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Forest Creek Return Flows Regulator

Review of Environmental Factors

NSW Department of Climate Change, Energy, the Environment and Water | October 2024

Acknowledgement of Country

The Department of Climate Change, Energy, the Environment and Water acknowledges that it stands on Aboriginal land. We acknowledge the Traditional Custodians of the land and we show our respect for Elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

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A Draft	September 2023	E Davis V Fink C Cadman	T Paull
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Declaration

This Review of Environmental Factors (REF) has been prepared 3Rivers, a joint venture between Jacobs Group (Australia) and GHD on behalf of the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW). The REF has been prepared to assess the environmental impacts to satisfy the requirements of Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and considers the factors listed in clause 171 of the Environmental Planning & Assessment Regulation 2021 (EP&A Regs).

The REF provides a true and fair assessment of the proposed activity in relation to its likely effects on the environment. It examines and takes into account to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposed activity.

Based on the information provided in the REF, it is concluded that:

(1) the proposed activity is not likely to have a significant impact on the environment, and an Environmental Impact Statement is not required.

(2) The proposed activity is not likely to significantly affect threatened species or ecological communities or their habitat,or be carried out in a declared area of outstanding biodiversity value. A Species Impact Statement (SIS) is not required.

(3) The proposed activity is not likely to significantly affect any Matters of National Environmental Significance, nor is the activity being carried out on or is it likely to impact Commonwealth land.

Based on the information presented in this REF, it is concluded that by adopting the safeguards identified in this assessment, it is unlikely that there would be significant adverse environmental impacts associated with the project. Subject to the adoption of the measures to avoid, minimise or manage environmental impacts listed in this REF, the proposed activity is recommended for approval.

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Certification

I, Julian Ardas, have examined this REF and the Declaration by the authors and accept the report on behalf the NSW Department of Climate Change, Energy, the Environment and Water.

Signature:

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22 October 2024

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1. Introduction

1.1 Background

The Yanco Creek System is located in the New South Wales (NSW) Riverina and comprises a creek and floodplain system that commences from the Murrumbidgee River at Yanco Weir located about 20 kilometres (km) west of Narrandera. It is a complex, braided system of interconnecting creeks and anabranches flowing east to west, eventually meeting the Edward River (part of the Murray River system) at Moulamein (Department of Primary Industries, 2015). The main branches of the system include the Yanco, Colombo, Billabong and Forest creeks.

Prior to the 1850s, Yanco Creek only connected with the Murrumbidgee River during floods and Billabong Creek was regularly reduced to deeper waterholes in summer. From the 1850s onwards, the creek underwent modifications over time to enable water delivery for stock and domestic use and irrigation and it became a perennially flowing system.

Today, the system supports numerous irrigation offtakes and canals, irrigation areas and water pumps. The creek also has numerous structures and flow blockages. Some of the structures are actively used to redirect flow and create weir pools that are used for irrigation or domestic use however, some are defunct and no longer serve a purpose.

The Yanco Creek Modernisation Project (YCMP) which forms part of the commitments within the Sustainable Diversion Limit Adjustment Mechanism (SDLAM) program as further discussed in section 2.1, involves infrastructure upgrades and new installations to improve water management within the Yanco Creek System. The construction of the new Forest Creek return flows regulator is one of the sub-projects of the YCMP being delivered by NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW).

The construction and operation of the Forest Creek return flows regulator is the subject of this Review of Environmental Factors (REF) and referred to as the **project** within this document.

Further information on the project is provided section 1.2 and section 3.

1.2 Project overview

Warriston Weir is currently used by WaterNSW to regulate flows in the upstream (regulated) reach of Forest Creek. Warriston Weir is located on Forest Creek, approximately 6.8 km south-west of Conargo.

The Piccaninny Creek offtake channel is approximately 400 metres (m) long, connecting Forest Creek to Piccaninny Creek and is 1.3 km upstream of Warriston Weir. An existing block bank and ungated DN600 pipe culvert located at the upper end of the Piccaninny Creek offtake channel diverts a proportion of the Forest Creek flow down Piccaninny Creek.

The project involves the construction of a new regulator (the Forest Creek return flows regulator) and the removal of the existing pipe culvert. The new regulator would be constructed in the same location as the existing culvert. The existing regulator is owned and operated by WaterNSW. The new regulator would also be owned and operated by WaterNSW.

The project would assist in maintaining the water level in Warriston Weir and prevent unplanned flows over the weir during normal regulated periods through controlled water delivery to Billabong Creek via Piccaninny Creek. This would reduce unplanned flows over Warriston Weir and help supply water demand along Billabong Creek.

The location of the project is shown in Figure 1.1 and the project's assessment areas is shown in Figure 1.2. Further detail on each component of the project is provided in section 3.

1.3 Purpose of this document

The purpose of the REF is to describe the project, document the likely impacts of the project on the environment, and detail measures to mitigate impacts that cannot be avoided. The REF is the key document to which NSW DCCEEW would use to fulfil its duty under section 5.5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), including taking into account the factors listed under clause 171 of the Environmental Planning and Assessment Regulation 2021 (EP&A Regulation) (see Appendix A Clause 171 Environmental Factors Checklist).

The findings of the REF would be considered when assessing:

- Whether the project is likely to have a significant impact on the environment and therefore the requirement for an Environmental Impact Statement (EIS) to be prepared and approval sought from Minister for Planning and Public Spaces under division 5.2 of the EP&A Act.
- The significance of any impact on threatened species as defined by the *Biodiversity Conservation Act 2016* (BC Act) and *Fisheries Management Act 1994* (FM Act) (referred to in section 1.7 of the EP&A Act) and therefore the requirement for a Species Impact Statement (SIS) or a Biodiversity Development Assessment Report (BDAR) to be prepared.
- The potential for the project to significantly impact on Matters of National Environmental Significance (MNES) or Commonwealth land and the requirement to make a referral to the Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW) for a decision to be made by the Commonwealth Minister for Environment and Water on whether assessment and approval is required under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Figure 1.1 Location of the project

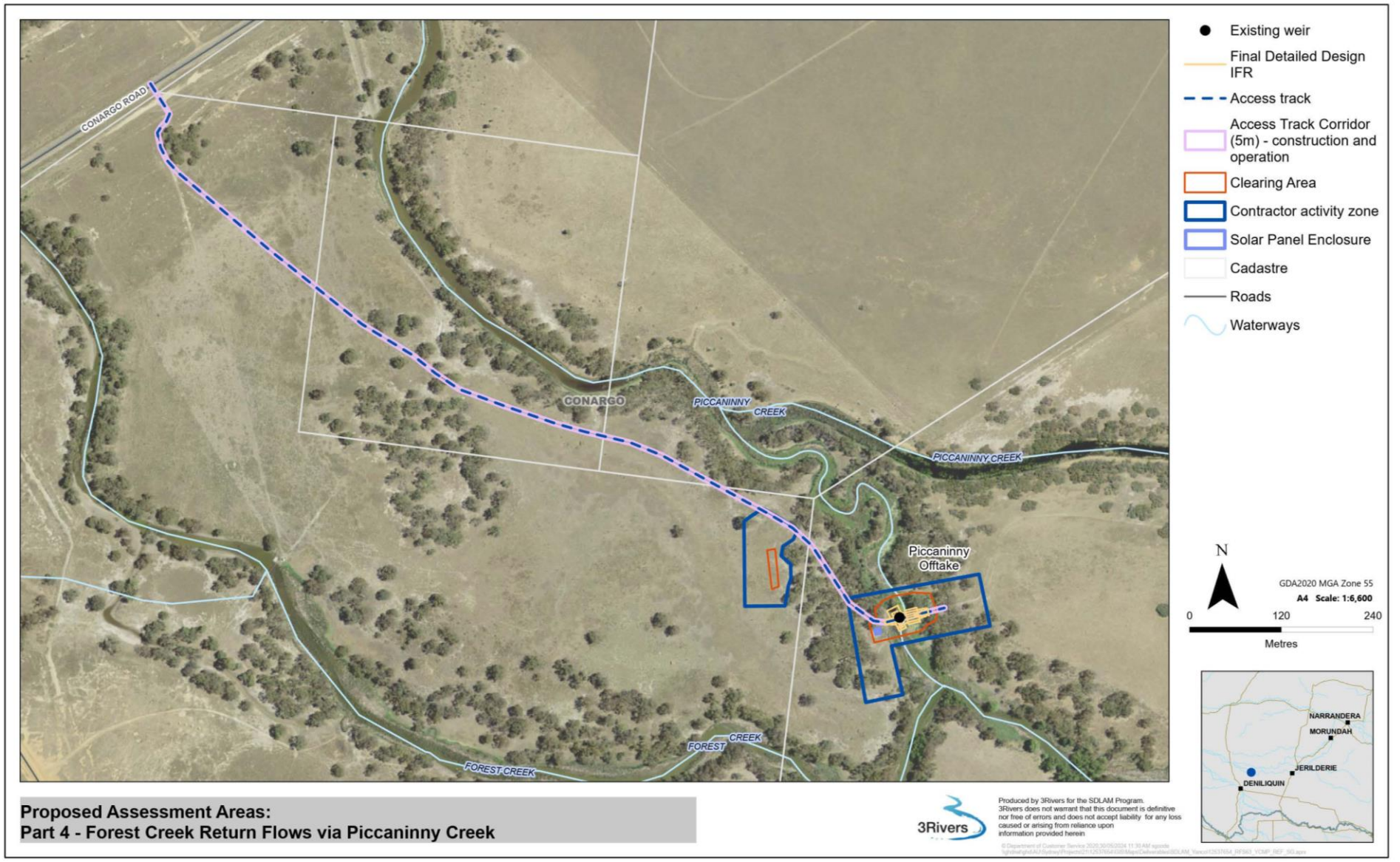

Figure 1.2 Project assessment area

2. Project need and justification

2.1 Background to the project

2.1.1 The Murray-Darling Basin Plan

The Federation drought (between 1895 and 1902) provided a catalyst to bring the states together to agree on the management of the Murray River. The River Murray Waters Agreement, involving the governments of NSW, Victoria, South Australia, and the Australian Government, commenced in 1915. The formation of the River Murray Commission followed in 1917.

The first Murray-Darling Basin Agreement, which established the Murray-Darling Basin Commission, was reached in 1987. The Millennium drought, which occurred from 1997 to 2009 in much of southern Australia, led to an increased understanding of environmental management constraints and water management requirements. This highlighted the limits and weaknesses of how water in the Murray-Darling Basin (the Basin) was managed and highlighted the need for continuing reform. In response, the *Water Act 2007* (Cth) (the Water Act) was enacted.

As a requirement of the Water Act, the Murray-Darling Basin Authority (MDBA) was formed. The MDBA was required to develop a plan to manage how much water could be used by industries and communities in the Basin. The Basin Plan was adopted in November 2012. The aim of the Basin Plan is to bring the Basin back to a healthier and sustainable level, while continuing to support farming and other industries for the benefit of the Australian population. The Basin Plan sets the amount of water that can be taken from the Basin each year.

There are several key components of water management in the Basin, which work as an integrated package:

- water entitlements – a permanent share/allocation of water within a catchment
- water trade – the ability to sell water entitlements and/or allocations
- water resource plans – management plans that define how water in a catchment can be used sustainably
- sustainable diversion limits – how much water can be used in the Basin while leaving enough water for the environment
- monitoring and accounting
- compliance.

2.1.2 The sustainable diversion limits and the adjustment mechanism

The Basin Plan sets sustainable diversion limits (SDL) for each catchment or group of catchments. The SDLs set were lower than the amount of water that was being used at the time. As a consequence, water has to be recovered to meet the limit. Across the Basin the additional amount of water needed to meet the SDLs and improve river and wetland health is an average of 2,750 gigalitres (GL) per year. It is estimated that 2,107 GL of water had been recovered by September 2021.

To provide flexibility, the Basin Plan includes a mechanism (the SDLAM) to adjust the SDLs to achieve equivalent social, economic and environmental outcomes with less water recovery. The SDLAM program allows the SDLs to be adjusted within defined limits to offset the remaining gap between extractions and the desired 2,750 GL of water saving. The ability to do this, and make additional water available for communities, is subject to the implementing a range of projects, which include:

- supply projects – improving the efficiency of how water is delivered to the environment
- efficiency projects – projects or activities that change water use practices and save water for the environment
- constraints projects – projects that aim to overcome some of the physical barriers and river management practices that impact the ability to move environmental water around the Basin.

In 2017, the Australian, NSW, South Australian and Victorian governments notified a package of supply and efficiency measure projects, of which NSW was the proposed lead or co-proponent jurisdiction for 22 projects. In early 2019, NSW signed a funding schedule with the Australian Government to undertake detailed planning for a number of these projects under the SDLAM Program. In September 2021 an agreement was reached to accelerate the funding for a certain number of these projects, including the YCMP.

This strategy provides a program-level approach to those projects within the NSW Government's SDLAM program.

SDLAM projects

Supply projects provide the opportunity to efficiently deliver water for the environment, balancing environmental water requirements with the needs of other water users. Supply projects must deliver equivalent or better environmental outcomes compared to those achieved under current Basin Plan settings, using less water. The water can then remain in the river for consumptive uses.

Supply projects are able to offset a quantity of water, which would otherwise need to be recovered from the Basin to a maximum volume of 605 GL. The projects seek to provide equivalent environmental outcomes with a reduced volume of water and reduce the amount of water that needs to be recovered to meet the SDLs. Project examples include environmental works, building or improving river or water management structures, changes to river operations, and works to reduce evaporation losses. Modelling of the supply projects indicates that implementing the projects would save up to 605 GL of water. This estimated saving has been incorporated into an amendment of the Basin Plan.

Constraints projects aim to overcome some of the physical barriers that impact delivering water in the system. Constraints projects can include changes to physical features such as crossings and bridges. They can also change river operating practices and rules. They could provide environmental water managers more flexibility in releasing and moving water through the system.

An assessment of the status of the SDLAM projects undertaken by the Murray– Darling Basin Authority in 2022, identified a shortfall of 190 to 315 GL/year from the expected 605 GL/year contribution as a result of project delays. As such, the NSW Government has brought forward its remaining SDLAM projects through the NSW SDLAM Acceleration Program (the Acceleration Program). The Acceleration Program, which has received $330 million in funding, would remove barriers and streamline construction funding to allow the delivery of five projects by December 2026. It would deliver up to 45 GL of the outstanding amount of water needed to reach the 605 GL target required by the Basin Plan each year, delivering strong ecological outcomes for the Basin.

The YCMP is being delivered as a supply measure under the SDLAM Acceleration Program.

Yanco Creek Modernisation Project

The YCMP involves infrastructure upgrades and new installations to improve water management as part of SDLAM program commitments. The objectives of the YCMP as defined in the *Yanco Creek Modernisation Project – Project Execution Plan v1.0* (DPE Water) August 2021 include:

- water savings through modernisation works involving replacement and/or modification of existing weirs, modification and/or removal of infrastructure to reduce transmission losses, access to alternative supply points, installation of new technology for monitoring and control, and the ability to divert operational surplus flows in Forest Creek near Warriston Weir back to the Billabong Creek via Piccaninny Creek
- improved fish passage and ability to provide environmental flow regimes
- renewal of water supply infrastructure and improved level of service to end-users.

The proposed construction of the Forest Creek return flows regulator is one of the sub-projects of the YCMP program and is the subject of this REF.

2.2 Project objectives

The primary purpose of the project is to assist in maintaining the water level in Warriston Weir and prevent unplanned flows over the weir during normal regulated periods through controlled water delivery to Billabong Creek via Piccaninny Creek.

The new Forest Creek return flows regulator would also allow river operators to direct flows down Forest Creek to water the various environmentally and culturally important wetland habitats.

Downstream environmental water would be delivered consistent with management plans developed by environmental managers (e.g. Commonwealth Environmental Water Office Water Management Plan 2022-23).

2.3 Options and alternatives considered

2.3.1 Yanco Creek Modernisation Project

The YCMP includes a suite of proposals to deliver the desired overall environmental outcomes of the project. These proposals have been developed through several rounds of option investigation and stakeholder engagement.

A combination of options for the YCMP was first documented in the 2015 Business case for modernising supply systems for effluent creeks - Murrumbidgee River (WaterNSW, 2015). Since then, the options have been refined and further options have been developed with stakeholder input, to assist in identifying preferred options and design elements for further investigation. The evaluation was centred around the application of a multi-criteria analysis approach incorporating both quantitative and qualitative data. Details of the options evaluation are contained in the NSW SDLAM Options Evaluation Framework (Alluvium, 2020a) and the User Guide for the NSW SDLAM Options Evaluation Framework (Alluvium, 2020b).

2.3.2 Design development

The concept design for the project has been subject to the following design development process:

- Basis of Design workshop held on 29 June 2021 with key stakeholders including Water Infrastructure New South Wales (WINSW), Fisheries and WaterNSW
- Safety in Design workshop held on 23 February 2022 (combined with Parts 1 and 3)
- Submission of draft concept design to the project Design Focus Group (DFG) on 16 March 2022. The DFG was established to review and endorse the designs for each of the structures. During concept design, the DFG included the following stakeholders:
  - NSW DCCEEW
  - WaterNSW
  - Department of Primary Industries (DPI) Fisheries
  - Constructability / design representatives for DCCEEW
  - SMEC (Owners Engineer for DCCEEW)
  - 3Rivers
  - Yanco Creek and Tributaries Advisory Council (YACTAC)
  - Department of Planning, Industry and Environment (DPIE) Environment and Heritage
  - Commonwealth Environmental Water Office.
  - receipt and compilation of DFG comments and engagement with relevant stakeholders to clarify intent of comments
  - meeting with DFG on 9 June 2022 to agree on approach to addressing comments
  - value management workshop held on 11 July 2022
  - update of draft concept design to final concept based on agreed approach
  - final concept design issued to WaterNSW in early December 2022

– DFG endorsement of draft detailed design on 13 September 2023.

2.3.3 Options assessment

The three primary options for the design for Forest Creek return flows are presented in Table 2.1.

Table 2.1 Design options for Forest Creek return flows

Option	Description	Option assessment
Regulator (layflat gate with flow measurement) at the existing block bank and pipe culvert.	A 1200H x 1200W RC box culvert with layflat gating installed at the upstream end of the existing block bank and pipe culvert.	• Increases the capacity of the existing pipe culvert (in excess of 50 ML/d design flow) • Layflat gate provides improved ability to regulate and measure flows, and facilitates downstream fish passage • Allows for operational flexibility at Warriston Weir to deliver environmental water
Regulator (penstock gate) (in addition to Option 1)	Installation of a penstock regulator gate on an existing access crossing of Piccaninny Creek, Purpose of the penstock gate was to reduce potential seepage and evaporation in the backwater reach of Piccaninny Creek, upstream of the connection channel from Forest Creek.	• Hydraulic and hydrologic assessment found that potential backwater effects would be of very short duration (i.e. less than a day) and/or would be unlikely to result in the perceived seepage and evaporation losses • Penstock gate was proposed to be attached to an existing privately-owned access culvert which presented ownership and operational management complexities
Do nothing option	Continuation of use of existing ungated DN600 culvert at the block bank on Piccaninny Creek offtake	• Flows would remain unregulated between Forest and Piccaninny Creek • Result in unintended spills over Warriston Weir • Reduced ability to efficiently deliver environmental water downstream of Warriston Weir

2.4 Preferred option

Option 3, 'do nothing', was discounted as the preferred option for the project as it would continue to allow unregulated flows between Forest and Piccaninny Creeks, limiting operational flexibility at Warriston Weir and ability to deliver environmental flows to the lower reaches of Forest Creek.

Option 2 involves the construction of a new regulator on an existing access crossing of Piccaninny Creek as well as the proposed Forest Creek return flows regulator. This option was discounted as the preferred option for the project as additional hydraulic and hydrologic assessment determined that the benefits of an additional regulator on Piccaninny Creek would be of limited value (i.e. seepage and evaporation losses would not be significantly reduced).

The preferred option, Option 1, is a new box culvert with a layflat gate on the existing block bank (the Forest Creek return flows regulator) at the Piccaninny Creek offtake. The preferred option has been designed to avoid and minimise impacts to the environment to the extent practicable and meets the objectives of the project, and the overall YCMP.

3. Description of the project

3.1 Overview

The proposed works involve the construction of the new Forest Creek return flows regulator at the location of an existing pipe culvert. This would involve:

- constructing a new box culvert offtake and flow rate control works with a layflat gate regulator with the following design features:
  - a 1200 millimetres (mm) wide and 1200 mm high reinforced concrete box culvert, approximately 10 m long with a design capacity of 50 megalitres of water per day
  - a new inlet structure adjoining the upstream end of the culvert fitted with a lay-flat gate
  - spillway and precast headwalls fitted to the downstream end of the culvert
  - the existing block bank to be upgraded to proposed design profile of new culvert
  - downstream fish passage would be facilitated by the use of a box culvert, the lay flat gate and a plunge pool downstream of the gate
  - bulkhead slots embedded in the concrete structure both upstream and downstream of the layflat
  - rock beaching erosion protection at the inlet and outlet of the culvert
  - seepage cut-off beneath the gate
  - precast metal walkway and handrails for access to the gate
  - solar power supply with solar panels and batteries on site.
- removing the existing pipe culvert at the location of the proposed works.

Other works at the site include possible trimming of cumbungi within the channel where it impacts the hydraulic performance of the regulator.

Communication and network connectivity is currently being investigated and it is likely a new communications mast would be installed as part of the project, which would be approximately 30 m tall.

An overview of the project is shown in Figure 1.2 and the proposed construction arrangement is depicted in Figure 3.1 and Figure 3.2 below. Further information regarding the proposed operating regime of the structures is detailed in section 3.5.

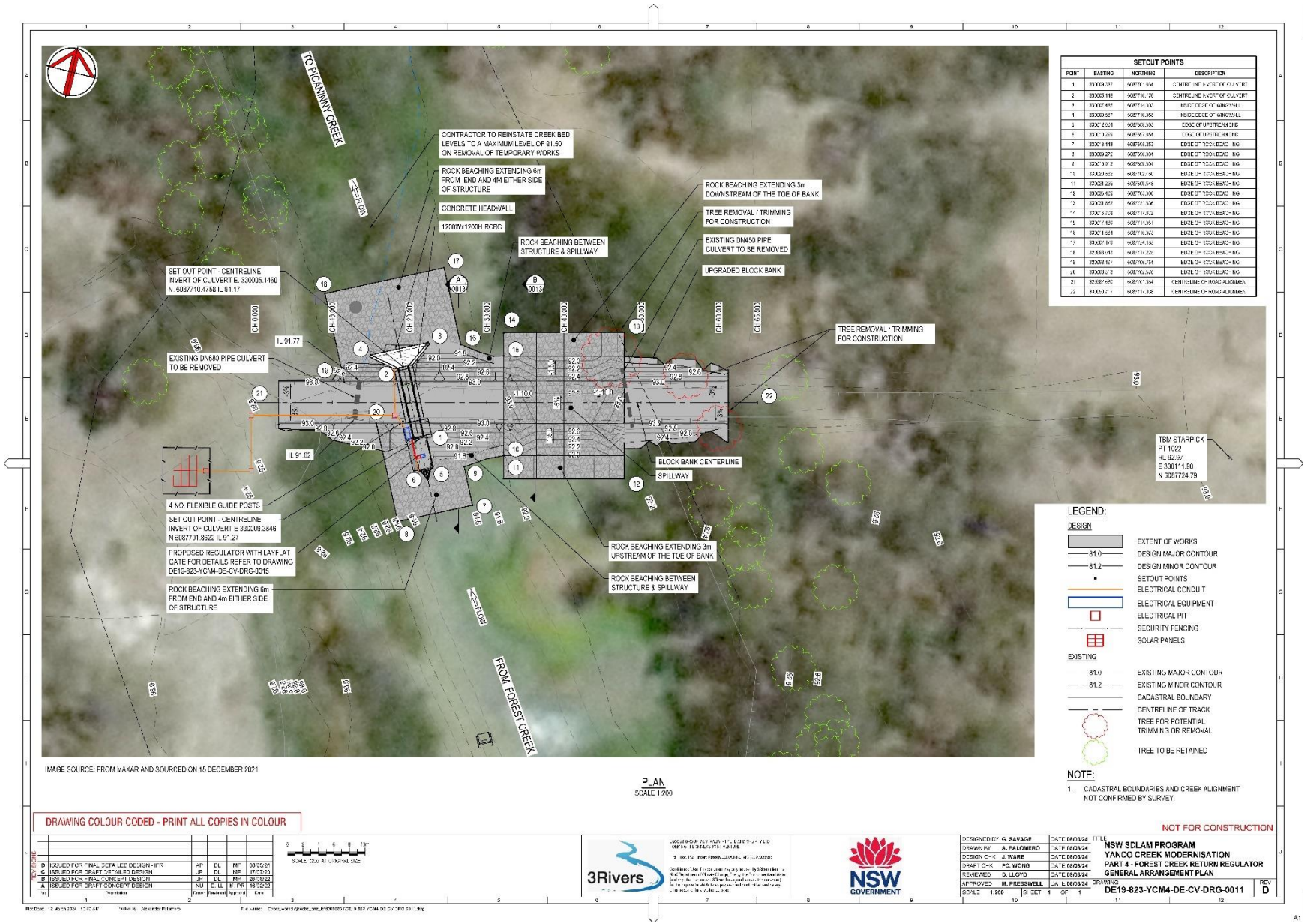

Figure 3.1 General arrangement plan

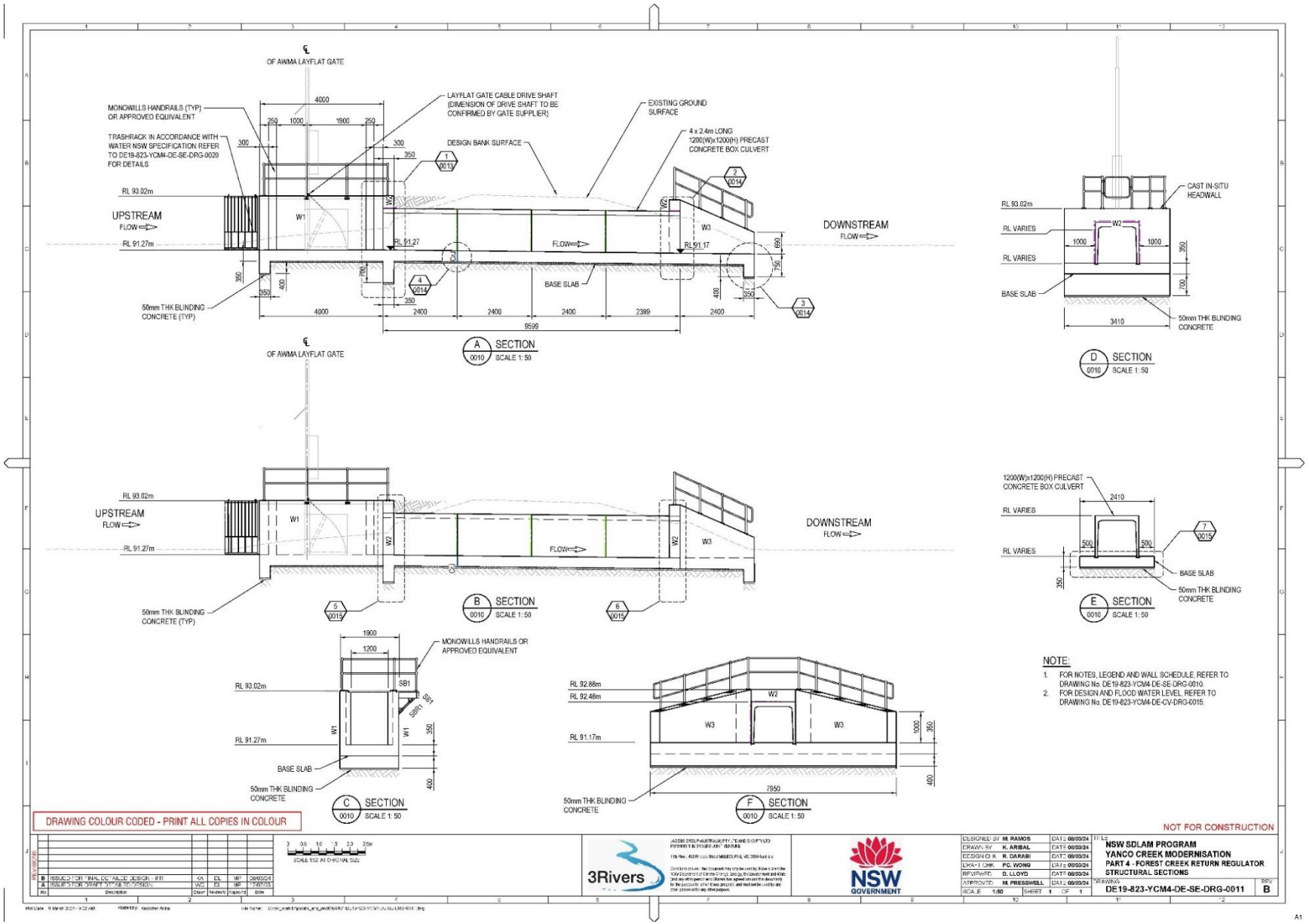

Figure 3.2 Regulator structural sections

3.1.1 Definitions

For the purposes of this REF, the following terms have been used:

- The '**project**' refers to the proposed works required to undertake Part 4 of the YCMP (Forest Creek return flows regulator)
- The '**project area'** includes:
  - **Clearing Area:** Areas required to construct the proposed infrastructure. Within this area it is assumed that all vegetation and habitat would be removed, however, this is a conservative assumption and contractors should be encouraged to avoid removal where they can (through the proposed mitigation measures, see section 8.3).

    Excavated material from the Clearing Area around the construction works may be reused as part of the projects, such as for the construction of water retaining structures, where the material is suitable for achieving compaction and complies with applicable requirements. If material is not suitable or where additional material is required, the construction of the projects would also require the importation of material (clay) from a nearby site, known as the 'borrow site'.
  - **Contractor Activity Zone**: Locations outside of the 'Clearing Area' that would be used for construction purposes e.g., laydown, site sheds, parking. Assumed topsoil would need to be removed / cleared, with some re-grading to create level areas and grubbing and clearing of small shrubs /grasses. Trimming of trees may be required.
  - **Access tracks**: Tracks required for construction and operation of the project. All access tracks would be up to 5 m wide and may include some upgrade works (such as surfacing and tree trimming).
  - **Borrow site**: Located within the Clearing Area in the western Contractor Activity Zone, the borrow site would be used for excavating material with the final quantities of suitable borrow material required determined during detailed design. At completion of works, the borrow site would be backfilled with surplus clean fill which is unsuitable for project construction, then reprofiled to a consistent surface level to form a local landscape depression. Topsoil would be reinstated across the borrow site to encourage vegetation re-growth.

3.2 Location of the project

3.2.1 Locality

The project area is located in the rural area of Conargo, in the Riverina Region of NSW, within the Edward River Local Government Area (LGA) and is bounded by Conargo Road to the north-west and Forest Creek to the south. The closest town is Conargo 6 km to the north-east with the town of Deniliquin 25 km to the south-west.

Figure 3.3 to Figure 3.5 illustrate the project area and features of existing offtake infrastructure.

Figure 3.3 Existing condition of the project area, illustrating Forest Creek at Warriston Weir

Figure 3.4 Piccaninny Creek downstream of culvert/road crossing

Figure 3.5 Existing condition of the project area, illustrating Piccaninny Offtake at block bank

3.2.2 Ownership

The project is located in Parish of Conargo, County of Townsend, Land District of Deniliquin. The regulator is proposed to be installed on private land on lot 89/-/DP756268 in a defined CAZ. Another CAZ would be located nearby to the east, within lot 9/-/DP756268 for use during construction for the purposes of a borrow site and construction material storage. Additionally, there is a proposed access track from Conargo Road that runs through lots 9/-/DP756268, 6/-/DP756268, and 7008/-/DP1025247. Refer to Figure 1.2 for the project location.

Table 3.1 outlines the key project area identifiers and information. Refer to Figure 4.1 for a map of land tenure and zoning information.

Table 3.1 Project location

Identifier	Location description
Regulator ownership	The existing regulator is owned and operated by WaterNSW. The new regulator would also be owned and operated by WaterNSW.
Lot and DP	**Clearing area and Contractors Activity Zone:** – Lot 89, DP756268
	Access track: • Part Lot 89, DP756268 • Part Lot 9, DP756268 • Part Lot 6, DP756268 • Part Lot 7008, DP1025247 • Part of the road reserve for Conargo Road
Street address	Conargo Road, Conargo
Ownership	**Private land:** • Lot 89, DP756268 • Lot 9, DP756268 • Lot 6, DP756268
	Crown Land: • Lot 7008, DP1025247 used as a travelling stock reserve • subject of an unresolved Aboriginal land claim (reference 44045) ○ DCCEEW will keep WaterNSW informed regarding progress on negotiations in relation to the unresolved Aboriginal Land Claim
	Public road managed by Transport for NSW (TfNSW) (Conargo Road)
Land use zoning	RU1 Primary Production under the Conargo Local Environmental Plan 2013

3.2.3 Description of the project area

The project area is located on the Piccaninny Creek offtake, which connects Forest Creek and Piccaninny Creek approximately 6 km south-west of Conargo. The project area comprises waterways with established riparian vegetation adjoining generally flat floodplain areas used for grazing.

The vegetation in the project area consists of two dominant plant community types (PCTs) of low to moderate condition, including *Black Box - Lignum woodland wetland of the inner floodplains in the*

semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 13) and *Cumbungi rushland wetland of shallow semi-permanent water bodies and inland watercourses* (PCT 182). Along the existing track the vegetation is characterised by a low diversity of exotic forbs and grasses.

The broader locality is dominated by several large rural blocks used for livestock grazing and cropping.

Figure 1.2 depicts the existing project assessment area with proposed clearing areas and construction zones. The site for the proposed borrow site would be located on private land within the clearing area of the CAZ to the west.

3.3 Construction works

The exact nature of works involved in the construction of the project may differ depending on the site-specific conditions identified during geotechnical investigations and those that are present at the time of construction (e.g. weather conditions). However, detailed construction methods, including consideration of site-specific requirements would be outlined in a Construction Environmental Management Plan (CEMP) developed for the project in accordance with the safeguards listed in Table 8.1.

3.3.1 Construction

Construction would generally follow the following steps:

- mobilise site facilities and construct hardstand (150 mm thick, should a crane be required). Any topsoil to be removed and stored separately for reuse
- upgrade the existing access track from Conargo Road which may include some light grading, resurfacing and compaction. Tree trimming may be required.
- undertake clearing and grubbing activities and vegetation removal.
- install silt fence across the waterway (downstream and upstream) and establish erosion and sediment controls
- install earthen cofferdam (if required) on connecting channel upstream and potentially downstream depending on tailwater levels
- dewater the construction zone within the cofferdam, by installing sump and dewatering pump and temporary bypass pump and pipe (if required)
- undertake removal / demolition of existing culvert (disposal to a suitable licensed facility)
- undertake excavation / earthworks for upgrading the block bank
- install culvert (pre-cast), gate (pre-cast / prefabricated unit) and headwall (pre-cast)
- install in-situ concrete cut offs
- prepare blinding layer for culvert and gate

- backfill around culvert / gate, possibly using cement stabilised sand)
- place and compact new block bank using impermeable clay fill material
- re-shape bank and creek bed
- place geotextile and erosion protection rock beaching
- topsoil and revegetate disturbed area
- install galvanised iron grid-mesh walkway and handrails
- install gate solar power/ controls / flow measurement (proprietary system)
- commission gate (as per manufacturer / WaterNSW requirements)
- flood / remove earth bank cofferdams
- tidy site and demobilise.

Construction of the project may require a cofferdam to provide for works within the watercourse when water is present, or to protect the works against high flows. In this event, it is expected that the contractor may construct an earthen cofferdam and the works area would be dewatered. The cofferdam construction method would be confirmed by the construction contractor and would factor in water depths, river flows, water velocity and ground conditions at the time of the works. The approval for the cofferdam construction method would be attained by NSW DCCEEW. Potential management plans associated with coffer dam construction, management and demobilisation is to be included in the CEMP (or as a sub-plan).

3.3.2 Proposed construction equipment

Plant and equipment likely to be used during construction may include, but is not limited to, the following:

- tipper trucks
- excavators
- compaction roller
- water cart
- front end loader
- concrete ready-mix truck
- semi-trailer
- light vehicles.

3.3.3 Proposed workforce

It is expected that a workforce of about three to 10 personnel would be required at different stages of construction.

3.3.4 Construction hours and duration

Subject to receiving approval, it is expected that construction would commence in mid-2025 and take approximately 2-3 months to complete.

The construction of the project would generally take place during standard construction hours or as agreed with the landowner. Standard construction hours are outlined in the Construction Noise and Vibration Guideline (CNVG) (NSW Roads and Maritime Service, 2016) as follows:

- Monday to Friday 7 am to 6 pm
- Saturday 8 am to 1 pm
- no work on Sundays or public holidays.

3.3.5 Traffic and access

During construction, there would be daily heavy vehicle movements during mobilisation and demobilisation. Once construction has commenced, vehicle movements to and from the site would consist generally of personal vehicles and deliveries when required.

Construction and operations access to the proposed Forest Creek return regulator is proposed via Conargo Road. Access to the site is via a track located on private land with a small section over Crown Land.

It is expected that some upgrade works would be required to provide access during construction. This may include some light grading, resurfacing and compaction. Tree trimming may be required.

Assumed all tracks would be 5 m wide.

