14. Offsets

Table of contents

Table index

Figure index

14.1 Introduction

14.1.1 Overview

This chapter outlines the offset requirements and options for the Lower Fitzroy River Infrastructure Project (Project). The assessment addresses Part C in relation to safeguards, mitigation measures and monitoring and offsets, specifically Section 1.55 and Section 1.56 of the terms of reference (ToR) for the environmental impact statement (EIS). A table cross-referencing the ToR requirements is provided in Volume 3, Appendix B. The purpose of this chapter is to summarise Project offset requirements under the Commonwealth Government's environmental offsets framework and propose methods of offset delivery. Environmental values requiring offsets under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) are identified in Chapter 10 Threatened species and ecological communities.

14.1.2 Regulatory framework

Where the Project will have unavoidable impacts on certain environmental values offsets are required under legislation administered by the Australian Government and the Queensland Government. The offset requirements of the Project were assessed with reference to the following regulatory framework:

- EPBC Act and the EPBC Act Environmental Offsets Policy, administered by the Australian Government
- *Environmental Offsets Act 2014* (Qld) (EO Act), Environmental Offsets Regulation 2014 (EO Regulation) and the Queensland Environmental Offsets Policy Version 1.0, administered by the Queensland Government (DEHP 2014)

This coordinated approach to offsets across jurisdictions means that specific offsets sought under one policy will not also be sought under another policy, providing that the offsets package satisfies the requirements of both policies. A state offset will count toward an offset under the EPBC Act to the extent that it compensates for the residual impact to the protected matter identified under the EBPC Act. A description of the State offset requirements is provided in Volume 1, Chapter 22 Offsets.

The purpose of the EPBC Act Environmental Offset Policy is to outline the Australian Government's position on the use of environmental offsets to compensate for adverse impacts on matters of national environmental significance (MNES) protected under the EPBC Act. Offsets seek to provide a net environmental gain through targeted actions (direct and indirect). Under the EPBC Act, environmental offsets can be used to maintain or enhance the health, diversity and productivity of the environment as it relates to MNES. Environmental offsets do not apply where the impacts of a development are considered to be minor in nature or could reasonably be mitigated.

A suitable offset under the policy must:

- Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environmental law and affected by the proposed action
- Be built around direct offsets but may include other compensatory measures
- Be in proportion to the level of statutory protection that applies to the protected matter

- Be of a size and scale proportionate to the residual impacts on the protected matter
- Effectively account for and manage the risks of the offset not succeeding
- Be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action)
- Be efficient, effective, timely, transparent, scientifically robust and reasonable
- Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

In assessing the suitability of an offset, government decision-making will be:

- Informed by scientifically robust information and incorporate the precautionary principle in the absence of scientific certainty
- Conducted in a consistent and transparent manner.

14.1.3 Approach and methodology

The approach to developing the offset proposal for the Project consisted of the following tasks:

- Review and interpretation of current Commonwealth offsets legislation and policies
- Quantification of offset requirements:
  - Identification of prescribed activities and prescribed environmental matters
  - Assessment of residual impact from the application of mitigation and management measures. The significance of residual impacts has been determined based on the Commonwealth *Matters of National Environmental Significance - Significant impact guidelines 1.1* (DoE 2013).
- Development of offset proposal:
  - Calculation of impact and offset requirement utilising the Commonwealth Offset Assessment Guide
  - Preparation of offset management plans (or frameworks as applicable)
  - Identification of opportunities for offset staging.

14.2 Project offset requirements

14.2.1 Overview

The term ‘environmental offset’ refers to measures that compensate for the residual adverse impacts of an action on the environment. Offsets provide environmental benefits to counterbalance the impacts that remain after the implementation of avoidance and mitigation measures. These remaining, unavoidable impacts are termed ‘residual impacts’ and offsets are only required if residual impacts are significant as defined in the *Matters of National Environmental Significance - Significant impact guidelines 1.1* (DoE 2013).

Significant residual impacts are predicted for:

- Brigalow (*Acacia harpophylla* dominant and co-dominant) (Brigalow) threatened ecological community (TEC)
- Fitzroy River turtle (*Rheodytes leukops*)

- Black ironbox (*Eucalyptus raveretiana*).

A detailed assessment of potential impacts and assessment of significance for residual impacts to MNES is provided in Chapter 10 Threatened species and ecological communities.

14.2.2 Brigalow threatened ecological community

Four TECs were identified as having the potential to occur in the Project area:

- Brigalow
- Semi-evergreen vine thickets the Brigalow Belt (North and South) and Nandewar Bioregions
- Weeping Myall Woodlands
- Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin

Based on likelihood of occurrence assessment and field surveys, Brigalow is the only TEC known to or likely to occur with the Project area and for which a significant residual impact is expected to occur as a result of the Project (Chapter 10 Threatened species and ecological communities).

Clearing of Brigalow TEC to facilitate construction activities at the weir sites, along existing and new access roads and at river crossings has been avoided as far as is practicable based on current survey and design. In the order of 1.6 ha will be cleared during construction activities associated with Rookwood Weir. Further opportunities to limit the extent of clearing of this TEC will be considered during detailed design.

Inundation of Brigalow TEC is an unavoidable consequence of the Project. Not all Brigalow TEC mapped within the Project footprint has been field verified and it is considered unlikely that all mapped areas comprise vegetation and characteristics required to comprise Brigalow TEC (Section 14.3.2). Conservatively however an area of approximately 18.5 ha is predicted to be impacted as a result of impoundment at the upper limits of development (along with incremental loss for intermediate developments).

