2. Project description

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2.1 Overview of the Project

The Lower Fitzroy River Infrastructure Project (Project) is the construction and operation of a raised Eden Bann Weir and/or a new weir at Rookwood on the Fitzroy River, Central Queensland. The Fitzroy River forms at the confluence of the Mackenzie (flowing from the north) and Dawson (flowing from the south) rivers flowing out into the Coral Sea (including the Great Barrier Reef World Heritage Area (GBRWHA) and Marine Park (GBRMP)), some 300 km downstream. The Fitzroy River passes through the city of Rockhampton which lies approximately 59 km from the river mouth.

Key Project components include the following:

- Eden Bann Weir
  - Eden Bann Weir Stage 2 (EB2) – a raise of the existing Eden Bann Weir to a full supply level (FSL) 18.2 m Australian Height Datum (AHD) and associated impoundment of the Fitzroy River
  - Eden Bann Weir Stage 3 (EB3) – the addition of 2 m high flap gates to achieve FSL 20.2 m AHD and associated impoundment of the Fitzroy River.
- Rookwood Weir
  - Rookwood Weir Stage 1 (RW1) – a new build to FSL 45.5 m AHD, saddle dams and associated impoundment of the Fitzroy, Mackenzie and Dawson rivers.
  - Rookwood Weir Stage 2 (RW2) – the addition of 3.5 m high flap gates to achieve FSL 49.0 m AHD and associated impoundment of the Fitzroy, Mackenzie and Dawson rivers.
- Any combination of the above
- Fish passage infrastructure and turtle passage infrastructure, namely fish locks and a turtle bypass, respectively, at each weir.

Other infrastructure components associated with the Project include:

- Augmentation to and construction of access roads (public and private) to and from the weir sites for construction and operations and upgrades to intersections
- Construction of low level bridges in areas upstream of weir infrastructure impacted by the impoundments, specifically at Glenroy, Riverslea and Foleyvale crossings
- Installation of culverts at Hanrahan Crossing downstream of Rookwood Weir to facilitate access during operation releases
- Relocation of existing and/or installation of new gauging stations
- Removal and decommissioning of existing low level causeways and culverts at river crossings described above
- Water supply for construction will be sourced directly from the Fitzroy River (weir infrastructure and Glenroy, Riverslea and Hanrahan crossings) and the Mackenzie River (Foleyvale Crossing) and will not require the construction of additional water supply infrastructure. Operational water for services/facilities at the weir sites will primarily be provided through rainwater harvesting systems.

The location of Project and its key components is shown in Chapter 1 Introduction.

For the purposes of assessment, the Project is divided into the following areas:

- Project footprint (Section 2.2.1 and Section 2.2.2)
  - Weir infrastructure comprising the permanent weir wall and abutments, spillway, fish and turtle passage infrastructure, control room and amenities, immediate downstream protection areas and saddle dams, as applicable to Eden Bann Weir and Rookwood Weir
  - Weir construction area incorporating the weir infrastructure area in addition to other in stream works such as coffer dams and excavations and areas adjacent to the river for the establishment of site facilities, as applicable to Eden Bann Weir and Rookwood Weir
  - Weir impoundment comprising the area within the riverbed and banks inundated at FSL and adjacent riparian areas that will be the subject of a water storage easement
  - Weir access roads (public and private, including intersection treatments)
  - River crossings comprising Glenroy, Riverslea, Foleyvale and Hanrahan crossings inclusive of road approaches
- Downstream riverine areas (Section 2.2.3) comprising river sections downstream of Rookwood and Eden Bann weirs to the Fitzroy Barrage, excluding existing impoundments
- Downstream estuarine/marine areas (Section 2.2.3) comprising areas downstream of the Fitzroy Barrage to the Great Barrier Reef Marine Park.

Details of the design, construction and operation of the Project are presented in following sections of this Chapter, and include design plans where applicable.

Operationally the Project comprises the maintenance and management of the weir infrastructure, private access roads and impoundments, inclusive of a flood buffer. Water releases will be made through 'run of river' methods and no water distribution infrastructure is required as part of the Project. It is expected that such infrastructure is or would be subject to its own separate environmental assessment process, for example as is the case for the Gladstone-Fitzroy Pipeline Project (Chapter 1 Introduction). Water releases will be made to satisfy environmental flow and water allocation security objectives in accordance with the Water Resource (Fitzroy Basin) Plan 2011 (Fitzroy WRP). Operating regimes will be developed and implemented through the Fitzroy Basin Resource Operations Plan (Fitzroy ROP) (as augmented) (Chapter 9 Surface water resources).

The development of weir infrastructure (and associated works), the resultant storage of water (inundation of the river bed and banks) and the transfer of water between storages through 'run of river' methods on the Fitzroy River comprise the scope of the Project. Abstraction, transmission and distribution to end users are not considered as part of the proposed Project and are subject to their own environmental investigations and approvals where applicable.

In addition the following infrastructure requirements have been considered for the Project and will be assessed under separate approvals processes:

- Power supply – Power supply to Eden Bann Weir already exists but may require augmentation as a result of the Project. New power supply infrastructure is required to service Rookwood Weir (Section 2.3.3.5). Separate applications will be made to Ergon Energy in this regard and assessment is not included within this draft environmental impact statement (EIS)

- Telecommunications - Similarly the provision of telecommunication infrastructure will be required at Rookwood Weir (Section 2.3.3.6). Separate applications will be made to service providers as applicable and assessment is not included within this draft EIS
- Construction material resource extraction areas – Potential construction material resource extraction areas to be used for the construction of each weir and associated infrastructure have been identified in close proximity to the weirs (Section 2.3.3.7). Subject to further sampling and investigations, separate assessments will be undertaken and approval of these areas will be sought and they are not included for assessment within this draft EIS.

Environmental design features of the Project include:

- Modification of an existing fishlock and provision of new fishways to facilitate fish passage over a range of impoundment levels (high and low) at Eden Bann Weir and the proposed Rookwood Weir as applicable
- Outlets that facilitate a range of release volumes, for example low or base flow discharge for water releases to meet downstream water allocations and base level environmental flow requirements and high flow releases to meet the high capacity post-winter environmental flow requirements
- Outlets with selective offtakes to manage the quality of water released
- Screens, surface treatments, stilling basins and operation of the outlets to allow controlled incremental release of water volumes to avoid and minimise injury and mortality of aquatic fauna
- Turtle passage infrastructure to facilitate movement of turtles around the weirs
- Construction programme and staging to avoid or minimise impacts on fish passage and turtle nesting periods as applicable
- Provision of low level bridges to provide improved access to the road network and improved immunity of river crossings during floods.

The Project is expected to be staged, with sequencing and timing dependant on a number of demand triggers including existing and new consumers, drought conditions and security of supply requirements. The Project will be implemented by way of a flexible strategy to allow the rapid delivery of water to meet anticipated future demands, when triggered (Chapter 1 Introduction). Investigations and preparatory works, including the draft EIS, are currently being carried out to ensure that this objective is achieved.

There is yet to be a decision on the order or composition in which the proposed developments will proceed.

Based on preliminary design with an accuracy of ±30 per cent capital costs (as at March 2014) for the weirs (calculated as standalone staged developments) are estimated as follows:

- Eden Bann Weir Stage 2: $123 million
- Eden Bann Weir Stage 3: $151 million
- Rookwood Weir Stage 1: $154 million
- Rookwood Weir Stage 2: $177 million.

Total Project costs (capital costs and including estimates for environmental treatment, management and offsets as well as land and property acquisition and compensation for injurious affection) (as at March 2014) are estimated as follows (calculated as standalone staged developments):

- Eden Bann Weir Stage 2: $204 million
- Eden Bann Weir Stage 3: $234 million
- Rookwood Weir Stage 1: $232 million
- Rookwood Weir Stage 2: $261 million.

Construction (per stage) is programmed to occur over at least two dry seasons (Section 2.4.4). A contract start time for draft EIS reporting purposes has been set so that site activities, particularly those related to the riverbed construction activities can commence at the end of the wet season (Q1 Year 1) due to the unpredictability and magnitude of the flows during the wet season. Further detail with regard to Project timeframe in relation to triggers is provided in Chapter 1 Introduction.

The milestones and timeframes for the Project are as follows, noting that an actual start date will be determined by a demand trigger coinciding with seasonal factors as explained above:

- Preparatory and early works (15 to 18 months prior to Q1 Year 1)
- Contract award (Q1 Year 1)
- Commencement of construction (start-Q1 Year 1)
- Spillway concrete complete (start-Q4 Year 2)
- Commencement of impounding (mid-Q4 Year 2)
- Weir construction practically complete (end-Q4 Year 2)
- Impoundment is expected to occur within a single wet season during which commissioning will take place (Chapter 9 Surface water resources).

2.2 Project location

2.2.1 Eden Bann Weir Project footprint

Eden Bann Weir is located approximately 62 km north-west of Rockhampton in central Queensland on the Fitzroy River at 141.2 km adopted middle thread distance (AMTD) from the coast. The existing impoundment extends to 184 km AMTD. Impoundment associated with Eden Bann Weir Stage 2 extends along the Fitzroy River to 205 km AMTD. The upstream extent of the Eden Bann Weir impoundment at Stage 3 is 211 km AMTD on the Fitzroy River.

Land use adjacent to the Eden Bann Weir Project area consists predominantly of large, rural agricultural (cattle grazing) land holdings. Settlement in the area is sparse and scattered. Views of, to and from the existing Eden Bann Weir are shown in Figure 2-1. A single homestead is identified as a sensitive receptor (mainly in terms of potential air and noise emissions during construction) in proximity to the weir site (Chapter 5 Land, Chapter 12 Air quality and Chapter 14 Noise and vibration) as shown in Figure 2-2. Figure 2-2 also shows the location of Eden Bann Weir infrastructure and impoundment extents at full supply levels.

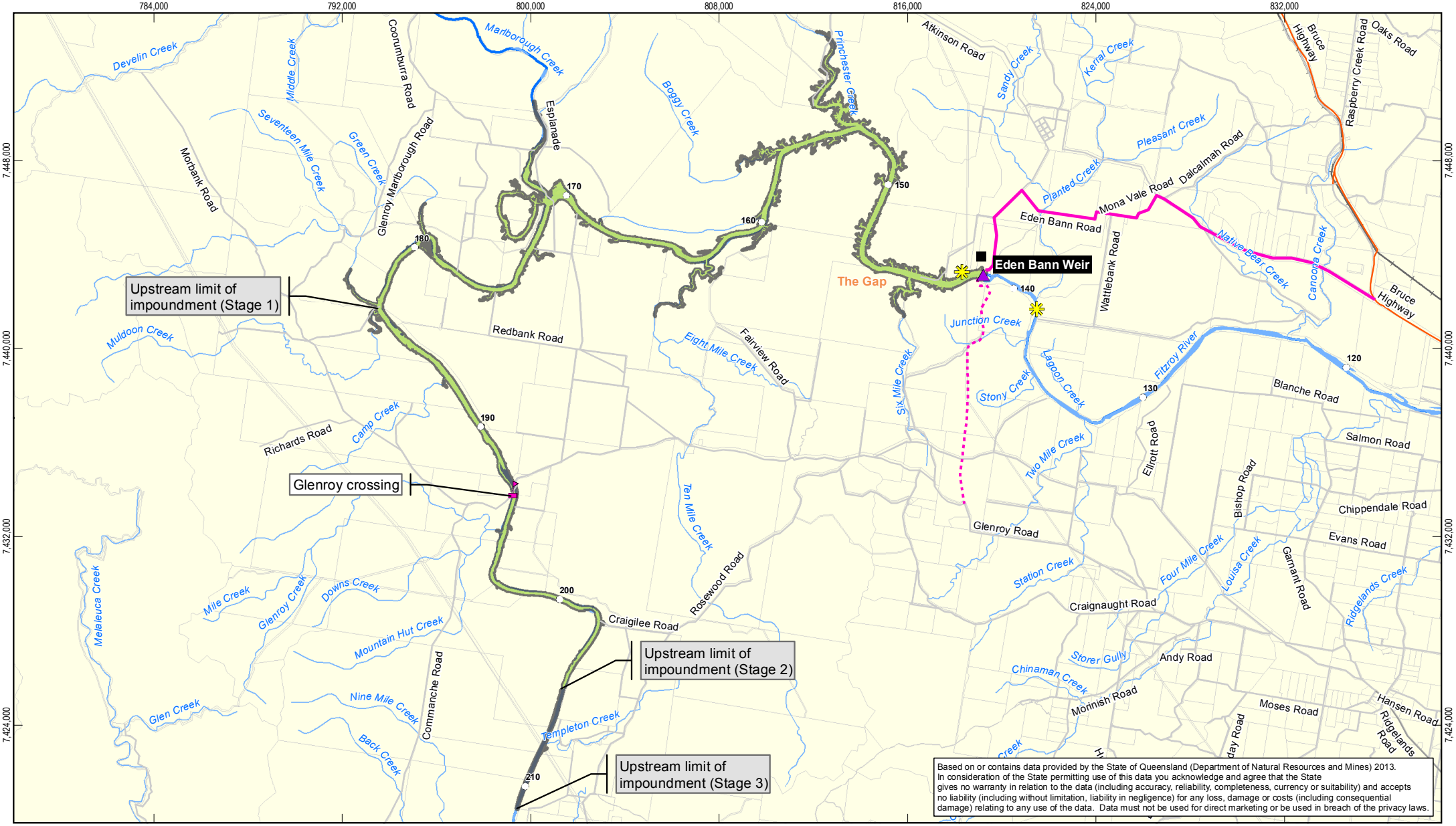
Figure 2-1 Existing Eden Bann Weir views

Left bank outlet works and fish lock

Right bank (downstream) looking across to the left bank

Left embankment and approach

Left embankment (upstream) looking across to the right bank



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0 2 4 6 8

Kilometres

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

N

LEGEND

- AMTD (km)
- Weir
- Location
- Fitzroy Barrage
- River Crossing
- Homestead
- Gauging Station
- Highway
- Major Road
- Streets (Local)
- Waterway
- Property Boundary
- Eden Bann Weir Stage 2 impoundment
- Eden Bann Weir Stage 3 impoundment
- Proposed Access Road
- Existing Access Road
- Fitzroy Basin

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Eden Bann Weir infrastructure and impoundment locations

Figure 2-2

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The Eden Bann Weir construction area is shown on Figure 2-3 and discussed in Section 2.4.1.1. No on site workers' accommodation will be required. The construction workforce will be housed locally in Rockhampton (or other local towns) and transported by bus and utility vehicles to and from the site via the existing public road network and new and existing access roads. Temporary site facilities will comprise site offices and general amenities (including emergency first aid facilities), workshops and power generators, storage, stockpile and laydown areas, concrete batching plants, internal access tracks and helipad, as applicable and subject to final determination during the detailed design phase. These facilities will be managed in accordance with all legislative requirements including the Health (Drugs and Poisons) Regulations 1996 and the *Tobacco and Other Smoking Products Act 1999* (Qld).

Existing road access to Eden Bann Weir is via the left bank from the Bruce Highway at Rockhampton and local gravel roads (Atkinson Road, Mona Vale Road and Eden Bann Road) and a private road. All public roads to be utilised are two-wheel drive accessible and are suitable for construction and operation vehicle access. The existing private road will require minor upgrades. An easement accommodates the existing access road within Lot 2016 on plan RP841502.

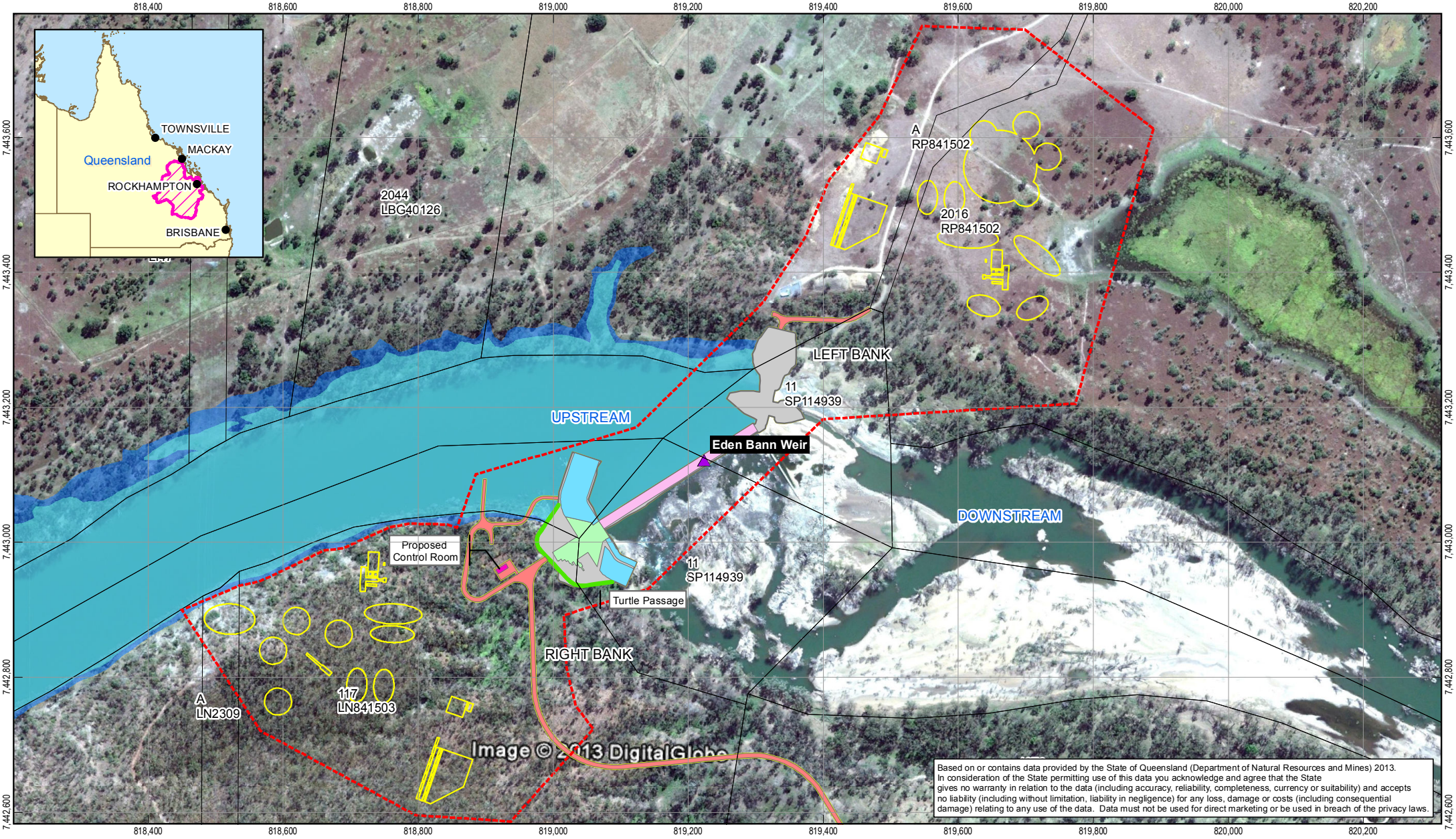
A new (12 km) access road will be constructed to the right (southern) bank of the Eden Bann Weir off Ridgelands and Marble Ridges roads providing access through to Rockhampton for construction and operation as described in Section 2.3.3.1. Figure 2-4 shows existing and proposed access routes to Eden Bann Weir.

A new low level bridge will be constructed at Glenroy Crossing (at 193 km AMTD on the Fitzroy River) (Figure 2-2) to replace the existing low level causeway within the proposed impoundment (Section 2.3.3.2). The location of temporary construction site facilities for this site will be determined during the detailed design phase.

The Eden Bann Weir Project footprint falls within the Rockhampton Regional Council (RRC) and Livingstone Shire Council (LSC) local government areas (LGAs). SunWater currently own and operate Eden Bann Weir under a Perpetual Lease (Lot 11 SP114939) (weir infrastructure only). Land either side of the weir is held in freehold. The Fitzroy River is Unallocated State Land (USL). The Eden Bann Weir impoundment as part of the watercourse holds no specific tenure. Land adjacent to the watercourse is largely held as freehold tenure. Some leasehold and reserve tenures exist. A State Forest area adjacent to the proposed impoundment is present. Further detail with regard to land tenure is provided in Chapter 5 Land.

At full supply levels, the Eden Bann Weir impoundments will include land in freehold/leasehold tenure on the river banks. In these areas, it is proposed that the Project will seek to secure a water storage easement by agreement, or where the head of power exists, through a resumption process. Further it is proposed to extend the easement to contain an agreed buffer area (flood margin or maintenance buffer). An easement exists over land accommodating the existing left bank access road. An easement will be required over freehold lots traversed by the new access road on the right bank. Subject to agreement with RRC and final design parameters, resumption of freehold and reserve land at Glenroy Crossing may be required for works outside of the existing road reserve. Further detail on land tenure is provided in Chapter 5 Land.

There are no stock routes associated with the Eden Bann Weir Project footprint.



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0 50 100 150 200

Metres

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 Basin
- Access Roads
- Channel
- Outlet works and fishway
- Proposed Control Room
- Proposed Spillway
- Turtle Passage
- Eden Bann Weir Proposed Structure
- Construction Footprints
- Construction Area
- Eden Bann Weir Stage 2 impoundment
- Eden Bann Weir Stage 3 impoundment

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Eden Bann Weir construction area

Figure 2-3

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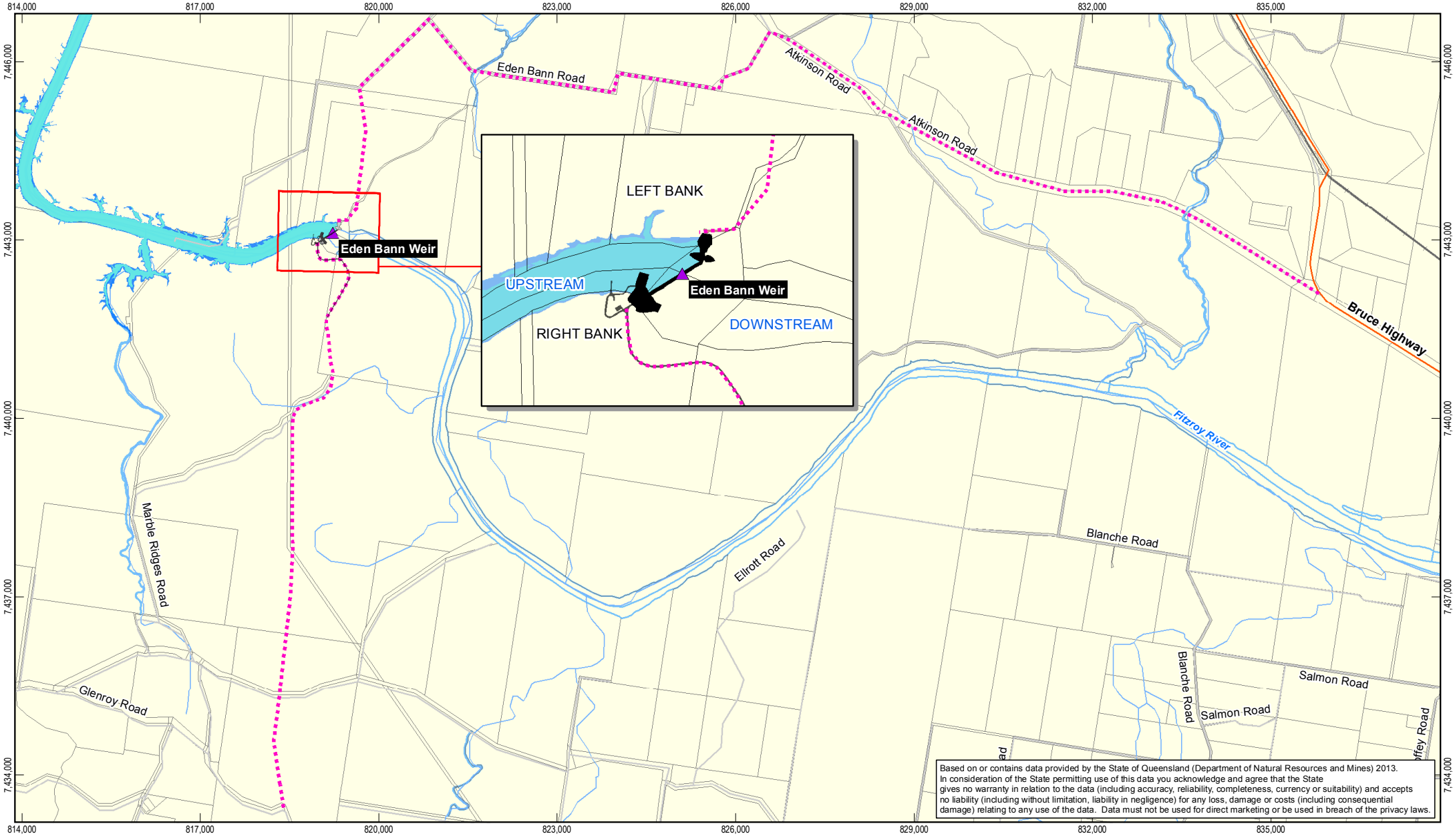
Data Source: © Copyright Commonwealth of Australia (Geoscience Australia): Waterways (2007); Sunwater: Waterways, Weir Locations - 2008, Google: Google Imagery Extraction 19/02/2013; GHD: Proposed Weir, Construction Area, Facilities/2013. Created by: MS *See Appendix for disclaimers and copyrights.



