LOWER FITZROY RIVER
INFRASTRUCTURE PROJECT

Appendix P1

Surface water resources supporting material

Part 1 Section 1 Regulatory framework

Part 1 Section 2 Yield modelling

SunWater
MAKING WATER WORK

Gladstone Area Water Board

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1. Regulatory framework

1.1 Overview

Legislation, plans, policies and strategies governing and guiding the protection, use and management of surface water resources in relation to the Project include the following as summarised:

- *Environmental Protection Act 1994* (EP Act) (Qld)
  - Environmental Protection Regulation 2008 (EP Regulation)
  - Environmental Protection (Water) Policy 2009 (EPP Water)
- *Water Act 2000* (Qld) (Water Act)
  - Water Resource (Fitzroy Basin) Plan 2011 (Fitzroy WRP)
  - Fitzroy Basin Resource Operations Plan (October 2011 and September 2014) (Fitzroy ROP)
- *Water Supply (Safety and Reliability) Act 2008* (Qld)
- Central Queensland Regional Water Supply Strategy (CQRWSS)

Volume 1, Chapter 3 Legislation and project approvals, provides further detail, as applicable.

1.2 Environmental Protection Act 1994

The EP Act identifies environmental protection policies created for the purposes of protecting and enhancing environmental values. The EPP Water seeks to achieve the objectives of the EP Act in relation to Queensland waters. This purpose is achieved within a framework that includes identifying environmental values for Queensland waters and stating corresponding water quality guidelines and water quality objectives to enhance and/or protect the environmental values as discussed in Volume 1, Chapter 11 Water quality.

1.3 Water Act 2000

The Water Act provides the legislative and institutional framework for water planning and water entitlements for all naturally occurring freshwater resources in Queensland. Under the Water Act, all rights to use water are vested in the State. The Water Act specifies the conditions under which a water entitlement is required for the taking of water and provides for the creation of water resource plans (WRPs) and resource operations plans (ROPs) to allocate and manage water.

Under the Water Act the taking of surface water from a watercourse, lake or spring requires a water entitlement except for prescribed minor uses such as for stock and domestic purposes. The take of groundwater or overland flow water requires an entitlement only if specified by a WRP, a moratorium or (for groundwater only) an area declared under the Water Regulation 2002.

The Water Act also specifies the process for the development of WRPs and ROPs including the requirements for resource assessments, the need to consider future requirements and the need to undertake community consultation (National Water Commission 2011). Water related development is regulated by the Water Act in parallel to the *Sustainable Planning Act 2009* (Qld).

1.4 Water Resource (Fitzroy Basin) Plan 2011

Water resource planning in Queensland is prescribed under the Water Act to meet the challenges of maintaining river health and groundwater reserves. Catchment specific WRPs set out the strategic framework for the allocation and sustainable management of water. Each WRP has a 10-year life. As subordinate legislation, WRPs are the legal templates specifying the outcomes and strategies used to address the full range of social, economic and environmental goals for each plan area.

The Fitzroy WRP is the catchment specific water resource plan that sets out the framework for the allocation and sustainable management of water in the Project area, specifically within the Mackenzie, Dawson and Fitzroy rivers in the Lower Mackenzie, Lower Dawson and Fitzroy subcatchments.

Figure 1-1 shows the Fitzroy WRP plan area comprising the following sub-catchments:

- Downstream of Fitzroy Barrage
- Fitzroy
- Isaac Connors
- Lower Mackenzie
- Upper Mackenzie
- Nogoa
- Comet
- Upper Dawson
- Lower Dawson.

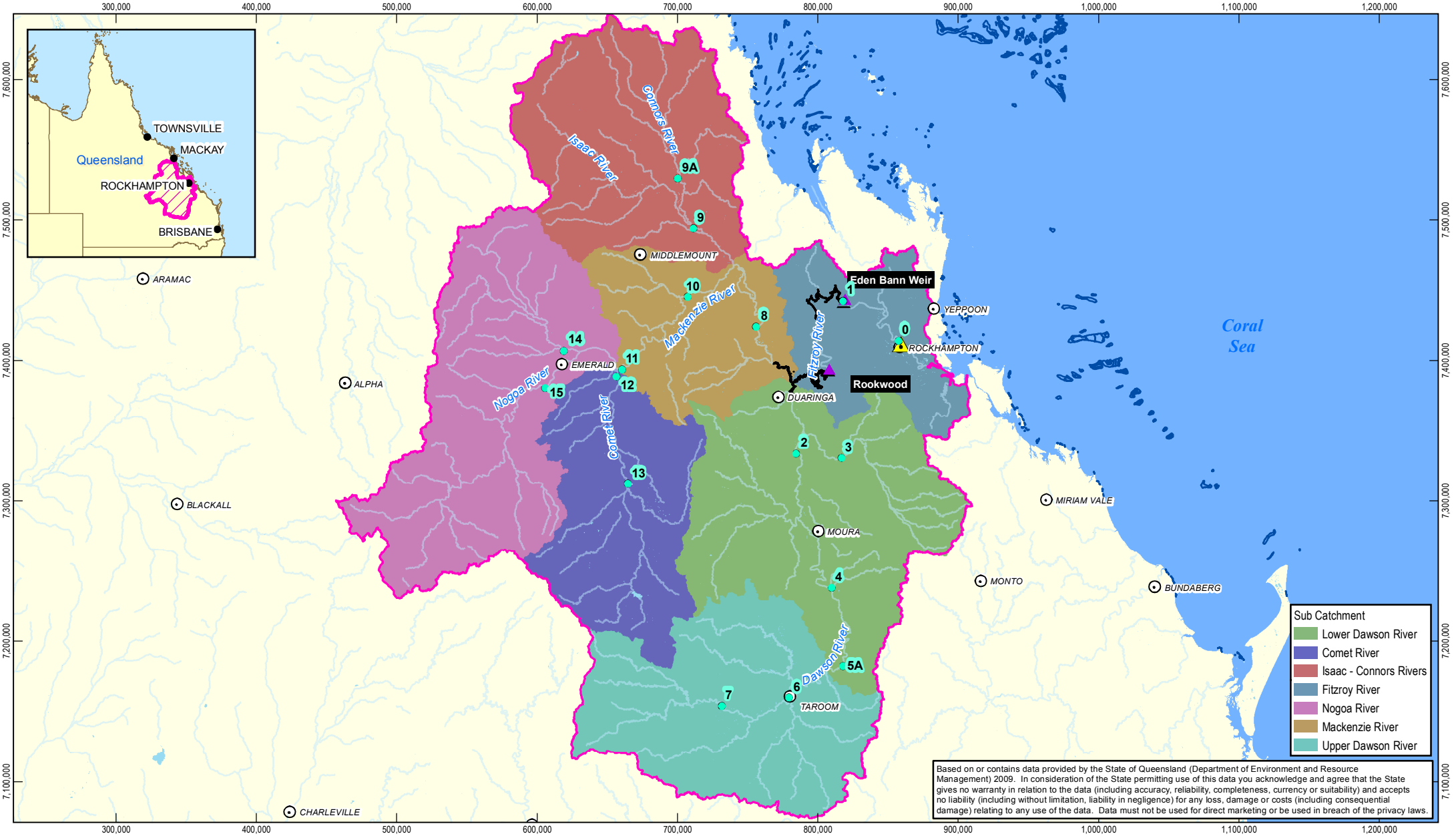
The Fitzroy WRP seeks to achieve general and specific outcomes for the sustainable management of water. The outcomes relate to providing:

- Security for water users and licence holders through the establishment of water allocation security objectives (WASOs)
- Environmental water for aquatic ecosystems through the establishment of environmental flow objectives (EFOs).

The Fitzroy WRP defines performance indicators for the WASOs (Section 1.4.3) and EFOs (Section 1.4.4) used to measure the achievement of surface water outcomes. For surface water, WASO performance indicators are associated with supplemented and unsupplemented water allocations within water supply schemes and water management areas, respectively. Geographical zones have been defined to determine the location of a water allocation within a particular reach of river as shown on Figure 1-2, namely (as relevant to the Project) Zones A through E for the Fitzroy River, Zone A for the Dawson River and Zone A for the Mackenzie River.