3.4 Ancillary facilities

Borrow site – The borrow site proposed for the project is located on private land within the Clearing Area of the CAZ in proximity to where the material would be used for the construction of the project infrastructure.

Proposed works at the borrow site include excavating material. Stockpiling of fill material would occur either adjacent to where it is excavated or at laydown areas within the CAZ. Clay material would be stockpiled for conditioning, which is the process by which the material is made ready for use in construction. Temporary storage of smaller quantities of material would occur within the infrastructure CAZ as the materials are used during construction.

At completion of works, the borrow site would be backfilled with surplus clean fill which is unsuitable for project construction, then reprofiled to a consistent surface level to form a local landscape depression. Topsoil would be reinstated across the borrow site to encourage vegetation re-growth.

Construction compounds may comprise of portable toilets and site office sheds.

3.5 Operation

3.5.1 Legislative basis

Water Sharing Plans

Water sharing plans are made under section 50 of the *Water Management Act, 2000* (Water Management Act). The plans set the rules for how water is managed and allocated to support sustainable environmental, social, cultural and economic outcomes.

Water sharing plans establish the allocation of water with provisions that address following aspects:

- provide water for the environment by protecting a proportion of the water available for fundamental ecosystem health and includes specific environmental rules (planned environmental water)
- establish adaptive environmental water (EWA accounts) which is water that can be used at the direction of the environmental water manager within the plan rules. Held environmental water (HEW) is entitlement which can arise from water recovery projects or by buying water licences. This water can be used at the discretion of the environmental water manager.
- protect the water required to meet basic landholder rights
- set annual limits on water extractions to ensure that water extractions do not increase and therefore erode the water for the environment or the security of supply to water users
- determine what type of additional licences can be granted such as local water utility access licences (for town water supplies) and Aboriginal cultural access licences
- determine how water is to be shared among the different types of licensed users by setting the priorities of supply
- provide flexibility for licence holders in the way they can manage their water accounts
- specify rules in groundwater plans to minimise impacts on other groundwater users, dependent ecosystems, water quality and the stability of the aquifer
- specify the rules for water trading or dealings.

The *Water Sharing Plan for the Murrumbidgee Regulated River Water Source 2016* applies to the Murrumbidgee Regulated River Water Source comprising the regulated rivers within the Murrumbidgee Western Water Source and the Lower Billabong Anabranch Water Source. This applies to the regulated portion of Forest Creek upstream of Warriston Weir, and defines the rules under which WaterNSW is permitted to provide water to Forest Creek for water users, including the environment.

Environmental Watering Plans

Environmental water held by both the Commonwealth and NSW has been delivered into the Yanco-Colombo-Billabong creeks system for over ten years. This is a legislated requirement combined with administrative arrangements for the assessment and management of environmental watering actions. *Chapter 8: Environmental watering plan* of the Basin Plan guides the planning and use of

water for the environment across the Basin. Releases of environmental water into Forest Creek and downstream of Warriston Weir, to Wanganella Swamp, are determined and managed consistent with this legislation and administrative arrangements.

The Commonwealth Environmental Water Holder (CEWH) and state environmental water holders in the Basin make decisions about when and where to use their allocated water to achieve specific and measurable environmental outcomes. Water holders consider the needs of ecosystems and how much water is forecast to be available to the river to decide what kind of watering activities will best support the health and condition of water dependent ecosystems across the Basin.

To achieve the objectives of Chapter 8, the MDBA develops the Basin-wide environmental watering strategy and annual priorities for water for the environment. The MDBA works with Basin governments and communities to coordinate the planning, prioritisation and use of water for the environment. Priorities are set by the MDBA and Basin governments by following the guidance provided in Schedule 7 of the Basin Plan and the Basin-wide environmental watering strategy.

The CEWH is an independent statutory position that owns and manages most entitlements to water for the environment in the Basin. The CEWH is supported by the Commonwealth Environmental Water Office (CEWO). The CEWH provides water for the environment consistent with the requirements of the Basin-wide environmental watering strategy and Chapter 8, and considers the annual priorities developed by the MDBA (Basin-wide) and Basin state governments (regional or catchment scale). Each year the CEWO considers and plans for how it will manage Commonwealth water for the environment. This is documented in annual water management plans.

Each Basin government develops regional long-term environmental watering plans (regional long-term plans) for each surface water resource plan area. The Murrumbidgee Long-Term Water Plan (MLTWP) is one of nine developed for NSW river systems as required under the Murray-Darling Basin Plan. The MLTWP is divided into planning units (PU) that provide local-scale information about ecological values and objectives, and environmental water requirements to meet these. Relevant to the YCMP are the following:

- PU11: Colombo & Billabong creeks – covers Cheverells Creek Offtake and Hartwood
- PU12: Lower Yanco Creek to lower Billabong Creek – covers Cheverells Creek and Wilson Anabranch
- PU13: Lower Billabong and intersecting streams – covers Forest Creek, Wanganella Swamp and Wanganella Weir.

Every year, the MDBA publishes Basin annual environmental watering priorities (Basin annual priorities). These priorities draw from the Basin-wide environmental watering strategy, regional long-term plans and regional annual priorities to identify which environmental assets should receive water for the upcoming year.

The MDBA works with Basin governments to identify which priorities are important for the Basin as a whole system, by consulting with holders and managers of water for the environment, scientists and other experts, river operators, relevant committees, and First Nations people.

Every year, Basin state governments identify environmental watering priorities for each of their surface water resource plan areas. These build on long-term watering plans and align with the Basin

annual priorities. State priorities are delivered by statutory agencies responsible for providing water for the environment.

Basin state governments develop their annual priorities based on consultation with environmental water holders and managers, scientists and other experts, river operators, and local communities, including First Nations people.

3.5.2 Design capacity and general operating principles

The design capacity of the proposed regulator is detailed in Table 3.2 below.

Table 3.2 Design capacity of the Forest Creek return flows regulator

Infrastructure	Design capacity	Design levels
Forest Creek return flows regulator	50 ML per day	92.12 m Australian Height Datum (AHD) – upstream level to be maintained for irrigators, 50mm below Warriston Weir crest level 92.40 m AHD – approximate upstream level for 250ML/day environmental flow delivery over Warriston Weir 93.14 m AHD – approximate upstream level for 1% AEP flood (1 in 100) 93.19 m AHD – approximate upstream level for 0.3% AEP flood (1 in 300) 93.17 m AHD – maximum gauged level at Warriston Weir (November 2022) 92.06 m AHD – downstream tailwater level at design flow rate of 50ML/day 91.88 m AHD downstream tailwater level at minimum flow rate of 1ML/day

The operation of the proposed Forest Creek return flows regulator would be based on the *Yanco Creek System Operations Plan* (as of November 2023). At the time of preparation of this REF, the *Yanco Creek System Operations Plan* is in draft form. The draft operations plan continues to be developed in collaboration with WaterNSW and DCCEEW's Licensing Team (particularly in relation to the Governance section of the plan). Should there be changes made to the operational approach, principles or limits, then further assessment would need to be undertaken to determine the implications for this REF and supporting specialist assessments.

General operating principles:

- WaterNSW would operate the regulator to deliver water to users consistent with the water sharing plan.
- Used to assist in preventing unplanned flows in the Forest Creek downstream of Warriston Weir during normal regulated periods.
- The only time the flow target downstream in Forest Creek at Warriston Weir is not 0ML/day is during managed environmental flow events aimed at downstream of Warriston Weir.

- Unplanned flows are diverted into the Piccaninny Creek offtake channel rather than being permitted to flow in the Forest Creek downstream of Warriston Weir up to the flow capacity of the Forest Creek Return Flows Regulator (50ML/day).
- Operated consistent with advice from environmental water managers during managed environmental flow events.
- Initially operated in downstream control to target minimum flow requirements in Piccaninny Creek at Congaro-Wanganella Road during moderate unregulated flow events (e.g. greater than 1,200ML/day downstream of Hartwood Weir) to maximise flows in the Forest Creek downstream of Warriston Weir.
- Operated in downstream control at 50ML/day (the design flow rate of the structure) when unregulated flows in Forest Creek at Warriston Weir increase above 500ML/day.*
- Regulator gate to be fully opened when unregulated flows in Forest Creek at Warriston Wrier increase above 1,000ML/day.*

Normal operating limits:

- During normal regulated operating periods when the flow target in Forest Creek at Warriston Weir is 0ML/day, place Forest Creek Return Flows Regulator on upstream control at 92.12 m (50 mm below the concrete sill level at Warriston Weir).
- During normal regulated operating periods when there is a managed environmental watering event downstream Forest Creek at Warriston Weir, WaterNSW would:
  - Place Forest Creek Return Flows Regulator in downstream control at a flow rate to meet the minimum flow requirement in Piccaninny Creek at Wanganella Conargo Road in times where the objective is to maximise the amount of flow in Forest Creek at Warriston Weir
  - Place Forest Creek Return Flows Regulator in upstream control at a level to provide a stable target flow in Forest Creek at Warriston Weir as during periods advised by environmental water managers.

Unregulated flows:

- Initially, unless advised to do otherwise by environmental water managers, during moderate unregulated flow events in the Forest Creek resulting from the 1,200ML/day flow trigger in the Billabong Creek at downstream Hartwood Regulator, place Forest Creek Return Flows Regulator on downstream control to target minimum flow requirements in Piccaninny Creek at Wanganella-Congaro Road to maximise flows in the Forest Creek at Warriston Weir.
  - This is intended to maximise flows in Forest Creek downstream of Warriston Weir during moderate unregulated flow events.
  - Operated in downstream control at 50ML/day (the design flow rate of the structure) when unregulated flows in Forest Creek at Warriston Weir increase above 500ML/day.*
  - Regulator to be fully opened when unregulated flows in Forest Creek and Warriston Weir increase above the 1,000ML/day.*
  - This is prior to the spillway adjacent to the Forest Creek Returns Regulator commencing to flow (92.80m) and is equivalent to above a one in ten year flow event.

The general operating principles for Warriston Weir are:

- Normal regulated flow target of 0 ML/d downstream of the weir apart from during managed environmental events.
  - This flow target would not be met during large unregulated or unplanned flow events following significant rainfall events.
- Normal regulated flow capacity during managed environmental flow events of 250ML/day.
  - This aligns with a 300ML/day inundation easement that includes a 50ML/day buffer above the 250ML/day design flow rate.
- During periods where environmental water managers advise it is appropriate to do so, aim to provide a stable constant flow downstream of the weir.
  - For example, unplanned flow variations increase the risk of unsuccessful water bird breeding outcomes at Wanganella swamp.

Normal operational limits:

- 250ML/day downstream of Warriston Weir during managed environmental flow events unless there is agreement with key stakeholders to deliver higher environmental flow rate.
  - This compares to a 300ML/day inundation easement from Forest Creek and Warriston Weir to Wanganella Swamp that makes provision for a 50ML/day buffer above the maximum 250ML/day target environmental flow.

*This operating principle was introduced into the Yanco Creek System Operations Plan in June 2023 to more closely align the draft Yanco Creek System Operations Plan with the existing situation for unregulated flows. Although operational modelling was undertaken prior to the inclusion of this principle, it is not considered necessary to revise the modelling that has informed this assessment as the change more closely aligns the Yanco Creek System Operations Plan with the existing situation for unregulated flows, and the change would allow for protection of the infrastructure assets (during unregulated flows). In addition, noting that the regulator would be replacing an existing culvert structure and would be similar in style and scale, any changes to flood impacts as a result of these unregulated flows are likely to be localised and insignificant. Therefore, these changes are not expected alter the findings in this report in relation to operational impacts.

3.5.3 Monitoring and review

The impact of water for the environment is regularly monitored and reviewed to ensure that it is effectively working towards the overall environmental objectives for the Basin.

The CEWH has entered into a formal partnership agreement with the NSW DCCEEW, as NSW's environmental water holder, which outlines the way in which the CEWH and staff of the CEWO will work with NSW DCCEEW to coordinate the management of environmental water.

Monitoring of daily discharge and fish passage would be undertaken in accordance with the safeguards as identified in section 8.3.

3.6 Timing and staging

Subject to receiving approval, it is expected that construction would commence in the mid-2025 and take approximately 2-3 months to complete.

3.7 Estimated Development Cost

Given the nature of the works, it is estimated that the approved project would have an estimated development cost of below $1,000,000.

Detailed costings for the proposed works would be determined during future stages of the project.

3.8 Public utility adjustment

The project would not impact any public utilities and no public utility adjustment would be required.

3.9 Land access and acquisition

3.9.1 Construction

Access for construction and land required to construct the proposed works will be negotiated and agreed with individual landowners.

3.9.2 Operations

DCCEEW is responsible for the acquisition (i.e. purchase) of land at the site of the new Forest Creek Regulator and an access easement from Conargo Road to the new regulator. It is then planned to transfer the ownership of these acquisitions to WaterNSW at a later date. It is also planned for WaterNSW to own and operate the new Forest Creek Return Regulator.

3.9.3 Inundation easement

DCCEEW is responsible for the acquisition (i.e. purchase) of inundation easements within the Piccaninny Creek System from the new Forest Creek Regulator to Billabong Creek.

- 100ML/day inundation easement (based on 50ML/day design flow plus a 50ML/day buffer)

During the period that the new regulator becomes operational and the new inundation easements being acquired, WaterNSW may (although unlikely) need to temporarily limit flows through the new regulator to avoid unmitigated third party impacts.

- Hydraulic modelling used to develop inundation easement areas indicates low level inundations areas only (i.e. low risk of third party impacts)

It is planned to transfer ownership of the inundation easements to WaterNSW at a later date.

4. Legislative context

4.1 NSW legislation

4.1.1 Environmental Planning & Assessment Act 1979

The EP&A Act and its associated regulation provide the framework for assessing the environmental impacts of proposed developments in NSW. The EP&A Act allows for the creation of Environmental Planning Instruments (EPIs) including Local Environmental Plans (LEPs) and State Environmental Planning Policies (SEPPs). The applicable EPIs and the EP&A Regulation made under the EP&A Act collectively determine the relevant planning approval pathway and the associated environmental assessment requirements for proposed development activities.

This REF has been prepared with consideration of section 171 of the EP&A Regulation (summarised in Clause 171 Environmental Factors Checklist), the *Biodiversity Conservation Act 2016*, the *Fisheries Management Act 1994*, and the *Environment Protection and Biodiversity Conservation Act 1999*. In doing so, the REF helps to fulfil the requirements of section 5.5 of the EP&A Act that NSW DCCEEW examine and take into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

4.1.2 State Environmental Planning Policy (Transport and Infrastructure) 2021

Chapter 2 of the *State Environmental Planning Policy (Transport and Infrastructure) 2021* (Transport and Infrastructure SEPP) aims to facilitate the effective delivery of infrastructure across the State. It does this by prescribing what infrastructure related works can be carried out without development consent (and the assessment requirements that apply to such development), as well as those that are exempt or complying development.

Division 24 applies to water supply systems, which (according to clause 2.157) have the same meaning for the for the purposes of the Transport and Infrastructure SEPP as in the Standard Instrument – Principal LEP (2006 EPI 155a) (the Standard Instrument). Water supply systems are defined by the Standard Instrument as follows:

> ***water supply system*** means any of the following:
>
> *(a) a water reticulation system,*
>
> *(b) a water storage facility,*
>
> *(c) a water treatment facility,*
>
> *(d) a building or place that is a combination of any of the things referred to in paragraphs (a)–(c).*

Water storage facilities are defined by the Standard Instrument as meaning '…a dam, weir or reservoir for the collection and storage of water and includes associated monitoring or gauging equipment'.

The proposed activity is a water storage facility for the purposes of the Transport and Infrastructure SEPP. Division 24 of the Transport and Infrastructure SEPP, Subsection 2.159(2), provides that development for the purpose of water storage facilities may be carried out without consent if it is carried out by, or on behalf of, a public authority on land in Zone RU1 Primary Production, Zone RU2 Rural Landscape, Zone SP1 Special Activities, Zone SP2 Infrastructure or an equivalent land use zone. The relevant local environment plan is the Conargo LEP 2013. The project area is zoned RU1 Primary Production under the Conargo LEP. The proponent is a public authority; therefore, the project is permissible without development consent under Part 4 of the EP&A Act.

4.1.3 State Environmental Planning Policy (Planning Systems) 2021

In accordance with *State Environmental Planning Policy (Planning Systems)* 2021 (Planning Systems SEPP) development is declared to be State Significant Infrastructure (SSI) under section 2.13 if it is permissible without development consent and specified in Schedule 3. Development may also be declared to be SSI under section 2.14 (for development specified in Schedule 4) or as critical SSI under section 2.15 (for development specified in Schedule 5). The project is not listed in either Schedules 4 or 5. Schedule 3 of the Planning Systems SEPP defines two categories of development that may be relevant to the project:

- infrastructure or other development that would require an EIS to be obtained under Part 5 of the Act (section 1 (1))
- water storage facilities that have a capital investment value of more than $30M (Schedule 3, clause 4(1))

Planning approval for development in the above categories would be subject to Part 5, Division 5.2 of the EP&A Act. The Minister for Planning and Public Spaces is the approval authority for such SSI. An EIS is required to accompany the application for approval of the development.

The project is considered 'development permitted without consent' under Section 2.158 of the Transport and Infrastructure SEPP.

As the project does not require an EIS to be prepared and has an estimated development cost below $1,000,000, it does not fall within the above categories of Schedule 3 of the Planning Systems SEPP, and the project is not considered SSI.

4.1.4 State Environmental Planning Policy (Biodiversity and Conservation) 2021

Koala habitat protection in Chapter 3 and Chapter 4 of the Biodiversity and Conservation SEPP contains provisions for development control of koala habitats, koala plans of management and other environmental planning measures formerly administered under the SEPP (Koala Habitat Protection) 2020 and SEPP (Koala Habitat Protection) 2021 respectively. The development control provisions of Chapter 3 do not apply to this project as a development application is not required to be submitted for approval. The provisions of Chapter 4 do not apply to the project as the provisions do not apply

to land within Zone RU1 and Edward River Council is not a nominated local government area (section 4.4(3)(d)) Koalas and Koala habitat have been considered in the biodiversity assessment.

Whilst these creeks enter the Murray River system, Forest and Piccaninny Creeks are not within the mapped River Murray lands or subject to the provisions of Chapter 5 of the Biodiversity and Conservation SEPP.

4.1.5 Conargo Local Environmental Plan 2013

The project is located within the Edward River LGA. The relevant local planning instrument for the project is the Conargo LEP 2013. The land use zoning of land at the location of the project is Zone RU1 Primary Production (see Figure 4.1).

The objectives of the RU1 Primary Production zone are:

- *To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.*
- *To encourage diversity in primary industry enterprises and systems appropriate for the area.*
- *To minimise the fragmentation and alienation of resource lands.*
- *To minimise conflict between land uses within this zone and land uses within adjoining zones.*
- *To allow for the development of processing and service industries relating to primary production.*
- *To encourage tourist and visitor accommodation that does not have an adverse impact on agricultural activities.*
- *To allow for the development of non-agricultural land uses that are compatible with the character of the zone.*
- *To permit small-scale rural tourism uses associated with primary production and environmental conservation that have minimal impact on primary production and the scenic amenity of the area.*
- *To provide opportunities for employment-generating development that adds value to local agricultural* production and integrates with tourism.

Under the Conargo LEP, water supply systems, which include water storage facilities, are permitted with consent in zone RU1. As detailed in section 4.1.2, development for the purpose of water storage facilities may be carried out by, or on behalf of, a public authority without development consent on land zoned RU1 Primary Production under the provisions of the Transport and Infrastructure SEPP. Other provisions of the Conargo LEP have been considered in this REF, including subsections 5.10 Heritage conservation (refer to sections 6.8 and 6.9) and 5.21 Flood planning (refer to section 6.2).

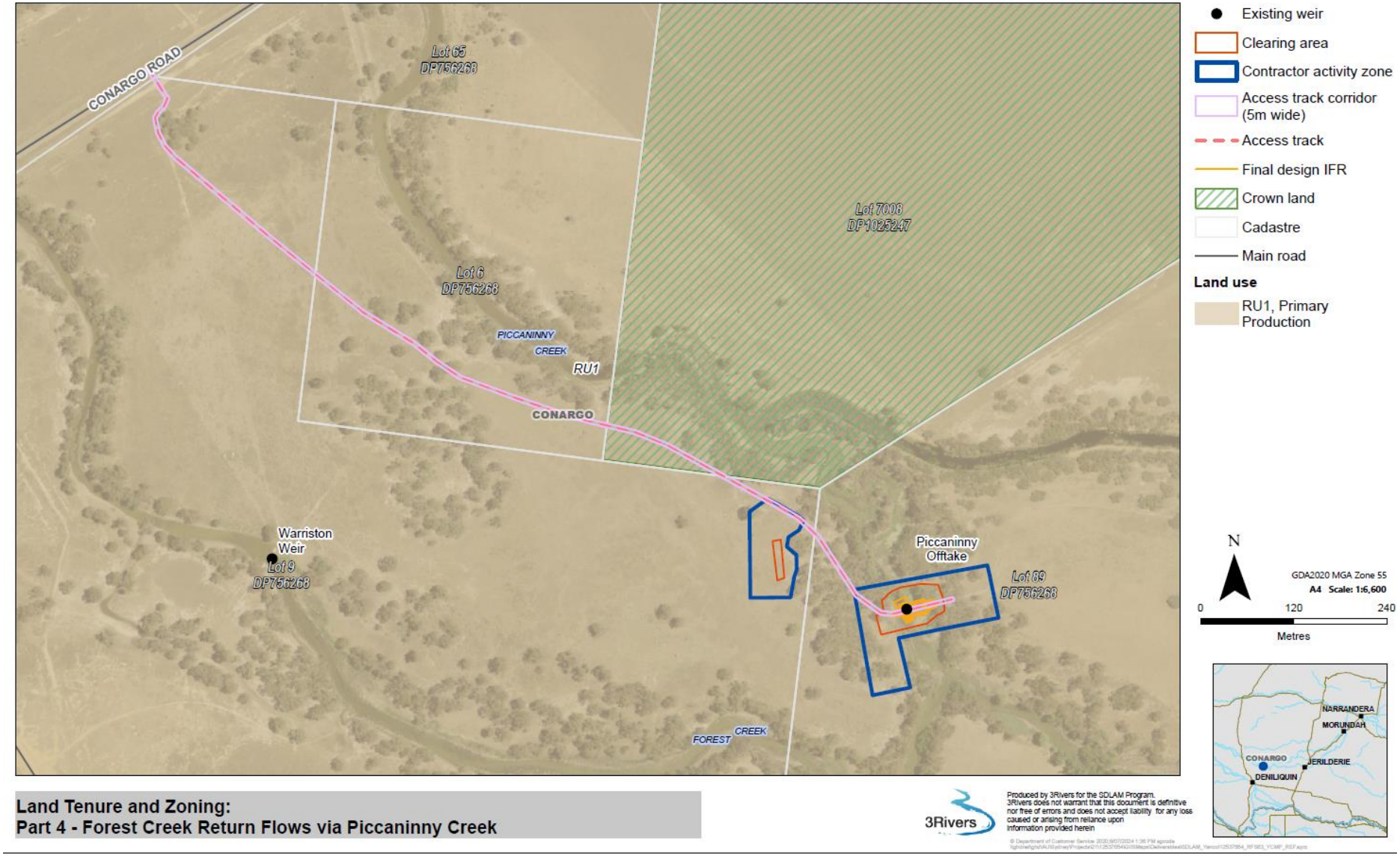

Figure 4.1 Land tenure and zoning

4.1.6 Assessment under the Environmental Planning and Assessment Act 1979

Environmental impact assessment of the project is to be considered under Part 5, Division 5.1 of the EP&A Act. NSW DCCEEW is the determining authority for the project and would examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the project (s.5.5(1) of the EP&A Act).

The EP&A Regulation identifies the list of factors that must be taken into account concerning the impact of the project on the environment (cl.228(2)) relating to environmental assessment under Part 5 of the EP&A Act. Clause 171 Environmental Factors Checklist considers the potential impacts of the project against these factors.

NSW DCCEEW has prepared this REF to document its assessment of the project and to ascertain whether the project is likely to significantly affect the environment. Where the project is found to be likely to significantly affect the environment, an EIS would be prepared.

Based on the outcomes of the environmental assessment undertaken in this REF, the project is not likely to have a significant impact on the environment, and an EIS is not required.

4.2 Other New South Wales legislation

Approval requirements under other NSW legislation that are relevant to the project are outlined below.

Table 4.1 Other relevant NSW legislation

Act	Requirement	Relevance to the project
***Protection of the Environment Operations Act 1997* (POEO Act)**	An environment protection licence (EPL) is required for scheduled activities or scheduled development work. Licences may also be issued for activities that are not listed in Schedule 1 of the POEO Act but are likely to cause pollution of water. These activities are referred to as 'non-scheduled activities'.	The project does not involve a 'scheduled activity' under Schedule 1 of the POEO Act, nor would it likely cause the pollution of water. Accordingly, an EPL is not required for the project.
***Roads Act 1993* (Roads Act)**	Approval under section 138(1) for carrying out works (in, on or over), digging up or disturbing a public road.	The project does not propose to impact on, or carry out work on or over, a public road and therefore would not need to seek the necessary approvals under the Roads Act.

Act	Requirement	Relevance to the project
National Parks and Wildlife Act 1974 (National Parks and Wildlife Act)	**General** Development may be carried out on land reserved under the National Parks and Wildlife Act only if it is authorised by or under that Act. **Aboriginal heritage** An Aboriginal heritage impact permit under section 90 to harm or desecrate an Aboriginal heritage object.	Sections 6.4, 6.5 and 6.8 assess the potential for impact on protected or threatened species, or items of Aboriginal heritage. The project is considered unlikely to disturb any potentially unknown artefacts or sites, or cause impacts to any significant vegetation, habitat, or threatened species.

Act	Requirement	Relevance to the project
Water Management Act 2000 **(Water Management Act)**	Water use approvals under section 89 authorise its holder to use water for a particular purpose, such as irrigation, at a particular location. A water management work approval (consisting of water supply work, drainage work and flood work approvals) under section 90. Section 90(2) provides that a water supply work approval authorises the construction and use of a water supply work at a specified location. An activity approval under section 91. Section 91(1) provides that there are two kinds of activity approvals, namely, controlled activity approvals (for works in, on or under waterfront land) and aquifer interference approvals.	As NSW DCCEEW is not intending to use the water for any particular purpose at a particular location but to regulate flows in the waterways for others to use, no section 89 approval is required. It is noted that the general operations would be specified in NSW DCCEEW's water licence. The project involves the construction of a new regulator (box culvert and gate) and removal of the existing culvert at the block bank on Piccaninny Creek offtake. As the project would involve impounding water the works would require a water supply work approval in accordance with section 90 (2). The project meets the definition of a controlled activity and possibly an aquifer interference activity. However, sections 91E (4)(a) and 91F(4)(a) remove the requirements for activity approvals as NSW DCCEEW would obtain a water supply work approval. The guidelines for controlled activity approvals under the Water Management Act are not specifically relevant to the project because a water supply approval would be sought. It is likely that this REF would be used to support the information and assessment requirements for a water supply work approval. DCCEEW is responsible (including the provision of funding) in collaboration with WaterNSW for drafting any applications to DCCEEW's Licensing Team for a new WaterNSW work approval or amendment to an existing WaterNSW work approval for the new Forest Creek Return Regulator.

Act	Requirement	Relevance to the project
Heritage Act 1977	Approval under section 57(1) for works to a place, building, work, relic, moveable object, precinct, or land listed on the State Heritage Register. An excavation permit under section 139 to disturb or excavate any land containing or likely to contain a relic.	The project is considered unlikely to impact upon any items of non-Aboriginal heritage (refer section 6.9).
Fisheries Management Act 1994	**Dredging and reclamation** Before carrying out dredging or reclamation work a public authority (other than a local government authority) must give the Minister notice in writing of the proposed work (section 199(1)(a)) and consider any matters that are raised by the Minister within 21 days of the notice (section 199(1)(b)). **Fish passage** Section 218(5) provides that a public authority that proposes to construct, alter or modify a weir on a waterway (or to approve of any such construction, alteration or modification) must notify the Minister of the project, and must, if the Minister so requests, include as part of the works a suitable fishway or fish bypass. Section 219 prohibits the blocking of fish passage without a permit.	The project involves the construction of a new regulator (box culvert and gate) and removal of the existing culvert at the block bank on Piccaninny Creek offtake. The project would facilitate downstream fish passage via the lay flat gate and plunge pool. The proposed works would meet the definition of dredging and reclamation works (moving or removing material on water land). NSW DCCEEW is not a local council and therefore is required to provide written notice to the Minister for Fisheries of the project and consider any matters raised within 21 days of notice being given. The project involves the construction of a new regulator which may alter the current operation of fish passage at the existing culvert. Therefore, NSW DCCEEW is required to notify the Minister for Fisheries of the proposed works, under section 199 (dredging and reclamation) of the FM Act. Further consultation with NSW Fisheries would be undertaken to determine the need for a permit under section 218(5). A permit under section 219 is not required as the activity is permitted by other Acts (EP&A Act and Water Management Act) (s219(5)(a)).

Act	Requirement	Relevance to the project
Crown Land Management Act 2016	The *Crown Land Management Act 2016* (CLM Act) provides for the ownership, use and management of Crown land in NSW. A licence is required to occupy and use Crown land for a specified purpose and term. The NSW DCCEEW exercises the functions of the Water Administration Ministerial Corporation and therefore the powers of a Constructing Authority under the *Public Works and Procurement Act 1912*. NSW DCCEEW is not required to obtain a licence to occupy of use Crown land for the project. NSW Crown Lands advises that authorities that exercise powers of entry should be mindful of Indigenous rights that apply to Crown land.	Part of the project associated with the access track would be located on Crown land at Lot 7008, DP1025247, part of a travelling stock reserve. Works on the existing access track may include resurfacing and tree trimming. Although no licence is required, the NSW DCCEEW is discussing the project with NSW Crown Lands and with the NSW Aboriginal Land Council about the unresolved Aboriginal land claim (reference 44045) that applies to the land. DCCEEW will keep WaterNSW informed regarding progress on negotiations in relation to the unresolved Aboriginal Land Claim

4.3 Commonwealth legislation

4.3.1 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) describes the Commonwealth's role in environmental assessment, biodiversity conservation and the management of protected areas and species, populations and communities and heritage items.

The approval of the Commonwealth Minister of Agriculture, Water and the Environment is required for an action which has, would have, or is likely to have, a significant impact on MNES, including:

- world heritage properties
- national heritage places
- listed threatened species and communities
- listed migratory species
- Ramsar wetlands of international importance
- Commonwealth marine environment
- the Great Barrier Reef Marine Park
- nuclear actions
- a water resource, in relation to coal seam gas development and large coal mining development.

The expected impact of the project on MNES is discussed in section 7. The assessment of the projects impact on MNES including nationally listed threatened species, ecological communities and migratory species, found that there is unlikely to be a significant impact on MNES. The project is not located on Commonwealth land.

4.3.2 Native Title Act 1993

Native title is the recognition that Aboriginal and Torres Strait Islander people have rights and interests to land and waters according to their traditional law and customs as set out in Australian Law. Native title is governed by the *Native Title Act 1993* (NT Act).

Native title may include rights and interests to:

- live on the area and erect shelters and structures
- access the area for traditional purposes, like camping or for ceremonies
- visit and protect important places and sites hunt, fish, and gather food or traditional resources like bush medicines, water, ochre and wood
- teach law, custom and engage in cultural activities.

Native title applications are made to the Federal Court under the NT Act for a determination, or decision about native title in a particular area.

The NT Act defines processes for dealing with 'future acts' or a proposal to deal with land in a way that affects native title rights and interests. Future act processes are based on the principle that in general, acts affecting native title would only be valid if they can also be done on freehold land. These processes give effect to the principle that in appropriate cases, these acts should only be done after every reasonable effort has been made to secure the agreement of the native title holders.

An Indigenous Land Use Agreement (ILUA), established under the NT Act, is a voluntary agreement between native title parties and other people or bodies about the use and management of areas of land and/or waters. It can be made over areas where native title has been determined to exist in at least part of the area, where a native title claim has been made or no native title claim has been made.

A desktop search undertaken on 25 September 2023 of the National Native Title Register identified three cases for native title within the Edward River Council LGA. Two were under the Deniliquin Local Aboriginal Land Council (2001 & 2007) and one under Yorta Yorta (1998). The outcome for all three were that 'native title does not exist'.

4.4 Summary of licenses and approvals

The project is development for the purpose of a water supply system and is being carried out by or on behalf of a public authority. Under clause 2.158 of the Transport and Infrastructure SEPP the project is permissible without consent. The project is not SSI or State Significant Development (SSD). The project can be assessed under Division 5.1 of the EP&A Act.

NSW DCCEEW is the proponent and determining authority for the project. This REF fulfils NSW DCCEEW's obligations under section 5.5 of the EP&A Act including to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity.

Any licences or approvals identified in this legislative context section as required by the project are summarised in Table 4.2.

Table 4.2 Summary of licences and approvals

Act	Relevant agency	Required licence/approval/notification
Water Management Act 2000	DCCEEW in collaboration with WaterNSW	Section 90(2) water supply work approval.
Fisheries Management Act 1994	NSW Department of Primary Industry – Fisheries	**Written notice** of dredging and reclamation work. **Written notice** of proposal to construct a weir on a waterway.
Crown Land Management Act 2016	Crown Lands	No licence is required. NSW DCCEEW has notified and consulted with Crown Lands.

5. Consultation

5.1 Overview

NSW DCCEEW has undertaken extensive community and stakeholder engagement through the strategic assessment, concept design and investigation phases of the project.

Table 5.1 identifies the key stakeholders that NSW DCCEEW engaged with during these phases. NSW DCCEEW would continue to consult with these stakeholders during the pre-construction and construction phases of the proposed project.

WaterNSW were provided a copy of the draft REF and comments received were reviewed and the REF was updated. Comments provided by WaterNSW related to the need to include further detail on the REF on ownership and operation of proposed assets, access arrangements, reinstatement requirements, safeguards, maintenance requirements and reporting. Comments relating to licencing and funding arrangements are considered best dealt with in consultation with NSW DCCEEW and WaterNSW.

Table 5.1 Key stakeholder groups

Government stakeholders	Community

• NSW Government Ministers
• NSW Government agencies and bodies including:
  – NSW DCCEEW
  – NSW DPI Fisheries
  – NSW Public Works Authority
  – WaterNSW
  – Water Administration Ministerial Corporation
• Australian Government Ministers
• Australian Government agencies including:
  – DCCEEW
  – Murray Darling Basin Authority (MDBA)
• Members of Parliament - state and federal for Murray and Farrer areas
• Public landholders
• Public asset owners
• Local councils including Murrumbidgee Council, Edward River Council and Federation Council.
	• Nations – Yorta Yorta, Wiradjuri, Wemba Wemba, Berapa Berapa
	• Local Aboriginal Lands Council's – Deniliquin and Cummergunja,
	• Registered Aboriginal Parties
	• 5 townships including Morundah, Jerilderie, Conargo, Wanganella and Moulamein
	• Community and interest groups including environmental groups, advocacy groups, fishing groups, farming groups, recreational groups and water user groups
	• Private landholders
	• Private asset owners
	• Industry and local business
	• Media

The key stakeholder groups were consulted with via stakeholder engagement activities during the YCMP program.

Table 5.2 details a summary of the key stakeholder engagement activities undertaken for the YMCP program.

Table 5.2 Summary of key engagement activities for the YMCP program

Engagement/communication channel	Purpose	Target audience	Timing	Output summary
Stakeholder Advisory Group (SAG) (formerly Community Advisory Group (CAG))	To be a key communication channel for the proposed project, particularly when COVID-19 restrictions limited face-to-face engagements. The group allows members and their community groups to share information and discuss concerns.	Advisory group members, their community groups, government bodies	Every 3 months, or as needed	26 meetings held
Community information sessions	To provide key details of the proposed project, benefits, needs, timings and contact details.	Wider community and key stakeholders	As required	5 online sessions, plus 10 in person sessions
Fact sheets	To provide key details of the proposed project, benefits, needs, timings and contact details	Wider community	To support key milestones	360 downloads of project overview fact sheet from the project webpage since February 2023
Phone calls, emails and short message service (SMS)	To contact community members and stakeholders directly and advise of timely information	Community members, stakeholders, government bodies	To support key milestones	Over 203 phone calls and text messages and over 2,273 emails.
Meetings	To discuss details and concerns about the proposed project, held in person or online	Community members, stakeholders, government bodies	As required	14 Technical Advisory Group meetings and 7 Design Focus Group meetings held
Project webpage https://dpie.nsw.gov.au/yanco-creek-modernisation-project	To provide key details of the proposed project, benefits, needs, timings and contact details	Wider community	Regularly updated	1,800+ webpage visitors since February 2023
Advertisements – print, radio, online	To inform the community about information sessions - these channels are trusted sources of information in the community	Wider community	To support community information sessions	Ad campaigns run in: • September 2021 • March 2022 • September 2022

Engagement/communication channel	Purpose	Target audience	Timing	Output summary
Electronic direct mail	To share updates and engagement opportunities as the proposed project progressed through planning stages.	Subscribers	To support key milestones	Electronic direct mails sent to 100+ subscribers: • September 2021 • March 2022 • August 2022 • November 2022 • September 2023 • March 2024 • May 2024.
Water enquiries phone line and project inbox **1300 662 077** **yanco.sdlprogram@dpie.nsw.gov.au**	Provides a free and accessible point of contact for questions and feedback	All stakeholders and community	Ongoing	Responded to as received
Maps / diagrams	A visual way of communicating about the proposed project and its benefits Published on project webpage	Wider community	To support key milestones	600 interactive map users on project webpage since February 2023
Surveys	An accessible platform for stakeholders and the broader community to provide feedback and input on the project.	Community members, stakeholders	As required	Field Surveys Aquatic Surveys Fauna Surveys Flora Surveys Cultural Heritage Surveys Geotechnical Surveys Ecological Surveys

Stakeholder Advisory Group

A CAG was established in 2019 to represent the Yanco Creek system. In 2020, this group was converted to the SAG to align with department policy, allowing sitting fees for members. The group has served as a key conduit for relaying broader community feedback.