The protected Brigalow TEC RE 11.3.1 mapped within the Project footprint is known to occur within the landscape immediately surrounding the Project footprint and across the region. Residual impacts from loss across the Project area are less than 0.03 per cent of the bioregional extent of the TEC. In the order of 612 ha of remnant RE 11.3.1 is mapped within 500 m from the watercourse, and 35,153 ha is mapped within the catchment, with the area of impact equating to 3.3 per cent and 0.06 per cent respectively. Brigalow TEC is well represented in the surrounding landscape and a relatively small proportion is impacted across the Project footprint. It is proposed to undertake further field assessment to fully quantify the area of this TEC that may be lost due to impoundment as it is considered likely that a significantly lesser area of Brigalow TEC will be inundated to that currently mapped. However, where loss due to impoundment is unavoidable, an offset will be provided.

Brigalow TECs within the Project area are already substantially fragmented as a result of historic and current land uses, and it is not anticipated that the Project will further fragment this TEC. Specifically, potential impacts as a result of this Project will predominantly be limited to numerous small areas along the boundaries of vegetation along the water's edge.

14.2.3 Fitzroy River turtle

The Fitzroy River turtle is listed as vulnerable under the EPBC Act and the *Nature Conservation Act 1992* (Qld) (NC Act). The Fitzroy River turtle is endemic to the Fitzroy Basin catchment with

the species' distribution extending from the Fitzroy Barrage to the upper reaches of the Dawson, Nogoa and Connors Rivers. The distribution of the Fitzroy River turtle encompasses the Project areas and the species is known to occur within both the Eden Bann Weir and Rookwood Weir Project footprints and in areas upstream and downstream. Important habitat in the form of historically significant type localities and mapped essential habitat is present and the footprints support isolated nesting in a number of areas. Due to the proportion of the species' habitat in which the Project is located and the significance of habitats within and downstream, the Project footprint is considered to support an important population of the Fitzroy River turtle. The largest known nesting aggregation for the species occurs downstream of Eden Bann Weir in the upper reaches of the Fitzroy Barrage impoundment.

The biggest threat to the survival of the Fitzroy River turtle is the lack of recruitment into the population. Predation of nests by feral animals, goannas and water rats and trampling of nests by cattle results in extremely poor survival of egg clutches (close to 100 per cent of clutches predated each season). The bias in favour of adult turtles within the Fitzroy Basin catchment indicates that low recruitment of hatchlings has been occurring over many decades (Limpus et al. 2007).

Other threatening processes (DERM 2008) include: loss of habitat; alteration of natural flow regime; movement barriers; physical injury and mortality; and poor water quality.

Detailed information on the Fitzroy River turtle is provided in Appendix L Fitzroy River turtle (*Rheodytes leukops*) technical report. Appendix M Fitzroy River turtle Species Management Program describes measures to be implemented to avoid, and if this is not possible, minimise the potential impacts of the Project on the species and provides a framework for the management of the species throughout the life of the Project. The Species Management Program will be implemented together with the Project construction environmental management plan (EMP) and operational EMP (Chapter 13 Environmental management system).

Unavoidable impacts are expected to remain in relation to operational activities. These residual impacts are considered significant in accordance with the *Matters of National Environmental Significance - Significant impact guidelines 1.1* (DoE 2013) (Chapter 10 Threatened species and ecological communities) and offsets are proposed consistent with the EPBC Act Environmental Offset Policy (Section 14.3.3). It is considered that offsets provided to satisfy the EBPC Act Environmental Offset Policy will also satisfy the offset requirements of the EO Act. Additional offsets for aquatic habitat are provided in accordance with the Queensland Government's financial settlement offset calculator (Volume 1, Chapter 22 Offsets). Like for like offsets for aquatic habitat are not practicable and cannot be achieved for this Project due to the nature of the habitat being offset. As such it is considered that a financial contribution provided as an indirect offset is appropriate and it could be utilised for beneficial research or similar activities aimed at improving survival of the species. In the order of 950 ha of aquatic habitat is proposed to be offset in this manner.

14.2.4 Black ironbox

Black ironbox, listed as vulnerable under the EPBC Act, is considered likely to be impacted by the Project. Black iron box was detected in the Project footprint during field surveys. Black iron box is a medium to large tree from riparian habitats with a natural distribution that roughly includes sub-coastal ranges between Rockhampton and Charters Towers. The southern limit of the population includes watercourses that drain out of the lower end of the Boomer Range, with Melaleuca, Leura and Glenroy Creeks accounting for a large proportion of the species' local habitat. Principal

threats to the species are identified as: a) habitat disturbance and smothering by rubbervine; b) timber harvesting; and c) disturbance of habitat during timber harvesting operations (TSSC 2008).

A significant population (200 trees over 5 m high) of black iron box was found along Melaleuca Creek within and above the Rookwood Weir Stage 2 impoundment. The population estimates suggest an approximate average density of 44 trees per km of creek. Field observations produced an estimate of approximately 100 plants that appeared to lie within the Rookwood Weir impoundment and 100 plants above the full supply level (FSL) 49 m. The population of black iron box along Melaleuca Creek includes what appears to be a reasonable proportion of larger mature trees (diameter at breast height > 0.8 m) and a patchy mix of younger trees and saplings. This population is currently facing the very real threat of serious impact from a rubbervine infestation though it is currently healthy.