EFOs specifically relate to flow-based performance indicators.

Performance indicators are defined at nodes. A node mentioned in the Fitzroy WRP is a place on a watercourse within the plan area. Figure 1-1 shows Fitzroy WRP nodes within the plan area.



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0 25 50 75 100

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA94)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Weir Location
- Fitzroy Barrage
- Waterway (Major)
- Waterway (Minor)
- Fitzroy Catchment
- Lakes
- Impoundment area
- Surface water nodes

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Lower Fitzroy River Infrastructure Project

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Revision C
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Fitzroy WRP plan area

Figure 1-1

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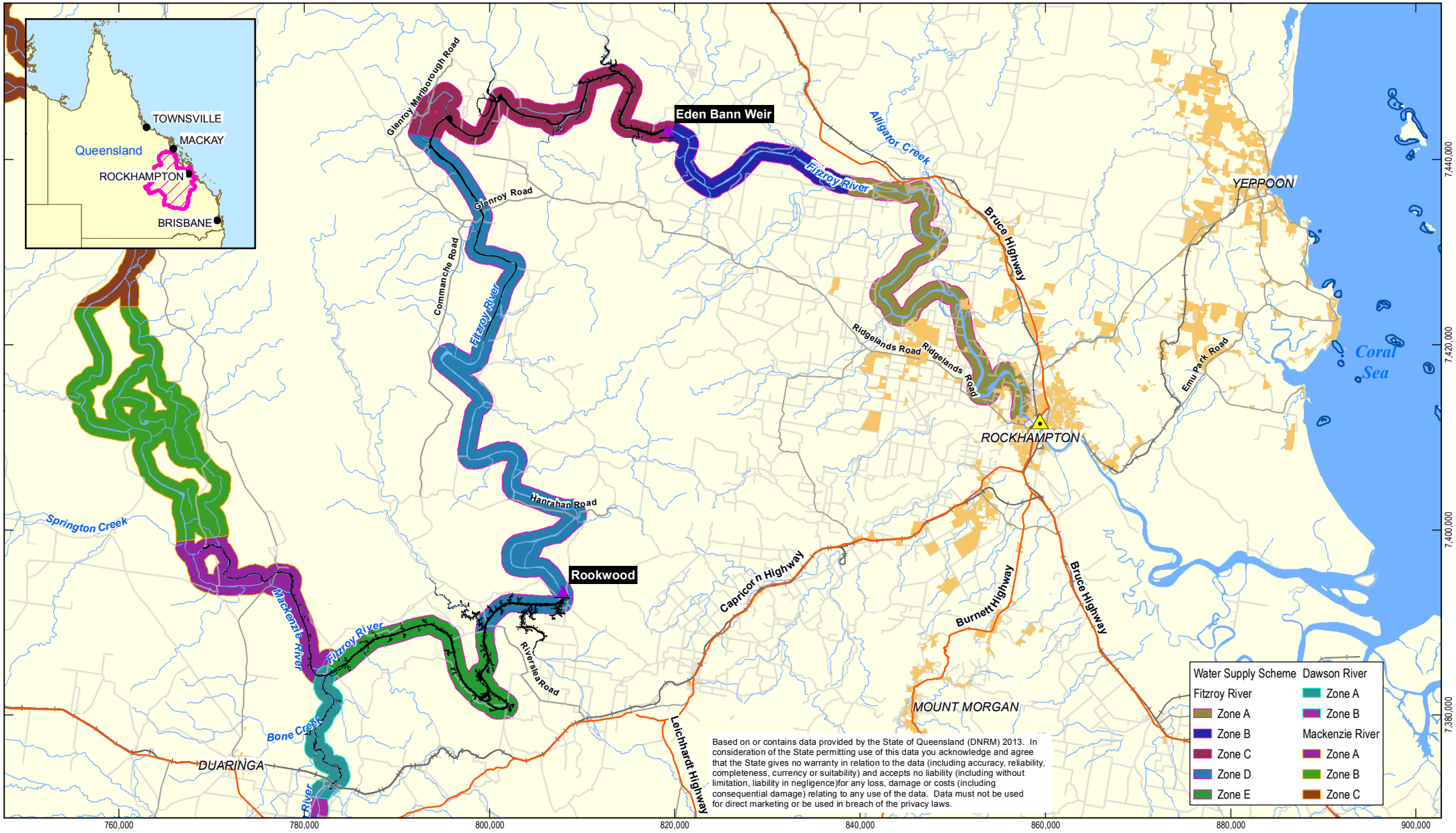

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0 5 10 15 20

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA94)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Weir Location
- Fitzroy Barrage
- Highway
- Major Road
- Streets (Local)
- Fitzroy Basin
- Urbanised Area
- Impoundment area
- Waterway

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Existing water allocation zones relative to the Project

Figure 1-2

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In relation to the Project, surface water Node 0 and surface water Node 1 are applicable. Node 0 is located on the Fitzroy River at the Fitzroy Barrage (AMTD 59.6 km). Node 1 is located on the Fitzroy River immediately downstream of the existing Eden Bann Weir (AMTD 141.2 km). The performance indicators may represent annual, monthly and other probabilities that are important to water allocation holders.

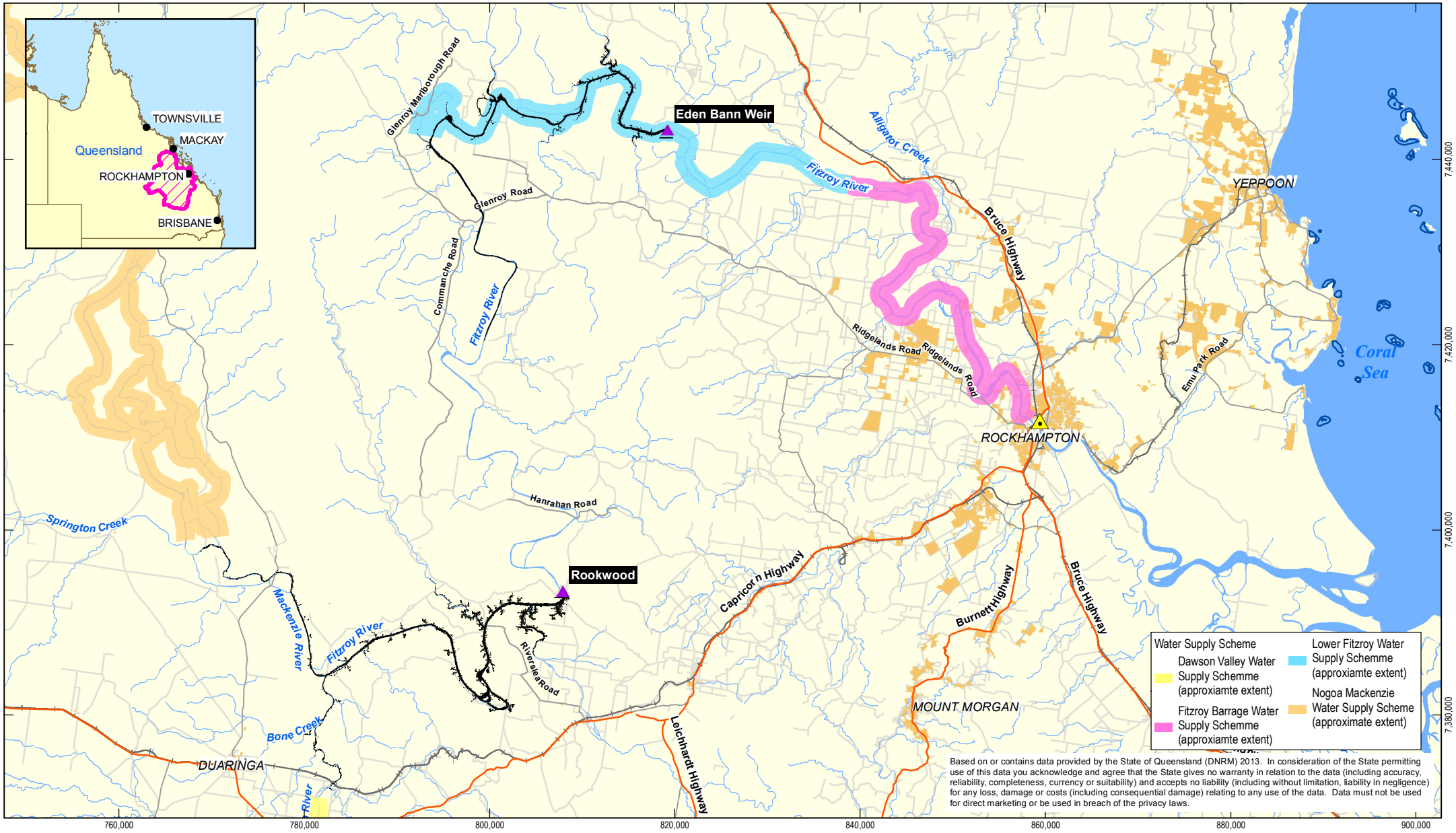
1.4.1 Supplemented water supplies

In the Project area supplemented water is supplied from Eden Bann Weir through the Lower Fitzroy Water Supply Scheme and downstream of Eden Bann Weir the Fitzroy Barrage supplies supplemented water through the Fitzroy Barrage Water Supply Scheme as shown on Figure 1-3 and described below:

- The Lower Fitzroy Water Supply Scheme comprises zones Fitzroy B and Fitzroy C and extends on the Fitzroy River from the upstream limit of Eden Bann Weir (183.4 km AMTD) to the upstream limit of the Fitzroy Barrage (115.0 km AMTD). The existing Eden Bann Weir supports the supply scheme. A resource operations license (ROL) is held by SunWater Limited for Eden Bann Weir. In the order of 94 per cent of the high priority allocation from the scheme is allocated to Stanwell Corporation Limited for the Stanwell Power Station
- The Fitzroy Barrage Water Supply Scheme (zone Fitzroy A) extends on the Fitzroy River from the upstream limit of the Fitzroy Barrage to the Fitzroy Barrage (59.6 km AMTD) at Rockhampton. The Rockhampton Regional Council (RRC) holds a ROL for the Fitzroy Barrage, which is operated by Fitzroy River Water (a business unit of RRC). All high priority water from the supply scheme is allocated to RRC. The Lower Fitzroy Water Supply Scheme, based on Eden Bann Weir, and the Fitzroy Barrage Water Supply Scheme, based on the Fitzroy Barrage, operate in conjunction with each other
- The Nogoa Mackenzie Water Supply Scheme comprises the Mackenzie A zone and extends on the Nogoa River from the upstream limit of Fairbairn Dam (737.5 km AMTD) to the Comet River junction (611.5 km AMTD); and on the Mackenzie River from the Comet River junction to the Springton Creek junction (339.3 km AMTD). The supply scheme extent falls outside of the Project area. The upper limit of inundation of a Stage 2 development at Rookwood is predicted to reach 335 km AMTD on the Mackenzie River
- The Dawson Valley Water Supply Scheme (within the Dawson A zone), particularly the lower Dawson sub-scheme that extends from the effective upstream limit of Neville Hewitt Weir (113 km AMTD) to the downstream limit of Boolburra waterhole (18.37 km AMTD), which is near Duaringa, on the Dawson River. The supply scheme extent falls outside of the Project area. The upper limit of a Stage 2 development at Rookwood is predicted to reach 16 km AMTD on the Dawson River.

1.4.2 Unsupplemented water supplies

Unsupplemented water in the Project area is managed within the Fitzroy Water Management Area (covering the Fitzroy River from the Dawson and Mackenzie Rivers' confluence to the Fitzroy Barrage) and the lower reaches of the Dawson Valley and Nogoa Mackenzie Water Management Areas (extending to the confluence of the Dawson and Mackenzie Rivers within the inundation area associated with the proposed Rookwood Weir) as shown on Figure 1-4 and described below:



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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA94)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Weir Location
- Fitzroy Barrage
- Highway
- Major Road
- Streets (Local)
- Fitzroy Basin
- Urbanised Area
- Impoundment area
- Waterway

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Supplemented water supply schemes relative to the Project

Figure 1-3

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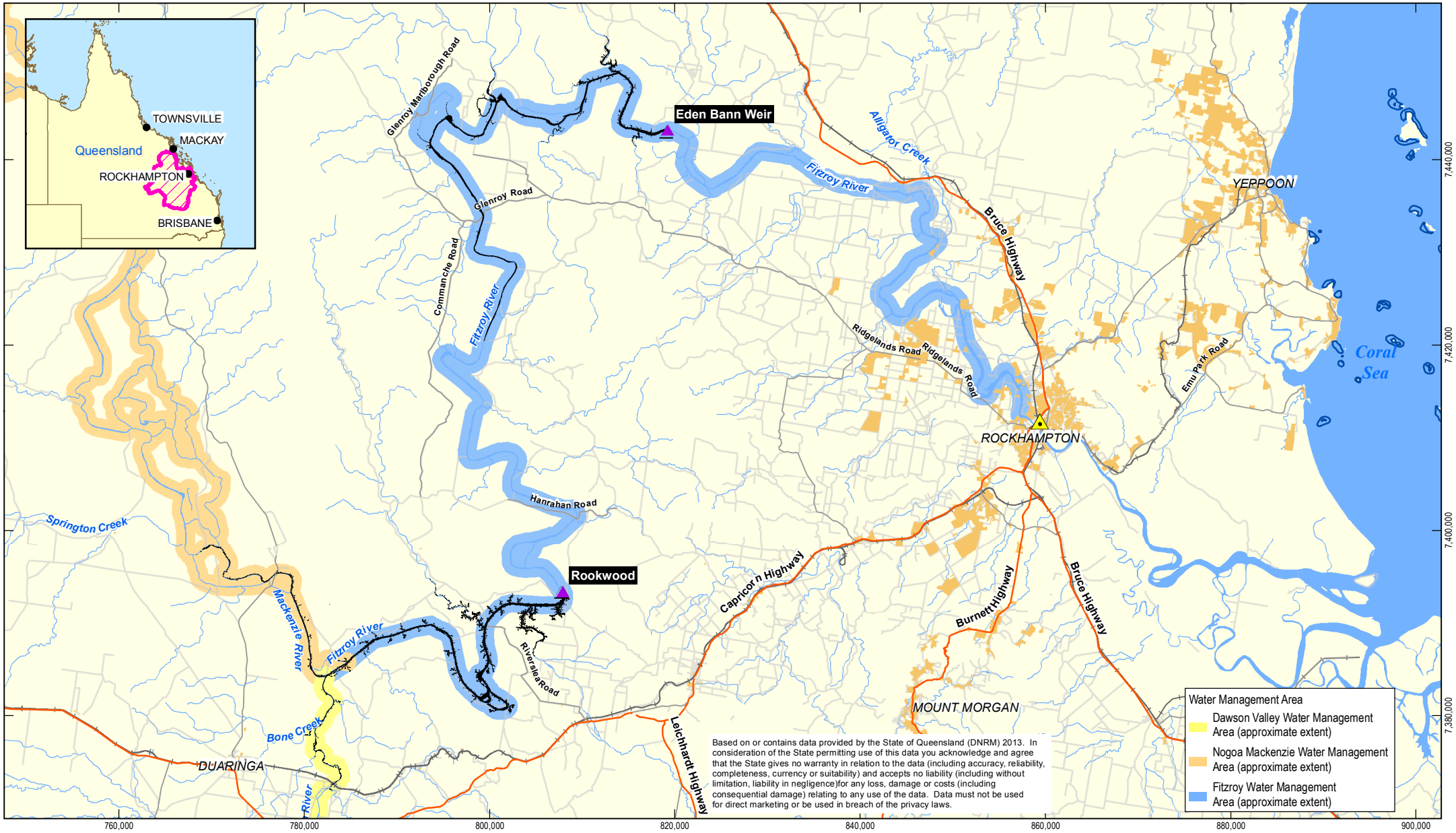

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA94)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Weir Location
- Fitzroy Barrage
- Highway
- Major Road
- Streets (Local)
- Fitzroy Basin
- Urbanised Area
- Impoundment area
- Waterway

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Existing unsupplemented water management areas relative to the project

Figure 1-4

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- The Fitzroy Water Management Area covering the Fitzroy River from the Dawson River junction to the Fitzroy Barrage and overlaps both the Lower Fitzroy and Fitzroy Barrage water supply schemes. These unsupplemented water arrangements refer to taking water under high stream flow conditions (waterharvesting) within the bounds of the both the water supply schemes and to taking any water upstream of the Eden Bann Weir pond
- The Dawson Valley Water Management Area that covers the Dawson River from the Glebe Weir pond to the Fitzroy River junction and overlaps with the Dawson Valley Water Supply Scheme
- The Nogoa Mackenzie Water Management Area covering the Nogoa and Mackenzie rivers from the Fairbairn Dam pond to the Dawson River junction and overlaps with the Nogoa Mackenzie Water Supply Scheme.