The group has representation from the following community groups/organisations:

- Yanco Creek and Tributaries Advisory Council (YACTAC)
- Creek Country Alliance
- Tourism
- Murrumbidgee Field Naturalists
- NSW Farmers Association
- Recreational Fishing Clubs
- First Nations
- Federation Council
- Edward River Council
- Murrumbidgee Council
- WaterNSW
- DPI Fisheries
- Environment and Heritage Group
- Commonwealth Environmental Water Office.

Technical Advisory Group

The Technical Advisory Group (TAG) was established to provide technical input on the project's options and design. It consists of representatives from both private and public organisations, including:

- DPI Fisheries
- Murray Irrigation Limited
- Commonwealth Environmental Water Office
- Coleambally Irrigation
- MDBA
- YACTAC
- 3Rivers.

5.2 Statutory consultation – NSW legislation

5.2.1 Transport and Infrastructure SEPP consultation

Part 2.2, Division 1 of the Transport and Infrastructure SEPP contains provisions for consultation with public authorities prior to the commencement of certain types of development. Table 5.3 lists the consultation requirements under the Transport and Infrastructure SEPP.

NOTE: All consultation periods listed below require a 21-day notification period.
For each row, if the response is 'yes', consultation with the relevant agency will be required.

Table 5.3 Transport and Infrastructure SEPP Consultation

Is consultation required the Transport and Infrastructure SEPP?	Yes	No
Will the proposed activity have a substantial impact on stormwater management services provided by a council? If 'yes', notification to Council is required.	☐	☒
Is the proposed activity likely to generate traffic to an extent that will strain the capacity of the road system in a local government area? If 'yes', notification to Council is required.	☐	☒
Will the proposed activity involve connection to, and a substantial impact on the capacity of, any part of a sewerage system owned by a council? If 'yes', notification to Council is required.	☐	☒
Will the proposed activity involve connection to, and use of a substantial volume of water from, any part of a water supply system owned by a council? If 'yes', notification to Council is required.	☐	☒
Will the proposed activity involve the installation of a temporary structure on, or the enclosing of, a public place that is under a council's management or control that is likely to cause a disruption to pedestrian or vehicular traffic that is not minor or inconsequential? If 'yes', notification to Council is required.	☐	☒
Will the proposed activity involve excavation that is not minor or inconsequential of the surface of, or a footpath adjacent to, a road for which a council is the roads authority under the *Roads Act 1993* (if the public authority that is carrying out the development, or on whose behalf it is being carried out, is not responsible for the maintenance of the road or footpath)? If 'yes', notification to Council is required.	☐	☒
Is the proposed activity likely to affect the heritage significance of a local heritage item, or of a heritage conservation area, that is not also a State heritage item, in a way that is more than minor or inconsequential? If 'yes', notification to Council is required.	☐	☒
Is the proposed activity located on flood liable land? If so, will the works change flooding patterns to more than a minor extent? If 'yes', notification to Council is required.	☐	☒

Is consultation required the Transport and Infrastructure SEPP?	Yes	No
Is the proposed activity land that is within a coastal vulnerability area and is inconsistent with a certified coastal management program that applies to that land? If 'yes', notification to Council is required.	☐	☒
Is the proposed activity located on flood liable land and permissible without development consent under the following provision of Part 2.3 of the Transport and Infrastructure SEPP: (a) Division 1 (Air transport facilities), (b) Division 2 (Correctional centres and correctional complexes), (c) Division 6 (Emergency services facilities and bush fire hazard reduction), (d) Division 10 (Health services facilities), (e) Division 14 (Public administration buildings and buildings of the Crown), (f) Division 15 (Railways), (g) Division 16 (Research and monitoring stations), (h) Division 17 (Roads and traffic), (i) Division 20 (Stormwater management systems). * This section does not apply in relation to the carrying out of minor alterations or additions to, or the demolition of, a building, emergency works or routine maintenance. If 'yes', consultation with the State Emergency Service is required.	☐	☒
Is the proposed activity located adjacent to a national park, nature reserve or other area reserved under the *National Parks and Wildlife Act 1974*, or on land acquired under that Act? If 'yes', consultation with the National Parks is required.	☐	☒
Is the proposed activity located on land in Zone E1 National Parks and Nature Reserves? If 'yes', consultation with the National Parks is required.	☐	☒
Does the proposed activity include a fixed or floating structure in or over navigable waters? If 'yes', notification to Roads and Maritime Services is required.	☐	☒
Will the proposed activity increase the amount of artificial light in the night sky within the dark sky region as identified on the dark sky region map? ? If 'yes', notification to the Director of the Observatory is required.	☐	☒
Is the proposed activity located on defence communications facility buffer land within the meaning of clause 5.15 of the Standard Instrument? If 'yes', notification to the Secretary of the Commonwealth Department of Defence is required.	☐	☒
Is the proposed activity within a mine subsidence district within the meaning of the Mine Subsidence Compensation Act 1961? If 'yes', notification to Subsidence Advisory is required.	☐	☒

Is consultation required the Transport and Infrastructure SEPP?	Yes	No
Is the proposed activity for a specified purpose within bush fire prone land?	☐	☒
Is the proposed activity located within a forestry area within the meaning of the Forestry Act 2012?	☐	☒
Is the proposed activity located in land reserved under the Crown Land Management Act 2016 for a public purpose that, in the opinion of the Planning Secretary, is an environmental protection or nature conservation purpose?	☐	☒
Is the proposed activity located within prescribed State land?	☐	☒
Is the proposed activity located on land zoned for conservation purposes?	☐	☒

Based on the review of consultation requirements undertaken in Table 5.3, no consultation under the Transport and Infrastructure SEPP has been undertaken for the project.

5.2.2 Biodiversity and Conservation SEPP consultation

Clause 5.10(1) of the Biodiversity and Conservation SEPP provides that, for activities proposed within the riverine land of the River Murray, consultation must be carried out by a public authority before carrying out the development. Clause 5.11(1) defines the general provisions for consultation under the Biodiversity and Conservation SEPP. The applicability of these provisions to the proposed activity is outlined in Table 5.4.

Table 5.4 Biodiversity and Conservation SEPP consultation

Consultation under Biodiversity and Conservation SEPP (clause 5.11(1))	Response
(a) Where development is contrary to the aims, objectives or principles of this Chapter and may have a significant environmental effect along the Murray River–the P&D (Vic), C&NR (Vic) and the adjacent local Council in Victoria must be consulted.	Not applicable – The proposed activity is considered to be consistent with the aims and objectives of Chapter 5 of the Biodiversity and Conservation SEPP and is not expected to have a significant environmental effect along the Murray River.
(b) Where development may affect boating safety–Transport for NSW must be consulted.	Not applicable – The proposed activity would not affect boating safety.

As outlined in Table 5.4, consultation under the Biodiversity and Conservation SEPP is not required for the proposed activity.

5.2.3 Fisheries Management Act 1994

Ongoing consultation with NSW Department of Primary Industries Fisheries (NSW Fisheries), regarding the project has occurred in accordance with the requirements of the FM Act. NSW Fisheries has reviewed the project's draft concept and detailed design. Feedback from NSW Fisheries has been used to update the design to provide suitable fish passage.

In addition, representatives from NSW Fisheries have attended the Technical Advisory Group and the Stakeholder advisory group meetings.

As the proposed activity involves instream works including excavation, dredging and temporary blockage of fish passage, notification and/or approval from NSW Fisheries is required under the FM Act as detailed in section 4.4.

5.3 Consultation with Aboriginal communities

The Yanco Creek system traverses the ancestral lands of the Wiradjuri, Bangerang, Yorta Yorta, Barapa Barapa, and Wamba Wamba peoples. The project's boundaries intersect with the jurisdictions of the Local Aboriginal Land Councils of Leeton, Narrandera, Cummeragunja, and Deniliquin.

A comprehensive Aboriginal Community Engagement Strategy was developed for the YMCP Program to identify and engage appropriate Aboriginal stakeholders. Additionally, an Aboriginal Cultural Strategy was formulated to provide for active participation of First Nations people in project matters affecting their cultural heritage. This strategy has been pivotal in safeguarding cultural practices, language, knowledge, and identity throughout the project's assessment phase.

Specific to the Forest Creek Return Flows project, eleven registered Aboriginal stakeholders, including two Registered Aboriginal Parties (RAPs) have been involved in the preparation of the Aboriginal Cultural Heritage Assessment (ACHA), which involved three community meetings. An on-site meeting was also conducted with the Deniliquin Local Aboriginal Land Council representatives.

Further information on consultation undertaken with the registered Aboriginal stakeholders for the project are provided in section 6.8.

5.4 Ongoing stakeholder and community consultation

The communication and engagement approach for the next phase of the project (pre-construction and construction) would focus on raising stakeholder awareness of the YCMP.

The overall engagement approach would include continuing the close working relationship with the Stakeholder Advisory Group members as champions of the project and advocates for the Yanco Creek system. Regular key stakeholder meetings and directly affected landholder engagement would continue.

There would also be continuing information on the project provided to the broader community relating to construction timing, sequencing and any access disruptions.

Once determined, this REF would be placed on public display for information via the NSW DCCEEW website.

6. Environmental assessment

6.1 Topography, geology, and soils

6.1.1 Existing environment

The project area is located on the southwestern Riverine Plain of southern NSW, which is characterised by low relief, sloping gradually to the west is dissected by prior streams, ancestral rivers and present-day creek and river systems (Forest Creek Working Group, 2000).

The bed level of Billabong Creek is estimated at around 93 m above sea level at Hartwood Weir where water from Billabong Creek is diverted down Forest Creek and 88 m at Piccaninny Weir where Piccaninny Creek joins Billabong Creek downstream of Conargo. Forest Creek lies approximately 4 m higher in elevation than Billabong Creek, and as a result the Piccaninny Creek offtake between Forest Creek and Piccaninny Creek acts as a tributary to transfer flows from Forest Creek via the existing culvert.

Soil distribution patterns of the Riverine Plain reflect the depositional characteristics of the prior and ancestral streams (Forest Creek Working Group, 2000). Soil types at the project area comprise grey and brown clays which are common over extensive areas of western NSW and are generally associated with the Murrumbidgee River and associated creek systems (Forest Creek Working Group, 2000). These clays are moderately deep and show little change in texture down the profile. The soils tend to form deep wide cracks when they dry out and are less susceptible to erosion than sandy or loamy soils because of their compact nature (Forest Creek Working Group, 2000).

A geotechnical investigation was conducted on 26 August 2023 for the project site. Below is a brief summary of the investigation results as provided in the Yanco Modernisation Part 4 Detailed Design Report (3River 2024).

- The geotechnical investigation revealed the existing embankment is in very poor condition and requires removal, with no bores drilled in the existing embankment.
- Testing of the side bank found that it consists of Silty CLAY soil (CH) utilized as fill material, with an underlying layer of Silty CLAY (CH) soil. The Silty CLAY layer beneath the fill, which comprised the foundation exhibits a plastic index ranging from 29% to 42%. Despite being classified as high-plasticity clay, the Silty CLAY (CH) demonstrates an Emerson Class of 6 and SPT values ranging from 16 to 40, indicating resistance to dispersion and the stiffness of the clay soil.
- The foundation is appropriate for the embankment and the concrete slab.
- The stability of the embankment fill of Forest Creek return regulator has been assessed for normal operating conditions, flood condition and critical condition. The critical case loading identified was with an upstream water level at 92.90 m AHD and downstream water level at the ground level (91.50 m AHD). In this condition upstream water level is at the maximum height,

while the downstream water level is at the ground level. For the borrow site classification and assessment, the friction angle of Forest Creek

- Borrow site is acceptable for use with the proposed slope (18 to 23 degrees) with plasticity index between 17 to 38, although it is suggested to use material in deeper sections (1.2 to 2.8 m).

An outcome of the geotechnical assessment was that the soil from the existing embankment is not suitable for reuse and should be removed. The other key outcome was that the soil from the identified borrow site is likely to be suitable for use as fill, ideally from the deeper sections from 1.2 to 2.8 m.

6.1.2 Impacts

Construction

The project would disturb the surface of the ground during construction through the removal of vegetation and excavation. Establishing access tracks and site compounds, and transporting equipment and material between the compound and work sites would disturb the land surface, which, if not appropriately managed, could lead to erosion and sedimentation of the Piccaninny Creek offtake channel.

Erosion and sediment controls would be outlined in the project CEMP and established prior to commencement of construction to avoid and minimise erosion and sedimentation related impacts.

Fuel and oil associated with construction vehicles, plant and equipment are potential sources of pollution. Any spills could potentially be transported into the creek(s) and impact water quality. Site specific controls to manage the risk of accidental spills or leaks of fuels, oils and chemicals would be outlined in the project CEMP and implemented during construction.

A search of the Australian Soil Resource Information System (ASRIS) for the occurrence of acid sulfate soils at the project area was undertaken on 5 October 2023. The search results indicate that there is a low probability of occurrence of acid sulfate soils at the project area.

Operation

Operational impacts of the project have been considered in section 6.2. Impacts on soils and geology would be considered during detailed design and managed through the project CEMP.

6.1.3 Safeguards

The safeguards proposed to avoid, minimise, or manage potential topography, geology, and soil impacts as a result of the project are included in Table 8.1.

6.2 Hydrology and water quality

6.2.1 Existing environment

Hydrology

The project area is part of the Yanco-Billabong Creek system which generally flows south-west from the Murrumbidgee River down stream of Narrandera until it joins the Edward River at Moulamein.

Piccaninny Creek flows from near Conargo running in a southerly direction, turns west running parallel with Forest Creek, then turns north-west before joining Billabong Creek at Piccaninny Weir. Flow to lower Piccaninny Creek is perennial, receiving its flows from the Warriston Weir pool on Forest Creek via an existing unregulated culvert on Piccaninny Creek offtake.

Forest Creek is a high level anabranch that leaves Billabong Creek approximately 10 km east of Conargo. Forest Creek flows in a generally western direction. Being higher in elevation, flows can divert north to Billabong Creek along breakout channels from Forest Creek. These breakout channels include Piccaninny Creek, and a number of other creeks downstream of Warriston Weir. In its entirety, Forest Creek spans about 38 km from its westernmost point to its easternmost point.

Approximately 570 m downstream from the project area is Warriston Weir, a fixed crest weir that currently regulates flows in the upstream reach of Forest Creek. However, due to unplanned flows occurring during normal regulated periods, the water stream has frequently been overtopping Warriston Weir.

Forest Creek currently receives regulated flows of water which is diverted from the Hartwood Weir pool on Billabong Creek. Environmental water is also diverted into Forest Creek which is used to deliver the environmental water past Warriston Weir to wetlands and waterways downstream, including Wanganella Swamp and the Forest Anabranch. However, a portion of this environmental water is currently lost to Piccaninny Creek along the offtake channel.

Stock and domestic water was historically supplied to Forest Creek downstream of Warriston Weir, but this ended in 2008. The Water Sharing Plan for the Murrumbidgee Regulated River Water Source 2003 required a 'replenishment flow' of 100 ML/d downstream of Warriston Weir. This was presumed to be for stock and domestic. In 2005 the target was reduced to 80 ML/d in summer and 60 ML/d in winter. In 2008, the Water for Rivers project ‘Forest Creek Stages 1& 2’ involved the removal of the requirement for the replenishment flow in Forest Creek. The saving was converted to a licenced entitlement which contributed to the Water for Rivers target of 282 GL. Water for Rivers provided offset payments to affected landholders downstream of Warriston Weir. This saving allowed for a reduction in Snowy Hydro's required release to the Murrumbidgee and lead to additional flows in the Snowy River. The Murrumbidgee water sharing plan requirement (cl.63) was repealed in the 2011 plan and the operational target at Warriston Weir remains at zero to preserve this saving.

Under current conditions the magnitude of infrequent (flood) flows is still substantial in Forest Creek due to the input of unregulated flows from upper Billabong Creek to the lower Yanco-Billabong System. Infrequent (flood) flows are generally of the same or similar magnitude under current conditions and pre-regulated conditions (Alluvium 2013).

Overall, the temporal variation in daily flows in Forest Creek are fairly similar to pre-regulated flows, certainly more so than other reaches of the Yanco-Billabong System. Under pre-regulated conditions the curves show that flows in the Forest Creek would have ceased for most of the time. Currently flows cease less often, but still persist around 30% of time. There is a temperate seasonal pattern with the lowest average monthly flows in February and March and the highest average flows in August (Alluvium 2013).

Water quality

The Basin Plan sets water quality targets and objectives to protect water quality in the Basin's rivers for people and livestock as well as for wetlands and floodplains. The Basin Plan requires environmental water managers to consider water quality targets when making decisions about environmental watering and running the river.

Threats to water quality in the Basin include physical and chemical stressors such as high salinity levels, toxins generated by blue-green algal blooms or inappropriate use of chemicals; high levels of nutrients including phosphorus and nitrogen from agricultural activity, stormwater, and erosion; high and low temperature extremes, and low dissolved oxygen levels.

Water quality objectives for Piccaninny and Forest Creeks within the Murray River catchment have been nominated in both the Basin Plan and the Department of Environment and Climate Change (DECC) (2006) *Water quality and river flow objectives.* Both Piccaninny Creek and Forest Creek have been classified as 'controlled rivers with altered flow pattern' which have a number of nominated water quality objectives for protection for which there are nominated guideline values that need to be met.

Existing water quality data is limited within Piccaninny and Forest creeks. There is no available water quality data for Piccaninny Creek (with the exception of data collected during a site visit as part of this project). The only available water quality data for Forest Creek near the project area is from WaterNSW's automatic flow gauge at Warriston Weir that also measures temperature and electrical conductivity. Daily water quality data measured at the Warriston Weir gauge was downloaded for the past 5 years (1 February 2018 – 5 February 2023) and shows a median electrical conductivity of 184 µS/cm.

Site specific water quality monitoring at the Piccaninny Creek offtake channel (PIC-OT) was carried out on 9 March 2023 as part of the project. Monitoring involved collecting in-situ water quality measurements using a calibrated water quality meter and grab samples for a variety of indicators. Grab samples were collected in pre-sterilised laboratory supplied bottles, labelled, stored on ice and sent to a National Association of Testing Authorities (NATA) accredited laboratory for analysis. The single sampling event is indicative of water quality at that time and may not characterise the overall quality of the waterway.

The in-situ monitoring was undertaken at four sites; Forest Creek at Conargo Road crossing (038), Warriston Weir, Piccaninny Creek offtake channel and Piccaninny Creek at Conargo Road (032). Grab samples for laboratory analysis were also collected at Piccaninny Creek offtake channel. At the time of sampling, all sites were flowing.

Results are provided in Table 6.1 and are indicative of water quality at the time of sampling.

Table 6.1 Water quality results from site visit (shaded cells denotes exceedance of guideline value)

Analyte	038	Warriston Weir	Piccaninny Creek offtake channel	032	Guideline value
Temperature (°C)	21.2	18.61	21.06	19.97	No guideline
pH	7.32	7.25	7.57	7.31	6.5-8 [1]
Dissolved oxygen (% saturation)	35	35.4	62.3	29	80-110[1]
Turbidity (NTU)	194	420	418	133	35[1]
Total suspended solids (mg/L)	No data	No data	189	No data	No guideline
Electrical conductivity (µS/cm)	422	364	356	360	162[2]
Ammonia (mg/L)	No data	No data	<0.01	No data	0.02[3]
Oxidised nitrogen (mg/L)	No data	No data	0.09	No data	0.04[3]
Total nitrogen (mg/L)	No data	No data	0.8	No data	0.6[1]
Total phosphorus (mg/L)	No data	No data	0.12	No data	0.05[1]
Soluble reactive phosphorus (mg/L)	No data	No data	<0.01	No data	0.02[3]
Chlorophyll-a (µg/L)	No data	No data	69	No data	5[3]
Total organic carbon (mg/L)	No data	No data	9	No data	No guideline
Total arsenic (mg/L)	No data	No data	0.004	No data	0.013[4]
Total cadmium (mg/L)	No data	No data	<0.0001	No data	0.0002[4]
Total chromium (mg/L)	No data	No data	0.008	No data	0.001[4]
Total copper (mg/L)	No data	No data	0.005	No data	0.0014[4]
Total nickel (mg/L)	No data	No data	0.005	No data	0.011[4]
Total lead (mg/L)	No data	No data	0.007	No data	0.0034[4]
Total zinc (mg/L)	No data	No data	0.016	No data	0.008[4]
Total mercury (mg/L)	No data	No data	<0.0001	No data	0.00006[4]

1. Basin plan water quality target

2. Median 162µS/cm or 80th percentile 258µS/cm (as per Schedule B, Appendix 1 of the Commonwealth Water Act (2007))

3. ANZG (2018) guideline value for protection of lowland river aquatic ecosystems for south-east Australia

4. ANZG (2018) trigger value for 95% level of protection for freshwater ecosystems

At the time of sampling the water quality of sites visited could be considered poor with key indicators not meeting relevant guideline values for protection of aquatic ecosystems. At all sites, dissolved oxygen fell below the lower limit of 80 percent saturation and turbidity was above the recommended limit of 35 NTU. The elevated turbidity measured during sampling appeared due to the heavily silted slow flowing water observed at all sites (supported by high suspended solids measured as Piccaninny Creek offtake channel). When waters are high in suspended sediment and silts, they can absorb heat which in turn lowers dissolved oxygen levels and could be a plausible reason for the low dissolved oxygen at these sites. pH levels at all sites fell within the Basin Plan's upper pH limit of 8, however electrical conductivity at all sites exceeded both the recommended median and 80th percentile concentration. Grab samples collected in the Piccaninny Creek offtake

channel had elevated nutrients with concentrations of total nitrogen, oxidised nitrogen, total phosphorus and chlorophyll exceeding the basin plan water quality target or the ANZG (2018) guideline values for protection of aquatic ecosystems at the time of sampling. Concentration of some metals at the offtake (total chromium, total copper, total lead and total zinc) also exceeded the recommended trigger values for 95% level of protection for freshwater ecosystems (ANZG, 2018). There were no detections of organochlorine pesticides, (OCs) organophosphorus pesticides (OPs), or Phenoxyacetic Acid Herbicides (PAHs).

6.2.2 Impacts

Hydrology

Construction

Construction of the project may require an earthen cofferdam to provide for works within Piccaninny Creek offtake if construction cannot be undertaken when the channel is naturally dry. Construction of the cofferdam would stop flows in the offtake channel for a short period (two months).

Construction is expected to take place during a natural low flow period (the warmer months), at which time cessation of flows are not considered an unnatural occurrence. The offtake channel derives its flows from Forest Creek and discharges 500 m downstream of the offtake into Piccaninny Creek. Piccaninny Creek catchment upstream of the offtake channel would be unaffected and would receive natural flows while the cofferdam is in place. Construction impacts on hydrology would therefore be localised short-term and minor and not affect the wider catchment.

Operation

Flow modelling for the project has focussed on three key elements of the flow regime: flow duration, seasonality of flow, and total flow volume. Modelling considered the:

- Base Case – current flow conditions
- Change Case – current conditions as well as operation of Forest Creek return flows regulator to direct regulated flows to Piccaninny Creek (up to a maximum of 50ML/day).

The model has been calibrated to existing and observed data and updated to reflect the current operational conditions in the catchment and run to produce results over the period 1895 to 2020.

This REF was initially drafted in May 2023 and used the modelling information current at that time. Since then, there has since been refinements to the model to reflect new information and improved understanding of the system. The results from the revised model dated November 2023 have been compared to the results available in May 2023, and while the numbers are slightly different, there is no change to the seasonality or magnitudes of flow as presented in May 2023. The quantum of change between the two sets of model results is around 1GL/yr. Given this, it is considered that the conclusions of the REF drafted in May 2023 are supported by the November 2023 modelling results. Further, as explained below, these modelling results are conservative in that they overestimate potential changes, and this principle has not changed.

Under the base case, regulated mean daily flows at the Piccaninny Creek offtake channel are extremely stable at 1 ML/day (Figure 6.1), with there being a 16% chance of falling below this value in a given year. Some level of flow is maintained 100% of the time, with the amount effectively being

unchanged throughout the year. Average annual flows are 0.3 GL/yr. Flows are regulated in Forest Creek and most of the flows continue on to Warriston Weir rather than through the offtake channel.

Under the change case, the operation of the Forest Creek return flows project is projected to substantially reduce low flows to Warriston Weir, effectively limiting the conditions under which the weir would be overtopped under normal operating conditions. Rather, these flows would be diverted through the Piccaninny Creek offtake channel, down Piccaninny Creek to Billabong Creek.

A substantial increase in average annual flow volume through Piccaninny offtake is expected with the implementation of the new regulator and operating regime (refer to Table 6.1). Average annual flow volumes through Piccaninny offtake are modelled to increase from 0.3 GL/yr to 2.1 GL/yr, equating to a 522% increase. The change in average annual flow volumes downstream of Warriston Weir (refer to Table 6.1) is relatively minor in comparison, with only a 5% decrease in volume from 33.3 GL/yr to 31.5 GL/yr.

Figure 6.1 shows the modelled average monthly flow volumes through Piccaninny offtake increase considerably, compared to base case (current), with implementation of the new regulator and operating regime (change case). The highest monthly average daily (ML/day) flows are modelled to occur from January to March (Figure 6.1) and it is assumed this is the result of the regulator being operated in upstream control to prevent unplanned flows in the Forest Creek downstream of Warriston Weir during normal regulated periods (i.e. when the flow target in Forest Creek at Warriston Weir is 0 ML/day). The current operational assumption at Piccaninny Offtake of 1 ML/d is an underestimate of the existing flows. However, this assumption is conservative with respect to assessing the change from the project. This assumption means that in the existing case more flow is discharged to along Piccaninny Creek to Billabong Creek in reality and change due to the project is therefore overestimated.

Figure 6.2 shows the modelled average monthly flow volumes downstream of Warriston Weir under base case and change case (with implementation of the new regulator and operating regime). A relatively minor decrease in monthly averaged daily flow volumes within Forest Creek downstream of Warriston Weir are predicted with implementation of the new regulator and operating regime, but there is no change in the annual pattern (seasonality) of flows (Figure 6.2). The project would slightly decrease the average monthly flow volumes downstream of Warriston Weir between 3.3-9.4 ML/ day.

Figure 6.3 shows the annual flow duration curve (i.e. cumulative frequency curve of the percent of time flows are predicted within the year) for Piccaninny offtake. With implementation of the new regulator and operating regime, increased flow volumes (compared to the base case of ~1 ML/day) through the Piccaninny offtake would occur greater than 65% percent of the time, and there is no change predicted in the frequency of low (<1 ML/day) flow events through the offtake. The 1 ML/d model assumption means that less flow over Warriston Weir as more would be diverted to Billabong Creek. That means the model results overestimate the difference with the change case when flows less than 50 ML/d are removed. Hence the assumption slightly overestimates the impact of the project.

The flow duration curve for Forest Creek downstream of Warriston Weir (Figure 6.4) indicates the frequency of 0 ML/day flow downstream of Warriston Weir would occur on 67% of days annually, compared to 10% under existing conditions. The analysis suggests the predicted frequency of flows less than 50 ML/day downstream of Warriston Weir would be essentially removed.

Table 6.2 Average annual change in volumes

Location	Base case (ML)	Change case (ML)	% change on base case
Piccaninny offtake	0.3 GL/yr	2.1 GL/yr	522% increase
Downstream Warriston Weir	33.3 GL/yr	31.5 GL/yr	5% decrease

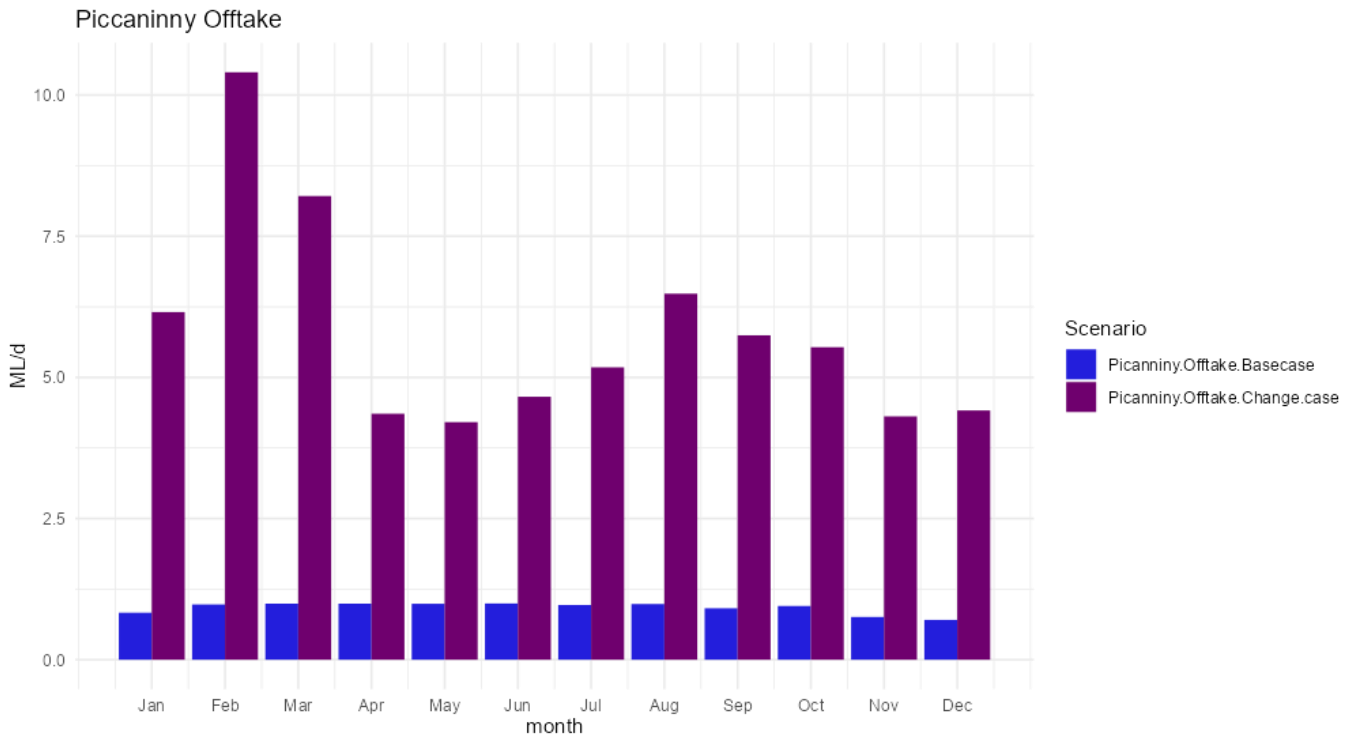

Figure 6.1 Average monthly flow volumes ML/day for Piccaninny offtake

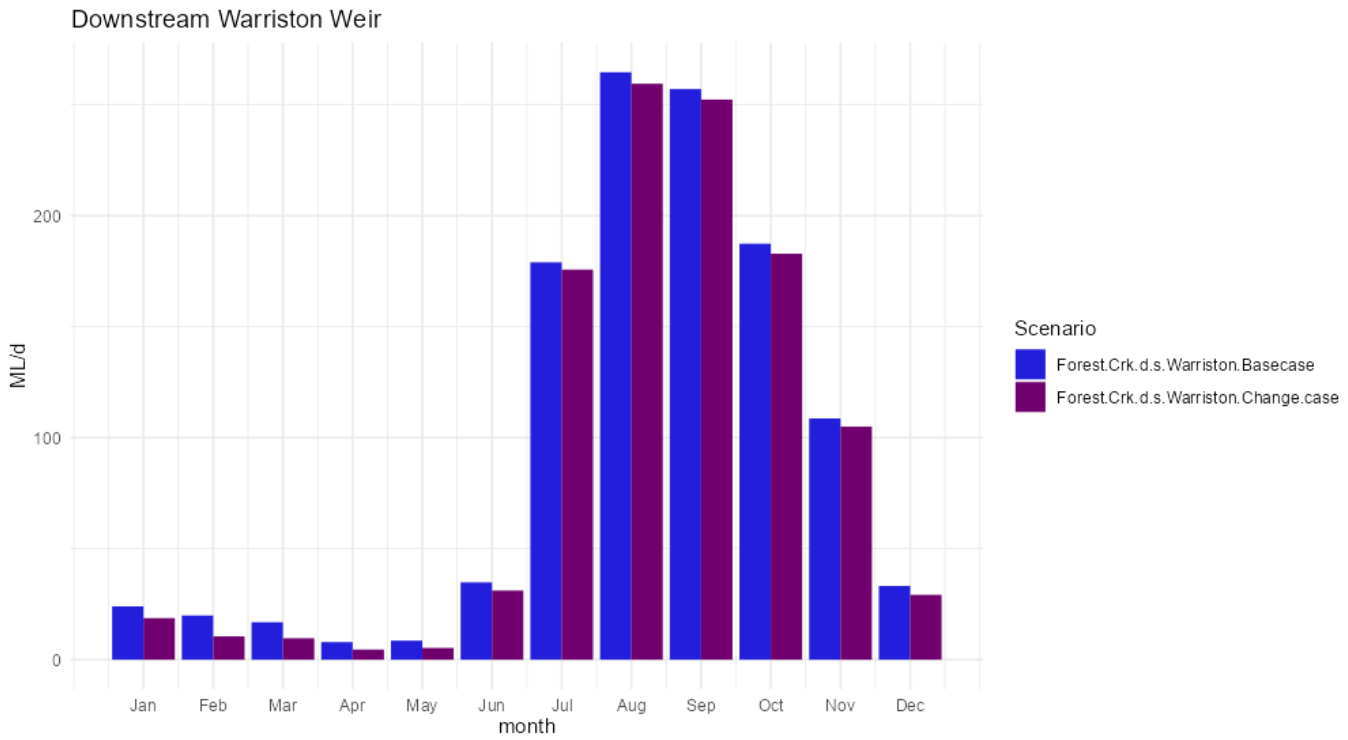

Figure 6.2 Average monthly flow volumes ML/day downstream Warriston Weir

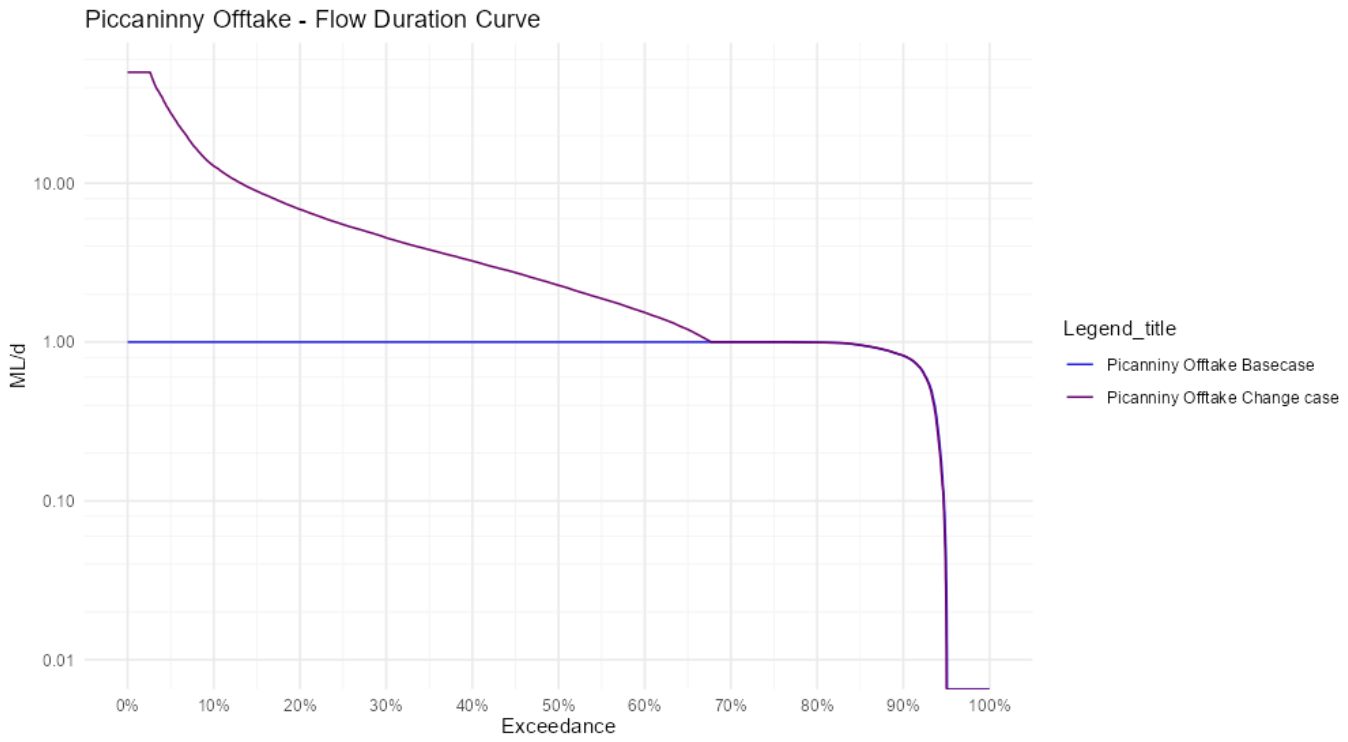

Figure 6.3 Annual flow duration curve for flows through Piccaninny offtake

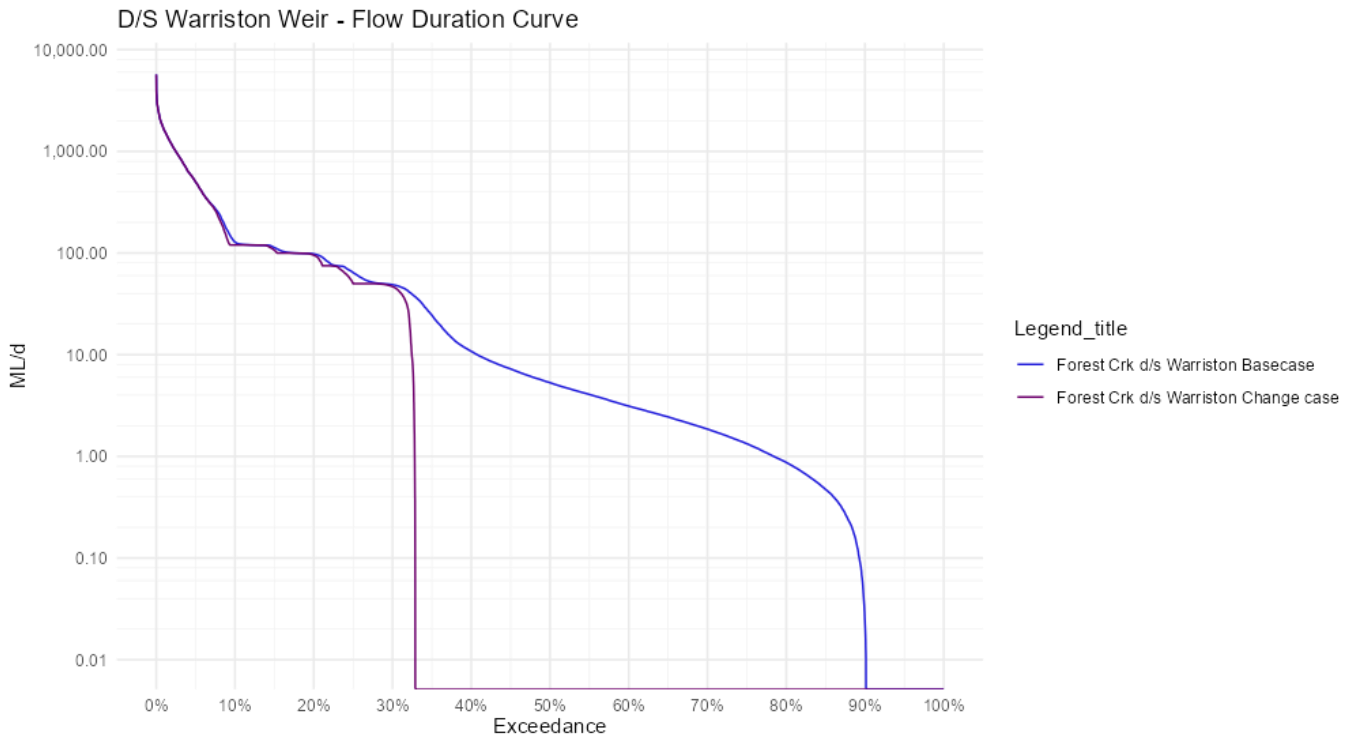

Figure 6.4 Annual flow duration curve for flows downstream of Warriston Weir

The new Forest Creek return flows regulator would allow river operators to direct flows down the Forest Creek to water the various environmentally and culturally important wetland habitats downstream of Warriston Weir.

