol. Refer to section 5.1.3 for more information on trading.

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 was integral to the development of the Resource Operations Plan (ROP), which implemented a number of plan requirements on its release in December 2011.

Additionally, the community provided input into an amendment of the plan in 2015 that included management arrangements for the inclusion of the Don and Dee Rivers and the Alma Creek WMAs.

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

DNRME monitors the implementation of each plan to make sure it is achieving its outcomes. The plan's outcomes were effectively implemented by the conversion of supplemented water entitlements to tradeable water allocations with associated water sharing rules and water allocation change rules, and ongoing decisions to limit the granting of additional water entitlements to take water. 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 potential conversion of unsupplemented water entitlements to tradeable water allocations, and the release of unallocated water reserves are items that remain to be implemented.

The plan's outcomes were implemented by the release of the Fitzroy Basin ROP. In 2016, the ROP was replaced by the Water Management Protocol (the protocol), Water Supply Scheme Operations Manuals and the Water Entitlement Notice¹. Key achievements in implementing the plan include:

- the total volume of entitlement in the Callide Valley alluvium was reduced and water allocations granted for take of surface water and groundwater in the Callide Valley water supply scheme. This improved long-term sustainability and supports improved resource management rules.

¹The Water Resource Plan (WRP) and Resource Operations Plan (ROP) were transitioned to various statutory instruments such as the water plan, water management protocol, water entitlement notice, resource operations licences and associated operations manuals. This occurred 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 G: Plan amendments and milestones**.

- Granting of unsupplemented groundwater allocations in the Lower Callide groundwater sub-area and amendment of groundwater licences in the Upper Callide and Prospect Creek groundwater sub-areas.
- Granting of unsupplemented surface water allocations (water harvesting) from water licences in the Dawson Valley, Theresa Retreat and Comet WMAs.
- Amendment of area-based water licences to volumetric entitlements in the Don and Dee Rivers and Alma Creek WMA and Lake Mary water users in the Lower Mackenzie subcatchment.
- Groundwater licences granted in the Don and Dee groundwater sub-area from notice of works process.

More detail is provided on the effectiveness of the environmental management rules in section 6.4.

Appendix A: Assessment of plan outcomes provides a comprehensive assessment of the effectiveness of the implementation of the plan in achieving the plan's outcomes.

Existing information indicates the implementation of the plan has been effective in achieving many of the plan outcomes.

5. Information on water use and authorisations in the plan area

5.1. Information on water use under water entitlements

Entitlements within the plan area are spread across five sub-catchment areas that consist of supplemented water allocations, unsupplemented water allocations and water licences. Within water supply schemes (WSSs), the Resource Operations Licence holder is responsible for reading all customer's meters and report annually to DNRME. For unsupplemented water there are a number of metered entitlement areas in the plan area and water use information about for these areas is provided from **Table 44** to **Table 53**.

The supplemented WSSs consist of the Dawson Valley, Nogoia Mackenzie, Lower Fitzroy, Fitzroy Barrage and Callide Valley WSSs.

The unsupplemented WMAs consist of the Dawson Valley, Nogoia Mackenzie, Comet, Don and Dee Rivers and Alma Creek, Theresa Retreat and Fitzroy WMAs and the Lower Callide Groundwater Sub-Area.

Details about the numbers of entitlements are outlined in **Appendix B: Water entitlements, Table 11, Table 12** and **Table 13**.

The metered volume of water used is outlined below in section 5.1.4.

DNRME is currently reviewing the 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.

DNRME 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. DNRME will adopt a risk based approach to implementation of a new water measurement policy.

5.1.1. Announced allocations, event announcements and announced entitlements

Announced allocation provisions apply to water allocations in the supplemented water supply scheme areas of the Dawson Valley, Nogoa Mackenzie, Lower Fitzroy Scheme, Fitzroy Barrage and the Callide Valley WSSs. Announced allocations for High priority groups are set at 100%. For medium and medium A priority groups, ranges of announced allocations for the period 2013–17 are provided in the **Table 2** and in **Appendix B: Water entitlements**.

Table 2 – Announced allocations for supplemented water supply schemes for Medium and Medium A Priority groups from 2013-17

Scheme area	Priority group	Range of announced allocation (%)	Appendix B table
Upper Dawson Valley	Medium	0 – 48	Table 15
Upper Dawson Valley	Medium A	0 – 68	Table 14
Lower Dawson Valley	Medium	10 – 79	Table 16
Nogoa Mackenzie	Medium	95 – 100	Table 18
Lower Fitzroy	Medium	100	Table 20
Fitzroy Barrage	Medium	100	Table 22
Callide Valley	Medium	75 – 100	Table 24

Unsupplemented water allocations are managed by DNRME for the Dawson Valley, Nogoa Mackenzie, Comet, Don and Dee Rivers and Alma Creek, Theresa Retreat and Fitzroy WMAs and the Lower Callide Groundwater Sub-Area. WMAs are managed by event announcements and groundwater by announced entitlements.

5.1.1.1. Dawson Valley WSS

The Dawson Valley WSS consists of the Upper Dawson sub-scheme and the Lower Dawson sub-scheme. These sub-schemes have small weirs that rely on annual replenishment and service high demand from irrigators. Unused entitlements are often carried over to the new water year. The water year for this scheme is 1 October to 30 September to coincide with pre-planting of seasonal crops.

A 20% announced allocation increase differential is applied to medium A priority water to minimise reductions in the reliability of water supplies to channel irrigators who do not have the advantages of river irrigators (location and infrastructure for storage).

The Upper Dawson sub-scheme high priority water allocations were set at 100% for the commencement of each water year for the last five years.

Drought in 2014 was a factor influencing announced allocation calculations for the medium and medium A priority water, being 0% at the start of the 2014 water year.

More detail is available in **Appendix B, Table 15** and **Table 16**.

5.1.1.2. Nogo Mackenzie WSS

The Nogo Mackenzie WSS consists of the Fairbairn Dam at the headwaters of the Nogo River and three weirs downstream into the Mackenzie River. Bedford weir, downstream of Fairbairn Dam, relies on inflows from Theresa Creek and the Comet River. Fairbairn Dam overflow also provides significant contributions to Bedford inflows. Binegang Weir, downstream from Bedford weir, receives no inflows from other tributaries and mostly relies on releases from Bedford Weir.

Over the long-term, approximately half of the inflows to Tartus Weir are provided from the Isaac Connors catchment, due to higher rainfall in the tropics. These flows are significant, particularly in comparison with the Mackenzie River.

Announced allocations for high priority and medium priority water were set at 100% for the last 5 years, except for 2016 when medium priority was set at 95%. More detail is available in **Appendix B, Table 18.**

5.1.1.3. Lower Fitzroy and Fitzroy Barrage WSS

This scheme consists of small storages with high demand and water sharing rules, including a restriction period for medium and high priority water when the Fitzroy Barrage is below 0.75 mAHD (elevation in meters above Australian Height Datum).

Medium and high priority announced allocations were 100% for the past five years and no restrictions were applied. More details are available in **Appendix B,**

Table 20 and Table 22.

5.1.1.4. Callide Valley WSS

DNRME transitioned the Callide Valley WSS from an Interim Resource Operations Licence to a ROL in 2014. The water sharing rules were revised and the plan defined WASOs for the high (high A and B-surface water) and medium (groundwater) priority supplemented water allocations.

DNRME sets high priority announced allocations at the required 100% at the start of the water year. Medium priority announced allocations vary depending on the observed (monitored) groundwater level in each zone. More detail is available in **Appendix B, Table 24**.

5.1.2. Entitlements granted from unallocated water reserves

The plan provides reserves of unallocated water which are composed of general, strategic (State purpose and Indigenous purpose) and strategic water infrastructure reserves.

One general release process is being conducted in the plan area. As at October 2018, this process is still underway. This release included surface water, OLF and groundwater.

There has been some interest in unallocated water reserves for mining developments and large agricultural projects; however, no process of release from the strategic reserve has been undertaken. More detail is available in **Appendix B, Table 43**.

5.1.3. Water trading

Water allocations may be traded in WSS areas operating under a ROL. ROL holders must also consent to the seasonal assignment of water held under a water allocation. Permanent supplemented water allocation trades and seasonal water assignments for the last five years are outlined in **Appendix B** from

Table 25 onwards.

Water allocations may also be traded in some WMAs where allocations are established with trading rules. Permanent unsupplemented water allocation trades and seasonal water assignments are outlined in **Appendix B** from **Table 32** onwards.

Transfer information (numbers of transfers and volumes of water) is also recorded where land and water sales occur together in **Appendix B Table 30, Table 31, Table 36** and **Table 37**.

There is a rising trend over the five-year period for the number of trades of medium priority water in the Dawson Valley WSS. Water trading in the Lower Fitzroy WSS is limited by demand in that scheme area.

Seasonal assignment is more commonly used than permanent trade-to-trade water in the water scheme areas. There were 1441 supplemented water seasonal assignment trades over five years compared with 350 supplemented permanent water trades.

5.1.4. Water use

Water use in the plan area is provided in **Table 3** with more detail in **Appendix B: Water entitlements**.

Table 3 – Water use from 2013-2017

Area	Range of volume taken (ML)	Range of water taken as % of entitlements	Appendix B tables
Dawson Valley WSS (supplemented surface water)	39 206 – 55 226	60 – 89	Table 14
Nogoa Mackenzie WSS (supplemented surface water)	157 187 – 192 883	62 – 68	Table 18
Lower Fitzroy WSS (supplemented surface water)	18 105 – 20 900	63 – 73	Table 19
Fitzroy Barrage WSS (supplemented surface water)	23 105 – 26 995	37 – 43	Table 21
Callide Valley WSS (supplemented surface and groundwater)	10 815 – 14 594	48 – 73	Table 23
Nogoa Mackenzie WMA (unsupplemented surface water)	0 – 5492	0 – 9	Table 44
Fitzroy WMA (unsupplemented surface water)	1339 – 5750	2 – 10	Table 45
Comet WMA (unsupplemented surface water)	0 – 21363	0 – 33	Table 46
Dawson WMA (unsupplemented surface water)	0 – 3520	0 – 6	Table 47
Don and Dee Rivers and Alma Creek section (unsupplemented surface water)	9020 – 2659	12 – 35	Table 48
Don and Dee Rivers and Alma Creek GMA (unsupplemented groundwater)	1927 – 5040	16 – 42	Table 49
Isaac Connors WMA (unsupplemented surface water)	725 – 4133	13 – 72	Table 50
Isaac Connors WMA (unsupplemented groundwater)	180 – 1350	1 – 10	Table 51
Callide Valley GMA (unsupplemented groundwater)	379 – 975	15 – 39	Table 52
Lower Callide groundwater sub-area	0 – 1972	0 – 33	Table 53

Over the five-year period, the Callide Valley WSS has used 81% of the entitlement. There is high demand for water in the Callide Valley to provide for the Callide Power Station and meatworks, town water supply for the town of Biloela and irrigation water supplied from underground water reserves.

The Dawson Valley WSS provides water to irrigators, the towns of Theodore, Moura, Baralaba and Daringa, to coal mines, an ammonium nitrate plant and a gold mine.

The Nogoa Mackenzie WSS includes Fairbairn Dam. This large storage supplies water to coal mining developments in the Bowen Basin and the towns of Emerald, Blackwater, Bluff, Tieri, Dysart and Middlemount. Other uses of water in this scheme include large irrigation enterprises supplied from the Nogoa or Mackenzie River and through pipeline and channel systems.

Most of the water use in the Lower Fitzroy WSS is by Stanwell Power Station; however, water is also used for agricultural purposes.

Water for the town of Rockhampton is sourced from the pondage area behind the Fitzroy River Barrage. The Fitzroy Barrage separates freshwater from the tidal reaches of the Fitzroy River. Other water use from the Fitzroy Barrage includes industry and commercial purposes.

The Dawson Valley, Nogoa Mackenzie and Lower Fitzroy WSSs have used over 50% of their entitlements over the five-year period. The Fitzroy Barrage has used a maximum of 43% of its water entitlement over the five-year period.

Water use in the WSSs is consistent considering the purpose of take and the number of inactive water allocations. Unsupplemented surface water use in the Isaac Connors WMA has the highest percentage of unsupplemented water use over the five years compared to the other WMAs. The take of unsupplemented water in the WMAs is provided in **Appendix B**, from **Table 44**.

5.2. Water taken or interfered with under statutory authorisations

The take of water under the category of statutory authorisations – such as stock and domestic take, OLF interference, and various prescribed activities – is typically not measured. This makes an accurate quantitative assessment difficult. However, by identifying broad trends in consumptive behaviour, it is possible to infer whether these trends are at risk of affecting existing water users' access to water or risk to the environment.

Appendix C: Water taken or interfered with under statutory authorisations presents an assessment of the risk posed to water users and the environment by the activities under the Water Act s93 – 103. The preliminary qualitative assessments presented in this report show that take has not changed significantly and therefore there are unlikely to be any impacts on existing water users or the environment. This assessment is based on the best available information at the time of publication.

6. Summary of research and monitoring findings for the plan

The water planning framework is supported by water monitoring activities that included water quantity and quality of surface freshwater and underground water systems across Queensland. Together with targeted ecological monitoring for 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 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.

DNRME manages, operates and maintains approximately 400 stream gauging stations across Queensland, 45 of which are located in the plan area. In addition, there are 10 privately owned stations in the Mt Morgan area that contribute data to DNRME. Streamflow measurements are an integral part of producing volumetric data at gauging stations, and measurements are taken throughout a full range of low and high flow conditions to enable derivation of accurate streamflow volumes. DNRME also manages, operates and maintains approximately 4300 underground water monitoring bores across Queensland. In the Fitzroy Basin, there are approximately 289 monitoring bores that are currently monitored. Seven of these provide publicly available data on DNRME's [Groundwater Online](https://water-monitoring.information.qld.gov.au/host.htm) website. Water monitoring data can be access at:

<https://water-monitoring.information.qld.gov.au/host.htm>.

Finally, an assessment of current environmental management rules for the protocol is presented. This forms a preliminary assessment of the progress of plan implementation. Rules assessed include seasonal base flow, first post winter flow, levels in waterholes and rates of release.

6.1. Summary of ecological monitoring

A number of monitoring, research and assessment projects were conducted in the plan area during the life of the first generation plan up to 2011. These projects involved various bodies including the Queensland Government, local government bodies, non-government science organisations and environmental consultants engaged by various water infrastructure proponents. Queensland Government programs include the EFAP, Enhanced Fitzroy Monitoring Program, Brigalow Catchment Study, Reef Plan (paddock monitoring and modelling) and the Queensland Wetlands Program. Further details are provided in '[Water Plan \(Fitzroy Basin\) 2011 Summary of Environmental Monitoring](#)'.

DNRME'S EFAP is a targeted ecological monitoring program that collects information on the flow requirements of ecosystems to support assessment of the ecological performance of each plan. Ecological assets with critical links to flow that represent the plan ecological outcomes and various aspects of the flow regime, are selected as indicators of the broader ecosystem for monitoring. The purpose of the program is to:

- confirm the critical flow requirements of selected ecological assets that represent the plan's ecological outcomes
- determine if current flow management strategies and rules are providing these critical water requirements

- determine the risk from water resource development to selected ecological assets, and evaluate if ecological outcomes are likely to be met under current flow management strategies
- determine potential mitigation strategies to address identified risks from water resource development.

Ecological assets are defined as natural components of an ecosystem for which flow is critical. Ecological assets can encompass the full suite of flow-related ecosystem components including processes (e.g. longitudinal connectivity), functions (e.g. waterhole productivity), species (e.g. Fitzroy golden perch), habitats (e.g. estuaries), geomorphology (e.g. channel variability/formation) and water quality (e.g. brackish conditions for prawn growth).

DNRME has collated a review of relevant government and external ecological research and monitoring studies over the life of the plan. Relevant local, state and federally funded government research and monitoring projects are listed in **Table 4**. Gaps in knowledge for specific plan ecological outcomes and assets, as well as for testing environmental flow objectives, have been identified and form the basis of proposed monitoring projects to inform the next Minister's report.

A summary of ecological monitoring is presented in **Appendix D: Ecological monitoring**.

Table 4 – Local, state and federally funded research and monitoring activities undertaken in the Fitzroy Basin water plan area since the last plan review

Project	Lead organisation/s	Timeframe of work
Lower Fitzroy River Infrastructure Project (LFRIP)	Gladstone Area Water Board & SunWater Pty Ltd.	2004 - ongoing
Nathan Dam and Pipeline EIS	SunWater & SKM	2008 – 2017
Connors River Dam and Pipelines EIS	SunWater & SKM	2008 – 2012
Enhancing the Water Market – Isaac-Connors	DNRME	2015
Queensland Wetlands Program	Department of Environmental and Science (DES)	2003 - ongoing
Paddock to Reef Integrated Monitoring, Modelling and Reporting Program	DNRME	2009 - ongoing
Queensland Government Water monitoring network	DNRME	1911 - ongoing
Great Barrier Reef Catchments Loads Monitoring Program	DES	2009 – ongoing

6.2. Summary of water monitoring

The stream monitoring network is operated by water monitoring staff within a quality management framework under International Organisation for Standardisation ISO 9001:2015 accreditation. Measurements taken at stream monitoring sites show that the Fitzroy Basin water plan area is characterised by highly variable river flows, both within and between years.

Most of the catchment receives summer rainfall, generally during the months of December through to April. The south-western part of the catchment can also receive significant winter rainfall. Rainfall varies from year to year and throughout the plan area, with the long-term annual average rainfall

within the catchment area varying between 500 mm in the western areas to over 1000 mm in the north-eastern area.

Major rainfall events normally linked to strong monsoonal / cyclonic influences in the north-eastern areas can cause major flood events in the lower section of the plan area. Flows throughout the system can be extreme and short lived, with flooding generally occurring after prolonged periods of dry; however months of general and intense rainfall can generate prolonged flows. Most major floods in the Fitzroy River originate from the Connors River catchment, but if the timing of combined moderate or major flood events from Callide Creek, Dawson River, Comet River, Nogoia River and Mackenzie River occurs then this can also lead to a major flood event in the Fitzroy River. Flood events can take days to travel from the top of the catchment and impact on the lower catchment for weeks.

Annual flows at Fitzroy River at Riverslea range from 96 120 megalitres (ML) in 1968–69 to a maximum recorded of 37 144 700 ML in 2010–11. The median flow is 2 764 000 ML per year. The maximum daily flow recorded was 1 554 000 ML on 01 February 1918. Since preparation of the current plan, there have been several significant flood events, including:

- In January 2013 the intense rainfall associated with ex-Tropical Cyclone Oswald led to widespread major flooding across the plan area's major river systems. The Don River at Rannes and Goovigen experienced their highest floods on record.
- Severe Tropical Cyclone Marcia in February 2015 was short-lived but significant for catchments extending from the Dawson, Don and Dee rivers and Callide Creek.
- Severe Tropical Cyclone Debbie in March 2017 caused new flood record levels for Funnel Creek (Main Rd) and Isaac (Yatton) and Mackenzie (Tartrus and Coolmaringa) rivers.

DNRME monitors subartesian groundwater across the entire plan area, with more than 65% of monitoring occurring in the alluvium of the Callide and Isaac Connors GMAs. Groundwater water quality in most areas is generally potable, although there are localised zones of magnesium and bicarbonate dominant groundwater near Marlborough, which is, associated with the Princhester Serpentine rocks in this area and low rainfall.

River discharge data and groundwater monitoring within the Fitzroy River catchments demonstrating the variability in discharge and groundwater levels is presented in **Appendix E: Water monitoring**.

Further data associated with stream flows and telemetered groundwater monitoring for the plan area can be found at:

https://water-monitoring.information.qld.gov.au?ppbm=FITZROY&rs&2&rsvm_org

6.3. Summary of ROL holder monitoring and reporting

The water supply schemes located in the plan area are considered to operate in compliance with the requirements of the protocol. SunWater and Fitzroy River Water have provided the monitoring and reporting required with no operational issues of note. There was an instance where technical issues have occurred in the collection of water quality data with processes put in place to minimise these occurrences. Frequent review of ROL reporting data is expected to continue. Refer to **Appendix F: Operational reporting by ROL holders** for more details.