This population of black ironbox is considered an important population necessary for the species' long term survival and recovery and the loss of 100 individuals is considered a significant impact in accordance with the *Matters of National Environmental Significance - Significant impact guidelines 1.1* (DoE 2013) (Chapter 10 Threatened species and ecological communities). As such offsets are proposed consistent with the EPBC Act Environmental Offset Policy.

14.3 Offset proposal

14.3.1 Overview

The assessment of offset requirements has identified three matters of national environmental significance requiring offsetting: Brigalow TEC, Fitzroy River turtle, and black ironbox. For each of these matters an offset proposal has been developed including impact and offset calculations, development of proposed management plan (or framework as applicable) and staging considerations. The offset proposal is consistent with the offset requirements of the EPBC Act Environmental Offset Policy.

14.3.2 Brigalow threatened ecological community

14.3.2.1 Offset requirements

Clearing of Brigalow TEC, to facilitate construction activities at the weir sites, along existing and new access roads and at river crossings has been avoided as far as is practicable based on current survey and design. In the order of 1.6 ha is predicted to be cleared during construction activities associated with Rookwood Weir. Further opportunities to limit the extent of clearing will be considered during detailed design. No Brigalow TEC is predicted to be cleared during construction activities associated with Eden Bann Weir.

Inundation of Brigalow TEC is an unavoidable consequence of the Project. In the order of 18.5 ha of Brigalow TEC is predicted to be impacted by operation (impoundment) of the Project at the upper limits of development. Areas impacted for Eden Bann Weir and Rookwood, respectively and include:

- Eden Bann Weir: 0.3 ha associated with Stage 2 impoundment; and 0.7 ha (cumulative) associated with Stage 3 impoundment
- Rookwood Weir: 2.3 ha associated with Stage 1 impoundment; and 17.8 ha (cumulative) associated with Stage 2 impoundment

It is likely that the total area of Brigalow TEC impacted by impoundment will be substantially less than the estimated 18.5 ha. Of this total, 8.1 ha (44 per cent) have been field verified (Nangura

2007) while the remaining 10.4 ha were determined based on mapping as produced by the Department of Natural Resources and Mines (DNRM) and are thus unverified. The estimated 18.5 ha also comprises mixed polygons, and where these polygons extend into adjacent alluvial areas, the percentage containing RE 11.3.1 may occur outside of the proposed impoundment.

An estimated 6.3 ha (61 per cent) of the unverified Brigalow TEC is mapped as occurring within and along Gogango Creek at the upper limits of the impoundment associated with Rookwood Weir. It is rare that Brigalow TEC persists within creek bed and banks due to the sensitivity of *Acacia harpophylla* to prolonged or frequent inundation (Nangura 2007). Nevertheless, the community is known to occasionally occur in association with river and creek flats (DoE 2014) and therefore the presence of the Brigalow TEC along Gogango Creek cannot currently be discounted.

Prior to the commencement of Project activities, further ecological surveys will be undertaken to verify the area of Brigalow TEC present and impacted as a result of the Project in accordance with approved conservation advice for this community (TSSC 2013).

14.3.2.2 Offset availability

A geospatial analysis was undertaken to determine the availability of potential offset sites for the Brigalow TEC within a 20 km radius surrounding the Project footprint. The following criteria were applied to the analysis:

- Pre-clear mapping of RE 11.3.1
- Freehold tenure
- Areas mapped as non-remnant.

The Commonwealth EPBC Act Environmental Offsets Policy does not require offsets to be on freehold land or within areas mapped as non-remnant. Nevertheless, these criteria were applied such that a conservative approach was adopted. Furthermore, it is relevant to note that there are other pre-clear RE types that would be suitable for use as an offset for the Brigalow TEC, such that this offset availability analysis is likely an underestimation of areas available and suitable for potential offsets.

The geospatial analysis identified a total of approximately 51,000 ha of potentially suitable offsets for the Brigalow TEC in proximity to the Project area. This area is substantially greater than the area of offset that would need to be provided for potential impact to up to 20 ha of Brigalow TEC.

14.3.2.3 Further ecological surveys

As noted above, further ecological surveys will be undertaken prior to the commencement of Project activities to verify the area of Brigalow TEC present and impacted as a result of the Project. This survey will include 'ecological equivalence' assessments of potential impact areas and offsite sites to determine their condition, which will in turn determine the quantum of offsets required and the suitability of potential offset sites. Subsequently, a Brigalow TEC offset management plan will be developed to detail the proposed approach to offset delivery and a framework for the management of the offset area.

14.3.2.4 Offset staging

A conservative total estimate of 20.1 ha of Brigalow TEC is proposed to be offset as a result of Project that is raising Eden Ban Weir to Stage 3, construction of Rookwood Weir to Stage 2 and development of all ancillary components (including construction areas, access roads and river

crossings). The Project is expected to be staged with sequencing and timing dependent on a number of demand triggers. The Project will be implemented by way of a flexible strategy to allow the rapid delivery of water to meet anticipated future water demands, when triggered. There is yet to be a decision on the order or composition in which the proposed developments will proceed. As shown in Table 14-1 the provision of offsets for Brigalow TEC will be staged in accordance with development of the Project.