The operation of the proposed Forest Creek return flows regulator would largely be at the discretion of the environmental water managers during managed environmental watering events and some large unregulated events. The operation of the Forest Creek return flows regulator is outlined in the *Yanco Creek System Operations Plan* as detailed in section 3.5.2. Operations would be consistent with the Operations Plan, work approval and WaterNSW water licence.

There is no mitigation proposed for flow related impacts as these would be considered in environmental water decisions and compliance with the operations plan and water sharing plan. Section 3.5.1 provides the legislative framework for environmental watering.

Water quality

Construction of the project has the potential to result in water quality impacts to downstream environments through:

- Vegetation removal exposing soils to weathering processes and increasing the risk of erosion and sedimentation.
- Earthworks including stripping topsoil, excavations and placement of fill as required. Soils exposed during earthworks have the potential to be mobilised to downstream environments via wind and stormwater runoff.
- Construction traffic and heavy vehicles could cause ground disturbance that leads to increased risk of erosion and sedimentation.

Dewatering of the cofferdam has the potential to result in water quality impacts if the discharge of water is not appropriately managed and results in disturbance of sediments. Therefore, this will need to be considered and addressed in the project CEMP.

The impacts of erosion and sedimentation on water quality and aquatic environments may include:

- increased turbidity and poor water clarity, which can potentially lead to smothering aquatic ecology
- sediments may contain high concentrations of nutrients which can lead to algal blooms in the open water areas of Warriston Weir pool, and subsequently lower dissolved oxygen content in water and reduced light penetration that limits the growth of aquatic vegetation, or further promote denser growth of Cumbungi in the offtake channel
- mobilised sediments may contain elevated concentrations of metals and other contaminants which can negatively impact aquatic ecology that may be sensitive to changes in water quality.

Waterway contamination from accidental spills or leaks of fuels, oils and chemicals (such as hydraulic oils) during construction is considered unlikely but possible. Accidental spills or washout of concrete can pollute waterways and alter the pH of downstream waterways. While sediment-laden runoff and pollutants from soil disturbance have the potential to temporarily reduce downstream water quality, it is unlikely to cause major or long-term impacts to the overall condition of waterways as they would be managed with the implementation of erosion and sediment controls outlined in Table 8.1.

6.2.3 Safeguards

The safeguards proposed to avoid, minimise, or manage potential impacts on hydrology and water quality as a result of the project are included in Table 8.1

6.3 Groundwater and salinity

6.3.1 Existing environment

Groundwater in the locality of the project is covered by the Water Sharing Plan for the Murray Alluvial Groundwater Sources Order 2020. The plan covers groundwater within alluvial deposits of the Murray River including those located between the Murray River and Billabong Creek. Two groundwater sources covered by the plan are identified in the locality, being a shallow alluvium and a deep alluvium – the Lower Murray Shallow Groundwater Source and the Lower Murray Groundwater Source, respectively. The locality is also within the Lower Murray Shallow (Eastern) Management Zone.

The shallow Shepparton Formation at up to approximately 70 m deep, deeper Calivil Formation and Renmark Group sequences at approximately 350 m deep are the main geological units within the Lower Murray Alluvium. The Renmark Group is the basal formation which sits upon a pre-Cenozoic basement (DPIE 2019).

The Shepparton Formation overlies the Calivil Formation and consists of clay and silty clay interbedded with sand layers. The groundwater within the uppermost 20 m of the Shepparton Formation aquifer is mostly saline although low salinity and high yielding groundwater supplies can be obtained from the coarser sediments associated with prior streams. Groundwater within the upper portion of the Shepparton Formation is unconfined (DPIE 2019).

Shallow aquifers of the Lower Murray Shallow Alluvium are also considered to be in hydraulic connection to major rivers, creeks, irrigation channels and other water bodies. The dominant recharge process into the alluvium is direct rainfall infiltration, leakage from irrigation activity including canals and leakage from the Murray River and its anabranches (DPIE 2019).

There is very little groundwater-surface water interaction information available for the Yanco Creek System as a whole (Alluvium 2013). An investigation into hydrological interactions in Billabong Creek identified the reach as being losing-disconnected stream with a well-established clogging layer near of slightly below the streambed, usually a clay unit (Lamontagne et al 2011).

The closest groundwater bore to the project site is approximately 1.7 km to the south-east (Site ID - GW029511) which is a 61 m deep test hole drilled in 1968. Two water zones were identified in sand lenses between clay layers at around 11 m and 30 m below ground level. Salinity levels were recorded as up to 14,200 µS/cm. Other bores, between 4-5 km from the site (GW502943, GW502621, GW502622 and GW502623), were regularly monitored for groundwater levels mostly between 1970 and 2005. At all these bores the distance to standing water below ground level was between 4 m to 11.6 m. The closest monitoring bore in current use is approximately 22 km west (GW500444). The groundwater level at this location has been in the range of 8-26 m below ground level for readings taken since 1996 (Bureau of Meteorology 2023, WaterNSW 2023).

6.3.2 Impacts

The base of the proposed Forest Creek return flows regulator would sit approximately 600 mm below the waterway bed level and 2 m below adjoining ground level, with a cut off wall extending a further 1 m into the waterway bed. The shallow nature of these works mean that they are unlikely to intersect with the shallow aquifer or alter recharge based on the above information from the locality. However, the construction of these works is likely to intersect with shallow ground water associated with infiltration from the creek, and the Warriston Weir pool. Any required dewatering would likely have localised and temporary impacts to groundwater, and construction impacts to regional groundwater systems or salinity are expected to be insignificant.

If dewatering of groundwater is required, it would be stored on-site and used for dust suppression, irrigated by sprinkler nearby or tested and discharged into Piccaninny Creek.

The Murray alluvium is dominated by the groundwater dependent communities of river red gum woodland wetlands, lignum wetlands, freshwater wetlands, black box-lignum, black box, and yellow box woodlands. Generally, the Groundwater Dependent Ecosystem (GDE) communities with high ecological value have large vegetation patches, are highly connected (such as riparian corridors) and have a high number of threatened species present (DPIE 2019). The water sharing plan does not identify any high priority groundwater dependent ecosystems in the locality.

During construction and operations a variety of dispersible liquids, including fuels, lubricants and chemicals, would be used which pose a potential pollutant threat to local water quality. The use of these liquids may pose a risk to water quality in the event of a spill or discharge, however the potential for groundwater interaction or contamination is very small. Appropriate mitigation measures would be implemented to avoid and minimise this risk of contamination. Environmental impacts to groundwater during the construction and operational phases are considered very unlikely due to the recorded depth of aquifers in the locality and limited potential for groundwater interaction during the proposed construction and operations.

Long-term changes to salt load in the Murray River are managed through the Basin Salinity Management 2030 (BSM2030) Strategy, under the Murray-Darling Basin Agreement. Accountability for long-term changes in salinity is expressed in terms of change in Murray River salinity at Morgan, South Australia, measured in electrical conductivity (EC). There are agreed procedures that outline the requirements for assessing the salinity effects under the BSM2030 Strategy to ensure equivalent assessment can be made across the Murray-Darling Basin. These include using accredited river salinity models, standard weather conditions and agreed sequencing of actions.

The *Preliminary Salinity Impact Assessment for SDLAM case study projects* (Jacobs, 2023) provides an assessment of the YCMP to determine the need for accountability under BSM2030, as required and in accordance with, the NSW DCCEEW Preliminary Salinity Assessment Procedure (EMS-WG-PRO-04/005). The Jacobs 2023 report estimates the total salinity impact on creeks in the Yanco system to be approximately 0.054 T/day, which converted to an EC impact of 0.067 EC at Morgan. The assessment concludes that the YCMP is not an accountable action (being an insignificant impact (<0.1EC at Morgan)) and there is no need for further analysis under EMS-WG-PRO-04/005.

6.3.3 Safeguards

A CEMP, including site specific erosion and sediment control and spill response would be prepared prior to works commencing to guide the implementation of environmental safeguards to mitigate risks to groundwater quality.

6.4 Terrestrial biodiversity

A Biodiversity Impact Assessment was undertaken and prepared as part of this REF (refer to Appendix B Biodiversity Impact Assessment). It assesses the potential impacts on biodiversity values as a result of the construction and operation of the project, with a particular emphasis on threatened ecological communities, populations and species listed under the NSW BC Act and FM Act, as well as the MNES listed under the Commonwealth EPBC Act.

The findings from the Biodiversity Impact Assessment are provided below.

6.4.1 Methodology

Literature and desktop reviews

The Biodiversity Impact Assessment consisted of a desktop study and site investigations of the study area. For the purposes of the Biodiversity Impact Assessment, the 'study area' was defined as the area associated with works inclusive of the 'Clearing Area', 'Contractors Activity Zone' and project access tracks.

The following literature and desktop databases were reviewed prior to conducting field surveys in order to identify threatened flora and fauna species, populations and ecological communities listed under the BC Act, FM Act, and EPBC Act that could be expected to occur within the locality of the project area (defined as a 20 km radius of the project area):

- BioNet Atlas for records of threatened species listed under the BC Act and EPBC Act which have been recorded within the locality (NSW DCCEEW 2024a, report generated 18/07/2024)
- Australian Department of Climate Change, Energy, the Environment and Water (DCCEEW) Protected Matters Search Tool (PMST) for Matter of National Environmental Significance (MNES) listed under the EPBC Act which may occur in the study area (DCCEEW 2024b, report created 18/07/2024)
- NSW threatened species profiles (DPE 2023a) and Commonwealth Species Profile and Threats Database (DCCEEW 2023b) for descriptions of the ecology, distribution and habitat requirements of threatened biota
- NSW BioNet Vegetation Classification (VIS 2.1) (DPE 2023a) to identify candidate plant community types (PCTs) in the study area.
- Existing vegetation mapping of the locality presented in the NSW State Vegetation Type Map (SVTM) (SVTM; DPE 2023b)
- priority weed declarations for the Edward River LGA/Murray Local Land Services region (DPI 2023)
- historical aerial photographs of the study area accessed via the Historical Imagery viewer (NSW Government, 2023).

Previous biodiversity studies of the locality were reviewed including:

- Yanco-Billabong Creek Broad-scale Wetland Monitoring Project: Frog communities of the Yanco-Billabong creek system (Walcott *et al* 2018)
- Yanco Creek and tributaries: Intensive frog surveys of creek and farm habitats 2019-20 (Turner *et al* 2020).

Following collation of database records and review of species and community profiles, a 'likelihood of occurrence' assessment was prepared with reference to the habitats contained within the study area. Identification of potential habitat for threatened and migratory species was based on information provided in the species profiles (NSW DCCEEW 2024b, DCCEEW 2024b), recovery plans, journal articles, and the field staff's knowledge of species habitat requirements. The likelihood of occurrence assessment was further refined following field surveys. The likelihood of threatened and migratory biota occurring within the study area was assessed based on the presence of records

from the locality for the last 20 years (since 2003), species distribution and habitat preferences, and the suitability of potential habitat present in the study area. The results of this assessment are provided in Appendix B of the Biodiversity Impact Assessment (refer to Appendix B Biodiversity Impact Assessment of this report).

Field surveys

An initial field survey was conducted by ecologists on 17 February 2022 and supplementary field surveys were conducted by ecologists on 3 March 2022, 26 July 2022 and 2 March 2023 to assess additional project areas not previously surveyed. The field surveys consisted of:

- vegetation mapping to ground-truth the existing vegetation mapping of the study area (SVTM; DPE 2023b)
- targeted flora surveys for threatened flora species that could potentially occur within the study area and habitat requirements for each species
- terrestrial fauna surveys including general fauna habitat assessments, diurnal bird surveys, spotlighting and call playback for the Southern Bell Frog (*Litoria raniformis*), Bush-stone Curlew (*Burhinus grallarius*), Koala's (*Phascolarctos cinereus*) and threatened forest owls such as the Barking Owl (*Ninox connivens*) and Masked Owl (*Tyto novaehollandiae*), and other opportunistic observations.

Figure 6.5 presents the survey effort, vegetation zones and habitat resources.

Survey limitations

The field surveys were not designed to detect all species, but rather to provide an overall assessment of the ecological values within the locality. Refer to section 3.3 of the Biodiversity Impact Assessment (Appendix B Biodiversity Impact Assessment for further details on the survey limitations.

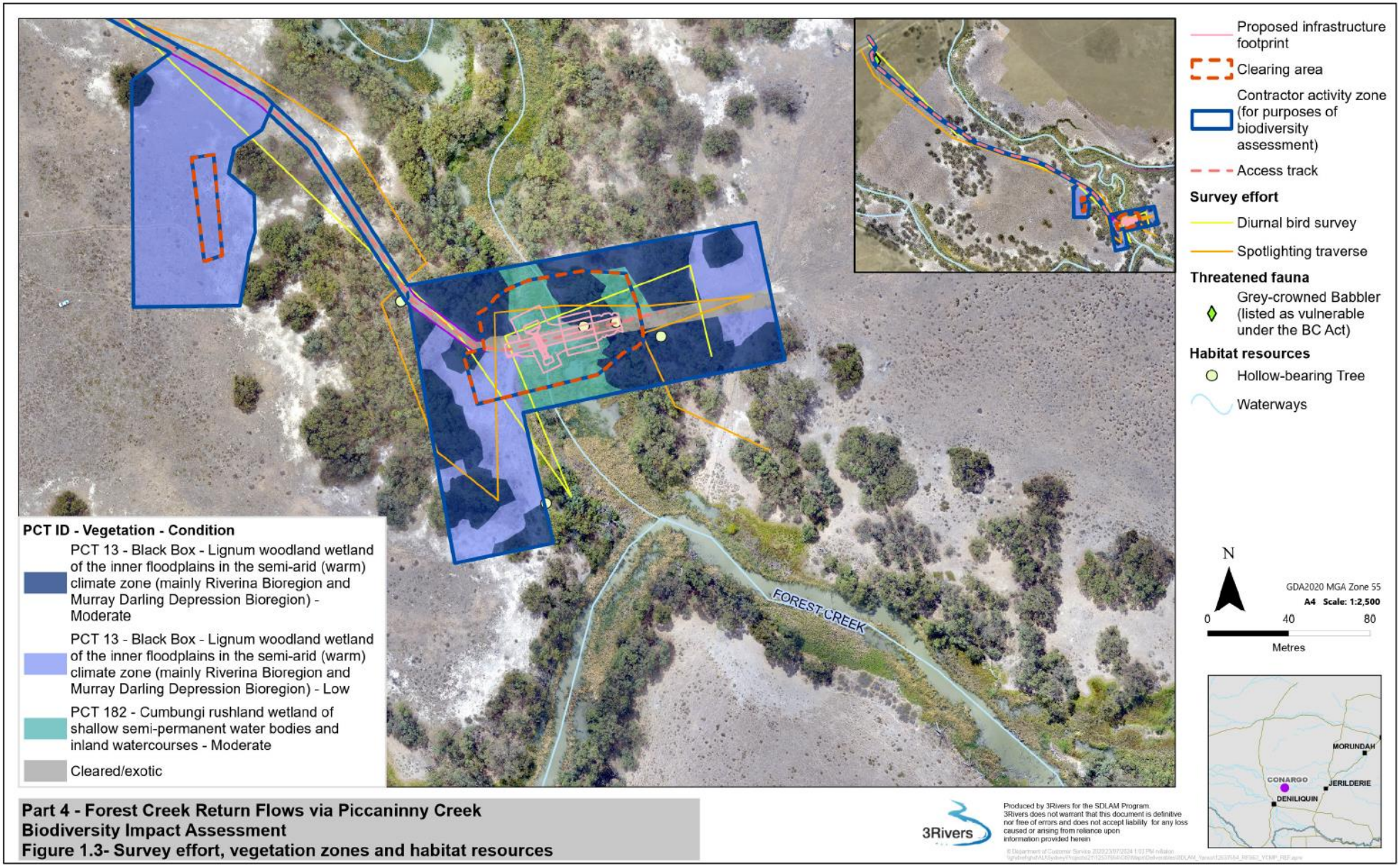

Figure 6.5 Survey effort, vegetation zones and habitat resources

6.4.2 Existing environment

Vegetation

The study area is positioned within the riparian corridor of the Piccaninny offtake channel. During the field surveys conducted, plant community assemblage and structure were ground-truthed, identifying two PCTs to be present within the study area:

- PCT 13: Black Box - Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
- PCT 182: Cumbungi rushland wetland of shallow semi-permanent water bodies and inland watercourses.

PCT 13 has been subject to differing levels of management within the study area and subsequently occurs in two condition states: low and moderate condition.

An existing track intersects the study area, with the track partially denuded and not commensurate with a PCT. The vegetation on the existing access track is dominated by a low diversity of exotic forbs and grasses.

Table 6.3 outlines detailed descriptions of the two PCTs identified to be present within the study area. A further comprehensive list of all flora identified within the study area is provided in Appendix A of the Biodiversity Impact Assessment (refer to Appendix B Biodiversity Impact Assessment).

Table 6.3 Vegetation zones within the study area (DPE 2023a)

PCT	PCT ID	Conservation significance	Description summary	Condition	Landscape position	Image
Black Box - Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	13	No alignment with any threatened ecological communities (TECs) under the BC Act or EPBC Act.	• Open woodland community dominated by Black box (*Eucalyptus largiflorens*). • Shrub layer consists of River Cooba (*Acacia stenophylla*), Black roly-poly (*Sclerolaena muricata*) and *Einadia nutans*. • Native groundcover species included Nardoo (*Marsilea drummondii*), Slender Knotweed (*Persicaria decipiens*) and Couch (*Cynodon dactylon*). • Lignum (*Duma florulenta*), is sparse. • Weed species present included African Boxthorn (*Lycium ferocissimum*), Ryegrass (*Lolium perenne*), Patterson's Curse (*Echium plantagineum*) and White Clover (*Trifolium repens*). • Soil consists of brown or grey clays subject to consistent inundation resulting in depressions becoming wetland areas that can harbour macrophytes (Water fern (*Azolla filiculoides*) and Narrow-leaved Cumbungi (*Typha domingensis*)). • Intergrades into PCT 182.	Moderate	Within inner floodplains, drainage channels and backplanes	 Figure 6.6 Vegetation typical of moderate condition PCT 13 in the study area
Black Box - Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	13	No alignment with any TECs under the BC Act or EPBC Act.	• Highly modified form of the community, lacking a canopy and with an understorey and midstorey showing evidence of ongoing disturbance. • Mid-storey vegetation is sparse and exclusively comprises Lignum (*Duma florulenta*). • Native groundcover species included Nardoo (*Marsilea drummondii*), Slender Knotweed (*Persicaria decipiens*) and Couch (*Cynodon dactylon*). • Subject to cattle grazing, sparse cover of exotic species • Soil consists of brown or grey clays subject to periodic inundation.	Highly modified	Within inner floodplains, drainage channels and backplanes	 Figure 6.7 Vegetation typical of low condition PCT 13 in the study area

PCT	PCT ID	Conservation significance	Description summary	Condition	Landscape position	Image
Cumbungi rushland wetland of shallow semi-permanent water bodies and inland watercourses	182	Not commensurate with the Artesian Springs Ecological Community in the Great Artesian Basin or any TECs listed under the EPBC Act	• A freshwater wetland community, occurring in areas of prolonged inundation within the study area. • Dominated by dense patches of Narrow-leaved Cumbungi (*Typha domingensis*). • Canopy vegetation is predominantly absent, with occasional River Cooba (*Acacia stenophylla*) from adjacent woodland vegetation (PCT 13). • Moderate diversity of macrophytes and water-tolerant forbs/sedges • Similar to PCT 13, the community had been subject to cattle grazing and has a high cover of exotic plants.	Moderate	Alongside the banks of the Piccaninny Offtake Channel adjoining Forest Creek on low-lying areas often with semi-permanent inundation.	 Figure 6.8 Vegetation typical of moderate condition PCT 182 in the study area

Priority weeds

The study area contains a low abundance of one species declared as a priority weed under the *Biosecurity Act 2015* in the Murray Local Land Services Region (African Boxthorn (*Lycium ferocissimum*)) (DPI 2023). This species predominantly occurs in low condition PCT 13 within the study area and in areas that do not regularly hold water. Within NSW, any person who deals with any plant, who is aware of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

Fauna and fauna habitat

Based on the literature and desktop reviews, as well as the field surveys conducted, three primary fauna habitat types were determined to be present within the study area:

- Riverine woodland,
- Wetlands and waterways,
- Grassland and cleared areas.

Further descriptions of these habitats are provided in Table 6.4 below.

Table 6.4 Fauna habitats

Habitat type	Description	Typical fauna recorded or likely to occur	Image
Riverine woodland	Riverine woodland in the study area has moderate habitat connectivity via a narrow corridor of trees, to other riverine vegetation along Piccaninny Creek and Forest Creek. Riverine woodland in the study area is separated from Forest Creek by wetland vegetation and swamps. Habitat resources only occur in the canopy and understorey, with a mid-stratum sparse or absent. Canopy species include a monotypic stand of Back Box (*Eucalyptus largiflorens*) which provide flowering resources for nectar-feeding fauna species, including honeyeaters, parrots, bats and arboreal mammals during flowering events as well as three hollow-bearing trees on the western side of Forest Creek. Hollow-bearing trees support small hollows (<10 cm in diameter) and narrow fissures with a range of orientations and landscape positions in both living and dead trees. Large amounts of woody debris are present under a mature canopy; however, leaf litter is generally low in cover. The understorey comprises a thick cover of grass and grass-like vegetation, that appears to have been subject to grazing by both native animals and livestock. Vegetation in this portion of the study area is likely to have been subject to previous clearing to allow for the construction of the existing block bank and access road, however many larger remnant trees have been retained.	• Nectarivorous birds: White-naped Honeyeater (Melithreptus lunatus) and White-plumed Honeyeater (Ptilotula penicillatus) • Birds of agricultural landscapes: Galah (Eolophus roseicapillus), Little Raven (Corvus mellori) and Willie Wagtail (Rhipidura leucophrys) • Hollow-dependent mammals: Common Brushtail Possum (Trichosurus vulpecula) • Ground-dwelling mammals: Eastern Grey Kangaroo (Wallabia gigantea), Swamp Wallaby (Wallabia bicolor) and Yellow-footed Antechinus (Antechinus flavipes).	 Figure 6.9 Riverine woodland habitat in the study area  Figure 6.10 Riverine woodland habitat in the study area

Habitat type	Description	Typical fauna recorded or likely to occur	Image
Wetlands and waterways	The Piccaninny Creek offtake channel intersects the study area and is about 20 m wide. As it occurs within the study area, this offtake channel is densely vegetated by emergent aquatic plants including Typha spp. in its main channel which may impede flows. The offtake channel also contains smaller side channels in the study area that contain slower moving brackish water and fringing reeds and/or sedges around the outer edge of the wetland including Juncus spp./ Eleocharis spp. Common Nardoo is also present in pools of standing water. There was no overhanging canopy vegetation over the offtake channel. Given these features, wetland habitat in the study area comprises moderate to high biodiversity value for frogs and wetland birds. Both guilds are likely to breed, forage and take refuge in the cover provided by aquatic vegetation within the offtake channel. Perching habitat for wetland birds occurs on the edge of the offtake channel where Black Box is present. Given the narrow width of the creek, the study area is unlikely to be used by colonial nesting birds such as Pied Cormorant (Phalacrocorax varius). Colonial nesting birds in the locality are likely to use Wanganella Swamp and other larger wetlands. There is no mudflat habitat in the study area.	• Large wading birds including the White-necked Heron (Ardea pacifica) and Purple Swamphen (Porphyrio porphyrio) • Wetland birds that shelter in dense emergent vegetation including the Australian Little Bittern (Ixobrychus dubius), Buff-banded Rail (Hypotaenidia philippensis) and Australian Spotted Crake (Porzana fluminea) • Wetlands birds common to disturbed wetlands including the Eurasian Coot (Fulica atra), Pacific Black Duck (Anas superciliosa) and Australian Wood Duck (Chenonetta jubata) • Frogs including the Spotted Marsh Frog (Limnodynastes tasmaniensis), Perons Tree Frog (Litoria peronii) and Eastern Sign-bearing Froglet (Crinia parasignifera). Wetland areas also provide habitat for a range of reptile species, including small lizards and common snakes such as the Red-bellied Black Snake (Pseudechis porphyriacus) and Tiger Snake (Notechis scutatus). These snakes are likely to feed on the adults and tadpoles of frogs mentioned above.	 Figure 6.11 Wetland and waterway habitat within the study area  Figure 6.12 Wetland and waterway habitat within the study area

Habitat type	Description	Typical fauna recorded or likely to occur	Image
Grassland and cleared areas	Grassland habitat occurs as part of the offtake, as well as the existing and proposed access track. Grassland habitat within the existing access track and offtake is partially denuded due to consistent vehicle use and maintenance of the track. The CAZ comprises degraded grassland habitat with a low cover, due to heavy grazing. Habitat values within grassland and cleared areas is restricted to foraging resources for granivorous and insectivorous birds as well as macropods. Grassy depression may provide moist refuge habitats for grassland adaptive frogs.	• Macropods including the Eastern Grey Kangaroo (Macropus giganteus), Swamp Wallaby (Wallabia bicolor) and Common Wallaroo (Macropus robustus) • Granivorous birds of grasslands including Eastern Rosella (Platycercus eximius), Blue Bonnet (Northiella haematogaster) and Sulphur-crested Cockatoo (Cacatua galerita) • Insectivorous birds of agricultural areas including Crested Pigeon (Ocyphaps lophotes), Grey Fantail (Rhipidura albiscapa) and Little Raven (Corvus mellori) • Raptors including Black-shouldered Kite (Elanus axillaris), Nankeen Kestrel (Falco cenchroides), Whistling Kite (Haliastur sphenurus), Wedge-tailed Eagle (Aquila audax) and Brown Goshawk (Accipiter fasciatus) • Frogs of grassy depressions including the Spotted Marsh Frog (Limnodynastes tasmaniensis), Perons Tree Frog (Litoria peronii), Eastern Sign-bearing Froglet (Crinia parasignifera) and Barking Marsh Frog (Limnodynastes flectcheri)	 Figure 6.13 Grasslands within the study area  Figure 6.14 Existing access tracks within the study area

Migratory fauna species

No migratory species listed under the EPBC Act were observed within the study area during field surveys. However, the desktop review identified a number of migratory species predicted to occur within the locality, based on the habitats present (refer to Table 6.4).

The following migratory species may forage within woodland riparian vegetation adjacent to the offtake channel on occasion:

- Satin Flycatcher (*Myiagra cyanoleuca*)
- White-throated Needletail (*Hirundapus caudacutus*)
- Fork-tailed Swift (*Apus pacificus*).

The Latham's Snipe (*Gallinago hardwickii*) is also likely to forage and potentially breed within instream semi-aquatic vegetation of the offtake channel on occasion.

However, the study area is not considered an important habitat for any of these species, according to the significant impact criteria for migratory species (DoE 2013). This is due to the fact that the habitat in the study area would not support an ecologically significant proportion of the population of these species, is not of critical importance to these species at particular life-cycle stages, is not at the limit of these species' ranges, and is not within an area where these species are declining.

Conservation significance

Threatened flora and flora habitats

Based on the desktop reviews and field surveys, a likelihood of occurrence assessment was completed to identify any threatened flora species that may occur within the study area. Only one species was found to have a moderate likelihood of occurrence within the locality as identified in Table 6.5. All other threatened species identified via the desktop reviews were determined to have a low likelihood of occurrence within the study area.

Table 6.5 Threatened flora that may occur within the locality

Species	Listing	Justification
Swainsona murrayana **Slender Darling Pea**	Vulnerable – BC Act, EPBC Act	Moderate likelihood of occurrence. Ten records of this species occurs within a 20 km radius of the study area. Additionally, the site contains broadly suitable habitat for this species, which is associated with Black Box (*E. largiflorens*) woodland.

Whilst the Slender Darling Pea was not identified within the study area, the timing of field surveys largely fell outside of the time of the year for detecting the species (and noting it is most detectable in September when it flowers). The nearest record of the species is approximately 12 km south-west of the study area, in Stud Park (NSW DCCEEW 2024a).

No individuals or populations of threatened flora listed under the BC Act or the EPBC Act were recorded during the field surveys.

Threatened fauna and fauna habitats

Based on the desktop reviews and field surveys, a likelihood of occurrence assessment was completed to identify any threatened fauna species that may occur within the study area. Two threatened fauna species were recorded during field surveys:

- Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*) (vulnerable under the BC Act)
- Brown Treecreeper (*Climacteris picumnus picumnus*) (vulnerable under the BC Act and the EPBC Act)

The Grey-crowned Babbler was recorded foraging in the western end of the access track at its intersection with Conargo Road. Up to ten individuals were observed foraging briefly within a small patch of Black Box within a grazed paddock. The flock is likely to comprise a single family group. No nests were observed in the study area. The study area is unlikely to comprise important foraging or breeding habitat for the species. The species is generally conspicuous and is known to occur in higher densities within the locality.

The Brown Treecreeper recorded was the arid zone subspecies, not the threatened eastern subspecies (*Climacteris picumnus victoriae*), which is listed as vulnerable under both the BC Act and EPBC Act. In NSW the western boundary of the range of *C. p. victoriae* runs approximately through Corowa, Wagga Wagga, Temora, Forbes, Dubbo and Inverell and along this line the subspecies intergrades with the arid zone subspecies of Brown Treecreeper (*C. p. picumnus*) (DPE 2023c). With the Billabong Creek system 200 km west of Wagga, the detection of this species does not warrant further assessment.

Based on the results of the desktop assessment and habitat assessment during field surveys, a number of additional threatened fauna species have a 'high' and 'moderate' likelihood of occurrence within the study area. These are summarised below in Table 6.6.

Table 6.6 Threatened fauna with a 'high' and 'moderate' likelihood of occurrence within the study area

Species	Listing	Justification
Birds		
Australasian Bittern (**Botarurus poiciloptilus**)	E – BC Act E – EPBC Act	Suitable habitat within dense *Typha* patches at Piccaninny offtake channel.
Australian Painted Snipe (***Rostratula australis***)	E – BC Act E – EPBC Act	Broadly suitable habitat present within creek line.
Black Falcon (***Falco subniger***)	V – BC Act	Suitable foraging habitat present along timbered waterways. No large stick nests recorded.
Black-chinned Honeyeater (***Melithreptus gularis gularis***)	V – BC Act	Broadly suitable habitat. Previously recorded to the east of Conargo Road in close vicinity of study area.

Species	Listing	Justification
Diamond Firetail (*Stagonopleura guttata*)	V – BC Act V – EPBC Act	Broadly suitable foraging habitat in grassy woodlands. Moderate numbers recorded in the locality.
Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)	V – BC Act	Suitable foraging and breeding habitat is present. Moderate numbers of records in locality.
Flame Robin (*Petroica phoenicea*)	V – BC Act	Broadly suitable habitat within grassy riparian woodland. Fallen timber in moderate densities in study area.
Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)	V – BC Act	Recorded at the western end of the access track. Suitable habitat in grassy woodlands. Large number of records within the locality.
Hooded Robin (*Melanodryas cucullata cucullata*)	V – BC Act E – EPBC Act	Suitable foraging and breeding habitat is present.
Little Eagle (*Hieraaetus morphnoides*)	V – BC Act	Potential foraging habitat is present. No large stick nests recorded; unlikely to breed in study area due to the ephemeral nature of the creek line.
Painted Honeyeater (*Grantiella picta*)	V – BC Act V – EPBC Act	Mistletoe habitat present in broader locality, but does not occur in study area. It is likely to be an occasional visitor passing through to better patches of foraging habitat.
Scarlet Robin (*Petroica boodang*)	V – BC Act	Broadly suitable habitat within grassy riparian woodland. Fallen timber in moderate densities in study area.
Spotted Harrier (*Circus assimilis*)	V – BC Act	Broadly suitable habitat within grassland and riparian woodland. Low number of records in locality. No large stick nests recorded.
Suburb Parrot (*Polytelis swainsonii*)	V – BC Act V – EPBC Act	Suitable woodland habitat occurs within study area. Known to breed along the Murrumbidgee River to the north.
White-fronted Chat (*Epthianura alibfrons*)	V – BC Act	Broadly suitable habitat within flooded grassland. Low number of records in locality.
Varied Sittella (*Daphoenositta chrysoptera*)	V – BC Act	Suitable habitat in grassy woodlands. Moderate number of records within the locality.

Species	Listing	Justification
Frogs		
Southern Bell Frog (*Litoria raniformis*)	E – BC Act V – EPBC Act	Suitable habitat present within the study area including within the clearing area.

Key:
V = Vulnerable
E = Endangered species

6.4.3 Impacts

Although the study area is already disturbed from previous construction works and agricultural uses, the project has the potential to result in direct impacts on native biota and their habitats. There is also the potential for indirect impacts on retained areas of native vegetation adjacent and downstream of the study area. These direct and indirect impacts are discussed in the following sections.

Construction

Vegetation

The project has been designed with consideration of identified ecological constraints. The project would make use of an existing unsealed track from Conargo Road to provide access to both CAZs and clearing areas during construction. Habitat resources (e.g. hollow-bearing trees) would be avoided where possible in accordance with the safeguards identified in Table 8.1.

A conservative worst-case scenario has been assumed for the level of full vegetation removal proposed. Full vegetation removal has been assumed within two distinct clearing areas (refer to Figure 1.2):

- the proposed infrastructure footprint in the east
- the location of the borrow site to the west of the study area.

This approach allows for flexibility during the detailed design and construction stage. It is therefore likely that construction of the proposal would result in less impacts than reported here.

Full vegetation removal is proposed for up to 0.39 hectares (ha) of native vegetation and an additional 0.06 ha of cleared/exotic grassland across both clearing areas. In the eastern clearing area (refer to Figure 1.2), this would be 0.22 ha of low and moderate condition Black Box – Lignum Woodland (PCT 13) and 0.17 ha of Cumbungi rushland wetland (PCT 182) for the construction of the proposed regulator at the block bank. In the western clearing area (refer to Figure 1.2), this would be the removal of 0.05 ha of Black Box – Lignum Woodland (PCT 13) for the borrow site.