6.4. Summary of existing environmental management rules

A preliminary review of the environmental management rules suggest that there are some areas for improvement. Final recommendations for specific rules and monitoring requirements will be made following completion of an ecological risk assessment for selected assets and review of ecological outcomes to inform the next Minister's report. A summary of the implementation and effectiveness of existing environmental management rules follows.

6.4.1. Dawson Valley water supply scheme

The seasonal base flow (SBF) management strategy was activated multiple times during the 2015–17 water years. Prior to this period, releases were not required of this strategy due to storages in the scheme (Moura, Theodore and Neville Hewitt Weirs) being consistently above the SBF trigger level. Based on the preliminary assessment completed, the SBF strategy is achieving its ecological intent of providing top-up flows for waterholes, as there were no notifiable incidences of waterholes being drawn down below allowable limits (less than 0.5m cease-to-flow (CTF)). However, further targeted science work needs to be completed to determine if the SBF releases are sufficient to provide connectivity for aquatic organisms, flows for riffle dependent taxa and downstream water quality maintenance.

Releases made from Moura, Gylanda and Neville Hewitt Weirs under of the First Post-Winter Flow (FPWF) management strategy, were implemented as per the protocol each year except during the 2016–2017 water year when releases were not required of the strategy. Similarly, further targeted science work is needed to determine if the scheme rules are meeting their ecological intent.

Restrictions on the rate of release of water from storages throughout the scheme, for supplying water allocation holders, maintaining minimal operating levels in downstream storages and for providing environmental management strategies (SBF, FPWF), have been effective in achieving the ecological intent. No instances of erosion, bank slumping or fish stranding have been reported.

6.4.2. Nogoia-McKenzie water supply scheme

The SBF management strategy has not been required in this water supply scheme (Bingegang, Bedford and Tartrus Weirs) during the last five years. There were no notifiable incidences of waterholes being drawn down below allowable limits in general waterholes (less than 0.5m CTF) or waterholes specified under the protocol (less than 0.6m CTF). Further targeted science work is required to confirm if SBF trigger values and subsequent SBF releases are sufficient to meet the ecological intent of the strategy of providing top-ups for waterholes, connectivity for aquatic organisms, flows for riffle dependent taxa and downstream water quality maintenance.

Releases made from Fairbairn Dam and Bedford Weir under of the FPWF management strategy were implemented as per the protocol each year, except during the 2016–17 water year. Conditions were not met for activation in this year from Fairbairn Dam. Further targeted science work is required to confirm if the strategy is meeting its ecological intent. A proposed project of additional science to

evaluate this strategy can be found in the Water (Fitzroy Basin) Plan 2011, Summary of Monitoring Report on the DNRME library page of [historical documents²](#) for the plan.

Restrictions on the rate of release of water from storages throughout the scheme, for supplying water allocation holders, maintaining minimal operating levels in downstream storages and for environmental management strategies (SBF, FPWF), appears to have achieved its ecological intent. No instances of erosion, bank slumping or fish stranding have been reported.

6.4.3. Lower Fitzroy and Fitzroy Barrage water supply schemes

The seasonal base flow (SBF) management strategy applies only to the Fitzroy Barrage water supply scheme. Water was released from Eden Bann weir yearly between 2012 and 2018, ranging from 12 days to 74 days, to facilitate SBF releases from the barrage. Preliminary assessments indicate that the strategy is achieving its ecological intent of providing top-up flows for waterholes as there were no notifiable instances of waterholes being drawdown below the general allowable limit (<0.5m CTF). Further targeted science work is required to confirm if SBF releases are sufficient to provide connectivity for aquatic organisms, flows for riffle dependent taxa and downstream water quality maintenance.

The Fitzroy barrage fishway has operated for the majority of the year, each year between 2012 and 2018. The barrage only dropped below the allowable level for fishway operation 3.2 mAHD for five days during March 2015. Other closure periods were related to maintenance and repairs. The existing vertical slot fishway was remediated and modernised during 2016 to improve the opportunity for fish to move pass the barrage. A new pre-cast cone fishway was also constructed to supplement the existing fishway. Pre- and post-construction monitoring found a significant improvement in the number and size of fish, as well as the diversity of species using the fishways to move past the barrage (Marsden et al., 2017). Consideration should be given to reinstating a fishway management strategy in the protocol as this strategy was removed in the amendment of 2015.

Restrictions on the rate of release of water from storages throughout the scheme, for supplying water allocation holders, maintaining nominal operating levels in downstream storages and for environmental management strategies (SBF), appears to have achieved its ecological intent. No instances of erosion, bank slumping or fish stranding have been reported in either the Lower Fitzroy or Fitzroy Barrage water supply schemes.

6.4.4. Callide Valley water supply scheme

Restrictions on the rate of release from storages throughout the scheme, for supplying water for groundwater recharge, to supply stock and domestic users or in accordance with an approved release strategy, appears to have achieved the ecological intent of the strategy. No instances of erosion, bank slumping or fish stranding have been reported in response to infrastructure releases.

²<https://qldgov.softlinkhosting.com.au/liberty/opac/search.do?anonymous=true&limit=All&action=search&branch=All&resourceCollection=All&corporation=DERM&operator=AND&url=%2Fliberty%2Fopac%2Fsearch.do&queryTerm=wrpfitzroy&mode=ADVANCED>

6.5. Assessment of low risk aquifers

Areas where take of underground water is not regulated include north and east of Rockhampton in the Caves, Marlborough areas and towards Yeppoon; a small area near Raglan and west of Mount Larcom; and a north-south strip from Duaringa south to Cracow.

Use of underground water is typically for stock-watering purposes, with some areas of irrigated agriculture. The use of underground water appears to be supplementary to other sources.

There are also a number of mining operations in the north-south strip from Duaringa to Cracow. Bores in these unregulated areas are generally low in density, however are denser in areas of rural subdivision.

A detailed analysis of underground water in the unregulated areas has not been carried out, however the risk of these aquifers is considered to be low, and there are no apparent immediate drivers to regulate these areas.

6.6. Assessment of OLF development

The development of the first generation plan included a comprehensive assessment of OLF developments across the plan area. Based on this, the current plan allows new OLF take if it is used for stock and domestic purpose, limited capacity works or to meet the requirements for an environmental authority or a development permit for carrying out an environmental authority.

The plan identified four large OLF developments with conjunctive use of unsupplemented water allocations (diversion from watercourse) and requires these developments to go through a process to be granted a water licence for OLF if they wish to change their on-farm arrangements for taking water under their unsupplemented water allocation.

The plan provides for property owners with OLF flow works to continue to use works for irrigation if the works were constructed as per the OLF flow moratorium notice on 13 September 2001 and have been notified with DNRME.

One other OLF development has been granted a water licence to enable reconfiguration of existing storages.

6.7. Social and Economic

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 available in **Appendix B, Table 43**.

The Australian Bureau of Statistics (ABS) census data was used to assess whether the plan is providing for the social and economic outcomes in the plan. This information was obtained using the [Queensland Government Statisticians Office](#) report generator based on relevant ABS statistical areas.

6.7.1. Population information

As at 30 June 2017, the estimated population for the Fitzroy Basin region was 142 583 persons. The current estimated population growth rate for the last five years (-0.5%) is slowing compared to previous estimates. Parts of the plan area are experiencing very low to zero growth rates or population decline. From 2011 to 2036, the population for the Fitzroy Basin region is projected to increase to 178 086 persons. This represents a small increase of 0.8% per year over 25 years.

6.7.2. Employment by industry

The top 3 industries in the Fitzroy Basin region are:

- Mining (12.4%)
- Agriculture, forestry and fishing (11.2%)
- Health care and social assistance (9.7%)

Most water use in the region is used for grazing and agriculture, town water supplies and mining. Surface water taken for irrigation across the plan area is used on crops such as cotton, horticultural crops, citrus, wheat and pulse crops.

6.7.3. ABS farm surveys

ABS farm survey data are available for [Natural Resource Management \(NRM\) group areas](#). The NRM group that relates to the Fitzroy Basin water plan area is the Fitzroy Basin Association. The plan area covers 84% of the Fitzroy NRM area.

The current total value for agricultural commodities in the Fitzroy NRM Regional Group was estimated at \$1.9 billion, with an increase of \$0.7 billion since 2012–13. The reserves of unallocated water available across the plan area can partially facilitate further expansion and diversification of agriculture.

6.7.4. Water trading and water prices

Water allocation trading in the plan area occurs as four types within the plan's water supply schemes:

- supplemented surface water
- unsupplemented surface water
- supplemented groundwater
- unsupplemented groundwater.

Table 5 shows the changes in the number and total of transferred volumes, percent turnover and the weighted average price per ML for the whole of the plan area. Generally, water trading is most active in supplemented water supply schemes because of minimal infrastructure required by the allocation holder to access water supply.

Table 5 – Total trades and pricing information for the plan for the last five water years

Water year	Number of transfers	Volume transferred	Volume turnover (%)	Weighted average price (\$/ML)
2013-14	62	25 881	7	1695
2014-15	35	10 230	3	1540
2015-16	48	4828	1	1538
2016-17	64	13 655	3	1464
2017-18	58	7967	2	1831

For more information, visit DNRME's [Water Market Information](#) website³. More detailed tables are available in **Appendix B: Water entitlements**.

6.8. 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 assessments were carried out by DES to determine any:

- variations in the climatic conditions since 2007
- impacts of potential climate change based on projection scenario to the year 2030.

6.8.1. Recent climate variation

The purpose of this assessment was to determine any significant change 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, evaporation and flow data recorded since July 2007 to June 2018 (recent 11 years) was compared to the data used in the Integrated Quantity and Quality Modelling (IQQM) simulation from 1 January 1900 to 30 June 2007 (107 years). The data recorded at stream gauging stations from 1900- to 2007 at Theresa Creek (**Figure 4**) and the Dawson (**Figure 5**), Isaac (**Figure 6**) and the Comet Rivers (**Figure 7**) were chosen for the comparison as being representative of the catchment and being of interest for the water security of the region.

Figure 4 (downstream of Fairbairn Dam) and **Figure 6** (Isaac River) show that the recent 11 years of annual streamflow as shown by the green dots is distributed within the range of the historical data. However the annual streamflows for 2010/11 are at the maximum end of the distribution for the Dawson (**Figure 5**) and Comet (**Figure 7**) rivers.

Figure 5) and Comet (**Figure 7**) rivers.

The recorded level in Fairbairn Dam shown in **Figure 8** shows that the storage overflowed on several times in 2010 to 2013 and is currently being drawn down.

³ <https://www.business.qld.gov.au/industries/mining-energy-water/water/water-markets/market-information#water-sales>

Theresa Creek at Gregory Highway (130206A)
Annual streamflow distribution

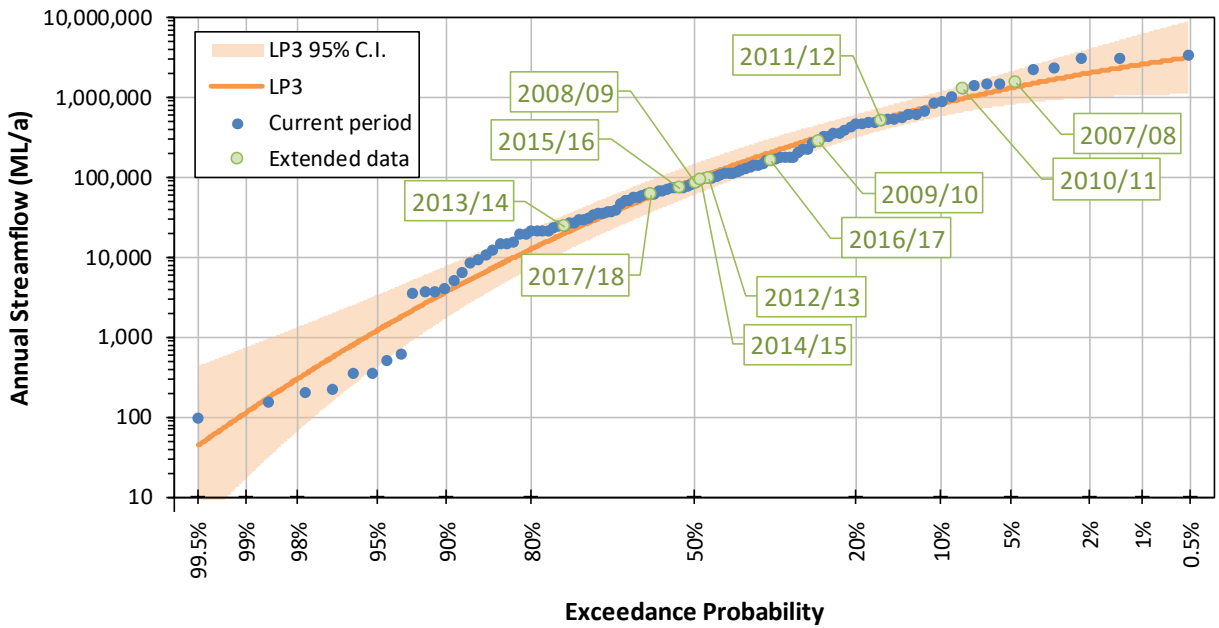


Figure 4 – Distribution of annual streamflow at Theresa Creek at Gregory Highway (GS 130206A)

Dawson River at Taroom (130302A)
Annual streamflow distribution

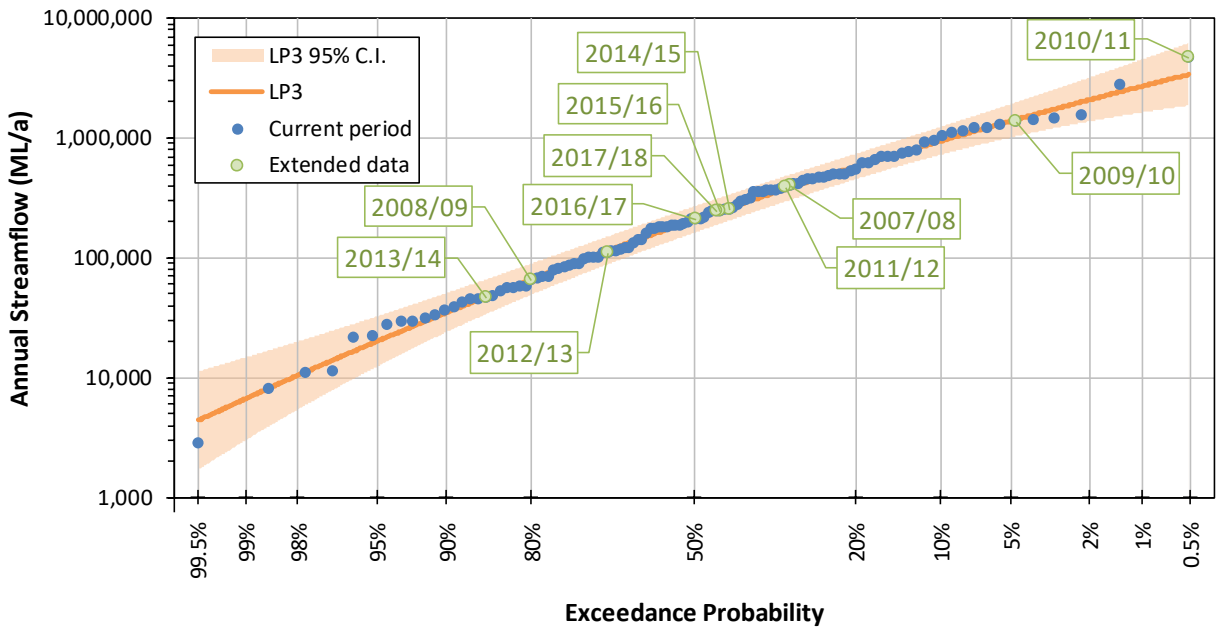


Figure 5 – Distribution of annual streamflow at Dawson River at Taroom (GS 130302A)

Isaac River at Yatton (130401A)
Annual streamflow distribution

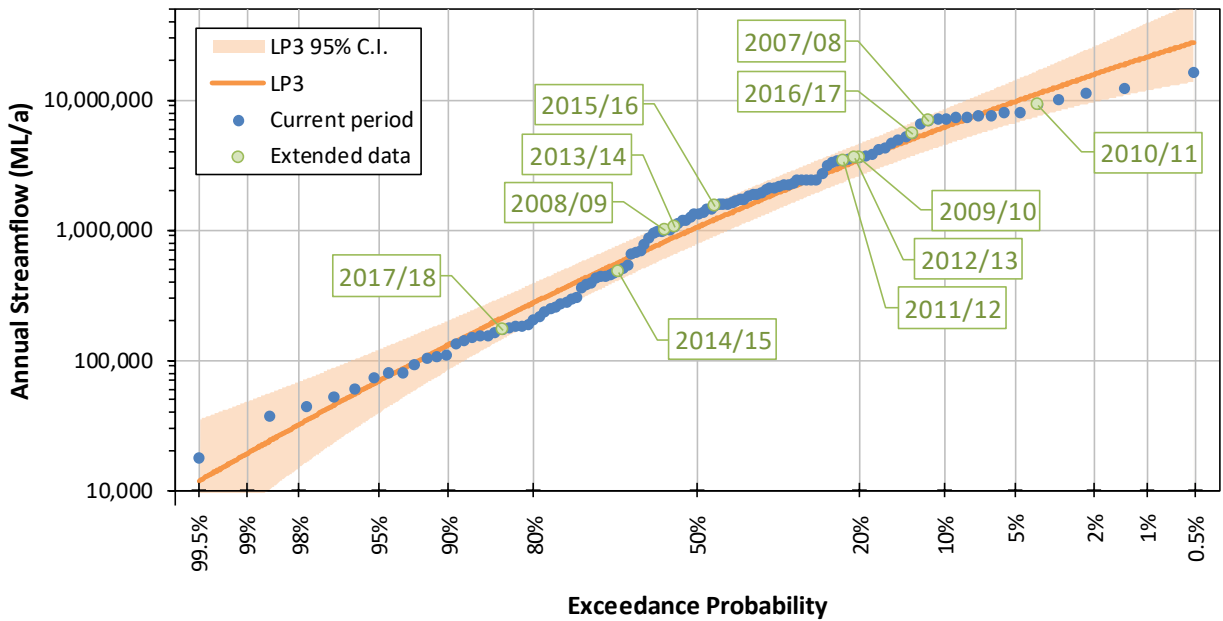


Figure 6 – Distribution of annual streamflow at Isaac River at Yatton (GS 130401A)

Comet River at Comet Weir (130504B)
Annual streamflow distribution

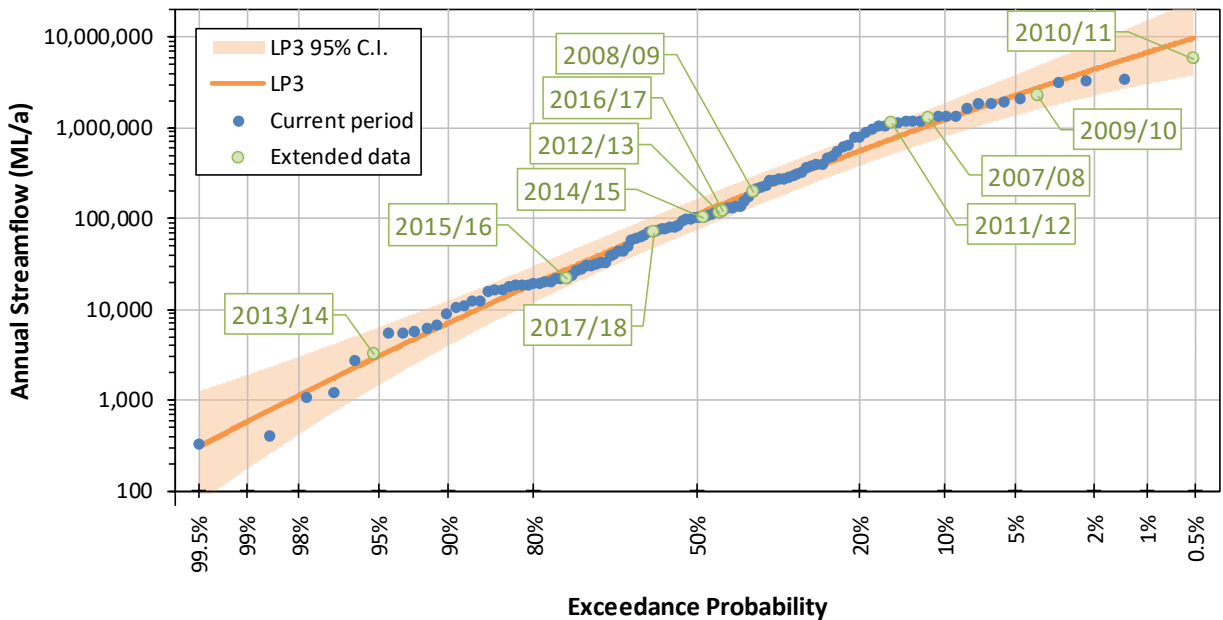


Figure 7 – Distribution of annual streamflow at Comet River at Comet Weir (GS 130504B)

