

Victorian Murray Floodplain Restoration Project

Flora and Fauna Assessment - Belsar-Yungera Floodplain Restoration Project

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Lower Murray Urban and Rural Water Corporation





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Executive Summary

Project understanding and Study Area

The Belsar-Yungera Floodplain Restoration Project is one of nine discrete environmental works projects being undertaken as part of the Victorian Murray Floodplain Restoration Project (VMFRP), which is being implemented as part of Victoria's obligations under the Murray Darling Basin Plan. The VMFRP aims to return a more natural wetting and drying regime across more than 14,000 ha of Murray River floodplain and wetlands of high ecological value in Victoria through the construction of new infrastructure and modification of existing infrastructure.

The VMFRP is being implemented in partnership between Lower Murray Urban and Rural Water Corporation (LMW), Goulburn-Murray Rural Water Corporation (GMW), Mallee Catchment Management Authority (Mallee CMA), North Central Catchment Management Authority (North Central CMA), Parks Victoria and the Department of Environment, Land, Water and Planning (DELWP), and is funded by the Commonwealth Department of Agriculture, Water and Environment. LMW has been nominated by the partnership as the project proponent for the purpose of submitting referrals and approval applications.

The Belsar-Yungera Floodplain Restoration Project (the Belsar-Yungera Project) aims to facilitate environmental watering and inundate 2,374 ha of the Belsar and Yungera Islands. Construction of infrastructure and modification of existing infrastructure is required for the project to divert, retain, release and control environmental water (Seran BL&A, 2018). The works associated with the Belsar-Yungera Project are located at 33 locations within Belsar and Yungera Islands. Ecological and biodiversity survey information has been compiled for the proposed Construction Footprint and Inundation Area in order to assist with the planning approvals process for the project.

VMFRP engaged R8 (GHD Pty Ltd and Jacobs Group Australia Pty Ltd partnering as the R8 Joint Venture) to survey the Area of Investigation and to identify any rare or threatened flora or fauna and communities within the (or immediately adjacent to) the Construction Footprint. The Inundation Area was also assessed at a desktop level, with a rapid ground-truthing assessment of any areas where non-water dependent EVCs had been modelled as occurring by DELWP (or where no modelled EVC data was available).

The purpose of this report is to provide a consolidated ecological assessment report of the Construction Footprint and Inundation Area, which includes findings from the recent flora and fauna survey (October to December 2019, and January 2020) as well as summarising previous ecological assessments undertaken within the Area of Investigation (Australian Ecosystems 2013, GHD 2013, GHD 2014, Ecology Australia 2016).

Results

The project is designed to maintain and enhance the health of more than 2,374 ha of native vegetation. This will increase the extent and condition of habitat for common indigenous and threatened aquatic and floodplain fauna, including waterbirds, fish, frogs, turtles and terrestrial species reliant on floodplain habitats, such as woodland birds, bats, small/medium mammals and reptiles. The project will enable environmental water to be delivered, which will be of particular benefit during long dry periods and under current climate change scenarios. To enable these works, construction of infrastructure is required.



Efforts have been made to avoid and minimise impacts to native vegetation throughout the project planning and design process. Despite the measures taken to avoid and minimise impacts to native vegetation it is not feasible to construct the required infrastructure without removing native vegetation. Native vegetation was identified within the Construction Footprint that has the potential to be impacted by the proposed works. In total, 50.35 hectares of native vegetation comprising eight different Ecological Vegetation Classes (EVCs) was identified within the Construction Footprint. 25.54 hectares is within the construction footprint for project infrastructure (including structures, containment banks, hardstands and laydown areas). The actual development footprint of this infrastructure is approximately 10 hectares and hence it is expected there will be further opportunity to avoid and minimise vegetation clearance associated with construction and then to rehabilitate areas of the construction footprint following completion of construction. 24.81 ha of native vegetation has been mapped along existing access tracks. Whilst it is anticipated that the majority of the track network will require minimal vegetation removal, for the purposes of this assessment a conservative approach has been taken when calculating impacts along access tracks and it is expected that the actual impacts will be much lower than 24.81 ha. The impacts to trees along access tracks will be confirmed by a qualified arborist once the required track maintenance works has been confirmed.

No communities listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or the *Flora and Fauna Guarantee Act 1988* (FFG Act) are present within the Construction Footprint or are anticipated to be impacted by the proposed inundation.

No EPBC Act-listed flora species were identified within the Study Area. Other rare or threatened flora were recorded in, or close to, and therefore may be impacted by works in the Construction Footprint including:

- Five FFG Act listed threatened plant species
- Twenty-two flora species considered rare or threatened in Victoria (DELWP Advisory)

The likelihood of occurrence and impact for threatened flora has been assessed at a desktop level. It is considered possible that 63 flora species listed under the FFG Act and/or listed as Victorian Rare Or Threatened Species (VROTS) have the potential to be present within the Inundation Area. It is expected that if these species were present, any impacts resulting from the operational phase of the project will be positive to neutral.

One threatened terrestrial fauna species listed under the Commonwealth EPBC Act occurs within the Study Area, Regent Parrot (*Polytelis anthopeplus monarchoides*) (Vulnerable under EPBC Act). One threatened fish species listed under the EPBC Act occurs within the Study Area, Murray Cod (*Maccullochella peelii peelii*) and one fish species has the potential to occur - Silver Perch (*Bidyanus bidyanus*). Two additional EPBC Act listed fauna species are considered possible to occur: the Painted Honeyeater (*Grantiella picta*) and Growling Grass Frog (*Litoria raniformis*).Three other EPBC-listed species were considered unlikely to occur to a lack of suitable habitat to support an important population and include the Corben's Long-eared Bat (*Nyctophilus corbeni*), Australasian Bittern (*Botaurus poiciloptilus*) and the Australian Painted Snipe (*Rostratula australis*). None of these species are considered likely to be significantly impacted by the proposed construction activities or inundation

An assessment of the likelihood of occurrence identified the following listed fauna species/communities as also possibly occurring:

- Eleven EPBC Act Migratory species
- Twenty-one FFG Act listed fauna species
- One FFG Act listed fauna community (Victorian Temperate Woodland Bird Community)

Impacts to EPBC Act migratory species and FFG Act listed fauna species/communities that are considered to have the potential to occur within the Construction Footprint are not anticipated to be significant where mitigation measures outlined in Section 11 are implemented in full. Impacts during operation (i.e. inundation phase) are considered to be largely beneficial to listed species.