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0 1 2 3

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 Basin
- Access Road
- Highway
- Railway
- Major Road
- Secondary Roads
- Waterway
- Eden Bann Weir Footprint
- Eden Bann Weir Stage 2 impoundment
- Eden Bann Weir Stage 3 impoundment

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Eden Bann Weir Access

Figure 2-4

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Data Source: © Copyright Commonwealth of Australia (Geoscience Australia): Waterways (2007); DNRM: DCDB/2013; Sunwater: Waterways, Weir Locations - 2008, GHD: Proposed Weir, Access Road/2013. Created by: MS *See Appendix for disclaimers and copyrights.

The Eden Bann Weir operational area will include the weir infrastructure and impoundment, private access to the left and right banks and erosion protection areas immediately downstream of the weir structure.

Subject to further discussions with RRC, it is intended that operation and maintenance of the new low level bridge at Glenroy Crossing will be undertaken by Council. Operation and maintenance of the existing public access roads to Eden Bann Weir are currently the responsibility of RRC and it is expected that this will remain.

2.2.2 Rookwood Weir Project footprint

The proposed Rookwood Weir site is located on the Fitzroy River at 265.3 km AMTD, approximately 10 km downstream from the Riverslea Road river crossing. The site is approximately 15 km north of Gogango adjacent to Thirsty Creek Road. Gogango lies approximately 66 km south west of Rockhampton along the Capricorn Highway.

Impoundment associated with Rookwood Weir Stage 1 extends up the Fitzroy River to the confluence and to an upstream limit on the Mackenzie River at 322 km AMTD and 10 km AMTD on the Dawson River. The upstream limit of the Rookwood Weir impoundment at Stage 2 is 335 km AMTD on the Mackenzie River and 16 km AMTD on the Dawson River. Saddle dams are located at approximately 268.5 km AMTD on the left bank upstream of the weir wall. Gauging stations are located on a rock bar (monitoring weir) directly downstream of the weir wall at approximately 264.7 km AMTD and upstream at Riverslea Crossing (276 km AMTD)

The Rookwood Weir Project area consists predominantly of large, rural agricultural (cattle grazing) land holdings. Settlement in the area is sparse and scattered. No sensitive receptors in proximity to the weir site have been identified (Chapter 5 Land, Chapter 12 Air quality and Chapter 14 Noise and vibration). Views of, to and from the Rookwood Weir site are shown in Figure 2-5. Figure 2-6 shows the location of Rookwood Weir infrastructure and impoundment extents at full supply levels.

The Rookwood Weir construction area is shown on Figure 2-7 and discussed further in Section 2.4.1.1. As per the proposed Eden Bann Weir construction program, no on site workers' accommodation will be required for the construction of Rookwood Weir. The construction workforce will be housed in Rockhampton (or other local towns) and transported by bus and utility vehicles to and from the site via the existing public road network and new and existing access roads. Temporary site facilities will comprise site offices and general amenities (including emergency first aid facilities), workshops and power generators, storage, stockpile and laydown areas, concrete batching plants, internal access tracks and helipad, as applicable and subject to final determination during the detailed design phase. These facilities will be managed in accordance with all legislative requirements including the Health (Drugs and Poisons) Regulations 1996 and the *Tobacco and Other Smoking Products Act 1999* (Qld).

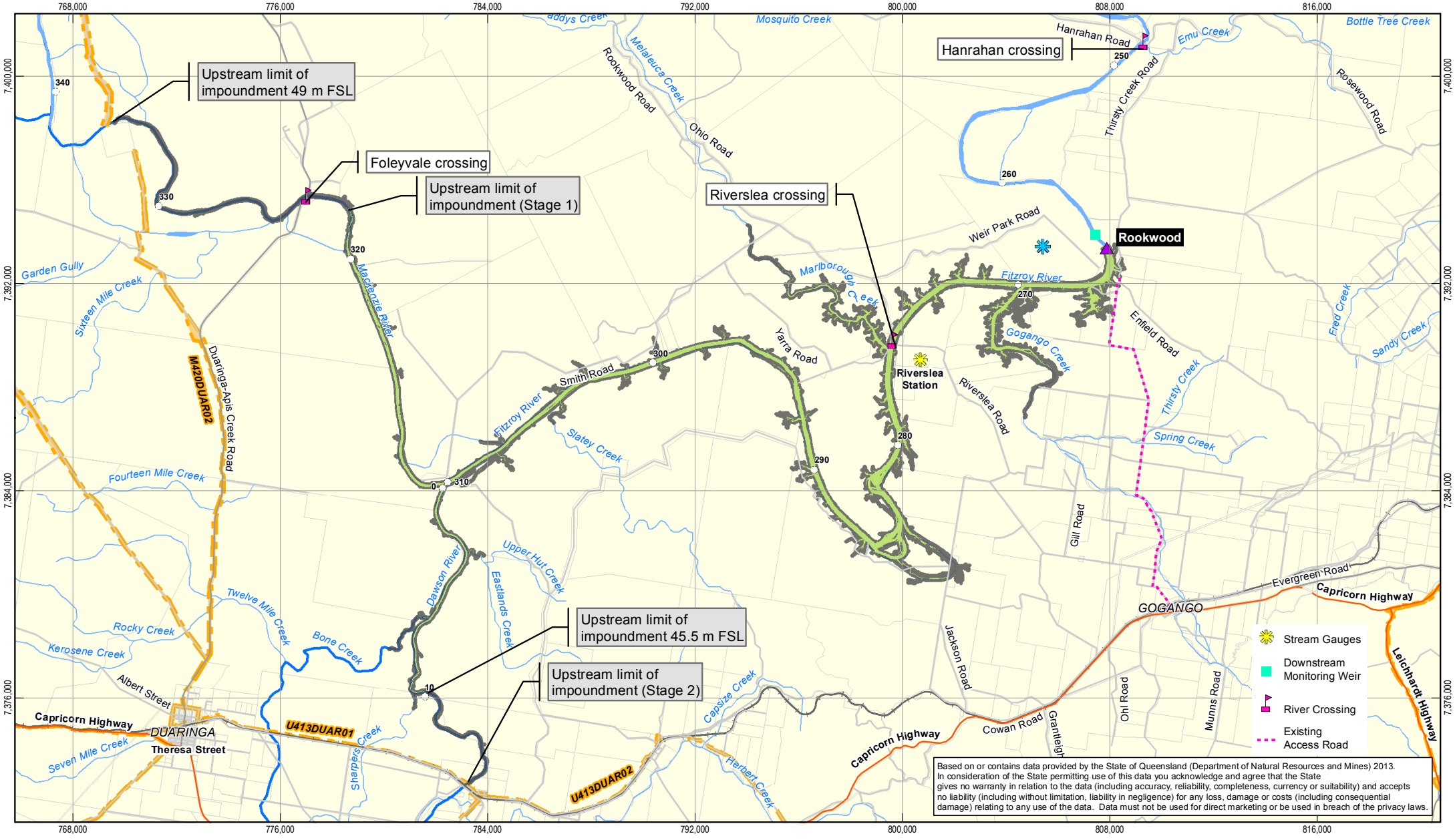
Figure 2-5 Rookwood Weir site views

Left bank slightly upstream

Left bank riverbed

Weir site looking downstream

View atop the right bank slightly downstream



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0 2 4 6 8

Kilometres

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

N

LEGEND

- AMTD (km)
- Weir Location
- Fitzroy Barrage
- Saddle dams
- Highway
- Major Road
- Streets (Local)
- Railway
- Waterway
- Fitzroy Basin
- Property Boundary
- Stock Routes
- Rookwood Weir Stage 1 impoundment
- Rookwood Weir Stage 2 impoundment

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Rookwood Weir infrastructure and impoundment location

Figure 2-6

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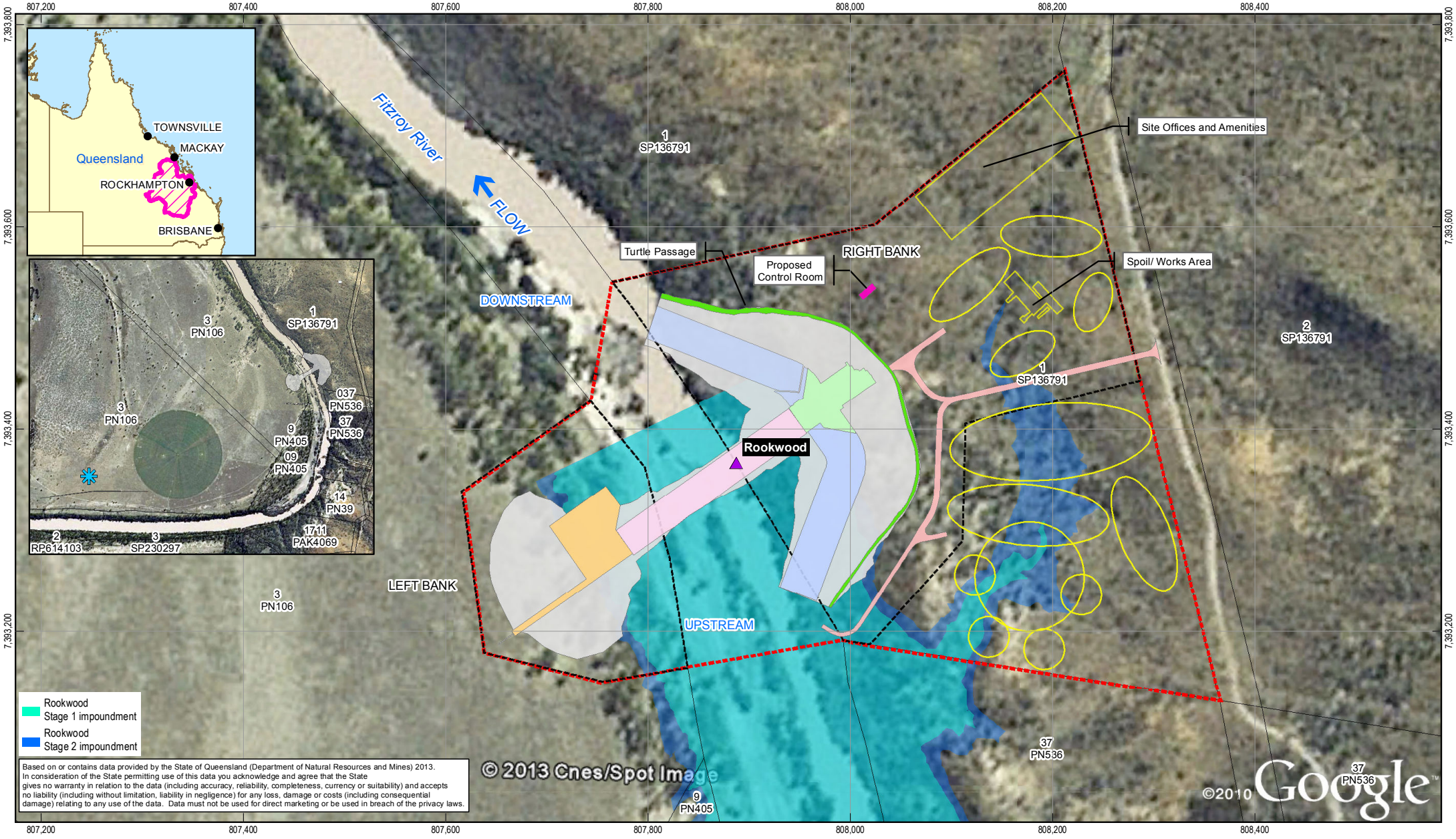

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0 50 100 150 200

Metres

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 Basin
- Construction Area
- Proposed Property Acquisition Boundary
- Rookwood Weir proposed structure
- Construction Site Facilities
- Abutement, Wide Rock filled mattress
- Access Roads
- Channel
- Outlet works and fishway
- Proposed Control Room
- Spillway
- Turtle Passage
- Saddle Dam

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Rookwood Weir construction area

Figure 2-7

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The proposed Rookwood Weir site is currently accessible via public roads from the right (eastern) bank, along Thirsty Creek Road travelling from Gogango off the Capricorn Highway, along Third Street, Riverslea Road and Thirsty Creek Road as shown in Figure 2-8. At Gogango, Third Street traverses an active rail level crossing (clearance height to overhead power is 5.2 m). The settlement at Gogango, located on the Capricorn Highway at the Third Street intersection, is identified as a sensitive receptor in terms of potential noise and dust impacts from construction traffic. Thirsty Creek Road will be upgraded to accommodate construction traffic. Similarly, the Capricorn Highway/Third Street intersection will be upgraded to accommodate construction traffic (together with traffic safety management measures) as described in Section 2.3.3.1.

A new low level bridge will be constructed at Riverslea Crossing at 276 km AMTD on the Fitzroy River (Figure 2-6) to replace the existing low level causeway within the Stage 1 impoundment. A new low level bridge will be constructed at Foleyvale Crossing at 324 km AMTD on the Mackenzie River (Figure 2-6) to replace the low level causeway within the Stage 2 impoundment. Hanrahan Crossing, located downstream of the proposed Rookwood Weir site at 249 km AMTD on the Fitzroy River, will be augmented (installation of a new bank of culverts) to facilitate access during operational releases.

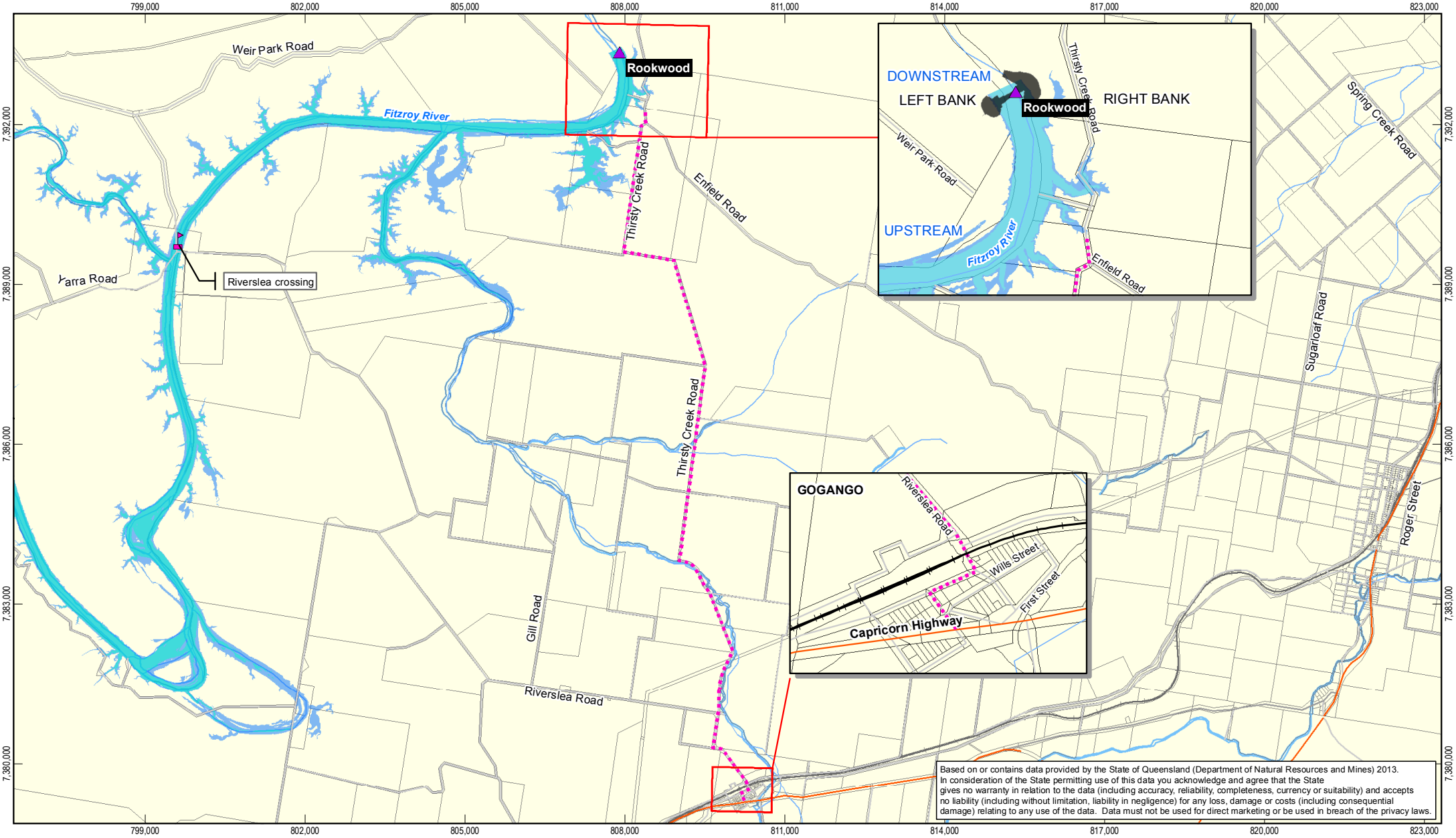
A high level rail crossing traverses the Dawson River at 16 km AMTD which coincides with the upstream limit of the Rookwood Weir impoundment at Stage 2 full supply level. The impoundment is not expected to impact the crossing and no augmentation is proposed.

The Rookwood Weir Project footprint lies within the RRC LGA. The Rookwood Weir impoundment borders parcels of the Woorabinda Aboriginal Shire Council LGA and sections of Central Highlands Regional Council LGA. The area designated for the Rookwood Weir infrastructure comprises USL within the Fitzroy River and freehold land on the adjacent left and right banks. It is proposed that a long-term lease will be acquired over these areas. A saddle dam is located within freehold land upstream of the weir on the left bank. A new access road (within the construction area) will be constructed from the existing track on the right bank within freehold land and will be included within the long-term lease area obtained for the weir infrastructure. Land adjacent to the watercourse comprises mainly freehold lots, some leasehold properties and a few reserves (Chapter 5 Land).

At full supply levels, the Rookwood Weir impoundments (Stage 1 and Stage 2) will encompass land in freehold/leasehold tenure on the river banks. In these areas, it is proposed that the Project will seek to secure a water storage easement by agreement, or where the head of power exists, through a resumption process. Further it is proposed to extend the easement to contain an agreed buffer area (flood margin or maintenance buffer).

Subject to agreement with RRC and the Department of Transport and Main Roads (DTMR), respectively, and confirmation of final design parameters, resumption of freehold and reserve land at Riverslea Crossing and freehold and leasehold land at Foleyvale Crossing may be required for works outside of the existing road reserves.

Further detail on land tenure is provided in Chapter 5 Land.



1:95,000 (at A4)

0 1 2 3

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
- River Crossing
- Fitzroy Basin
- Existing Access Road
- Highway
- Railway
- Major Road
- Secondary Roads
- Waterway
- Rookwood Weir Footprint
- Rookwood Weir Stage 1 impoundment
- Rookwood Weir Stage 2 impoundment

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Rookwood Weir access

Figure 2-8

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Stock Route M420DUAR02 (co-located with Apis Creek Road) traverses the Mackenzie River at the upstream limit (approximately 335 km ATMD) of the Stage 2 Rookwood Weir impoundment at full supply level (Figure 2-6). Similarly, Stock Route U413DUAR01 (co-located with the Duaringa/Boolbura Road) crosses the Dawson River at the upstream limit (approximately 15 km ATMD) of the Stage 2 impoundment at full supply level (Figure 2-6). Further detail on stock routes is provided in Chapter 5 Land.

The Rookwood Weir operational area will include the weir infrastructure and impoundment, and private access and erosion protection areas immediately downstream of the weir. The gauging station at Riverslea will be retained within the impoundment and recalibrated. A new gauging station will be installed at a rock bar immediately downstream from the weir wall.

Subject to further discussions with RRC, it is intended that operation and maintenance of the low level bridge at Riverslea Crossing and the upgraded causeway at Hanrahan Crossing, will be undertaken by Council. Operation and maintenance of the existing public access roads to Rookwood Weir are currently the responsibility of RRC and it is expected that this arrangement will remain. Similarly, subject to further discussions with DTMR, it is intended that operation and maintenance of the low level bridge at Foleyvale Crossing will be undertaken by DTMR.

2.2.3 Downstream areas

Unless specified in sections above (for example erosion protection works and Hanrahan Crossing), no additional infrastructure is proposed to be developed in riverine or marine areas downstream of the Eden Bann Weir Project footprint or Rookwood Weir Project footprint as part of the Project. Operational releases of water will utilise 'run of river' methods to transfer water between the storages (including down to the Fitzroy Barrage impoundment). This is discussed further in Section 2.5.2 and Chapter 9 Surface water resources.

2.3 Design of water resources infrastructure

2.3.1 Water storage infrastructure

2.3.1.1 Basis of design

Weir design for the Project has been undertaken to a concept/preliminary level informed by studies and concept designs undertaken by SunWater (2008a, 2008b). Commencing in late 2008/2009, in parallel with environmental investigations and assessment, GHD was appointed to further progress the concept/preliminary design stages. This included:

- Aerial laser survey and aerial photography
- Hydrological and hydraulic investigations and modelling, including for flood conditions
- Yield modelling and associated development of Project stages
- Geotechnical reviews and investigations
- Concept/preliminary engineering design

2.3.1.2 Development of preliminary construction methodologies and cost estimates

In 2010, design parameters for the Project were established in accordance with accepted practice for dam engineering to facilitate that the weirs will be of a standard of safety that satisfies the requirements of relevant statutes and meet the following requirements:

- The dam safety provisions of the Water Act 2000, Queensland Dam Safety Management Guidelines - February 2002 and the Australian National Committee on Large Dams (ANCOLD) Guidelines (ANCOLD 1991)
- The provision of documentation that will meet the requirements of the development permit under the *Water Act 2000* (Qld), including a Dam Break Analysis and Failure Impact Assessment to assess if the weirs are a 'Referable Dam'. If so, further documentation, such as an Emergency Action Plan may be required
- The design, construction, commissioning and documentation of a weir, outlet works and fauna movement structures that meets all requirements of the EIS, Commonwealth and State Approvals
- The provision of appropriate monitoring, surveillance and recording instrumentation in accordance with the relevant standards, guidelines or statutory requirements including but not limited to seepage monitoring, deformation measurements, foundation and internal pore pressures, storage water level and volume and rate of water released
- The provision of equipment to enable remote operation and surveillance of the weir's outlet works, crest gates and fish passage facilities
- The provision of outlets or other such measures that can make the regulated or environmental releases required to comply with the Fitzroy WRP and Fitzroy ROP
- The provision of the necessary facilities, equipment and access that will enable all mechanical and electrical equipment to be isolated, inspected, maintained and/or removed
- The provision of backup equipment and facilities that will enable the operation of essential mechanical and electrical equipment during power failure
- An assessment of the corrosion potential of all metal components to be used and suitable mitigation measures against corrosion implemented
- An assessment of the design for 'Safety in Design' as per Workplace Health and Safety requirements.

The following Project performance criteria apply:

- The maximum fixed crest level will be set such that the afflux is 300 mm at both Eden Bann and Rookwood weir sites at bank full flow
- The maximum gate level will be determined as less than bank full level and the level at which upstream impacts are acceptable in terms of acquisitions, crossings and environmental matters
- Environmental flow objectives will be as per the Fitzroy WRP
- Fishways will perform as per the design specification set by the Fishway Design Process undertaken in conjunction with (then) Department of Agriculture, Forestry and Fisheries (DAFF), Queensland Fisheries

- Turtle passage requirements will be incorporated into weir design as per design specifications drafted in consultation with the Department of Environment and Heritage Protection (DEHP) as necessary and applicable.