Where water management areas overlap with water supply schemes, the unsupplemented water management arrangements generally allow for the taking of water under high stream flow conditions (water harvesting) within the bounds of the water supply scheme and for the taking of any water upstream or downstream of water supply scheme limits. An unsupplemented water allocation is described in terms of volume (volumetric limit and nominal value), location, the purpose for which water may be taken, the maximum rate for taking water and the flow conditions under which it may be taken.

Flow conditions under which unsupplemented water may be taken is defined for a number of water allocation groups within the Fitzroy water Management area as described in Table 1-1.

Table 1-1 Fitzroy Water Management Area water allocation groups

Location	Zone (Fitzroy)	Water allocation group	Flow conditions
Fitzroy River from the Dawson Junction to the Fitzroy Barrage	A, B, C, D, E	Class 5A	2,592 ML/d passing flow
		Class 5B	4,320 ML/d passing flow
Fitzroy River from the Dawson River junction to the upstream limit of Eden Bann Weir	D and E	Class 6C	No flow condition 9 ML/d passing flow
		Class 7D	260 ML/d passing flow

1.4.3 Water allocation security objectives

WASOs aim to ensure that future decisions about the allocation and management of water will protect the long-term probability of water users being able to obtain water under a water allocation. WASOs are statistically derived values that provide a measure of how allocations would have been expected to perform using simulated historical data, assuming full use of existing water entitlements and development of additional unallocated water.

In the Fitzroy WRP, the WASO performance indicators for supplemented water in the Lower Fitzroy Water Supply Scheme and Fitzroy Barrage Water Supply Scheme for water allocation in the high priority group are:

- The annual supplemented water sharing index is to be at least 94 per cent
- The monthly supplemented water sharing index is to be at least 98 per cent.

For water allocations in the medium priority group the performance indicator is based on the monthly supplemented water sharing index that must be at least 82 per cent.

The annual and monthly supplemented water sharing indices are defined as the percentage of years/months (respectively) in the simulation period in which the allocations are fully supplied.

The WASO performance indicator for taking of unsupplemented surface water is the annual volume probability, for a water allocation group, defined as the percentage of years in the simulation period in which the volume of water that may be taken by the group is at least the total of the nominal volumes for the allocations in the group. WASOs for water allocations per water allocation group in the Fitzroy Water Management Area are listed in Table 1-2. The Fitzroy WRP states that the annual volume probability is to be at least the percentage stated for the group in Table 1-2.

Table 1-2 Unsupplemented surface water WASOs

Water allocation group	Flow conditions for water allocation	Annual volume probability (%)
Class 5A	2,592 ML/day passing flow	61
Class 5B	4,320 ML/day passing flow	73
Class 6C	No flow conditions, and 9 ML/day passing flow	95
Class 7D	260 ML/day passing flow	93

1.4.4 Environmental flow objectives

EFOs are specified at nodes within the Fitzroy WRP plan area and aim to:

- Protect the health and natural ecosystems from future decisions made under water resource plans.
- Minimise changes to natural flow conditions (or groundwater levels).

Performance indicators specify the part/s of the flow regime subject to limitations set for the EFOs, and includes important flow characteristics across regimes. The performance indicators for the EFOs specified in the Fitzroy WRP are:

- For assessing periods of low flow (the seasonal base flow)
- For assessing periods of medium to high flow
- For assessing the first post-winter flow (FPWF) event.

EFOs relevant to the Project are reported only at Node 0 (Fitzroy River at the Fitzroy Barrage, 59.6 km AMTD).

The seasonal base flow objectives relevant to the Project are those applying to a watercourse within a water supply scheme. The base flow for Node 0 is 288 ML/day.

The Fitzroy WRP defines guideline values for seasonal base flow indicators at Node 0 of between 0.8 and 1.2. That is the percentage of the total number of days in a water flow season in the simulation period that the base flow (288 ML/day) is equalled or exceeded should be between 0.8 and 1.2 times the percentages stated for the water flow season as detailed in Table 1-3. It is

important to note that the Fitzroy WRP states that these values 'should be' met indicting aspirational targets, rather than mandated minimum requirements.

Table 1-3 Seasonal base flow objectives (Node 0)

Water flow season	Objective
January to April	88%
May to August	57%
September to December	47%
Node 0 base flow: 288 ML/day	

Table 1-4 summarises EFOs for periods of medium to high flow that apply to Node 0, noting that all EFOs listed are mandatory requirements as indicated by the statement of 'is to be at least' or 'is to be not more than'.

The FPWF events that pass through the weirs are to mimic the pre-development flow pattern of the FPWF events in duration, timing and magnitude as per objectives summarised in Table 1-5 for Node 0. Again, EFOs listed are mandatory requirements under the Fitzroy WRP.

1.4.1 Unallocated water

Unallocated water within the Fitzroy WRP plan area is divided into a strategic reserve, strategic water infrastructure reserve and general reserve. For the Project, unallocated water held as the strategic water infrastructure reserve may be granted for water infrastructure on the Fitzroy River (nominal volume of 76,000 ML). The Project is recognised as strategic water infrastructure to which allocations may be granted. However, the Fitzroy WRP 2011 requires that decisions made about the allocation and management of water in the plan area must be consistent with WASOs and EFOs.

Table 1-4 Medium to high flow objectives (Node 0)

Performance indicator	Objective
Mean annual flow in the simulation period, expressed as a percentage of the mean annual flow for the pre-development flow pattern, is to be at least	77%
Median annual flow ratio in the simulation period, expressed a as percentage, is to be at least	58%
Annual proportional flow deviation is to be not more than	2.5
Mean wet season flow in the simulation period, expressed as a percentage of the wet season flow for the pre-development flow pattern, is to be at least	80%
Four per cent daily exceedance duration flow in the simulation period, expressed as a percentage of the four per cent daily exceedance duration flow for the pre-development flow patter, is to be at least	74%

Performance indicator	Objective
Ten per cent daily exceedance duration flow in the simulation period, expressed as a percentage of the ten per cent daily exceedance duration flow for the pre-development flow patter, is to be at least	55%
Two year daily flow volume in the simulation period, expressed as a percentage of the two year daily flow volume for the pre-development flow pattern, is to be at least	75%
Five year daily flow volume in the simulation period, expressed as a percentage of the two year daily flow volume for the pre-development flow pattern, is to be at least	87%
Twenty year daily flow volume in the simulation period, expressed as a percentage of the two year daily flow volume for the pre-development flow pattern, is to be at least	88%

Table 1-5 First post-winter flows event objectives (Node 0)

Performance indicator	Objective
Number of FPWF events in the simulation period expressed as a percentage of the number of post winter-flow years in the period is to be at least	80%
Number of five-week lag events in the simulation period expressed as a percentage of the number of post winter-flow years in the period is to be at least	60%
Number of two-week lag events in the simulation period expressed as a percentage of the number of five-week lag events in the period is to be at least	70%
Average volume ratios for the post-winter flow years in the simulation period is to be at least	70%
Average of the peak flow ratios for the post-winter flow years in the simulation period is to be at least	Not applicable
Number of two-times base flow events in the simulation period expressed as a percentage of the number of post winter-flow years in the period is to be at least	70%
Number of five-times base flow events in the simulation period expressed as a percentage of the number of post winter-flow years in the period is to be at least	70%

1.5 Fitzroy Basin Resource Operations Plan

The Fitzroy ROP is used to implement strategies in the corresponding Fitzroy WRP. The ROP achieves the objectives in the WRP by defining the rules that guide the management and allocation of water. A ROL is then granted under section 108 of the Water Act in accordance with the ROP and includes information on the licence holder, the ROP to which the licence relates, the water infrastructure, such as dams and weirs, covered by the licence, and any conditions that the holder of the licence must comply with, including operating arrangements and water supply requirements.