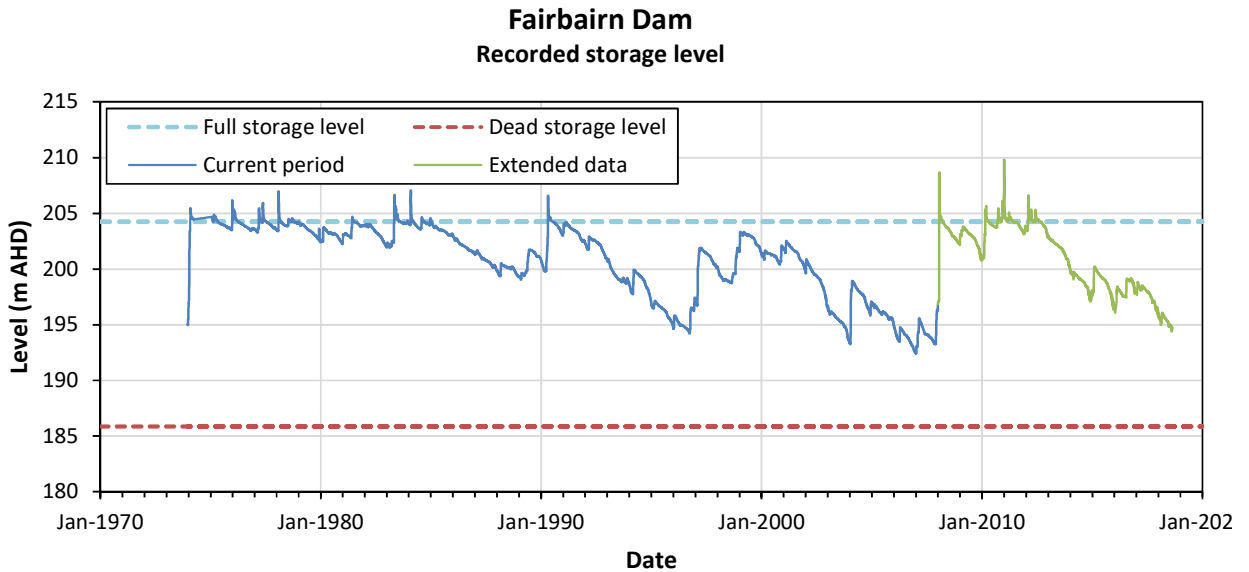


Figure 8 – Recorded storage level for Fairbairn Dam

6.8.2. Climate projections

A range of Global Circulation Models (GCMs) from were used in the assessment. The results consider the Representative Concentration Pathway (RCP) 8.5 emission scenario. This scenario is commonly used for climate prediction work and corresponds to a business-as-usual scenario which follows current emission trends. Evaporation and rainfall and data were sourced from long-term gauge at Comet Post Office (35021).

6.8.2.1. Evaporation

The monthly variation in the potential evaporation predicted for the years 2030 is shown in **Figure 9**. The GCMs predicted an increase in the evaporation for all months. 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.

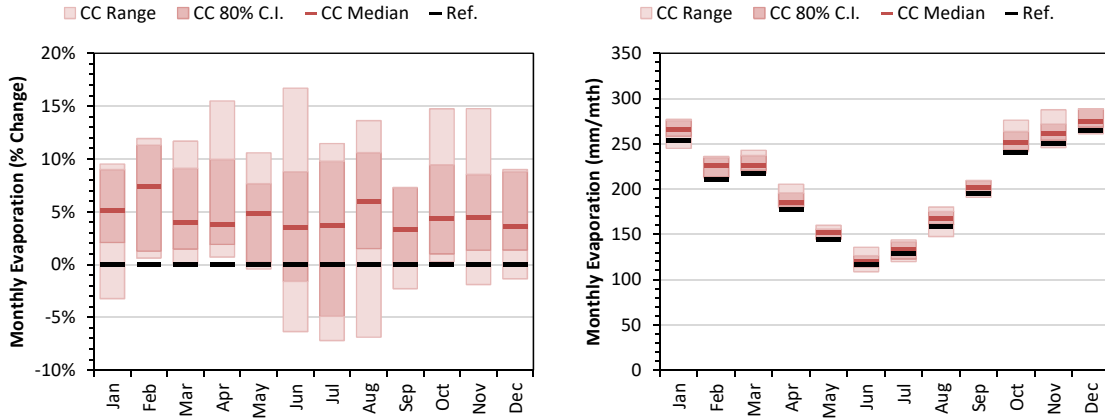


Figure 9 – Monthly potential evaporation projection for RCP 8.5 scenario through to the year 2030

6.8.2.2. Rainfall

The monthly variation in the rainfall predicted by the GCMs for 2030 is shown in **Figure 10**. For 2030, the median rainfall (red line) tends to show a decrease mainly during June to November, except for January and May. Changes in rainfall patterns (including intensity) can affect not only the volume of water that can be captured by OLF storages and streamflow, but can also affect groundwater recharge. Likewise, on land, changes to rainfall patterns can affect crop choice and resultant pressures on water resources.

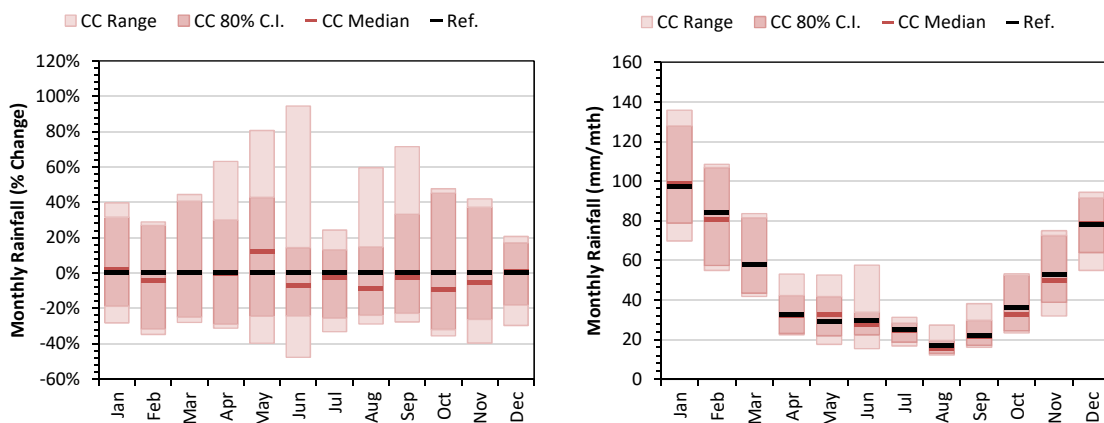


Figure 10 – Monthly rainfall projection for RCP 8.5 scenario through to the year 2030

7. Plan amendments and previous reports

7.1. Plan amendments and milestones

Following the release of the water resource plan a number of amendments have been made to reflect administrative changes relating to the Water Act. The main amending acts are:

- *The Land, Water and Other Legislation Amendment Act 2013 (LWOLA 2013)*
- *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 11**.

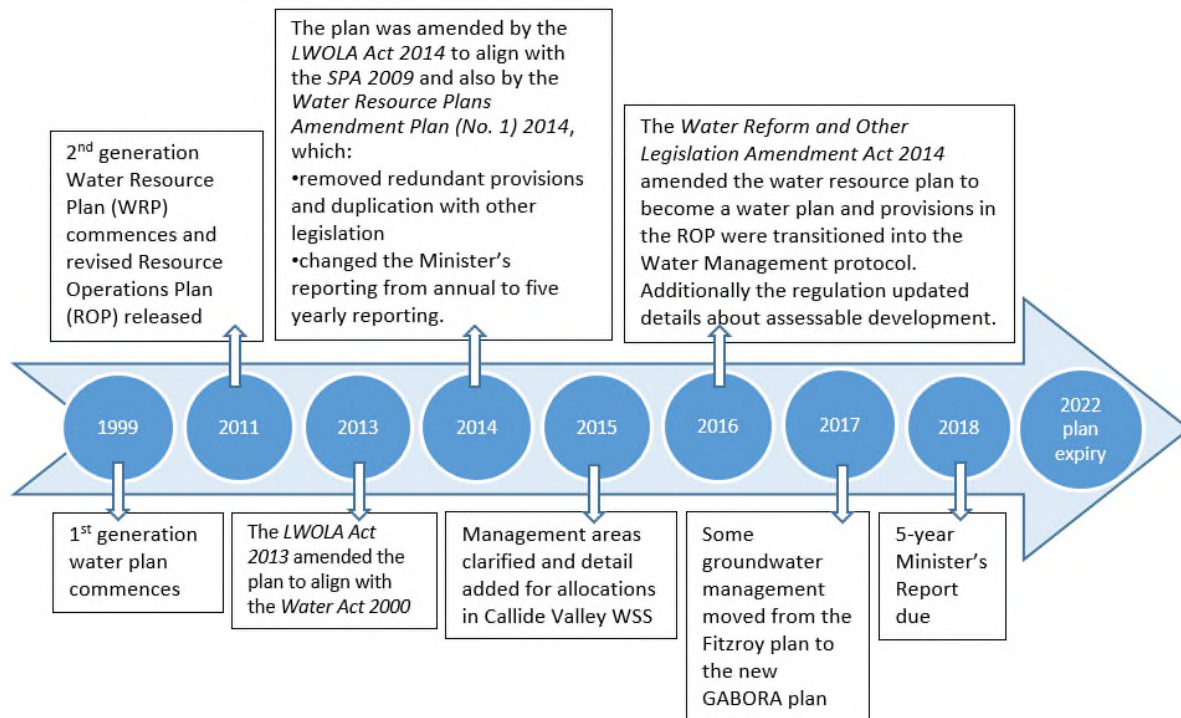


Figure 11 – Water planning milestones for the plan

Additionally the *Mineral, Water and Other Legislation Amendment Bill 2018* was passed in October 2018. This requires any plan review to include plan outcomes for cultural values and climate change.

For more detail, see **Appendix G: Plan amendments and milestones**.

7.2. Previous assessments and reports

The last Minister's Report for the plan area was prepared in 2013. This report provided a snapshot of the level of implementation within the plan, but did not assess in detail the effectiveness of implementation or risk to plan outcomes.

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

A risk assessment was completed in August 2018 to identify potential risks to the plan's outcomes that could emerge before the current 1 September 2022 plan expiry date. 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 is 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**). Those risks assessed as either medium or high have mitigation strategies proposed where appropriate. Under this assessment framework, the level of risk, along with other factors, including a plan's ability to continue to balance economic, social and environmental outcomes, were taken into consideration prior to recommending the most appropriate course of action.

Of the 29 outcomes assessed, one plan outcome was at high risk, 11 plan outcomes at medium risk and 16 plan outcomes at low risk. One plan outcome relating to water-related cultural values in the plan area was unable to be assessed due to insufficient information. More detailed information on the results of the risk assessment can be found in **Appendix A: Assessment of plan outcomes**. In summary, issues identified representing high and medium risk to the plan outcomes are:

- Ability of the plan to support flexible and diverse water supply arrangements. Stakeholders are seeking more products to facilitate growth of enterprises through access to unallocated water and trading arrangements for existing entitlements. Also, good water market information to support trading is limited.
- Conversion of area-based licences. There remain a number of area-based water licences in unsupplemented watercourses that do not have a specified volumetric limit. Conversion to volumetric water entitlements could facilitate trading and would help to provide for known demand for irrigation and other uses.
- Efficient use of water. For the plan to encourage continual improvement in the efficient use of water, the trading framework requires optimisation and further water measurement, e.g. water metering. 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.
- Demand for new water. There is demand for water in the Upper Dawson and Lower Dawson subcatchment areas, including for unallocated water. In the Don and Dee Rivers and Alma Creek WMA, water sharing rules have not been completed and this creates water availability risks particularly in dry periods. To adaptively manage the system over time, more targeted monitoring would improve knowledge of surface-groundwater interaction in the Don and Dee Rivers and Alma Creek WMA.
- Natural variability of flows to support aquatic ecosystems. Approved and proposed future infrastructure could potentially present risks to the natural variability of flows that support aquatic ecosystems but these can be mitigated. Proposals for new infrastructure will need to ensure that construction and operation meet the outcomes of the plan. Identified risks to

ecological assets (for example, risks to the White Throated Snapping Turtle in the Fitzroy River) will require further assessment associated with the proposed infrastructure. A targeted amendment of the plan to accommodate Rookwood Weir will ensure that all identified aquatic ecosystems are provided for through the operation of this infrastructure.

- Ecosystem connectivity. Lateral and longitudinal movement of aquatic animals is impeded by barriers (bunds, levees, weirs, and non-operational fishways). The presence of these barriers is outside direct influence of the plan. However, further targeted science work is required to improve knowledge of the critical flow thresholds enabling aquatic fauna to pass these barriers.
- Maintaining connected resources and groundwater dependent ecosystems. The plan and water management protocol implement rules and strategies to protect groundwater-surface water interactions. The plan recognises connected water resources in the Callide and Isaac Connors catchments but not in other GMAs. More knowledge would improve understanding of groundwater dependent ecosystems and connected surface and groundwater resources in the plan area. This can be gained through targeted monitoring and research into groundwater-surface water interaction and ecological studies at appropriate sites. Groundwater level and usage data would also help fill this gap.
- Protection of flows for flow spawning fish. While strategies are in place in the plan, targeted monitoring is required to confirm that the environmental flow objectives and strategies are achieving the intended plan outcomes. This monitoring is important to demonstrate the ecological benefits of the first post-winter flow strategy.
- Flows required to maintain coastal wetlands. Medium and high flows in the lower Fitzroy catchment are impeded by temporary floodplain barriers such as ponded pasture bunds and flood levees that reduce the frequency of key flushing events. These barriers are outside the scope of the plan to manage, however there are strategies in the plan to assist in maintaining flows, such as the first post winter flow strategy and environmental flow objectives. Flood events facilitate overbank flows to flush and fill these wetlands, however increasing climate variability may change the periodicity of these flushing events.
- Protection of flows necessary for estuarine function. Flow management rules are in place to protect existing water entitlements and ecological values, however there is potential for flow regime variability and increased stress due to climate change. Flood events maintain brackish habitat, however increasing climate variability may change the periodicity of these flushing events.

For more detail, see **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. DNRME reviews the plan through Minister's reporting at least every five years to track changes in the plan area. Some of these potential emerging issues include:

- Climate projections – Climate projections for 2030 show changes to evaporation and rainfall in the plan area. Increased evaporation will increase water consumption and losses from farm storages, and may reduce the persistence time of waterholes that are used for refugia by stream biota. Changes in rainfall patterns (including intensity) can affect not only the volume of water that can be captured by OLF storages and streamflow, but can also affect groundwater recharge. Likewise, on land, changes to rainfall patterns can affect crop choice and resultant pressures on water resources. Climate risks will be considered to inform the next Minister's report.
- Final voids in floodplains (mining) – Keeping a watching brief of the taking of and interfering with water on floodplains by mining voids in the landscape will continue to be important over the next Minister's reporting period.
- Access to infrastructure reserve volumes – The changes in 2018 to the Water Act has paved the way for short term access of water that is committed in infrastructure reserves, until such time the water is allocated to the proposed infrastructure. This new mechanism is of particular interest for the unallocated volumes reserved for Nathan Dam on the Dawson River and may present a new short term opportunity for landholders in the future.
- Inflatable fabridam – Bedford Weir – The Bedford Weir inflatable fabridam has not been in place since November 2008. Although the fabridam provided an additional 5000 ML of storage for the Nogoia Mackenzie water supply scheme, security of water allocations is largely protected by Fairbairn Dam which can store approximately 1 300 000 ML.
- OLF development – The plan restricts increased development of OLF and requires a notification process for users to continue using OLF works for consumptive use. To date the notification process has been implemented for some areas, but not for the whole of the plan area. The availability of remote sensing technologies may be used to improve OLF development assessment.
- Regional Water Supply Security Assessments – The Regional Water Supply Security Assessment for Rockhampton released in 2016 highlighted potential options for increasing water security for the area into the future. These options are currently being investigated by Rockhampton Regional Council. Regional Water Supply Security Assessments have also been undertaken for Emerald (2017) and Mt Morgan (2018) and these assessments also provide options for improving future water security for these areas.

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

There have been a number of relatively minor instances of non-compliance in relating to unauthorised take of water and over use of water entitlements within the plan area. **Appendix H: 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 DNRME compliance response procedures.

11. Way forward

This report presents information and assessments that have been used to determine a way forward for the plan. In summary, existing information indicates the implementation of the plan has been effective in achieving many of the plan outcomes. However, a number of current risks and emerging issues have been identified. The plan is due to expire in September 2022.

Before the end of 2021, a targeted amendment is likely to be undertaken to incorporate the new Rookwood Weir. This presents an opportunity to consider addressing other identified issues in this report however that will be explored as part of mapping the scope of any targeted amendment proposal.