2.3.1.3 Eden Bann Weir design

The existing Eden Bann Weir (Stage 1) was constructed in 1994 to supply water to Stanwell Power Station. The existing weir has a total storage capacity of 35,980 ML and provides in the order of 28,600 ML/a of high and medium priority water to the lower Fitzroy River system (including 24,000 ML/a of high priority water allocated to Stanwell Power Station). SunWater (2008b) note that whilst no specific provisions for future raising were made in the original design, care was taken with the spillway crest provisions and downstream excavation which was extended to accommodate a larger structure with future raising. The existing weir infrastructure is accessible via a private access road from the left bank, with a small storage and maintenance area further away on higher ground.

Eden Bann Weir's existing development areas of impact and proposed development levels and areas of impact are summarised in Table 2-1. Figure 2-2 shows the impoundment extents. Buffer areas and flood margins are discussed in Chapter 5 Land and Chapter 9 Surface water resources.

Due to the risk of inundation during flood events, all equipment on the weir is controlled hydraulically from a control room located on the right bank. No electrical equipment will be used on the weir except where it is temporary and can be removed in time of flooding. Further detail is provided in Section 2.3.3.4.

Table 2-1 Eden Bann Weir existing and proposed development levels

Criteria	Stage 1 (existing)	Stage 2	Stage 3
Weir infrastructure			
Weir type	Conventional concrete weir with fixed crest and earth embankment at left abutment (Figure 2-1).	Conventional concrete weir raise with an un-gated concrete gravity ogee spillway section and earth abutment on left bank.	Addition of 18 flap gates (2 m high) with reinforced concrete piers such that development comprises a conventional concrete weir with 2 m high gated gravity spillway section and earth abutment on left bank. An example of a flap gate is provided in Figure 2-9.
Purpose	Water supply		
Catchment area	135,000 km^2		
FSL	RL 14.5 m AHD	RL 18.2 m AHD	RL 20.2 m AHD
Storage at FSL	35,980 ML	67,690 ML	91,450 ML
Yield (per stage) at FSL	Not applicable	35,000 ML/a	50,000 ML/a
Dead storage level	7.25 m		
Dead storage volume	9,650 ML		
Impoundment area at FSL	670 ha	1,170 ha	1,690 ha
Impoundment extent at FSL	184 km AMTD	205 km AMTD	211 km AMTD
Impoundment length (main channel) at FSL (approximate)	43 km	64 km	70 km
Total weir length	427 m	461.70 m	461.70 m

Criteria	Stage 1 (existing)	Stage 2	Stage 3
Fauna passage	Fish lock (left bank) The existing weir incorporates a fish lock on the left bank adjacent to the outlet works and a 1.5 m diameter outlet conduit. A diversion channel cut through a rock bar services the outlet works and fish lock	Fish lock (left bank) Fish lock (right bank) Turtle ramp (right bank)	Fish lock left bank) Fish lock (right bank) Turtle ramp (right bank)
Spillway section			
Type	Split level concrete un-gated spillway with a low section over 92 m (at 14.5 m AHD) adjacent to the left abutment and a high level section over the remaining 180 m (at 14.8 m AHD)	Spillway: un-gated concrete ogee spillway (Figure 2-10)	2 m high flap gates with concrete ogee spillway(Figure 2-11)
Crest level	RL 14.5 m	RL 18.2 m	RL 18.2 m
Crest length	The left abutment is perpendicular to the left bank for about 92 m and then the axis for the spillway and right abutment skews across the river perpendicular to the right bank	Primary spillway: 270 m (Figure 2-12)	
Downstream slope	0.8 H : 1.0 V		
Energy dissipation method	Not required as foundation rock is non-erodible and consists of large boulders and irregular rock outcrops which assist in energy dissipation	Not required given satisfactory performance of existing structure	
Design headwater level (bank full level)	Not applicable	RL 30 m	RL 30 m
Control description	Not applicable	Not applicable	2 m high crest gates with hydraulic controls
Height above riverbed	Approximately 5 m	Approximately 13 m	Approximately 15 m

Criteria	Stage 1 (existing)	Stage 2	Stage 3
Other		A crane/pedestrian access bridge over the crest of the weir for maintenance purposes	
Left abutment			
Crest level	RL 18.5 m	RL 26.2 m	
Crest width (non-spillway)	Varies	6 m	
Section type	Earthfill	Zoned earthfill	
Embankment downstream slope	2.5 H : 1.0 V		
Embankment slope protection	Rockfill / rip rap	Reinforced concrete and rip rap	
Right abutment			
Crest level	RL 18.5 m	RL 26.2 m	
Crest width (non-spillway)	4 m	6 m	
Section type	Mass concrete	Conventional concrete	
Embankment downstream slope	0.8 H : 1.0 V	0.8 H : 1.0 V	
Embankment slope protection	Not required	Not required	
Outlet works (Figure 2-13 and Figure 2-14)			
Provision for selective withdrawal	Manual selection of baulks	Outlet control gates with selective withdrawal capability and trash screens	
Low level outlet conduit	Inlet structure 1200 mm x 1200 mm	1,800 mm diameter inlet to a 1,400 mm outlet	
Low level outlet valve	Sluice gate to 1500 mm x 1500 mm box culvert	Vertical discharge regulating valve	
Low level outlet capacity	Adjacent to fish lock (left bank)	Discharge rate: 15 m^3/s (or a volume of 1,300 ML/day)	
Siting	Approximately 12 m in length	Adjacent to fish locks	
Environmental flow outlet size	Outlet capacity 5.5 m^3/s (maximum volume	3 bays of culverts (1.9 m x 2 m) with gated sluice	

Criteria	Stage 1 (existing)	Stage 2	Stage 3
Environmental flow outlet length	500 ML/d) Concrete overflow stilling basin	Approximately 12 m	
Environmental flow outlet capacity		Discharge rate: 58 m^3/s (or a volume of 5,000 ML/day)	
Environmental flow outlet stilling basin type		USBR impact type basin	
Saddle dam	Not applicable	Not required	

Figure 2-9 Flap gate (example)

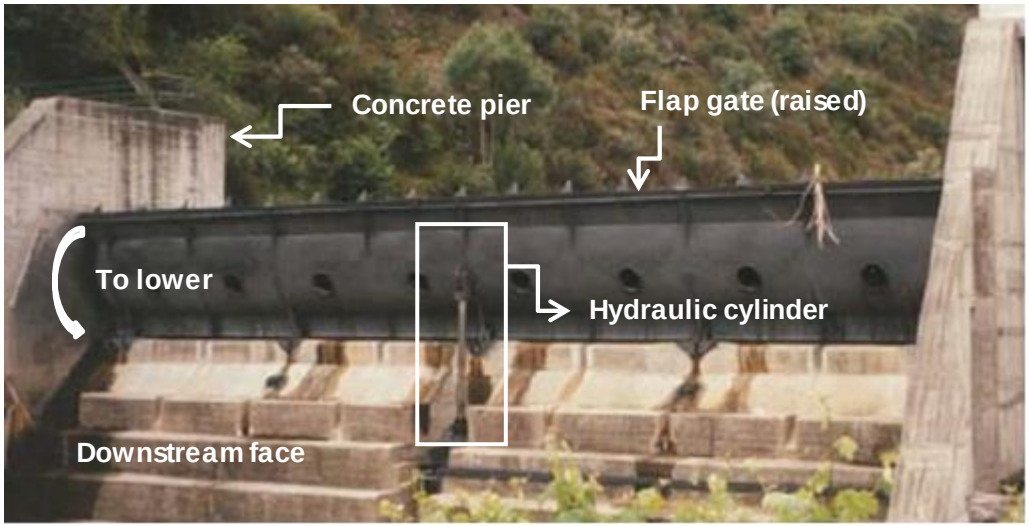


Figure 2-10 Eden Bann Weir Stage 2 ogee spillway section

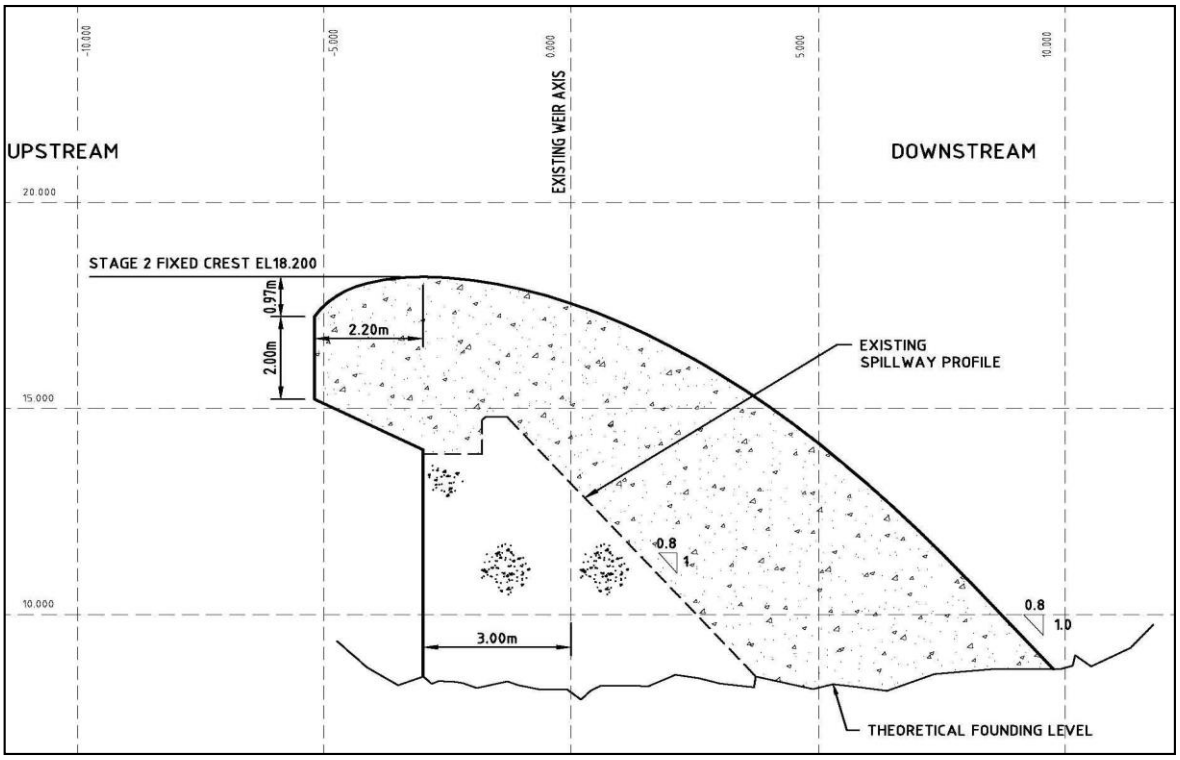
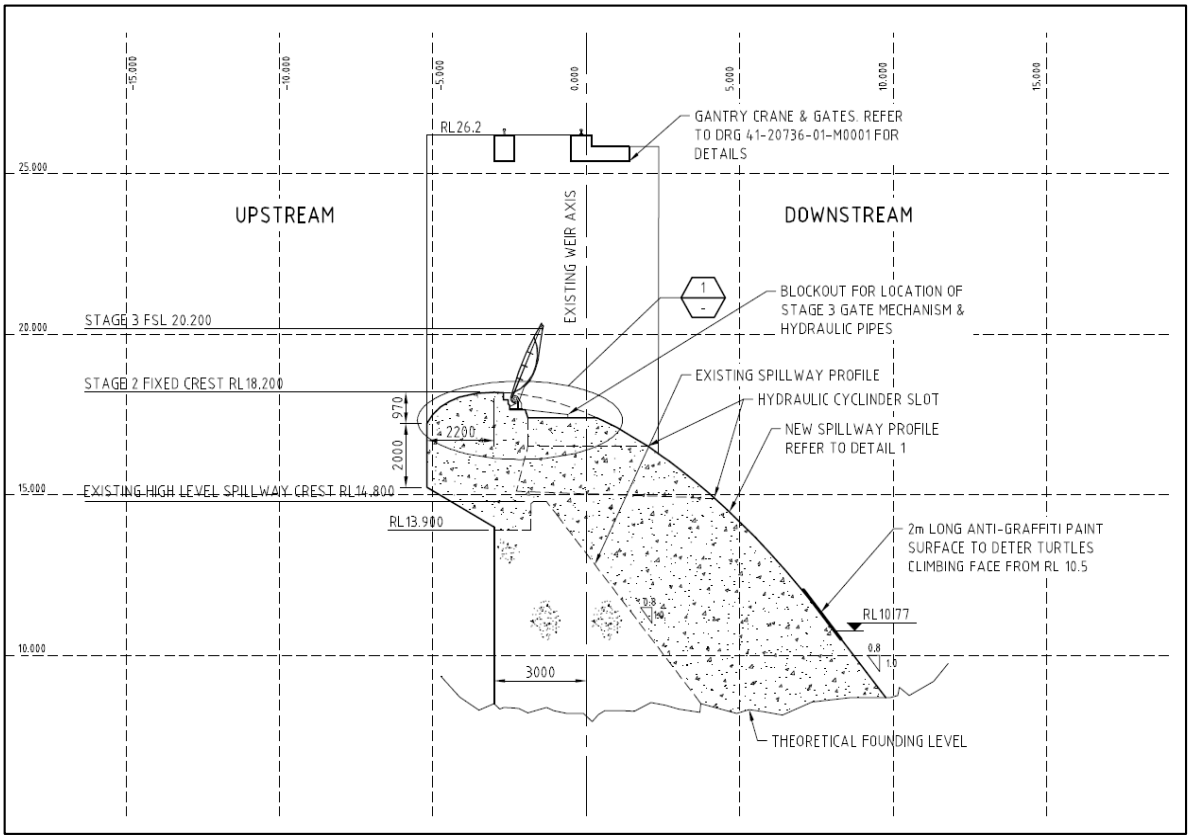
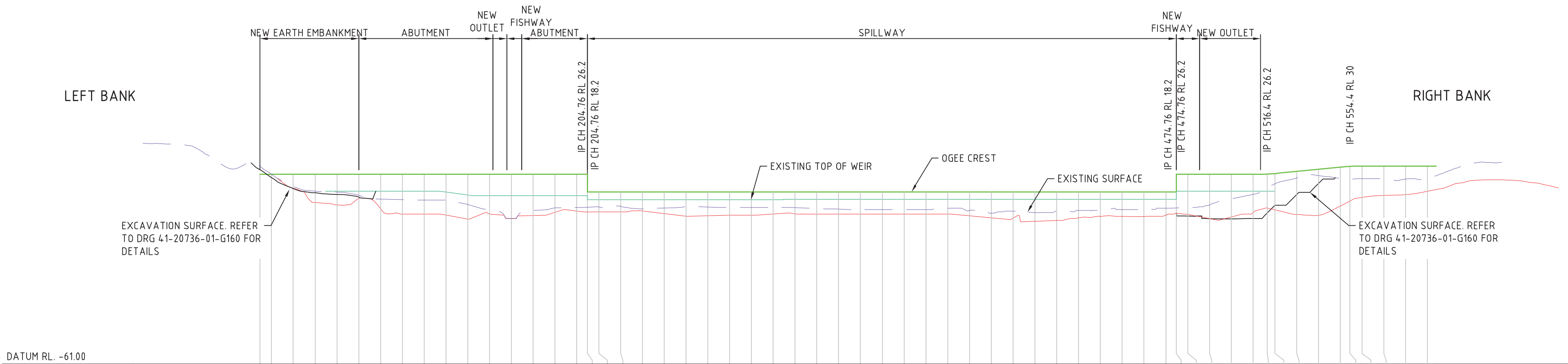


Figure 2-11 Eden Bann Weir Stage 3 ogee (high level) spillway section with flap gates





VERTICAL ALIGNMENT: L=150.06m G=0%; L=270m G=0%; L=36.64m G=0%; K=1 L=10m; L=28m G=10%; K=1 L=10m; L=34.5m G=0%

HORIZONTAL ALIGNMENT: L=200.00m 191°10'16"; L=450.00m 235°16'48"

CHAINAGE	EXISTING SURFACE LEVEL	DESIGN SURFACE LEVEL	LEVEL DIFFERENCE CUT - / FILL +	THEORETICAL FOUNDING LEVEL	EXISTING WEIR LEVEL
0.00	40.38				
10.00	40.25				
20.00	39.75				
30.00	35.40				
40.00	29.23				
50.00	31.50				
60.00	26.25	26.200			
70.00	20.72	26.200	5.62	19.85	
80.00	18.58	26.200	7.62	13.25	
90.00	18.06	26.200	8.20	12.20	18.50
100.00	16.61	26.200	9.59	15.10	18.50
110.00	14.81	26.200	11.39	10.48	18.50
120.00	14.51	26.200	11.69	8.00	18.50
130.00	14.43	26.200	11.77	8.00	18.50
140.00	14.45	26.200	11.75	7.54	18.07
150.00	12.39	26.200	13.81	5.66	16.74
160.00	9.84	26.200	16.36	7.95	16.50
170.00	6.00	26.200	20.20	6.00	16.50
180.00	9.58	26.200	16.62	7.30	16.50
190.00	10.88	26.200	15.32	8.81	16.50
200.00	11.09	26.200	15.11	9.36	16.50
204.76	11.09	26.200	15.11	9.00	
210.00	11.26	18.200	6.94	9.00	14.50
220.00	11.54	18.200	6.66	9.00	14.50
230.00	10.89	18.200	7.31	9.47	14.50
240.00	10.88	18.200	7.32	8.27	14.50
250.00	11.51	18.200	6.69	7.06	14.50
260.00	11.21	18.200	6.99	7.23	14.50
270.00	11.00	18.200	7.20	7.42	14.50
280.00	11.00	18.200	7.20	7.51	14.50
290.00	11.00	18.200	7.20	8.07	14.50
300.00	10.89	18.200	7.31	8.10	14.80
310.00	10.51	18.200	7.69	8.00	14.80
320.00	10.23	18.200	7.97	8.00	14.80
330.00	10.00	18.200	8.20	8.00	14.80
340.00	10.00	18.200	8.20	8.00	14.80
350.00	10.00	18.200	8.20	8.00	14.80
360.00	10.00	18.200	8.20	8.00	14.80
370.00	10.61	18.200	7.59	8.00	14.80
380.00	9.59	18.200	8.61	7.23	14.80
390.00	8.39	18.200	9.81	6.32	14.80
400.00	9.39	18.200	8.81	6.11	14.80
410.00	8.74	18.200	9.46	4.68	14.80
420.00	9.32	18.200	8.88	5.02	14.80
430.00	9.61	18.200	8.59	6.29	14.80
440.00	10.08	18.200	8.12	7.00	14.80
450.00	10.00	18.200	8.20	6.98	14.80
460.00	9.73	18.200	8.47	6.86	14.80
470.00	10.60	18.200	7.60	7.50	14.80
474.76	10.78	18.200	7.42	8.37	
480.00	11.00	26.200	15.20	7.87	18.50
490.00	12.15	26.200	14.05	5.94	18.50
500.00	14.96	26.200	11.24	6.59	18.50
510.00	17.01	26.200	9.19	8.72	18.50
516.40	19.90	26.325	6.42	10.76	
520.00	21.90	26.570	4.67	9.92	
530.00	24.52	27.560	3.04	7.82	
540.00	25.63	28.560	2.93	7.43	
550.00	24.36	29.558	5.20	11.64	
554.40	24.10	29.875	5.77	13.88	
560.00	24.19	30.000	5.81	15.65	
570.00	24.14	30.000	5.86	16.54	
580.00	24.05	30.000	5.95	16.90	
590.00	24.42	30.000	5.58	18.38	
600.00	27.92			20.91	
610.00	31.12			23.35	
620.00	31.51			23.70	
630.00	31.48			23.45	
640.00	29.31			22.18	
650.00	28.68			19.99	

LONGITUDINAL SECTION - WEIR

SCALE HORIZ 1:1000 VERT 1:1000

0 10 20 30 40 50m
SCALE 1:1000 AT ORIGINAL SIZE

NOTES:

1. WEIR AXIS IS OFFSET 3m FROM UPSTREAM FACE OF WEIR.
2. EXISTING WEIR CHAINAGES RUN IN OPPOSITE DIRECTION (FROM RIGHT TO LEFT BANK) WITH BEND AT CH 334.777.
3. GATES, PIERS & DECKS HAVE BEEN OMITTED FOR CLARITY.

Figure 2-12 Eden Bann Weir spillway longitudinal section including founding levels

Figure 2-13 Eden Bann Weir right bank outlets and fish lock design

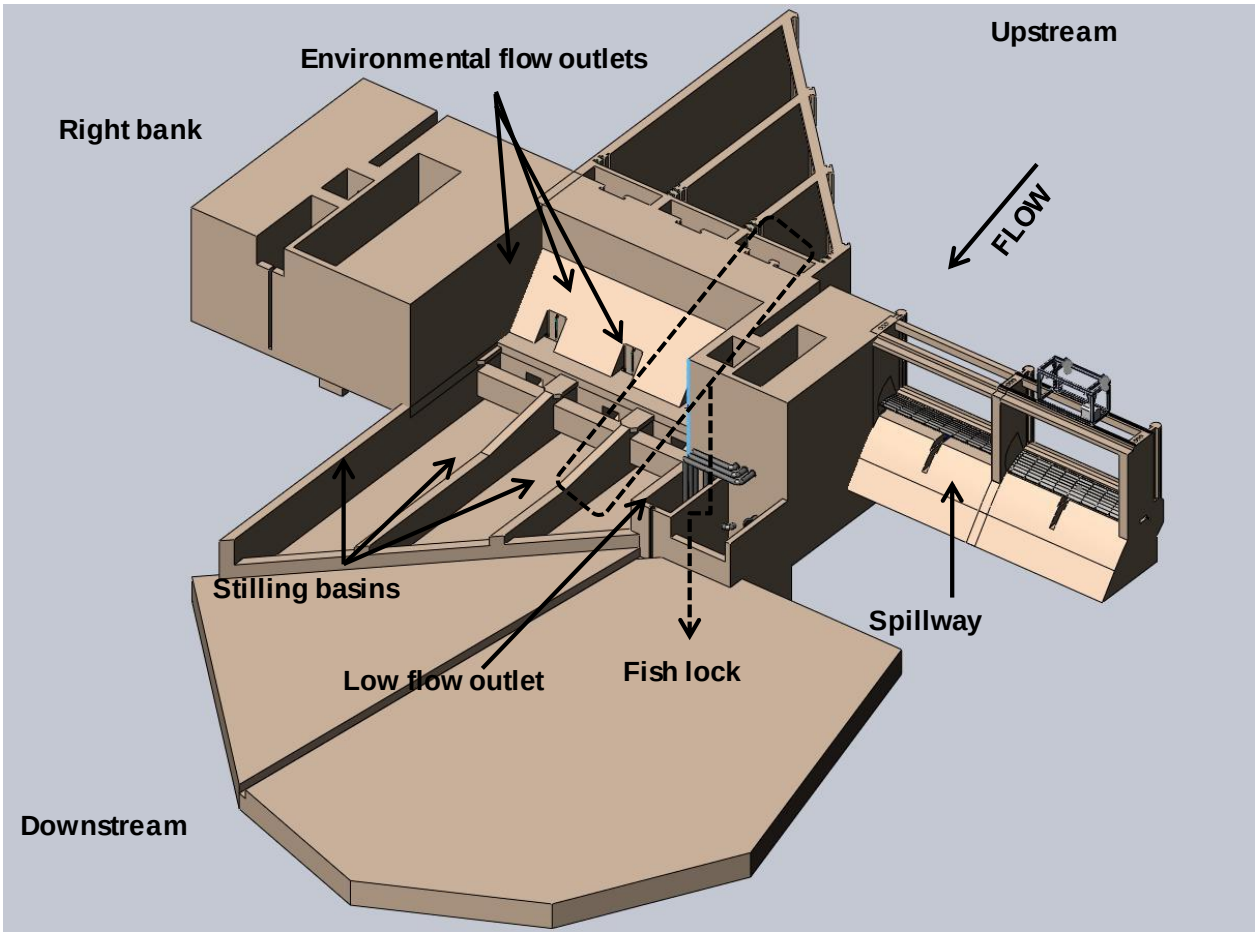
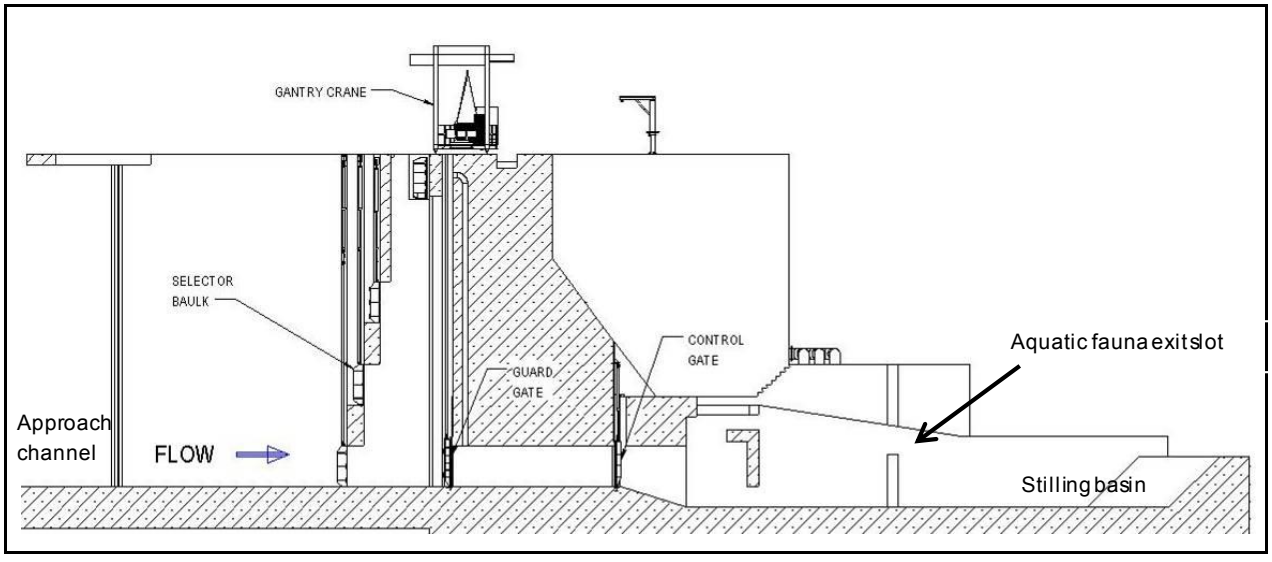


Figure 2-14 Section through Eden Bann Weir environmental flow outlets



2.3.1.4 Rookwood Weir design

The proposed Rookwood Weir is a 'greenfield' development near Rookwood Crossing at 265.3 km AMTD on the Fitzroy River. Inundation associated with the proposed development of the site extends upstream into the Mackenzie (from the north) and Dawson (from the south) rivers (Figure 2-6). A flood runner has been identified upstream of Rookwood Weir on the left bank and a saddle dam is proposed at this location (Figure 2-7). The proposed Rookwood Weir development levels and areas of impact are summarised in Table 2-2.