The Fitzroy ROP specifically deals with the management arrangements for supplemented water supply schemes and associated infrastructure, and those for unsupplemented water in water management areas. In the Project area supplemented water is supplied from Eden Bann Weir through the Lower Fitzroy Water Supply Scheme. Downstream of Eden Bann Weir the Fitzroy Barrage supplies supplemented water through the Fitzroy Barrage Water Supply Scheme (Figure 1-3). ROLs are held by SunWater for Eden Bann Weir and Rockhampton Regional Council (RRC) for the Fitzroy Barrage in each supply scheme area, respectively. Unsupplemented water in the Project area is largely managed within the Fitzroy Water Management Area (Figure 1-4).

The Fitzroy WRP reserves a nominal volume of water (76,000 ML) for strategic water infrastructure on the Fitzroy River as the strategic water infrastructure reserve. The Project is recognised as strategic water infrastructure to which water allocations may be granted.

The Fitzroy ROP specifies that submissions to make unallocated water available from the strategic water infrastructure reserve on the Fitzroy River may be made as follows:

- Gladstone Area Water Board (GAWB): up to 30,000 ML of the reserve for urban and industrial water supplies
- Local government authority: up to 4,000 ML of the reserve for urban water supplies for the Capricorn Coast

The Fitzroy ROP does not specify the intended use of the remaining 42,000 ML and nominates that any person or entity may make a submission in this regard.

1.6 Central Queensland Regional Water Supply Strategy

The CQRWSS (DNRM 2006) was initiated through the Central Queensland Regional Water Supply Study in response to prolonged severe drought that identified the need for a regional, whole-of-government approach to enable that water supply challenges could be efficiently addressed.

The CQRWSS provides an adaptive long-term statement that outlines equitable and timely solutions for future water supply needs for urban, industrial and mining and agricultural uses in the central Queensland region.

The CQRWSS concludes that for the Lower Mackenzie–Fitzroy sub-region's[1] short to medium term urban and industrial needs that cannot be met by trading or efficiency measures are expected to be met by the raising of Eden Bann Weir and construction of a weir at Rookwood (Volume 1, Chapter 1 Introduction).

[1] Approximately the lower portion of the Mackenzie River subcatchment and the whole of the Fitzroy River subcatchment including the Fitzroy Barrage and Capricorn Coast areas.

1.7 Water Supply (Safety and Reliability) Act 2008

The *Water Supply (Safety and Reliability) Act 2008* (Qld) aims to strengthen the safety and reliability of Queensland's water supply and contains regulatory provisions relating to:

- Infrastructure management and service provision by water and sewerage service providers
- Supply of drinking water by water service providers
- Production and supply of recycled water
- Dam safety including dam failure risk assessment and flood mitigation plans.

With regard to surface water a failure impact assessment (Volume 1, Chapter 20 Hazard and risk) and flood hydrology (Section 6) and hydraulic modelling (Section 7) have been undertaken for the Project to satisfy these regulatory provisions.

2. Yield modelling

2.1 Approach

2.1.1 Integrated Water Quantity and Quality Model

The Project yield is assessed using the Integrated Water Quantity and Quality Model (IQQM). IQQM is a computer program with associated statistical analysis and reporting programs developed by the Department of Natural Resources and Mines (DNRM) and the Department of Science, Information Technology, Innovation and the Arts (DSITIA). The IQQM simulates daily stream flows, flow management, storages, releases, in-stream infrastructure, water diversions, water demands and other hydrologic events in the Fitzroy WRP plan area.

The IQQM for the Fitzroy Basin (CAS2134) has been calibrated using recorded stream flow, rainfall and water use data, where available, for the simulation period. The calibrated model has been used to simulate various water resource development scenarios in the sub-catchments to inform decision-making, in particular amendments to the Fitzroy ROP (DERM, 2011). The period of simulation specifically relevant to the Fitzroy WRP is 1 January 1900 to 31 December 2007.

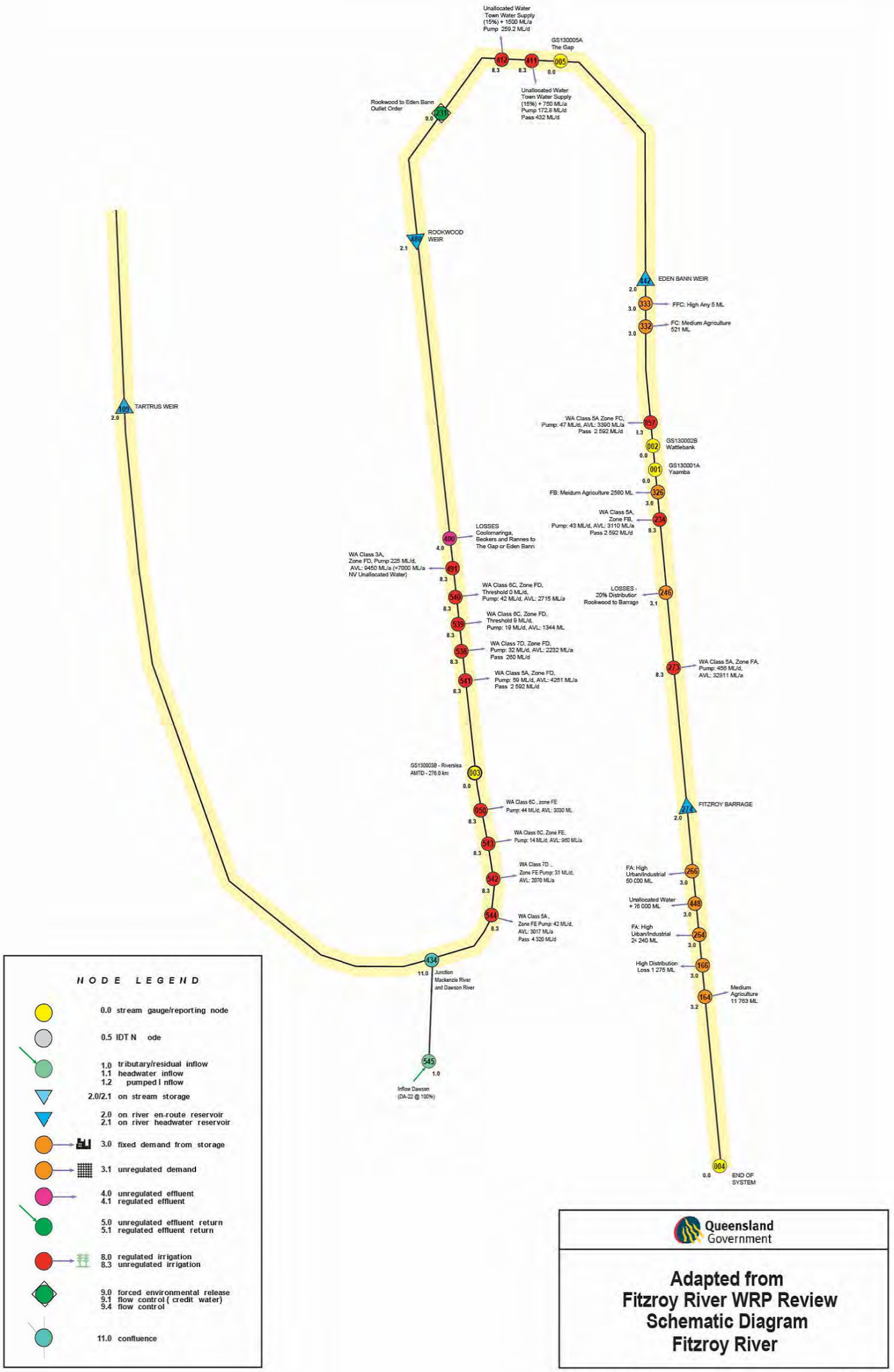
Water resources data within the IQQM (CAS2134) as provided by DSITIA included:

- Unsupplemented licensed diversions covering all water licences that affect the Fitzroy basin
- Catchment and subsequent stream flow
- Environmental low flow releases in the Fitzroy basin
- Licensed and non-licensable storages and in-stream storages
- Proposed unallocated water for each sub-catchment
- Fixed demands, such as town water supplies, industrial, agricultural (including stock and domestic)
- Supplemented and unsupplemented irrigation and water harvesting
- Minimum flow requirements (environmental flows). (DERM 2011)

For the purposes of the Project, the IQQM (CAS2134) (as augmented to IQQM-Project (Section 2.1.2) is specifically used to determine Project yields and whether the associated water extraction is consistent with the Fitzroy WRP WASOs and EFOs for surface water.