In addition to the 0.39 ha of full vegetation removal, the project is likely to require the partial removal of 1.69 ha of vegetation within the CAZs. Table 6.7 below outlines the approximate area of proposed vegetation clearing for both partial and full vegetation removal.

Table 6.7 Approximate area of proposed vegetation clearing

PCT ID	Plant Community Type	Condition	Conservation status	Partial vegetation removal within the Contractor Activity Zones (ha)[1]	Full vegetation removal within clearing area (ha)
13	Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Low	Not listed	0.95	0.10
		Moderate	Not listed	0.67	0.12
182	Cumbungi rushland wetland of shallow semi-permanent water bodies and inland watercourses.	Moderate	Not listed	0.07	0.17
-	Cleared/exotic	N/A	N/A	0.68	0.06
	Total native vegetation (ha)			1.69	0.39
	Total (ha)			2.37	0.45

[1] Note: Assumed clearing in understorey only with no removal of trees anticipated.

Environmental safeguards to minimise impacts regarding the clearing of native vegetation are outlined in Table 8.1.

As outlined above in section 6.4.2 the slender darling pea is the only threatened flora species identified to occur within the study area. The construction phase of the project pose an impact through the excavation around clearing areas at the existing block bank and borrow site, as well as grubbing and general clearing of the understorey within the CAZ. These activities comprise of:

- the removal of 0.22 ha of potentially suitable habitat within the clearing area
- the removal of up to 1.62 ha of suitable habitat within the CAZ.

However, as no known occupied habitat exists within, or in proximity to the clearing area, the clearing area is unlikely to constitute important habitat for the species within the locality, and the likelihood of significant impact is considered low. Refer to Section 6.4.3.1 below for further explanation on this.

Fauna

The vegetation within the study area has moderate biodiversity values for native fauna, and the open riparian woodland along Forest Creek and Piccaninny Creek comprises small fauna habitat movement corridors. The project has the potential to impact and require the removal of *Black Box – Lignum woodland wetland* and *Typha rushland* from the clearing areas.

The trees potentially impacted by the project may provide flowering resources for local fauna populations as well as roosting and breeding microhabitats for birds and arboreal mammals. This could create small gaps in habitat for less mobile or shelter-dependant fauna. However, there are sufficient areas of refuge habitat for any fauna that may be displaced, pollinator species and less mobile fauna (including small mammals or frogs) would be able to traverse the gaps created during the construction phase, or traverse around the project footprint, with minimal additional energy costs or risk of predation. Overall, the project would result in a very minor and short-term (approximately two months) habitat fragmentation.

During construction, it is likely that any species would be capable of vacating the clearing areas. Safeguards proposed in Table 8.1 would limit the potential for impacts on fauna during the construction phase of the project.

Noise and vibration from construction activities such as vegetation clearing, ground disturbance, machinery and vehicle movements, and general human presence can potentially disturb resident fauna and may disrupt foraging, reproductive or movement behaviours. Impacts from noise and vibration are likely to be minor as they would be localised and temporary.

Operation

The operation of the proposed regulator would be consistent with the requirements to deliver environmental water, the water sharing plan and in accordance with the *Yanco Creek System Operations Plan (draft as of November 2023).* The draft operations plan continues to be developed in collaboration with WaterNSW and DCCEEWs Licensing Team (particularly in relation to the Governance section of the plan).

Potential effects to ecological values during the operation phase of the project may include changes in the health of local riparian vegetation and habitat. These effects have been subject to a high-level assessment outlined in section 6.4 of the Biodiversity Impact Assessment (refer to Appendix B Biodiversity Impact Assessment).

The project would increase the volume and frequency of water flows, which would maintain, or likely increase, the health of the Black Box dominated community within the study area. Similarly, the delivery of water into Piccaninny and Forest creeks during high flow events is likely to improve the overall health of the riparian and wetland vegetation throughout its associated systems, including Wanganella Swamp. This includes native plants downstream, such as *Austrostipa wakoolica*, a previously recorded threatened grass species, that rely on water-availability to maintain their health (DPE 2023a).

A total reduction in annual water flow of 5% from existing conditions downstream of Warriston Weir has the potential to result in a minor reduction in the health of riparian vegetation in this location, however the operations plan aims to maintain seasonal environmental watering through managed environmental flows to maintain these communities (NSW DCCEEW 2023b). Diversion of additional water to Piccaninny Creek may impact vegetation within the offtake channel. This impact is unlikely

to impact the longevity of wetland communities within the stream but may alter the distribution and cover of exotic weed species. Given existing levels of disturbance and weed abundance in the area, the spread of exotic species is considered to be minor. By increasing the health and vigour of native plant individuals, the project would allow native species to outcompete their exotic counterparts. As such, the benefits to riparian vegetation would likely outweigh the potential impacts by weeds spread by waterways associated with the project.

Downstream hydrological changes and resulting effect on vegetation and habitat would be monitored as part of environmental watering actions and managed as part of the Basin-wide Environmental Watering Strategy for the Murray-Darling Basin, the *Murrumbidgeee Long Term Water Plan 2020* (DPIE 2020b) and the *Yanco Creek System Operations Plan* (NSW DCCEEW 2023).

6.4.3.1 Significance of potential impacts to threatened and migratory biota

The project has the potential to result in direct impacts to threatened species and/or their habitats within the Clearing Area. Indirect impacts may also occur downstream from the study area.

The following sections provide an assessment of the likely significance of those impacts on threatened biota that have the potential to occur throughout the locality.

Threatened and migratory species

No TECs listed under the BC or EPBC Act were identified within the study area during the field survey. As a result, the project is unlikely to result in any impacts to TECs listed under the BC Act or EPBC Act.

Flora

No threatened flora species were recorded within the study area, however, associated habitat for the Slender Darling Pea (*Swainsona murrayana*) is present.

Whilst the Slender Darling Pea was not recorded during field surveys, the field surveys were conducted outside of the recommended survey period and due to associated habitat being present within the study area, a conservative approach was taken, and it is considered the Slender Darling Pea does have a moderate likelihood of occurrence. As such, an assessment of the likely significance of impacts pursuant to Section 7.3 of the BC Act (5-part test) and the EPBC Act *Matters of National Environmental Significance Significant Impact Guidelines 1.1.* has been prepared (see Appendix B of the Biodiversity Impact Assessment in Appendix B Biodiversity Impact Assessment of this report). These assessments concluded that the project would be unlikely to have a significant impact upon the Slender Darling Pea given:

- Permanent clearing would be limited to 0.22ha within the clearing area and 1.62 within the CAZ.
- Based on regional vegetation mapping there are extensive patches of comparable riverine vegetation elsewhere within the locality, including at Piccaninny Creek, downstream Forest Creek and the northerly Billabong Creek (DPE 2023c).
- No known or occupied habitat for the species would be removed, nor does any known or occupied habitat exist in close proximity to the clearing area.
- The clearing area is unlikely to constitute important habitat for the species within the locality.

Consequently, a Species Impact Statement (SIS) or Biodiversity Development Assessment Report (BDAR) would not be required for impacts on *Swainsona murrayana*. Measures to avoid and minimise impacts on this species would be implemented and are outlined in Table 8.1.

Fauna

Four threatened fauna species identified as having a 'high' likelihood of occurrence within the study area have been assessed pursuant to Section 7.2 of the BC Act (5-part test) and the EPBC Act *Matters of National Environmental Significance Significant impact guidelines 1.1*. These assessments are provided in Appendix B of the Biodiversity Impact Assessment (refer to Appendix B Biodiversity Impact Assessment of this report) and is summarised in Table 6.8 below.

Table 6.8 Summary of impact assessments for threatened fauna species with a high likelihood of occurrence

Species	Occurrence / distribution	Potential construction and operation impact
Superb Parrot (*Polytelis swainsonii*)	Potential to occur in Black Box Woodland within the study area. While no individuals of this species were recorded during surveys, this species is regularly recorded within the locality (DPE 2023a).	The project would remove up to 1.84 ha of potential foraging habitat for the Suburb Parrot, however, the impact assessments conducted concluded the proposal is unlikely to have a significant impact on this species given: • Full vegetation removal of up to 0.22 ha of potential foraging habitat comprising highly disturbed riverine woodland. • Partial vegetation removal of up to 1.62 ha of potential foraging habitat comprising mostly groundcover vegetation. • Removal of maximum two hollow-bearing trees, that may comprise potential breeding habitat outside the key breeding range of the species. • The clearing area and CAZ is unlikely to form a core part of its home range. • A large number of hollow-bearing trees are present along the riparian zone of the offtake channel, Forest and Piccaninny Creek that provide alternate potential roosting and breeding habitat in close proximity to the clearing area.

Species	Occurrence / distribution	Potential construction and operation impact
Wetland birds: Australasian Bittern (*Botarurus poiciloptilus*) and Australian Painted Snipe (*Rostratula australis*)	Potential to occur within instream-aquatic vegetation of the offtake channel within the study area. While, the larger Yanco-Billabong System provides a large amount of potential habitat for both species, the Australian Painted Snipe is yet to be recorded in the locality (DPE 2023a).	The impact assessments conducted concluded the proposal is unlikely to have a significant impact on this species given: • Full vegetation removal of up to 0.17 ha of instream Typha vegetation, mainly comprising refuge, foraging and breeding habitat within the eastern clearing area. • Partial vegetation removal of up to 0.07 ha of instream vegetation comprising dense Typha stands within the CAZ. • The instream vegetation in the clearing area and CAZ is unlikely to comprise occupied breeding habitat for these species.
Southern Bell Frog (*Litoria raniformis*)	Potential to occur within instream-aquatic vegetation of the offtake channel within the study area. The species may also take refuge within woody debris and leaf litter in the adjacent riverine woodland. While the species has not been recorded within the locality, the offtake channel is connected to waterways comprising the species within the NSW Riverina region (A. Turner., *pers comm* May 15, 2023).	The impact assessments conducted concluded the proposal is unlikely to have a significant impact on this species given: • The clearing area contains a small amount of potential foraging and breeding habitat for the species which is unlikely to form core habitat for a resident population (if present). • The proposal would remove a small amount of potential refuge habitat on the banks of the creek under limited leaf litter and woody debris which is heavily grazed and sub-optimum to be used by the species.

Further assessment has not been undertaken for fauna species identified with a 'moderate' or 'low' likelihood of occurrence within the study area given the absence of important habitat resources for those species (such as breeding habitat), the broad habitat requirements of these species, the small extent of direct vegetation removal in the Clearing Area, and that the project only involves the partial removal of a small amount of potential foraging habitat within the Contractors Activity Zone.

As the project is unlikely to result in a significant impact on any threatened biota listed under the BC Act, the project does not trigger the Biodiversity Offset Scheme (BOS) and assessment and biodiversity offset under the Biodiversity Assessment Method (BAM) via a BDAR or a SIS are not required.

While no migratory species were recorded during the field survey, the Satin Flycatcher (*Myiagra cyanoleuca*), White-throated Needletail (*Hirundapus caudacutus*), Fork-tailed Swift (*Apus pacificus*) and the Latham's Snipe (*Gallinago hardwickii*) may occasionally occur within the study area. The project is not considered to have a significant impact on these species (under the BC Act and the EPBC Act) as the project would not remove any important mudflat habitat for these species.

6.4.4 Safeguards

The safeguards proposed to avoid, minimise, or manage potential cumulative impacts associated with the project are included in Table 8.1.

6.5 Aquatic biodiversity

An Aquatic Ecology and Water Quality assessment was undertaken and prepared as part of this REF (refer to Appendix C Aquatic Ecology). It assesses the potential impacts on water quality and the aquatic ecologic value of waterways and other aquatic environments within the study area as a result of construction and operation of the project.

These findings are summarized below. The following stream reaches were considered as part of the project area for the purposes of the Aquatic Ecology and Water Quality assessment:

1. Forest Creek Return Flows offtake channel
2. Piccaninny Creek between the offtake channel and its downstream confluence with Billabong Creek, and
3. Warriston Weir pool between the offtake channel and the weir wall.

6.5.1 Methodology

Literature and desktop review

The Aquatic Ecology and Water Quality assessment consisted of a desktop study and site investigations of the study area adopted for the assessment. For the purposes of the Aquatic Ecology and Water Quality assessment, the 'study area' was defined as including the project area as well as all land and waterways within 10 km of the project area. It also includes a consideration of effects beyond the 10 km radius (i.e., Murrumbidgee River upstream and Murray River downstream of the projects).

The following databases were used to identify aquatic species with the potential to occur within the study area. The review considered published records, predicted occurrences of aquatic species and habitat distribution models within a 10 km buffer of the project area. These sources include:

- PMST for species and communities listed under the EPBC Act 1999 maintained by DCCEEW
- NSW Department of Primary Industries (DPI) threatened species distribution maps (Freshwater threatened species distribution maps (nsw.gov.au))
- Atlas of Living Australia (ALA)
- The Australian Platypus Monitoring Network (APMN), an initiative of the Australian Platypus Conservancy (APC)BDA
- TurtleSAT, a community-focused freshwater turtle mapping initiative.

The following ecological assessments and information associated with the project were also reviewed to inform the desktop assessment:

- McNeil, D, G. and Griffiths, J. (2021). Platypus in the Yanco Creek: Understanding Distribution and Population Status. Report to the
- Yanco Creek and Tributaries Advisory Council, Jerilderie, NSW
- Sharpe, C. (2018). Trout cod in Yanco Creek; Patterns of spawning, recruitment and population status in 2017/18. Final Report for Murray Local Land Services by CPS Enviro, Irymple Victoria
- Sharpe, C. and Stuart, I. (2015). The Distribution of Trout cod in Yanco and Colombo Creeks. Final Report for Murray Local Land Services by CPS Enviro and Kingfisher Research, Irymple Victoria
- Sharpe, C., Stuart, I. and Vilizzi, L (2013). Billabong, Yanco and Colombo Creek Fish Baseline Project 2012-13. Final Report, for Murray Catchment Management Authority by CPS Environmental Research, Irymple Victoria. July 2013
- Stuart, I. (2022). Yanco Creek fish movement model. Unpublished Client Report. Arthur Rylah Institute for Environmental, DELWP, Heidelberg
- Walcott, A., Wolfenden, B., Hall, A. & Wassens, S. (2018) Yanco-Billabong Creek Broad-scale Wetland Monitoring Project: Frog communities of the Yanco-Billabong creek system. Final Report prepared for Murray Local Land Services. Institute of Land Water and Society, Charles Sturt University, Albury
- Gilligan, D. (2005) Fish communities of the Murrumbidgee catchment: Status and trends. NSW Department of Primary Industries - Fisheries Final Report Series No. 75
- Charles Sturt University (2022) data from a 2022 aquatic and terrestrial fauna survey of the Yanco-Billabong System (unpublished).

Field surveys

Site investigations of the project area were undertaken by aquatic ecologists between 8 March 2023 and 9 March 2023 which comprised of a visual assessment of aquatic habitat and waterway conditions and an eDNA survey targeting fish communities. The purpose of site investigations was to assess aquatic ecosystems and environmental values of waterways in the project area, adding more targeted, on-ground information to the desktop analysis to help refine the understanding of potential impacts from the project. The survey area at each assessment site included the site location and 100m upstream and downstream, the condition of the waterway including the water quality, bank stability, as well as aquatic and riparian habitat quality were assessed, with the location of each site recorded and photograph taken. The locations of the aquatic fauna, water quality and habitat field surveys are shown in Figure 6.15.

In conjunction with assessing aquatic habitat, hydrological characteristics, water quality and waterway condition were assessed to gain an understanding of where nominated environmental values are currently being achieved. This included undertaking in-situ water quality monitoring (pH, turbidity, conductivity, dissolved oxygen, temperature) with a calibrated Hanna HI 9829 water quality meter and grab samples for analysis by certified and NATA accredited laboratory. In-situ water quality parameters recorded include temperature, pH, electrical conductivity, turbidity and dissolved oxygen. Grab samples were collected and analysed for total suspended solids, total organic carbon, total metals, nutrients, pesticides, herbicides and chlorophyll-a.

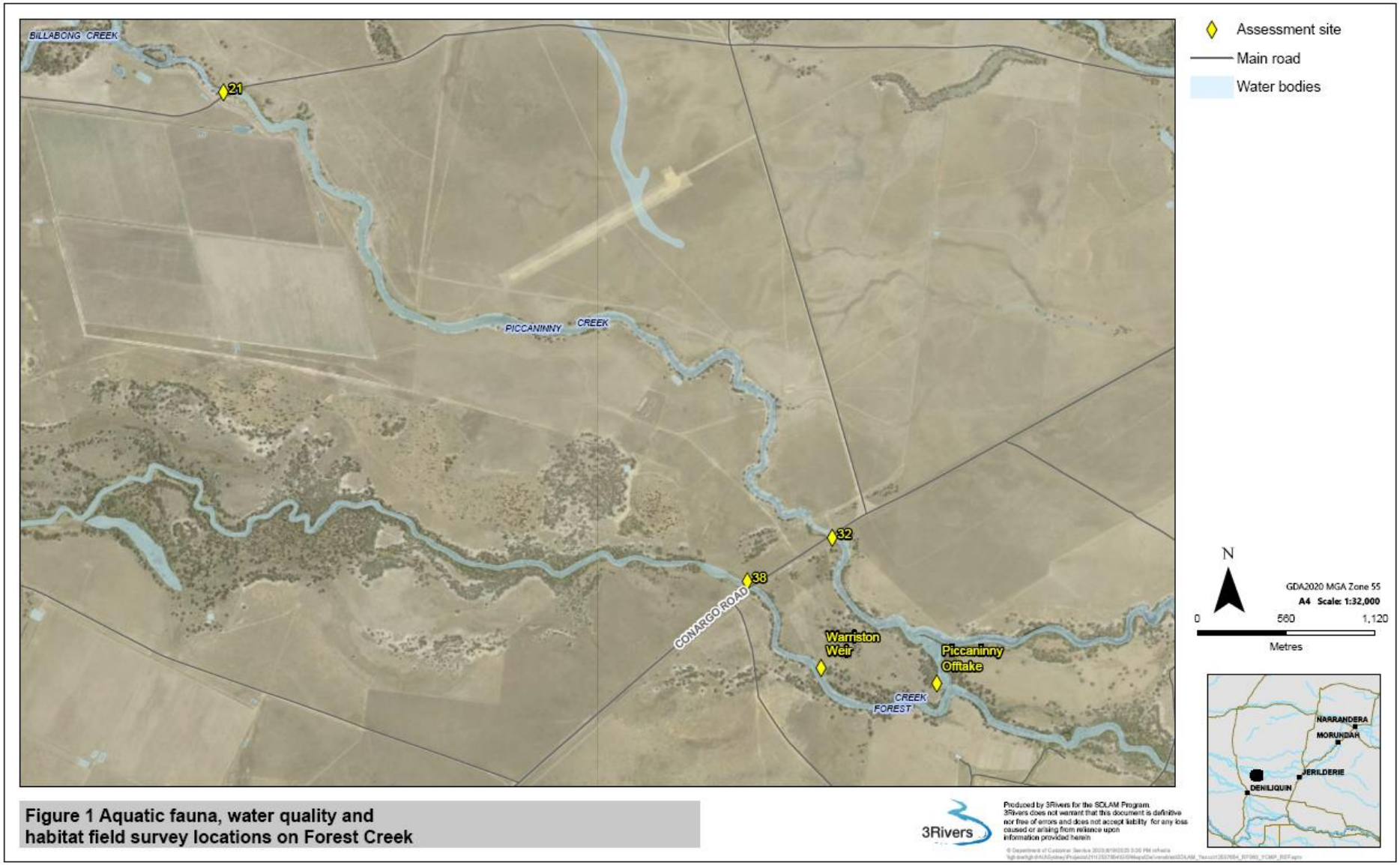

Figure 6.15 Aquatic fauna, water quality and habitat field survey locations on Forest Creek

Likelihood of occurrence assessment

Based on the desktop study, literature review and field surveys, a likelihood of occurrence assessment was used to determine the likelihood of each species' presence within the project area. The criteria used for evaluating the likelihood of occurrence for each species is presented in Table 6.9 below.

Table 6.9 Likelihood assessment criteria for threatened species

Likelihood	Criteria
Present	Species recorded within study area based on historical records within the last 30 years.
Possible	Potentially suitable habitat occurs within the study area and species' known range encompasses the study area. Species recorded historically in the study area but not regularly observed within the last 30 years. This category is mainly informed by NSW DPI threatened species distribution models.
Unlikely	Species' known range encompasses the study area, but suitable habitat does not occur within the study area or occurs within the study area but with generally low quality and quantity. Species recorded historically in the study area but not within the last 30 years.
Highly unlikely	No historical records of the species and/or no suitable habitat in the study area.

Potential effects on threatened species and communities, and threatening processes were considered for both construction and operation stages. This was undertaken through a risk assessment to:

- identify and describe the key risks and effect pathways, resulting from the construction and operation of the project, that have the potential to negatively impact on the environment and/or local communities
- evaluate the significance of potential adverse effects
- develop measures to avoid or limit the adverse effects to acceptable levels.

The potential for impact to threatened species listed under the EPBC Act and FM Act was determined using relevant criteria including DoE (2013) Significant Impact Assessment Criteria.

6.5.2 Existing environment

Catchment overview

The Yanco-Billabong System has a moderately diverse native fish community, with at least 11 species recorded in the system since 1980 (Sharpe et al. 2013) as identified in Table 12 of the Aquatic Ecology report in Appendix C Aquatic Ecology. The Southern Pygmy Perch (*Nannoperca australis*), Olive Perchlet (*Ambassis agassizii*), Murray Hardyhead (*Craterocephalus fluviatilis*) were recorded in the system before 1980, but are now thought to be locally extinct (Gilligan, 2005). Four species (Murray Cod, Trout Cod, Silver Perch, Freshwater Catfish) have high conservation significance and are listed under the FM Act and/or the EPBC Act. Other non-threatened large and medium bodied fish species present throughout the system include the Golden Perch (*Macquaria*

ambigua) and Bony Herring (*Nematalosa erebi*). The most common native species found within the Yanco-Billabong System are small-bodied fish such as Australian Smelt (*Retropinna semoni*), Unspecked Hardyhead (*Craterocephalus fulvus*), Murray Rainbowfish (*Melanotaenia fluviatilis*), and Carp Gudgeon species complex (*Hypseleotris* spp.) (Gilligan, 2005). Refer to Table 12 of the Aquatic Ecology report for further detail on the presence of individual fish species in the Yanco-Billabong System.

Large-bodied macroinvertebrates including freshwater mussels are known within the lower Murray River. However, there are very few records of crayfish and mussels in the Yanco-Billabong System and none from Forest Creek or Piccaninny Creek. The presence of River Mussel (*Alathyria jacksoni*) and Billabong Mussel (*Velesunio ambiguous*) in the Caroonboon Weir pool would indicate that the conditions in weir pools are suitable to a degree for both species. While targeted mussel surveys have not been conducted in the Yanco-Billabong System and their distributions may be wider, searches for mussel shells conducted as part of the aquatic habitat assessment indicate their patchy distribution.

Forest Creek and Piccaninny Creek aquatic habitat

The aquatic habitat provided in Appendix C Aquatic Ecology, identifies three broad vegetation zones in the Forest Creek/Piccaninny Creek system in the vicinity of the project area:

- Open water zone: Contains mostly floating plants such as Water Fern (*Azolla filiculoides*) and Nardoo (*Marsilea drummondii*). No submerged aquatic vegetation was observed, likely due to the expansion of Carp.
- Shallow edge zone: Dominated by aquatic grasses including Cumbungi (*Typha latifolia*) and Giant Rush (*Juncus ingens*). Emergent taxa such as these commonly grow best when water levels fluctuate on a seasonal basis, with high water levels in winter and spring and low water levels in summer. Conversely, constantly high water levels encourage the growth of Cumbungi (*Typha* spp.) that can become invasive in slow flowing, permanent habitats such as weir pools with shallow edges such as within the Warriston Weir pool. Regulated perennial flows in the Forest Creek system have led to the extensive invasion of Cumbungi, and Warriston Weir is heavily impacted (Forest Creek Working Group 2000; Cooling and Gippel 2018).
- Wet-dry zone and occasionally flooded zone: Contains a sparse scattering of herbs, sedges and native grasses close to the waterline when the river is at base flow. This zone is seasonally inundated. Higher on the stream banks, Black Box, River Coobah and, to a lesser extent, River Red Gum dominate. River Red Gum lie closer to the water where they are more frequently inundated, and Black Box (*Eucalyptus largiflorens*) is most dominant slightly higher up the banks where inundation is less frequent and is shorter. In a few locations, River Cooba (*Acacia stenophylla*) is present as a canopy-forming tree. The riparian zone is predominantly made up of mature trees with a scattering of newer growth.

The aquatic habitat assessment included surveys at five stream reaches as identified in Table 6.10. A summary of the findings at each reach, including the Key Fish Habitat (KFH) type defined in NSW DPI (2013), and Waterway Class descriptions as defined in Fairfull and Witheridge (2003), are presented in Table 6.10 below. Refer to section 6.2 for information regarding water quality.

Table 6.10 Aquatic habitat assessment results

Stream Reach	Key Fish Habitat type and Waterway Class	Summary of relevant habitat features observed during site investigations	Riparian Channel and Environment (RCE) score*
Forest Creek at Warriston Weir	Type 2 Moderately Sensitive KFH Class 2 – Moderate fish habitat	The stream channel choked with Cumbungi everywhere except where flow is greatest. The riparian zone consists of scattered juvenile and mature Black Box and River Cooba and, to a lesser extent River Red Gum.	30
Forest Creek below Warriston Weir	Type 2 Moderately Sensitive KFH Class 2 – Moderate fish habitat	Minimal vegetation instream except for some occasional stands of floating aquatic plant -Floating primrose (*Ludigiwia peploides*) – in slow flow zones. Substantial stands of Cumbungi are present along edges in slow flow zones. The riparian zone consists scattered juvenile and mature Black Box and River Cooba and, to a lesser extent River Red Gum. Other aquatic habitat features include limited and fairly small (less than 3m) instream snags.	33
Piccaninny Creek offtake at Block bank	Type 2 Moderately Sensitive KFH Class 2 – Moderate fish habitat	Wetland vegetation is diverse, with several instream emergent and floating aquatic plants. Species observed include: Spike Rush (*Eleocharis palustris*), Cumbungi, Common Reed, Water Couch (*Paspalum distichum*), Pale knotweed (*Persecaria lapathafolia*), Water Fern (*Azolla filiculoides*), Nardoo (*Marsilea drummondi*) and Floating primrose. Riparian vegetation is dominated by juvenile and mature Black Box and River Cooba, with a scattering of River Red Gum. Other aquatic habitat features include instream snags, trailing and overhanging vegetation. Carp were observed at the site during the inspection. No large woody debris observed at the site.	35
Piccaninny Creek at Conargo Road crossing	Type 1 Highly sensitive KFH (as Piccaninny Creek at least supported Murray Cod (listed as Vulnerable under the EPBC Act) Class 2 – Moderate fish habitat	Minimal vegetation instream except for substantial stands of Cumbungi present along edges in slow flow zones. The riparian zone consists of scattered juvenile and mature Black Box and River Cooba.	28
Piccaninny Creek at Wanganella-Conargo Road crossing	Type 1 Highly sensitive KFH (as Piccaninny Creek at least supported Murray Cod (listed as Vulnerable under the EPBC Act) Class 2 - Moderate fish habitat	Minimal vegetation instream except for some occasional stands of Common Reed. Riparian vegetation is dominated by juvenile and mature Black Box and River Cooba, with a scattering of River Red Gum. Understory is made up of scattered native grasses. Other aquatic habitat features include submerged terrestrial grasses and Typha. No evidence of snags.	28

*The Riparian Channel and Environment score descriptions, categories and associated values are defined in Appendix A of the Aquatic Biodiversity report.

There is no data on aquatic macroinvertebrate fauna for Forest Creek or Piccaninny Creek. However, it is expected that communities would differ between regulated and unregulated stream reaches, as well as between wetland and riverine habitats.

The potential impact of the project on GDEs was considered as part of the Aquatic Ecology and Water Quality assessment. A search of the Australian GDE Atlas found that there were no aquatic or terrestrial GDEs in the vicinity of Forest Creek, Piccaninny Creek, or anywhere throughout the broader Yanco-Billabong System as such the issue was not considered further.

Threatened aquatic fauna species

While there are no fish surveys of the regulated upper section of Forest Creek and Piccaninny Creek, nearby (within 10 km), and recent (within 10 years), surveys in Forest Creek below Warriston Weir, and mid and lower Billabong Creek have shown that the Silver Perch and Murray Cod do occur in the vicinity of the study area. Other threatened species and populations either occur in the broader Yanco-Billabong System or species distribution models suggest that there is suitable habitat (NSW DPIE, 2022b). Table 6.11 outlines the Commonwealth and state listed aquatic species that are known to, or are predicted to, occur within the study area based on available survey evidence, database searches, and professional opinion. Assessment of impacts to these species is provided in section 6.5.3.

Table 6.11 Likelihood of occurrence of listed threatened aquatic species within the project area

Common Name	Species Name	EPBC Act	FM Act	Distribution and preferred habitat	Likelihood of occurrence
Murray Cod	*Maccullochella peelii*	V	-	Occurs naturally in the watercourses of the Murray-Darling Basin and was formerly widespread in lower and mid altitudes, however the species now has patchy distribution (Lintermans, 2007). Preferred habitat for both juvenile and adult Murray Cod generally consists of deep holes in low-flowing rivers, and particularly around instream rocks, woody debris, fallen trees or undercut banks which provide shelter and protection from predators (Lintermans, 2007).	**Present**
Silver Perch	*Bidyanus bidyanus*	CE	V	The species has experienced dramatic decline throughout the region and likely to be limited to a portion of the mid-Murray River below Yarrawonga Weir, as well as several of its anabranches and tributaries including Edward River, an anabranch of the River Murray that flows through Deniliquin, and the Murrumbidgee River. Found in a wide range of habitats in the Murray-Darling system including in fast-flowing, more open sections of river (DPI, 2017a) and lowland, turbid and slow-flowing rivers (Lintermans, 2007).	**Present**
Flathead Galaxias	*Galaxias rostratus*	CE	CE	Historically known from the Southern Murray-Darling Basin including the Macquarie, Lachlan, Murrumbidgee and Murray Rivers with patchy recordings (Lintermans, 2007). Generally found mid-water in still and gently moving waters of small streams, lakes, lagoons, billabongs and backwaters. Its habitat consists of coarse sand or mud substrate and aquatic vegetation (DPI, 2014).	Unlikely

Common Name	Species Name	EPBC Act	FM Act	Distribution and preferred habitat	Likelihood of occurrence
Freshwater Catfish	*Tandanus tandanus*	-	En. Pop.	Non-migratory, benthic species, relatively sedentary, and adults typically only move within a 5 km range. Found in a diverse range of freshwater environments including rivers, creeks, lakes, billabongs and lagoons. They prefer clear, slow following or still waters, but can also be found in faster flowing streams with turbid waters. Substrates range from mud to gravel and rock. Freshwater Catfish are naturally distributed throughout the Murray-Darling Basin and in east coast drainages between Clarence River (NSW) and Pioneer River (Qld). The species has declined substantially in the Murray-Darling Basin due to a range of impacts including river regulation, invasive species, habitat degradation, cold water pollution, and fishing pressure. Only a small number of isolated populations remain in the southern Murray-Darling Basin; one of which occurs in the study area.	Possible
Macquarie Perch	*Macquaria australasica*	E	E	Typically found in the cool upper reaches of the Murray-Darling Basin. In NSW, natural inland populations are isolated to the upper reaches of the Lachlan, Goulburn and Murrumbidgee Rivers. Translocated populations in NSW are found in the Mongarlowe River, Queanbeyan River upstream of the Googong Reservoir and in Cataract Dam (Lintermans, 2007). Prefers clear water and deep, rocky holes with abundant cover such as aquatic vegetation, large boulders, debris and overhanging banks (NSWDPI, 2016a)	Unlikely
Trout Cod	*Maccullochella macquariensis*	E	E	Endemic to the southern Murray-Darling Basin including the Murrumbidgee, Murray and Macquarie Rivers. There are only three known self-sustaining populations left in the wild. The largest is in the River Murray below Yarrawonga and small translocated populations in Cataract Dam and upper reaches of Sevens Creek (Lintermans, 2007). Prefers similar habitat to the Murray Cod such as deep pools and instream cover such as large boulders, fallen trees and woody debris (NSWDPI, 2017b).	Unlikely
Murray Hardyhead	*Craterocephalus fluviatilis*	E	CE	Small freshwater fish, native to the floodplains of the southern Murray-Darling Basin. The species has suffered a serious decline in abundance and distribution and are now considered one of the most threatened vertebrate species in Australia. Preferred habitat is along the edges of wetlands and slow-flowing lowland rivers. They are often found among aquatic plants, particularly in saline waters containing few other fish species (NSWDPI, 2016b).	Unlikely

Other species of cultural importance and growing conservation concern

Eight other ecologically, commercially, and culturally important aquatic and semi-aquatic species have been recorded in the Yanco-Billabong Creek System in the vicinity of the project area. These include native fish (Golden Perch), turtles (Eastern Long-necked Turtle, Broad-shelled Turtle and Murray River Turtle), Platypus and Rakali. Refer to section 3.12.4 of the Aquatic Ecology Report for the full list of species and their likelihood of occurrence within the study area.

Threatened ecological communities

The project area is situated wholly within the bounds of the endangered ecological community (EEC) known as 'the Lower Murray River Drainage System EEC' (Figure 6.16). This encompasses all natural creeks, rivers and associated lagoons, billabongs and lakes of the regulated portions of the Murray, Murrumbidgee and Tumut Rivers, and means that the whole fish and invertebrate community is listed as Endangered under the FM Act. The aquatic habitats present in Forest Creek, Piccaninny Creek, and the broader Yanco-Billabong Creek System are representative of this EEC, including permanent and intermittent river channels, and intermittent to permanent wetlands.

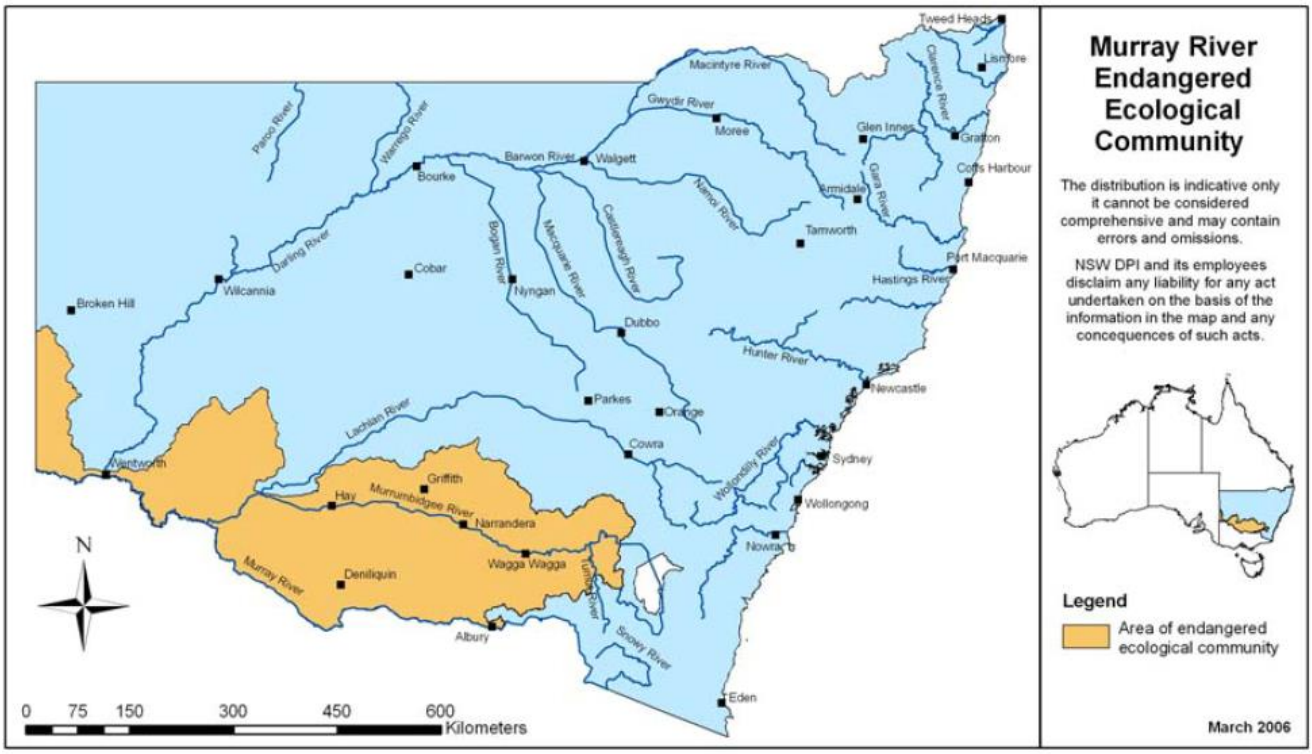

Figure 6.16 Map of Lower Murray River EEC (DPI, 2007)

Threatening processes

A threatening process is defined as a potential or key threatening process if it threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community. In NSW, such processes are listed under to the FM Act and EPBC Act.

The threatening processes listed under the EPBC Act relevant to the study area include:

- land clearance
- loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants
- novel biota and their impact on biodiversity
- predation by European Red Fox and feral cats.