Due to the risk of inundation during flood events, all equipment on the weir will be controlled hydraulically from a control room located on the right bank. No electrical equipment will be used on the weir except where it is temporary and can be removed in time of flooding.

Table 2-2 Rookwood Weir proposed development levels

Criteria	Stage 1	Stage 2
Weir infrastructure		
Weir type	An uncontrolled gravity ogee weir constructed using roller compacted concrete and conventional concrete and earth embankment on the left abutment.	Addition of 14 flap gates (3.5 m high). An example of a flap gate is provided in Figure 2-9.
Purpose	Water supply	
Catchment area	135,000 km^2	
FSL	RL 45.5 m AHD	RL 49.0 m AHD
Storage at FSL	65,400 ML	117,290 ML
Yield at FSL	54,000 ML/a	86,000 ML/a
Dead storage level	RL 31.0 m	
Dead storage volume	2,640 ML	
Impoundment area at FSL	1,430 ha	1,930 ha
Impoundment extent at FSL	Mackenzie River: 322 km AMTD Dawson River: 10 km AMTD	Mackenzie River: 335 km AMTD Dawson River: 15 km AMTD
Impoundment length (main channel) at FSL (approximate)	61 km	84 km
Total weir length	460 m	
Fauna passage	Fish locks (right bank) Turtle ramp (right bank)	
Spillway section		
Type	Un-gated concrete ogee spillway (Figure 2-15)	3.5 m high crest gates with concrete ogee spillway (Figure 2-16)
Crest level	RL 45.5 m	RL 49.0 m
Crest length	209 m (Figure 2-17)	
Downstream slope	0.8 H: 1.0 V	

Criteria	Stage 1	Stage 2
Energy dissipation method	Type 1 stilling basin	
Design headwater level (bank full level)	RL 56.7 m	
Control description	Not applicable	3.5 m high gates hydraulic controls
Height above riverbed	Approximately 14 m	Approximately 17.5 m
Other	A crane/pedestrian access bridge over the crest of the weir for maintenance purposes only	
Left abutment		
Crest level	RL 52.5 m	
Crest width (non-spillway)	6 m	
Section type	Roller compacted concrete	
Embankment downstream slope	0.8 H: 1.0 V	
Embankment slope protection	Wrap around embankment with roller compacted concrete face protection and rock filled mattresses downstream	
Right abutment		
Crest level	RL 52.5 m	
Crest width (non-spillway)	6 m	
Section type	Conventional concrete	
Embankment downstream slope	0.8 H : 1.0 V	
Embankment slope protection	Not required	
Outlet works (Figure 2-18 and Figure 2-19)		
Provision for selective withdrawal	Outlet control gates with selective withdrawal capability and trash screens	
Low level outlet conduit	1800 mm diameter inlet to a 1400 mm outlet	
Low level outlet valve	Vertical discharge regulating valve	
Low level outlet capacity	Discharge rate: 14.5 m^3/s (or a volume of 1250 ML/day)	
Siting	Adjacent to fish locks (right bank)	
Environmental flow outlet size	3 bays of culverts (1.5 m x 2 m)	
Environmental flow outlet length	Approximately 12 m	
Environmental flow outlet capacity	Discharge rate 58 m^3/s (or a maximum volume of 5,000 ML/d)	
Environmental flow outlet stilling basin type	USBR impact type basin	
Saddle dam	Earth embankment/reno mattress (6 m wide by 230 mm thick)	

Figure 2-15 Rookwood Weir Stage 1 ogee spillway section

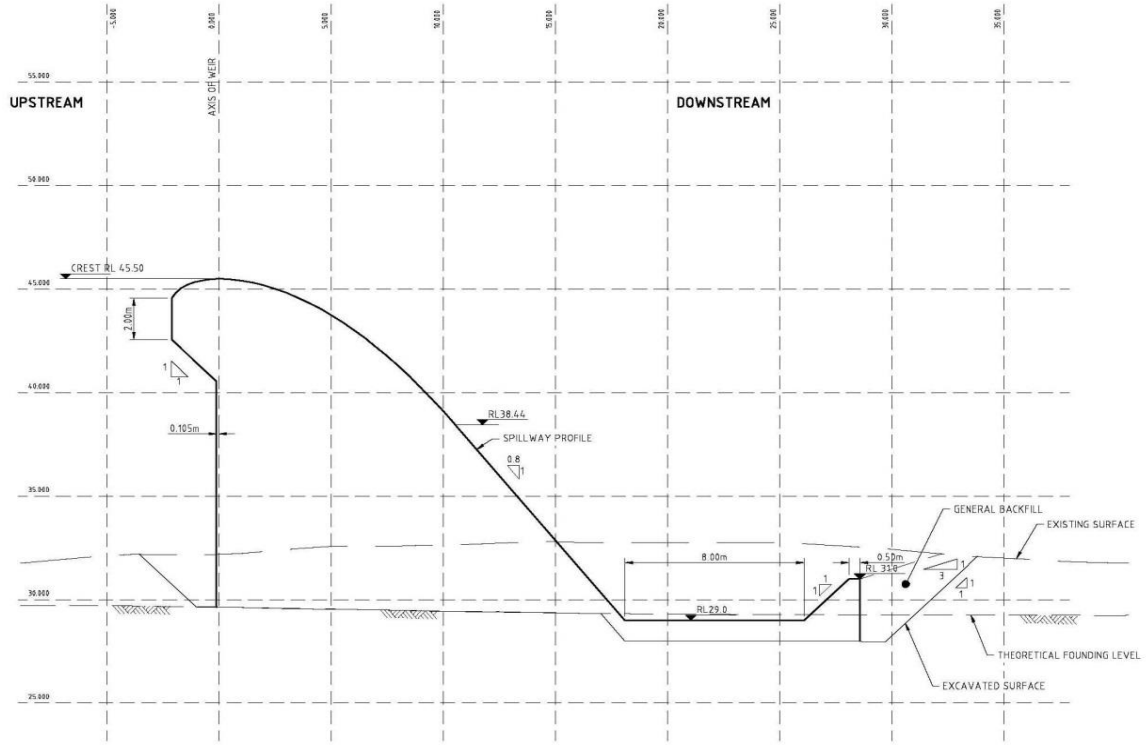
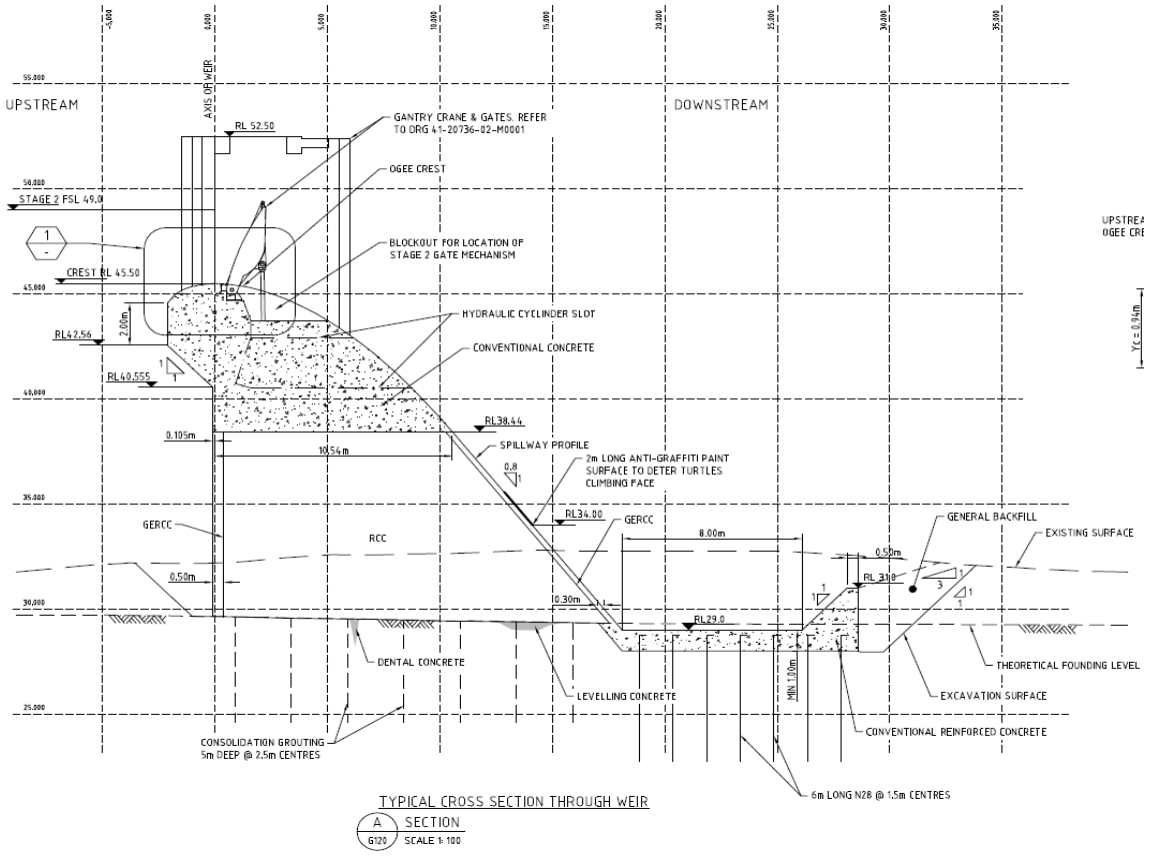
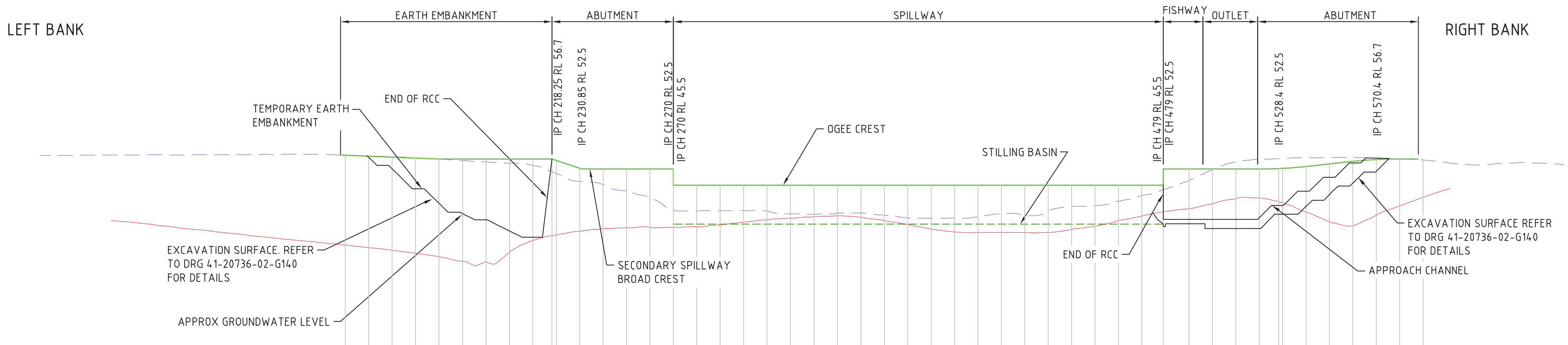


Figure 2-16 Rookwood Weir Stage 2 ogee spillway section





DATUM RL. -54.00

VERTICAL ALIGNMENT: L=42.0m; L=48.25m G=0%; L=12.6m G=-33.33%; L=39.15m G=0%; L=209m G=0%; L=44.4m G=0%; K=1 L=10m; L=32m G=10%; K=1 L=10m; L=12.6m G=0%

HORIZONTAL ALIGNMENT: L=650.00m 52°24'40"

CHAINAGE	THEORETICAL FOUNDING LEVEL	LEVEL DIFFERENCE CUT - / FILL +	DESIGN SURFACE LEVEL	EXISTING SURFACE LEVEL
0.00				58.27
10.00				58.31
20.00				58.37
30.00				58.43
40.00	29.72			58.48
50.00	28.51			58.55
60.00	27.27			58.51
70.00	26.29			58.54
80.00	25.20			58.58
90.00	24.05			58.63
100.00	23.01			58.68
110.00	22.07			58.75
120.00	21.09			58.73
130.00	20.06	0.00	58.390	58.39
140.00	19.00	0.00	58.030	58.03
150.00	17.82	0.00	57.690	57.69
160.00	16.59	0.00	57.220	57.22
170.00	15.01	0.00	56.730	56.73
180.00	13.15	0.65	56.700	56.05
190.00	12.89	1.28	56.700	55.42
200.00	17.03	1.71	56.700	54.99
210.00	21.96	2.61	56.700	54.09
218.25	24.11	5.43	56.700	51.27
220.00	24.40	5.55	56.117	50.57
230.00	25.96	5.66	52.783	47.12
240.00	27.18	6.66	52.500	45.84
250.00	27.39	9.43	52.500	43.07
260.00	27.57	12.20	52.500	40.30
270.00	27.65	17.50	52.500	35.00
280.00	27.86	11.00	45.500	34.50
290.00	28.63	10.75	45.500	34.75
300.00	29.84	10.75	45.500	34.75
310.00	30.91	10.96	45.500	34.54
320.00	31.53	12.16	45.500	33.34
330.00	32.17	12.23	45.500	33.27
340.00	32.59	11.92	45.500	33.58
350.00	31.96	11.75	45.500	33.75
360.00	30.54	12.62	45.500	32.88
370.00	28.82	13.86	45.500	31.64
380.00	26.93	14.00	45.500	31.50
390.00	25.66	14.00	45.500	31.50
400.00	25.35	13.32	45.500	32.18
410.00	25.47	12.00	45.500	33.50
420.00	25.39	12.78	45.500	32.72
430.00	25.44	10.89	45.500	34.61
440.00	26.73	8.93	45.500	36.57
450.00	28.03	8.62	45.500	36.88
460.00	30.48	6.70	45.500	38.80
470.00	32.50	4.33	45.500	41.17
479.00	34.24	1.88	45.500	43.62
490.00	35.61	4.97	52.500	47.53
500.00	37.65	0.27	52.500	52.23
510.00	39.92	-3.14	52.500	55.64
520.00	40.22	-4.07	52.500	56.57
528.40	38.45	-4.31	52.625	56.93
530.00	37.95	-4.30	52.718	57.02
540.00	34.10	-3.59	53.660	57.25
550.00	29.90	-2.72	54.660	57.38
560.00	28.39	-1.75	55.660	57.41
570.00	32.83	-0.62	56.554	57.17
580.00	36.69	-0.14	56.700	56.84
590.00	40.42	0.38	56.700	56.32
600.00				55.31
610.00				54.29
620.00				54.58
630.00				55.13
640.00				54.94
650.00				54.27

LONGITUDINAL SECTION - WEIR

HORZ 1:1000 VERT 1:1000

0 10 20 30 40 50m

SCALE 1:1000 AT ORIGINAL SIZE

NOTES

1. WEIR AXIS IS OFFSET 0.105m FROM UPSTREAM FACE OF WEIR.
2. GATES, PIERS & DECK HAVE BEEN OMITTED FOR CLARITY.

Figure 2-17 Rookwood Weir spillway longitudinal section inlcuding founding levels

Figure 2-18 Rookwood Weir right bank proposed outlets and fish lock design

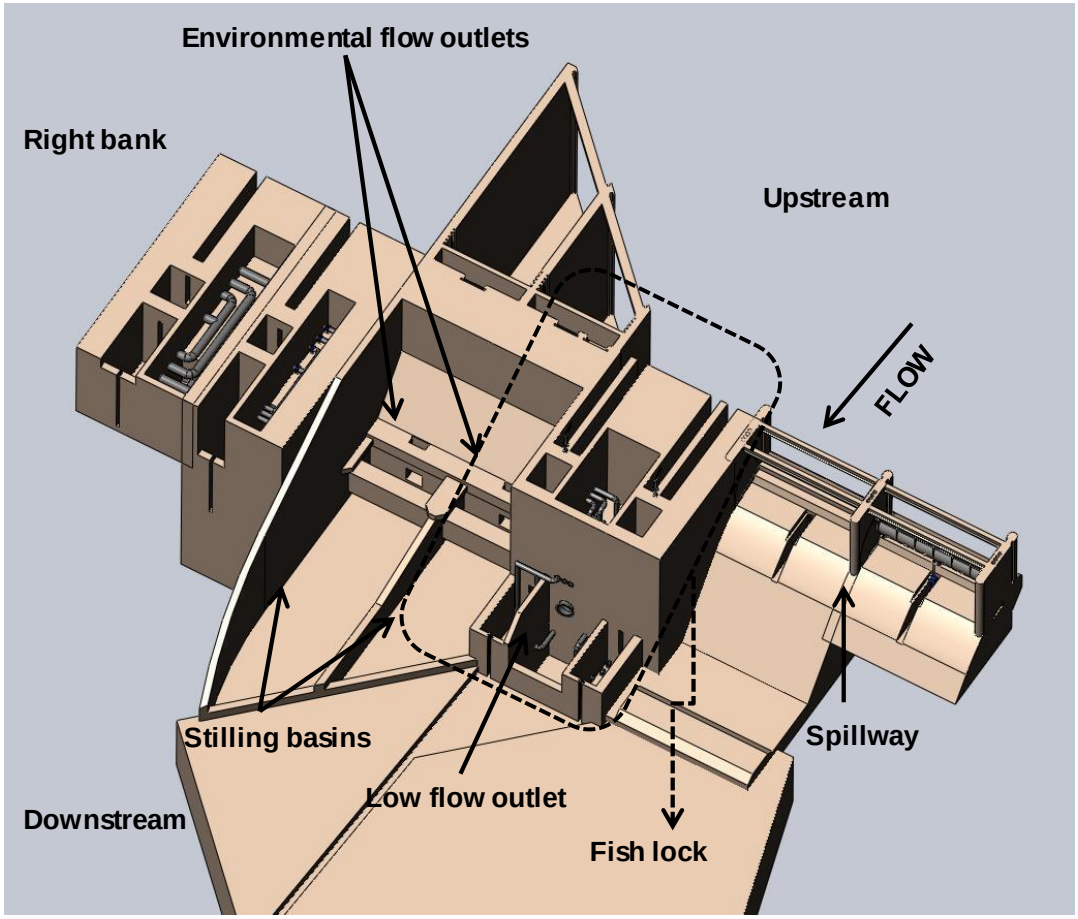
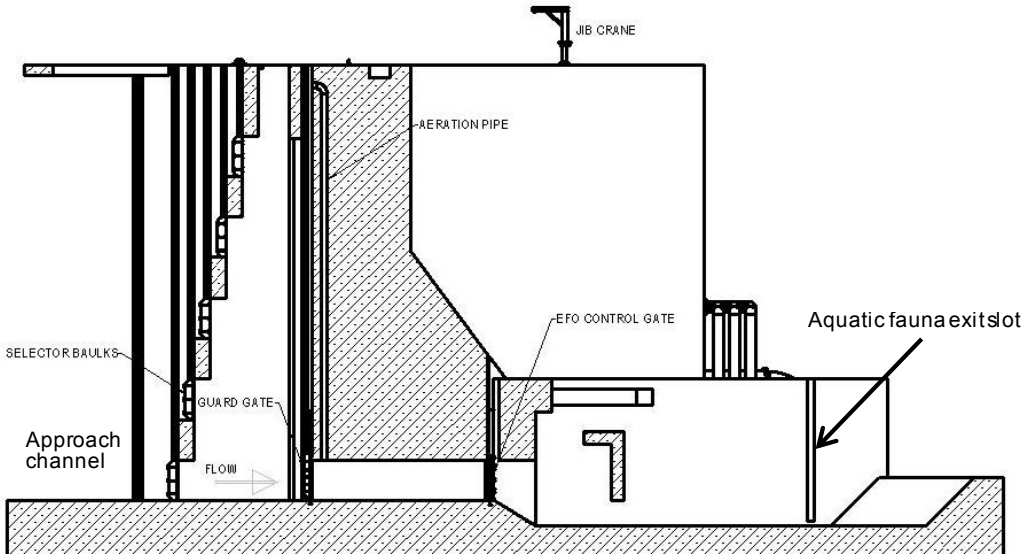


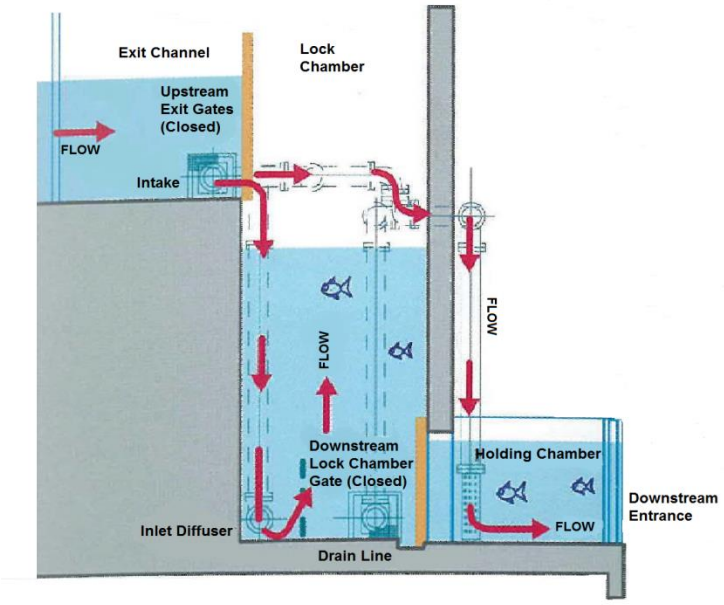
Figure 2-19 Section through Rookwood Weir environmental flow outlets



2.3.1.5 Aquatic fauna passage

A typical fish lock arrangement is illustrated in Figure 2-20. It comprises an entry or holding chamber on the downstream side; a lock chamber and an upstream exit channel. At the downstream entrance, a gate lifts vertically upward to open the lock chamber and allows fish to enter. Upstream the gate drops vertically downwards to open and allow access to the exit channel. Associated valves and pipework between the entrance and exit allow water to flow into the holding chamber which acts as attraction flow, fills the lock chamber and drains from the lock to the downstream holding chamber. Fish lock operations are described further in Section 2.5.4.