Legislation, permits and approvals

There are a number of ecological values present within the study site with the potential to trigger the requirement to obtain a permit under various items of legislation if impacted.

The following referrals, permits and approvals are likely to be, required for this project:

- A referral to the Victorian Minister for Planning for a determination under the *Environment Effects Act 1978* (EE Act) as to whether an Environment Effects Statement, is required. This assessment has determined that the project is likely to require the removal of more than 10 hectares of native vegetation, which is a criterion for referral under the EE Act.
- A referral to the Commonwealth Environment Minister for a determination under the EPBC Act is being developed, as although it has been suggested that it is unlikely that a significant impact will occur on Matters of National Environmental Significance (MNES), a precautionary approach to refer the project has been adopted.
- Planning approval to remove native vegetation under the Swan Hill Planning Scheme in accordance with the Guidelines for the removal, destruction or lopping of native vegetation (DELWP 2017a).
- Offsets will be sought in accordance with the requirements of the *Guidelines for removal, destruction or lopping of native vegetation* (DELWP 2017a) or through an alternate arrangement agreed with the Secretary to DELWP such as a conservation exemption under clause 52.17 of the Swan Hill Planning Scheme. The loss of native vegetation due to construction activities is proposed to be offset, at least in part, by the expected improvement in native vegetation quality in the Inundation Area resulting from environmental watering. The method for confirming this offset will be developed in consultation with DELWP. Any offset requirements that cannot be met through environmental watering will be purchased by the project.
- A permit under the FFG Act is required where works may impact threatened and/or protected flora and native vegetation that threatened fauna are likely to use. Once the Construction Footprint at each of the sites is finalised a permit will need to be obtained for impacts to both listed and protected flora species.
- A permit (Management Authorisation) under the *Wildlife Act 1975* is likely to be required for salvage, handling and disturbance of native fauna that may be at risk of harm during construction. This could be achieved by engaging a qualified ecologist in possession of this permit to undertake this task.
- If the capture, handling or translocation of fish is required during construction (e.g. dewatering work sites) or operation of the project, persons undertaking these activities will need to hold the appropriate permit or licence under the *Fisheries Act 1995*.

Recommendations and Next Steps

Additional steps to avoid and minimise impacts to ecological values during the design, construction and implementation of the project have been outlined in Section 13.1, including but not limited to the following steps:

- Refine the Construction Footprint within the bounds of the 50.35 ha footprint utilising the existing Construction Footprint ecological values mapping to avoid and minimise impacts to native vegetation and threatened flora/fauna and communities within the Construction Footprint.
- It is recommended that once the Construction Footprint and required track access has been confirmed, that a qualified arborist is engaged to undertake an assessment along the existing tracks, with a project engineer and construction contractor, to confirm the extent of works required (if any) and any potential losses to trees along the existing tracks either directly (through removal) or indirectly (through encroachment of their TPZs, or the removal of >30% of their canopy). Once this assessment has been undertaken, the extent of impacts to native vegetation for the project can be confirmed. It is anticipated that the actual impacts to native vegetation along the existing access tracks will be significantly lower than the conservative estimate (24.81 ha) that has been currently accounted for.
- Engage with DELWP, discussing the proposed Construction Footprint and the efforts that have been
 made to avoid and minimise impacts to native vegetation during the preliminary and refinement phases
 of the project.



- The Habitat Hectare assessments were undertaken at the time of the fieldwork in 2016 using the Construction Footprint that was current at the time (Ecology Australia 2016). Due to changes in the Construction Footprint since the 2016 survey and the fact that vegetation along tracks hasn't been fully mapped, some areas of native vegetation proposed to be impacted have not yet been assessed (11.7 ha). In these areas the DELWP modelled condition data has been used to fill these gaps. Once the design process is complete and the Construction Footprint has been finalised, it is recommended that a Vegetation Quality Assessment (Habitat Hectares) is undertaken in these areas (gaps) to confirm the condition and extent of native vegetation within these areas.
- Depending on the extent of impacts to areas of treed vegetation a qualified arborist may need to be
 engaged to determine the full extent of impacts to native trees (both within and immediately adjacent to
 the proposed Construction Footprint). This assessment will take in to account direct impacts to trees
 (tree removal) and indirect impacts to trees (through encroachment of their TPZs). An arborist
 assessment will also consider the individual tree location and habit, as well as specific characteristics of
 certain tree species (e.g. mallee eucalypts) where it's possible that individual trees will survive greater
 than 10% encroachment of their TPZs or the pruning of over 30% of the existing crown (the standard
 measures for determining indirect tree losses under the guidelines).
- Engage with DELWP, discussing the proposed approach for planning approval and obtaining offsets for the project under the *Planning and Environment Act 1987* and whether a conservation exemption may apply to the works at Belsar-Yungera. This approach may include the establishment of a vegetation condition monitoring regime within the proposed Inundation Areas that will identify changes in condition to the vegetation within these areas that results from the environmental watering regime.
- Prepare an Offset Plan for the project to support any application for planning approval to remove native vegetation under the *Planning and Environment Act 1987*.
- Develop specific impact mitigation measures related to the works. These should be incorporated into a Construction Environmental Management Plan (CEMP) for the project.
- A CEMP should be developed for the project and implemented in full to further avoid and minimise impacts to areas of ecological value. The CEMP should be prepared once the footprint and construction methods for the proposed works have been finalised, and should include provisions relevant to protecting the ecological values identified within the Construction Footprints
- Develop and implement an Aquatic Fauna Management Plan (as part of the CEMP) to manage impacts to aquatic values with emphasis on threatened fish species, as well as turtles that may be present in the vicinity of construction sites. Any construction activities that could lead to entrapment of fauna or temporary loss of habitat (e.g. due to the use of coffer dams and dewatering) should be considered.
- Obtain planning approval for the removal of native vegetation under the Swan Hill Planning Scheme.
- Obtain a permit for removal of flora listed as threatened and/or protected under the FFG Act.