The threatening processes listed under the FM Act relevant to the study area include:

- installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams

- degradation of native riparian vegetation along NSW water courses
- introduction of fish to waters within a river catchment outside their natural range
- removal of large woody debris from NSW rivers and streams
- hook and line fishing in areas important for the survival of threatened fish species.

These threatening processes have been assessed within Appendix C Aquatic Ecology, with findings presented in Table 20 of that report.

6.5.3 Impacts

The proposed regulator is situated within the offtake channel which is a short, shallow, open channel lacking substantial habitat complexity. It is unlikely to support significant aquatic communities, although it would likely be used to some extent by certain species as described in section 6.5.2. The installation and operation of the regulator would result in changes to flows in Piccaninny Creek downstream of the offtake channel where regulated flows would increase, and in Warriston Weir on Forest Creek, downstream of the offtake channel, where regulated flows would decrease.

Construction

The Aquatic Biodiversity assessment has identified four categories of construction impact pathways relevant to the project. These pathways are discussed below.

Loss of connectivity and impeded passage for native aquatic species

The use of cofferdams and silt curtains to facilitate construction of the regulator would present obstructions to fish movement or, in the event that the cofferdam or silt curtain completely blocks the watercourse, become a barrier to fish movements during the construction period. However, noting that the existing block bank already presents a barrier to fish movement, the amount of habitat that aquatic species would be excluded from during the construction of the project when compared with the existing situation, is considered to be negligible, and is unlikely to impact on population health. In addition, species that can traverse the terrestrial environment such as Rakali, Platypus, turtles, and crayfish would still be able to navigate around the barrier if necessary and this would be facilitated by the low gradient riverbanks in the vicinity of the works. Following application of relevant safeguards, the residual risk likelihood of this impact pathway is unlikely, with a minor consequence.

Degradation of aquatic habitat through water quality or water regime changes

The construction of the proposed regulator would involve excavation and ground disturbance in areas with soils potentially susceptible to dispersion, erosion, and instability. To address this, measures to avoid and minimise erosion and sediment would be implemented as outlined in the safeguards as detailed in section 6.5.4. This includes minimising clearance of vegetation where possible, particularly along areas with unstable soils such as along waterways, stabilising exposed soil, placing stockpiles away from the watercourse, and installing sediment controls around stockpiles.

It is anticipated that construction would generally occur during a low or no flow period and as such, the project site is unlikely to experience flood or over bank events during construction. However, in the event that a heavy rainfall event does occur during construction, the work sites would be secured and demobilised until such time as the site is accessible and control measures can be re-established or reinstated. Based on this, and considering the implementation of the proposed safeguards, aquatic habitat degradation due to input of erosion and sediment is considered to be unlikely, with a minor consequence.

The removal of riparian vegetation has the potential to negatively impact on aquatic habitat and fauna. However, for this project, this impact pathway is considered rare, with a negligible consequence on the basis that project area already contains existing disturbed, degraded and/or modified lower quality vegetation, and that impacts would be mitigated through a range of approaches as detailed in the safeguards in section 6.5.4. This includes minimising the removal of mature trees, retaining vegetation where possible along drainage lines and waterways, and reinstating vegetation as soon as possible.

Accidental spills and leaks of various toxic substances (e.g., fuels, oils and hydraulic fluids) during construction could flow into aquatic ecosystems and impact aquatic biota and habitats. However, the relatively small size of the construction site and the various proposed elements of construction mean that the amount of toxic substances that would be used at any given time is not expected to be substantial. Based on this, and considering the implementation of the proposed safeguards, the residual risk likelihood of this impact pathway is unlikely with a moderate consequence.

Following the installation of a downstream silt curtain and construction of the cofferdams there is potential for aquatic fauna to become trapped between these barriers, leading to impacts associated with water quality and dewatering. Large, mobile species such as Rakali, Platypus, turtles and large bodied fish such as Murray Cod and Silver Perch are unlikely to be among those trapped as they tend to relocate away from disturbed sites, but small-bodied fully aquatic species and juveniles may remain. To address this, a dewatering plan would be prepared and implemented which would include requirements for capturing and relocation of entrained nature aquatic fauna.

With these measures in place, the residual risk likelihood of this impact pathway is considered unlikely, with a minor consequence.

Spread of weeds, pest species or pathogens

The potential of the project to facilitate the spread of exotic species is considered to be minor given the existing levels of disturbance and weed abundance in the area. However, there is the potential that new, additional weeds could be introduced to the project footprint via machinery. In the Murray Darling Basin, the most significant introduced parthenogenic threat to aquatic communities is from Epizootic Haematopoietic Necrosis Virus (EHNV) (NSWDPIE, 2021a). Any construction activity within streams using equipment or vehicles that have come into contact with freshwater systems where the virus is present, has the potential to transfer the virus to native fish.

To address this, a weed and pathogen control plan would be prepared and implemented to avoid and minimise the spread of weeds, pests and pathogens. Following implementation of these safeguards (refer to Table 8.1), the residual risk likelihood of this impact pathway is unlikely with a moderate consequence.

Direct impacts to aquatic habitat or species

Direct impacts relate to the physical impact of construction activities on animals and their habitat. This includes aquatic species being entrained in pumping mechanisms, bank disturbance resulting in loss of habitat, removal of large woody habitat and injury or death of fauna.

To address these issues, a range of safeguards would be implemented as detailed in section 6.5.4 including: the requirement for aquatic fauna to be removed and relocated to a nearby suitable habitat in parts of the waterway that become isolated by silt curtains or cofferdams; provisions for excluding animals from the construction sites and any open trenches; requirement for snags and woody debris to be returned to the waterway post construction; and safely storing and removing food waste so that semi-aquatic animals such as Rakali aren't attracted to the area.

With the implementation of the proposed measures the impact is considered insignificant to unlikely, with a negligible to minor consequence.

Operation

The Aquatic Biodiversity assessment has identified four categories of operation impact pathways relevant to the project. These pathways are discussed below.

Loss of connectivity and impeded passage for native aquatic species

The construction of the new regulator would provide an improvement to fish passage as currently the block bank and culvert structure impedes fish movement in both upstream and downstream directions. As per NSW DPI Fisheries requirements, the new regulator would be designed in a way that allows movement of small to large-bodied fish in a downstream direction and this may provide some benefit to the aquatic community in Forest Creek as it would make more habitat available, although noting that the suitability of habitat in Piccaninny Creek over the range of flow conditions isn't well known. Further, there are several other weir and culvert structures on Piccaninny Creek that may also present barriers to fish movement through the creek to Billabong Creek. Therefore, while the proposed regulator would improve fish passage between Forest Creek and Piccaninny Creek in a downstream direction, connectivity in the system would still be limited.

The proposed regulator would likely present a barrier to instream turtle, Platypus, and Rakali passage, but no more than the current culvert. There are no plans to change the slope or height of the riverbanks near the structure, so the potential for overland passage for these species would be similar to the existing situation. While species such as Murray River Turtles, Broad-shelled Turtles show a preference for remaining in the water and rarely undergo terrestrial migration (Baggiano, 2012), they are still capable of travelling hundreds of meters overland which would be sufficient to circumvent the regulators if conditions required it (Cann & Sadlier, 2017). This would increase susceptibility to predation from terrestrial animals such as foxes, but no more than under current conditions (Grant & Temple-Smith, 2003). Passage through the new regulator may also be possible, although this hasn't been examined.

The residual risk of these impact pathways is rare to unlikely, with a minor consequence.

Degradation of aquatic habitat through water quality or water regime changes

Modelling of changes in regulated flows in Forest Creek immediately downstream of Warriston Weir and in the offtake channel has been undertaken considering flow duration, seasonality of flow and

total flow volume. The base case (current conditions) has been compared with the modelling results from the change case, being the current conditions and the operation of the Forest Creek offtake regulator.

The modelling results indicate that the operation of the Forest Creek return flows project is projected to substantially reduce the likelihood that regulated flows would overtop Warriston Weir. Under the change case, the flow regime in Piccaninny Creek is projected to become far more variable with a greater range of flow events that exceed the current (base case) typical flow of 1 ML/day, and that the total annual flow would increase. The results indicate that the project would be effective in reducing unplanned flows to Forest Creek below Warriston Weir and in diverting them back to Billabong Creek via the offtake channel and Piccaninny Creek.

The flow regime in the offtake channel under the change case is modelled to be similar to the natural seasonal pattern, but with a second peak in flows during the driest months (January to March, maximum 11 ML/day). In the context of the Forest Creek system, and freshwater systems more broadly, these are very small average daily flows, so the impact on the local aquatic community in the offtake channel and Piccaninny Creek is likely to be limited. Furthermore, the changes are likely to improve the flow regime in the offtake channel as the flow pattern better matches seasonal flow cycles and flows would be greater overall, providing more aquatic habitat. Importantly, the changes are unlikely to benefit exotic species that prefer stable flows.

The water delivery principles to meet aquatic ecological objectives in Billabong Creek outlined in NSW DPIE (2021b) largely revolve around allowing flows to fluctuate seasonally, maintaining small freshes and occasional overbank flows, and limiting the speed of draw downs. Specific to flows in the regulated section of Forest Creek, Alluvium (2013) also recommend maintaining weir pool habitat so it can act as drought refuge. The proposed changes in the flow regime are expected to result in the following changes regarding these principles:

- a greatly increased low and no flow period below Warriston Weir that helps to restore the natural flow regime
- improved seasonality of flows in the offtake channel, albeit with a peak in flows between January and March
- water levels in Warriston Weir are not expected to be impacted, thus its capacity as drought refuge is unchanged.

As a result, the proposed changes are expected to benefit the aquatic community in the study project area.

Accordingly, the residual risk is unlikely and the consequence is considered minor as the current flow regime is already highly altered.

Similarly to construction, there is potential for accidental spills and leaks of various toxic substances (e.g., fuels, oils and hydraulic fluids) during operation mainly related to the use of vehicles in the area and maintenance works. Following implementation of standard safeguards such as locating refuelling and storage areas away from watercourses, providing spill kits and appropriate storage of toxic substances, as well as spill response measures in accordance with WaterNSW O&M and environmental management procedures, the residual risk of this impact pathway is rare, with a minor consequence.

There is the potential for erosion and turbidity impacts during operation associated with the earthen block bank, and the area around where the regulator is installed within the block bank, and the semi-permanent erosion controls along the creek bed and bank. Given, the relatively small size of the block bank and regulator structures, the erodible area is naturally limited and any increased erosion would be proportionate. Following implementation of safeguards including maintenance of semi-permanent erosion control structures and annual assessment of the block bank and regulator structures for two years following construction, the residual risk of this impact pathway is unlikely, with a minor consequence.

Spread of weeds, pest species or pathogens

Five exotic fauna species are present in Forest Creek and Piccaninny Creek (Common Carp, Goldfish, Redfin Perch, Eastern Gambusia and Oriental Weatherloach). The operation of the new regulator is not expected to increase suitable habitat for exotic species. While exotic species could benefit from increased fish passage through the new regulator, they already occur throughout the study area and would already be able to bypass the block bank during flood events. The residual risk of this impact pathway is unlikely, with a moderate consequence, due to the existing presence of exotic species.

When over abundant, aquatic plants (even native) can become detrimental to a system by degrading water quality, slowing water velocity, exacerbating siltation or flooding, and reducing species diversity (Dugdale et al., 2013). Within the offtake channel, the Warriston Weir pool, and slow flowing sections of Piccaninny Creek, the still to slow flowing conditions have led to the proliferation of tall native species, such as Cumbungi and Common Reed that have overgrown a large proportion of these stream reaches. These species were less prolific in Forest Creek downstream of Warriston Weir where stream drying occurs more regularly. Aquatic plants that can potentially become weeds such as Water Fern, and Nardoo were also present in reaches of Forest and Piccaninny creeks, but were in low abundance.

The existing aquatic plant community is the product of the current hydrology (flood timing, depth, duration, rate of drawdown, frequency and time since last flood) and interactions with morphological, physiological and life history characteristics of the plants as well as a potential dispersal vectors. The proposed changes in the hydrological regime in the offtake channel and downstream in Piccaninny Creek is unlikely to lead to an increase in the abundance of these species. Firstly, no new areas are expected to be flooded, so no new habitat for aquatic plants would become available. Secondly, an increase in flow is more likely to decrease slow flowing sections in the offtake channel and Piccaninny Creek that are suitable for aquatic plant growth. Below Warriston Weir, where unplanned flows are expected to cease, the conditions for most aquatic plants are expected to decline due to increased frequency and longevity of stream drying. Cumbungi, for instance, has decreased dramatically in abundance downstream of the weir since the flows became unregulated (Cooling & Gippel, 2018).

There is potential for the increase in the volume of flows through the offtake channel to exacerbate the spread of aquatic weeds by providing improved connectivity for dispersal of propagules (e.g. seeds or vegetative parts) within the waterways. However, these propagules would be able to spread through the current culvert structure, or over it when the block bank is overtopped and, as such, the increase in opportunities for dispersal is considered negligible.

Based on this, the residual risk an impact on aquatic biodiversity values due to proliferation of invasive aquatic plant species, is considered unlikely, with a moderate consequence.

Direct impacts to aquatic habitat or species

Turtles, Platypus, and Rakali may be directly injured and/or killed through vehicle impacts during operation. However, given that vehicle tracks already exist, and that the nature of the small, dirt, winding track negates fast driving, and considering that maintenance of the structure is unlikely to require regular site visits, the residual risk of this impact pathway is rare, with a negligible consequence.

Threatened aquatic fauna

The following section assesses how the effect pathways discussed above could specifically impact on MNES under the EPBC Act, and threatened species and communities under the FM Act, identified as being present or likely to be present in the project area. The two types of MNES identified in the study area are Vulnerable (Murray Cod) and Critically Endangered (Silver Perch) species. Further to this, the Freshwater Catfish population in the Yanco-Billabong System is considered threatened (FM Act), and the entire project area is representative of the Lower Murray River EEC which means that the whole fish and invertebrate community is listed as Endangered under the FM Act.

The significant impact criteria for these MNES are outlined by DoE (2013) and provide a clear framework for the impact assessment, described in Table 6.12.

Table 6.12 EPBC Significant Impact Criteria

Criteria	Critically Endangered and Endangered Species	Vulnerable Species
A	Lead to a long-term decrease in the size of a population	Lead to a long-term decrease in the size of an important population of a species
B	Reduce the area of occupancy of the species	Reduce the area of occupancy of an important population
C	Fragment an existing population into two or more populations	Fragment an existing important population into two or more populations
D	Adversely affect habitat critical to the survival of a species	Adversely affect habitat critical to the survival of a species
E	Disrupt the breeding cycle of a population	Disrupt the breeding cycle of an important population
F	Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Criteria	Critically Endangered and Endangered Species	Vulnerable Species
G	Result in harmful invasive species becoming established in the endangered or critically endangered species' habitat	Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
H	Introduce disease that may cause the species to decline	Introduce disease that may cause the species to decline
I	Interfere with the recovery of the species	Interfere with the recovery of the species

While these are developed specifically for MNES, the same criteria have been used to assess potential impacts to State significant species and communities as there is no specific assessment framework to assess them against. Table 6.13 provides a significant impact assessment for the construction and operation phases of the project, including expected or potential impacts, safeguards and residual impacts expected following implementation of safeguards. For species listed as Vulnerable, the term 'important population' is considered to be populations which are defined as strongholds within relevant Species Profile and Threats Database (SPRAT) profiles (Report (environment.gov.au)), or by recovery plans for the target species.

Table 6.13 Threatened aquatic fauna impact assessment

Species Name	EPBC Act / FM Act	Expected or potential impact	Safeguards	Significant impact assessment
Construction phase				
Murray Cod **Silver Perch** **Lower Murray River Drainage System Endangered Ecological Community**	Vu / Not listed CE / Vu Not listed / En	Minor impacts are possible (residual risk likelihoods are considered Unlikely or Rare) through some impact pathways (e.g., temporary changes in water quality and loss of small areas of potential habitat), but they are unlikely to be significant under the EPBC Act.	Fish passage Erosion and sedimentation during construction Water quality – spills and leaks Weeds and pathogen management Aquatic habitat disturbance minimisation Reinstatement Pest control Aquatic fauna management	Significant impacts are considered unlikely. **A, B, C:** No important Murray Cod or Silver Perch populations have been identified in the study area, so the operation of the project would not impact on one. Regardless,it is unlikely that the construction phase of the project would lead to a decrease in the size, area of occupancy, or connectivity of Murray Cod and Silver Perch populations. The construction footprint is small and the impacts on downstream water quality are considered minor and temporary if the listed safeguards are followed. Furthermore, the potential for a temporary loss of connectivity is considered minor as the species are unlikely to be present within the construction footprint as it is a relatively small area of stream and fish are likely to avoid disruptive construction works. If the species were to become entrapped within coffer dams, safeguards are in place to have them safely removed. **D:** It is unlikely that habitat critical to survival of Murray Cod or Silver Perch would be adversely impacted by the proposed construction. This is by virtue of the small construction footprint, beneficial changes in stream hydrology, and the proposed safeguards. Potential water quality impacts which would affect critical habitat include erosion and sedimentation. Safeguards have been proposed for each of these broad impacts, which would minimise the likelihood or consequence of an impact to the species. **E:** The physical habitat being impacted on is not characteristic of Murray Cod and Sliver Perch spawning sites (i.e. it is shallow and lacking large woody structure) and the construction works would occur over a small area and a short timeframe. They are also planned to take place outside of the core spawning season (Spring) during the Summer low flow period. Safeguards to prevent downstream water quality impacts would also help ensure there is no impact on breeding populations that may occur in the downstream Billabong Creek, Edward, and Murray rivers.

Species Name	EPBC Act / FM Act	Expected or potential impact	Safeguards	Significant impact assessment
				F: Construction would not destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline. The construction footprint is small and relatively unintrusive and the construction activities are temporary. Furthermore, safeguards are in place to reinstate any large woody habitat removed, and to rehabilitate impacted banks and riparian vegetation. **G:** The construction phase of the project is unlikely to lead to an increase in invasive species as the safeguards in place would minimise the risk of any new species being introduced during construction and the construction activities themselves would not improve habitat for exotic species. **H:** Introduction of disease during the construction phase is unlikely if proposed hygiene protocols in the safeguards are implemented. **I:** NMCRT (2010) lists threats to Murray Cod, which include habitat degradation, lowered water quality, barriers, and alien species. The construction phase of the project is unlikely to exacerbate any of the listed threats if proposed safeguards are implemented, thus the potential for recovery of the species is unchanged. Key threats to Silver Perch relevant to the construction phase are provided by Koehn et al. (2020). These include barriers to longitudinal connectivity, decreased water quality and being sucked into pumps. The construction phase of the project is unlikely to exacerbate any of the listed threats if proposed safeguards are implemented.

Species Name	EPBC Act / FM Act	Expected or potential impact	Safeguards	Significant impact assessment
Operation phase				
Murray Cod **Silver Perch** **Lowland Murray River Drainage System Endangered Ecological Community**	Vu / Not listed CE / Vu En	Safeguards, in addition to the project operation and construction plans, are expected to effectively minimise the risk likelihood of any potential impacts during operation (no identified risks had residual risk likelihoods greater than Unlikely). As such adhering to these plans and safeguards would adequately minimise the risk of any impact on Murray Cod and Silver Perch within the project area and in downstream reaches.	Hydrology Erosion and sedimentation during operation Water quality – spills and leaks during operation Fish passage management during operation Water quality management downstream of Warriston Weir Fauna management during operation	Significant impacts are considered unlikely. **A, B, C**: No important Murray Cod or Silver Perch populations have been identified in the study area, so the operation of the project would not impact on one. Potential water quality impacts include erosion and sedimentation. Safeguards have been proposed for these broad impacts, which would minimise the likelihood or consequence of an impact to the species. **D**: It is unlikely that habitat critical to survival of Murray Cod, Silver Perch would be adversely impacted. This is by virtue of the small construction footprint, minimal change to stream hydrology, and the proposed safeguards. Potential water quality impacts which would affect critical habitat include changes to geomorphological values leading to erosion and sedimentation. safeguards have been proposed for each of these broad impacts, which would minimise the likelihood or consequence of an impact to the species. **E**: Hydrological modelling indicates that the flow regime in the offtake channel and Piccaninny Creek would become more seasonal with more high flow events that are more likely trigger spawning in Murray Cod and Sliver Perch. There would be a greater volume of flows in general. Forest Creek at Warriston Weir does not support suitable habitat for Murray Cod and Silver Perch breeding either. Regardless, the flow regime is expected to be broadly similar, albeit with reduced flows, so flow related spawning ques are unlikely to be inhibited. Temperature is also a strong spawning que for Murray Cod, but stream temperature is not expected to be changed by operation of the project. Negligible impacts on water quality are also projected. Furthermore, no significant changes to the physical habitat available to these species are expected. Therefore, breeding success is unlikely to be impacted by operation of the project. Safeguards to prevent downstream water quality impacts would also avoid and minimise impacts so that there is no impact on breeding populations that may occur in the downstream Billabong, Edward, and Murray rivers. For these reasons, the breeding success of these species is unlikely to be impacted by operation of the project and may benefit in the project footprint. **F**: Operation would not destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Species Name	EPBC Act / FM Act	Expected or potential impact	Safeguards	Significant impact assessment
				G: The operation phase of the project is unlikely to lead to an increase in invasive species. First, the regional invasive species community are already present in the project area and can already access the site freely from upstream areas. Second, the new fishways would likely increase exotic fish passage, but the difference is negligible as migration isn't a critical to the life history stage of the exotic species and they can breed in the available habitat without migration. Third, the project is not expected to greatly increase suitable habitat for invasive species. H: Introduction of disease during the operation phase is unlikely. While fish passage would likely improve due to the installation of the regulator, there has not been any evidence to suggest that fish communities in the surrounding area are carrying novel diseases, or that they are disproportionately impacted by disease. I: NMCRT (2010) lists threats to Murray Cod, which include habitat degradation, lowered water quality, barriers, and alien species. The operations phase of the project is unlikely to exacerbate any of the listed threats if proposed safeguards are implemented. Physical habitat (flowing habitat, woody debris, riparian cover) is not projected to decline due to operation of the project, water quality is not expected to be impacted upon by operation, and it is likely that fish passage would improve overall due to the installation of the new regulator. Thus, the potential for recovery of the species is unchanged.

In summary, all effect pathways from construction and operation of the project were found to pose a low to insignificant residual risk of impact to the national and State listed species, populations, and communities following adoption of the proposed safeguards.

6.5.4 Safeguards

The safeguards proposed to avoid, minimise, or manage potential cumulative impacts associated with the project are included in Table 8.1.

6.6 Air quality

6.6.1 Existing environment

The project is located within a sparsely populated area, with the nearest sensitive receiver, a rural property, located approximately 1 km to the south of the project area. The closest populated area is approximately 6 km north-east of the project in Conargo. The ambient air quality in the project area and surrounds is characteristic of rural areas, which are generally low particulate matter and pollutants. The main factors affecting the air quality in the area are road traffic, agricultural activities and prevailing meteorological conditions.

A search of the National Pollutant Inventory in October 2023 found one facility located about 29.5 km south of the project area at Deniliquin, which reported the emission of pollutants.

6.6.2 Impacts

Construction

The construction of the project would generate dust from activities such as:

- construction traffic on unsealed roads and haulage routes
- vegetation clearing
- rock and concrete crushing
- earthworks including stripping topsoil, excavations, and placement of fill.

Associated impacts on air quality would be localised and temporary in nature (limited to the construction period of two months) and are therefore considered unlikely to be significant. These would be managed in accordance with safeguards outlined in Table 8.1.

Exhaust emissions produced from vehicles, plant and machinery would be low in volume, readily dispersed by winds and would be likely to have only a negligible impact on local air quality.

Operation

Air quality impacts during operation are expected to be negligible once the site is rehabilitated. Changes to flows downstream of Warriston Weir could potentially result in creek beds being exposed for periods of time and a source of wind-blown clay and slit contributing to dusts. However, this potential increase is not likely to be significant when considered in the context of the changes

to downstream flows and the scale of regional air quality catchment. Maintenance activities could also result in minor and occasional vehicle and plant emissions.

6.6.3 Safeguards

Specific safeguards proposed to avoid, minimise, or manage potential air quality impacts as a result of the project are included in Table 8.1.

6.7 Waste, contamination, and hazards

6.7.1 Existing environment

Contamination

A search of the NSW Environment Protection Authority (EPA) Contaminated Land Register undertaken in October 2023 identified two contaminated sites within the Edward River Council LGA. Both these sites are located over 30 km from the project area.

Land surrounding the project area is predominately undeveloped land, suggesting a low likelihood of site contamination.

Hazards

The project area is located within Bushfire Prone Land (Vegetation Category 1). Bushfire risk is managed under the *Bushfire Risk Management Plan 2009* (BFRMP), prepared by the Mid Murray Bush Fire Management Committee. The aim of the BFRMP is to minimise the risk of adverse impact of bushfires on life, property, and the environment.

The project area is not mapped in an area subject to flooding.

6.7.2 Impacts

Construction

Small quantities of waste may be generated by the project which may include waste streams such as:

- green waste from cleared vegetation
- concrete and rock riprap materials from removal of existing structures
- excess fill material from any excavation of soil and fill embankments
- dried surplus concrete and minor quantities of other surplus construction materials such as timber
- general wastes from construction contractors.

Waste produced during construction would be managed in accordance with the waste management hierarchy and in accordance with the *Waste Classification Guidelines* (NSW EPA, 2014). This provides that waste avoidance is a priority, followed by reuse and recycling/reprocessing, with disposal as a last resort.

Potential ignition sources may be present including construction machinery and vehicles, and the potential for fuel leaks, spills and the storage of any flammable goods. Localised contamination from accidental spills or leaks of fuel, oils and chemicals during construction is considered unlikely. This risk would be managed by safeguards outlined in section 6.7.3.

The project would not involve the handling or generation of hazardous waste. Wherever possible, suitable excavated spoil would be re-used on site for backfilling, landscaping and other uses. If spoil is unable to be re-used on-site, opportunities for off-site re-use would be investigated. If re-use opportunities are unable to be identified, or the spoil is unsuitable for re-use due to its geotechnical or contamination characteristics, spoil would be tested and classified according to the *Waste Classification Guidelines* (NSW EPA, 2014) and disposed of at an appropriately licensed waste management facility.

Salvaged concrete from demolition of existing structures including the existing culvert would be assessed for suitability of reuse. The project would also further minimise construction waste through:

- sustainable selection of construction materials
- detailed estimation and accurate ordering of quantities of materials required
- balancing earthworks to minimise the demand for imported fill or the need to export/dispose of excess spoil material.

Operation

It is expected that only minimal waste would be generated during operation, including as a result of maintenance activities.

6.7.3 Safeguards

Specific safeguards proposed to avoid, minimise, or manage potential waste, contamination and hazardous materials impacts as a result of the project are included in Table 8.1.

6.8 Aboriginal heritage

An Aboriginal Cultural Heritage Assessment Report (ACHAR) was prepared by Austral Archaeology Pty Ltd in order to identify any potential Aboriginal heritage values within the project area and assess any potential impacts to these values the project may have. The ACHAR was prepared to address Requirement 11 of the *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010b) (the Code of Practice) and details the archaeological assessment that was undertaken for the project area.

The assessment is summarised across the following sections.

6.8.1 Methodology

For the purpose of the ACHAR, the **'Study Area** comprised the access track, a borrow site and construction zone.

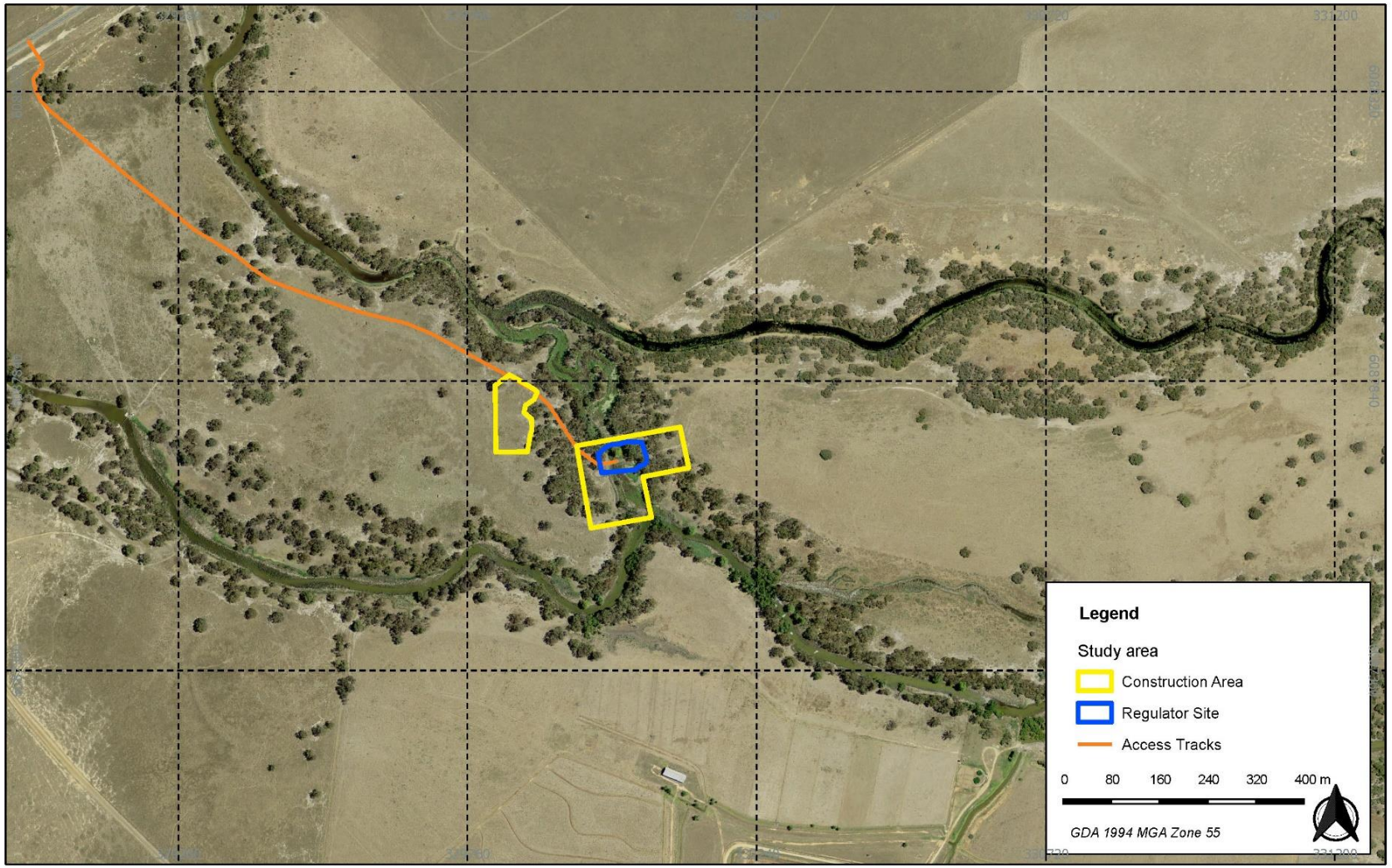

Figure **1.2** - Detailed aerial of the **study area**

23039 - Yanco Creek Modernisation Project

Source: NSW LPI Aerial *Drawn by: ARH Date: 2023-08-22*

AUSTRAL ARCHAEOLOGY

Figure 6.17 Project overview and ARCHAR study area

The ACHAR has been prepared in accordance with the consultation process specified in the *National Parks and Wildlife Act 1974* (NPW Act) and the *National Parks and Wildlife Regulation 2019*. This has included a four-stage process which has broadly consisted of:

- notification and registration of interest including providing agency letters, advertisement, development of a stakeholder list, and establishment of the Registered Aboriginal Parties (RAPs)
- presentation of information through engagement with the RAPs on the survey methodology and presentation of the proposal and archaeology methodology
- gathering of information about cultural significant through RAPs contributing to culturally appropriate information gathering to determine the cultural significance of Aboriginal objects and places within the study area to input into the development of cultural heritage management options
- review of draft reports and comments provided.

The ACHAR consists of a desktop assessment, fieldwork surveys and post fieldwork analysis, and the development of management measures for the protection of Aboriginal cultural heritage (refer to section 6.8.4). The ACHAR was designed to identify and assess the archaeological characteristics of the Study Area. For the purposes of the assessment, archaeological characteristics have been determined to comprise of the following elements:

- registered Aboriginal objects
- likely Aboriginal objects
- archaeological deposits
- potential archaeological deposits
- archaeologically sensitive landforms and areas.

Aboriginal objects are defined by the *National Parks and Wildlife Act 1974* (NPW Act) as:

- *Any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction and includes Aboriginal remains.* (NPW Act – Part 1, Clause 5(1)).

6.8.2 Existing environment

As discussed in section 1.1, the project is located within the Riverina Region where much of the NSW portion is home to the Wiradjuri people, also known as the 'People of Three Rivers' (Bathurst Regional Council 2023). The rivers and floodplains provided ample resources for local Aboriginal groups in the past.

Desktop assessment

A desktop search of the Aboriginal Heritage Information Management System (AHIMS) was undertaken as part of this assessment. A search undertaken in June 2023 by Austral Archaeology identified a total of six sites within 10 km of the study area (refer to Figure 6.18). Table 6.14 below outlines these results in further detail, including a breakdown of the sites by type and percentage.

Table 6.14 Frequency of registered site types within the area of interest

Site Type	Frequency	Percentage (%)
Artefact	1	16.67
Modified Tree	5	83.33
Total	6	100

Of the six registered site types, none of these sites were identified to be located within or within 500 m of the study area.

Field surveys

In addition to the desktop assessment, an archaeological field survey was conducted by Austral Archaeology Pty Ltd, Darkinjung Local Aboriginal Land Council and NSW DCCEEW on 27 June 2023. The survey was undertaken in accordance with the approaches outlined in Requirements 5 to 10 of the Code of Practice (DECCW 2011). The archaeological field survey objectives were to:

- complete a systematic survey that targets areas that have been identified as having the potential to contain Aboriginal heritage values
- identify and record Aboriginal archaeological sites visible on ground surface and areas of PAD.

No Aboriginal objects or areas of potential value were identified during the archaeological field survey (27 June 2023). Limitations during the pedestrian survey included low GSV and exposure, which may limit identification of surface Aboriginal cultural heritage. The areas surveyed (Survey Tracks) and results of the pedestrian survey undertaken within the study area are shown in Figure 6.19.