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Appendix A: Assessment of plan outcomes

Table 6 – General outcomes

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Protocol rules that provide for outcome	Qualitative risk ranking and preliminary assessment of outcome
12) General outcomes: Each of the following is a general outcome for surface water in the plan area—			
(a) to provide for the use of water entitlements and other authorisations in the plan area;	<p>The plan provides for continued use of all entitlements and authorisations in the plan area.</p> <p>The plan provides a framework for specifying tradeable water allocations with a defined level of security.</p> <p>Decisions made under the plan must be consistent with water allocation security objectives stated in the plan.</p>	<p>The protocol outlines rules for converting to, amending and granting water allocations.</p> <p>The protocol outlines rules for amending existing water licences to have volumetric elements.</p> <p>The protocol outlines change rules that set out how water allocations can be traded in water supply schemes and WMAs.</p> <p>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.</p>	<p>LOW risk</p> <p>This outcome is being achieved.</p>
(b) to provide for the continued use of existing OLF works;	<p>The plan provides for continued use and replacement of existing authorised OLF works, but specifies limits on taking OLF water other than for particular purposes or in specific circumstances to control OLF development to ensure its sustainable management.</p>	<p>The protocol provides rules for granting and amending water licences to take OLF water.</p>	<p>LOW risk</p> <p>This outcome is being achieved.</p>
(c) to provide for the continued use of existing groundwater works;	<p>The plan provides for continued use and replacement of existing authorised groundwater works within defined GMAs.</p>	<p>The protocol outlines operating and environmental management rules, water sharing rules and change rules (seasonal assignment and trading) for WSSs and WMAs specific to groundwater.</p>	<p>LOW risk</p> <p>This outcome is being achieved.</p>

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Protocol rules that provide for outcome	Qualitative risk ranking and preliminary assessment of outcome
12) General outcomes: Each of the following is a general outcome for surface water in the plan area—			
(d) to protect the probability of being able to take water under a water allocation;	<p>The plan provides a framework for specifying tradeable water allocations with a defined level of security.</p> <p>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.</p>	<p>The protocol outlines rules for converting to, amending and granting water allocations.</p> <p>The protocol outlines operating and environmental management rules, water sharing rules and change rules (seasonal assignment and trading) for WSSs and WMAs.</p>	<p>LOW risk</p> <p>This outcome is being achieved.</p>
(e) to support water related cultural values including the values of the traditional owners in the plan area;	<p>The plan defines environmental flow objectives for various flow magnitudes that support environmental processes including cultural values.</p>	<p>The protocol outlines a release process for unallocated water that recognises cultural values of traditional owners.</p>	<p>Not able to be assessed</p> <p>There was insufficient information available to assess this outcome.</p> <p>Further consultation is required to better understand the current and emerging cultural uses of water in the plan area.</p> <p>To inform the next Minister's report, DNRME will:</p> <ul style="list-style-type: none"> • identify key stakeholders, start the conversation and undertake initial engagement • identify cultural values and uses of water • record the engagement process and outcomes.
(f) to provide mechanisms that support water being made available for the following— (i) population growth in towns and communities dependent on water resources in the plan area; (ii) growth in industries dependent on water resources in the plan area; (iii) stock or domestic purposes in the plan area; (iv) Indigenous communities dependent on water resources in the plan area to achieve their economic and social aspirations;	<p>The plan provides for unallocated water as strategic, strategic infrastructure and general reserve.</p> <p>The plan provides for limited capacity OLF works up to 50ML for any purpose.</p> <p>The plan provides for stock and domestic take from watercourse and underground water supplies.</p>	<p>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 allocations.</p> <p>The protocol outlines a process for granting water licences for OLF.</p>	<p>LOW risk</p> <p>This outcome is being achieved.</p>
(g) to support flexible and diverse water supply arrangements for consumptive water users;	<p>The plan provides a framework for specifying tradeable water allocations with a defined level of security.</p> <p>Decisions made under the plan must be consistent with water allocation security objectives stated in the plan.</p>	<p>The protocol outlines change rules that set out how water allocations can be seasonally assigned and traded in WSSs and WMAs.</p>	<p>MEDIUM risk</p> <p>This outcome is being partially achieved. No immediate treatment required.</p>

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Protocol rules that provide for outcome	Qualitative risk ranking and preliminary assessment of outcome
12) General outcomes: Each of the following is a general outcome for surface water in the plan area—			
(h) to maintain flows that support water-related aesthetic, economic and recreational values in the plan area, including, for example, tourism;	<p>The plan outlines the volumes of unallocated water reserves that may be accessed.</p> <p>The plan requires water licences to be amended to state a volume, purpose, rate of take and any conditions.</p> <p>Environmental flow objectives are used to assess the consistency of water management decisions.</p> <p>The plan outlines limits on watercourse interference.</p>	<p>The protocol outlines a release process for strategic, strategic infrastructure and general reserve unallocated water and a process for granting water licences and un-supplemented water allocations.</p> <p>The protocol outlines operating and environmental management rules, water sharing rules and change rules (seasonal assignment and trading) for WSSs and WMAs.</p> <p>The protocol outlines dealing with water licence applications that prevents the increase in the rate of take and total annual volume taken.</p>	<p>LOW risk</p> <p>This outcome is being achieved.</p>
(i) to encourage continual improvement in the efficient use of water;	<p>The plan requires water licences to be amended to state a volume, purpose, rate of take and any conditions.</p> <p>Water use efficiency The efficient use of water is also a consideration in dealing with unallocated water.</p>	<p>The protocol outlines operating and environmental management rules, water sharing rules and change rules (seasonal assignment and trading) for WSSs and WMAs.</p> <p>The protocol outlines dealing with water licence applications that prevents the increase in the rate of take and total annual volume taken.</p>	<p>MEDIUM risk</p> <p>This outcome is being partially achieved. No immediate treatment required.</p>
(j) to provide a flow regime that supports the quality of water for human and ecological use.	<p>The plan defines environmental flow objectives for various flow regimes that support environmental processes including cultural values.</p>	<p>The protocol outlines operating and environmental management rules, water sharing rules and change rules (seasonal assignment and trading) for WSSs and WMAs.</p>	<p>HIGH risk</p> <p>It is unclear if this outcome is being achieved due to the lack of well-defined water quality values. DNRME will continue its monitoring programs and working with the Fitzroy Basin Association.</p>

Table 7 – Specific surface water outcomes

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Protocol rules that provide for outcome	Qualitative risk ranking and preliminary assessment of outcome
13 Specific surface water and groundwater outcomes: (1) Each of the following is a specific outcome for surface water in the plan area -			
<p>(a) to make water available in the Isaac Connors subcatchment to support—</p> <p>(i) water supplies for mining; and</p> <p>(ii) growth in the population of towns and communities, industry and agriculture;</p>	<p>The plan provides for unallocated water as strategic, strategic infrastructure (Connors River Dam) and general reserve.</p> <p>The plan provides for limited capacity OLF works up to 50ML for any purpose.</p> <p>The plan provides for stock and domestic take from watercourse and underground water supplies.</p>	<p>The protocol outlines a release process for strategic, strategic infrastructure and general reserve unallocated water and granting water licences.</p>	<p>LOW risk</p> <p>This outcome is being achieved.</p>
<p>(b) to make water available in the Upper Dawson and Lower Dawson subcatchments to support—</p> <p>(i) water supplies for mining and industry; and</p> <p>(ii) growth in the population of towns and communities and agriculture;</p>	<p>The plan provides for unallocated water as strategic, strategic infrastructure (Nathan Dam on Dawson River) and general reserve.</p> <p>The plan provides for limited capacity OLF works up to 50ML for any purpose.</p> <p>The plan provides for stock and domestic take from watercourse and underground water supplies.</p>	<p>The protocol outlines a release process for strategic, strategic infrastructure and general reserve unallocated water and granting water licences.</p> <p>The protocol outlines operating and environmental management rules, water sharing rules and change rules (seasonal assignment and trading) for Dawson Valley WSS, Callide Valley WSS, Dawson Valley WMA and Lower Callide GMA.</p>	<p>MEDIUM risk</p> <p>No immediate treatment required.</p>

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Protocol rules that provide for outcome	Qualitative risk ranking and preliminary assessment of outcome
13 Specific surface water and groundwater outcomes: (1) Each of the following is a specific outcome for surface water in the plan area -			
(c) to make water available in the Fitzroy subcatchment to support urban, industrial and other uses.	<p>The plan provides for unallocated water as strategic, strategic infrastructure (Lower Fitzroy Infrastructure Project including Rookwood Weir) and general reserve.</p> <p>The plan provides for limited capacity OLF works up to 50ML for any purpose.</p> <p>The plan provides for stock and domestic take from watercourse and underground water supplies.</p>	<p>The protocol outlines a release process for strategic, strategic infrastructure and general reserve unallocated water and granting water licences.</p> <p>The protocol outlines operating and environmental management rules, water sharing rules and change rules (seasonal assignment and trading) for Lower Fitzroy and Fitzroy Barrage WSS and Fitzroy WWMA.</p>	<p>LOW risk</p> <p>This outcome is being achieved.</p>

Table 8 – Specific groundwater outcomes

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Protocol rules that provide for outcome	Qualitative risk ranking and preliminary assessment of outcome
13 Specific surface water and groundwater outcomes: (2) Each of the following is a specific outcome for groundwater in the Upper Callide, Lower Callide and Prospect Creek groundwater sub-areas and the Callide Valley WSS—			
(a) to provide for the use of groundwater that can be sustained in the long term;	<p>The plan outlines amending the nominal entitlement volumes for groundwater licences in the Upper Callide and Prospect Creek ground sub-area to a long term sustainable total volume of 2500ML from 6633ML.</p> <p>The plan outlines determining the nominal volumes for converted supplemented groundwater allocations in the Callide Valley WSS Upper Callide and Prospect Creek ground sub-area to a long term sustainable total volume of 14624ML from 19524ML.</p> <p>The plan outlines determining the annual volumetric limits for converted unsupplemented groundwater allocations in the Lower Callide groundwater sub-area to 6000ML from 11115ML.</p>	The protocol outlines operating and environmental management rules, water sharing rules and change rules (seasonal assignment and trading) for Callide Valley WSS and Lower Callide GMA.	<p>LOW risk</p> <p>This outcome is being achieved.</p>
(b) to provide for increased security for town water supplies and rural water supply boards that rely on groundwater;	<p>The plan outlined supplemented water allocations in the Callide Valley WSS for town water supply and water supply boards belong to a high B priority group with a higher level of water allocation security objective.</p> <p>The plan outlined unsupplemented water allocations for town water supply in the Lower Callide groundwater sub-area belong to GWIA water allocation group</p>	The protocol outlines operating and environmental management rules, water sharing rules and change rules (seasonal assignment and trading) for Callide Valley WSS and Lower Callide GMA.	<p>LOW risk</p> <p>This outcome is being achieved.</p>

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Protocol rules that provide for outcome	Qualitative risk ranking and preliminary assessment of outcome
13 Specific surface water and groundwater outcomes: (2) Each of the following is a specific outcome for groundwater in the Upper Callide, Lower Callide and Prospect Creek groundwater sub-areas and the Callide Valley WSS—			
	with a higher level of water allocation security objective.		
(c) to provide security of supply for existing enterprises that rely on groundwater.	The plan defines water allocation security objectives for supplemented groundwater water allocations in the Callide Valley WSS for high B, risk and medium priority groups. The plan defines water allocation security objectives for unsupplemented groundwater water allocations in the Lower Callide groundwater sub-area for GW1A and GW1B water allocation groups.	The protocol outlines operating and environmental management rules, water sharing rules and change rules (seasonal assignment and trading) for Callide Valley WSS and Lower Callide GMA.	LOW risk This outcome is being achieved.

Table 9 – General ecological outcomes

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Protocol management rules that provide for outcome	Related ecological assets	Summary of monitoring and assessment relevant to current plan	Qualitative risk ranking and preliminary assessment of outcome	Future risks beyond life of the plan
14 General ecological outcomes for water in the plan area: Each of the following is a general ecological outcome for water in the plan area—						
<p>(a) to minimise changes to the natural variability of flows that support aquatic ecosystems;</p>	<p>The plan identifies performance indicators and provides for the maintenance of flows through EFOs.</p> <p>Environmental flow objectives:</p> <p>Seasonal Base Flow (SBF).</p> <p>Medium – High Flow</p> <p>First post-winter flow (FPWF).</p>	<p>The protocol outlines the process for the granting of unallocated water.</p> <p>The protocol establishes operating and environmental management rules.</p> <p>The protocol outlines the process for managing OLF.</p>	<p>All</p>	<p>Todd et al. (2013) found that the maintenance of perennial flows in unregulated river reaches is vitally important to support persistence of endemic turtle species in the plan area.</p> <p>Stitz et al. (2017) found that a variable flow regime was an important determinant of macroinvertebrate community composition in the lower Fitzroy River.</p> <p>Cockayne et al. (2013) found that flow events of both low and medium to high magnitudes are important determinants of the success of spawning events of endemic Fitzroy River golden perch.</p> <p>Burdred et al. (2015) found that release of 12,000ML/yr of unallocated water in the Isaac-Connors sub-catchment posed a low risk to refugial waterholes. However, under a full development scenario (including Connors Dam) FPWF and SBF must be enforced to mitigate risk.</p> <p>Extreme rainfall events caused extensive flooding and the dieback of riparian vegetation (Pollock and Vardy, 2014).</p> <p>Prolonged drought conditions impacted coastal phytoplankton communities by restricting flows to</p>	<p>MEDIUM risk</p> <p>This outcome is partially being achieved.</p> <p>The plan and protocol implement rules and strategies to provide protection to the overall flow regime.</p>	<p>Lower Fitzroy River Infrastructure Project (LFRIP)</p> <p>Proposed and/or modelled impacts (GHD, 2015; Limpus et al., 2011) of LFRIP include:</p> <ul style="list-style-type: none"> - Reduced frequency & magnitude of low-medium flows downstream of Rookwood Weir. - Prolonged riffle flows & no flow periods downstream of Rookwood Weir. - Limited dispersal of macroinvertebrates up-and-downstream of impoundments. - Loss of remaining nesting sites for Fitzroy River turtle

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Protocol management rules that provide for outcome	Related ecological assets	Summary of monitoring and assessment relevant to current plan	Qualitative risk ranking and preliminary assessment of outcome	Future risks beyond life of the plan
14 General ecological outcomes for water in the plan area: Each of the following is a general ecological outcome for water in the plan area—						
				<p>the marine environment; potentially impacting estuarine and marine food webs (Jones et al., 2016).</p> <p>Subsidence voids and sub-surface cracking created by underground longwall mining are modelled to potentially increase the depth of in-channel waterholes and modify the paths of affected watercourses (Lucas & Crerar, 2011). This may potentially impact water-related ecosystems, SW-GW interactions and river-forming processes.</p>		<p>and White-throated snapping turtle.</p> <ul style="list-style-type: none"> - Changes to natural flow variability, impacting dependant flora and fauna. <p>Nathan Dam Proposed and/or modelled impacts (SKM, 2012) of Nathan Dam include:</p> <ul style="list-style-type: none"> - Increased frequency of medium flows downstream of dam. - Increased dry season flows, mimicking pre-development model flows. <p>Connors Dam Proposed and/or modelled impacts (SKM, 2012) of Connors Dam include:</p> <ul style="list-style-type: none"> - Increased magnitude and duration of low flows downstream of dam. - Reduced spring flood flows downstream of dam. <p>Climate Change Increases in extreme weather events due to climate change may impact the natural variability of flows through increased drought along with increased severity of rainfall events (Cobon et al., 2017; Abbas et al., 2016).</p>

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Protocol management rules that provide for outcome	Related ecological assets	Summary of monitoring and assessment relevant to current plan	Qualitative risk ranking and preliminary assessment of outcome	Future risks beyond life of the plan
14 General ecological outcomes for water in the plan area: Each of the following is a general ecological outcome for water in the plan area—						
<p>(b) to provide for the continued capability of 1 part of the river system to be connected to another, including by maintaining flows that—</p> <p>(i) allow for the movement of native aquatic fauna between riverine, floodplain, wetland, estuarine and marine environments; and</p> <p>(ii) support water-related ecosystems; and</p> <p>(iii) support river-forming processes;</p>	<p>The plan identifies performance indicators and provides for the maintenance of flows through EFOs.</p> <p>The plan outlines the volumes available and the process for dealing with unallocated water.</p> <p>The plan outlines daily, monthly and annual volumetric limits and rates of take for un-supplemented water.</p> <p>The plan stipulates the level of interference permissible in a watercourse, lake or spring by impounding water.</p> <p>The plan outlines the limitations for taking OLF water.</p>	<p>The protocol outlines the process for the granting of unallocated water.</p> <p>The protocol establishes operating and environmental management rules.</p> <p>The protocol outlines the process for managing OLF.</p> <p>The protocol outlines the process for dealing with water licence applications.</p>	All	<p>In addition to response to outcome (a) above:</p> <p>Large flood events during 2010-11 provided connectivity and flushing flows for movement of aquatic biota and ecosystem functions (Johnson et al., 2015).</p> <p>GHD (2015) found turtle movement is currently restricted by existing Eden Bann Weir.</p>	<p>MEDIUM risk</p> <p>This outcome is partially being achieved.</p> <p>The plan and protocol implement rules and strategies to provide protection to the overall flow regime.</p> <p>Lateral and longitudinal movement of aquatic animals is impeded by barriers (bunds, levees, weirs, and non-operational fishways).</p>	<p>In addition to (a) above:</p> <p>Lower Fitzroy River Infrastructure Project (LFRIP) Proposed and/or modelled impacts (GHD, 2015; Limpus et al., 2011) of LFRIP include:</p> <ul style="list-style-type: none"> - Changes to natural flow variability, impacting sedimentation and river forming processes. - Barrier to migration for aquatic fauna. <p>Nathan Dam Proposed and/or modelled impacts (SKM, 2012) of Nathan Dam include:</p> <ul style="list-style-type: none"> - Reduce un-impounded length of Dawson River to 59%. - Reduce opportunity for fish passage past barriers downstream of dam by changing current flow regime. - Changes to sedimentation and river forming processes both up-and-downstream of the dam wall. - Barrier to migration for aquatic fauna. <p>Connors Dam Proposed and/or modelled impacts (SKM, 2012) of Connors Dam include:</p> <ul style="list-style-type: none"> • Increased opportunity for between pool movements due to prolonged riffle flows.

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Protocol management rules that provide for outcome	Related ecological assets	Summary of monitoring and assessment relevant to current plan	Qualitative risk ranking and preliminary assessment of outcome	Future risks beyond life of the plan
14 General ecological outcomes for water in the plan area: Each of the following is a general ecological outcome for water in the plan area—						
<p>(c) to provide a flow regime that—</p> <p>(i) maintains delivery of fresh water to the estuaries of watercourses and the Great Barrier Reef Lagoon; and</p> <p>(ii) supports productivity in the receiving waters of the Great Barrier Reef and inshore reefs;</p>	<p>The plan identifies performance indicators and provides for the maintenance of flows through EFOs.</p> <p>The plan outlines the volumes available and the process for dealing with unallocated water.</p> <p>The plan outlines daily, monthly and annual volumetric limits and rates of take for un-supplemented water.</p> <p>The plan stipulates the level of interference permissible in a watercourse, lake or spring by impounding water.</p> <p>The plan outlines the limitations for taking OLFwater</p>	<p>The protocol establishes operating and environmental management rules.</p> <p>The protocol outlines the process for the granting of unallocated water.</p> <p>The chief executive will use monitoring and reporting to assess the performance of the plan against ecological outcomes.</p>	<ul style="list-style-type: none"> • Diadromous fish • Barramundi • King threadfin • Banana prawns • Flow spawning fish • Floodplain wetlands (coastal) 	<p>Jones et al., (2016) found that seasonal large flow events stimulated shifts and blooms in phytoplankton communities in the coastal environment. Vital for maintaining estuarine and marine food-webs.</p>	<p>LOW risk</p> <p>This outcome is being achieved.</p> <p>The plan and protocol implement rules and strategies to provide protection to the overall flow regime.</p>	<p>Additional relevant points for risks below are detailed in (a) and (b) above:</p> <p>Lower Fitzroy River Infrastructure Project (LFRIP) Proposed operating rules for the LFRIP are not modelled to have an impact on delivery of water, sediment and nutrients to the Fitzroy estuary or GBR in normal years. Only during extreme dry years and under an 'upper limit' development scenario flows may be affected.</p> <p>Nathan Dam The Nathan Dam is not expected to influence flow and sediment transport to the Fitzroy R. Estuary (SKM, 2012).</p> <p>Connors Dam The Connors Dam is not proposed to have an impact on delivery of water and sediments to the estuary or GBR (SKM, 2014).</p> <p>Climate Change Increasing drought (Cobon et al., 2017; Abbas et al., 2016) may affect delivery of freshwater and nutrients to the estuarine and marine environment. Future modelling should include freshwater flows being delivered on an annual basis to the estuary and GBR.</p>

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Protocol management rules that provide for outcome	Related ecological assets	Summary of monitoring and assessment relevant to current plan	Qualitative risk ranking and preliminary assessment of outcome	Future risks beyond life of the plan
14 General ecological outcomes for water in the plan area: Each of the following is a general ecological outcome for water in the plan area—						
<p>(d) to improve understanding of the matters affecting the flow-related health of ecosystems in the plan area;</p>	<p>Monitoring and reporting are a legislative requirement under the plan.</p> <p>The minister reports on matters affecting the environment and water users in the Ministers 5yrs report.</p>	<p>The chief executive will use ROL holder and other monitoring and reporting to assess the performance of the plan against ecological outcomes.</p>	<p>All</p>	<p>In addition to responses to outcomes (a), (b) and (c) above:</p> <p>Invasive fish species 'tilapia' have recently colonised parts of the plan area (Power, 2014 & 2015; Jerry et al., 2015). Tilapia are highly adaptable and proliferate in degraded habitats characterised by low flow, poor water quality and reduced riparian shading — outcompeting native species for resources and habitat.</p> <p>Good wet season rain and significant flooding events (2010-11) increased recruitment and catchability of barramundi, threadfin salmon and to a lesser degree banana prawn in the Fitzroy catchment (Sanders et al., 2016; Whybird et al., 2016; Larcombe et al., 2016).</p> <p>Repeated high temperatures and flooding events increased stress which negatively affected estuarine seagrass meadows (McKenzie et al., 2014).</p> <p>First post-winter flow events and preceding small flow events are critical for the quality and success of spawning events for Fitzroy River golden perch (Cockayne et al., 2013).</p> <p>Maintenance of perennial flows in river reaches not forming part of weir or dam pools are vital to support population persistence of endemic turtle species across the plan area (Todd et al., 2013).</p>	<p>LOW risk</p> <p>This outcome is being met.</p> <p>Some additional focus in this area would assist in future reporting cycles.</p>	<p>Points relevant to below risks detailed in (a)–(c) above:</p> <p>Lower Fitzroy River Infrastructure Project (LFRIP)</p> <p>Nathan Dam</p> <p>Connors Dam</p> <p>Climate Change</p>