This report is subject to, and must be read in conjunction with, the limitations set out below and the assumptions and qualifications contained throughout the report.



Abbreviations

Abbreviation	Description
ARI	Arthur Rylah Institute
CaLP	Catchment and Land Protection Act 1994
СМА	Catchment Management Authority
DAWE	Commonwealth Department of Agriculture, Water and Environment (formerly DOEE and DOTE)
DBH	Diameter at Breast Height
DELWP	Department of Environment, Land, Water and Planning (formerly DEPI)
DEPI	Department of Environment and Primary Industries (now DELWP)
DOEE	Commonwealth Department of the Environment and Energy (formerly DOTE, now DAWE)
DOTE	Commonwealth Department of the Environment (now DAWE)
EE Act	Victorian Environment Effects Act 1978
EMP	Environmental Management Plan
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EVC	Ecological Vegetation Class
FFG Act	Flora and Fauna Guarantee Act 1988
GHD	GHD Pty Ltd
GIS	Geographic Information System
LGA	Local Government Authority
MDB	Murray Darling Basin
MER	Monitoring, Evaluation and Reporting
MNES	Matters of National Environmental Significance
PMST	Protected Matters Search Tool
R8	R8 Joint Venture by GHD and Jacobs
SDL	Sustainable Diversion Limits
sp.	Species
spp.	More than one species
subsp.	Subspecies
RobP	Robinvale Plains Bioregion
TPZ	Tree Protection Zone
var.	Variety
VBA	Victorian Biodiversity Atlas
VMBC	Victorian Mallee Bird Community
VMFRP	Victorian Murray Floodplain Restoration Project
VTWBC	Victorian Temperate Woodland Bird Community
VROTS	Species listed on DELWP's Advisory List of Rare or Threatened Plants in Victoria
WoNS	Weed of National Significance



Important note about your report

The purpose of R8's engagement under the Victorian Murray Floodplain Restoration Project (VMFRP) is to design infrastructure for the VMFRP including regulators, containment banks, roads, access tracks and culverts. The purpose of this infrastructure is to allow floodplains to be watered at the hydraulic design levels nominated by VMFRP. R8 is also engaged to provide Regulatory Approvals and Cultural Heritage Services. The purpose of these services is to support VMFRP to lodge the necessary approvals documents for the project with the relevant approval authorities.

The sole purpose of this report and the associated services performed by R8 is to complete a Flora and Fauna Assessment Report for VMFRP, as set out in Section 1.3 of this report and in accordance with the scope of services set out in the contract between R8 and VMFRP. That scope of services, as described in this report, was developed with VMFRP.

R8 has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. However, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

In preparing this report, R8 has relied on the information provided by VMFRP in the data handover pack at the commencement of the project and others (government agencies). In particular R8 is reliant on VMFRP's prior flood modelling work to define inundation levels and extents. R8 is not responsible for achievement of the project's desired operational ecological outcomes.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by R8 for use of any part of this report in any other context. This report has been prepared on behalf of, and for the exclusive use of VMFRP, and is subject to, and issued in accordance with, the provisions of the contract between R8 and VMFRP. R8 accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

The services undertaken by R8 in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report, including:

- An ecological assessment limited to vascular plant species (ferns, conifers and flowering plants). Nonvascular flora (e.g. mosses, liverworts, lichens), fungi and terrestrial invertebrates have not been considered in detail as part of this assessment, except where listed threatened species are known or suspected to occur, or where bryophytes comprise part of the Ecological Vegetation Class (EVC) benchmark used for the habitat hectare assessment (e.g. cover of Bryophytes).
- Maps in this report displaying site information should not be relied on for the detailed design during the construction process. Please refer to engineering drawings/specifications and survey for detailed site information.
- An ecological assessment limited to terrestrial vertebrate fauna. Freshwater fauna or invertebrate fauna were considered at a desktop level only.
- Involved the use of Collector for ArcGIS version 10.3.3 mapping application to record site information. This mapping tool is accurate to within ten metres on site.
- Assumed there will be no impacts to native vegetation outside the proposed Construction Footprint
 provided by VMFRP at the time of the field assessments. Since the fieldwork was completed there have
 been some amendments to the Construction Footprint at infrastructure sites and along tracks, that
 extend outside of areas currently mapped (11.7 ha in total). If these areas are proposed to be impacted
 once the detailed design phase of the project is complete, additional field assessments will be required
 to document any native vegetation present in these areas and to confirm any additional losses of native
 vegetation associated with the project.