Figure 2-20 Typical fish lock arrangement



(Source: SunWater, Undated, Bowen River Weir Fishway brochure)

Fish passage infrastructure has been designed to preliminary level as follows:

- Eden Bann Weir fish passage infrastructure:
  - An upgraded fish lock on the left bank
  - A new fish lock located on the right bank for high and low reservoir levels to cater for flows from about 500 m^3/s to 2700 m^3/s. This provides for normal operating conditions as well as low spillway flow conditions at the weir.
- Rookwood Weir fish passage infrastructure:
  - A right bank fish lock to cover low and high reservoir levels to cater for flows from a minimum operating level up to 500 m^3/s.

The lock arrangements proposed are considered suitable for the purpose of fish passage at Eden Bann Weir and Rookwood Weir as:

- The locks are in a configuration known to work for the purpose of fish passage (although physical model studies are required to assist with refinement of entry/exit conditions and sedimentation management)

- The addition of a right bank fish lock at Eden Bann Weir will improve on the current passage efficiency above spilling flows. Currently, fish are attracted to the right bank spillway section of the weir, and as there is no passage, can become stranded as tailwater levels drop
- It caters for small and large-bodied fish
- It provides upstream and downstream passage
- It can be shut down in large floods to maximize operation following flood.

Preliminary level design for turtle passage includes the following:

- A turtle ramp incorporated within right bank infrastructure at both Eden Bann Weir and Rookwood Weir as shown on Figure 2-3 and Figure 2-7, respectively
- Design criteria to avoid or mitigate injury and mortality.

Further detail with regard to aquatic fauna passage is provided in Chapter 7 Aquatic ecology, Appendix M and Appendix X.

2.3.2 Water distribution infrastructure

The scope of the Project comprises investigations into the development of weir infrastructure, the resultant storage of water (inundation within river bed and banks) and the transfer of water between storages on the Fitzroy River. Operational regimes are described in Section 2.5. Releases of untreated (raw) water from the impoundments will be facilitated through outlet works and 'run of river' methods. No direct abstraction or pumping from within either of the impoundments is proposed, other than meeting existing landowners' rights to current approved water allocations from the Fitzroy River (Chapter 9 Surface water resources and Chapter 18 Social impact).

The operational drawdown strategy and flow releases are discussed in Section 2.5.2 and Chapter 9 Surface water resources.

2.3.3 Other Project specific infrastructure and services

2.3.3.1 Access roads

Existing road access to Eden Bann Weir and the proposed Rookwood Weir sites comprise the following:

- Access to Eden Bann Weir is via the Bruce Highway at Rockhampton and local gravel roads (Atkinson Road, Mona Vale Road and Eden Bann Road) (Figure 2-4). All public roads are two-wheel drive accessible and are suitable for construction and operation vehicle access
- Access to Rookwood is via the Capricorn Highway, at Gogango, and on Thirsty Creek Road (local road) (Figure 2-8). All public roads are two-wheel drive accessible and are suitable for operation vehicle access. Upgrades are required to facilitate construction access as discussed below.

Augmentation, upgrades or new access roads are required to facilitate the Project as described in Chapter 16 Transport (and detailed in Appendix Q) and summarised as follows:

- Eden Bann Weir:
  - The existing left bank local road access is considered suitable for use by construction traffic in its current state
  - Augmentation of the access road servicing the landholder's homestead which is currently impacted during flood events will be raised (earth embankment and pipe culverts) to facilitate flows to waterholes and lake areas as per the existing conditions
  - A new private permanent access road is required to service the right bank and will be developed based on the following: 6 m width, unsealed road; approximately 12 km in length; 1 m shoulders; application of road base layers; chemical stabilisation as a permanent treatment for both the construction period and long term; and stock fencing, gates and cattle grids as required, in accordance Austroads or ARRB guidelines and standards
  - Temporary construction access roads will be required from construction material borrow areas to the site
  - Opportunistic river crossings immediately upstream and/or downstream of the weir sites may be developed during periods of low flow to facilitate access subject to detailed design.
- Rookwood Weir:
  - The access road to the site from Gogango will be required to carry heavy construction traffic including low loaders and carriers. Allowance has been made to upgrade the access road to the site along Thirsty Creek Road (a local road) from the Capricorn Highway (including the intersection with the State controlled road) at Gogango
  - The Capricorn Highway/Third Street intersection at Gogango will require a channelized right turn treatment with a short turn slot off the Capricorn Highway and the acceleration lane (heading east) from Third Street onto the Capricorn Highway will be increased in width and length (subject to a road safety audit and agreement with DTMR and RRC
  - For Thirsty Creek Road, most of the areas that require attention are at creek and waterway crossings to allow gentler vertical geometry, with works retained within the existing road footprint as far as is practicable as detailed in Appendix Q
  - A new private, permanent access road (in the order of 500 m long) is required from Thirsty Creek Road to the weir site on the right bank and is accommodated within the weir site footprint area.
- Access to river crossings:
  - Access to river crossings is via existing local roads as described in Table 2-3. Augmentation to these local roads is not expected but will be subject to condition surveys prior to construction of the crossings.

The existing and proposed access roads are shown on Figure 2-4 and Figure 2-8 for Eden Bann Weir and Rookwood Weir sites, respectively. Concept layout plans and further detail is provided in Chapter 16 Transport and Appendix Q.

Table 2-3 River crossing access

River crossing	Access
Glenroy	Access from Rockhampton via Ridgelands Road (70 km).
Riverslea	Access via the Capricorn Highway at Gogango (66 km west of Rockhampton) and Riverslea Road (20 km).
Foleyvale	Access via the Capricorn Highway at Duaringa (111 km west of Rockhampton) and Duaringa-Apis Creek Road (22 km).
Hanrahan	Access via the Capricorn Highway at Wycarbah (40 km west of Rockhampton), Rosewood-Wycarbah Road (21 km) and Hanrahan Road (4 km).

2.3.3.2 River crossings

Inundation areas will impact on public and private infrastructure, such as roads (tracks) and river crossings (low level bridges and causeways) that may require upgrades to accommodate raised water levels. Road and crossing upgrades are discussed in further detail in Chapter 16 Transport.

Road and river crossing works associated with the Project aim to maintain the connectivity and function of the existing road network and provide at least the same flood immunity as the existing roads.

The design criteria for the access roads and hardstand areas are:

- Flood immunity equal to the abutments at the weir sites
- The design vehicle is a Heavy Load Platform (320 tonne) for the access road
- A design speed of 60 km/hr has been assumed for the access roads. Speed limits are less than the design speed and are nominated based on a road safety audit
- For construction access roads, a low loader semitrailer was used as the basis of design for ground clearance of the vertical geometry
- Based on the design traffic, the pavements for the reconstructed or new roads would be designed for a 20 year life
- Private roads such as access roads to the weir sites were designed to enable construction traffic to access the site. Austroads or ARRB “Unsealed Road Manual: Guidelines for good practice” 3rd Ed. was used for this purpose
- Cross drainage provisions are such that pipes are designed for a 20 year storm event based on outlet velocity to minimise scour (being approximately 2.4 m/sec); and would pass the 100 year storm event at a higher velocity.

The Glenroy Road river crossing (at 193 km AMTD) will be impacted as a result of raising Eden Bann Weir (Stage 2). The existing crossing is a causeway comprising two high box culverts, twenty 1.2 m diameter pipes and a number of smaller pipes. It is proposed that this crossing will be upgraded to a single lane bridge. No further augmentation is required to accommodate development of Eden Bann Weir Stage 3.

The river crossing at ‘Riverslea’ on Riverslea Road (at 276 km AMTD) will be impacted as a result of developing a weir at Rookwood (Stage 1). It is proposed that Riverslea be upgraded to single lane bridge. No further augmentation is required to accommodate development of Rookwood Weir Stage 2.

'Foleyvale' on the Duaringa-Apis Creek Road (323.5 km AMTD on the Mackenzie River) will be impacted as a result of raising Rookwood Weir to Stage 2. No impacts will be experienced as a result of Rookwood Weir Stage 1. It is proposed that Foleyvale Crossing be upgraded to a double lane bridge.

Hanrahan Road, comprising a track across the bed of the river, with a concrete causeway and pipe culvert at the low flow channel, may be impacted as a result of operational releases from Rookwood Weir. It is proposed that the crossing upgrade will comprise the installation of a new bank of culverts designed to accommodate flows up to 50 m^3/s. Such culverts are large and will facilitate fish passage.

Preliminary design for the bridges was undertaken in accordance with the Australian Standard for Bridge Design (AS 5100). Waterway crossings will be designed to meet the requirements of the *Fisheries Act 1994* (Qld) and in consultation with DAFF.

2.3.3.3 Gauging stations and monitoring weirs

A control weir and gauging station at Wattlebank, approximately 2 km downstream of Eden Bann Weir, maintains the tailwater level of the existing Eden Bann Weir (Figure 2-2). The Project will not alter the existing monitoring weir at Wattlebank, other than the need for recalibration of the stream gauge. SunWater's existing stream gauging station at The Gap (Figure 2-2) will be inundated by the weir reservoir as a result of raising Eden Bann Weir for the Project. The station would require reinstatement and recalibration.

An existing Department of Natural Resources and Mines (DNRM) stream gauge is located upstream of the proposed Rookwood Weir site at the Riverslea Road river crossing (Figure 2-6). This gauge will be inundated as a result of construction and will require reinstatement or relocation and recalibration. Minor works are required approximately 700 m downstream of Rookwood Weir for the construction of a new monitoring weir. The monitoring weir is proposed to be located on a natural rock bar and is designed so as not to impede fish passage. A new gauge downstream of Rookwood Weir is proposed at the same location as the monitoring weir.

2.3.3.4 Site facilities

During construction, temporary site facilities at both sites are likely to comprise: storage and office areas, amenities, power generation and reticulation infrastructure and water reticulation infrastructure (pumps and pipes), fuel (diesel) and chemical stores, batching plants, screening and crushing facilities (and associated stockpiles), and washdown and minor (motor vehicle) maintenance facilities/workshop. On-site treatment of sewage or water is not proposed or necessary (Chapter 15 Waste). Environmentally relevant activities potentially triggered by the Project are listed in Chapter 3. Water use during construction is discussed in Section 2.4.3.4.

Facilities at the existing Eden Bann Weir comprise an operational control room, covered shelter and single toilet facility located on the left bank. Water supply for these facilities is via a rainwater harvesting system. The proposed Rookwood Weir site currently has no facilities. A new permanent operational control room will be established at each site. The control building (17.5 m by 7 m) is proposed as a single storey reinforced masonry wall building with a reinforced concrete single slope (skillion) slab roof. The building sits upon a reinforced concrete strip footing with an integral slab floor. The building provides for the following rooms: a generator room; two power pack rooms; an operations control room; and a bathroom.

Permanent water supply requirements during operations are limited to ablution facilities, that is a single toilet and washbasin at each site. Use will be made of rainwater harvesting systems capturing runoff from the control room roofs. Water required during shut downs and large scale maintenance operations will be trucked to site. Drinking water quality will be tested and maintained in accordance with Schedule 3A of the Public Health Regulation 2005 and Australian Drinking Water Guidelines (2014).

2.3.3.5 Power supply infrastructure

Electrical plant at Eden Bann Weir and Rookwood Weir comprises the following components:

- Main control room with associated air-conditioning, lights, computers, kitchen appliances, fire water pump as well as 240V AC to 24V DC rectifiers/charges/battery system for controls and total single-phase load up to approximately 8-10 kW
- Fishway valve and gate motor drives with a total 3-phase load up to 24 kW
- Motor drives (3-phase) for the flap gates with hydraulic backup of between 5 kW and 10 kW each operating sequentially one at the time.

The total power requirement at Eden Bann Weir is approximately 48 kW with an average maximum demand of approximately 30 kW. Currently the available power supply is a 12.7 kV Single Wire Earth Return provided by Ergon via a 22 km long overhead power line. Applications will be made to Ergon with regard to capacity upgrades required and will be subject to separate environmental approval. Ergon has traditional 3-phase power infrastructure approximately 30 km north of the Project site, adjacent to the Bruce Highway, comprising a 22 kV line (Feeder PD203) and a 66 kV line to a QMAG mine site fed from Ergon's Pandoin Substation.

The total power requirement at the proposed Rookwood Weir will be approximately 60 kW of total installed with an average maximum demand of approximately 30 kW. There is no current supply to the site.

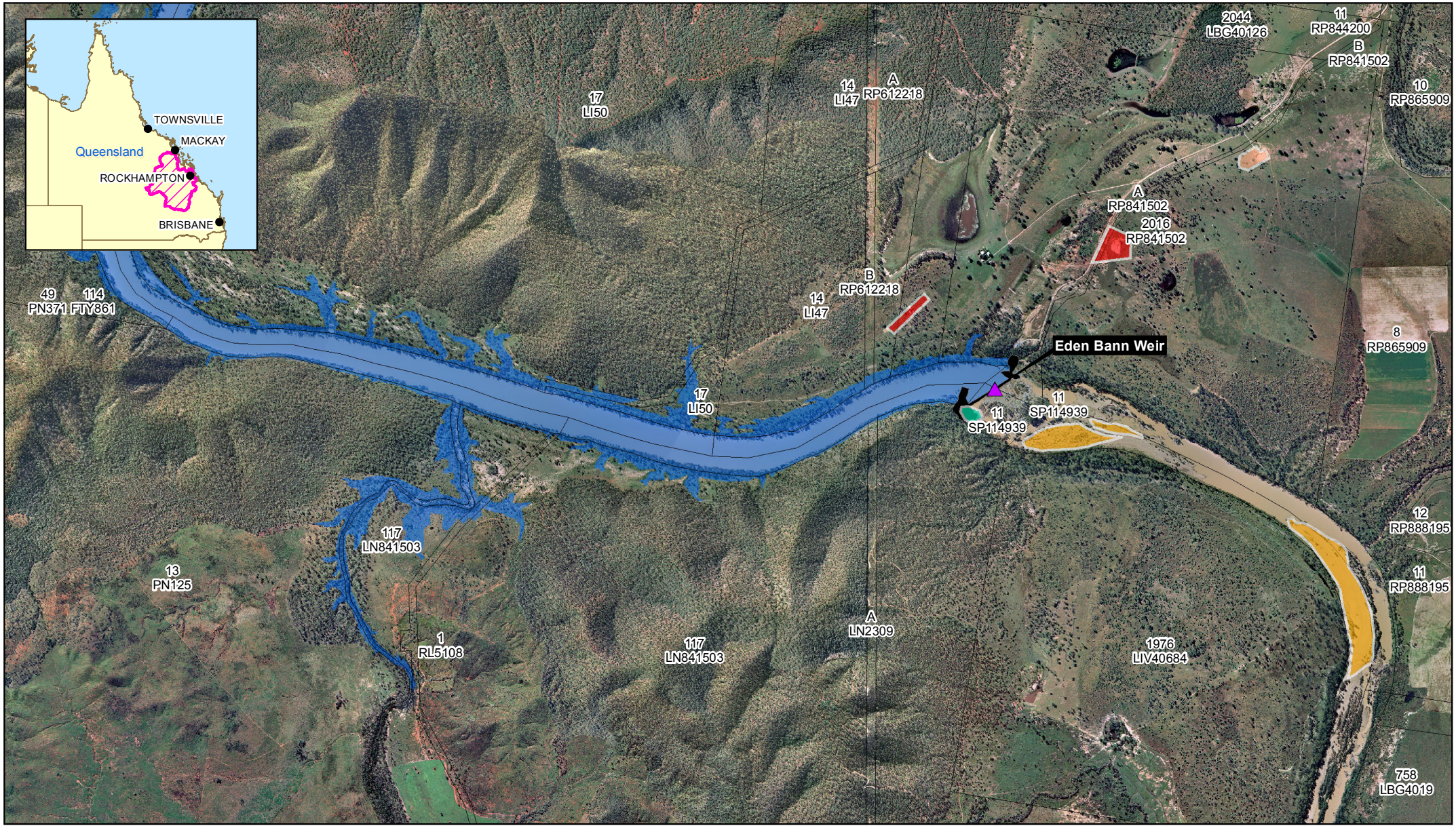
Suitably available power for the Rookwood Weir site power supply would be a remote end of the Ergon 22 kV Feeder WN213 which already provides power for local houses and relatively large water pumping loads. The supply originates at Ergon's Wowan Substation. Connection of the proposed 50-60 kVA size load to the network will be straightforward due to its relatively small size. A standard Ergon pole-mounted 100kVA, 22/0.433kV power transformer and metering unit will be sufficient and an application will be made to Ergon.

2.3.3.6 Telecommunications infrastructure

Each site will have a control room serviced by a landline and internet communications. Eden Bann Weir currently operates in this manner. Mobile phone coverage is inconsistent. During construction, mobile phone coverage will be supplemented by satellite communication facilities.

2.3.3.7 Resource extraction areas

A number of potential source locations for the supply of construction materials have been identified adjacent to the weir sites. As shown in Figure 2-21 and Figure 2-22 for Eden Bann Weir and the proposed Rookwood Weir, respectively, haulage of material is required over short distances (up to a kilometre).



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Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA94)
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N

LEGEND

- Weir Location
- Fitzroy Basin

Material Resources Areas

- Clay
- Gravel
- Sand
- Weathered Rock
- Eden Bann Impoundment

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Eden Bann Weir- Potential construction material resource areas

Figure 2-21

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Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA94)
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LEGEND

- Weir Location
- Fitzroy Basin

Material Resource Areas

- Clay
- Gravel
- Sand
- Weathered Rock
- Rookwood Impoundment

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Rookwood - Potential construction material resource areas

Figure 2-22

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Construction materials required include:

- Concrete, comprising coarse (gravel) and fine (sand) aggregates for the weir structures, outlet works and fish locks and river crossings
- Embankment fill in the form of clay, sand, gravel or rock for weir embankments and saddle dams
- Rock for rip rap and erosion protection
- Road base material, general construction fill material and dump rock for new access roads, upgrades to local roads and river crossings.

Provisional quantities of construction materials have been estimated and are presented in Table 2-4.

Table 2-4 Provisional quantities of construction materials

Construction material	Use	Eden Bann Weir (Quantity m^3)	Rookwood Weir (Quantity m^3)
Aggregates	Concrete and filters	53,000	112,000
Clayey soil	Earthfill and impervious core	26,000	50,000
Rock (fresh)	Rockfill, rip rap, reno mattresses and gabions	11,000	17,000
Rock (weathered)	Temporary works, cofferdams, roads and river crossings	126,000	393,000
Road base	Roads and river crossings	16,000	
General fill	Roads and river crossings	155,000	

Further sampling and investigations are required to confirm the quality and quantity of the available resources and separate assessment and approval of these areas will be sought (Chapter 3 Legislation and project approvals).

2.4 Construction phase

2.4.1 Overview

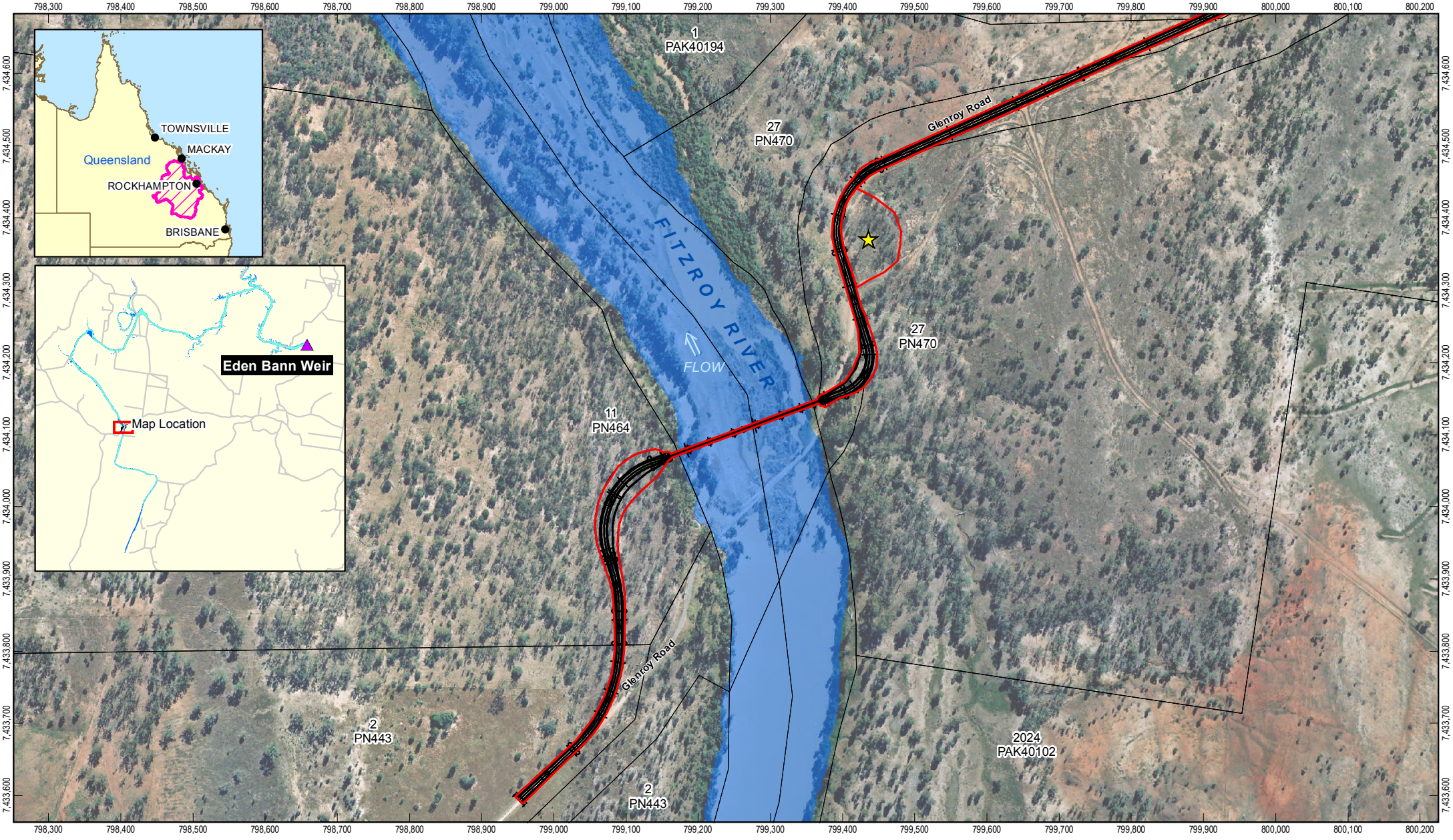
2.4.1.1 Construction areas

Table 2-5 shows the total construction area for each component of the Project and remnant vegetation to be cleared. The weir construction areas are shown in Figure 2-3 and Figure 2-7 for Eden Bann Weir and Rookwood Weir, respectively. The river crossing construction areas are shown on Figure 2-23, Figure 2-24, Figure 2-25 and Figure 2-26 for Glenroy Crossing, Riverslea Crossing, Foleyvale Crossing and Hanrahan Crossing, respectively. Upgrades required at select locations along Thirsty Creek road and at the Gogango/Capricorn Highway intersection are generally within existing disturbed areas and detailed in Appendix Q.