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Protocol management rules that provide for outcome	Related ecological assets	Summary of monitoring and assessment relevant to current plan	Qualitative risk ranking and preliminary assessment of outcome	Future risks beyond life of the plan
14 General ecological outcomes for water in the plan area: Each of the following is a general ecological outcome for water in the plan area—						
<p>(e) to minimise the impact of the taking of water on aquatic ecosystems, including ecological assets;</p>	<p>The plan identifies performance indicators and provides for the maintenance of flows through EFOs.</p> <p>The plan outlines the volumes available and the process for dealing with unallocated water.</p> <p>The plan outlines daily, monthly and annual volumetric limits and rates of take for un-supplemented water.</p> <p>The plan stipulates the level of interference permissible in a watercourse, lake or spring by impounding water.</p> <p>The plan outlines the limitations for taking OLF water.</p> <p>Monitoring and reporting are a legislative requirement under the plan. The minister reports on matters affecting the environment and water users in the Ministers five years report.</p>	<p>The protocol establishes operating and environmental management rules.</p> <p>The protocol outlines the process for dealing with water licence applications.</p> <p>The protocol outlines the process for the granting of unallocated water.</p> <p>The protocol outlines the process for managing OLF.</p> <p>The chief executive will use ROL holder and other monitoring and reporting to assess the performance of the plan against ecological outcomes.</p>	<p>All</p>	<p>Details in relevant points in responses to outcomes (a)–(d) above.</p>	<p>LOW risk Outcome is being met.</p> <p>The plan and protocol implement rules and strategies to provide protection to the overall flow regime.</p> <p>Insufficient monitoring has been conducted to assess whether this outcome is being met for all ecological assets.</p>	<p>Additional relevant points for below risks detailed in (a)–(d) above:</p> <p>Nathan Dam SKM (2012) found no impact on riparian habitat of the Boggomoss snail from construction and operation of Nathan Dam.</p> <p>Lower Fitzroy River Infrastructure Project (LFRIP)</p> <p>Connors Dam</p> <p>Climate Change</p>

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Protocol management rules that provide for outcome	Related ecological assets	Summary of monitoring and assessment relevant to current plan	Qualitative risk ranking and preliminary assessment of outcome	Future risks beyond life of the plan
14 General ecological outcomes for water in the plan area: Each of the following is a general ecological outcome for water in the plan area—						
<p>(f) to protect and maintain refugia associated with waterholes, lakes and wetlands;</p>	<p>The plan has implemented GMAs.</p> <p>The plan specifies the performance indicator for assessing groundwater levels is the drawdown duration.</p> <p>Performance indicators and EFOs are established for surface water.</p> <p>The plan outlines the limitations for taking OLF water.</p> <p>The plan stipulates the level of interference permissible in a watercourse, lake or spring by impounding water.</p> <p>The plan outlines daily, monthly and annual volumetric limits and rates of take for un-supplemented water.</p>	<p>The protocol establishes operating and environmental management rules.</p> <p>The protocol outlines the process for dealing with water licence applications.</p> <p>The chief executive will use ROL holder and other monitoring and reporting to assess the performance of the plan against ecological outcomes.</p>	<ul style="list-style-type: none"> • Waterholes • Floodplain wetlands <p>Floodplain vegetation communities</p>	<p>In addition to relevant points in (a)–(e) above:</p> <p>Halford & Fensham (2014) found water depth and slope were key determinates of vegetation community patterns of wetlands filled by overland/overbank flow in the upper Dawson sub-catchment. Wetland were in good condition.</p> <p>Coastal wetlands in the lower Fitzroy River are impacted by ponded pasture bunds and flood levees. These structures limit the frequency of flushing events that stimulate productivity and provide connectivity for aquatic biota (Marsden, 2015; Holmes et al., 2013).</p>	<p>MEDIUM risk overall. Outcome is being met.</p> <p>Waterholes – LOW risk Currently meeting intent in the Isaac-Connors sub-catchment. Risk may increase to medium/high if Connors Dam is constructed.</p> <p>More monitoring would improve understanding of the risks.</p> <p>Wetlands – MEDIUM risk Flows required to maintain coastal wetlands are impeded by barriers in the lower Fitzroy. Only high flood events facilitate overbank flows to flush/fill these wetlands. Increasing climate variability may significantly change the periodicity of these events.</p> <p>Impacts of subsidence/surface cracking from underground mining on water supply to lacustrine/palustrine wetlands and GDEs needs to be assessed. Management conditions need to be implemented to limit impacts.</p>	<p>Points relevant to below risks detailed in (a)–(e) above:</p> <ul style="list-style-type: none"> • Lower Fitzroy River Infrastructure Project (LFRIP) • Nathan Dam • Connors Dam • Climate Change

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Protocol management rules that provide for outcome	Related ecological assets	Summary of monitoring and assessment relevant to current plan	Qualitative risk ranking and preliminary assessment of outcome	Future risks beyond life of the plan
14 General ecological outcomes for water in the plan area: Each of the following is a general ecological outcome for water in the plan area—						
(g) to support surface water and groundwater interactions;	<p>The plan outlines the volumes available and the process for taking un-supplemented groundwater.</p> <p>The plan outlines nominal and annual volumetric limits for the taking of groundwater.</p> <p>The plan specifies the performance indicator for assessing groundwater levels is the drawdown duration.</p> <p>The plan outlines the monitoring and reporting requirements to be included in the protocol for assessing the effectiveness of management strategies.</p>	<p>The protocol outlines that the plan applies to groundwater that is not from, or connected to, artesian water.</p> <p>The protocol outlines the process for managing OLF.</p> <p>The protocol establishes operating and environmental management rules.</p> <p>The protocol outlines the process for the granting of unallocated water.</p> <p>The chief executive will use ROL holder and other monitoring and reporting to assess the performance of the plan against ecological outcomes.</p>	<ul style="list-style-type: none"> • Waterholes • Floodplain wetlands • Floodplain vegetation communities • Stable flow spawning fish 	<p>In addition to relevant points in (a)–(f) above:</p> <p>Groundwater levels in the Callide and Nogoia catchments were fairly deep at 32% and <20% respectively for the long term 10 year average between 2010 -2016 (FBA, 2015). The only exception being between 2010-2012 which was probably due to recharge following the 2010-2011 extreme flood event.</p> <p>Local rising salinity problems are occurring in streams in areas of the Callide Valley and creeks north of Theodore to Lonesome Creek (GHD, 2015). Rising salinity is associated with groundwater migration due to rising water tables, attributed partly to extensive land clearing and overuse of groundwater.</p>	<p>MEDIUM risk</p> <p>This outcome is partially being met.</p> <p>The plan and protocol implement rules and strategies to provide protection to the surface/groundwater interactions.</p> <p>Impacts of subsidence/surface cracking from underground mining as well as the impact of aquifer dewatering due to mining operations needs to be assessed. Better understanding this issue and opportunities for conditions may help to mitigate/manage impacts on SW-GW interactions from mining.</p>	<p>Localised increases in groundwater levels are expected from construction of new water supply infrastructure (SKM, 2012; GHD, 2015). This may increase base flow in nearby streams and springs though surface expression of groundwater.</p> <p>Additional relevant points for below risks detailed in (a)-(f) above:</p> <ul style="list-style-type: none"> • Lower Fitzroy River Infrastructure Project (LFRIP) • Nathan Dam • Connors Dam • Climate Change

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Protocol management rules that provide for outcome	Related ecological assets	Summary of monitoring and assessment relevant to current plan	Qualitative risk ranking and preliminary assessment of outcome	Future risks beyond life of the plan
14 General ecological outcomes for water in the plan area: Each of the following is a general ecological outcome for water in the plan area—						
<p>(h) to support ecosystems dependent on groundwater including, for example, riparian vegetation and wetlands.</p>	<p>The performance indicator for environmental flow objectives for assessing groundwater levels to support relevant GDEs is the drawdown duration.</p> <p>The plan outlines the volumes available and the process for taking un-supplemented groundwater.</p> <p>The plan outlines nominal and annual volumetric limits for the taking of groundwater.</p> <p>The plan outlines the limitations for taking or interfering with groundwater in a GMA.</p>	<p>The protocol establishes operating and environmental management rules.</p> <p>The chief executive will use ROL holder and other monitoring and reporting to assess the performance of the plan against ecological outcomes.</p>	<ul style="list-style-type: none"> • Waterholes • Floodplain wetlands • Floodplain vegetation communities 	<p>In addition to relevant points in (a)–(g) above:</p> <p>A moderate to high level of connectivity between surface and groundwater was found as part of the EIS for the proposed Connors River dam (SKM, 2012 & 2014). Streams in the area are predominately losing but may gain in some reaches for short periods of time. These gains may be important for maintaining refugial waterholes outlined in Burndred et al., 2015.</p>	<p>MEDIUM risk This outcome is partially being met.</p> <p>Monitoring and research into targeted groundwater interaction and ecology groundwater requirements, as well as groundwater level and usage data, may assist with more accurate assessment of this outcome in future report cycles.</p>	<p>Additional relevant points for below risks detailed in (a)-(f) above:</p> <ul style="list-style-type: none"> • Lower Fitzroy River Infrastructure Project (LFRIP) Riparian vegetation communities (e.g. <i>Eucalyptus spp.</i>) will be impacted through inundation from the construction of the LFRIP (GHD, 2015). This will result in dieback of waterlogged vegetation. • Nathan Dam 28 GAB springs will be lost due to construction of Nathan Dam (SKM, 2012). Spring flows as a result of Nathan Dam may increase up to 94% above the dam wall and up to 660 % below the dam wall (SKM, 2016). • Connors Dam • Climate Change

Table 10 – Specific ecological outcomes

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Protocol management rules that provide for outcome	Related ecological assets	Summary of monitoring and assessment	Qualitative risk ranking and preliminary assessment of outcome	Future risks beyond the life of the plan
15 Specific ecological outcomes: Each of the following is a specific ecological outcome for water in the plan area—						
(a) to protect flows and water quality for flow-spawning fish and endemic species, including, for example, the Fitzroy golden perch (<i>Macquaria ambigua orientis</i>);	<p>The plan identifies performance indicators and provides for the maintenance of flows through EFOs.</p> <p>The plan outlines the limitations for taking OLF water.</p> <p>The plan stipulates the level of interference permissible in a watercourse, lake or spring by impounding water.</p> <p>The plan outlines the volumes available and the process for dealing with unallocated water.</p> <p>The plan outlines daily, monthly and annual volumetric limits and rates of take for un-supplemented water.</p>	<p>The protocol establishes operating and environmental management rules.</p> <p>The protocol outlines the process for the granting of unallocated water.</p> <p>The chief executive will use monitoring and reporting to assess the performance of the plan against ecological outcomes.</p>	<ul style="list-style-type: none"> • Diadromous fish • Banana prawns • Barramundi • King threadfin • Flow spawning fish • Waterholes • Floodplain vegetation • Floodplain wetlands 	<p>Cockayne et al. (2013) found that flow events of both low and medium to high magnitudes are important determinants of the success of spawning events in Fitzroy River golden perch.</p> <p>Mine affected water was found to have significant impacts on fish, tadpoles and invertebrates in laboratory and field monitoring experiments (Dunlop et al., 2016; Chua et al., 2018; Lanctôt et al., 2016a, 2016b & 2016c). Bioaccumulation of metals, decreased condition, decreased activity and morbidity were all found to be directly correlated with exposure to mine affected water.</p> <p>The Fitzroy EEMP found no significant impact of mine releases on aquatic biota (OD Hydrology, 2016).</p>	<p>MEDIUM risk</p> <p>This outcome is partially being achieved.</p> <p>The plan and protocol implement rules and strategies to provide protection to the overall flow regime.</p> <p>Targeted monitoring and research would assist in assessing whether EFOs are meeting intended water quality and ecological responses.</p>	<p>Additional points relevant to below risks detailed in section 14 above:</p> <ul style="list-style-type: none"> • Lower Fitzroy River Infrastructure Project (LFRIP) <p>*Note particular risk to endemic turtle species from infrastructure development.</p> <ul style="list-style-type: none"> • Nathan Dam • Connors Dam • Climate Change
(b) to provide for flows necessary for estuarine ecosystem functions,	The plan identifies performance indicators and provides for the maintenance of	The protocol establishes operating and environmental management rules.	<ul style="list-style-type: none"> • Diadromous fish • Banana prawns • Barramundi 	Large flood events during 2010-11 increased recruitment success and catchability of barramundi in subsequent years (Saunders et al. 2016).	<p>MEDIUM risk</p> <p>This outcome is being achieved.</p>	See points relevant to below risks detailed in section 14 above:

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Protocol management rules that provide for outcome	Related ecological assets	Summary of monitoring and assessment	Qualitative risk ranking and preliminary assessment of outcome	Future risks beyond the life of the plan
15 Specific ecological outcomes: Each of the following is a specific ecological outcome for water in the plan area—						
including flows for— (i) barramundi (<i>Lates calcarifer</i>) and king threadfin salmon (<i>Polydactylus macrochir</i>) recruitment; and (ii) banana prawn (<i>Penaeus merguensis</i>) growth;	flows through EFOs. The plan outlines the limitations for taking OLF water. The plan outlines the volumes available and the process for dealing with unallocated water. The plan outlines daily, monthly and annual volumetric limits and rates of take for un-supplemented water.	The protocol outlines the process for the granting of unallocated water. The chief executive will use monitoring and reporting to assess the performance of the plan against ecological outcomes.	<ul style="list-style-type: none"> • King threadfin • Flow spawning fish • Floodplain vegetation • Floodplain wetlands 	Above average rainfall during the summers of 2009-2013 increased commercial catch tonnage and tag-and-release and recapture by recreational fishers of threadfin in the Fitzroy region (Whybird et al. 2016; DAF, 2018). Commercial catch of banana prawn has been variable with no discernible trend (Larcombe, et al. 2016; DAF, 2018). Catch rates appear correlated with temperature, rainfall and river flow (Larcombe et al., 2016). Jones et al., (2016) found that seasonal large flow events stimulated shifts and blooms in phytoplankton communities in the coastal environment. Vital for maintaining estuarine and marine food-webs.	The plan and protocol implement rules and strategies to provide protection to the overall flow regime.	<ul style="list-style-type: none"> • Lower Fitzroy River Infrastructure Project (LFRIP) • Nathan Dam • Connors Dam • Climate Change
(c) to provide for groundwater levels to support relevant groundwater-dependent ecosystems and wetlands that rely on groundwater in— (i) the Upper Callide groundwater sub-area; and (ii) the Lower Callide groundwater sub-area; and (iii) the Prospect Creek groundwater sub-area; and	The plan identifies performance indicators and provides for the maintenance of flows through EFOs. The plan outlines the limitations for taking or interfering with groundwater in a GMA. The plan outlines nominal and annual volumetric limits for the taking of groundwater.	The protocol establishes operating and environmental management rules. The protocol outlines the process for the granting of unallocated water. The chief executive will use ROL holder and other monitoring and reporting to assess the performance of the plan against ecological outcomes.	<ul style="list-style-type: none"> • Waterholes • Floodplain wetlands • Floodplain vegetation communities 	Local rising salinity problems are occurring in streams in areas of the Callide Valley and creeks north of Theodore to Lonesome Creek (GHD, 2015). Rising salinity is associated with groundwater migration due to rising water tables, attributed partly to extensive land clearing and overuse of groundwater Groundwater levels in the Callide and Nogoia were fairly deep at 32% and <20% respectively for the long term 10 year average between 2010 -2016 (FBA, 2015). The only exception being between 2010-2012 which was probably due to recharge following the 2010-2011 extreme flood event. Subsidence voids and sub-surface cracking created by underground longwall mining are modelled to	LOW risk Partially met. There is insufficient information available to determine if this outcome is being achieved across all GM sub-areas. The plan and protocol implement rules and strategies to provide protection to the surface/groundwater interactions. Impacts of subsidence/surface cracking from underground mining as well as the impact of aquifer dewatering due to mining operations needs to be assessed. Better understanding this issue and opportunities for conditions may help	See points relevant to below risks detailed in section 14 above: <ul style="list-style-type: none"> • Nathan Dam • Climate Change

Plan outcome (as per part 3 of plan)	Plan strategies that provide for outcomes	Protocol management rules that provide for outcome	Related ecological assets	Summary of monitoring and assessment	Qualitative risk ranking and preliminary assessment of outcome	Future risks beyond the life of the plan
15 Specific ecological outcomes: Each of the following is a specific ecological outcome for water in the plan area—						
(iv) the Callide Valley WSS				potentially increase the depth of in-channel waterholes and modify the paths of affected watercourses (Lucas & Crerar, 2011). This may potentially impact water-related ecosystems, SW-GW interactions and river-forming processes.	to mitigate/manage impacts on SW-GW interactions from mining.	
(d) to maintain groundwater discharge to watercourses in the Isaac Connors GMA.	<p>The plan identifies performance indicators and provides for the maintenance of flows through EFOs.</p> <p>The plan outlines the limitations for taking or interfering with groundwater in a GMA.</p> <p>The plan outlines the volumes available and the process for taking un-supplemented groundwater.</p>	<p>The protocol outlines the process for the granting of unallocated water.</p> <p>The chief executive will use monitoring and reporting to assess the performance of the plan against ecological outcomes.</p>	<ul style="list-style-type: none"> • Waterholes • Floodplain wetlands • Floodplain vegetation communities • Stable flow spawning fish 	<p>A moderate to high level of connectivity between surface and groundwater was found as part of the EIS for the proposed Connors River dam (SKM, 2012 & 2014). Streams in the area are predominately losing but may gain in some reaches for short periods of time.</p> <p>Groundwater-surface water connection in the upper Isaac catchment (20 km north of Moranbah) was found to be limited (URS, 2013a). Bed sands are dry for the majority of the year with depth to water in the alluvial aquifer between 11 – 13 metres below ground level. No GDEs were found/mapped in the project area.</p> <p>Subsidence voids and sub-surface cracking created by underground longwall mining are modelled to potentially increase the depth of in-channel waterholes and modify the paths of affected watercourses (Lucas & Crerar, 2011). This may potentially impact water-related ecosystems, SW-GW interactions and river-forming processes.</p>	<p>LOW risk</p> <p>This outcome is currently being achieved.</p> <p>Strengthening of assessment of SW-GW interactions in this sub-area at the time of mining project assessment would assist in identifying and mitigating risks.</p>	<p>Connors Dam</p> <p>Changes in groundwater levels were considered to be minimal due to the construction of the dam with the alluvial aquifer the most susceptible to impacts.</p> <p>Risk to groundwater may increase if dam is constructed and all un-active entitlements in the area become active.</p> <p>Climate Change</p> <p>See points relevant to this risk detailed in section 14 above:</p>

Appendix B: Water entitlements

Table 11 - Summary of the supplemented water allocations in the plan area

Water supply scheme	Water allocation volume (ML)				Number of supplemented water allocations	
	High priority	Medium priority	Risk Priority	Total		
Dawson Valley	5679	Medium priority	36 719	-	61 737	231
		Medium priority A	19 339			
Nogoa Mackenzie	46 127	186 864	-	232 991	667	
Lower Fitzroy	25 520	3101	-	28 621	43	
Fitzroy Barrage	50 483	11 610	-	62 093	298	
Callide Valley	High A	4311	13 434	514	24 702	161
	High B	1066				

* The details supplied in this table are correct as of the 13th July 2018. Any changes that occurred after that date will not be reflected in the table.

Table 12 - Summary of unsupplemented surface water allocations

WMA	Number of Allocations	Volume (ML)
Dawson	164	45532
Nogoa Mackenzie	113	47051
Comet	29	42491
Theresa Retreat Creek	11	9085
Fitzroy	125	45598
Lower Callide	57	5614.75

*The details supplied in this table are correct as of the 13th July 2018. Any changes that occurred after that date will not be reflected in the table.

Table 13 - Summary of unsupplemented water licences

Water Classification	Volume based entitlements		Area based entitlements		No. of entitlements with no volume or area specified
	Number of Licences	Total nominal entitlement (ML)	Number of Licences	Total area based entitlement (HA)	
Surface Water	121	42939	236	8898.8	155
Groundwater	577	92624	-	-	213

*The details supplied in this table are correct as of the 13th July 2018. Any changes that occurred after that date will not be reflected in the table.

*Entitlements with no volume or area specified, including entitlements to interfere with the flow of water (e.g. dams, weirs).