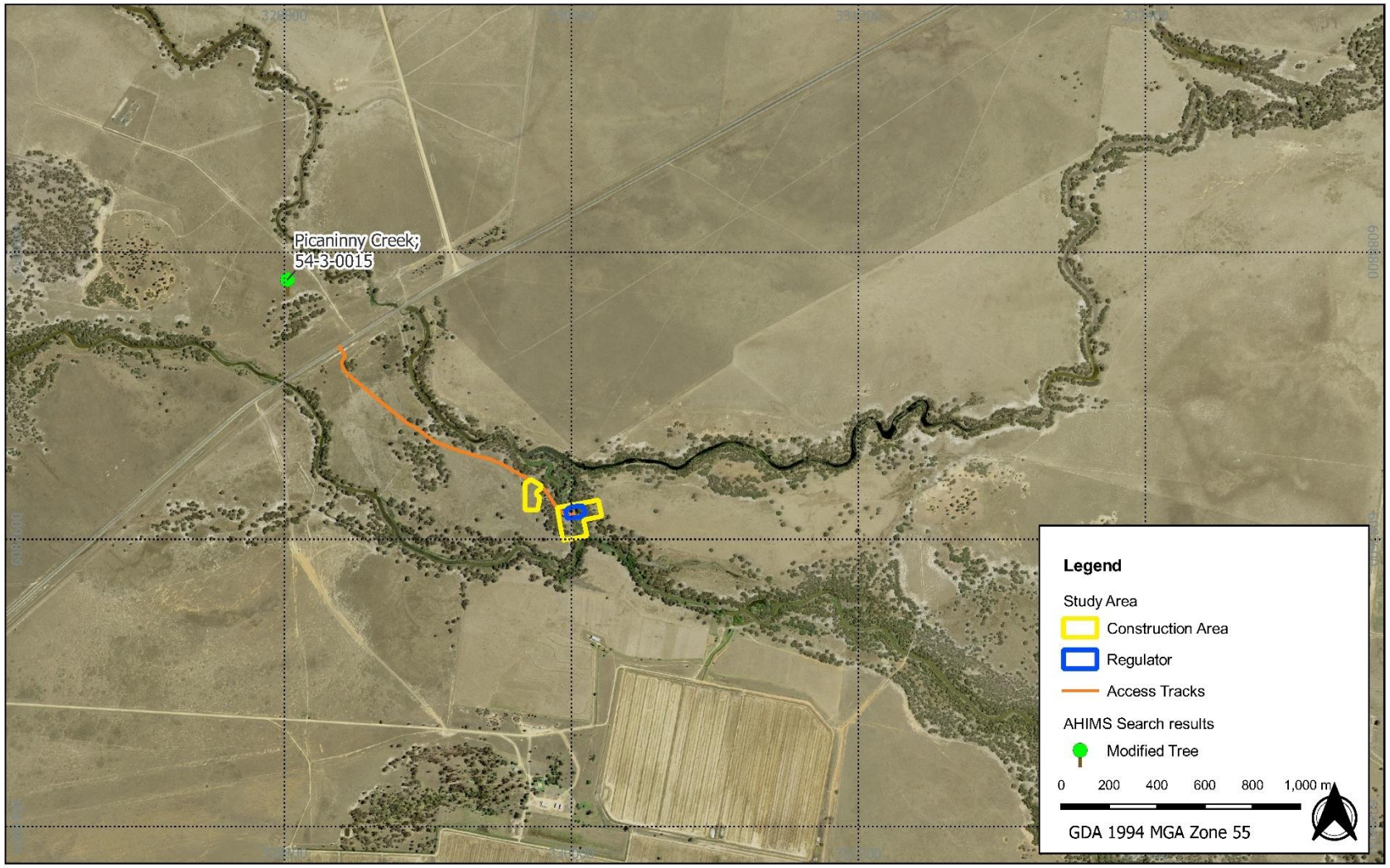

Figure 4.4 - AHIMS sites within close proximity to the study area

23039 - Yanco Creek Modernisation Project

Source: NSW LPI Aerial Drawn by: ARH Date: 2024-03-19

AUSTRAL ARCHAEOLOGY

Figure 6.18 AHIMS search results

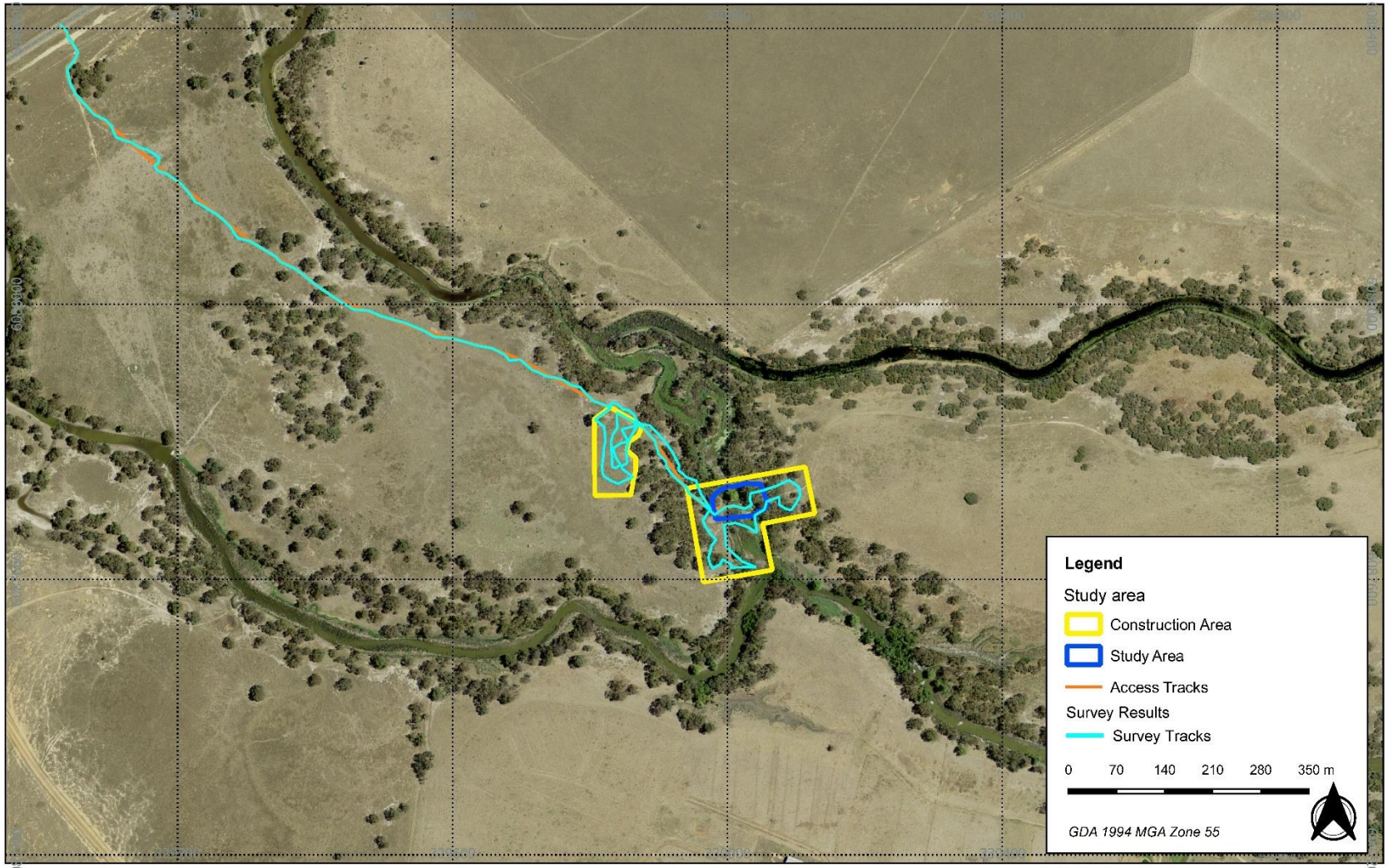

Figure 7.4 - Results from the archaeological survey

23039 - Yanco Creek Modernisation Project

Source: NSW LPI Aerial, Jacobs *Drawn by: ARH Date: 2023-10-06*

AUSTRAL ARCHAEOLOGY

Figure 6.19 Pedestrian survey results

Archaeological context

The following is a summary of the relevant information regarding the archaeological context of the project. Refer to Appendix D Aboriginal Heritage Assessment of this report for further information.

Between the years 1990 and 2022, five regional archaeological studies were conducted in the Murray Valley, Riverine Plain, the Murray River, LGAs across Buronga to Wagga Wagga and the Murrumbidgee sub-region. The site types identified included oven mounds, scarred trees, burials, middens, suspected ceremonial sites, archaeological deposits.

A study of the Upper Murray that included the Riverine Plain, the Lachlan, Murrumbidgee and Murray rivers and their tributaries and anabranches identified 164 sites. The sites consisted of 739 burials which were found most frequently followed by clay pans, levees, and shelters (Littleton 1999).

Between the years 1987 and 2023, 11 local archaeological investigations localised to the project area at Yanco-Billabong catchment and Edward River LGA were conducted. The surveys identified scarred trees, isolated stone artefacts, open campsites, earth mounds, oven mounds, artefact scatter, burials, Potential Archaeological Deposits (PADs) and occupation sites. One study noted most of the sites it identified were located close to water or at areas of previous water sources (McIntyre 1987).

Ethnohistorical context

The following is a summary of the relevant information regarding the ethnohistorical context of the project. Refer to the Archaeological Assessment Report in section 4 (refer to Appendix D Aboriginal Heritage Assessment of this report) for further information.

The ethnography of the Riverina region has been described notably by two people, though their maps and descriptions do not necessarily accurately depict the distribution of Aboriginal groups. The study area location is currently considered to be shared land, with representatives from multiple groups attending field work. The study area is located close to the boundaries of traditional lands of three Aboriginal peoples, the Yorta Yorta, Barapa Barap, and the Jeithi (Tindale 1974). The study area has also been described through the location of Aboriginal language groups, with the study area situated within the boundary of Baraba, Baraba, Yorta Yorta and Waradjuri (Horton 1994).

The Riverina would have been able to support large populations of Aboriginal people, due to the number of permanent water bodies, and associated food and material resources. These resources would have included materials that were used for the creation of canoes, nets, stone tools, and other items for the collection and transportation of goods (Atkinson & Berryman 1983).

The total population estimation of Aboriginal groups is hard to estimate in the Riverina region. The borders of the Aboriginal people were not static, and the introduction of European diseases caused a decrease in population. It has been estimated at the time of European occupation, that population numbers varied, with some groups noted to have up to 3,000 people. These numbers should not be considered an accurate representation of the total population, as areas considered fertile by the European settlers may not be the same for Traditional Owners (Read 1983).

Predictive statements

The following statements address the likelihood of Aboriginal cultural material being found within the study area, taking into consideration the review of previously recorded sites and archaeological studies conducted in the region:

- The study area is highly likely to contain sites with all features due to it being within 500 m of a hydrological feature.
- The soils of the study are equivalent to the Murray Channels and Floodplains and coarsely cracking clays, where scar trees and earth mounds are most likely to be identified.
- Any levees and/or earth mounds are likely to contain burials.

6.8.3 Impacts

Construction and operation of the project would not result in any direct or indirect physical impacts to any known items of Aboriginal heritage cultural significance.

6.8.4 Safeguards

The key recommendations arising from the assessment are:

- A site monitor would be present during any ground clearing works in the event of unexpected finds.
- If during the project, unexpected finds or human remains are identified, the safeguard relating to the unexpected finds in section 8.3 must be followed
- Consultation to inform Aboriginal stakeholders about the management of Aboriginal cultural heritage within the study area would be undertaken throughout the completion of the project.

The safeguards proposed to avoid, minimise, or manage potential Aboriginal heritage impacts as a result of the project are included in Table 8.1.

6.9 Non-Aboriginal heritage

A Non-Aboriginal Heritage Assessment (Appendix E Non-Aboriginal Heritage Assessment) was undertaken and prepared in order to identify any potential for non-Aboriginal heritage values within the project area and assess any potential impacts to these values. The assessment is summarised across the following sections.

For the purpose of the Non-Aboriginal Heritage assessment, the study area includes the land required for the construction of the proposed regulator, the two CAZs marked in Figure 1.2 including clearing areas, the land designated for the borrow site, as well as the access track footprint. In addition, the assessment the land between Conargo Road on the west, and bordered by the two creeks: Forest Creek in the south and Piccaninny Creek to the north. The full extent of this study area allows for an in-depth analysis and understanding of the historical context for the land use and development within the area. Refer to Figure 6.20 for the study area assessed.

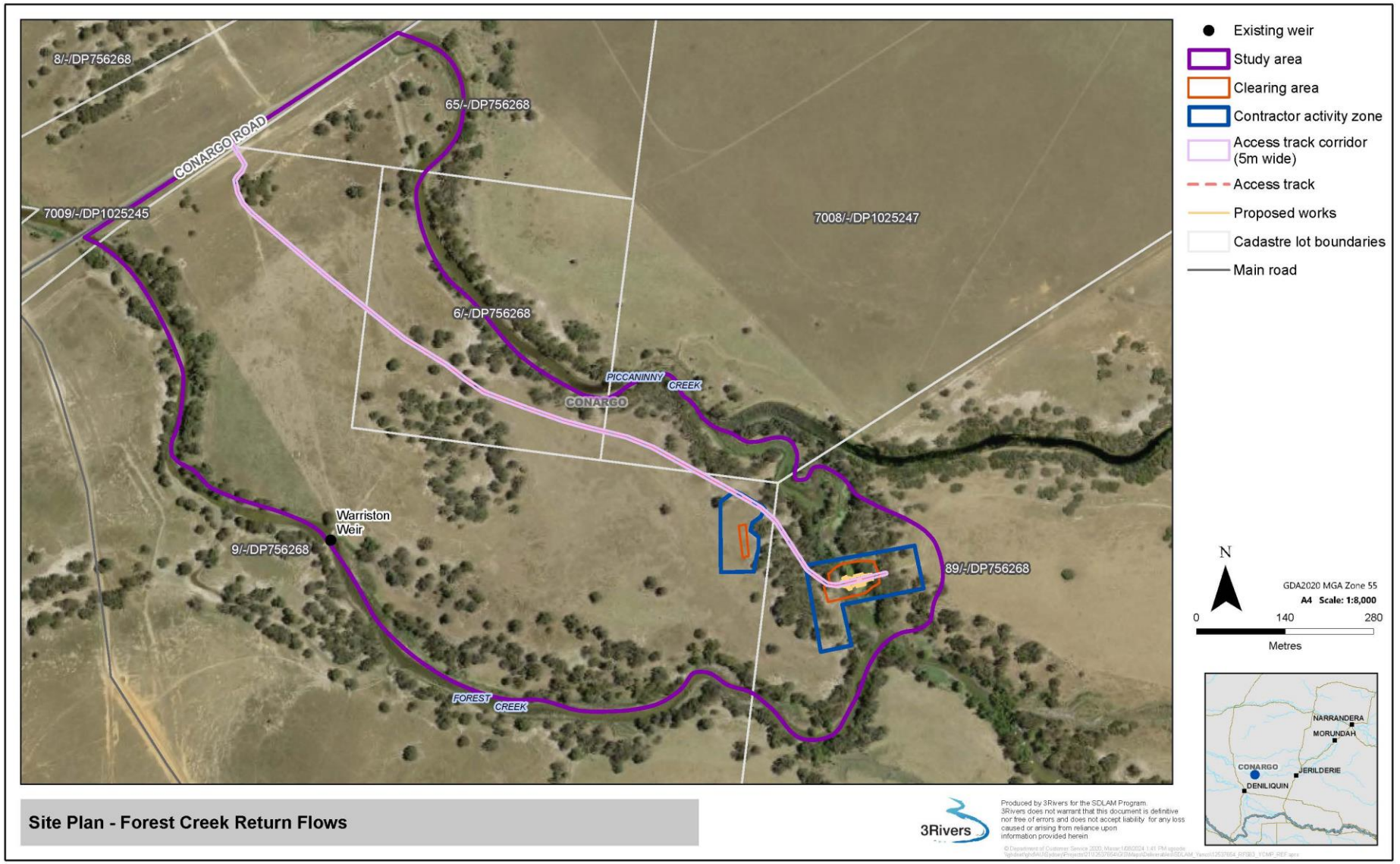

Figure 6.20 Site plan of the project with non-Aboriginal heritage assessment study area outlined

6.9.1 Methodology

In preparation for the non-Aboriginal heritage assessment, the following registers and databases were searched on 26 April 2023 to identify known heritage items within, or in proximity to, the study area using a combination of spatial data tools and online databases. These included:

- State Heritage Register (SHR)
- State Heritage Inventory (SHI)
- Section 170 Heritage and Conservation Registers (S170)
- Conargo LEP 2013
- National Heritage List (NHL)
- Commonwealth Heritage List (CHL)
- World Heritage List (WHL)
- Register of the National Estate (RNE) (Non-statutory)
- National Trust of Australia (NSW) Register (NTR) (Non-statutory).

The assessment also included a desktop historical research review using a variety of online resources such as the:

- NSW State Records & Archives
- NSW Government's Historical Imagery Viewer
- The State Library of NSW
- The National Library of Australia
- WaterNSW Archives and Records
- local libraries.

Additionally, a review of historical mapping was undertaken to understand changes made within proximity to the study area over time, including Crown plans purchased from NSW Land Registry Services.

Finally, in addition to these desktop searches a literature review was carried out to identify previous historical investigations which have been undertaken within the region.

6.9.2 Existing environment

The project is located in the Parish of Conargo, County of Townsend, Land District of Deniliquin. It is part of the Riverina agricultural district, forming part of the Central Division district. The project infrastructure and associated CAZ would be located on Lot 89/-/DP756268, with a second CAZ located in Lot 9/-/DP756268. The access track from Conargo Road runs through Lots 9/-/DP756268, 6/-/DP756268, 7008/-/DP1025247.

Based on the searches listed in section 6.9.1 it was concluded that there are no registered historical heritage items within the study area.

The closest State Heritage items are located in Deniliquin, which is over 28 km south of the study area. There are a number of non-Aboriginal heritage items listed on the Conargo LEP, with three located in the nearby town of Conargo, 6 km north-east from the study area. However, none of these impact on the study area boundaries.

The literature review carried out to identify previous historical investigations undertaken within the region determined that the region is under-represented in terms of historical studies and heritage assessments. The local authority, Edward River Council, is still in the process of finalising the Edward River Heritage Study, noting as requiring completion in 2020 (Edward River Council 2020). An in-depth summary of previous heritage studies and relevant historical investigations accessed as part of the assessment are provided in section 4.2 of the non-Aboriginal Heritage Assessment (refer to Appendix E Non-Aboriginal Heritage Assessment).

Section 4.3 of the non-Aboriginal Heritage Assessment (Appendix E Non-Aboriginal Heritage Assessment) provides an in-depth summary of the study areas surrounding historical context, including early exploration, first landholders, the portioning of the Parish lands, and the history of water management within the Murrumbidgee region.

6.9.3 Impacts

The desktop heritage assessment undertaken identified numerous potential heritage constraints within or adjacent to the study area. These constraints appear to relate mainly to the siting of the access track, as the majority of evidence for historical occupation within the project area relates to the proximity of Conargo Road. These constraints are discussed across the following sections.

Location of the regulator

The proposed location of the physical infrastructure at the junction of Piccaninny and Forest Creek is located in a section of the study area that has had minimal historical information available. No maps or plans showing historical use of this area have been located as part of this assessment.

The age and history of the existing infrastructure is not yet understood and may have some bearing on the heritage of the place depending on what is still extant. Historical records and consultation with WaterNSW could not identify the exact date of installation of the reinforced concrete pipe. However, an inspection of aerial photographs taken on site, has determined that the concrete pipe was installed after 1910, which is when reinforced concrete pipes came into wide-spread use.

As such, based on the information available as part of this assessment, the proposed location of the regulator and broader project area is considered to have a low potential for impacts to non-Aboriginal heritage.

Access track siting

Historic aerials of the study area collected as part of this assessment revealed that the proposed path for access for the project appears to follow an existing path that appears in aerial imagery from the mid-1990s.

It is important to note that the most significant and potentially sensitive sections of the study area are likely to be located close to Conargo Road. Of particular interest is the potential for remnants or evidence of the former structures on the site, notably Thomas Stalley's Forest Creek Hotel on Forest Creek at the crossing of Conargo Road and the residence of John Abdallah on Piccaninny

Creek. Located close to Conargo Road, they are sited well away from the CAZs. As such, it is unlikely that any remnants of these two periods of occupation would be found in the project area, but there is a possibility that the access track might traverse into an area of the site close to the location of one of these former uses.

Based on the information available as part of this assessment, the proposed siting of the access track is considered to have a low potential for impacts to non-Aboriginal heritage.

Borrow site

The area to the northwest of the existing infrastructure (refer to the clearing area marked in Figure 1.2) has been identified as land suitable for use as a borrow site and CAZ. It is located in a different historical parcel of land than the proposed location for the project.

While no site inspection was undertaken as part of this assessment, no other consultant reports nor drone imagery collected in August 2023 indicate the presence of any evidence of historic heritage within this area.

Therefore, based on the information available as part of this assessment, the proposed location for the borrow site and associated CAZ is considered to have a low potential for impacts to non-Aboriginal heritage.

6.9.4 Safeguards

The scope of this assessment was limited to a desktop assessment based on historical information currently available. While it would usually be recommended to expand the research to include additional historical research held in the physical archives of the NSW State Archives, given the project footprint is located away from the main area of historical archaeological potential, the current conclusions and recommendations can be made based on a desktop assessment.

The key constraint arising from this desktop assessment is the historical archaeological potential associated with early land use. Located on Conargo Road, the study area was sited on the main route between the towns of Deniliquin and Conargo, which was part of three major stock routes through NSW down south. Historical records indicate that there was a hotel located on Conargo Road near the crossing over Forest Creek as well as a hut on Piccaninny Creek. The exact location of these historical items has not been determined through desktop research, however they are not expected to be located in vicinity of the project where the regulator is to be installed or where the borrow site would be situated during construction.

There is a possible intersection between the area with the historical archaeological potential and the access track, therefore it would generally be recommended to keep the track and vehicles well away from the trees, within the already defined track.

The key recommendations arising from this assessment are:

1. An unexpected finds protocol should be prepared and implemented to manage any unexpected historical archaeological material uncovered.
2. Requirement for further assessment should the project footprint or access track alignment change.

The safeguards proposed to avoid, minimise, or manage potential historic heritage impacts as a result of the project are included in Table 8.1.

6.10 Noise and vibration

6.10.1 Existing environment

The acoustic environment of the project area and surrounds is typical of a rural area. The main noise sources are related to the natural environment, activities associated with surrounding agricultural land uses and local roads. The nearest sensitive receiver is a homestead located approximately 1 km south of the project area.

6.10.2 Impacts

Construction

There may be localised and temporary noise impacts during construction of the project, however, construction noise is likely to be inaudible at the nearest sensitive receivers and consistent with similar activities in the locality.

The construction of the project would generally take place during standard construction hours or as agreed with the landowner. Standard construction hours are outlined in the Construction Noise and Vibration Guideline (CNVG) (NSW Roads and Maritime Service, 2016) as follows:

- Monday to Friday 7 am to 6 pm
- Saturday 8 am to 1 pm
- No work on Sundays or public holidays.

Operation

There would be minor temporary noise from maintenance activities that are carried out periodically. The power and communication features for the project are to be via solar power and are not expected to generate any noise.

6.10.3 Safeguards

There are no specific safeguards proposed to address negligible noise and vibration impacts as a result of the project. Standard construction practices would be followed.

6.11 Traffic and access

6.11.1 Existing environment

A search of the NSW Road Network Classifications (TfNSW 2023) was undertaken in October 2023 and indicates the road network within vicinity of the project area consists mainly of state and regional roads. The project area is accessed off Conargo Road, approximately 500 m east of its intersection with Boonoke Road, via an existing private farm track. Conargo Road is a regional road located about 2 km west of the project area.

Conargo Road carries two-way traffic and is the main road providing access between Conargo and Deniliquin. The road spans approximately 35 km between Conargo and Deniliquin and mainly services local traffic.

Other main roads within vicinity of the project area are Wanganella - Conargo Road, the Cobb Highway (B75), Sturt Highway (A20) and Newell Highway (A39).

6.11.2 Impacts

Construction

Access to the project area would be via the sealed Conargo Road and an unsealed access track from Conargo Road to the project area. Construction of the project may include upgrade to the existing access track from Conargo Road, which would involve surfacing with local stream gravel compacted from 150mm by a towed roller.

Construction would have a minor temporary impact on local traffic conditions. Additional vehicle movements above existing traffic levels are expected to be about 10 heavy vehicle movements. The rural road network has a large capacity to accommodate construction vehicles, and so traffic impacts during construction would be negligible. No roads closures would be required for the works. Construction vehicles would park within the Contractors Activity Zone in the project area.

Access to the private property, approximately 1 km south of the project area, is via a separate access track and therefore would not be impacted by construction of the project.

Operation

It is expected that operational traffic would be consistent with current activities and therefore no long-term changes to traffic and access are expected.

Periodic maintenance would be undertaken by WaterNSW which would result in minor traffic increase, but would be within the capacity of the roads.

6.11.3 Safeguards

The safeguards proposed to avoid, minimise, or manage potential impacts to traffic and access as a result of the project are included in Table 8.1.

6.12 Visual

6.12.1 Existing environment

The regional landscape is visually characterised by flat open plains and wide shallow creeks with scattered trees and vegetation along the creek edges. Existing infrastructure at the project area is low profile and largely screened by surrounding trees (refer section 283.2.3). Construction and operational access to the project area would be via an existing unsealed private access track.

The nearest sensitive receiver is located about 1 km to the south of the project area and would not have direct views of the project area due to local topography and intervening vegetation. Users of Conargo Road would have limited views of the project area due to the distance and vegetation scattered throughout the open plain and along Forest and Piccaninny creeks.

6.12.2 Impacts

Construction

Temporary impacts to visual amenity would occur during construction in the immediate vicinity of the project area. These impacts would be due to the presence of construction vehicles and equipment accessing work sites. Visual impacts are not considered to be significant due to the short duration of the construction period and lack of sensitive receivers that have visibility towards the Contractors Activity Zone.

Operation

The proposed infrastructure would only be visible from the immediate vicinity (the project area) and would not be visible from the closest sensitive receiver.

The structure would be similar in appearance of those associated with water infrastructure in the surrounding region. Its low profile would mean that it would only be visible when in close proximity to the new works, and not from any public viewpoints along Conargo Road.

Therefore, visual impacts are considered to be negligible.

6.12.3 Safeguards

There are no specific safeguards proposed to address negligible visual impacts as a result of the project. Standard construction practices would be followed.

6.13 Socio-economic

6.13.1 Existing environment

The Edward River LGA covers an area of about 8,880 km^2. The Edward River LGA has a population of 8,437 (2021 Census), with about 7,862 residing in the city of Deniliquin.

The LGA includes a number of smaller population centres surrounding the city of Deniliquin, including the towns Blighty, Booroorban, Conargo, Mayrung, Morago, Pretty Pine and Wanganella (Edward River Council website, 2016). These small towns and villages access the larger centre of Deniliquin for a range of educational, social, employment and medical services.

In 2016, the main employment industry in the Edward River LGA was agriculture, forestry and fishing, employing 16.5% of the workforce. Other industry sectors which residents work mainly include health care and social assistance, retail trade, manufacturing and construction.

Conargo, which is located about 35 km north of Deniliquin, is the main town in the vicinity of the project located approximately 6 km to the north-east. In 2016, the population of Conargo was 123 people.

The town is relatively small and includes a rural fire brigade service, tourist information centre, church, public school and a convenience store. The surrounding rural area consists of large farms and merino studs.

There is currently one existing private irrigation pump which takes water from the Warriston Weir pool.

6.13.2 Impacts

Construction

The scope and significance of potential socio-economic impacts during construction would be limited due to the remote context of the project and minimal potential for social impacts to occur. Amenity-related impacts (including air, noise and visual) are addressed in sections 6.6, 6.10 and 6.12 would be considered negligible due to the minor impacts and the lack of sensitive receivers to the project area.

Construction of the project may provide temporary economic benefits to Conargo and other local towns in the surrounding area through sourcing of local jobs and supplies.

Operation

The project aims to divert unplanned flows in Forest Creek downstream of the existing Warriston Weir into Piccaninny Creek and back to Billabong Creek to help supply water demand. The reduction in unplanned flows over Warriston Weir into Forest Creek is anticipated to result in a more efficient delivery of water, including for irrigation. The project would not adversely affect current access to water from Forest or Piccaninny creeks or the allocation of water under the water sharing plan.

Ongoing consultation is being held with private irrigators and stakeholders in relation to the operation of the project and ongoing water allocations, as outlined in section 5, and potential impacts would be mitigated through the implantation of the safeguards in Table 8.1.

6.13.3 Safeguards

Specific safeguards proposed to avoid, minimise, or manage potential socio-economic impacts as a result of the project are included in Table 8.1.

6.14 Land use

6.14.1 Existing environment

The project is located within the Edward River LGA. The relevant local planning instrument for the project is the Conargo LEP 2013. The land use zoning of land at the location of the project is Zone RU1 Primary Production (see Figure 4.1).

6.14.2 Impacts

Section 3.9 describes the land requirements for the project, which includes temporary occupation, permanent acquisition and access for operation and maintenance. Once construction is complete, with the exception of the area required for the infrastructure, the works areas would be reinstated and returned to the former land use. No ongoing land use impacts are anticipated.

6.14.3 Safeguards

There are no specific safeguards proposed to address land use. Agreements and /or lease agreements would be entered into with private landowners as detailed in Section 3.9.

6.15 Cumulative

6.15.1 Existing environment

The project forms part of the overall YCMP which involves infrastructure upgrades and new installations to improve water management across the Yanco Creek system.

The project, known as *Part 4 – Forest Creek Return Flows via Piccaninny Creek* is one of several project parts comprising the YCMP. Subject to receiving approval, it is expected that construction would commence in mid-2025 and take approximately 2-3 months to complete.

The nearest YCMP project part to the project area is located approximately 15 km east at Hartwood Weir on Billabong Creek (YCMP Part 2A – Hartwood Regulator). The proposed works involve

replacing the existing weir with a new regulator and fishway. Construction at the Hartwood Weir site is anticipated to start mid-2024 and be completed by the end of 2025.

A search of the NSW Major Projects website identified a number of major projects within the vicinity of the Forest Creek return flows regulator. Details of each of these projects have been included in Table 6.15.

Table 6.15 Major projects within the vicinity of the Forest Creek Return Flows project

Project name	Distance to the project area	Project details	Project timing
Conargo Wind Farm	16 km northeast	Construction and operation of a 300 MW windfarm.	Construction of the project is targeted to commence in 2027 for up to 24 months. Operation is expected to begin in 2028 or 2029.
Victoria to NSW Interconnector West	19 km north	Construction and operation of a new electrical connection between NSW and Victoria. The connection is proposed to be located across the north of Edward River LGA.	Construction of the project is targeted to commence in 2026 subject to regulatory and applicable planning approvals. Operation is expected to begin in 2028.
Currawarra Solar Farm	19 km southeast	Construction and development of a 195 MW solar farm and associated infrastructure.	Construction timing of the project is not listed. Construction duration is expected to take approximately 18 months.
Deniliquin East Battery Energy Storage System	25 km south	Construction and operation of a 100MW battery energy storage facility with associated infrastructure.	Construction of the project is targeted to commence in 2024 for approximately 12 months subject to regulatory and applicable planning approvals.
Deniliquin Battery Energy Storage System (BESS)	27 km south	Construction, operation, and decommissioning of a BESS with a capacity of 120MW and ancillary infrastructure.	Construction of the project is targeted for 2027 for approximately 12 months. Operation is expected to begin in 2028.
Tarleigh Park Solar Farm	34 km south	Construction and operation of a 90 MW solar farm.	Construction timing of the project is not listed. Construction duration is expected to take approximately 12 months.

Project name	Distance to the project area	Project details	Project timing
Yanco Delta Wind Farm	47 km northeast	Construction and operation of a wind farm 10 north-west of Jerilderie in NSW. The proposed wind farm will include approximately 210 turbines, a battery energy storage system, solar panels and associated electrical infrastructure.	Construction of the project is targeted to begin in late-2024 subject to planning approval, with an expected duration of 36 months. Operation is expected to begin in 2025 with an operation life of at least 30 years.
Booroorban (Saltbush) Wind Farm	52 km northwest	Construction and operation of a 400 MW wind farm, including 70 wind turbines.	Construction of the project is targeted to begin in 2028. Operation is expected to begin in mid-2030.
Bullawah Wind Farm	59 km north	Installation, operation, maintenance and decommissioning of up to 170 wind turbines, Battery Energy Storage System (BESS) facilities, ancillary infrastructure and temporary facilities associated with the construction of the wind farm.	Construction phase of the project is expected to begin in mid to late 2025 and take approximately 24 months.
Pottinger Wind Farm	61 km northwest	Construction and operation of a wind farm with up to 247 wind turbines, battery storage and associated infrastructure.	Construction of the project is expected to begin in 2026 and take approximately 24 months.
Romani Solar Farm	70 km northwest	Construction, operation and decommissioning of a solar photovoltaic energy generating facility of 250 MW with an associated battery energy storage system.	Construction of the project is expected to begin in late 2025. Operation is expected to begin in 2026.

6.15.2 Impacts

Construction

Given the relatively minor environmental impacts associated with the Forest Creek return flows regulator, the staggered timing for construction and the distance to each of the nearest YCMP parts and other major projects, any potential cumulative impacts associated with construction are considered to be negligible.

Furthermore, construction of each of the YCMP parts would be coordinated by NSW DCCEEW to minimise any potential cumulative impacts.

Operation

Operation of the project would be undertaken in accordance with the *Yanco Creek System Operations Plan* currently being developed for the broader YCMP, and in consultation with key stakeholders. Operation of each of the YCMP project parts would take into consideration a range of environmental and other factors when deciding which regulators to operate and the size and duration of the flows passed through those regulators. Monitoring and evaluation undertaken through the operations plan would enable ongoing improvement to the operation of the system through adaptive management and minimise any potential cumulative impacts associated with the operation of each of the project parts.

The proposed regulators would provide greater control of water levels which would be operated to meet environmental and water supply objectives. The water levels would be more variable (either higher or lower) than that currently stored behind the existing weirs, in accordance with the new proposed operations plan.

6.15.3 Safeguards

The safeguards proposed to avoid, minimise, or manage potential cumulative impacts associated with the project are included in Table 8.1.

7. Matters of national environmental significance under the EPBC Act

The MNES were considered through the environmental assessment provided in section 6, and the subsequent likelihood of the project having a significant impact on these matters is summarised in Table 7.1.

Table 7.1 EPBC matters of national environmental significance factors for consideration

MNES	Applicable?	Assessment	Impact
Listed threatened species or ecological communities	Yes	Four threatened terrestrial fauna species listed under the EPBC Act are considered to have a high likelihood of using the habitats in the study area: the Superb Parrot (*Polytelis swainsonii*) (listed as vulnerable), Australasian Bittern (*Botarurus poiciloptilus*) (listed as endangered), Australian Painted Snipe (*Rostratula australis*) (listed as endangered), and the Southern Bell Frog (*Litoria raniformis*) (listed as vulnerable). Assessments of significance for these species have been prepared in accordance with the EPBC Act and summarised in section 6.4.3. Two threatened aquatic fauna species listed under the EPBC Act are identified as likely to be present in the study area: the Murray Cod (*Maccullochella peelii*) (listed as vulnerable) and Silver Perch (*Bidyanus bidyanus*) (listed as critically endangered). Assessments of significance for these species have been prepared in accordance with the EPBC Act and summarised in section 6.5.3. No threatened terrestrial flora species listed under the EPBC Act are considered to have a high likelihood of occurrence. The Slender Darling Pea (*Swainsona murrayana*) was determined to have a moderate likelihood of occurrence (DPE 2022a). An assessment of significance for this species has been prepared in accordance with the EPBC Act and summarised in section 6.4.3.	The project is unlikely to have a significant impact.

MNES	Applicable?	Assessment	Impact
Listed migratory species	Yes	While no migratory species were recorded during the field survey, the Satin Flycatcher (*Myiagra cyanoleuca*), White-throated Needletail (*Hirundapus caudacutus*), Fork-tailed Swift (*Apus pacificus*) and the Latham's Snipe (*Gallinago hardwickii*) may occasionally occur within the study area. Assessments of significance for these species have been prepared in accordance with the EPBC Act and summarised in section 6.4.3.	The project is unlikely to have a significant impact as the project would not remove any important mudflat habitat for these species.
Wetland of international importance (listed under the Ramsar Convention)	No	There are no Ramsar wetlands in proximity to the proposed activity. The nearest Ramsar wetland (Hattah-Kulkyne Lakes) is over 200 km away from the proposed activity.	N/A
World heritage areas	No	There are no world heritage areas in proximity to the proposed activity.	N/A
National heritage places	No	There are no national heritage places in proximity to the proposed activity.	N/A
Commonwealth marine areas	No	There are no Commonwealth marine areas in proximity to the proposed activity.	N/A
Great Barrier Reef Marine Park	No	The proposed activity is not in proximity to the Great Barrier Reef.	N/A
Nuclear actions	No	No nuclear action is proposed.	N/A
Water resources (relating to coal seam gas development and/or large coal mining development)	No	The proposed activity does not entail a coal seam gas development and/or a large coal mining development.	N/A

8. Environmental management

A number of safeguards have been proposed in this REF to avoid, minimise or manage potential environmental impacts of the project (refer to Table 8.1). Should the project proceed, these safeguards would be incorporated into the relevant management plans and applies during construction and operation of the project.

8.1 Construction environmental management

A CEMP would be prepared prior to construction to outline site specific environmental management measures and performance targets that would be adopted during the construction of the project. The CEMP would detail how the safeguards proposed in this REF would be implemented, including who would be responsible for their implementation and when.

The CEMP would be prepared prior to commencement of construction. The CEMP would be a working document, subject to ongoing change and updated as necessary.

The key objective of the CEMP would be to deliver and implement the environmental commitments made in the REF throughout the construction period, together with conditions imposed by any licences and approvals. The CEMP would include the following information:

- details of all positions and contact details of all key personnel
- audit and reporting program to ensure all actions/measures are implemented
- training requirements, including site induction requirements to ensure that all personnel understand the principles of environmental management
- emergency and incident response procedures
- list of approvals to be obtained before work commences
- consultation requirements (government and community) and complaint handling procedures
- actions for meeting environmental objectives based on the mitigation measures identified in this REF and any statutory or regulatory obligations
- details of person responsible for the implementation of each action.

8.2 Operational environmental management

As discussed in section 3.5.2, the proposed Forest Creek return flows regulator would be operated in accordance with the *Yanco Creek System Operations Plan* and be consistent with water sharing plans and environmental watering requirements.

Additionally, a number of safeguards have been proposed in this REF to avoid, minimise or manage potential environmental impacts during operation of the project. These are summarised in Table 8.1.

8.3 Summary of safeguards

A summary of all measures proposed to avoid, minimise or manage potential environmental impacts of the project are detailed below in Table 8.1.