In IQQM, river systems are configured to a schematic system represented by nodes and reaches. A node in terms of IQQM can be defined as a point in a river system that has an operational or physical function associated with it, herein referred to as an IQQM node. Each IQQM node is identified by a type number defining the activity. More than one IQQM node may be located at a point where more than one function occurs. Reaches within IQQM represent the distance, and routing, throughout the catchment and link the nodes together to provide the physical drainage structure of the catchment.

Figure 2-1 provides a simplified schematic of the IQQM (CAS2134) nodes as relevant to the Project.


Unallocated Water
Town Water Supply
(15%) + 1500 ML/a
Pump 259.2 ML/d
GS130005A
The Gap
412
8.3
411
8.3
005
0.0
Unallocated Water
Town Water Supply
(15%) + 750 ML/a
Pump 172.8 ML/d
Pass 432 ML/d
Rookwood to Eden Bann
Outlet Order
2110
9.0
ROOKWOOD
WEIR
487
2.1
EDEN BANN WEIR
442
2.0
333
3.0
FFC: High Any 5 ML
332
3.0
FC: Medium Agriculture
521 ML
TARTRUS WEIR
109
2.0
WA Class 5A Zone FC,
Pump: 47 ML/d, AVL: 3360 ML/a
Pass 2 592 ML/d
057
3.3
002
0.0
GS130002B
Wattlebank
001
0.0
GS130001A
Yaamba
FB: Meidum Agriculture 2580 ML
326
3.0
WA Class 5A,
Zone FB,
Pump: 43 ML/d, AVL: 3110 ML/a
Pass 2 592 ML/d
234
8.3
LOSSES
Coolomaringa,
Beckers and Rannes to
The Gap or Eden Bann
400
4.0
WA Class 3A,
Zone FD, Pump 225 ML/d,
AVL: 9450 ML/a (+7000 ML/a
NV Unallocated Water)
491
8.3
WA Class 6C, Zone FD,
Threshold 0 ML/d,
Pump: 42 ML/d, AVL: 2715 ML/a
540
8.3
WA Class 6C, Zone FD,
Threshold 9 ML/d,
Pump: 19 ML/d, AVL: 1344 ML
539
8.3
WA Class 7D, Zone FD,
Pump: 32 ML/d, AVL: 2232 ML/a
Pass 260 ML/d
538
8.3
WA Class 5A, Zone FD,
Pump: 59 ML/d, AVL: 4281 ML/a
Pass 2 592 ML/d
541
8.3
LOSSES -
20% Distributior
Rookwood to Barrage
246
3.1
WA Class 5A, Zone FA,
Pump: 456 ML/d,
AVL: 32611 ML/a
273
8.3
GS130003B - Riverslea
AMTD - 276.0 km
003
0.0
WA Class 6C , zone FE
Pump: 44 ML/d, AVL: 3080 ML
050
8.3
WA Class 6C, Zone FE,
Pump: 14 ML/d, AVL: 980 ML/a
543
8.3
WA Class 7D ,
Zone FE Pump: 31 ML/d,
AVL: 2070 ML/a
542
8.3
WA Class 5A ,
Zone FE Pump: 42 ML/d,
AVL: 3017 ML/a
Pass 4 320 ML/d
544
8.3
FITZROY BARRAGE
474
2.0
FA: High
Urban/Industrial
50 000 ML
266
3.0
Unallocated Water
+ 76 000 ML
448
3.0
FA: High
Urban/Industrial
2+ 240 ML
264
3.0
High Distribution
Loss 1 275 ML
166
3.0
164
3.2
Medium
Agriculture
11 783 ML
434
11.0
Junction
Mackenzie River
and Dawson River
545
1.0
Inflow Dawson
(DA-22 @ 100%)
004
0.0
END OF
SYSTEM
NODE LEGEND
0.0 stream gauge/reporting node
0.5 IDT N ode
1.0 tributary/residual inflow
1.1 headwater inflow
1.2 pumped I nflow
2.0/2.1 on stream storage
2.0 on river en-route reservoir
2.1 on river headwater reservoir
3.0 fixed demand from storage
3.1 unregulated demand
4.0 unregulated effluent
4.1 regulated effluent
5.0 unregulated effluent return
5.1 regulated effluent return
8.0 regulated irrigation
8.3 unregulated irrigation
9.0 forced environmental release
9.1 flow control (credit water)
9.4 flow control
11.0 confluence
Queensland
Government
Adapted from
Fitzroy River WRP Review
Schematic Diagram
Fitzroy River
28 November 2011
A0 508256

2.1.2 Methodology

For the purposes of the Project, the IQQM is specifically used to determine Project yields and whether the proposed water extraction is consistent with the Fitzroy WRP WASOs and EFOs for surface water.

The approach adopted by the Project for yield modelling is summarised as follows:

- The IQQM for the Fitzroy Basin (IQQM (CAS2134)) was obtained from the Queensland Government (DSITIA) for use under licence
- IQQM (CAS2134) nodal parameters were assessed and agreed with DNRM and DSITIA and augmented to develop IQQM-Project
- The 'existing case' was simulated to include all existing water storage infrastructure within the Nogoa/Fitzroy system. Specifically with relevance to the Project this included the Fitzroy Barrage and existing Eden Bann Weir (Stage 1). In-flow data from the Mackenzie and Dawson rivers also accounted for the presence of proposed water storage infrastructure, namely Connors River Dam and Nathan Dam, respectively (Section 2.1.3)
- Project staging options or development scenarios were identified as described in Table 2-1
- Theoretical high priority water yield estimates were determined (existing case and Project scenarios), that is the potential maximum yield achievable per project scenario
- IQQM-Project was also run with the high priority yield capped at 76,000 ML/a (capped yield); this aligns with the supplemented water nominal volume stated in the Fitzroy WRP for water infrastructure on the Fitzroy River (strategic water infrastructure reserve)
- Post-processing of the high priority yield model runs (IQQM-Project) (for the theoretical yields and capped yield) was completed to assess compliance with the requirements of the Fitzroy WRP (WASOs and EFOs) or at least such that there is no worsening of the existing situation (existing case). Results are presented as shown in Table 2-2
- A third party review of results and findings.

Additional medium priority water availability was not specifically assessed for the Project as securing medium priority water is not the primary Project objective. Existing water sharing rules for medium priority groups in the IQQM-Project were unchanged and in accordance with the Fitzroy ROP. Post-processing assessment of compliance with the requirements of the Fitzroy WRP WASOs for medium priority users is however presented for completeness.