Table 14-1 Brigalow TEC offset staging

Stage	Brigalow TEC offset provision
Eden Bann Weir Stage 2	Construction activities: nil offsets Impoundment: offset up to 0.3 ha
Eden Bann Weir Stage 3 (FSL 20.2 m)	Construction activities: nil offsets Impoundment: offset a further (up to) 0.4 ha
Rookwood Weir Stage 1 (FSL 45.5 m)	Construction activities: offset up to 1.4 ha Impoundment: offset up to 2.3 ha
Rookwood Weir Stage 2 (FSL 49 m)	Construction activities: offset up to 0.2 ha Impoundment: offset a further (up to) 15.5 ha

14.3.3 Fitzroy River turtle

14.3.3.1 Overview

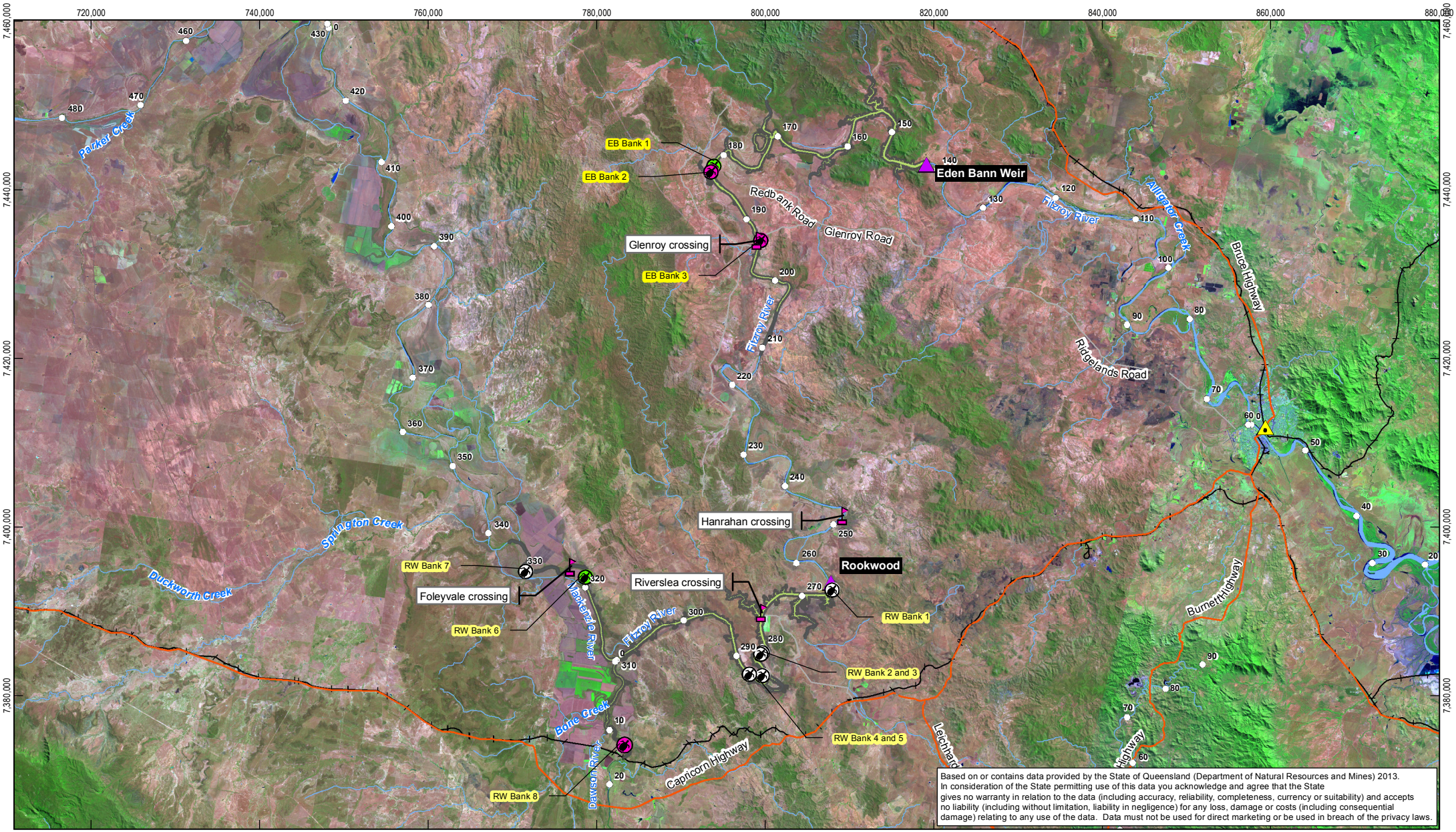
The offset proposal for the Fitzroy River turtle has been developed using the Offsets assessment guide that accompanies the EPBC Act Environmental Offsets Policy. The Offsets assessment guide utilises a balance sheet approach to estimate impacts and offsets. The offset proposal presented here is considered to satisfy the Commonwealth offset requirements.

14.3.3.2 Impact calculator

Direct residual impacts to Fitzroy River turtle nesting as a result of the Project will occur through the inundation of nesting habitat within the Project footprints (Figure 14-1).While the Project's residual impact is related to the loss of turtle nesting habitat, protecting nests is considered more effective than protecting nesting habitat in relation to improving birth rates and recruitment of hatchlings into the population.