Table 2-5 Project construction areas

Construction area	Total area (ha)	Remnant vegetation to be cleared (ha)
Eden Bann Weir	45.8	28.8
Rookwood Weir	19.1	10.9
Glenroy Crossing[#1]	3.5	1.7
Riverslea Crossing[#2]	2.2	0.5
Foleyvale Crossing[#3]	2.6	0.7
Hanrahan Crossing[#4]	1.2	0.3
Eden Bann Weir access road	9.6	3.0

[#1] Associated with Eden Bann Stage 2; [#2] Associated with Rookwood Weir Stage 1; [#3] Associated with Rookwood Weir Stage 2; [#4] Associated with Rookwood Weir Stage 1



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Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA94)
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LEGEND

- Weir Location
- Fitzroy Basin
- Construction Corridor
- Eden Bann Weir Impoundment (Stage 3)
- Property Boundary
- Indicative Site Compound
- Bridge Infrastructure

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Glenroy Crossing Layout

Figure 2-23

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Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA94)
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LEGEND

- Weir Location
- Fitzroy Basin
- Property Boundary
- Rookwood Weir Impoundment (Stage 2)
- Site Compound
- Construction Corridor
- Bridge Infrastructure

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Riverslea Crossing Layout

Figure 2-24

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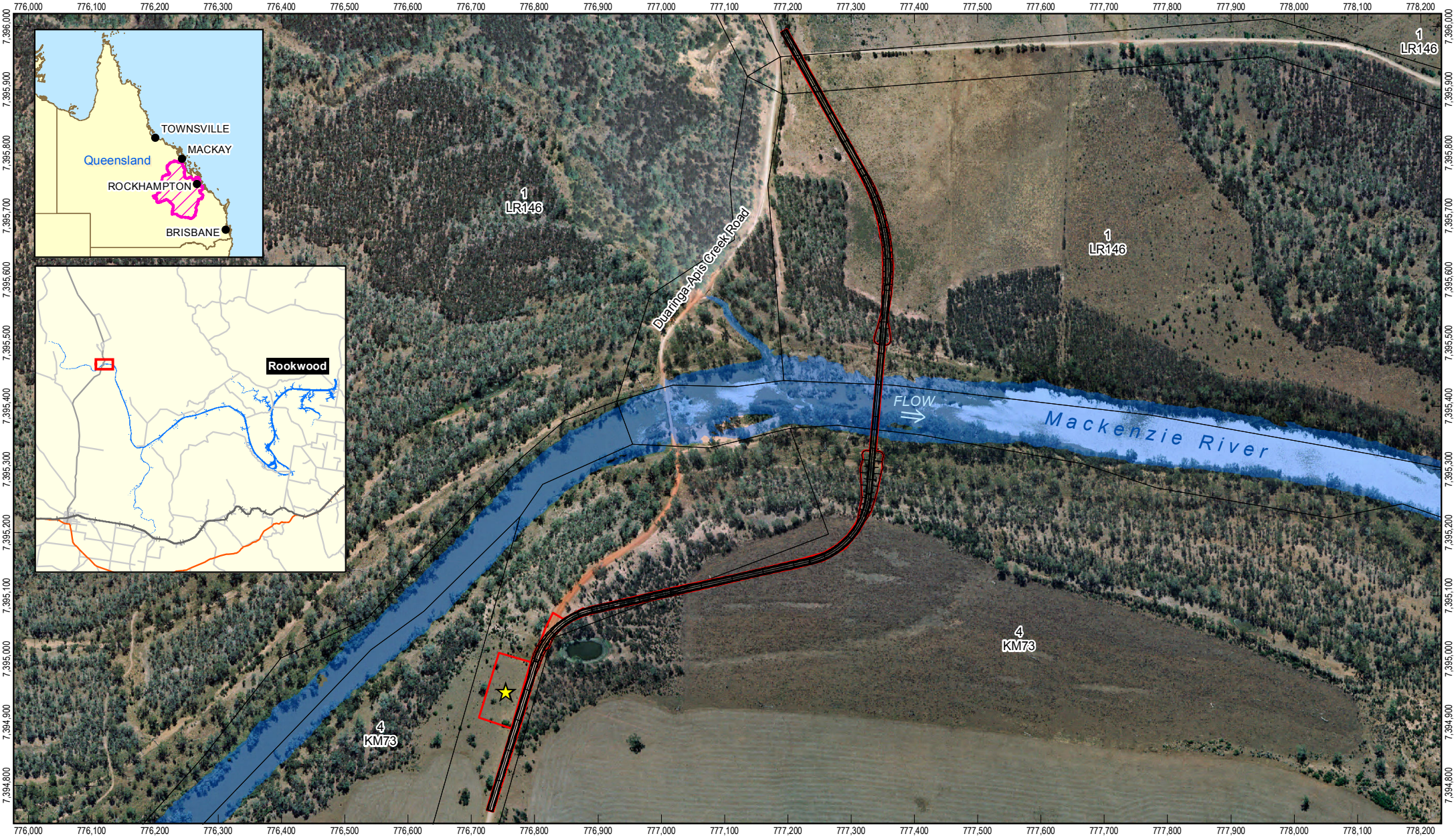

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Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA94)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Weir Location
- Fitzroy Basin
- Property Boundary
- Rookwood Weir Impoundment (Stage 2)
- Site Compound
- Construction corridor
- Bridge Infrastructure

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Foleyvale Crossing Layout

Figure 2-25

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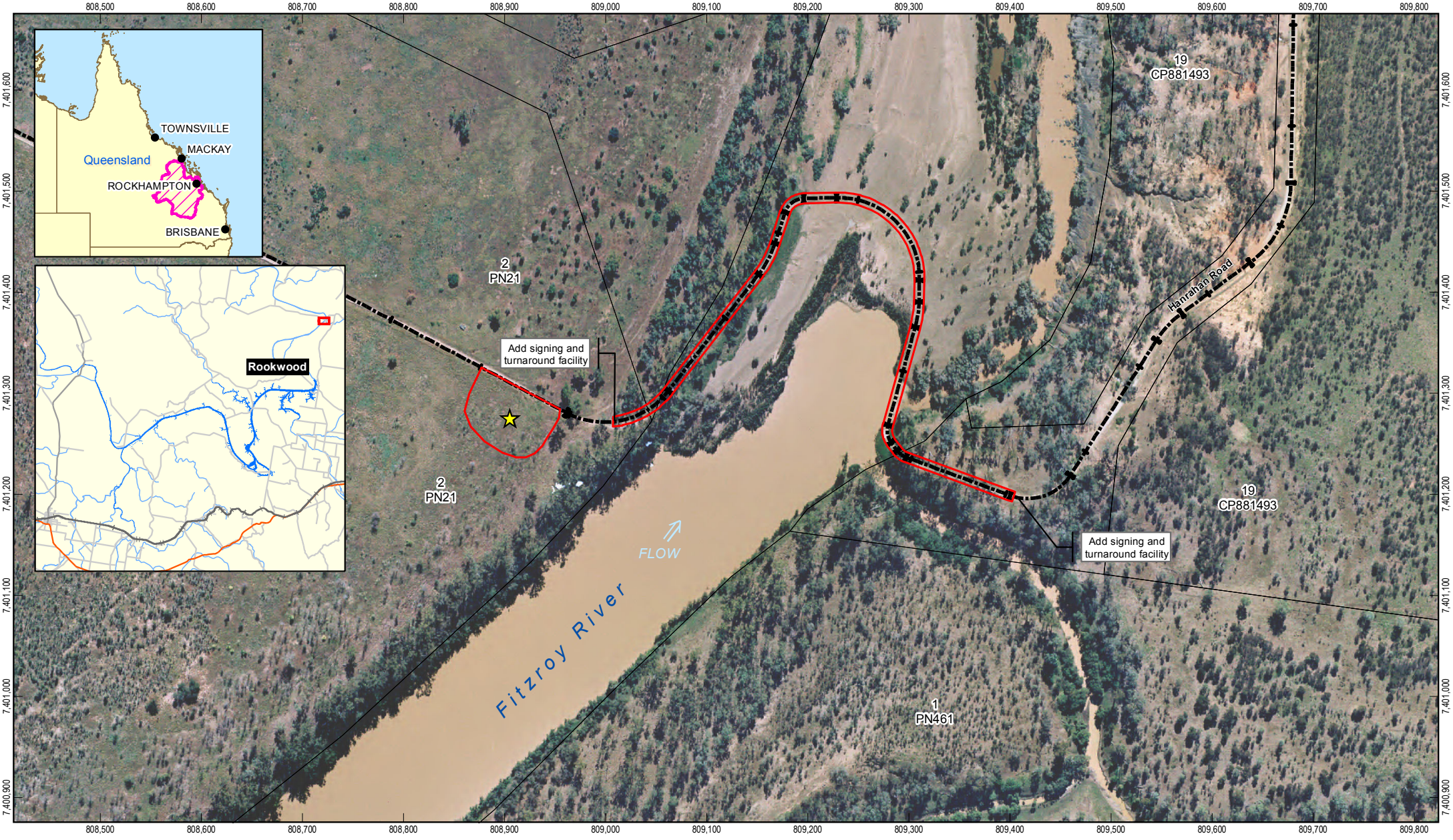

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Metres

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 Basin
- Property Boundary
- Site Compound
- Construction Corridor
- Bridge Infrastructure

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Revision B
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Hanrahan Crossing Layout

Figure 2-26

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2.4.1.2 Workforce and accommodation

Based on employment numbers at similar water infrastructure construction projects, raising Eden Bann Weir may require a workforce of approximately 40 people on site at the busiest stage and last at this number for 12 months. Construction of Rookwood Weir may require a workforce of approximately 60 people during the busiest stage which is expected to last 12 months. In total, a workforce of approximately 150 persons across both weir sites is anticipated over the approximate two-year weir construction period if Eden Bann Weir is raised and Rookwood Weir is constructed simultaneously. It is however expected that the Project will be staged in response to demand triggers and as such workforce profiles will differ depending on the stage build. Concrete raises and construction for Eden Bann Weir Stage 2 and Rookwood Weir Stage 1 are considered the most labour intensive. Weir design is such that installation of gates for Eden Bann Weir Stage 3 and Rookwood Weir Stage 2 will require limited construction activities and consequently a significantly reduced workforce.

The level of resourcing required at each river crossing site will depend on the contractors approach however it is anticipated that workforce levels will be kept to a minimum. Peak workforce levels at each river crossing site are expected to be less than 50 people.

It is not anticipated that a construction camp will be developed for the Project as most employees are likely to be sourced from and/or accommodated within the regional area and be transported daily to the construction site. Suitable accommodation for construction personnel is available in Rockhampton and surrounding areas (Chapter 18 Social impact). The nearest towns to the proposed Rookwood Weir site with accommodation facilities are Duaringa, Mt Morgan, Stanwell and Gracemere. Caravan accommodation is also available at Mt Hay. The Eden Bann Weir site can be serviced from Rockhampton and Yaamba.

The skills required for employment in the on-site workforce will include:

- Plant and equipment operation
- Formwork construction and reinforcement setting
- Concrete batching, pouring and finishing
- Welding, electrical, plumbing, dogmen, riggers, drillers and other specialist trades
- Trenching, pipe laying and joining
- Explosives (only if required during excavation)
- Surveying
- Clerical and record keeping
- Construction engineering supervision (range of skills, including foremen)
- Environmental supervision
- Laboratory technicians.

A full workforce composition will be developed during detailed design following a Project trigger.

2.4.2 Pre-construction activities

Site establishment will involve site clearing, construction of site access roads, the establishment of site facilities and development of resource material extraction areas (Section 2.3.3.7). Site clearing of the construction areas will be carried out by bulldozer or front end loader fitted with a

tree rake. The tree rake attachment allows for the loading of trees and vegetation without removing a significant amount of soil. Allowance has been made for chipping the cleared vegetation. Following clearing, topsoil will be stripped, loaded and carted to a stockpile area using a bulldozer, front end loader and trucks.

As per discussions with DAFF, harvesting of forestry timber products as appropriate and necessary in accordance with the requirements of the *Forestry Act 1959* (Qld) will be undertaken where such activities would not cause adverse environmental impacts prior to construction.

Site access will require the augmentation of existing roads and intersections and the construction of new permanent roads as described in Section 2.3.3.1 and shown in Figure 2-2 and Figure 2-6 for Eden Bann Weir and the proposed Rookwood Weir sites, respectively. Temporary access roads are required from the borrow areas to the works areas. Temporary river crossings can be installed immediately downstream of the weir during periods of low river flows with design taking into account consideration of fish passage as necessary.

Site facilities are listed in Section 2.3.3.4.

Power supply during the construction phase will be facilitated through the use of diesel generators and existing reticulated supply (at Eden Bann Weir). It is expected that the lead time required for mains power to the proposed Rookwood Weir site would inhibit the reliance on this for construction power. Onsite diesel storage will be required with quantities yet to be determined in accordance with construction schedules (Chapter 3 Legislation and project approvals).

2.4.3 Construction

2.4.3.1 General activities

General construction activities relevant to weir and/or crossing construction are provided below in Table 2-6.

Table 2-6 Construction activities

Construction activities	Description
Steel reinforcing supply and fixing	Reinforcement material will be supplied cut and bent from commercial steel yards in Rockhampton.
Formwork types and allocations	The formwork for the various sections of the concrete works is standard type econoform/ply beam formwork systems that can be purchased or hired easily.
Grouting	Curtain grouting is carried out through cored holes and consolidation grouting through percussion drilled holes. Grouting equipment is readily available and generally robust and simple. Grouting will be undertaken by a specialist contractor.
Concrete cut-off	Concrete cut-off walls will extend into the left and right abutments. Use will be made of bentonite slurry to hold trenches open until the concrete is placed. Work will be undertaken by a specialist contractor.
Dewatering	Dewatering of the excavation will be carried out from dewatering stations with sumps. The dewatering installation would be located in a large dewatering trench dug through the flood plain materials.
Gate fabrication and installation	Gate fabrication and testing will be undertaken by specialist subcontractors using a testing frame prior to delivery on site.

Construction activities	Description
Mechanical and electrical components	Components such as, pipework, valves and screens, as well as electrical instrumentation will be manufactured offsite and transported to and assembled on site for installation.
Piling	Construction of bored pile foundations at river crossings, including driving liners where necessary, installation of reinforcement and placement of pile concrete and construction of pile caps.

2.4.3.2 Construction inputs, handling and storage

Concrete aggregates will be sourced from excavations or river bed deposits as required using conventional earthmoving equipment. Stockpiling will be limited to materials required for backfilling after completion of concrete work and materials required for portions of the coffer dams. An Erosion and Sediment Control Plan would be developed prior to construction in accordance with the Best Practice Erosion and Sediment Control Guideline (IECA 2008) to minimise erosion and releases of sediment to the river.

Impervious lining material for the coffer dam will be sourced from the excavations and borrow areas. Sound rock from either existing materials in the river bed or blasted rock from foundation excavations will be used for permanent rock protection (rip-rap).

Spoil surplus materials will be utilised for filling gully areas to create hardstand works areas and in the restoration of temporary construction areas and quarries. No offsite disposal of spoil is proposed.

Required rock excavation will be carried out by drilling or blasting assisted by excavator mounted hydraulic rock breakers. With regard to Eden Bann Weir, due to the proximity of the existing weir infrastructure, limits on the maximum peak particle velocity levels and appropriate blast designs relying on low maximum instantaneous charge and high burden relief will be required. The need for blasting at Eden Bann Weir is not expected but will be confirmed during detailed design.

Mobile aggregate and crushing plants (inclusive of stockpile areas for unprocessed and processed aggregate) will be located adjacent to batch plants on the right banks. Aggregate will be screened using a standard mobile crushing and screening plant. Washing of riverine gravels may be required depending on silt and clay contents as determined during detailed design. Treatment of works water will comprise settling ponds and dosing facilities at the batch plant while the aggregate plant will require settlement ponds and drying beds for the removal of the very fine silt washed out from the aggregate. As far as practicable, water used will be collected and re-used in construction activities (for example dust suppression). Where necessary and subject to compliance with water quality parameters, releases will be made to the Fitzroy River.

Cement will be supplied from Rockhampton and transported to site in bulk tankers. Flyash is proposed to be sourced from the nearby Stanwell Power Station or alternatively the Callide Power Station. Chapter 16 Transport describes routes and expected volumes. It will be supplied dry and transported to site in bulk tankers. Onsite storage of cement and flyash will be in silos.

Mobile concrete batching plants may be established on site (both left and right bank at Eden Bann Weir and right bank only at the proposed Rookwood Weir site). An example of a typical concrete batching plant setup is shown in Figure 2-27.

Figure 2-27 Typical mobile concrete batching plant

Concrete will be batched in two ways, namely wet batched from a pan mixer or dry batched directly into mixer trucks. For temperature control, the standard approach of shading and keeping the coarse aggregate saturated will be adopted along with the use of white/reflective cement silos, and concrete mixer bins. Water will be chilled if necessary and stored in insulated poly tanks.

Concrete will be transported around the site in mixer trucks. Placing of mass concrete will be via direct discharge from the mixer trucks or by chute. Placement of concrete is temperature sensitive. Together with other cooling methods, placement may occur in the early mornings or at night to facilitate placement at the right temperatures.

At Rookwood, in addition to the use of conventional concrete, roller compacted concrete will be produced at a mobile continuous concrete mixing plant. An example of a typical mobile continuous mixing plant is shown in Figure 2-28. Roller compacted concrete will be transported in trucks (tandem highway or articulated dump trucks).

Figure 2-28 Typical mobile continuous concrete mixing plant

2.4.3.3 Hazardous materials

The Project will potentially use a number of environmentally hazardous substances including those listed in the Australian Dangerous Goods Code. Detail on environmentally hazardous substances including likely quantities, storage and transport is provided in Chapter 20 Hazard and risk. Hazardous substances to be used on site include: diesel, oils (lubrication/hydraulic oils), acetylene (dissolved), ammonium nitrate and detonators (Chapter 3 Legislation and project approvals).

2.4.3.4 Water supply

Water for construction purposes will be pumped from the impoundment/pools immediately upstream of the site subject to the obtaining of the relevant permit under the *Water Act 2000* (Qld). As the Fitzroy River is a regulated stream, it is considered unlikely that the Project construction will be affected by water shortages. During and following flood events, the construction water will require treatment by the addition of a flocculent to remove excess suspended sediment material (Chapter 23 Environmental management plan).

Construction water will be pumped to storage tanks on site and then reticulated to the various sections of the works. Demand for water will come from:

- Aggregate production and evaporative cooling of aggregates
- Earthworks moisture content control
- Concrete and grout mixing
- Concrete curing
- Foundation and lift joint cleanup

- Dust suppression
- Human consumption (ablutions and amenities)
- Rehabilitation activities.

Potable water for human consumption will be trucked to the site, likely from Rockhampton.

2.4.3.5 Restoration of temporary construction areas

Rehabilitation of construction areas at the weir sites will be undertaken in accordance with the environmental management plan (Chapter 23). Most areas disturbed during construction will remain as part of the infrastructure works. Temporary installations (site offices, batch plants, fuel storage and so on) will be demobilised and removed from site. Areas such as quarries and borrow pits will require rehabilitation and will be addressed separately in the investigations for applications. Sediment basins will be drained and cleared. Waste will be disposed of at regulated facilities.

Temporarily cleared areas will be reinstated as soon as possible after cleared areas are no longer required. Topsoil removed during clearing and stockpiled will be utilised for landscaping and revegetation. Chipped and mulched waste vegetation generated during clearing will be utilised during rehabilitation and revegetation works and 'habitat' green waste will be used to provide fauna habitat in rehabilitated areas. Use will be made of native vegetation as far as is practicably possible. Interim use of short-lived, non-native ground cover species will be required to facilitate rapid cover.

Downstream areas that have been disturbed will be rehabilitated as part of the Project and include scour and erosion protection measures to facilitate operational aspects of the Project.

2.4.4 Construction methodology and work sequence

2.4.4.1 Weirs

Raising Eden Bann Weir is scheduled to be constructed in four phases dictated by alternating wet (typically December to March) and dry (typically April to November) seasons over an approximate two-year period. Similarly, construction of a weir at Rookwood is scheduled to be constructed in four phases dictated by alternating wet and dry seasons over an approximate two-year period. Staging and development options may alter the sequencing but, in general, activities to be undertaken are summarised in Table 2-7 and Table 2-8 for Eden Bann Weir and Rookwood Weir, respectively. Construction sequencing is illustrated in Figure 2-29 for Eden Bann Weir and Figure 2-30 for Rookwood Weir.

Normal daytime work hours for the Project's construction activities will generally be between 7.00 am and 6.00 pm. Construction activities will as far as practicable be restricted to daytime work hours. Limited evening and night-time works are proposed and night time haulage of materials and plant will be restricted. However, on occasion it may be necessary to undertake activities during night-time periods, for example, concrete pour operations at the weir sites or to avoid peak traffic periods during the upgrade of the Capricorn Highway intersection. Visual amenity and lighting impacts during construction are discussed in Chapter 5 Land and noise impacts are considered in Chapter 14 Noise and vibration.

Table 2-7 Eden Bann Weir construction methodology and work sequence

Phase	Description
Wet season 1	
Site establishment	• Development of site access and the site working areas (right bank followed by left bank) • Establish aggregate and concrete processing plants • Commence flap gate fabrication
Dry season 1	
Materials handling	• Aggregate extraction, processing and production (concrete batch plant operational) • Demobilise aggregate processing plant prior to the wet season
Right bank	• Complete right bank access road • Excavate right abutment and construct upstream cofferdam • Commence excavation and concrete works associated with the abutment raise, the fishway and the outlet works • Commence excavation of the intake and outlet channels and downstream coffer dam • Opportunistic placement of concrete to the downstream section of the outlet works • In preparation for the wet season, the removal of the upstream and downstream cofferdams
Spillway	• Establishment of an initial access road below the weir • Foundation preparation and preparation of the existing concrete spillway section. This work includes the installation of drill anchor holes and scabbling concrete for the spillway raise. Estimated foundation levels are presented in Figure 2-12 based on current geotechnical information • Commence construction of the spillway
Left bank	• Construction of the concrete works for the raising of the abutment
Wet season 2	
	• Continue with right abutment concrete works to finished level • Continue with concrete placement on the left abutment • Commence installation and commissioning of mechanical and electrical equipment • Commence concrete construction for the intake structure
Dry season 2	
Right bank	• Complete concrete works to the downstream section of the outlet works • Complete concreting to the right abutment, fishway and outlet works • Installation of mechanical and electrical equipment • Commission fishway and outlet works
Spillway	• Reconstruction of the access road below the weir • Commence ogee crest concrete works • Construct piers for the installation of flap gates near the end of concrete placement
Left bank	• Complete excavation and construction of the earth embankment and backfill to the new spillway • Complete final concrete works to the left bank abutment

Table 2-8 Rookwood construction methodology and work sequence

Phase	Description
Wet season 1	
Site establishment	• Development of site access and the site working areas (right bank followed by left bank) • Establish aggregate and concrete processing plants • Excavate the upper right abutment • Commence flap gate fabrication
Dry season 1	
Materials handling	• Aggregate extraction, processing and production (concrete batch plant operational) • Demobilise aggregate processing plant prior to the wet season
Right bank	• Excavate for the right abutment • Construct the large cofferdam • Commence concrete works for the fishway and outlet works
Left bank	• Excavate for the left abutment • Construct the lower section of the left abutment monolith, backfilling, cut off wall left abutment, and the apron slab and training wall (no river diversion required)
Wet season 2	
	• Continue with concrete works on the right bank • Establish continuous concrete mixing plant
Dry season 2	
Right bank	• Continue with concrete works to fishway, outlet works and right abutment • Commence installation of mechanical and electrical equipment • Construct new transverse cofferdams upstream and downstream to allow access to riverbed in the existing channel • River diversion through the outlet works block-outs provides passage for low flows and fish and fauna passage
Spillway	• Prepare foundation (including stripping of loose rock and cleaning). Estimated foundation levels are presented in Figure 2-17 based on current geotechnical information • Concrete placement • Construct piers for the installation of flap gates near the end of concrete placement • River channel final closure (fishway commissioned)
Left bank	• Excavate, concrete and backfill the left abutment • Concrete placement • Backfill