- Did not include a detailed assessment of planning implications with relation to legislation outside of those considered from an ecological perspective.
- Did not include an on ground assessment of the vegetation and fauna habitat present along proposed access tracks. As impacts to existing access tracks has not been confirmed, a buffer was applied using a conservative approach and the modelled condition data has been applied to vegetation proposed to be impacted along tracks.
- Included flora investigations as part of the ecological assessment during late spring and summer, which
 is not always an optimal time of year for conducting botanical assessments in the Mallee region,
 although timing suitability can vary depending on rainfall (surveys in spring could be appropriate
 following previous rainfall). Some native flora are difficult or impossible to locate or identify at certain
 times of the year, due to a lack of reproductive material and/or the seasonal nature of some species (in
 particular, annuals and geophytes). Additional native species may be recorded at the site at other times
 of the year. Therefore, it is considered possible that additional rare or threatened flora may be present,
 but were not detected during the survey because of the timing of the survey. However, extensive
 previous surveys and database records partially offset this limitation.
- Included a field investigation as part of the ecological assessment during mid spring and early summer which is an adequate time of year for conducting fauna assessments in the Mallee region. R8 did not conduct assessments which would be optimal for detecting other fauna species, e.g. February-March for juvenile and hence more readily detectable small mammals and reptiles; however, extensive previous surveys and database records partially offset this limitation. This was beyond the scope of this assessment. It should also be noted that we also did not conduct trapping (i.e. pitfall, Elliot and funnel trapping).
- Did not consider targeted surveys for rare or threatened fauna species that involved extensive trapping (e.g. pitfall, Elliot, funnel trapping). This was beyond the scope of this assessment. Fauna surveys were limited to timed bird survey, active searching and incidental observations.
- Using the Victorian Biodiversity Atlas (VBA) database, a defined geographical area can be searched to produce lists and details of flora and fauna species that have been documented within the defined search area. These database results are only as accurate as the quality and quantity of data that have been recorded and documented from the area. The use of the database for this assessment has the following limitations:
 - Observations are regularly updated but there is a delay. Consequently, all known records, particularly recent records, may not be available at the time of use. The VBA was most recently accessed in February 2020.
 - This dataset is not exhaustive. Many locations locally and across Victoria have a low level of documented survey effort for one or more groups of flora and fauna. During field surveys, it is not uncommon to find species at locations for which there are few or no previous nearby database records.
- The inundation extent has primarily been assessed at a desktop level only, with rapid ground truthing having only been undertaken in areas where non-water dependent EVCs were modelled by DELWP, or where there was no modelled EVC data available.
- The Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act 1999 is undergoing a review that commenced in October 2019. Any changes to the applicable legislation and agreements may affect the recommendations or conclusions of this report.
- The Victorian Flora and Fauna Guarantee (FFG) Act Amendment Bill 2019 has passed through Victorian Parliament with amendments taking effect on 1 June 2020. This report has been prepared based on the current requirements of the Act and these may change prior to the construction of the project.



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R8 acknowledges the assistance, advice and/or information provided by:

- The Victorian Department of Environment, Land, Water and Planning (DELWP) for access to the VBA database and NatureKit
- The Commonwealth Department of Agriculture, Water and Environment (DAWE) for access to its Protected Matters Search Tool (PMST)



1. Introduction

The Belsar Yungera Floodplain Restoration Project (the project) is one of nine discrete environmental works projects being undertaken as part of the Victorian Murray Floodplain Restoration Project (VMFRP), which is being implemented as part of Victoria's obligations under the Murray Darling Basin Plan. The VMFRP aims to restore a more natural inundation regime across more than 14,000 ha of high ecological value Murray River floodplain in Victoria through the construction of new infrastructure and modification of existing infrastructure.

The VMFRP is being implemented in partnership between Lower Murray Urban and Rural Water Corporation (LMW), Goulburn Murray Rural Water Corporation (GMW), Mallee Catchment Management Authority (Mallee CMA), North Central Catchment Management Authority (North Central CMA), Parks Victoria and the Department of Environment, Land, Water and Planning (DELWP), and is funded by the Commonwealth Department of Agriculture, Water and Environment (DAWE). LMW has been nominated by the partnership as the project proponent for the purpose of submitting referrals and approval applications.

R8 is a joint venture formed between Jacobs and GHD, which has been engaged by LMW to deliver design, cultural heritage and approvals services for the VMFRP. This flora and fauna assessment has been prepared for the project to support the preparation of referrals under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Victorian *Environment Effects Act 1978*.

1.1 Project overview

The Belsar-Yungera Floodplain Restoration Project is located on the Murray River floodplain, approximately 30 km upstream of the Euston weir, near Robinvale in north-west Victoria. The project is designed to facilitate managed inundation by isolating a large section of Narcooyia Creek and Yungera Creek from the Murray River. This is expected to be achieved through either the capture of a natural flooding event, pumping into the creek system over a period of time, or pumping into the creek system on top of a natural flooding event, extending the natural event in size and duration.

The Belsar-Yungera Floodplain Restoration Project (the Project) involves the construction of new infrastructure, the modification of existing infrastructure and removal of some existing barriers to flow (created by existing irrigation and road infrastructure) within the Murray River Reserve, including Belsar and Yungera Islands, the Narcooyia, Bonyaricall and Yungera creeks, and Lakes Powell and Carpul (see **Figure 1** and **Figure 2**). The project aims to restore a more natural inundation regime across approximately 2,374 ha of high-ecological-value Murray River floodplain adjacent to Belsar-Yungera.

There are four distinct environmental works areas for the project including (see Figure 2):

- Area 1 Primary Inundation Area: Inundation to level of 52.3 m AHD.
- Area 2 Lower J1 Creek area: Inundation to level of 52.9 m AHD.
- Area 3 Upper J1 Creek area: Inundation to level of 53.3 m AHD.
- Area 4 Lake Powell and Lake Carpul Area: Inundation to level of 52.6 m AHD and an Inundation Area of approximately 278 ha.

The Study Area encompasses a broad area within the Robinvale Plains (RobP) Bioregion of the Mallee CMA area in north western Victoria, 30 km east of Robinvale. The area is currently managed for environmental conservation by Parks Victoria.

The Construction Footprints are comprised of wetlands, floodplain forest and woodland areas that receive water from the Murray River via the Narcooyia, Bonyaricall and Yungera creeks, and includes infrequently flooded higher floodplain terraces dominated by Black Box (*Eucalyptus largiflorens*) with a chenopod understory along with more frequently flooded terraces and creek lines that largely support River Red-gum (*Eucalyptus camaldulensis*) and Lignum swampy woodlands (Australian Ecosystems, 2013).