The biggest threat to the survival of the Fitzroy River turtle is the lack of recruitment into the population. Nest predation rates are currently extremely high with close to 100 per cent of clutches predated each season (Limpus et al. 2007; DERM 2008). The key predators of turtle eggs include: feral animals (foxes, dogs, pigs and cats), goannas and water rats. Trampling of nests by cattle has also contributed to low recruitment into the population (Limpus et al. 2007; DERM 2008).

A study conducted at the Tartrus Weir, on the Mackenzie River, found that 100 per cent of the 90 clutches identified in the aggregated nesting area downstream had been destroyed (Limpus et al. 2011). Similarly, 13 of 15 clutches located at on an island in the Isaac River had been predated or destroyed by trampling (Limpus et al. 2011).



1:600,000 (at A4)

0 10 20

Kilometres

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

N

LEGEND

- AMTD (km)
- Weir Location
- Fitzroy Barrage
- River Crossing
- Highway
- Minor Road
- Waterway
- Railway
- Historical turtle nesting site
- Confirmed turtle nesting site
- High Potential Turtle Nesting Suitability
- Rookwood Weir Stage 1 impoundment
- Rookwood Weir Stage 2 impoundment
- Eden Bann Weir Stage 2 impoundment
- Eden Bann Weir Stage 3 impoundment

GHD CLIENTS | PEOPLE | PERFORMANCE

Gladstone Area Water Board

SunWater Making Water Work

Gladstone Area Water Board, SunWater
Lower Fitzroy River Infrastructure Project

Job Number 41-20736
Revision C
Date 04 Aug 2014

Location of historical, confirmed and high potential nesting habitat within the Project footprints

Figure 14-1

G:\41\20736\GIS\Projects\MXD\900_Baseline Terrestrial Fauna Report\4120736_915_Nesting_both_weir_Rev_A.mxd

Level 9, 145 Ann St Brisbane QLD 4000 **T** 61 7 3316 3000 **F** 61 7 3316 3333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

Data Source: © Copyright Commonwealth of Australia (Geoscience Australia): Waterways, State (2007); Sunwater: Waterways, Weir Locations - 2008; DNRM: Roads - 2010, Railways - 2010, Imagery/2005, Essential Habitat /2008. Created by: MS

The high mortality of rate has led to a significant reduction in the recruitment of hatchlings over the last decade. The Fitzroy River turtle population is now primarily comprised of adult individuals. The high rates of nest predation and bias in favour of adult turtles has been observed at all sites surveyed throughout the Fitzroy Basin catchment (Limpus et al. 2007; Limpus et al. 2011) inclusive of Project areas.

While mitigation measures are proposed (Chapter 13 Environmental management system) the Project has the potential to increase the abundance of predators within the Eden Bann Weir and Rookwood Weir impoundments. The increase in permanent water resource availability may increase the abundance of terrestrial predators, potentially resulting in an increase in predation of Fitzroy River turtle nests. Nesting habitat located within the impoundments may also be subject to increased rates of trampling by cattle with river margins made more accessible. Weed infestation within the Fitzroy catchment also impacts upon turtle nesting success as weeds prevent turtles from accessing suitable nesting habitat.

Due to the existing extremely high predation rates (close to 100 per cent) the potential Project impact on birth rate is considered to be minimal. Direct residual impacts on Fitzroy River turtle as a result of the Project will occur through inundation of nests. Conservatively the Project is expected to impact 80 per cent of nests within the inundation area. Not all nests would be inundated every year.

Current recruitment rates are not considered adequate to sustain the Fitzroy River turtle population within the catchment (Limpus et al. 2007). As such, the protected matters attribute proposed to be protected and managed through the provision of an offset is Fitzroy River turtle birth rate. The protection and management of nests will improve nest success and thus birth rate; will target Project specific impacts; as well as address the key processes currently threatening the survival of the species throughout the catchment. These actions will reduce nest predation, increase population recruitment and promote the recovery of the species.

Table 14-2 presents the impact calculator relative to birth rate in relation to the Fitzroy River turtle.

14.3.3.3 Offset calculator

Table 14-3 is an extract of the Offsets assessment guide relevant to calculating offset requirements for residual impacts to the Fitzroy River turtle. The calculator shows that the degree to which the proposed offset compensates for the total quantum of impact is 100 per cent and therefore the direct offset requirement is met (offsets are required to achieve at least 90 per cent) and no additional financial contributions are required.

In order to offset the residual impact of the Project on Fitzroy River turtle it is proposed that a nest protection program be implemented. Greening Australia currently implements a Fitzroy River Turtle Conservation Program with funding contributions from Australia Pacific LNG and the Fitzroy Basin Association. It is proposed that funding will be provided by the Project to continue this program or to develop similar programs.

Table 14-2 Impact calculator for Fitzroy River turtle

Protected matter attribute	Description	Quantum of impact	Unit	Information source
Birth rate	Loss of nests	80	%	Predation of nesting banks by feral animals, goannas and water rats and trampling of nests by cattle results in extremely poor survival of egg clutches (close to 100 per cent of clutches predated each season). Sourced from reports: Limpus et al. 2007; Limpus et al. 2011; DERM 2008 Chapter 10 Threatened species and ecological communities; Appendix L Fitzroy River turtle technical report.