Table 14 - High, Medium and Medium A priority water use in the Dawson Valley WSS, in terms of volume taken and the percentage of entitlements

Water year	Entitlement (ML)	Volume taken (ML)	Water taken as % of entitlements
13/14	58614.06	43276.72	73.83
14/15	61081.90	39839.77	65.22
15/16	64935.19	39206.13	60.38
16/17	61717.01	55225.5	89.48

*Entitlement Volume is determined by announced allocation, carry over, forward draw, temporary transfers, usage and other factors

Table 15 - Upper Dawson Valley sub-scheme announced allocations for start of water year for High, Medium and Medium Priority A water

Date	Priority group	Announcement (%)	Zones
1 Oct 2013	High	100	All
1 Oct 2013	Medium	2	All
1 Oct 2013	Medium A	22	All
1 Oct 2014	High	100	All
1 Oct 2014	Medium	0	All
1 Oct 2014	Medium A	0	All
1 Oct 2015	High	100	All
1 Oct 2015	Medium	1	All
1 Oct 2015	Medium A	21	All
1 Oct 2016	High	100	All
1 Oct 2016	Medium	48	All
1 Oct 2016	Medium A	68	All
1 Oct 2017	High	100	All
1 Oct 2017	Medium	0	All
1 Oct 2017	Medium A	15	All

Table 16 - Lower Dawson Valley sub-scheme announced allocations for start of water year for High and Medium priority water

Date	Priority group	Announcement (%)	Zones
1 Oct 2013	High	100	All
1 Oct 2013	Medium	26	All
1 Oct 2014	High	100	All
1 Oct 2014	Medium	11	All
1 Oct 2015	High	100	All
1 Oct 2015	Medium	10	All
1 Oct 2016	High	100	All
1 Oct 2016	Medium	79	All
1 Oct 2017	High	100	All
1 Oct 2017	Medium	34	All

Table 17 - High and Medium priority water use in the Nogo Mackenzie WSS, in terms of volume taken and the percentage of entitlements

Water year	Entitlement (ML)	Volume taken (ML)	Water taken as % of entitlements
13/14	258 605.3	192 883.48	61.89
14/15	253 962	157 186.9	61.89
15/16	269 949.54	183 877.08	68.11
16/17	266 843	167 542.05	62.79
17/18	285 246	178 945.93	62.73

**Entitlement Volume is determined by announced allocation, carry over, forward draw, temporary transfers, usage and other*

Table 18 - Nogo Mackenzie WSS announced allocations for start of water year for High, Medium and Medium A priority water

Date	Priority group	Announcement (%)	Zones
1 July 2013	High	100	All
1 July 2013	Medium	100	All
1 July 2014	High	100	All
1 July 2014	Medium	100	All
1 July 2015	High	100	All
1 July 2015	Medium	100	All
1 July 2016	High	100	All
1 July 2016	Medium	95	All
1 July 2017	High	100	All
1 July 2017	Medium	100	All

Table 19 - High and Medium priority water use in the Lower Fitzroy WSS, in terms of volume taken and the percentage of entitlements

Water year	Entitlement (ML)	Volume taken (ML)	Water taken as % of entitlements
13/14	28 621.00	20 900.46	73.02
14/15	28 621.00	18 104.50	63.25
15/16	28 621.00	19 877.95	69.45
16/17	28 621.00	19 058.43	66.59
17/18	28621.00	19 740.57	68.97

**Entitlement Volume is determined by announced allocation, carry over, forward draw, temporary transfers, usage and other*

Table 20 - Lower Fitzroy WSS announced allocations for start of water year for High, Medium and Medium Priority A water

Date	Priority group	Announcement (%)	Zones
1 July 2013	High	100	All
1 July 2013	Medium	100	All
1 July 2014	High	100	All
1 July 2014	Medium	100	All
1 July 2015	High	100	All
1 July 2015	Medium	100	All
1 July 2016	High	100	All
1 July 2016	Medium	100	All
1 July 2017	High	100	All
1 July 2017	Medium	100	All

Table 21 - High and Medium priority water use in the Fitzroy Barrage WSS, in terms of volume taken and the percentage of entitlements

Water year	Entitlement (ML)	Volume taken (ML)	Water taken as % of entitlements
13/14	62 104.89	26 067.09	41.97
14/15	62 081.77	25 839.63	41.62
15/16	62 094.72	26 995.39	43.47
16/17	62 094.72	23 105.14	37.24
17/18	62 108.66	24 634.10	39.66

*Entitlement Volume is determined by announced allocation, carry over, forward draw, temporary transfers, usage and other

Table 22 - Fitzroy Barrage WSS announced allocations for start of water year for High, and Medium priority water

Date	Priority group	Announcement (%)	Zones
1 July 2013	High	100	All
1 July 2013	Medium	100	All
1 July 2014	High	100	All
1 July 2014	Medium	100	All
1 July 2015	High	100	All
1 July 2015	Medium	100	All
1 July 2016	High	100	All
1 July 2016	Medium	100	All
1 July 2017	High	100	All
1 July 2017	Medium	100	All

Table 23 – High and Medium priority water use in the Callide Valley WSS, in terms of volume taken and the percentage of entitlements

Water year	Entitlement (ML)	Volume taken (Surface Water) (ML)	Volume Taken (Groundwater) ML	Volume taken (total) ML	Water taken as % of entitlements
13/14	-	4186.80	9621.28	13 808.08	-
14/15	22 758.67	4764.16	6050.56	10 814.72	47.52
15/16	21 562.46	5472.33	8619.85	14 092.18	65.35
16/17	20 209.06	5468.87	8946.72	14 415.59	71.33
17/18	20 124.28	5721.64	8872.12	14 593.76	72.51

Table 24 – Callide Valley WSS announced allocations for start of water year for High, and Medium priority water

Date	Priority group	Announcement (%)	Zones
1 July 2013	High	100	All
1 July 2013	Medium	80	3A, 5, 7, 8B, 10B
1 July 2013	Medium	75	3B
1 July 2013	Medium	85	8A
1 July 2014	High	100	All
1 July 2014	Medium	100	8A, 8B
1 July 2014	Medium	90	3A, 5
1 July 2014	Medium	80	7, 10B
1 July 2014	Medium	75	3B
1 July 2015	High A	100	All
1 July 2015	High B	100	All
1 July 2015	Medium	100	All
1 July 2016	High A	100	All
1 July 2016	High B	100	All
1 July 2016	Medium	100	All
1 July 2017	High A	100	All
1 July 2017	High B	100	All
1 July 2017	Medium	95	8B
1 July 2017	Medium	100	3A, 3B, 5, 7, 8B, 10B

*There are no announced allocations for Risk Priority water.

Table 25 - Permanent trades of supplemented surface water allocations in the Dawson Valley WSS

Water year	Priority group	Number of trades (no land)	Volume traded (ML) (no land)
12/13	Medium	1	1000
13/14	High	1	1
13/14	Medium	8	675
14/15	High	5	635
14/15	Medium	2	Q522
14/15	Medium A	2	25
15/16	Medium	4	816
15/16	Medium A	1	30
16/17	Medium	9	2062
16/17	Medium A	3	1593
17/18	High	1	91
17/18	Medium	12	1599
17/18	Medium A	2	228

*2017/2018 trading data is only up until 31 May 2018

Table 26 - Permanent trades of supplemented surface water allocations in the Nogoa Mackenzie WSS

Water year	Priority group	Number of trades	Volume traded (ML)
12/13	High	1	220
12/13	Medium	10	84
13/14	Medium	41	25073
14/15	High	2	35
14/15	Medium	20	8906
15/16	Medium	29	3836
16/17	Medium	41	8341
17/18	High	4	2026
17/18	Medium	27	3990

*2017/2018 trading data is only up until 31 May 2018

Table 27 - Permanent trades of supplemented surface water allocations in the Lower Fitzroy WSS

Water year	Priority group	Number of trades	Volume traded (ML)
12/13	-	0	0
13/14	High	1	5
14/15	Medium	1	5
15/16	Medium	1	1
16/17	Medium	2	1600
17/18	High	4	9

*2017/2018 trading data is only up until 31 May 2018

Table 28 – Permanent trades of supplemented surface water allocations in the Fitzroy Barrage WSS

Water year	Priority group	Number of trades	Volume traded (ML)
12/13	Medium	10	84
13/14	Medium	11	127
14/15	Medium	2	27
15/16	Medium	13	145
16/17	Medium	9	59
17/18	Medium	8	24

*2017/2018 trading data is only up until 31 May 2018

Table 29 – Permanent trades of supplemented groundwater water allocations in the Callide Valley WSS

Water year	Priority group	Number of trades	Volume traded (ML)
12/13	-	0	0
13/14	-	0	0
14/15	Risk	1	75
14/15	Medium	4	212
15/16	Medium	1	6
16/17	Medium	7	337
17/18	Medium	5	796

*2017/2018 trading data is only up until 31 May 2018

Table 30 – Permanent trades of supplemented surface water allocations in the plan area (land and water)

Water year	Number of Transfers	Volume transferred (ML)
12/13	19	1408
13/14	15	5790
14/15	23	4002
15/16	13	2863.7
16/17	30	7348
17/18	24	6242

Table 31 – Permanent trades of supplemented underground water allocations in the plan area (land and water)

Water year	Number of Transfers	Volume transferred (ML)
12/13	0	0
13/14	0	0
14/15	3	184
15/16	2	127
16/17	6	789
17/18	5	204

Table 32 – Permanent trades of unsupplemented surface water allocations in the Dawson Valley WMA

Water year	Water Allocation group	Number of trades	Volume traded (ML)
12/13	-	0	0
13/14	-	0	0
14/15	11B	2	1236
14/15	11A	2	494
14/15	12A	1	144
16/17	11A	11	1453
17/18	11A	4	278

Table 33 – Permanent trades of unsupplemented surface water allocations in the Nogoa Mackenzie WMA

Water year	Water allocation group	Number of trades	Volume traded (ML)
12/13	4C	2	633
13/14	1A	8	9721
13/14	3A	7	4648
14/15	Not applicable	0	0
15/16	0A	1	38
16/17	Not applicable	0	0
17/18	Not applicable	0	0

Table 34 – Permanent trades of unsupplemented surface water allocations in the Fitzroy WMA

Water year	Water Allocation group	Number of trades	Volume traded (ML)
12/13	7D	1	25
12/13	5A	1	536
13/14	5A	2	220
14/15	5A	1	375
15/16	5A	2	89
16/17	6C	1	369
16/17	5A	1	1166
17/18	7D	2	88

Table 35 – Permanent trades of unsupplemented underground water allocations in the Lower Callide groundwater sub area

Water year	Water Allocation group	Number of trades	Volume traded (ML)
12/13	-	-	-
13/14	-	-	-
14/15	-	-	-
15/16	GW1B	2	383
16/17	GW1B	2	732
17/18	GW1B	1	368

Table 36 – Permanent trades of unsupplemented surface water allocations transferred in the plan area (land and water)

Water year	Number of Transfers	Volume transferred (ML)
12/13	-	-
13/14	6	3276
14/15	8	4919
15/16	11	1693
16/17	16	8750
17/18	8	1274

Table 37 – Permanent trades of unsupplemented underground water allocations transferred in the Fitzroy catchment (land and water)

Water year	Number of Transfers	Volume transferred (ML)
12/13	-	-
13/14	-	-
14/15	6	151
15/16	3	735
16/17	3	256
17/18	5	614

Table 38 – Seasonal assignment of supplemented surface water allocations in the Dawson Valley WSS

Water year	Number of assignments	Volume assigned (ML)
13/14	124	10775.39
14/15	89	10610.27
15/16	46	5765.3
16/17*	158	15237.77

*Trading data is available only up to the 2016-17 water year

Table 39 – Seasonal assignment of supplemented surface water allocations in the Nogoia Mackenzie WSS

Water year	Number of assignments	Volume assigned (ML)
13/14	62	72102.25
14/15	270	61626.56
15/16	283	73289.81
16/17	240	65736.09
17/18	301	83702.68

Table 40 – Seasonal assignment of supplemented surface water allocations in the Lower Fitzroy WSS

Water year	Number of assignments	Volume assigned (ML)
13/14	8	112.41
14/15	8	77.77
15/16	11	82.88
16/17	10	46.41
17/18	12	54.35

Table 41 – Seasonal assignment of supplemented surface water allocations in the Fitzroy Barrage WSS

Water year	Number of assignments	Volume assigned (ML)
13/14	5	439.51
14/15	7	943.54
15/16	9	1490.39
16/17	2	116
17/18	2	200

Table 42 – Seasonal assignment of supplemented surface water allocations in the Fitzroy Barrage WSS

Water year	Number of assignments	Volume assigned (ML)
13/14	46	2141.40
14/15	20	1065.35
15/16	13	887.46
16/17	30	1659.51
17/18	22	1249.88

Table 43 – Water reserved in the plan area

Reserve name	Initial reserved (ML)	Remaining reserve (ML)
Strategic Surface Water- State purposes - water licence	16 000	16 000
Strategic Surface Water- Indigenous purposes	5 000	5 000
Strategic Groundwater – water licence	4950	4950
General Surface Water- Water licences and water allocations	43 500*	43 500*
General Surface Water – water allocation	15 000	15 000
General- Groundwater – water licence	31 250*	31 250*
Strategic Water Infrastructure	222 400	222 400

*50 250ML of general reserve water is currently part of a release process.

Table 44 – Unsupplemented surface water use in the Nogoia Mackenzie WMA

Water year	Annual volumetric limit (ML)	Volume taken (ML)	Water taken as % of annual volumetric limit
13/14	62 787	0	0
14/15	62 787	0	0
15/16	62 787	0	0
16/17	62 787	0	0
17/18	62 787	5 492	8.7

Table 45 – Unsupplemented surface water use in the Fitzroy WMA

Water year	Annual volumetric limit (ML)	Volume taken (ML)	Water taken as % of annual volumetric limit
13/14	58 940	5 365	9.1%
14/15	58 940	1 339	2.3%
15/16	58 940	2 852	4.8%
16/17	58 940	5 750	9.8%
17/18	58 940	4 826	8.2%

Table 46 – Unsupplemented surface water use in the Comet WMA

Water year	Annual volumetric limit (ML)	Volume taken (ML)	Water taken as % of annual volumetric limit
13/14	65 461	0	0.0%
14/15	65 461	0	0.0%
15/16	65 461	0	0.0%
16/17	65 461	14 962	22.9%
17/18	65 461	21 363	32.6%

Table 47 – Unsupplemented surface water use in the Dawson WMA

Water year	Annual volumetric limit (ML)	Volume taken (ML)	Water taken as % of annual volumetric limit
13/14	62 787	0	0.0%
14/15	62 787	0	0.0%
15/16	62 787	308	0.5%
16/17	62 787	0	0.0%
17/18	62 787	3520	5.6%

Table 48 – Unsupplemented surface water use in the Don and Dee Rivers - Alma Creek section

Water year	Nominal entitlement volume (ML)	Volume taken (ML)	Water taken as % of nominal entitlement volume
13/14	7624	902	11.8%
14/15	7624	1601	21.0%
15/16	7624	2659	34.9%
16/17	7624	1936	25.4%
17/18	7624	1890	24.8%

Table 49 – Unsupplemented groundwater water use in the Don River, Dee River and Alma Creek GMA

Water year	Nominal entitlement volume (ML)	Volume taken (ML)	Water taken as % of nominal entitlement volume
13/14	12 097	2670	22.1%
14/15	12 097	2677	22.1%
15/16	12 097	5040	41.7%
16/17	12 097	3618	29.9%
17/18	12 097	1927	15.9%

Table 50 – Unsupplemented surface water use in the Isaac Connors WMA

Water year	Nominal entitlement volume (ML)	Volume taken (ML)	Water taken as % of nominal entitlement volume
13/14	5783	725	12.5%
14/15	5783	1827	31.6%
15/16	5783	2831	49.0%
16/17	5783	4133	71.5%
17/18	5783	1751	30.3%

Table 51 – Unsupplemented groundwater use in the Isaac Connors WMA

Water year	Nominal entitlement volume (ML)	Volume taken (ML)	Water taken as % of nominal entitlement volume
13/14	13 399	180.3	1.3%
14/15	13 399	465.4	3.5%
15/16	13 399	482.7	3.6%
16/17	13 399	1350.8	10%
17/18	13 399	565.9	4.2%

Table 52 – Unsupplemented water use in the Upper Callide and Prospect Creek groundwater sub areas

Water year	Nominal entitlement volume (ML)	Volume taken (ML)	Water taken as % of nominal entitlement volume
13/14	2500	379.2	15.2%
14/15	2500	974.5	39.0%
15/16	2500	686.0	27.4%
16/17	2500	890.1	35.6%
17/18	2500	631.1	25.2%

Table 53 – Unsupplemented water use in the Lower Callide groundwater sub area

Water year	Annual Volumetric limit (ML)	Volume taken (ML)	Water taken as % of annual volumetric limit
13/14	6000	1973.2	32.9%
14/15	6000	1128.6	18.8%
15/16	6000	676.3	11.3%
16/17	6000	0	0
17/18	6000	0	0

Appendix C: Water taken or interfered with under statutory authorisations

Table 54 – 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	
Section 93 General authorisations to take water e.g., 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.
Section 94 General authorisations to interfere with water. e.g., OLF, impoundments for state monitoring purposes	No new impoundments or interference identified under this general authorisations There has been no observed proliferation of erosion control or land management structures that interfere with OLF.
Section 95 Aboriginal and Torres Strait Islander parties	No impacts identified under this authorities. These activities deal with very low quantities of water, which present a low risk to plan outcomes. DNRME is not aware of an increase in water take or interference for traditional activities or cultural purposes.
Section 96 Land owners may take water for stock or domestic purposes	No impacts identifies under this general authorisation Stock and domestic water can be taken from any location in the plan area, other than the area of water supply schemes. There have been no reported incidents of significant increases in take.
Section 97 Environmental authorities to take or interfere with OLF	No identified change in water taken under this general authorisations. 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 <i>Sustainable Planning Regulation 2009</i> and <i>Water Regulation 2016</i> . DNRME is not aware of a significant increase in the construction of OLF dams for these purposes through the notification process The Bowen Basin contains almost all of the state's hard coking coal, and is the most important coal-bearing province in Queensland. There are 50 operating coal mines in the Bowen Basin with 16 new coal mines under construction or recently completed. ⁴ This could increase the amount of water taken and interfered with through this section within the term of the plan
Section 98 Resource activities that interfere with the flow of water by diversion of a watercourse	No identified change in interference with watercourses under this general authorisation The impacts of interference by diversion can be assessed through requirements of the <i>Environmental Protection Act 1994</i> . With the increase of new mine developments in the future it is anticipated there will be an increase in diversions approved under Environmental Authorities throughout the next plan period.
Section 99 Constructing	No identified change in water taken under these authorisations.

⁴ Department of Natural Resources and Mines 'Queensland coal – mines and advanced projects', July 2017

Form of take	Catchment information sources
authorities and water service providers	<p>Limited volumes of water are required for road and rail construction and maintenance and public amenities. DNRME has record of 1422 notifications by constructing authorities within the plan area over the last 5 years.</p> <p>There are five water supply schemes and their associated Resource Operations Licences.</p>
Subdivision 2 – Authorisations that may be limited by water planning instrument or regulation	
Section 101 Authorisations that may be altered or limited by water planning instrument or regulation.	<p>No impacts identified for water taken under these authorities.</p> <p>1 (a) Grazing and agriculture is the major land use in the plan area. Prescribed activities that would be most utilised are washing down equipment, plant or vehicles, filling spray units to apply herbicides or pesticides, using stock dips and spray chases for controlling parasites on livestock. The plan limits the take of water for these purposes to 5ML</p> <p>Mining is also a predominant land use in the Bowen Basin and prescribed activities such as road maintenance and construction of infrastructure, temporary and reasonably necessary for or incidental to carrying on mining under a mining lease is limited to 5ML.</p> <p>1 (b) 318 notifications have been received for existing OLF dams for purposes other than stock and domestic, constructed prior to 13 September 2001.</p> <p>Since September 2001, notification has been required for construction of stock and domestic dams and for dams of limited capacity (50ML Upstream of the Barrage and 5ML downstream of the Barrage) for any purpose. There have been 125 notifications received.</p> <p>1 (c) Groundwater is regulated in GMAs of the plan area and take is not metered outside of these areas. The major land use (grazing) has not changed greatly within the GMAs and therefore it is anticipated there has been limited increase for demand for stock or other purposes.</p> <p>1(d) There have been 125 OLF notifications since 2006.</p>
102 Authorisations under water plans or regulation	<p>No identified change in water taken under these authorities</p> <p>The plan provides for the authorisation of OLF dams for any purpose up to the capacity of 50ML upstream of the Barrage and 5ML downstream of the Barrage.</p> <p>There have been 125 notifications received since 2006.</p>
103 Authorisations to take water for stock or domestic purposes may be limited	<p>No identified change in water taken under these authorities</p> <p>The plan does not provide any additional rules for how water for stock and domestic is managed.</p>

Appendix D: Ecological monitoring

A brief summary of the ecological monitoring and research relevant to evaluating the effectiveness of the plan is outlined below. Further details are provided in '[Water Plan \(Fitzroy Basin\) 2011 Summary of Environmental Monitoring](#)'.