The broader Study Area includes all land within 10 km of the Construction Footprint and Inundation Area, including private properties and roadsides. This covers a more extensive area than the expected zone of impact but this additional information provides context for the significance of any ecological features recorded from the Construction Footprints and Inundation Area. Biodiversity values in the broader Study Area were assessed at a desktop level only.

1.2 Previous ecological assessments

Biodiversity information has been collected for the project over a number of years and during this time, the location and extent of construction areas has been revised numerous times with the overall aim of minimising impacts to areas of ecological value.

This flora and fauna assessment has been informed by the following previous studies undertaken for the project:

- DELWP (2018) *SDL Fish Management Plan Belsar-Yungera*. The Arthur Rylah Institute was engaged by Mallee CMA to prepare a Fish Management Plan for the Belsar-Yungera complex.
- Ecology Australia (2016) *Mallee Sustainable Diversion Limit: Belsar & Yungera Islands Flora & Fauna Assessment*. Report prepared for Mallee CMA. In 2016, Ecology Australia was engaged by Mallee CMA to undertake baseline flora and fauna surveys across broader Belsar-Yungera area.
- GHD (2014). SDL Offsets Fauna Survey. Hattah North and Belsar Yungera. Report prepared for Mallee CMA. In 2013, GHD was engaged by Mallee CMA to undertake baseline fauna surveys across the broader Belsar-Yungera area.
- Australian Ecosystems (2013) *Hattah North and Belsar Yungera Islands Flora Census*. Report prepared for Mallee CMA. In 2013, Australian Ecosystems was engaged by Mallee CMA to undertake baseline flora survey across the broader Belsar-Yungera area.
- GHD (2013) *Preliminary Ecological Investigations. Belsar and Yungera Island Water Management Functional Design Phase*. Report prepared for Mallee CMA. In 2012/13, GHD was engaged by Mallee CMA to undertake targeted surveys for threatened flora and fauna across the broader Belsar-Yungera area.
- GHD (2009). *Belsar and Yungera floodplain complex investigations: fish survey, barrier assessments. Irymple, Victoria.* GHD was engaged by Mallee CMA to assess the fish population present within the Belsar-Yungera complex.

A summary of previous ecological assessments, including methods, key findings and recommendations is presented in Appendix A, with conclusions and recommendations incorporated throughout this report.

1.3 Purpose of this report

The purpose of this report is to present an assessment of the potential for significant impacts to flora and fauna values to occur associated with the Belsar-Yungera Floodplain Restoration Project in order to inform referrals under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Victorian *Environment Effects Act 1978*.

In addition, this report documents the findings of targeted surveys completed at all proposed construction sites of the Belsar-Yungera project for threatened flora and fauna species listed under the Commonwealth EPBC Act, Victorian FFG Act and Victorian Advisory List of Rare or Threatened Plants in Victoria (DEPI 2014), Advisory List of Threatened Invertebrate Fauna (DSE 2009) and/or Advisory List of Threatened Vetebrate Fauna (DSE 2014). The results of these surveys will be used to assist with avoiding and minimising impacts from the proposed construction on these threatened species, and to identify project planning, EPBC and EE Act referrals and planning approval requirements.



In particular, the purpose of this report is to:

- Summarise the findings of an updated desktop assessment to review flora, fauna (native species and habitat) and vegetation communities within 10 km of the Area of Investigation.
- Summarise the previous ecological assessments (Australian Ecosystems, 2013; GHD, 2013; GHD, 2014; Ecology Australia, 2016) undertaken for the project.
- Describe targeted surveys for flora and fauna species and communities, listed under the Commonwealth EPBC Act and the Victorian FFG Act undertaken by R8 in late 2019 / early 2020.
- Describe the outcomes of field surveys undertaken by R8 in June 2020 to ground-truth vegetation within specific locations within the proposed Inundation Area that are mapped by DELWP (2005) (modelled extant EVC mapping) as either non-water dependent vegetation types (e.g. Mallee and Semi-arid Woodland) or in locations where no EVC data are available, and update EVC mapping in these areas.
- Provide an inventory of all incidental observations of fauna and threatened flora recorded during 2019 and 2020 surveys undertaken by R8.
- Determine the extent of impacts to native vegetation (including large trees) within the proposed construction areas in accordance with the Guidelines for the removal, destruction or lopping or native vegetation (DELWP 2017a).
- Describe specific threatening processes associated with the project as listed under the FFG Act and EPBC Act.
- Determine the likelihood of occurrence of listed threatened flora and fauna species, listed threatened ecological communities and listed migratory species within the proposed construction and Inundation Areas. Where listed species or communities are identified as occurring or having the potential to occur, determine the likely impact on these listed species and communities by the project (during both the construction and operation phases).
- Undertake an assessment of potential impacts on significant wetlands (e.g. Ramsar sites, nationally important wetlands) and other aquatic ecosystems and species.
- Identify potential impacts to ecological values during the construction and operation of the project and recommend mitigation measures to minimise these impacts.
- Discuss potential legislative requirements of the proposed works during the construction and operation phase (with respect to potential flora and fauna impacts).

1.4 Scope of works

The scope of this assessment and report is to:

- Review botanical values (plant species and vegetation communities) within 10 km of the project site.
- Review recorded fauna values (native species and habitat) within 10 km of the project site.
- Determine the likelihood of occurrence of rare or threatened flora and fauna within the extended construction buffer zones at the project site.
- Conduct targeted surveys for flora and fauna and communities, listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act).
- Provide an inventory of all observations of threatened flora and fauna.
- Discuss potential legislative requirements of the proposed works (with respect to terrestrial flora and fauna impacts).
- Identify potential impacts to threatened species by the construction works and recommend mitigation measures to minimise these impacts.