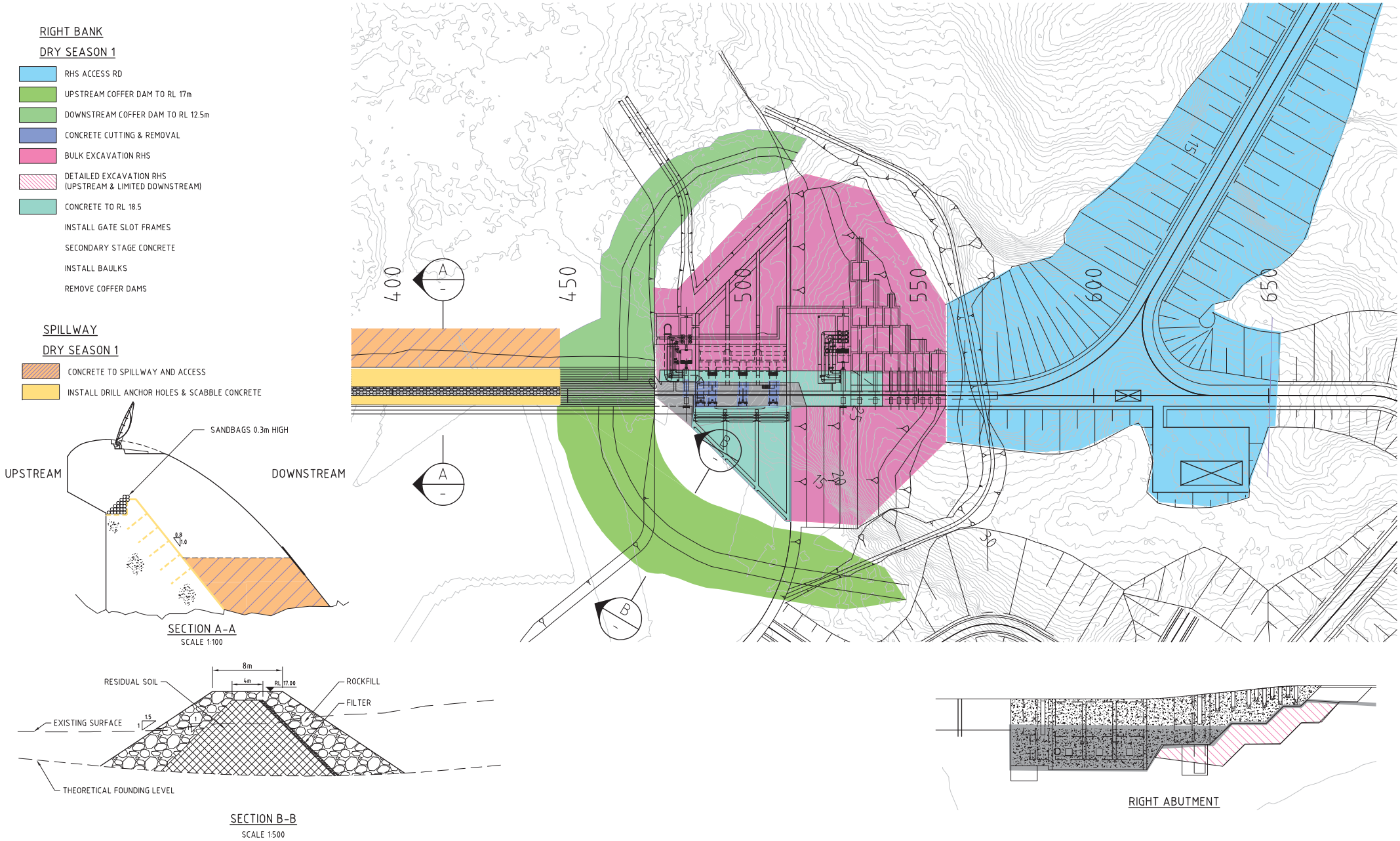


Figure 2-29 Eden Bann Weir construction sequencing (Sheet 1 of 4)

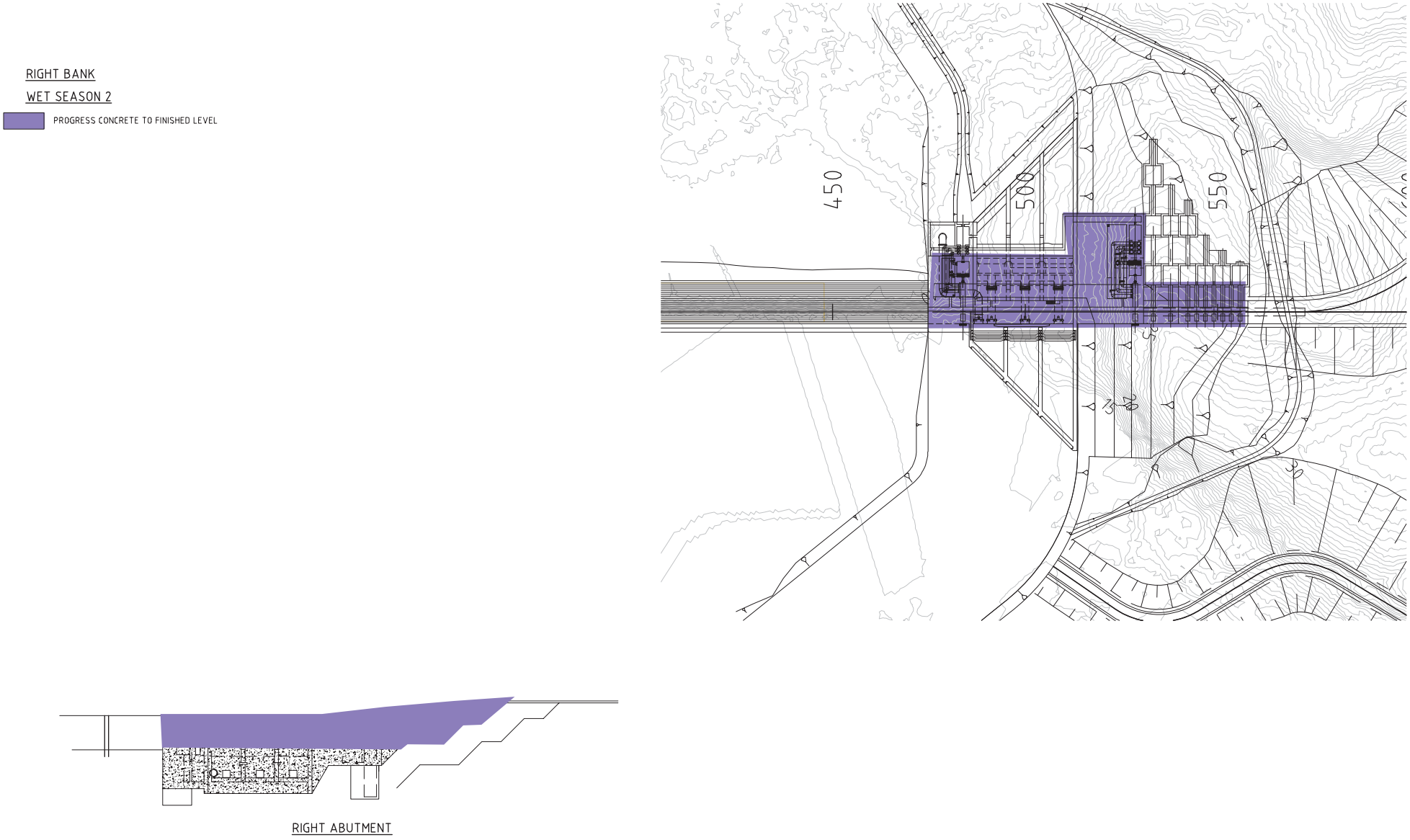


Figure 2-29 Eden Bann Weir construction sequencing (Sheet 2 of 4)

RIGHT BANK

DRY SEASON 2

COMPLETE CONCRETE WORKS DOWNSTREAM

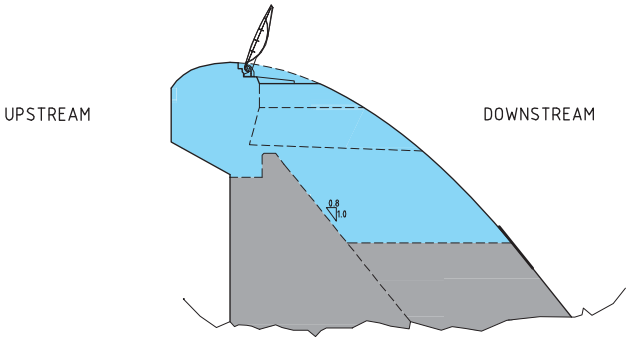
EXCAVATE FISHWAY CHANNEL

INSTALL MECHANICAL EQUIPMENT

SPILLWAY

DRY SEASON 2

FRP SPILLWAY IN ALTERNATE BAYS



SECTION A-A

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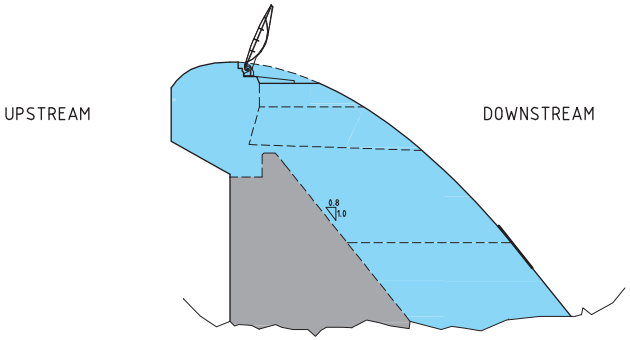


SECTION B-B

SCALE 1:100

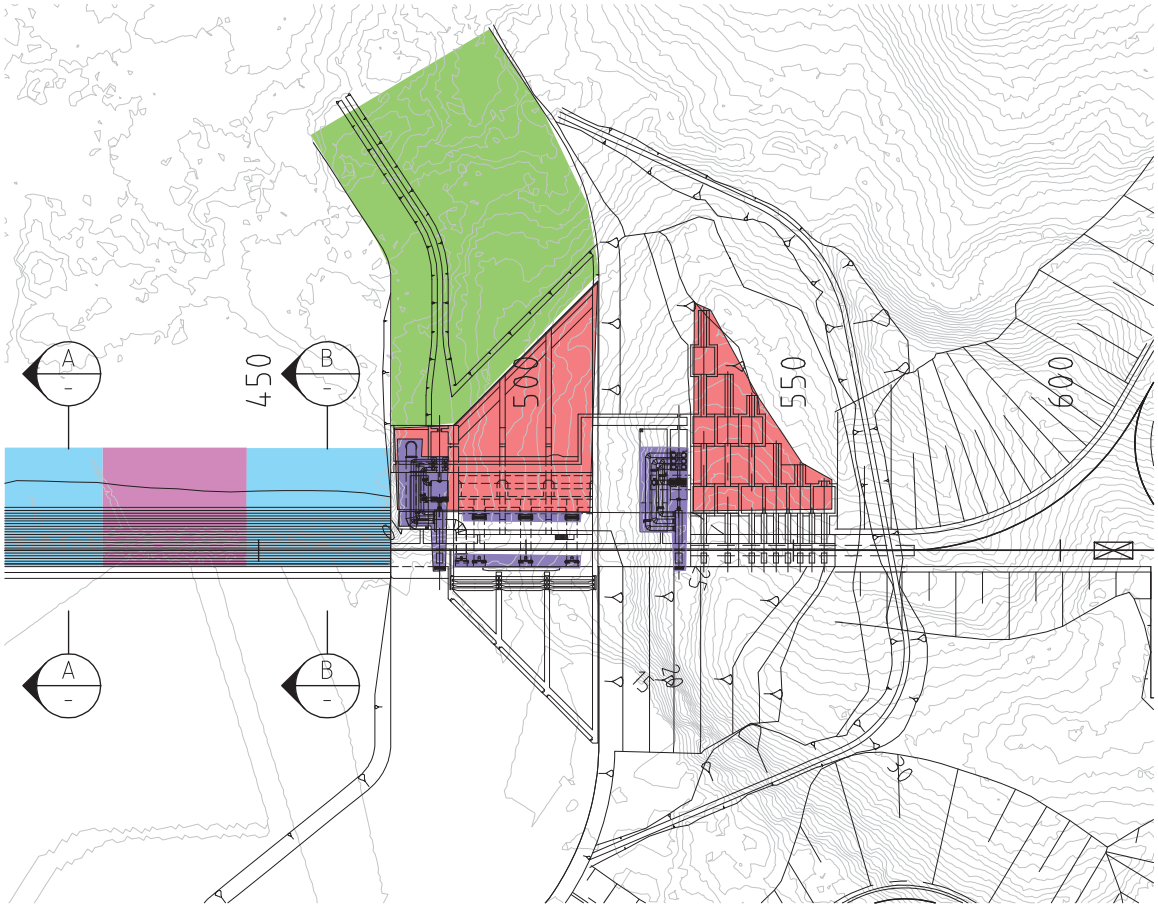


Figure 2-29 Eden Bann Weir construction sequencing (Sheet 3 of 4)

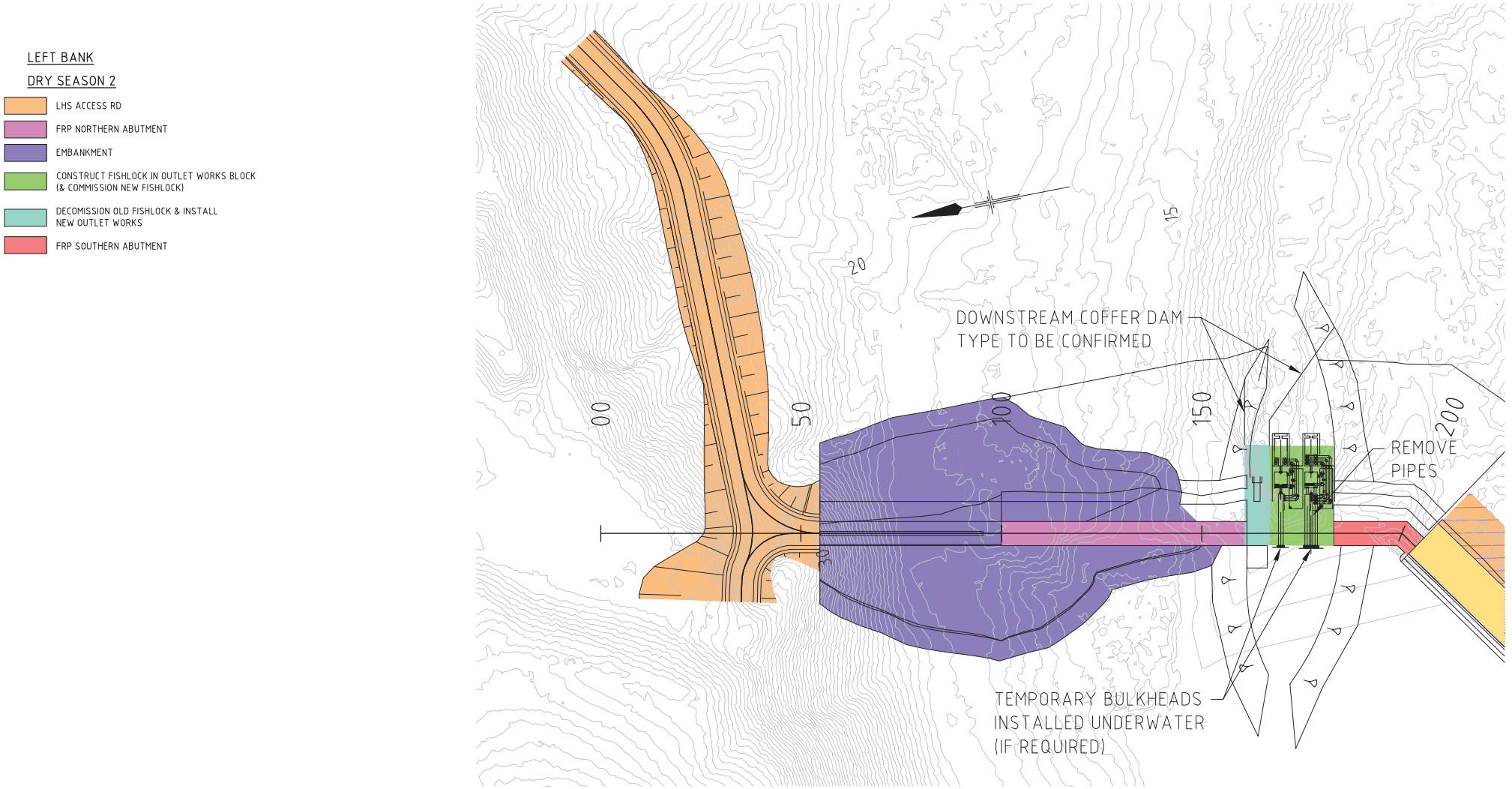


Figure 2-29 Eden Bann Weir construction sequencing (Sheet 4 of 4)

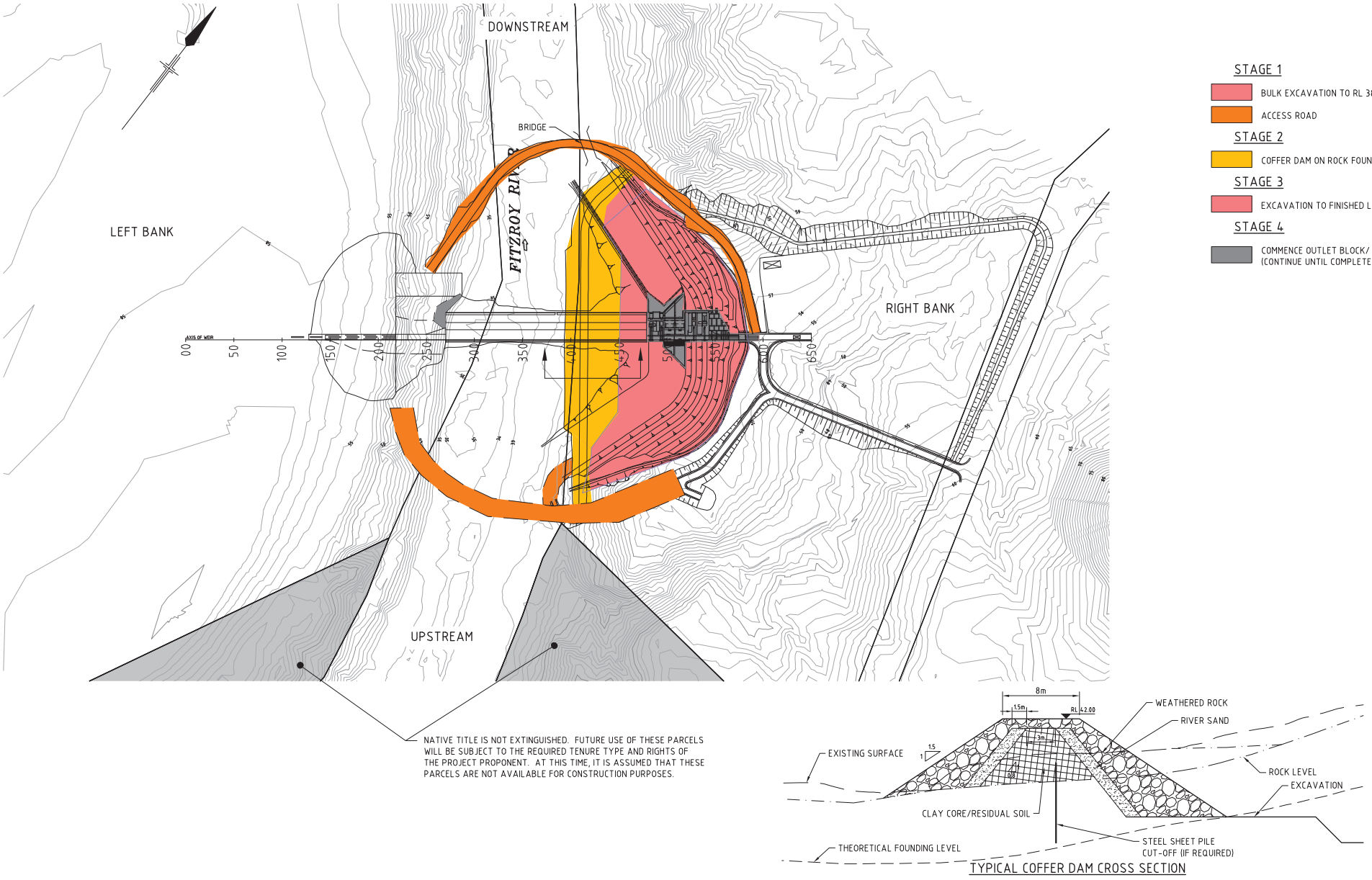
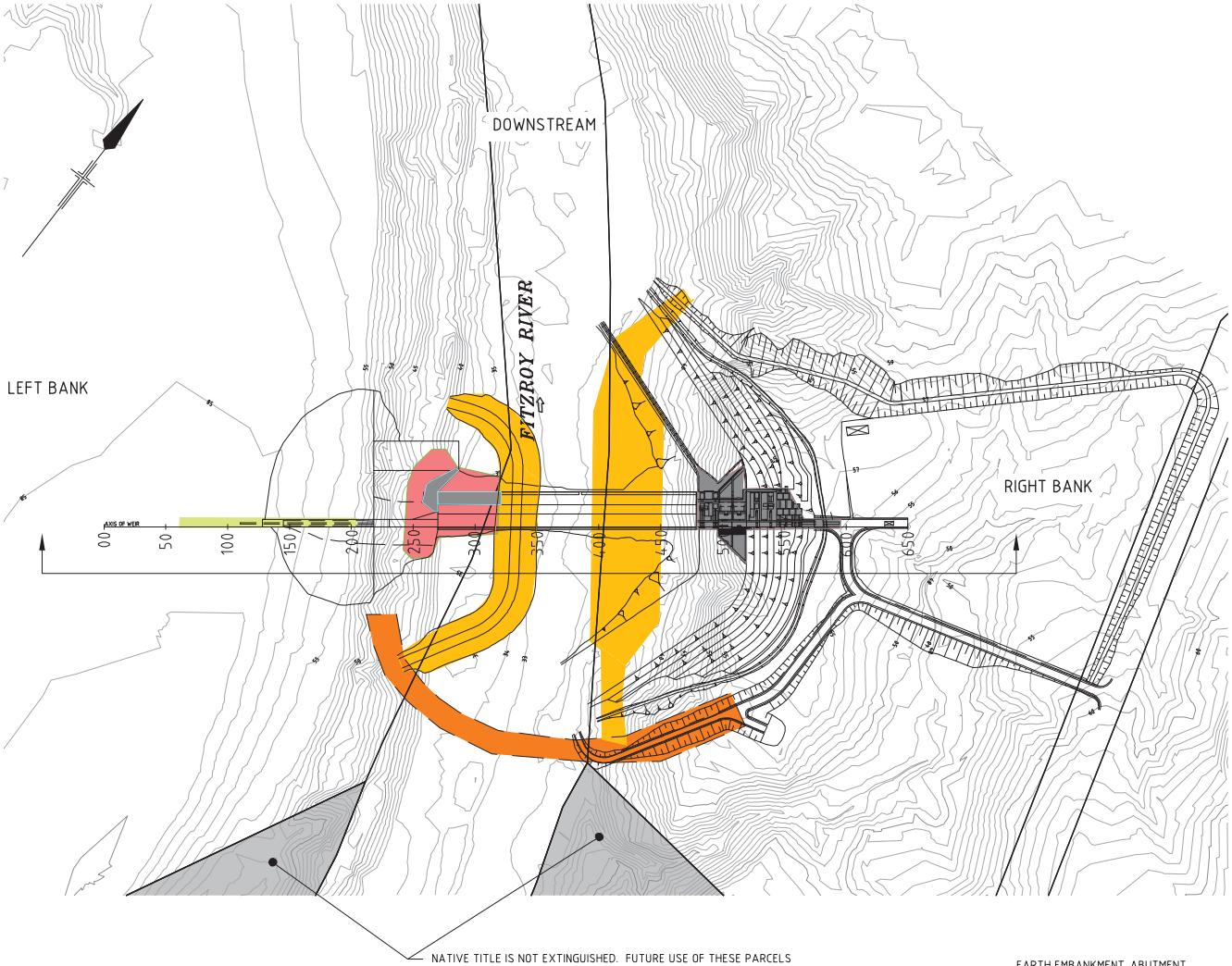


Figure 2-30 Rookwood Weir construction sequencing (Sheet 1 of 4)



STAGE 5

CH240-340 EXCAVATION FOUNDATION CLEANUP. CAST DENTAL,

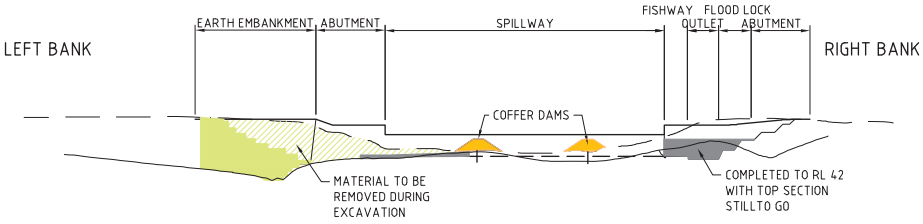
APRON SLAB & TRAINING WALL

STAGE 6

CUTOFF

WET SEASON

NATIVE TITLE IS NOT EXTINGUISHED. FUTURE USE OF THESE PARCELS WILL BE SUBJECT TO THE REQUIRED TENURE TYPE AND RIGHTS OF THE PROJECT PROPONENT. AT THIS TIME, IT IS ASSUMED THAT THESE PARCELS ARE NOT AVAILABLE FOR CONSTRUCTION PURPOSES.