Waterholes as refugia

The Isaac-Connors sub-catchment was identified as a high priority catchment for release of un-allocated water and conversion of existing water licences to tradeable water allocations. As part of this process, a targeted environmental assessment was undertaken by DNRME aquatic ecologists to meet provisions of the existing plan and protocol (Burndred et al., 2015). Nine significant refugial waterholes were identified in the sub-catchment and were assessed against three key criteria (frequency of flushing flow events, frequency of drawdown below 0.5m, frequency and duration of no-flow periods) under four Integrated Quantity and Quality Modelling (IQQM) scenarios (pre-, current, probable, full development).

Modelled results indicated that the release of 12,000 ML/yr of un-allocated water in the Isaac-Connors sub-catchment (the probable scenario) posed a low risk to the environmental values of refugial waterholes within the system (under the provision of current water entitlement conditions and model assumptions). However, under the full development scenario, which combined the release of 12,000 ML/yr of unallocated water plus additional demands associated with the proposed Connors River Dam (a future risk beyond the life of the current plan), an increased level of risk to the environmental values of refugial waterholes was found. The assessment recommended that if a full development scenario was implemented (i.e. construction of the Connors Dam and full un-allocated water release 12,000 ML/yr), passing of FPWF and SBF events by the new dam must be enforced.

Wetlands

Halford and Fensham (2014) investigated the vegetation patterns and underlying environmental conditions of a large complex of wetlands in the Upper Dawson River catchment. The wetland complex is represented by 192 ephemeral lakes and reedy swamps in the Palm Tree Creek and Robinson Creek catchments and is listed on the Australian Government's Directory of Important Wetlands. The wetland complex is filled by OLF and flooding when levels are sufficient to breach the banks of adjacent streams. Water depth was found to have the greatest influence over vegetation patterns with slope, assumed to effect drainage, having a secondary influence. Most vegetation species present had tropical affinities with the wetland complex overall being in excellent natural condition

Flow dependent taxa

Medium to high flows

Cockayne et al. (2013) established the critical link between post-winter flow events and spawning of the Fitzroy River golden perch (*Macquaria ambigua orientalis*). Spawning predominately occurs on the peak and/or fall of the first or second flow events of the season (November-January), when water temperature exceeds 24°C. Small 'low' flow events preceding the first post-winter flow events (FPWF) were also found to be an important determinate of the magnitude and subsequent success of spawning and recruitment events. These pre-spawning 'priming' flows are important for ecological processes and functions such as stimulating productivity, provision of connection to spawning habitats and improving reproductive condition of spawning adults.

Low flows; Perennial flows

Riverine turtles such as those species present in the Fitzroy plan area— the white-throated snapping turtle *Eiseya albagula* and the locally endemic Fitzroy River turtle *Rheodytes leukops*, are considered habitat specialists, requiring well oxygenated, flowing waters (Clark et al., 2009). Todd et al., (2013) examined the population genetic structure of *E. albagula* across the species entire distribution (Mary-

Burnett catchments and Fitzroy Basin catchments) and found two evolutionary significant units. The Fitzroy Basin plan area population is a distinct genetic lineage, deeply divergent from that in the Mary-Burnett catchments reflecting historical isolation of the Fitzroy Basin from neighbouring drainages. Given the evolutionary significance and critically endangered conservation status (EPBC, 2004) of the plan area population of *E. albagula*, coupled with the specific habitat preferences of this and the other endemic species *R. leukops*, both are potentially highly susceptible to changes in flow regime associated with river regulation and resultant habitat loss. Maintenance of perennial flows in river reaches not forming part of weir or dam pools is therefore vitally important to support the persistence of these endemic turtle species across the plan area.

Natural variability of flow regime

'Minimising changes to the natural variability of flows to support aquatic ecosystems' is a general ecological outcome of the plan. Stitz et al. (2017) found that a variable flow regime is an important determinant of macroinvertebrate community composition in the lower Fitzroy River. Community composition was found to vary with the shape of the hydrograph (e.g. flood pulse, main flow, low flow, no flow), reaffirming the need for natural flow variation to support biological processes (e.g. reproduction and recruitment) and stimulation of primary and secondary productivity. These findings support the ecological intent of the SBF and FPWF strategies currently implemented under the plan.

Groundwater

Level

Groundwater levels in four sub-catchments across the plan area have been compared yearly to the 10-year long-term range for continuous bore data as part of the Fitzroy Basin report card (FBA, 2015). Between 2010–16 groundwater levels across the plan area were generally fairly shallow (distance to water relative to ground level) in the Callide, Connors and Nogoia River Catchments, being between 60%–100% of levels in the 10 year long-term dataset. The only exception was the Callide in 2012–13 which dropped to 32% of the long-term range but then recovered to 100% the following year. The potential reason for this temporary drop was not given. The Nogoia River catchment over the same period was consistently <20% of the long-term range with the exception of 2010–11 and 2011–12 which were between 45%–100%. This was probably due to the extreme wet season event which occurred during 2010–11, causing recharge of sub-surface aquifers.

Chemistry

Local rising salinity problems in streams are found in the Wowan area of the Don River, Bell Creek and Prospect Creek areas in the Callide Valley, and creeks north of Theodore to Lonesome Creek (GHD, 2015). Elevated salinity is associated with groundwater migration as a result of rising water tables, attributed partly to extensive land clearing in the surrounding areas and partly due to overuse of groundwater supplies (GHD, 2015).

Water quality and the freshwater aquatic environment

Waste water from coal mines in the plan area is typically characterised by elevated conductivity, pH, sulphates as well as high total and dissolved metals (As, Al, B, Cu, Mn, Ni, Se and Zn) (Lanctôt et al., 2016a). Numerous studies have assessed the toxicity of these constituents on the freshwater aquatic flora and fauna of the plan area (e.g. Dunlop et al., 2016; Chua et al., 2018; Lanctôt et al., 2016a; Lanctôt et al., 2016b; Lanctôt et al., 2016c). On the whole, lethal effects are experienced by some macroinvertebrates (water fleas and flatworms) with decreased condition, reduced liver weight, decreased movement (apart from basic functions like ventilation) and bioaccumulation of metalloids occurring in vertebrates (fish and tadpoles). Degree of effect, particularly with regard to bioaccumulation and morbidity, was directly correlated with levels of toxicants *in situ*. Prasad et al. (2012) found that higher ionic compositions (higher salinity) increased the toxicity of other ions (e.g. metals). The authors recommended a salinity trigger value as a good guideline indicator for overall water quality monitoring across the plan area.

Duivenvoorden et al. (2017) investigated the baseline water quality parameters of the Marlborough region which is characterised by unique serpentine geology. Water and sediments in this catchment were found to be naturally extremely hard, high in dissolved salts and some species of metals (Cu, Zn, Cr, Ni, Cd). Following this work the authors stressed the importance of understanding background environmental water quality chemistry when setting and interpreting water quality guideline values.

Water quality and the Great Barrier Reef

The health of the GBR in the offshore region of the plan area has consistently scored moderate to very poor over the life of the existing plan. Between 2012–15 coral, seagrass and water quality health scores were all between poor and very poor for the Fitzroy region (Fitzroy Partnership, 2018). These scores reflect water quality issues driven by land use and management practices throughout the plan area. Waterhouse et al. (2012) scored the Fitzroy Basin catchment a medium-to-high risk catchment for contribution of land based pollutants to the GBR. These pollutants, stemming from grazing of beef in the Basin, were dominated by suspended sediments (TSS) and PS-II herbicides (Waterhouse et al., 2012). Tebuthiuron has repeatedly been identified as the main herbicide of concern in this region (Fitzroy Partnership, 2018; Huggins et al., 2017; Wallace et al., 2014; Turner et al., 2013)).

Estuaries and fisheries resources

Freshwater flows and rainfall

Significant rainfall events were experienced across the Basin on a number of occasions since the last plan review. The total annual volume of water passing the most downstream DNRME gauge at The Gap (130005A) was up to 12 times more in 2011 than any other year during the reporting period (2011–2017). Further significant rainfall events were also experienced during December 2013 when the Fitzroy Basin received significant rainfall due to ex-Tropical Cyclone Oswald. A number of sites within 40 kilometres of Rockhampton exceeded 400 millimetres of rain in 24 hours, including 587 millimetres at Upper Dee (near Mount Morgan) and 556.6 millimetres at Pacific Heights. Rockhampton itself received 349 millimetres (BoM, 2013a; BoM, 2013b). The impact of these freshwater flows on specific ecological assets are discussed further below but on the whole, improved connection has been provided between freshwater wetland, floodplain and lagoon systems that are important nursery areas for many fish and migratory bird species (Johnson et al., 2015).

Barramundi fishery

Following the large floods of 2010-2011, commercial barramundi catch in the central east coast stock increased five-fold (Saunders et al., 2016). The Fitzroy catchment experienced increased catchability and recruitment success into the fishery as evidenced from age-length frequency analysis. The 2010 cohort has dominated catches since 2013, with catch rates double that of rates prior to 2011. At the end of 2015, the main commercial fishing area open to net fishing in the Fitzroy Basin was closed. The results of this closure on barramundi stocks are still being collated by the Department of Agriculture and Fisheries (DAF) who are now assessing recreational fisher's catches through targeted boat ramp surveys (DAF, 2017).

King threadfin fishery

No recent stock assessment of the east coast king threadfin fishery has been undertaken. During the summers of 2009–2010 and 2012–2013 the central region experienced above average rainfall including some significant flood events. This increase in freshwater flowing to the estuary was reflected in both an increase in tonnage of the commercial catch (Whybird et al., 2016, DAF, 2018) and the tag-and-release and recapture rates of threadfin by recreational fishers in the Fitzroy region (Infotish Australia, 2014). At the end of 2015, the main commercial fishing area open to net fishing in the Fitzroy Basin was closed. The results of this closure on king threadfin stocks are still being assessed (DAF, 2017).

Banana prawn fishery

Commercial catch of banana prawn in the Capricorn Bunker region has been variable since the last plan review with no long-term trend discernible (Larcombe, et al., 2016; DAF, 2018). Commercial catch tonnage appears tied to environmental factors with temperature, rainfall and river flow rates linked to recruitment rates and biomass availability (Larcombe et al., 2016). Commercial catch rates peaked at a record tonnage during 2010-2011 and were again at high levels during 2012 through to 2015 (DAF, 2018). Relatively low numbers of banana prawns were caught in 2011–2012 and between 2015 and 2017 (DAF, 2018).

Estuaries

Estuaries of the Fitzroy Delta are vulnerable to declining water quality resulting from agricultural and industrial land-use and the effects of urban storm water (Johnson et al., 2015). The health of the Fitzroy Delta has scored consistently between fair and good in the Fitzroy Partnership for River Health Annual Report Cards (2011–2017). Estuarine seagrass meadows in the region have fluctuated between poor and moderate in condition, being highly influenced by periods of stress associated with high temperatures and periods of repeated flooding (McKenzie et al., 2014).

Physical barriers, connectivity and fishways

It is a general ecological outcome of the plan to provide continued connectivity by maintaining flows that ‘allow for the movement of native aquatic fauna between riverine, floodplain, wetland, estuarine and marine environments’. In the downstream of Fitzroy Barrage sub-catchment area, the plan limits the amount of OLF water that may be taken by a person to 5ML. However, due to physical barriers such as dams, weirs and other water supply and road infrastructure, simply providing sufficient environmental ‘flows’ may not achieve the desired ecological response.

Through a study commissioned by the Fitzroy Basin Association (FBA) (Moore and Marsden, 2008; Marsden, 2015), over 10,000 instream barriers to connectivity for migrating fauna were identified across the Basin. These barriers were then prioritised as part of the Fitzroy Basin Water Quality Improvement Plan (FBA, 2015) and a list of the top 46 barriers across the Basin were flagged as those most critical for remediation. The Fitzroy Barrage, long recognised as having a detrimental effect on fisheries resources and aquatic habitats of the lower Fitzroy River, was highest priority. The existing barrage fishway was remediated and modernised in 2016 as part of the Fish Friendly Fitzroy: Bypassing the Barrage project (FBA, 2014 in Marsden et al., 2017). Pre- and post-construction monitoring found a significant improvement in the number of individuals and number of fish species moving through the barrage fishway (Marsden et al., 2017). This significant improvement to connectivity should facilitate the unimpeded movement of migratory diadromous fishes such as the barramundi between critical habitats which, in turn, will improve fisheries resources and productivity in the lower Fitzroy River and connected waters.

It should be noted that this prioritisation project did not include off stream barriers such as ponded pasture bunds and flood levees which prevent tidal or floodwater ingress. These off-stream structures prevent vital connections to critical wetland habitats for aquatic fauna and interfere with the natural flow of water. This limits the frequency of important flushing events that stimulate productivity and connectivity to nursery habitats for important commercial species such as the barramundi (Marsden, 2015; Holmes et al., 2013).

Turtles

Currently, turtle movement is restricted at Eden Bann Weir as result of the existing weir. Provision of a ‘turtle ramp’ will improve the movement of turtles past this structure and restore the connectivity of the population in this region. A turtle ramp has been selected based on expert knowledge of turtle movement capabilities and evidence of turtle behaviour at existing structures (GHD, 2015).

Fitzroy River Enhanced Environmental Monitoring Program (EEMP)

In an effort to improve mine water management in the Fitzroy Basin, the Queensland Government initiated a pilot program to assess whether changes to regulatory and operational factors would reduce onsite legacy water storage. Four coal mines in the Isaac River sub-catchment were initially chosen to participate in the pilot program. This number was expanded in the 2013–2014 and 2014–2015 wet seasons to include eight mines. The program was concluded in July 2016. Monitoring undertaken pre-and post- release over the life of the pilot focused on both water quality and fish community assessments.

Water releases were found to not have measurable effects on salinity concentrations downstream of the participating pilot mines (Droop and Jacob, 2013; OD Hydrology, 2014; OD Hydrology, 2016). Similarly other water quality parameters (e.g. metals, pH, DO, TSS etc.) showed no attributable impacts due to pilot mine water releases (Droop and Jacob, 2013; OD Hydrology, 2014; OD Hydrology, 2016). Metal levels in some samples, however, were elevated — although this could not be directly attributed to mine water releases (OD Hydrology, 2016). Fish community monitoring over the life of the pilot has focused on metrics such as abundance, species diversity and the physical condition of individuals (presence of sores, parasites or abnormalities). Pre- mine release surveys (pre- wet season) found no significant differences in any of the metrics assessed between sampling years (2012–2016) (BMT WBM, 2014; BMT WBM, 2015; BMT WBM, 2016). Similarly, post- mine releases (post- wet season) fish community diversity, abundance and fish condition were comparable between pre-and post-release sampling and between reference and impact sites (Moffatt et al., 2012; Moffatt et al., 2013).

Overall it was concluded the release of legacy mine water as part of the pilot scheme did not have any noticeable impact on water quality, ecosystem health, stock, irrigation or domestic use (OD Hydrology, 2016).