1.5 Structure of this report

This report is structured as follows:

- Section 1 provides an overview of the project, identifies previous assessments undertaken and summarises the purpose and scope of work for the report.
- Section 2 provides a summary of the ecological objectives and benefits associated with environmental watering in order to provide project context.
- Section 3 presents a description of the project including the location of proposed works, as well as key construction, operational and decommissioning activities.
- Section 4 describes the desktop and field assessment methods used to inform the impact assessments and recommendations.
- Section 5 provides an overview of existing ecological conditions and floodplain characteristics.
- Section 6 describes the results of targeted threatened flora and fauna species surveys undertaken in the areas where works are proposed.
- Section 7 describes the results of ground-truthing surveys undertaken within the proposed project inundation area.
- Section 8 provides a summary of potential impacts to flora and fauna during the construction and operational stages of the project.
- Section 9 assesses the significance of potential impacts to Commonwealth and Victorian listed flora, fauna, communities and wetlands.
- Section 10 details the anticipated impacts to native vegetation and ecological vegetation classes from project construction and operation.
- Section 11 provides information on the measures undertaken, or proposed, to avoid, minimise and mitigate impacts to listed flora and fauna species.
- Section 12 summarises the requirements of relevant Commonwealth and Victorian policy and legislation.
- Section 13 provides recommendations and outlines the next steps for the project based on the assessment results
- Section 14 presents the literature reviewed and cited throughout this document.

A number of appendices are provided to this document. These include detailed assessments of the likelihood of occurrence and impact to threatened flora and fauna species, as well as significance assessments for Commonwealth listed flora and fauna species.



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Figure 2: Inundation Extent at Belsar Yungera



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2. Project Context

2.1 Biodiversity responses to environmental watering

The lowland-dryland rivers of the Murray-Darling Basin (MDB) have either perennial, seasonal, intermittent or ephemeral hydrological regimes and their flows are variable over annual, decadal and centennial time-scales. Weather and climate variability drive the flow regimes of inland Australian rivers, while inland floodplain wetlands experience changes in the frequency, magnitude and duration of flooding in response to climatic cycles and extreme events of rainfall and runoff in their catchments (Ralph and Rogers 2011).

Over the past century, the natural pattern of wetting and drying on floodplains of the MDB has been altered by flow regulation due to dam and weir construction, extraction of water for irrigation, stock and domestic uses, and construction of levees (Boulton & Brock 1999;). In many cases, the effect has been to remove water from the environment, with the result that inundation of floodplain wetlands occurs less frequently and/or for shorter periods than in pre-European times, leading to chronic desiccation.

Flooding is essential for the effective functioning of floodplain ecosystems; however, flow-ecology relationships and processes in rivers and floodplain wetlands are complex. Many biota in the MDB are adapted to variable flow and respond to flooding, but the optimal frequency, timing, duration and magnitude of floods vary between biota. Despite the variability in response, some common themes emerge when the benefits of flooding are examined for different groups of plants and animals:

- **Vegetation:** Hydrological regimes are the major factor responsible for determining the composition, structure, diversity and function of floodplain forest and wetland communities
- **Trees:** Successful regeneration of floodplain trees usually occurs after major floods, while floods also provide an essential source of water to maintain tree canopy health
- **Lignum:** Provides unique floodplain habitat and is dependent on floods for rapid vegetative growth and reproduction
- **Water birds:** Flooding acts as the primary stimulus for breeding water birds, increasing reproductive performance as the flood pulse stimulates productivity in the wetlands
- Fish: Flooding may trigger spawning or migration to suitable breeding habitat
- **Frogs:** Flooding promotes a rapid response in frog activity, including calling, spawning, and tadpole development and metamorphosis

The most extensive and severe drought of the past century, known as the Millennium drought (1997-2010), brought the issue of floodplain ecosystem health into the mainstream, with widespread tree dieback across the MDB symptomatic of an ecosystem in decline. During this time, the Murray Darling Basin Committee (MDBC) acknowledged that for the condition of floodplain ecosystems to be improved and to function effectively, adequate amounts of water needed to be provided to key iconic sites to ensure their continued survival. Consequently, since this time the focus of floodplain restoration/rehabilitation has centred on the return of water to help facilitate a more natural (i.e. pre-European settlement) hydrological regime (Boon 2011).

While drought-breaking rain (and subsequent flooding) in 2010-11 and natural floods again in 2016 have provided a much needed boost to MDB floodplain ecosystem condition, these natural floods have been supplemented by a range of environmental watering measures over the past decade, which have been considerably aided by the construction of water infrastructure (e.g. regulators, levees, channels) in strategic locations at a number of Murray River icon sites. This infrastructure has allowed floodplain managers to control the timing, volume, rate, depth and duration of environmental water into designated sites, so that maximum benefit of the water to the environment is able to be generated.

During this time, numerous long-term monitoring programs have been established, including The Living Murray icon site condition monitoring program, to monitor and track the response of floodplain forests and wetlands over time, and in particular, determine how the ecosystem responds to watering. Results to date indicate that the floodplain systems of the mid-lower Murray respond positively to flooding, whether it be landscape-scale overbank flooding or smaller scale events, e.g. watering of creeks, floodrunners and low-lying wetlands.



2.2 Ecological benefits – Belsar-Yungera project

Relatively little ecological monitoring has been completed at Belsar-Yungera or the surrounding area. Analogies to changes in ecological condition at Belsar-Yungera may be drawn from the previous investigations of the downstream Hattah Lakes area which has received environmental watering and subsequent monitoring for almost 15 years. The Hattah Lakes had received environmental water in spring-summer 2014-15, followed by a natural flood in 2016-17, which was supplemented with an allocation of environmental water. Following the 2017 monitoring, it was concluded that the overarching ecological objective for the Hattah Lakes (i.e. "to restore a mosaic of healthy wetland communities") was being achieved (Wood et al. 2018).