Table 14-3 Fitzroy River turtle offset calculator

Protected matter attribute	Total quantum of impact	Proposed offset	Time horizon (years)	Start value	Future value		Raw gain	Confidence in results	Adjusted gain	Net present value	% of impact offset	Information source
					Without offset	With offset						
Birth rate	80%	Nest protection	5 (until ecologic benefit)	5	5	95	90	90%	81	80	100	Limpus et al. 2011 Connell and Wedlock 2006 Connell 2011 Connell 2012 Stockfeld and Kleinert 2013

To protect natural nests the program would aim to:

- Identify and select priority nesting banks within the Fitzroy catchment where there is an aggregation of the Fitzroy River turtle (for example Alligator Creek) (Section 14.3.3.4).
- Identify landowners willing to participate in the protection program and allow access to the river bank during the nesting season
- Field officers or volunteers would:
  - Monitor stream banks for signs of turtle nesting, especially after rainfall
  - Secure a 70 – 100 cm square plastic mesh cover with a 10 cm grid (to allow hatchlings to escape) with sand pegs
  - Mark nests with a numbered stake to allow hatching success to be monitored.
- Encourage landowners to use electric fences during the nesting season to minimise trampling by stock or more permanent fencing if preferred
- Manage terrestrial and aquatic weeds to prevent weeds from blocking access to suitable nesting habitat (Weed Management Plan).

A Feral Animal Control Program will also be developed and implemented for the Project in collaboration with local councils, community groups and landholders. Specific control measures may include culling, baiting and trapping of pigs, foxes, wild dogs and feral cats. The Feral Animal Control Program will be developed in accordance with approved conservation advice for the species and approved threat abatement plans for feral cats (DEWHA 2008a), European red fox (DEWHA 2008b) and feral pigs (DEH 2005).

It would be ideal to legally secure the land within the offset areas however the nesting banks are mainly within unallocated state land and nesting locations will vary from year to year thus making it unfeasible to secure the land.

Nest protection programs implemented at Alligator Creek by Greening Australia (assisted by the Fitzroy Basin Association, and under guidance from DEHP) (Limpus et al. 2011) and in other river systems throughout Australia (Connell and Wedlock 2006; Connell 2011; Connell 2012; Stockfeld and Kleinert 2013), are shown to immediately improve turtle nesting success and recruitment of hatchlings within a single breeding season. In 2007 the Greening Australia team protected over 110 nests with an average of 15 eggs per nest. The sites were searched every morning at dawn for evidence of new nests between mid-September and the end of November (Hale 2009). A protective mesh was placed over nests found to keep predators from gaining access but still allowing the turtles to hatch and make their way to the water. It is estimated that over 1700 hatchlings reached the Fitzroy River (Hale 2009). This success was repeated in 2008 (Hale 2009). It is estimated that the time required for the proposed offset to achieve ecological benefits is five years.

During periods of management, recruitment of hatchlings at Alligator Creek is shown to increase (Greening Australia, Dr Col Limpus, pers comms). Nest management has also proven successful at protecting the Mary River turtle (*Elusor macrurus*) along the Mary River (Connell and Wedlock 2006; Connell 2011; Connell 2012) and broad-shelled river turtle nests (*Chelodina expansa*) on Gunbower Island (Stockfeld and Kleinert 2013), resulting in an increase in the recruitment of hatchlings into the population. Due to the existing extremely high predation rates (close to 100 per cent), it is considered that the future value of the Fitzroy River turtle birth rate without secure and consistent management from the proposed offset will be at a low level (rated as 5 out of 100).With

protection and the implementation of management measures proposed, the future value of the Fitzroy River turtle birth rate is predicted to improve (rating of 95 out of 100). This improvement as has been observed during implementation of nest management programmes at the Alligator Creek site and in other similar environments. Based on proven results, the confidence in the proposed change in nesting success and improved recruitment of hatchlings is 90 per cent.

The Greening Australia Fitzroy River Turtle Conservation program is currently funded by contributions from Australia Pacific LNG (one nesting season) and the Fitzroy Basin Association. This current program utilises volunteers for implementation of the program. It is likely that paid staff would be required to guarantee the program and therefore these costs have been considered within the Project's offset proposal based on an estimate of cost provided by Greening Australia (April 2015), inclusive of costs associated with pest management and weed control. Offset costs are included within the Project's economic analysis (Chapter 12 Environmental management system; Appendix S) and cover a period of five years during which time it is expected that an ecological benefit would be achieved. The birth rate and nesting success of the species will be monitored and reviewed over time. When it can be shown that the nesting banks within the inundation zones have re-established and that the Fitzroy River turtle population has recovered and has viable recruitment into the population, the program will cease.

It is considered that as the current funding is generally limited and inconsistent to support the continuity of programmes, the Project's proposal to guarantee secure funding for conservation programs, such as the Greening Australia Fitzroy River Turtle Conservation Program, will improve nesting success and achieve ecological benefits.

14.3.3.4 Potential offset areas

Table 14-4 and Table 14-5 show nesting sites identified within the Eden Bann Weir and Rookwood Weir impoundments, respectively (Figure 14-1) where potential nesting habitat would remain above the full supply level of the impoundments. The methodology for nesting site identification is provided in Appendix L.

There are three sites within the upper reaches of the proposed Rookwood Weir impoundment that could be suitable offset sites; particularly the confirmed nesting site on the Mackenzie River (329 km AMTD). While potential nesting habitat would remain at Glenroy Crossing above the full supply level of Eden Bann Weir Stage 2, this habitat would likely be inundated by the Stage 3 impoundment.