Table 8.1 Summary of safeguards

Theme	Safeguards	Responsibility	Timing
Erosion and sedimentation	Erosion protection to be considered and included in detailed design in accordance with SDLAM Acceleration Project General Technical Specification.	NSW DCCEEW	Detailed design
Acid sulfate soils	Requirement for an acid sulfate soils management plan (ASSMP) would be confirmed after final detailed design and based on the findings of geotechnical investigations.	NSW DCCEEW	Detailed design
General	A construction environmental management plan (CEMP) prepared in accordance with the NSW DCCEEW Environmental Management Plan - minimum standards guideline, will be endorsed by the NSW DCCEEW Environmental Management Plan prior to works commencing	Construction contractor	Prior to construction
Water quality	Water quality sampling would be obtained from Piccaninny Creek offtake (upstream and downstream of construction activities) prior to construction. This will allow more accurate assessment and management of potential impacts during construction.	NSW DCCEEW	Prior to construction
Vegetation clearing	The limits of the assessed Clearing and Contractor Activity Zone will be clearly marked on-site. As far as practicable, minimise vegetation clearance and disturbance, including impacts to mature trees and hollow-bearing trees. Where possible, limit clearing to trimming rather than the removal of whole plants.	Construction contractor	Prior to construction

Theme	Safeguards	Responsibility	Timing
Cultural heritage	All personnel working on site are to be provided site specific cultural heritage induction to highlight the cultural sensitivities of work sites and are to be made aware of the procedures for the management of Aboriginal cultural heritage during construction, such as the discovery of Aboriginal artefacts or other cultural material.	Construction contractor	Prior to construction
Historical archaeology and research	If project footprints or access track alignments change, then the potential for historical archaeology will need to be reconsidered for the changed area and an assessment of impact may be required.	NSW DCCEEW	Prior to construction
Aboriginal Heritage Consultation and Impact Permit	NSW DCCEEW to continue to inform the Aboriginal stakeholders about the management of Aboriginal cultural heritage through to the completion of the project. The consultation outlined as part of the Aboriginal Cultural Heritage Assessment is valid for six months and must be maintained by the proponent for it to remain continuous. If a gap of more than six months occurs, then the consultation will not be suitable to support an Aboriginal Heritage Impact Permit for the project if required.	NSW DCCEEW	Prior to construction
Traffic and access	Private landowners will be consulted about access arrangements.	NSW DCCEEW / Construction contractor	Prior to construction / construction
Environmental inductions	All workers to be provided with an environmental induction prior to starting work on site. This would include information on the ecological values of the site and measures to be implemented to protect biodiversity.	Construction contractor	Prior to construction / construction
Protection of threatened species	If any threatened species (flora or fauna) are discovered during the works, stop work immediately and notify the NSW DCCEEW. Work will only recommence once the impact on the species has been assessed and appropriate control measures provided.	Construction contractor	Prior to construction / construction

Theme	Safeguards	Responsibility	Timing
Damage to vegetation	If any damage occurs to vegetation outside of the Clearing Area and Contractors Activity Zone, notify the NSW DCCEEW - Water Project Manager and Environmental Representative so that appropriate remediation strategies can be developed.	Construction contractor	Construction
Protection of sensitive areas	Adjust methodology (e.g. avoid area, hand excavate, use hand tools for branch trimming, employ arborists to complete tree trimming of any hollow-bearing trees, implement exclusion fencing) to protect sensitive areas where possible such as hollow-bearing trees.	Construction contractor	Construction
Water flow	Based on the timing and duration of construction the requirement for a flow to be maintained during construction in Piccaninny Creek at Wanganella-Conargo Road will be discussed and agreed with the NSW Department of Primary Industries - Fisheries. This will be monitored by the Water Infrastructure Contractor Representative.	Construction contractor	Construction
Fish passage management	• If possible, schedule construction activities within the watercourse during low or no flow periods when fish passage won't be impacted. • Minimise the duration of fish passage restrictions.	Construction contractor	Construction
Erosion and sediment	Implement site specific control measures to manage potential erosion or sedimentation impacts from instream works including but not be limited to: • floating silt fences for instream works • undertaking work when flows are low/dry and minimise the duration of works within the watercourse as far as practicable • minimise clearance of vegetation and retain existing vegetation as much as possible	Construction contractor	Construction

Theme	Safeguards	Responsibility	Timing
	• develop a methodology with consideration of contingencies for moderate to high flows during instream works should this occur while works are occurring. • wherever possible, prefabricate instream structural elements prior to instream installation • install sediment controls around stockpiles and borrow areas to contain coarse soil and sediment, as applicable to prevent sedimentation of watercourses • placement of stockpiles away from the watercourse (at least 20 m of creek channels) and be covered when not in use to prevent sediment runoff, and consider whether covering of stockpiles containing coarse soil and sediment is also required • stabilise exposed soil where applicable with the appropriate structural materials and media for the construction activities (e.g., stabilisation matting, rock armour or vegetation) • regular, at least daily, visual water quality monitoring of waterways adjacent to the project area during construction, to assess the effectiveness of silt fences, so they can be fixed if necessary. If the visual assessment identifies potential water quality issues, further testing should be undertaken for comparison against the baseline. • erosion and sediment controls established prior to commencement of vegetation clearing or earthworks. These controls to be documented in the CEMP.		

Theme	Safeguards	Responsibility	Timing
Aquatic habitat disturbance minimisation	• Disturbance to riparian vegetation and snags would be limited to the assessed clearing areas and avoided wherever possible. • Relocate large woody debris and snags (>3 m long or 30 cm wide) from the construction footprint area to a suitable location upstream or downstream of the site in consultation with a qualified ecologist and the NSW DCCEEW and with WaterNSW so that the removal does not impact operations or cause future damage to the offtake. • Consult with NSW DPI - Fisheries prior to removal and relocation of in-stream snags.	NSW DCCEEW / Construction contractor	Construction
Spills or leaks	Site specific controls to be developed to manage the risk of accidental spills or leaks of fuels, oils and chemicals (such as hydraulic oils), or concrete, during construction. These controls to be documented in the CEMP and would include: • Emergency spill response procedure in accordance with the NSW DCCEEW incident management protocols. • Site specific controls to reduce the risk of the release of potentially harmful chemicals from spills or leaks entering waterways downstream. • Storage of hazardous materials such as oils, chemical and refuelling activities in bunded areas within contractor's temporary work areas. • Bunded receptacles for concrete waste including concrete slurries and washout water provided at the work sites to capture, contain and appropriately dispose of any concrete waste at a suitably licenced waste facility. These will be located as far from waterways as feasible.	Construction contractor	Construction

Theme	Safeguards	Responsibility	Timing
Weeds and pathogen management	Develop and implement a weed and pathogen control plan that includes the following requirements and measures to mitigate spread: • Vehicle, personnel, material and equipment hygiene protocols (including measures required to prevent the spread or transmission of Chytrid Fungus) as per Hygiene protocols for the control of diseases in Australian frogs (Murray et al. 2011). • Weed, pest animal and pathogen management and monitoring and reporting requirements during the construction period. Weed and pathogen management and monitoring and reporting requirements should be documented. Measures must be auditable and linked to management outcomes such as: • Identify listed weeds (identified in NSW WeedWise) in the construction area and assess the risk of additional spread prior to relocating topsoil. Implement measures to manage this risk during clear and grade, and reinstatement. • To a reasonable extent practicable during the clear and grade phase, check that vehicles and plant equipment are free of soil (dust/clods) and vegetation prior to entry and exit from the construction area. • Evaluate disturbed areas post-construction and implement rehabilitation in accordance with the appropriate safeguards.	Construction contractor	Construction

Theme	Safeguards	Responsibility	Timing
	To avoid and minimise spread of pathogens, all vehicles and plant undertaking construction works directly in the watercourse must be cleaned and free of debris prior to entrance of each waterway and on exit if working between multiple waterways (excluding vehicles and plant equipment using the constructed access route).		
Vegetation clearing	During clearing and excavation, topsoil will be retained and stored for reuse during site rehabilitation. Stockpiles are to be identified and managed in accordance with the CEMP.	Construction contractor	Construction
Pest control	Food waste accumulated on site will be stored in inaccessible bins and disposed off-site regularly so that the waste doesn't attract predatory pests such as cats and foxes.	Construction contractor	Construction
Aquatic and terrestrial fauna management	Implement the following fauna management procedures during construction, to be documented in the CEMP: • Prepare a dewatering plan for temporary works associated with the construction of the new regulator to avoid potential impacts to aquatic fauna such as fish stranding. – As a requirement of the plan, in parts of the waterway that become isolated during construction by silt curtains, coffer dams, or the block bank, entrained native aquatic fauna will be captured and relocated to a nearby suitable habitat by qualified aquatic ecologists. – Isolated reaches will be re-cleared of native fish if the isolating structures are overtopped by a flood. – Large woody debris will be removed from the dry site as a final step	Construction contractor	Construction

Theme	Safeguards	Responsibility	Timing
	following fauna salvage and dewatering. – Any groundwater that enters excavations within the work sites will be tested and, if suitable, pumped into nearby waterways or otherwise transferred into a treatment pond and treated before being discharged into nearby waterways. The CEMP will include water quality criteria for any water to be discharged into nearby waterways. • Development and implementation of handling and salvage protocols for terrestrial and aquatic fauna during construction, including legislative permit and authorisation requirements of wildlife handlers. This will include procedures for pre-clearing and clearing surveys and procedures should fauna or nests/burrows be found during these surveys. The protocols will include details of requirements, including wildlife handler/ecologist/any permits. • All fencing must be fauna friendly to minimise risk of injury from collision and include provision of egress points, for example: – Temporary to exclude construction: High visibility string of bunting or plastic mesh (not transparent) attached to star pickets with plastic caps (or weighted posts that avoid ground penetration in culturally sensitive areas). – Temporary to exclude wildlife (e.g., from open trenches): Fencing stays located inside the exclusion area, or with high visibility mesh to guide wildlife away from obstructions. Shade cloth or other suitable deterrent attached to the lower 50 cm of the outside of the		

Theme	Safeguards	Responsibility	Timing
	exclusion zone and weighted to the ground. – No barbed or razor wire will be used. – Trench management, including avoiding open trenches overnight where practicable. Where trenches cannot be closed, check trenches at the start and end of each day (i.e., dawn/dusk), and consider feasibility of measures (e.g., ramps) to aid animal escape. – Avoiding night works during periods of high insect/bird/bat activity (October to March) as far as reasonably practical, so as to minimise disturbance to fauna communication, foraging and other behaviours that depend on sound and darkness.		
Fauna vehicle protection	Construction vehicles movements will be defined in a site access plan which could include a limitation to access site during daytime only and a speed limit implemented to reduce the risk of vehicle strike to fauna.	Construction contractor	Construction
Reinstatement	• Disturbed areas will be revegetated with endemic riparian and floodplain species (replacing like for like) to be undertaken as soon as practical, progressively. • Rehabilitation at construction sites to include replacing topsoil. • Mature trees removed from the construction footprint will be cut into appropriate sections and relocated adjacent to waterways. Existing woody debris will also be relocated. Consultation with WaterNSW would be undertaken prior to reinstatement.	NSW DCCEEW /Construction contractor (in consultation with Water NSW)	Construction

Theme	Safeguards	Responsibility	Timing
Unexpected finds – Aboriginal heritage	• A traditional owner is to be present during all ground clearing works. • If an Aboriginal object is identified, it is a legal requirement under Section 89A of the NPW Act to notify Heritage NSW as soon as possible. The process for further investigations include: – Confirming if the site (find) is of Aboriginal heritage origin. This verification is to be done by a Traditional Owner – Stopping works in the vicinity of the identified Aboriginal heritage site and fencing off this area. – WaterNSW to be notified of the find. – Recording the Aboriginal heritage site (by a qualified archaeologist) and if possible, removal of the cultural material before work recommences – An AHIMS site card will be completed for each new find located under the unexpected find process – An AHIP may be required prior to certain activities recommencing. – If human skeletal remains (or suspected human remains) are encountered, all work must cease immediately and NSW Police must be contacted, they will then notify the Coroner's Office. Following this, if the remains are believed to be of Aboriginal origin, then the Aboriginal stakeholders and NSW DCCEEW — Heritage must be notified. Procedures outlined in the unexpected finds protocol within the CEMP must be followed.	NSW DCCEEW / Construction contractor	Construction

Theme	Safeguards	Responsibility	Timing
Unexpected finds – non-Aboriginal heritage	An unexpected finds protocol is to be prepared and implemented during construction to manage any unexpected historical archaeological material uncovered. The protocol needs to follow a process that if unexpected items are discovered during construction, all work will cease in the area and a WaterNSW heritage officer will be notified. The Contractor will inform the site supervisor and Project Manager, and a Historical Archaeologist will be engaged to assess the item's significance.	NSW DCCEEW / Construction contractor	Construction
Waste	All construction and operation waste would be classified in accordance with the Waste Classification Guidelines (EPA, 2014) and would be disposed of at licensed waste receiving facilities. Records are to be kept with regards to the total volume of waste disposed to: • Landfill • Recycled • Disposed offsite • Other.	Construction contractor	Construction
Hazard	Emergency contacts and response procedures will form part of the CEMP and site inductions	Construction contractor	Construction
Air quality	Dust suppression would be applied by means of water spray during any construction activities causing substantial dust.	Construction contractor	Construction
Hydrology	The proposed offtake regulator will be subject to review and flow reporting, to allow improvements in operation, as required by the Yanco Creek System Operations Plan	NSW DCCEEW – Water Group /WaterNSW	Operation

Theme	Safeguards	Responsibility	Timing
Erosion and sediment	• Erosion and sediment controls, including semi-permanent controls along the creek bed and bank as required, will be maintained post construction until disturbed areas are stabilised. • Undertake two post-construction visual assessments of the block bank and regulator over 2 years to identify and assess any erosion caused by the structure, so it can be addressed if required. • Assessment would be undertaken as part of WaterNSW's O&M works.	WaterNSW	Operation
Monitoring flow	Daily discharge will be monitored based on measured water levels and gate settings. Gate position will be set in accordance with the Operating Plan.	WaterNSW	Operation
Water quality	Site environmental management, inclusive of spill response measures, will be in accordance with broader WaterNSW O&M and environmental management procedures for operations.	WaterNSW	Operation
Fish passage during operation	Inspect the regulator annually to check that fish passage is not obstructed and remove obstructions (e.g. rocks, logs) if present.	WaterNSW	Operation
Water quality downstream of Warriston Weir	Develop and conduct a water quality monitoring program for Forest Creek, downstream of Warriston Weir, including Wanganella Wetland. This may be incorporated into existing catchment-based monitoring programs if not already covered.	WaterNSW	Operation
Fauna management during operation	• All operation personnel would be informed of environmental responsibility with respect to the protection of aquatic and terrestrial fauna and their habitat. • All vehicles driven by operation personnel would be required to remain on designated tracks and not drive through water.	WaterNSW	Operation

Theme	Safeguards	Responsibility	Timing
Hazard	Emergency contacts and response procedures will form part of the WaterNSW operation and maintenance procedures which will be incorporated into an O&M manual.	WaterNSW	Operation

9. Conclusion

9.1 Justification

Warriston Weir is currently used by WaterNSW to regulate flows in the upstream (regulated) reach of Forest Creek. A portion of the Forest Creek flow is currently diverted to Piccaninny Creek via an unregulated culvert at Piccaninny Creek offtake. Currently, unplanned flows often overtop Warriston Weir resulting in a loss of regulated water supply for licensed users and the inefficient delivery of environmental water with part of these flows lost to Billabong Creek via Piccaninny Creek.

The project involves the construction of a new regulator (Forest Creek return flows regulator) and removal of the existing pipe culvert to assist in preventing unplanned flows over Warriston Weir during normal regulated periods. This would allow for controlled water delivery via Piccaninny Creek and help supply water demand along Billabong Creek. It would also allow better control of environmental water deliveries over Warriston Weir to Forest Creek and downstream wetlands.

The project is being delivered as one of the projects of the YCMP, which forms part of the commitments within the SDLAM program being delivered by NSW DCCEEW.

Potential environmental impacts of the project have been identified and assessed in section 6 and found to be insignificant under the EP&A, BC and the EPBC Acts. Required native vegetation removal would be limited, and over time, it is expected that vegetation would regenerate in areas cleared during construction. The project is unlikely to significantly impact threatened species, populations, ecological communities or migratory species.

The objectives of the FM Act is to promote ecologically sustainable development, including the conservation of biological diversity, promote ecological sustainable development and provide social and economic benefits for the wider community. The project would be consistent with the FM Act by regulating flow, control water supply and water delivery to wetlands.

Safeguards specific to the project and the project area have been developed to avoid, minimise or manage these potential impacts and are outlined in Table 8.1.

The minor potential environmental impacts of the project are outweighed by the broader, long-term benefits and the project is considered to be in the public interest.

9.2 Objectives of the EP&A Act

A review of the project's consistency with the objectives of the *Environmental Planning and Assessment Act 1979* (EP&A Act) is presented in Table 9.1. The project is found to be consistent with the EP&A Act.

Table 9.1 Consideration of the objectives of the EP&A Act

Objective	Project response
To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.	The key objectives of the project relate to delivering improved environmental outcomes for the Yanco Creek system, as discussed in section 2.2. This is also expected to deliver positive outcomes for the local community, with negligible adverse socio-economic impacts, as described in section 6.13.
To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	This REF comprehensively assesses potential environmental impacts of the project, including potential socio-economic impacts, and has found them to be primarily positive. Potential adverse environmental impacts are minor or insignificant.
To promote the orderly and economic use and development of land.	The project is not expected to affect land use in the region.
To promote the delivery and maintenance of affordable housing.	N/A
To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats.	The design of the project has sought to minimise impacts. A biodiversity assessment considering aquatic and terrestrial biodiversity has been completed (refer to sections 6.4 and 6.5) and found that the project is unlikely to have a significant impact on threatened species, populations, ecological communities and migratory species.
To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	Potential impacts to Aboriginal heritage and non-Aboriginal heritage have been assessed in sections 6.8 and 6.9 respectively and the project will have minor or negligible effects. .
To promote good design and amenity of the built environment.	Potential visual impacts of the project area assessed in section 6.12 and were found to be negligible.

Objective	Project response
To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	N/A
To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	As described in sections 1 and 4, the project would not require approval from the Commonwealth government. The project is unlikely to significantly impact on MNES including nationally listed threatened species, ecological communities and migratory species, or the environment of Commonwealth land.
To provide increased opportunity for community participation in environmental planning and assessment.	Completed and ongoing community and stakeholder consultation is described in section 5.

9.3 Ecological sustainable development

Ecologically sustainable development is development that improves the total quality of life, both now and in the future. Clause 193 of the EP&A Regulation identifies four principles of ecologically sustainable development that are presented in Table 9.2. The table also identifies how the project aligns with each of the principles.

Table 9.2 Consideration of the EP&A Regulation principles of ecologically sustainable development

EP&A Regulation principles of ecologically sustainable development	Project response
The precautionary principle This principle states: 'if there are threats of serious or irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.'	The key objectives of the project relate to delivering improved environmental outcomes for the Yanco Creek system, as discussed in section 2.2. This REF assesses potential environmental impacts of the project, including potential socio-economic impacts, and has found them to be primarily positive. Potential adverse environmental impacts are minor or insignificant.
Intergenerational equity This principle states: 'the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.'	

EP&A Regulation principles of ecologically sustainable development	Project response
Conservation of biological diversity and ecological integrity This principle states: 'the diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong, must be maintained and improved to ensure their survival.'	A biodiversity assessment considering aquatic and terrestrial biodiversity has been completed (refer to sections 6.4 and 6.5) and found that the project is unlikely to have a significant impact on threatened species, populations, ecological communities and migratory species, and residual biodiversity impacts are low.
Improved valuation, pricing, and incentive mechanism This principle is defined as: 'Improved valuation, pricing and incentive mechanisms, namely, that environmental factors should be included in the valuation of assets and services, such as: i. polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement ii. the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste iii. environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems'.	As discussed in section 2.3, a qualitative multi-criteria analysis was carried out to assess the relative advantages and disadvantages of each project option alongside the capital cost. The preferred option was selected due to the lowest environmental impact, high functionality and design life scores and a mid-range capital cost score, giving it the best overall desired outcome score.

9.4 Conclusion

The project is subject to assessment under Division 5.1 of the EP&A Act. This REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

This REF demonstrates that the site selection, options assessment and concept design development of the project aimed to minimise environmental impacts, and the project as described in this REF best meets the project objectives described in section 2.2. Whilst the project would have some minor environmental impacts as identified in section 6, safeguards outlined in section 8.3 would avoid, minimise or manage these potential impacts.

Furthermore, the project is expected to provide broader, long-term environmental benefits to the Yanco Creek system channel and floodplain ecology and, on balance, the project is considered justified.

In response to the purpose of this REF document described in section 1.3:

- The project is not considered likely to have a significant impact on the environment and therefore preparation of an EIS under division 5.2 of the EP&A Act is not required.
- The project is not considered likely to have a significant impact on threatened species as defined by the BC Act and FM Act (referred to in section 1.7 of the EP&A Act) and therefore an SIS or a BDAR is not required.
- The project is not considered likely to have a significant impact on MNES or Commonwealth land under the EPBC Act.

10. References

Alluvium 2020, Sustainable Diversion Limit Adjustment Mechanism Options Evaluation Framework.

Alluvium Consulting Australia 2013, Yanco Creek system environmental flow study (final report). Report prepared for State Water, Leeton NSW.

Atkinson, W., & Berryman., A. 1983, Aboriginal Association with the Murray Valley Study Area, Prepared for the Victorian Land Conservation Council.

Atlas of Living Australia 2023

Australia Bureau of Statistics 2021, Census

Australian Government 2016, Environment Protection and Biodiversity Conservation Act 1999.

Australian Government 2017, Native Title Act 1993 No. 110.

Australian Platypus Conservancy 2023, Australian Platypus Monitoring Network.

Baggiano, O. 2012, The Murray-Darling Turtles: Gene Flow and Population Persistence in Dryland Rivers (Ph. D. Thesis). Griffith University, Australia.

Bureau of Meteorology 2023, Australian Groundwater Explorer.

Bureau of Meteorology 2023, Groundwater Dependent Ecosystems Atlas.

Cann, J., & Sadlier, R. A. 2017, Freshwater Turtles of Australia. CSIRO Publishing, Melbourne.

Cooling, M. P., & Gippel, C. J. 2018, Integrated Hydrological Operations Plan for the Billabong, Yanco and Colombo Creeks - Literature Review and Stakeholder Consultation. Ecological Associates report FL001-1-F prepared for Murray Local Land Services, Albury.

CSIRO 2023, Australian Soil Resource Information System.

Department of Climate Change, Energy, the Environment and Water 2006, NSW Water Quality and River Flow Objectives.

Department of Climate Change, Energy, the Environment and Water 2013, Significant Impact Guidelines 1.1 - Matters of National Environmental Significance

Department of Climate Change, Energy, the Environment and Water (2022a). National Recovery Plan for the Superb Parrot Polytelis swainsonii. Accessed at National Recovery Plan for the Superb Parrot Polytelis swainsonii - DCCEEW

Department of Climate Change, Energy, the Environment and Water (2022b). National Recovery Plan for the Australian painted Snipe (Rostratula australis). Accessed at: https://www.dcceew.gov.au/environment/biodiversity/threatened/publications/recovery/australian-painted-snipe-2022

Department of Climate Change, Energy, the Environment and Water (2022c). National Recovery Plan for the Australasian Bittern (Botaurus poiciloptilus). Accessed at: National Recovery Plan for the Australasian Bittern (Botaurus poiciloptilus) - DCCEEW

Department of Climate Change, Energy, the Environment and Water (2023) *Swainsona murrayana* — Slender Darling-pea, Slender Swainsona, Murray Swainson-pea – SPRAT profile. Accessed at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=6765

Department of Climate Change, Energy, the Environment and Water 2023, Australia's Commonwealth Heritage List

Department of Climate Change, Energy, the Environment and Water 2023, Australia's National Heritage List

Department of Climate Change, Energy, the Environment and Water 2023, Register of the National Estate

Department of Climate Change, Energy, the Environment and Water 2024a, Protected Matters Search Tool.

Department of Climate Change, Energy, the Environment and Water 2024b, Species Profile and Threats Database.

Department of Planning and Environment 2020, Murrumbidgee Long-Term Water Plan Part A: Murrumbidgee catchment, 31 July, NSW Government.

Department of Planning and Environment 2022, Yanco Creek Modernisation Project Overview.

Department of Planning, Industry and Environment 2019, Murray Alluvium Water Resource Plan – Groundwater Resource Description. Sydney: NSW Department of Planning, Industry and Environment.

Department of Primary Industries 2015, Business case for modernising supply systems for effluent creeks – Murrumbidgee River , 30 November.

Dugdale, S, Hannah, D & Malcolm, I 2013, 'River temperature modelling: A review of process-based approaches and future directions', ScienceDirect, pp. 97–113.

Edward River Council 2016

Edward River Council 2020, Annual Report 2020-2021

Fairfull, S., & Witheridge, G. 2003, Why do fish Need to Cross the Road? Fish Passage Requirements for Watercourse Crossings. Department of Primary Industries – Fisheries.

Forest Creek Working Group 2000, Management Plan for the Forest Creek System including Forest Creek, and Eight Mile Creek the Forest Anabranch Stage 1 (Draft).

Gilligan, D. 2005, Fish communities of the Murrumbidgee catchment: Status and trends. NSW Department of Primary Industries – Fisheries. Final Report Series No. 75. New South Wales Government, Parramatta.

Grant, T. R., & Temple-Smith, P. D. 2003, Conservation of the Platypus, Ornithorhynchus anatinus: threats and challenges. Aquatic Ecosystem Health & Management, 6(1), 5-18.

Horton, D. 1994, The Encyclopedia of Aboriginal Australia.

Jacobs, 2023. *Preliminary Salinity Impact Assessment for SDLAM case study projects*.

Lamontagne, S., Taylor, A.R., Crosbie, R.S., & Cook, P.G. 2001, Interconnection of surface and groundwater systems – River losses from losing/disconnected streams. Billabong Creek site report. CSIRO: Water for a Healthy Country National Research Flagship, Adelaide.

Littleton, J 1999, 'East and West: Burial Practices along the Murray River', Archaeology in Oceania, vol. 34, no. 1, pp. 1–14.

McIntyre, S 1987, Archaeological Survey of the Proposed Wagga to Darlington point 330 kV Transmission Line, The Electricity Commission New South Wales.

Mid Murray Zone Bush Fire Management Committee 2009, Bush Fire Risk Management Plan.

Murray-Darling Basin Authority 2023, Murray Darling Basin Plan.

NSW DCCEEW 2023a, BioNet Vegetation Classification

NSW DCCEEW 2023b, NSW State Vegetation Type Map

NSW Department of Planning & Environment 2023, State Heritage Inventory

NSW Department of Planning & Environment 2023, State Heritage Register

NSW Department of Planning & Environment 2023, Threatened biodiversity profile search.

NSW DCCEEW 2024a, BioNet Atlas.

NSW DCCEEW 2024b, NSW threatened species/community profiles.

NSW Environment Protection Authority 2009, Construction Noise and Vibration Guideline

NSW Environment Protection Authority 2014, Waste Classification Guidelines

NSW Environment Protection Authority 2023, Contaminated Land Register.

NSW Government 2020, Water Sharing Plan for the Murray Alluvial Groundwater Sources Order 2020.

NSW Government 2021, Heritage Act 1977 No 136.

NSW Government 2022, Roads Act 1993 No 33.

NSW Government 2023, Environmental Planning and Assessment Act 1979 No 203.

NSW Government 2023, Environmental Planning and Assessment Regulation 2021.

NSW Government 2023, Historical Imagery Viewer

NSW Government 2023, Biodiversity Conservation Act 2016 No 63.

NSW Government 2023, Conargo Local Environmental Plan 2013.

NSW Government 2023, Fisheries Management Act 1994 No 38.

NSW Government 2023, Crown Land Management Act 2016 No 58.

NSW Government 2023, State Environmental Planning Policy (Transport and Infrastructure) 2021.

NSW Government 2023, Standard Instrument — Principal Local Environmental Plan (2006 EPI 155a).

NSW Government 2023, National Parks and Wildlife Act 1974 No 80.

NSW Government 2023, Protection of the Environment Operations Act 1997 No 156.

NSW Government 2023, State Environmental Planning Policy (Biodiversity and Conservation) 2021.

NSW Government 2023, State Environmental Planning Policy (Planning Systems) 2021.

NSW Government 2023, Water Management Act 2000 No 92.

NSW Transport Asset Holding Entity 2023, Section 170 Heritage and Conservation Register.

NSWDPIE 2021, Epizootic Haematopoietic Necrosis Virus (EHNV). Available at: https://www.dpi.nsw.gov.au/fishing/aquatic-biosecurity/aquatic-industries/wildfish-shellfish/ehnv [accessed 26 November 2022]. Department of Planning, Industry and Environment. New South Wales Government, Parramatta.

Office of Environment & Heritage 2009, Interim Construction Noise Guideline.

Read, PJ. 1983, A history of the Wiradjuri People of New South Wales 1883-1969. [PhD thesis, Australian National University].

The National Trust Register 2023

Tindale, NB. 1974, Aboriginal Tribes of Australia - Their Terrain, Environmental Controls, Distribution, Limits, and Proper Names, Australian National University Press, Canberra.

Transport for NSW 2023, NSW Road Network Classifications

Turner, A., Wassens, S. & McNeil, D. 2020, Yanco Creek and tributaries: Intensive frog surveys of creek and farm habitats 2019-20. Final report for Yanco Creek and Tributaries Advisory Council. Institute of Land Water and Society, Charles Sturt University, Albury.

TurtleSAT 2023

UNESCO World Heritage Convention 2023, World Heritage List

Walcott, A, Wolfenden, B, Hall, A & Wassens, S 2018, Yanco-Billabong Creek Broad-scale Wetland Monitoring Project: Frog communities of the Yanco-Billabong creek system. Institute of Land Water and Society, Albury/Wodonga.

WaterNSW 2023, Real Time Data

11. Terms and abbreviations

Glossary of terms

Term	Definition
Block bank	A block bank is a bank or wall, usually of earthen material, that acts as a dam that blocks the flow of water resulting in an increase in the water level upstream of the bank.
Effluent	An effluent stream is one that leaves the main river and does not return.
Environmental water	Environmental water is water that is allocated and managed specifically to maintain and improve the health of rivers, wetlands and floodplains.
Regulated river	A river that is gazetted under the *NSW Water Management Act 2000*. Flow is largely controlled by major dams, water storages and weirs.
Sustainable diversion limit	Defined by the Murray-Darling Basin Plan. The maximum long-term annual average quantities of water that can be taken, on a sustainable basis, from the Murray-Darling Basin's water resources as a whole, and the water resources, or particular parts of the water resources, of each water resource plan area.
Sustainable diversion limit adjustment mechanism (SDLAM)	A mechanism under the Murray-Darling Basin Plan that allows the sustainable diversion limit to be adjusted under certain circumstances.
Water resource plan (WRP)	A document prepared by state authorities and accredited by the Commonwealth under the Basin Plan. The document describes how water will be managed and shared between users in an area.
Water sharing plan (WSP)	A plan made under the *NSW Water Management Act 2000* that sets out specific rules for sharing and trading water between the various water users and the environment in a specified water management area. It forms part of a WRP.
Water entitlement	The volume of water authorised to be taken and used by an irrigator or water authority; includes bulk entitlements, environmental entitlements, water rights, sales water and surface-water and groundwater licences.

Abbreviations

Abbreviation	Definition
AHD	Australian Height Datum
ALA	Atlas of Living Australia
APC	Australia Platypus Conservancy
APMN	Australian Platypus Monitoring Network
ASRIS	Australian Soil Resource Information System
ASSMP	Acid Sulfate Soils Management Plan
BAM	Biodiversity Assessment Method
BC Act	Biodiversity Conservation Act 2016
BDAR	Biodiversity Development Assessment Report
BFRMP	Bushfire Risk Management Plan 2009
BOS	Biodiversity Offset Scheme
CAZ	Contractor Activity Zone
CAG	Community Advisory Group
CEMP	Construction Environment Management Plan
CEWH	Commonwealth Environmental Water Holder
CEWO	Commonwealth Environmental Water Office
CHL	Commonwealth Heritage List
CLM Act	Crown Land Management Act 2016
CNVG	Construction Noise and Vibration Guideline
DCCEEW	The Australian Government Department of Climate Change, Energy, the Environment and Water
DECC	Department of Environment and Climate Change

Abbreviation	Definition
DFG	Design Focus Group
DPE	Department of Planning and Environment
DPI	Department of Primary Industries
EEC	Endangered Ecological Community
EHNV	Epizootic Hematopoietic Necrosis Virus
EIS	Environmental Impact Statement
EP&A Act	Environmental Planning and Assessment Act 1979
EPA	Environment Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPI	Environmental Planning Instrument
EPL	Environment Protection Licence
FM Act	Fisheries Management Act 1994
GDE	Groundwater Dependent Ecosystem
GL	Gigalitres
ILUA	Indigenous Land Use Agreement
KFH	Key Fish Habitat
km	Kilometres
LEP	Local Environmental Plan
LGA	Local Government Area
MDBA	Murray-Darling Basin Authority
MLTWP	Murrumbidgee Long-Term Water Plan
MNES	Matters of National Environmental Significance

Abbreviation	Definition
NATA	National Association of Testing Authorities
NHL	National Heritage List
NSW	New South Wales
NT Act	Native Title Act 1993
NTR	National Trust of Australia Register
OCs	Organochlorine pesticides
OPs	Organophosphorus pesticides
PAHs	Phenoxyacetic Acid Herbicides
PCT	Plant Community Type
PMST	Protected Matters Search Tool
POEO Act	Protection of the Environment Operations Act 1997
PU	Planning Units
REF	Review of Environmental Factors
RNE	Register of the National Estate
SAG	Stakeholder Advisory Group
S170	Section 170 Heritage and Conservation Registers
SDL	Sustainable Diversion Limit
SDLAM	Sustainable Diversion Limit Adjustment Mechanism
SEPP	State Environmental Planning Policy
SHI	State Heritage Inventory
SHR	State Heritage Register
SIS	Species Impact Statement

Abbreviation	Definition
SSD	State Significant Development
SSI	State Significant Infrastructure
SVTM	State Vegetation Type Map (NSW)
TEC	Threatened Ecological Community
TfNSW	Transport for New South Wales
WHL	World Heritage List
WINSW	Water Infrastructure New South Wales
YACTAC	Yanco Creek and Tributaries Advisory Council
YCMP	Yanco Creek Modernisation Project

Appendix A Clause 171 Environmental Factors Checklist

The following factors listed in clause 171(2) of the EP&A Regulation, have also been considered to assess the likely impacts of the Proposed Activity on the environment. These are provided in the table below. These considerations are required to comply with sections 5.5 and 5.7 of the EP&A Act.

Environmental Factor	Impact
(a) the environmental impact on the community	The key objectives of the project are about delivering improved environmental outcomes for the Yanco Creek system, as discussed in section 2.2. This is also expected to deliver positive outcomes for the local community, with negligible adverse socio-economic impacts, as described in section 6.13.
(b) the transformation of the locality	The project is not expected to significantly affect land use in the region. The project is replacing existing infrastructure. Potential visual impacts of the project assessed in section 6.12 were found to be negligible.
(c) the environmental impact on the ecosystems of the locality	A biodiversity assessment considering aquatic and terrestrial biodiversity has been completed (refer to sections 6.4 and 6.5) and found that the project is unlikely to have a significant impact on threatened species, populations, ecological communities and migratory species, and residual biodiversity impacts are low.
(d) reduction of the aesthetic, recreational, scientific or other environmental quality or value of the locality	This REF assesses potential environmental impacts of the project and has found them to be primarily positive. Potential adverse environmental impacts are minor or insignificant.
(e) the effects on any locality, place or building that has— **(i) aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance, or** **(ii) other special value for present or future generations**	Potential impacts to Aboriginal heritage and non-Aboriginal heritage have been assessed in sections 6.8 and 6.9. This concludes that no Aboriginal cultural heritage sites or areas of archaeological potential were identified and therefore no impact assessment is needed.

Environmental Factor	Impact
(f) the impact on the habitat of protected animals, within the meaning of the *Biodiversity Conservation Act 2016*	A biodiversity assessment considering aquatic and terrestrial biodiversity has been completed (refer to sections 6.4 and 6.5) and found that the project is unlikely to have a significant impact on threatened species, populations, ecological communities and migratory species, and residual biodiversity impacts are low.
(g) the endangering of a species of animal, plant or other form of life, whether living on land, in water or in the air	
(h) long-term effects on the environment	This REF assesses potential environmental impacts of the project and has found them to be primarily positive. Potential adverse environmental impacts are minor or insignificant.
(i) degradation of the quality of the environment	
(j) risk to the safety of the environment	The project is to replace the existing infrastructure and would not create risks to the safety of the environment.
(k) reduction in the range of beneficial uses of the environment	The key objectives of the project are about delivering improved environmental outcomes for the Yanco Creek system, as discussed in section 2.2. The project is not expected to significantly affect land use in the region. The project is replacing existing infrastructure.
(l) pollution of the environment	There is a low potential for minor impacts to water quality due to erosion and sedimentation during construction, as assessed in section 6.2. This risk is readily managed by standard construction practices and additional safeguards outlined in Table 8.1.
(m) environmental problems associated with the disposal of waste	Waste management during construction of the project is a minor risk and would be readily controlled by construction practices and safeguards outlined in Table 8.1.
(n) increased demands on natural or other resources that are, or are likely to become, in short supply	Concrete and steel quantities used for construction are widely available and would deliver long-term beneficial environmental outcomes by operation of the project. Re-use of materials is discussed in section 6.7.
(o) the cumulative environmental effect with other existing or likely future activities	As discussed in section 6.15, given the relatively low environmental impacts associated with the project, cumulative environmental impacts are not considered likely.
(p) the impact on coastal processes and coastal hazards, including those under projected climate change conditions	N/A

Environmental Factor	Impact
(q) applicable local strategic planning statements, regional strategic plans or district strategic plans made under the Act, Division 3.1	The project comprises the construction and operation of a weir, and is defined as a water storage facility. Division 24 of the Transport and Infrastructure SEPP, Subsection 2.159(2)(a), provides that development for the purpose of water storage facilities may be carried out without consent if it is carried out by, or on behalf of, a public authority on land in Zone RU1 Primary Production, Zone RU2 Rural Landscape, Zone SP1 Special Activities, Zone SP2 Infrastructure or an equivalent land use zone. The project area is zoned RU1 Primary Production under the Conargo LEP 2013. The proponent is a public authority, therefore the project is permissible without development consent under Part 4 of the EP&A Act.
(r) other relevant environmental factors.	This REF assesses potential environmental impacts of the project, including potential socio-economic impacts, and has found them to be primarily positive. Potential adverse environmental impacts are minor or insignificant.

Appendix B Biodiversity Impact Assessment

Appendix C Aquatic Ecology and Water Quality Assessment

Appendix D Aboriginal Heritage Assessment

Appendix E Non-Aboriginal Heritage Assessment