Table 2-1 Project development scenarios

Development scenario	Description
Eden Bann Weir Stage 1 (EB1)	The existing environment or base case, that is the system as it currently operates, included existing water storages and assumed full utilisation of all existing water entitlements.
Eden Bann Weir Stage 2 (EB2)	The existing Eden Bann Weir (EB1) raised to a new fixed crest at FSL 18.2 m AHD.
Eden Bann Weir Stage 3 (EB3)	The addition 2 m high gates to EB2 raising the weir to FSL 20.2 m AHD
Rookwood Weir Stage 1 (RW1) +	A greenfield weir development to a fixed crest at FSL 45.5 m AHD

Development scenario	Description
EB1	
RW1 +EB2	A greenfield weir development to a fixed crest at FSL 45.5 m AHD plus a raised Eden Bann Weir to FSL 18.2 m AHD.
RW1 + EB3	A greenfield weir development to a fixed crest at FSL 45.5 m AHD plus Eden Bann Weir with 2 m high gates to FSL 20.2 m AHD.
Rookwood Weir Stage 2 (RW2) + EB1	The addition of 3.5 m gates to RW1 raising the weir to FSL 49.0 m AHD
RW2 + EB2	The addition of 3.5 m gates to RW1 and a raise to EB1
RW2 + EB3	The addition of 3.5 m gates to RW1 and the addition of 2 m gates to EB2

Table 2-2 IQQM Project compliance reporting criteria

Key	Compliance criteria
	All Fitzroy WRP objectives are achieved
	Fitzroy WRP non-mandatory objectives are not achieved and the Project achieves at least the same results as the existing case
	Fitzroy WRP non-mandatory objectives are not achieved and the Project achieves results of less than the existing case
	Fitzroy WRP mandatory objectives are not achieved

The yield modelling results reported are based on the following:

- The Fitzroy WRP as accessed from https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/W/WaterReFBP11.pdf (19 June 2013)
- The Fitzroy ROP (amended October 2011, revision 3). The following are however noted:
  - The Fitzroy ROP was revised in December 2013 (revision 4). The accompanying *Fitzroy Basin Resource Operations Plan Omit Insert Document* (DNRM 2013) indicates that amendments relate to inclusion of provisions for (a) interim programs to be submitted allowing for situations where ROL holders cannot work within the ROP rules and (b) operating and environmental management rules and monitoring requirements to the interim programs comply with reporting requirements of water supply scheme ROPs.

    These amendments will enable SunWater to deliver and distribute treated coal-seam gas (CSG) water to Glebe Weir for take by agricultural and industrial customers along the Dawson River, within the Dawson Valley Water Supply Scheme. The Draft Fitzroy ROP will include specific provisions for the delivery and distribution of treated CSG water to users in the Dawson Valley Water Supply Scheme. Consequently, these amendments are not considered to influence yield modelling or assessment thereof undertaken for the Project.

  - The Fitzroy ROP is under review and is being developed to implement the strategies of the Fitzroy WRP. The Draft Fitzroy ROP was released for public comment during October 2013 to February 2014 and is expected to be finalised in late 2014. The Fitzroy Basin Draft Resource Operations Plan Overview Report (DNRM 2013) indicates that the Draft Fitzroy ROP provisions are unlikely to influence the yield modelling undertaken or the assessment thereof for the Project.
- The IQQM (CAS2134) Fitzroy Basin Nogoa/Fitzroy as provided to GAWB (and subsequently GHD as consultants for use) under licence from DSITIA.

2.1.3 Development of 'existing case'

An 'existing case' model (EB1) was developed to assess the yield associated with the existing system, that is, modelling the existing infrastructure, allocations and entitlements to assess the associated WASOs and EFOs such that the impacts of additional yield associated with the Project can be identified and used to inform the EIS.

The existing case includes all existing water storage infrastructure within the Nogoa/Fitzroy system. Specifically with relevance to the Project this includes:

- Fitzroy Barrage (FSL RL3.78m)
- Eden Bann Weir (existing Stage 1, FSL RL14.5m).

In-flow data from the Mackenzie and Dawson rivers also accounts for the presence of proposed water storage infrastructure, namely Connors River Dam and Nathan Dam, respectively. These storages are incorporated into the 'existing case' so as to conservatively represent the potential yield for the Project only. In the IQQM (CAS2134) and IQQM-Project Connors River Dam assumes a 373,662 ML capacity dam supply with 56,400 ML/a high priority allocation from the storage. For Nathan Dam, IQQM (CAS2134) and IQQM-Project assumes a dam capacity of 1,149,754 ML replacing Glebe Weir with 90,000 ML/a high priority and 10,000 ML/a medium priority allocation supplied from the storage.

Consistent with the modelled infrastructure scenarios and as agreed with DNRM, alterations were made to IQQM Node 246 (transmission loss node) (Figure 2-1) within the IQQM (CAS2134).

2.1.4 Modelled infrastructure scenarios

The existing infrastructure and entitlements were tested as:

- Existing Eden Bann Weir (existing case) (EB1).

The infrastructure staging options for the Project are:

- Eden Bann Weir raised to fixed crest (Full Supply Level (FSL) RL[2] 18.2 m) (EB2)
- Eden Bann Weir raised with 2.0 m gates (FSL RL18.2 m) (EB3)
- Rookwood Weir constructed to fixed crest (FSL RL45.5 m) (RW1)
- Rookwood Weir raised with 3.5 m gates (FSL RL49.0 m) (RW2)
- A combination thereof.

The modelled scenarios are described in Table 2-3.

[2] RL = reduced level

Table 2-3 Project development scenarios modelled

Development scenario	Description
Eden Bann Weir Stage 1 (EB1)	The existing environment or base case, that is the system as it currently operates, included existing water storages and assumed full utilisation of all existing water entitlements.
Eden Bann Weir Stage 2 (EB2)	The existing Eden Bann Weir (EB1) raised to a new fixed crest at FSL 18.2 m AHD.
Eden Bann Weir Stage 3 (EB3)	The addition 2 m high gates to EB2 raising the weir to FSL 20.2 m AHD
Rookwood Weir Stage 1 (RW1) + EB1	A greenfield weir development to a fixed crest at FSL 45.5 m AHD
RW1 +EB2	A greenfield weir development to a fixed crest at FSL 45.5 m AHD plus a raised Eden Bann Weir to FSL 18.2 m AHD.
RW1 + EB3	A greenfield weir development to a fixed crest at FSL 45.5 m AHD plus Eden Bann Weir with 2 m high gates to FSL 20.2 m AHD.
Rookwood Weir Stage 2 (RW2) + EB1	The addition of 3.5 m gates to RW1 raising the weir to FSL 49.0 m AHD
RW2 + EB2	The addition of 3.5 m gates to RW1 and a raise to EB1
RW2 + EB3	The addition of 3.5 m gates to RW1 and the addition of 2 m gates to EB2

2.1.5 Nodal parameterisation

A node-by-node interrogation of all the supplied IQQM files (CAS2134) was completed in consultation with DSITIA, DEWS and DNRM. While all water resources data, licence operations rules and environmental flow rules as provided in the IQQM (CAS2134) were used for the assessment, the following four primary amendments were made for the 'existing case' or development infrastructure options as appropriate for the Project:

- Revised storage capacity curves to reflect updated survey data for Rookwood Weir
- Revised infrastructure details and preliminary designs for the Project
- Alteration to IQQM node 246, a transmission loss node
- Alteration to the release operating rules for IQQM node 231 to adequately describe releases from Rookwood Weir.

These changes were undertaken to more accurately reflect the existing situation, the Project and its operational intent.

2.2 Yield assessment results

2.2.1 Theoretical high priority yields

Theoretical yield results achievable for the Project are presented in Table 2-4. Section 2.2.3 and Section 2.2.4 summarise outputs of post-processing to test compliance with Fitzroy WRP WASOs and EFOs, respectively.

Table 2-4 High priority theoretical yields

Scenario	Theoretical Project yield (ML/a)	Annual water sharing index (94%)	Monthly water sharing index (98%)
EB1	0	Not applicable	Not applicable
EB2	35,000	94.4	98.7
EB3	50,000	94.4	98.8
RW1 + EB1	54,000	94.4	98.8
RW1 + EB2	77,000	95.3	98.7
RW1 + EB3	87,000	94.4	98.6
RW2 + EB1	86,000	95.3	98.7
RW2 + EB2	105,000	94.4	98.5
RW2 + EB3	110,000	94.4	98.5

2.2.2 Capped (76,000 ML/a) high priority yield

As stated in the Fitzroy WRP, the strategic infrastructure reserve volume for supplemented water allocations is 76,000 ML. Five infrastructure scenarios listed in Table 2-5 achieve high priority yields of at least 76,000 ML/a. IQQM-Project runs have been undertaken with the yield capped at 76,000 ML/a for these development scenarios and post-processing undertaken to test compliance with WASOs and EFOs. Section 2.2.3 and Section 2.2.4 provide commentary on outputs of post-processing to test compliance with Fitzroy WRP WASOs and EFOs, respectively.