SECTION

Figure 2-30 Rookwood Weir construction sequencing (Sheet 2 of 4)

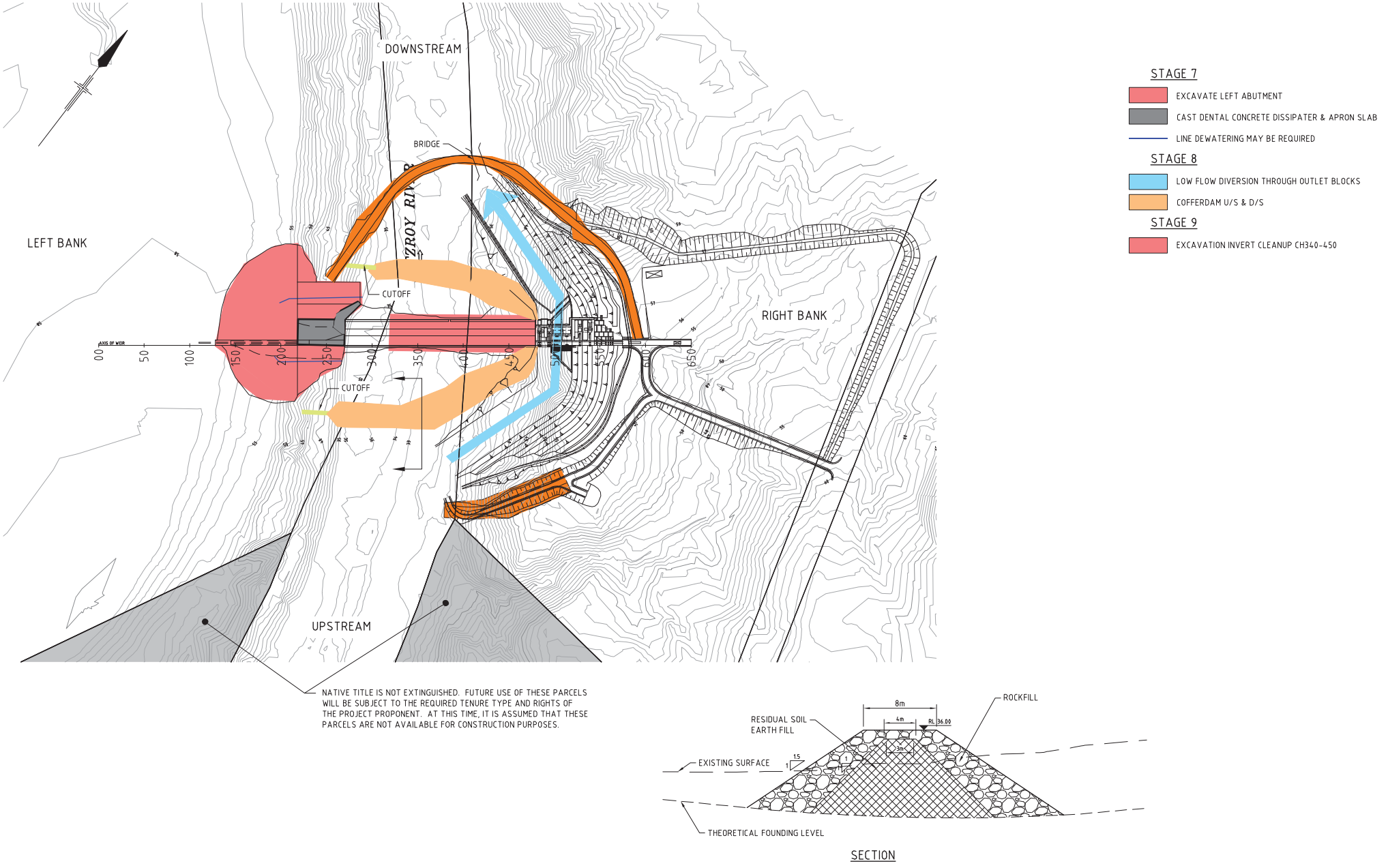


Figure 2-30 Rookwood Weir construction sequencing (Sheet 3 of 4)

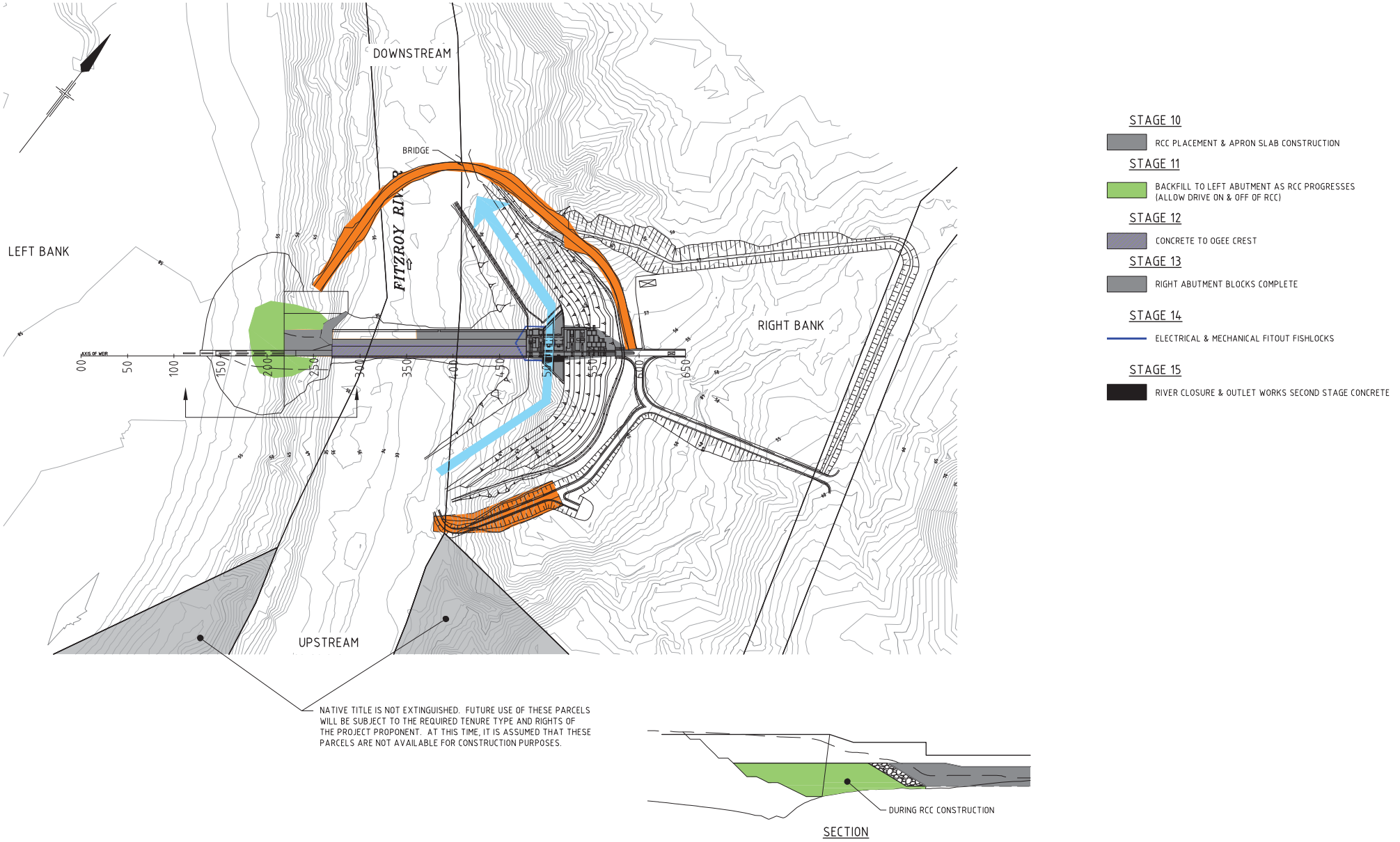


Figure 2-30 Rookwood Weir construction sequencing (Sheet 4 of 4)

2.4.4.2 Diversion strategies

Eden Bann Weir is an existing structure that has varying flood immunity for different work areas across its length. Work in the river channel downstream of the existing spillway will be limited to the depth of flow of water that can be channelled around areas so that work can continue. Work adjacent to the spillway needs to be protected by low height cofferdams. These will offer immunity to minor flooding events. Work to be carried out on both abutments can be carried out over longer periods as the abutments themselves offer a higher level of immunity to flooding. Through analysis of flood levels during the summer months, relative cofferdam levels have been estimated and are provided in Table 2-9.

Table 2-9 Cofferdam levels and associated flood flows – Eden Bann Weir

Section of works / river diversion arrangements	Height above existing spillway (m)	Cofferdam height (m AHD)	Flood diversion capacity (m^3/s)
Spillway and riverbed / sand bagging or boarding of spillway in lengths	+ 0.3	14.8	40
Right abutment works/upstream cofferdam	+ 1.0	15.5	300
Right abutment low level works / downstream cofferdam		10.0	300
Right abutment works protected by existing abutment	+ 3.0	17.5	2,000
Left abutment works / protected by existing abutment	+ 1.5	16.0	605
Left abutment works/downstream cofferdam; upstream baffle system	+ 1.5	16.0	605

In accordance with Queensland Fisheries requirements to maintain fish movement upstream and downstream during construction, the following actions will be undertaken:

- The existing fish lock and outlet structure will remain operational throughout construction
- When construction is complete or when the river channel is closed, the existing and new fish movement structures are fully operational.

The diversion strategy adopted for Rookwood Weir is to limit river diversion to a single dry season with river diversion undertaken as follows:

- Low longitudinal cofferdams will be constructed to protect the works and secure the abutments with the river remaining in its natural course. High diversion capacities are achievable with relatively low cofferdams
- Longitudinal cofferdams between 1.5 m and 10 m high above the riverbed (to accommodate flood flows of between 90 m^3/s and 1,500 m^3/s, respectively) will be constructed across the river to allow for dewatering and excavation of the weir abutment foundations. Note that the river remains in its natural course at this time
- River flows will be diverted through the partly completed outlet structure (up to 90 m/s) which will be open to fish passage. Larger floods must pass over the partly completed roller compacted concrete embankment. Temporary works will either be removed prior to flooding or designed to withstand the predetermined flow event.

River diversion sequencing is illustrated in Figure 2-29 and Figure 2-30 for Eden Bann Weir and Rookwood Weir respectively.

2.4.4.3 River crossings

Each river crossing could be completed within a 12 month period. Assuming that Eden Bann Weir is raised and gates added (Stage 3) and Rookwood Weir is constructed and gates added (Stage 2), should the work be undertaken by a single contractor, for resource optimisation purposes, the contractor is likely to construct the three river crossings by sequentially moving plant and construction teams from site to site for optimum cost control. On this basis, all crossings could be constructed within 18 months. However, these times could be extended if adverse foundation conditions are experienced or if extended flooding of the river occurs. Given that the Project is expected to be staged, it is unlikely that all river crossings would be constructed simultaneously.

Raising Eden Bann Weir to Stage 2 triggers the construction of a low level bridge at Glenroy Crossing. Raising Eden Bann Weir further by adding gates (Stage 3) at a later time will not trigger further augmentation or construction at Glenroy Crossing. Construction of Rookwood Weir will trigger the construction of a low level bridge at Riverslea Crossing and the installation of culverts at Hanrahan Crossing. Construction of Rookwood Weir Stage 1 does not trigger construction of a low level bridge at Foleyvale Crossing. Raising Rookwood Weir to Stage 2 by adding gates will not trigger further augmentation or construction at either Riverslea or Hanrahan crossings. Rookwood Weir Stage 2 will however trigger construction of a low level bridge at Foleyvale Crossing.

The construction sequence for individual river crossings is expected to be as follows:

- Site compound including site office, ablution facilities, works area and parking areas setup. No onsite camp or accommodation is expected. No onsite treatment or disposal of liquid and solid wastes will occur
- Establishment of survey controls and set out
- Establishment of erosion and sedimentation controls
- Site preparation, including clearing, grubbing, removal and stockpiling of topsoil, construction of access roads and stockpile areas
- Progressive establishment of access tracks to river bed, construction of equipment pads, coffer dams to pier foundations and dewatering of foundations
- Excavation for and construction of pier footings and foundation anchors and/or piling for bored pile foundations
- Reinforced concrete pier construction
- Construction of pier headstocks
- Placing of precast bridge girders
- Reinforced concrete deck construction (joint less system preferred)
- Cut earthworks at abutments
- Pile construction at abutments, either similar to piers or comprising driving of steel H piles, depending upon final design

- Formation of abutment and construction of abutment headstock
- Finalising abutment including erosion protection works
- Installation of joints (if required), surfacing, bridge traffic rails and other finishing works
- Construction of left and right approach embankments and pavements and signage
- Site rehabilitation and demobilisation.

2.4.5 Commissioning

Commissioning of mechanical and electrical equipment, as incorporated in the outlet works, fish locks and crest gates including access cranes, hydraulic and instrumentation controls will be undertaken as each element is complete. Commissioning will be undertaken under supervision of the relevant suppliers and in accordance with relevant Operations and Maintenance Manuals and manufacturer's instructions. Commissioning of fish passage structures will be completed in consultation with Queensland Fisheries.

2.5 Operation phase

2.5.1 Overview

Post-construction and commissioning, it is expected that filling to FSL can be achieved at both weirs within a single wet season (Chapter 9 Surface water resources). In simple terms, the storages capture and retain river flows during the wet season allowing for slow, regulated releases through the dry season, allowing for environmental releases as necessary and in accordance with regulations. Releases downstream will be made through 'run of river' methods, that is, releases will be made directly to the river and not through the use of pipelines, canals or other infrastructure. The Project area currently has limited access and recreational use opportunities. There is no facilitated public access to the existing Eden Ban Weir impoundment. It is not intended to increase or further facilitate recreational use of the Fitzroy, Dawson and Mackenzie Rivers as a result of the Project. Access to the impoundments would be restricted as there are few public access points. Recreational use of the impoundments would not be encouraged and no public access to the river would be provided as part of the Project. The weir sites will be fenced and visitor access to the weir would be restricted.

Post construction, the Project is expected to employ between one and five full time equivalent persons in operations and maintenance capacities.

2.5.2 Drawdown strategy and flow releases

For the purposes of the EIS, and to achieve Project objectives of capturing and storing all unallocated but available water, development of both the Eden Bann Weir raises and Rookwood Weir construction has been assumed. The Project will operate in concert with the existing Eden Bann Weir and Fitzroy Barrage (Chapter 9 Surface water resources).

On this basis, the overall storage and release strategy is proposed to operate as follows, subject to the Fitzroy WRP and subsequent Fitzroy ROP provisions:

- Nominal FSLs will be maintained at Eden Bann Weir and the Fitzroy Barrage through releases from Rookwood Weir
- Once the Rookwood Weir storage is emptied, nominal full supply would be maintained at the Fitzroy Barrage through releases from Eden Bann Weir

- Once the storages at Rookwood Weir and Eden Bann Weir have been emptied, drawdown at the Fitzroy Barrage will occur.

By implementing this strategy, losses relating to seepage and evaporation will be kept to a minimum, thus maximising available yield.

During operations, releases from Eden Bann Weir and Rookwood Weir can made as follows:

- Up to 15 m^3/s or a volume of up to 1,300 ML/day can be released through the low flow outlet at Eden Bann Weir
- Low flows through the outlet works at Rookwood Weir will have a capacity to discharge at a rate of 14.5 m^3/s. Releases for the required environmental flow base flow of 15 m^3/s will be supplemented through the fish locks (various release volumes and velocities). Preference will be given to releases through the fish lock over releases via the low flow outlet as far as is practicable
- Up to 58 m^3/s or a volume of 5,000 ML/day can be released through the environmental flow outlets to satisfy environmental flow objectives when either weir is full
- Over the spillway during flood events.

Environmental flow releases will be made in accordance with the Fitzroy WRP and ROP. The outlets are not used for flood control or for safety reasons. Outlets are required to facilitate base flow discharges for consumers, and to meet base flow environmental objectives. In order to inform design parameters, environmental flow objectives were tested using the integrated quantity and quality model (IQQM) based on the Fitzroy WRP (Chapter 9 Surface water resources).

The low flow outlet can be operated after the post-winter flow to allow for the required number of days of release to be met. After this, the outlet works will only discharge base flows or flows required to meet downstream demands. The outlet works also serve to provide attraction flows to fish at the downstream end of the fish locks.

It is important to note that it is possible for the required 5,000 ML/day to be met without environmental flow outlets if the weirs fill and spill quickly. The existing Eden Bann Weir operates in this way, with 58 m^3/s passing over the spillway upon filling within the required timeframe as opposed to being met through an environmental flow outlet.

The requirement (or not) for the environmental flow outlets will be further determined in consultation with State agencies during detailed design.

Environmental flow outlets are controlled by local operator input. The environmental flow outlet control gates will open at a slow rate for the first 50 mm of travel to gently flush (and not injure) any turtles that may collect downstream of the gate into the stilling basin below the wall. The speed of opening will be determined from observations on site after installation of the control gates. It is estimated that an opening speed of 0.5 m/min will be sufficient with a five minute stop when a 50 mm gap is open. The opening speed will then be increased to 1 m/min. The control gates will be closed in one continuous motion at a speed of 1 m/min. During detailed design the maximum closing speed will be determined to prevent transient loads in the conduit upstream of the control gates.

Flows will discharge from the outlets into an impact type stilling basin or pond and then discharge over a natural rock bar acting as a small monitoring weir (Section 2.3.3.3) into the original river channel.

2.5.3 Flap gate operation strategy

The 18 crest flap gates proposed for Eden Bann Weir would operate in four banks of four with the two gates closest to the right bank outlet works (gates one and two) operating independently. Similarly, the 14 crest flap gates proposed for Rookwood Weir, would operate in three banks of four with gates one and two closest to the right bank outlet works operating independently. Opening the gates entails lowering them while closing the gates entails a raise. The gates are proposed to be operated as follows:

- Up to 300 mm spill flow over the top of the gates is accommodated prior to opening
- The gates adjacent to the right bank fishway will open first and close last to assist with maintaining attraction flows to the fishway during spill events
- In a flood the gates will be operated as shown in Table 2-10. The opening sequence will be reversed for closing.

Table 2-10 Gate operation opening sequence

Eden Bann Weir opening sequence		Rookwood Weir opening sequence	
1	Gate 1 open	1	Gate 1 open
2	Gate 2 open	2	Gate 2 open
3	Gates 3 to 6 open	3	Gates 3 to 6 open
4	Gates 7 to 10 open	4	Gates 7 to 10 open
5	Gates 11 to 14 open	5	Gates 11 to 14 open
6	Gates 15 to 18 open		

Each bank of gates will open and close sequentially within a minimum of 30 minutes (or slower as required). Gates will only be operated in the fully raised or fully lowered positions. The rate of lowering will be determined during detailed design to limit high incremental flows which might affect aquatic species in proximity to the gates and to prevent fish stranding due to rapid flow level reduction.

There will be four modes of operation for the flap gates. Automatic, remote and local controls are considered as modes for normal operation. In an emergency situation, gates will be able to be manually operated either with or without electrical power being available. Modes of operation are described as follows:

- Automatic control: This mode uses input from water level sensors at the weir, flow measurements from upstream and programmed algorithms to lower and raise the gates automatically
- Remote control: Control of the gates can be done from a remote location (for example, Rockhampton) via telemetry with input from water level recorders at the weir and flow measurement higher in the catchment area
- Local control: The gates can be controlled by an operator in the control room at the weir
- Manual (and emergency) operation: The operator can control the gates by manipulating manual valves. In the absence of electrical power or an operator being on site, gates will lower under water pressure due to a certain height of overflow.

2.5.4 Fishway operation

Fishway operation involves valves and gates operating in stages. The velocities prescribed by fish biologists for ideal fish migration conditions are around 0.3 m/s minimum velocity in the exit chamber and capable of up to 1.8 m/s design velocity at the entry slot. The pipe arrangements will be designed to provide velocities of this order, to allow throttling back of flow with the valves provided to establish the necessary flow conditions. Further detail is provided in Chapter 7 Aquatic ecology and Appendix X.

2.5.5 Control systems

For both Eden Bann Weir and Rookwood Weir, all equipment on the weir will be controlled by hydraulics from the control room on the right embankment. No electrical equipment will be used on the weir except where they are temporary and can be removed prior to flooding.

All equipment will be controlled from control panels in the control room. Four separate power packs will be used, two for the crest gates, one for the environmental flow outlets and low flow outlet and one for the fishways. Each power pack will have two identically sized pumps, one as duty and the other as standby.

A supervisory control and data acquisition (SCADA) system is proposed to be used. The system will facilitate the monitoring, controlling and alarming of the weirs from a central location, and is likely to be at Rockhampton from where SunWater currently operates the existing Eden Bann Weir.

Grid power will be used as the primary power source, with a standby generator as backup.

2.5.6 Maintenance

The proposed infrastructure has been designed to reduce maintenance requirements and to allow adequate access for maintenance activities such as periodic cleaning and clearing of screens, hydraulic repairs, seal adjustment and/or replacement and corrosion repair of flap gates.

No general maintenance of the fish lock gates is expected to be required. Should seals on the gates or actuators need replacement, the gate or actuator would have to be removed using a 10 tonne mobile crane. Dismantling the gate or actuator would be undertaken from a person cage or scaffolding. The gate frame would not have to be removed.

Maintenance requirements for the low flow outlet discharge valve would involve replacement of seals every 25 years depending on the silt load of the water. This would be undertaken with the valve in situ. Corrosion protection would also be undertaken with the valve in situ. Complete removal and replacement of the valve would only be required possibly every 50 years using a mobile crane positioned downstream of the weir.

All bearings for the crest flap gates will be maintenance free and self-lubricating. Expected maintenance would consist of hydraulic work, seal adjustment/replacement and corrosion repair on downstream side. The gates should not have to be removed once installed.

To provide a maintenance facility for the crest gates even during full supply level of the weir, stoplog grooves for stoplog installation would be provided upstream of the flap gates. This allows isolation of a gate for maintenance purposes. The stoplogs would be installed under no flow conditions or into flowing water up to 0.5 m deep in emergency situations using a travelling gantry crane. Once the stoplogs are installed, the auxiliary hoist of the gantry crane would be used to provide access to the gate level using a personnel cage.

2.6 Decommissioning and rehabilitation

While the design life of the Project is 100 years it is anticipated that the weir infrastructure will be maintained and operational after this period. As such, effective prescriptive planning for decommissioning and rehabilitation cannot be undertaken at present as best practice standards and legislative requirements are likely to change over the life of the Project. Management obligations for the infrastructure will continue in accordance with the approval requirements until such time as the infrastructure is decommissioned and the area rehabilitated. These responsibilities remain with the owner of the infrastructure.

Decommissioning of the Project may be required if the weirs are no longer needed for water supply or if the infrastructure is severely degraded and can no longer be maintained to meet safety standards. When decommissioning of the Project is required, an assessment of current legislative requirements and best practice decommissioning and rehabilitation methodologies will be undertaken. This assessment will inform the preparation of a decommissioning and rehabilitation plan which will be developed in consultation with relevant authorities prior to commencing works.

It is probable that all areas to be rehabilitated will be restored, where possible, to their condition prior to construction. Rehabilitation will be done progressively and achieve a stable and functioning landform consistent with the surrounding landscape and environmental values.

Potential short and long term environmental impacts may arise as a result of weir decommissioning. Potential environmental impacts to be addressed during decommissioning and rehabilitation may include:

- Restoration and stabilisation of river banks at the weir sites and land upstream of the sites that would no longer be inundated.
- Treatment/removal of sediments that present a risk to downstream water quality and ecosystem health.
- Identification of any potential contamination that may have occurred during the operational phase and development of appropriate remediation strategies.
- Development of a weed and pest management plan including a monitoring and inspection programme to be implemented during and for a period following decommissioning and rehabilitation.