For some components, e.g. River Red-gum and Black Box, condition rebounded strongly after the breaking of the Millennium drought in 2010-11, and has subsequently been maintained, while responses to floods since then have been more subtle, most likely because the baseline condition is now higher than 2010. Conversely, for other components (e.g. wetland and floodplain vegetation, birds), objectives are only partially being met, and there is still work to be done to ensure that these components of the ecosystem are restored so that they meet the benchmark objectives of the program. To summarise, environmental benefits of watering at the Hattah Lakes were multiple and included (DELWP 2017b; VEWH 2019):

- Maintenance or improvement in the abundance of native vegetation and water-dependent plant functional groups, particularly on the lakebed, lake edges and the lower floodplain (DELWP 2017b)
- Reduction in abundance of plants favouring terrestrial dry habitats (DELWP 2017b), although this trend was most evident at sites receiving more frequent flooding (whereas rarely flooded sites were still dominated by drought tolerant species) (Wood et al. 2018)
- Improved tree canopy cover (and by extension, health) of River Red-gum and Eumong (DELWP 2017b; Wood et al. 2018)

Cook et al. (2011) and Wood et al. (2018) have shown that the introduction of environmental water has had positive benefits for threatened water birds including observations of the nationally endangered (EPBC-listed) Australian Painted Snipe (*Rostratula australis*). Other threatened water birds recorded during the 2018 inundation event included Freckled Duck (*Stictonetta naevosa*), Blue-billed Duck (*Oxyura australis*) and Glossy Ibis (*Plegadis falcinellus*), with several White-bellied Sea-eagle (*Haliaeetus leucogaster*) were observed including a successful breeding pair.

The key environmental objectives of the Belsar-Yungera Project are to restore the environmental functions of this part of the Murray River Reserve, and to restore key indigenous flora and fauna species, communities and habitats through construction of hydrological environments. Specifically, the business case for the Belsar-Yungera Environmental Water Management Plan (EWMP) (DSE, 2010) with regard to ecological benefits was to restore a more natural inundation regime, mimic the impact of natural flood events, improve the condition of vegetation communities, and provide seasonal aquatic habitat for native fauna. The specific ecological objectives of the project, as listed in the EWMP are summarised as:

- Maintain migration of medium and small-bodied native fish to maintain populations
- Maintain seasonal populations of medium and small-bodied native fish
- Increase native habitat for local populations of fauna by increasing the extent of wetland and riparian vegetation
- Support metapopulations of Growling Grass Frogs
- Reduce high threat exotic plant cover
- Maintain threatened native flora presence
- Maintain successful breeding for platform-building waterbirds
- Maintain the health of native trees
- Increase abundance of native woodland birds



- Increase the abundance of bats as an indicator of increased resources resulting from increased floodplain productivity
- Increase the abundance of carpet pythons as an indicator of increased resources resulting from increased floodplain productivity
- Provide reliable native foraging and breeding habitat for waterbirds
- Provide habitat for hundreds of waterbirds at least once in every five years
- Contribute to the carbon requirements of the Murray River channel ecosystem to support system productivity

The Fish Management Plan for the site (DELWP, 2018) also proposed specific ecological objectives for fish, based on an assessment of opportunities that could be realised during operation of the project. The objectives focus on both large-bodied (riverine) and small-bodied native fish:

Small-bodied generalist native fish:

- Re-establish seasonal populations of small-bodied fish in Narcooyia and Bonyaricall creeks and the floodplain
- Annual spawning and recruitment of small-bodied wetland generalist fish populations
- Maximise macrophyte diversity and complexity
- Dispersal of wetland generalist fish among wetlands and maximise spatial distribution

Larger-bodied native fish:

- Provide seasonal feeding opportunities for riverine fish species, such as juvenile Murray Cod and Golden Perch
- Provide a seasonal larval rearing habitat for larval Golden Perch and Silver Perch on the Belsar-Yungera floodplain



3. **Project description**

3.1 Overview and works areas

The project involves the construction of three new large regulators (ER1, ER3 and S7), a fishway at ER1, a number of small regulators and a series of containment banks to divert, retain and release water within the floodplain and two pipelines and associated hardstands to enable temporary pumping that will transfer environmental water from the Murray River into the Narcooyia Creek system and Lake Powell.

The proposed works will occur within four distinct environmental works areas for the project including:

- Area 1 Primary Inundation Area. Inundation to level of 52.3 m AHD using three large environmental regulators and eight supporting regulators and containment banks to provide an Inundation Area of approximately 1,539.71 ha.
- Area 2 Lower J1 Creek area. Inundation to level of 52.9 m AHD using two environmental regulators and four supporting regulators and containment banks to provide an Inundation Area of approximately 526.24 ha.
- Area 3 Upper J1 Creek area. Inundation to level of 53.3 m AHD using one environmental regulator and one supporting inflow structure to provide an Inundation Area of approximately 35.96 ha.
- Area 4 Lake Powell and Lake Carpul Area. Inundation to level of 52.6 m AHD via two environmental regulators, a permanent pipeline and temporary pumping installation to provide an Inundation Area of approximately 272.19 ha.

The design and location of all project structures and access track upgrades has not yet been confirmed and will be refined through the detailed design process. The final construction footprint for the structures is proposed to be located within the Area of Investigation, utilising recommendations from this report and other specialist studies (including Cultural Heritage) to further refine the design in order to avoid and minimise impacts Therefore, the information in this section is indicative only, but provided as a basis of assessing the potential impacts of the project during construction and operation to inform referrals under the EE Act and EPBC Act.