Table 2-5 High priority Project yield capped (76,000 ML/a)

Scenario	Annual water sharing index (94%)	Monthly water sharing index (98%)
RW1 + EB2	95.3	98.7
RW1 + EB3	96.3	99.0
RW2 + EB1	96.3	99.0
RW2 + EB2	97.2	99.1
RW2 + EB3	97.2	99.3

2.2.3 Water allocation security objectives

2.2.3.1 Supplemented water supply

Post processing of the theoretical yield volumes (Table 2-4) was completed to assess compliance with Fitzroy WRP WASOs.

Table 2-6 provides a summary of compliance with high and medium priority user group supplemented WASOs in the Lower Fitzroy Water Supply Scheme and the Fitzroy Barrage Water Supply Scheme.

Table 2-6 Compliance with high and medium priority supplemented water user group WASOs

Infrastructure scenario	Theoretical Project yield (ML/a)	High priority user groups		Medium priority user groups
		Annual supplemented water sharing index (94%)	Monthly supplemented water sharing index (98%)	Monthly supplemented water sharing index (82%)
EB1	0			
EB2	35,000			
EB3	50,000			
RW1 + EB1	54,000			
RW1 + EB2	77,000			
RW1 + EB3	87,000			
RW2 + EB1	86,000			
RW2 + EB2	105,000			
RW2 + EB3	110,000			

Key: All Fitzroy WRP objectives are achieved

Table 2-6 indicates that the WASOs are achieved at the theoretical yield volumes.

For infrastructure scenarios that achieve at least 76,000 ML/a (Table 2-5) (if the yield is capped at 76,000 ML/a) WASOs are achieved and water sharing indices for high priority user groups are improved.

The results for medium priority user group supplemented WASOs suggested that due to more water being available in the system as a result of the increased storage provided by the Project, that rules in the IQQM for medium priority users may be allowing an increased reliability for medium priority users thus allowing them an equivalent 'take' to high priority water.

It is not the Project's intent to increase medium priority supplemented water supply and/or improve medium priority water user groups' supply reliability. Water sharing rules will be further investigated during augmentation of the Fitzroy ROP once the Project is triggered. It is likely that operating rule adjustments will be made to bring medium priority users supply reliabilities back in line with their existing WASOs.

2.2.3.2 Unsupplemented water supply

Post-processing of the theoretical yield volumes (Table 2-4) was completed to assess compliance with Fitzroy WRP WASOs. Table 2-7 provides a summary of compliance with unsupplemented water user group WASOs in the Fitzroy Water Management Area.

Table 2-7 indicates that unsupplemented WASOs are achieved for flow classes 5B, 6C and 7D for all infrastructure scenario adopted yields. Unsupplemented WASOs are achieved for flow Class 5A under infrastructure scenario EB2. For the remaining infrastructure scenarios the system average annual volume probabilities fall between one and five per cent below the specified objective.

Table 2-7 Compliance with unsupplemented water user group WASOs

Infrastructure scenario	Theoretical Project yield (ML/a)	Water allocation group (annual volume probability) (%)			
		Class 5A (61%)	Class 5B (73%)	Class 6C (95%)	Class 7D (93%)
EB1	0				
EB2	35,000				
EB3	50,000				
RW1 + EB1	54,000				
RW1 + EB2	77,000				
RW1 + EB3	87,000				
RW2 + EB1	86,000				
RW2 + EB2	105,000				
RW2 + EB3	110,000				

Key: All Fitzroy WRP objectives are achieved

Fitzroy WRP mandatory objectives are not achieved

2.2.4 Environmental flow objectives

Summaries of compliance with Fitzroy WRP environmental objectives are provided for the existing system and infrastructure scenarios at the theoretical high priority yields as follows:

- Table 2-8 provides a summary of compliance with seasonal base flow environmental objectives
- Table 2-9 provides a summary of compliance with medium to high flow environmental objectives
- Provides a summary of compliance with FPWF event environmental objectives.

Table 2-8 Compliance with seasonal base flow environmental objectives

Infrastructure scenario	Theoretical Project yield (ML/a)	Water flow season (non-mandatory objective 0.8 – 1.2)		
		January - April	May - August	September - December
EB1	0			
EB2	35,000			
EB3	50,000			
RW1 + EB1	54,000			
RW1 + EB2	77,000			
RW1 + EB3	87,000			
RW2 + EB1	86,000			
RW2 + EB2	105,000			
RW2 + EB3	110,000			

Key: All Fitzroy WRP objectives are achieved

Fitzroy WRP non-mandatory objectives not achieved and Project achieves at least the same results as existing case

Fitzroy WRP non-mandatory objectives are not achieved and Project achieves results of less than the existing case

Table 2-9 Compliance with medium to high flow environmental objectives

Medium to high flow environmental objective performance indicators (Objective)	Infrastructure scenarios (theoretical Project yield in ML/a)								
	EB1	EB2 (35,000)	EB3 (50,000)	RW1 + EB1 (54,000)	RW1 + EB2 (77,000)	RW1 + EB3 (87,000)	RW2 + EB1 (86,000)	RW2 + EB2 (105,000)	RW2 + EB3 (110,000)
Mean annual flow (77%)									
Median annual flow ratio (58%)									
Annual proportional flow deviation (2.5)									
Mean wet season flow (80%)									
2-year daily flow volume (75%)									
5-year daily flow volume (87%)									
20-year daily flow volume (88%)									
4% daily exceedance duration flow (74%)									
10% daily exceedance duration flow (55%)									

Key: All Fitzroy WRP objectives are achieved

Fitzroy WRP mandatory objectives are not achieved

Table 2-10 Compliance with first post-winter flow event objectives

FPWF event objective performance indicators (Objective)	Infrastructure scenarios (theoretical Project yield in ML/a)								
	EB1	EB2 (35,000)	EB3 (50,000)	RW1 + EB1 (54,000)	RW1 + EB2 (77,000)	RW1 + EB3 (87,000)	RW2 + EB1 (86,000)	RW2 + EB2 (105,000)	RW2 + EB3 (110,000)
Number of FPWFs (80%)									
Number of five-week lag events (60%)									
Number of two-week lag events (70%)									
Average volume ratios (70%)									
Average of the peak flow ratios									
Number of two-times base flow events (70%)									
Number of five-times base flow events (70%)									

Key: All Fitzroy WRP objectives are achieved

Table 2-8 indicates that seasonal base flow environmental benchmark objectives are met for all infrastructure scenarios at theoretical yields (Table 2-4) during the January to April water flow season. During the May to August water flow season and September to December water flow season the existing system (represented by the existing case as EB1) does not meet the Fitzroy WRP seasonal base flow objectives, reporting 0.7 and 0.6, respectively against the 0.8-1.2 benchmark values. Similarly all Project infrastructure scenarios achieve the same or similar values. No alteration was made to the EFO rules in the IQQM (CAS2134) received from DSITIA. Discussions with DNRM and DSITIA indicate that while the Project does not achieve the guideline objectives they are considered appropriate as they do not further adversely impact on the existing situation and are consistent with the non-mandatory nature of the specific EFOs.

As indicated in Table 2-9 all infrastructure scenarios comply with medium to high flow EFOs except scenario RW2+EB3 which failed against the 20 year daily flow volume objective, reporting 87.46 per cent against the 88 per cent benchmark. It is noted that RW2+EB3 yield may be limited by the Fitzroy WRP requirement to achieve the 20 year daily flow volume. Alternatively operating rules may be modified.

Table 2-9 shows that all FPWF event EFOs are achieved for all Project infrastructure scenarios at the adopted yields (Table 2-4).

For infrastructure scenarios that achieve at least 76,000 ML/a (Table 2-5) and if the yield is capped at 76,000 ML/a compliance with Fitzroy WRP EFOs is summarised as follows:

- Seasonal base flows: compliance reflects that shown for the theoretical yields in Table 2-4. Benchmark objectives are met for all infrastructure scenario yields during the January to April water flow season. During the May to August water flow season and September to December water flow season the existing system (represented by the existing case as EB1) does not meet the seasonal base flow objectives, reporting between 0.6 and 0.7, respectively against the 0.8-1.2 benchmark values. Similarly all Project infrastructure scenarios achieve these same values and again there is no worsening situation as a result of the Project
- Medium to high flows: all benchmark objectives are met, including the 20-year daily flow volume at RW2+EB3
- FPWF events: all benchmark objectives are met.