Appendix E: Water monitoring

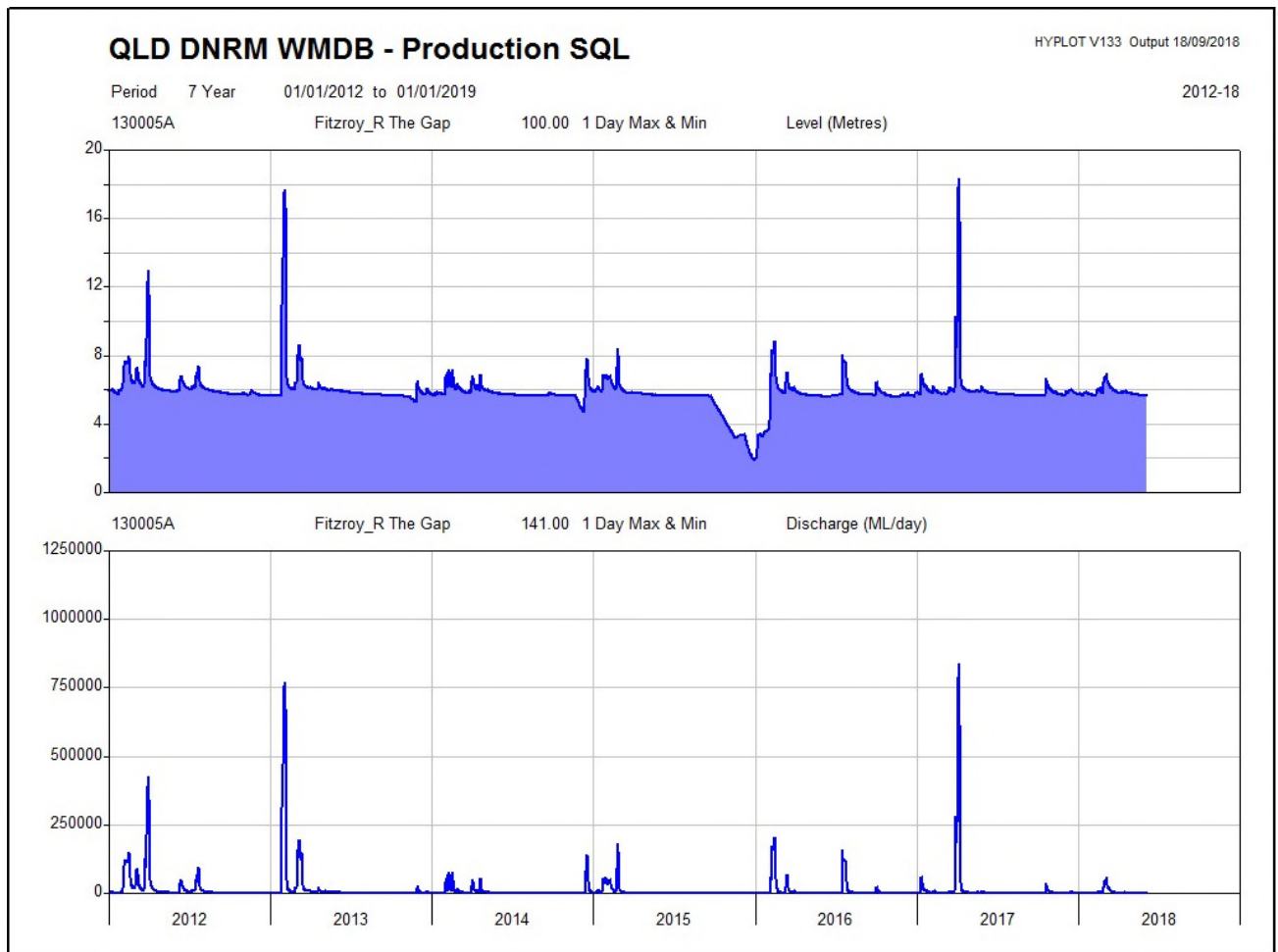


Figure 12 – Fitzroy River 130005A – The Gap 2012–2017

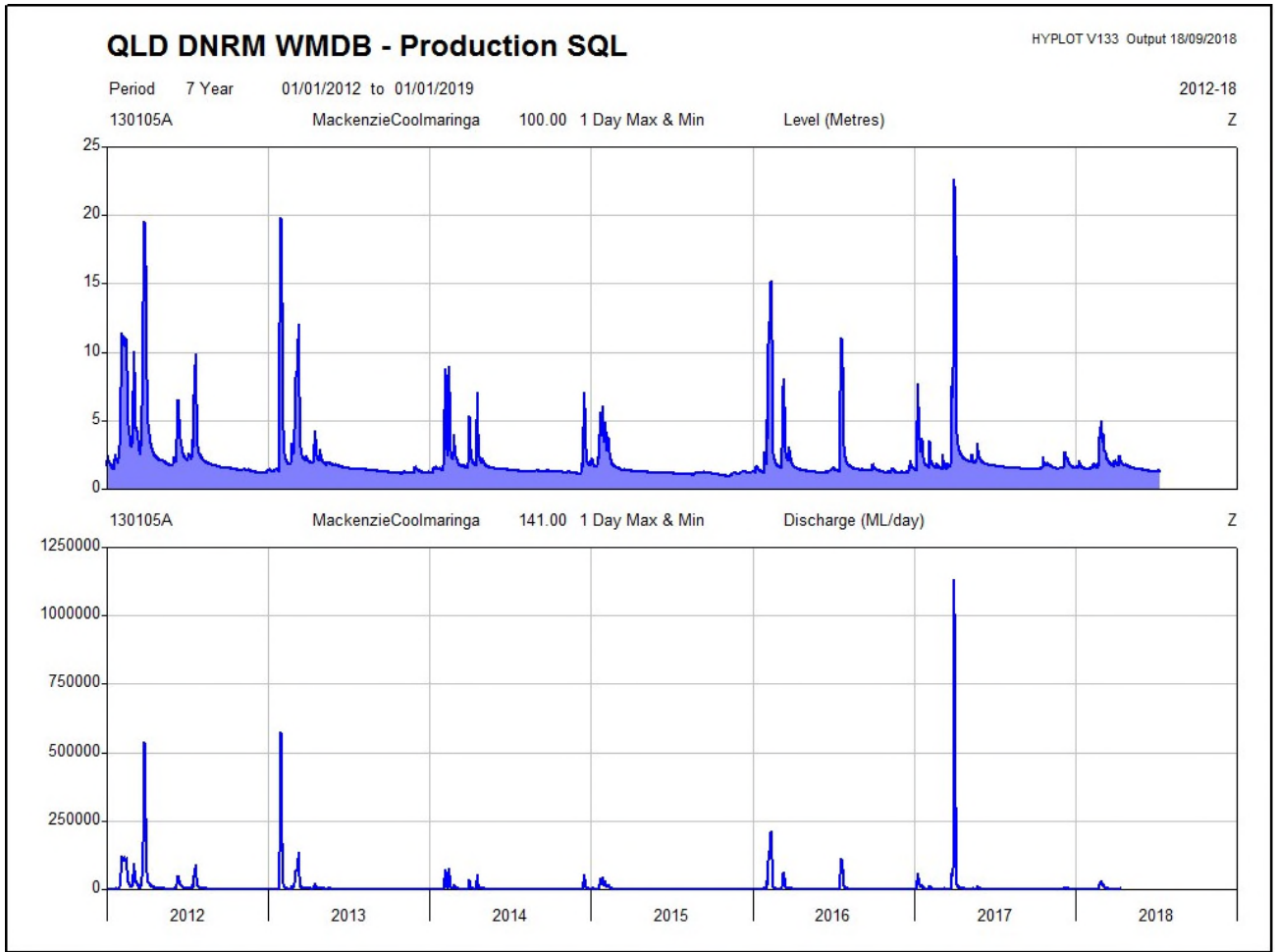


Figure 13 – Mackenzie River 130105A – Coolmaringa 2012 to 2017

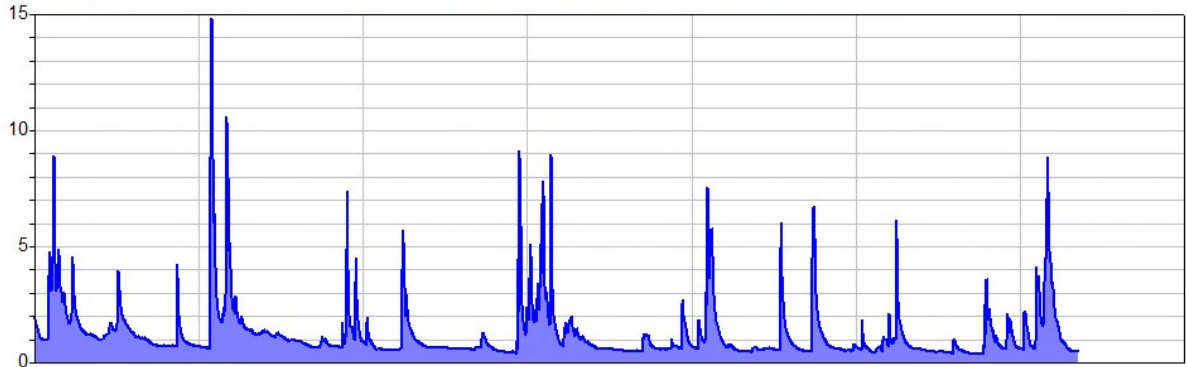
QLD DNRM WMDB - Production SQL

HYPLOT V133 Output 18/09/2018

Period 7 Year 01/01/2012 to 01/01/2019

2012-18

130322A Dawson_R Beckers 100.00 1 Day Max & Min Level (Metres)



130322A Dawson_R Beckers 141.00 1 Day Max & Min Discharge (ML/day)

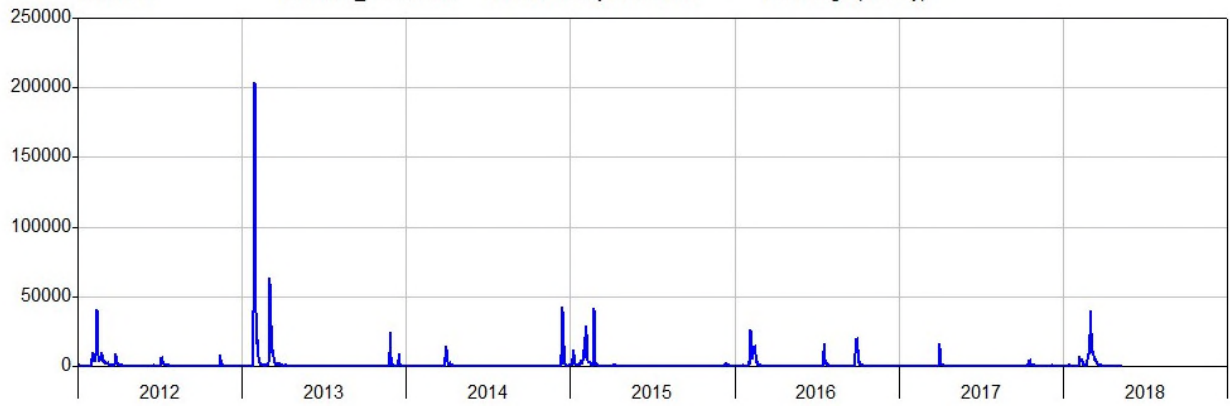


Figure 14 – Dawson River 130322A – Beckers 2012–2017

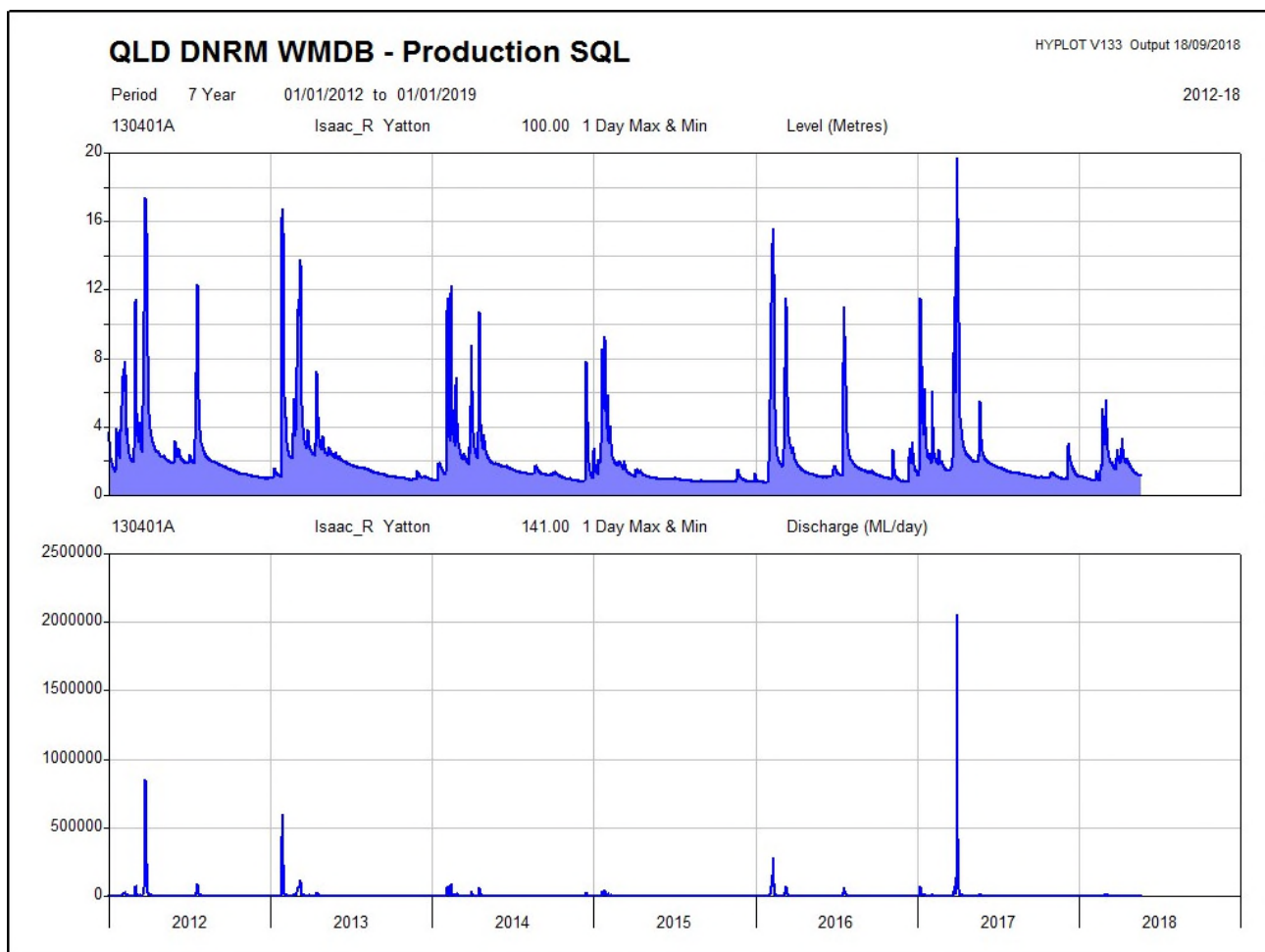


Figure 15 – Isaac River 130401A – Yatton 2012–2017

Table 55 – Discharge summaries for gauging stations in the Fitzroy Basin area since commencement of the plan

Gauging Station	Parameter	Discharge in ML/day (Year)
Connors River at Mt Bridget (130403A)	Instantaneous Maximum	1 008 163 (2016/17)
Connors River at Pink Lagoon (130404A)	Instantaneous Maximum	1 236 008 (2016/17)
Isaac River at Deverill (130410A)	Instantaneous Maximum	154 771 (2015/16)
Isaac River at Yatton (130401A)	Instantaneous Maximum	2 059 683 (2016/17)
Mackenzie River at Rileys Crossing (130113A)	Instantaneous Maximum	113 287 (2011/12)
Mackenzie River at Coolmaringa (130105A)	Instantaneous Maximum	1 131 074 (2016/17)
Dawson River at Taroom (130302A)	Instantaneous Maximum	63 836 (2011/12)
Dawson River at Woodleigh (130317B)	Instantaneous Maximum	44 942 (2011/12)
Dawson River at Beckers (130322A)	Instantaneous Maximum	203 521 (2011/12)
Fitzroy River at Riverslea (130003B)	Instantaneous Maximum	1 020 055 (2016/17)
Fitzroy River at Eden Bann Weir (130005A)	Instantaneous Maximum	839 741 (2016/17)

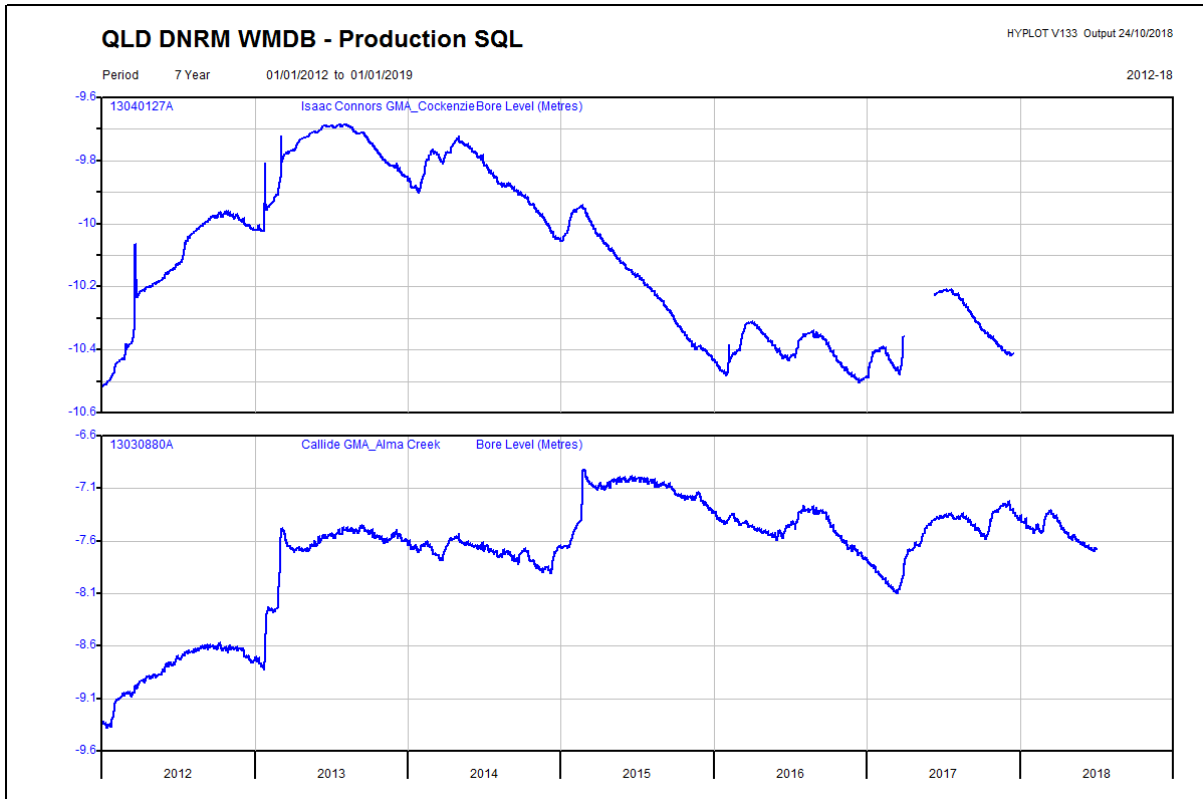


Figure 16 – Groundwater plots for the Isaac Connors (top graph) and Callide GMAs (2012–2018)

Appendix F: Operational reporting by ROL holders

Table 56 – Operational reporting for the Dawson Valley WSS

Incident	Details	Management Actions
Continuous Monitoring	Due to damage during excavation work the continuous data could not be provided for Glebe Weir T/W from 27 February to 31 March 2014.	SunWater provided an operational report and repairs were undertaken
Continuous Monitoring	Due to damage during excavation work the continuous data could not be provided for Dawson River at Glebe Weir T/W for stream height and stream flow from 1 April to 15 April 2014	SunWater provided an operational report and repairs undertaken
Continuous Monitoring	Due to an instrument failure the continuous data could not be provided for the Dawson River at Neville Hewitt H/W for 1 January to 31 March 2015	SunWater provided an operational report and repairs undertaken
Monitoring	Missed cyanobacteria sample at Moura Weir on 10 November 2015	SunWater provided an operational report and undertook an assessment of their procedures

Table 57 – Operational reporting for the Nogoa Mackenzie WSS

Incident	Details	Management Actions
Continuous monitoring	Due to flood damage the continuous data could not be provided for Mackenzie River at Bingegang T/W stream flow from 1 October to 31 December 2013	SunWater provided an operational report and sought to undertake repairs
Continuous monitoring	Due to flood damage the continuous data could not be provided for Mackenzie River at Bingegang T/W from 1 April to 30 June 2014	SunWater provided an operational report and sought to undertake repairs
Continuous monitoring	Due to flood damage the continuous data could not be provided for Mackenzie River at Bingegang T/W for stream height and stream flow from 1 July to 30 September 2014	SunWater provided an operational report and sought to undertake repairs
Continuous monitoring	Due to flood damage the continuous data could not be provided for Mackenzie River at Bingegang T/W from 1 October to 31 December 2014	SunWater provided operational report and undertook repairs
Continuous monitoring	Due to breakdown of a gauge the continuous data could not be provided for Mackenzie River at Bedford Weir T/W for stream height and stream flow from 1 July to 13 July 2014	SunWater provided an operational report and undertook repairs
Continuous monitoring	Due to an instrument failure the continuous data could not be provided for Mackenzie River at Bedford Weir T/W from 1 January to 30 June 2015	SunWater provided an operational report and repairs were undertaken

Table 58 – Operational reporting for the Callide Valley WSS

Incident	Details	Management Actions
Continuous monitoring	Cyanobacteria sampling was not undertaken at Callide Dam on 16 February 2015	SunWater provided an operational report and undertook an assessment of their procedures
Continuous monitoring	Due to flood damage the continuous data could not be provided for stream height and stream flow at Callide Creek from 1 January to 31 March 2015	SunWater provided an operational report and sought to undertake repairs.
Continuous monitoring	Due to flood damage the continuous data could not be provided for stream height and stream flow at Callide Creek from 1 April to 30 June 2015	SunWater provided an operational report and sought to undertake repairs.

Appendix G: Plan amendments and milestones

Table 59 – Water resource planning milestones for the plan

Effective date	Milestone
23 December 1999	The Water Resource (Fitzroy Basin) Plan 1999
9 December 2011	A new Fitzroy Basin water resource plan commenced in December 2011 and applied to surface water, groundwater and OLF water. The 2011 plan identified strategic, strategic water infrastructure and general reserves to provide for future water requirements, including the opportunity for additional water to be taken. The plan allowed continued use of all water entitlements and improved certainty of supply for water entitlement holders. The plan also provided the framework for conversion of water entitlements to tradeable water allocations, and water for essential supplies and natural ecosystems as well as recognising cultural values important to traditional owners. A revision of the Fitzroy Basin resource operations plan (ROP) was in place shortly before the water resource plan.
27 September 2013	The <i>Land, Water and Other Legislation Amendment Act 2013</i> amended the plan to update a section number cross reference with the <i>Water Act 2000</i> .
28 May 2014	The <i>Land, Water and Other Legislation Amendment Act 2014</i> amended the plan to align with the <i>Sustainable Planning Act 2009</i> .
27 June 2014	The plan was amended by the <i>Water Resource Plans Amendment Plan (No. 1) 2014</i> , which: <ul style="list-style-type: none"> • Removed unnecessary prescription while retaining policy intent and standardised, simplified and enhanced the transparency of selected provisions. • Removed redundant provisions and removed duplication with the <i>Water Act 2000</i> and the <i>Water Regulation 2002</i>. • Moved the monitoring and reporting requirements into the ROP. • Changed the Minister's reporting period on the plan to five years.
11 September 2015	The plan was amended to include management of the Don and Dee Rivers and Alma Creek. Other updates were included to clarify where general reserve was available and to provide detail on water allocations in the Callide Valley WSS.
6 December 2016	The <i>Water Reform and Other Legislation Amendment Act 2014</i> amended the water resource plan to become a plan and the ROP to a water management protocol. Additionally the <i>Water Regulation 2016</i> included new detail about assessable development for works under the plan.
2 September 2017	The Water Plan (Great Artesian Basin and Other Regional Aquifers) 2017 commenced and included groundwater in its plan area that used to be in the Fitzroy plan.

Appendix H: Overview of non-compliance

Table 60 – Non-compliance incidents for the Fitzroy Basin plan area

Year	Number of non-compliances	Types of non-compliances	Outcome
2013/14	0	-	-
2014/15	1	Unauthorised take	No Action (no offence found)
2015/16	2	Unauthorised Take	No Action (no offence found)
2016/17	2	Over Use	Warning Notices
	1	Unauthorised take	No Action
2017/18	1	Unauthorised take	Information Notice

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