In addition to the sites identified within the impoundment, further potential sites were identified based on a desktop assessment outside the impoundment as follows:

- Nine sites were identified downstream of Eden Bann Weir to the Fitzroy Barrage impoundment
- Ten sites were identified between the upper extent of the proposed raised Eden Bann Weir impoundment and the proposed Rookwood Weir site
- Twenty-seven sites were identified within 50 km upstream of the Rookwood Weir impoundment on the Dawson and Mackenzie rivers.

Table 14-4 Historical, confirmed and high potential nesting sites within the Eden Bann Weir impoundment

Site number	Nesting site location	Nesting habitat suitability (field verified)	Eden Bann Weir	
			Stage 2	Stage 3*
EB Bank 3	Glenroy Crossing Fitzroy River (193 km AMTD)	Historical	Potential nesting habitat remains above the impoundment	Unlikely to be suitable nesting habitat above the impoundment

Table 14-5 Historical, confirmed and high potential nesting sites within the Rookwood Weir impoundment

Site number	Location	Nesting habitat suitability (field verified)	Rookwood Weir	
			Stage 1	Stage 2
RW Bank 6	Mackenzie River (321 km AMTD)	High potential	Potential nesting habitat remains above the impoundment	Potential nesting habitat remains above the impoundment
RW Bank 7	Mackenzie River (329 km AMTD)	Confirmed	Potential nesting habitat remains above the impoundment	Potential nesting habitat remains above the impoundment
RW Bank 8	Boolburra, Dawson River (15 km AMTD)	Historical	Potential nesting habitat remains above the impoundment	Potential nesting habitat remains above the impoundment

14.3.3.5 Offset management plan

To achieve the offset outcomes, a Fitzroy River turtle nest habitat offset management plan has been drafted and is presented in Table 14-6. The proposed offset management plan details the management actions that will be implemented to specifically target the key threatening processes of high nest predation and low population recruitment. Management actions, based on current measures utilised by Greening Australia and DEHP will include predator control (Feral Animal Control Program), weed management (Weed Management Plan), and individual nest protection (Chapter 13 Environmental management system). These management actions are known to reduce nest predation rates and increase recruitment of hatchlings into the population as reported in Connell and Wedlock 2006; Connell 2011; Connell 2012.

Table 14-6 Fitzroy River turtle nest habitat offset management plan

Element	Fitzroy River turtle
Operational policy	• Protection and management of Fitzroy River turtle nests
Legislative compliance requirements	• Commonwealth EPBC Act 1999 • EPBC Act Environmental Offset Policy • NC Act 1992 • EO Act 2014 • Environmental Offsets Regulation 2014 • Queensland Environmental Offset Policy.

Element	Fitzroy River turtle
Performance criteria	• Reduction in nest predation and increased recruitment of hatchlings into the population
Implementation strategy	• Priority turtle nest monitoring areas are to be identified, this will be based on access requirements, landowner agreement and suitability of site for nesting (for example, existing aggregation) • A Feral Animal Control Program will be developed and implemented for the Project in collaboration with local council, community groups and landholders. Specific control measures may include culling, baiting and trapping of pigs, foxes, wild dogs and feral cats • A Weed Management Plan will be developed and implemented to enhance the quality of habitat within and adjacent to the Project area. Specific management measures will include regular monitoring, removal and control of terrestrial and aquatic weeds within and adjacent to the Fitzroy River. Monitoring and removal will be undertaken prior to the peak Fitzroy River turtle nesting season • The Feral Animal Control Program and Weed Management Plan will be implemented in accordance with the plans and strategies set out by Biosecurity Queensland (Department of Agricultural, Fisheries and Forestry). As such, identification and management of declared pests will be undertaken in accordance with the *Land Protection (Pest and Stock Route Management) Act 2002* (Qld) and relevant local government strategies and plans, including the Rockhampton Regional Council Draft Pest Management Plan 2012-2016 and the Central Highlands Regional Council Pest Management Plan 2012 • Individual turtle nests laid within monitoring areas (to be determined) will be protected within 24 h of being laid. Nests laid by the Fitzroy River turtle will be identified and nesting characteristics recorded (e.g. date, location and depth of nest). Aluminium grid (1 m^2) will then be placed over each individual nests and secured with sand pegs. The grid size should be large enough to allow hatchlings to pass through it • The hatching success of individual nests protected will be recorded throughout the egg hatching season (November to March). Protected nests will be excavated to the top of the first egg to check for evidence of hatching. For those nests that have hatched, the number of eggs from which hatchlings have successfully emerged will be recorded and compared to the total number of eggs laid. Predated egg shell and evidence of predators (e.g. tracks and scats) will also be recorded. Nests that have not hatched at the time of survey will be covered over and re-assessed during subsequent monitoring.
Monitoring	• The identified monitoring areas will be monitored to describe the existing habitat conditions and level of nesting activity prior to the implementation of the offset management plan. Monitoring will be undertaken during the peak turtle nesting season (September to November) and hatching season (November to March). Individual monitoring events for nesting activity will follow periods of rainfall. Parameters recorded will include: bank characteristics (bank width, height, slope, substrate, vegetation), levels of disturbance, presence of weeds and pests, nesting activity (number and location of turtle nests or attempted nesting), nest characteristics (distance from waters' edge, depth, number of eggs, species), and nesting success (number of successful hatchings) • Following implementation of the offsets management plan, identified sites will be monitored regularly (indicative frequency of three times per week) during the peak Fitzroy River turtle nesting season (September to November) for the purposes of identifying and protecting individual nests. Nesting is triggered by rainfall and monitoring should occur during and/or immediately following each

Element	Fitzroy River turtle
	event • Throughout the egg hatching season (November to March), protected nests will be monitored regularly (indicative frequency of once per month) for the purposes of recorded hatching success and rates of nest predation • The Fitzroy River turtle population in the vicinity of the offset area will be monitored annually for a period of five years from the implementation of the offset management plan. Turtles will be tagged with passive integrated transponder (PIT) tags, carapace notching and numbered monel metal foot tags. Parameters recorded will include: – Morphometric measurements – Age and sexual maturity – Reproductive biology – Evidence of injury, mortality and disease. • The success of the offset management plan will be monitored to evaluate the suitability of the management actions and assess the requirement for adaptive management in light of new information and developments in technology. Monitoring tools may include the use of remote cameras to record nesting and predator activity.

14.3.3.6 Offset staging

The Project will be implemented by way of a flexible strategy to allow the rapid delivery of water to meet anticipated future water demands, when triggered. There is yet to be a decision on the order or composition in which the proposed developments will proceed. While the Project is expected to be staged with sequencing and timing dependent on a number of demand triggers, it is proposed that the offset management plan in relation to the Fitzroy River turtle will be implemented when a first stage of development is triggered. In effect, offsets are therefore provided in advance of future development stages.

14.3.4 Black ironbox

14.3.4.1 Impact calculator

Field observations produced an estimate of approximately 100 black ironbox trees (out of a population of approximately 200) within the Rookwood Weir Stage 2 impoundment at Melaleuca Creek (Nangura 2007). Table 14-7 provides an extract of the offsets assessment guide relevant to calculating impacts for the black ironbox.

14.3.4.2 Offset calculator

The offset calculator presented in Table 14-8 identifies that 220 black ironbox trees are required to be planted and managed for the Project to meet the required level of commitment in the EPBC Act Environmental offsets policy.

Black ironbox seeds will be collected from a broad range of mature individuals prior to inundation at Melaleuca Creek and other locations along the Fitzroy River in the vicinity of the impoundment with similar site conditions (e.g. soil, slope position, aspect). Collections will be taken at the appropriate time of year and will span the entire range of populations at risk. Seeds will be collected from trees separated by a distance of 100 m to facilitate maintenance of local genetic diversity (Greening Australia 2012). Collected seeds will be lodged with a suitably experienced nursery for propagation to 140 mm pots.

Table 14-7 Black ironbox impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact	Information source
Number of individuals	Yes	Loss due to impoundment	100 trees	Nangura 2007

Table 14-8 Black ironbox offset calculator

Protected matter attributes	Total quantum of impact	Proposed offset	Time horizon (years)	Start value	Future value without offset	Future value with offset	Raw gain	Confidence in results (%)	Adjusted gain	Net present value (adjusted ha)	% of impact offset
Number of individuals	100 trees	Plant 250 black ironbox trees	1	200	100	220	120	90	108	108	108

After the maximum impoundment level has been reached, locations with suitable site conditions in proximity to the impacted population at Melaleuca Creek will be cleared of rubber vine and other weeds, in accordance with approved conservation advice (TSSC 2008), and revegetated with black ironbox trees under the guidance of suitably qualified revegetation specialist. A one year time horizon has been adopted in calculating the offset requirement which accounts for the time between the Project impact and the delivery of the proposed offset required for the full supply level to be established. As Melaleuca Creek is located in the lower reaches of the Rookwood Weir impoundment the full supply level is expected to be reached in the first year of filling.

The revegetated area will be fenced to prevent grazing by livestock and the site will be inspected on an ongoing basis and weeds removed as required. The trees will be watered weekly post-planting until established (or through the initial dry period) to ensure high survival. With these measures in place, a 100 per cent survival rate is anticipated based on verbal advice from local nurseries (Fitzroy Nurseries Pty Ltd and Yarrandoo Nursery), based on careful planting of seedlings. Confidence in achieving the proposed offset is conservatively estimated at 90 per cent for the purpose of calculating offset requirements.

14.3.4.3 Offset management plan

An offset management plan will be developed which will detail the protection afforded to the revegetated offset area and the management actions to be undertaken including fencing, weed management, fire management, watering and ongoing monitoring in accordance with approved conservation advice for the species (TSSC 2008).

14.3.4.4 Offset staging

Staging of the Project development will be determined based on demand. Given that the impact to the black ironbox is limited to development of the Rookwood Weir the staging of offsets will be tied to its development. The majority of impacts are resultant from Stage 1 of the Rookwood Weir as such the proposed offset will be implemented in full with the implementation of Stage 1.

14.4 Summary

As described in Section 14.2, the Project includes a number of matters of national environmental significance for which a significant residual impact has been identified and for which an offset is required in accordance with the EPBC Act:

- Brigalow threatened ecological community
- Fitzroy River turtle
- Black ironbox

The proposed offsets have been developed to meet the offset requirements of the EPBC Act on the basis that a condition for an offset imposed under that authority will satisfy the requirements for offsets under the Queensland EO Act.