3.2 Infrastructure

The proposed infrastructure within the work areas includes:

Area 1: Primary Inundation Area

- Three main regulator structures (ER1, ER3 and S7) are used to isolate a large portion of Narcooyia Creek and Yungera Creek from the Murray River to manage breakout areas. A vertical slot fishway will be constructed at Regular ER1.
- Seven small regulator structures (ER1 South, ER1 North, S4, S105, S5, S108, S109) in Area 1 to enable smaller breakouts to be contained within the system. These minor regulators will be operated in either a fully opened or fully closed position, with all works designed to minimise the impact on the distribution of natural flood flows.
- Realignment and extension of irrigator pipeline which discharges water into Narcooyia Creek after the ER3 regulator is constructed.
- A series of containment banks to enable water to be held at the design inundation level.
- A permanent pump hard stand and a permanent underground pipeline from the hard stand to the downstream side of ER3 to facilitate the pumping of environmental water from the Murray River into the system. Temporary pump infrastructure would include a trailer-mounted rig with a suction pipe extending into the Murray River, which would be brought onto site as required.
- Potential removal of the existing block bank at the entrance of Narcooyia Creek and the waterway reshaped to enable the ER3 Regulator to be the control point for inflows.



Area 2: Lower J1 Creek area

- Two small regulators (J1a 1 and 2) on the downstream end of J1 creek, with the primary purpose to retain water within Inundation Area 2 and regulating passing flows through the system from Inundation Area 2 to Inundation Area 1.
- Four small regulators (J1b, J1d, J1e, J1f) included in containment banks that are required to prevent water flowing out through secondary flood runners, to contain water in Area 2 and allow for inflows from Narcooyia Creek in flood events.
- A series of containment banks to enable water to be held at the design inundation level.

Area 3: Upper J1 Creek area

- Two small regulators (J1c and J1g) included in containments banks to allow for the inundation and containment of water in Area 3, release of water to Area 2 and allow flood flows through the system.
- A hard stand for a temporary pump arrangement provides a secondary location for delivering water from the Murray River to all four Inundation Areas identified in this project. The hardstand would be located at the site previously used by the Mallee Catchment Management Authority (MCMA) for pumping in the past. There are no pipes or other assets at this site. Temporary pump infrastructure would include a trailer-mounted rig with a suction pipe extending into the Murray River, which would be brought onto site as required.

Area 4: Lake Powell and Lake Carpul

- A 1.8 km long pipeline would be constructed between Bonyaricall Creek and Lake Powell. The pipeline, together with a temporary pump installation, provides the ability to inundate Lake Powell and Lake Carpul.
- A small regulator (Lake Powell) will be located on the southern side of the Murray Valley Highway to hold water to the design inundation level.
- A new culvert will be installed across the Murray Valley Highway to increase the flow capacity at this location, improving the ability for natural flood flows to enter and exit the lakes at a lower commence to flow level.
- A small regulator (Lake Carpul) would be constructed south of Lake Powell within the cutting to improve hydraulic connectivity between Lake Powell and Lake Carpul and prevent Lake Carpul being drawn down too quickly following an environmental watering event.

Containment banks approximately 2.7 km in Area 1, 1.4 km in Area 2, 0.2 km in Area 3 and 0.7 km in Area 4 of will also be constructed by raising existing access tracks to enable water to be held to the design level. Seven spillways, each 20 m in length, will be incorporated into the construction of the small regulators and containment banks. They will include rock beaching with concrete sills and would be trafficable.

The project may also include the decommissioning of the existing regulator on Narcooyia Creek. The footprint of the existing structure has been included in the Construction Footprint as the location is known, however the potential access track to be used if decommissioning is required has only been included in the Area of Investigation as decommissioning works have not been confirmed. The requirement for decommissioning of this structure and associated access will be confirmed as the project progresses.

A channel between Lake Powell and Lake Carpul is also currently being investigated as part of the design process. The requirement for this channel will be confirmed in later stages of the design process. Given the uncertainty around the requirement for this channel, it has not been included in the proposed area of impact (i.e. Construction Footprint) but for completeness has been included in the Area of Investigation.



3.3 Fish passage

Explicit fish passage is planned to be provided at the proposed ER1 regulator at the downstream end of Area 1. The fish passage provision at ER1 is a vertical slot fishway (up to 4.3 m head difference, with 40 pools). No fishways are proposed at ER3 and S7 large regulators; however, passive fish passage has been provided when the gates are open.

The design of all other regulators allows for movement of fish directly through the regulator structure. Small regulator structures will be operated either in fully open or fully closed position. When water is released with the regulator gate in fully open position, fish have passage through the regulator both in managed release and natural flood scenarios. Structures have been designed to have flow velocities appropriate for fish passage (based on O'Connor et. al, 2015).

Water will generally enter the upper reaches of Narcooyia Creek under pumped conditions and so the potential for fish passage under these conditions is low. Under natural flooding conditions there will be unobstructed access for fish across all regulators (as they will be fully open in large floods) (DELWP, 2018).

3.4 Ancillary components of the project

Ancillary components of the project will include:

- Containment bank alignments designed to correspond to existing access tracks to minimise disturbance to vegetation and areas of potential cultural heritage significance.
- Access via existing tracks. Existing tracks will be upgraded for operational or construction purposes. Access track dimensions on levee crests are to be consistent with Parks Victoria access track design and maintenance guidelines.
- Construction sites and laydown areas.
- Borrow pits to acquire material (clay/rock) required for construction. VMFRP is in the process of identifying possible locations, with the objective of selecting locations as close as possible to the project, on private land outside of Belsar and Yungera Islands, while also avoiding and minimising impacts.

3.5 Key construction activities

Construction activities will include:

- Establishment of construction sites, including removal of vegetation, stripping and stockpiling of topsoil, establishing temporary parking and truck turnaround areas, laydown and stockpiling areas
- Removal of existing structures / block banks where required
- Construction / installation of new structures

Construction will involve use of vehicles and machinery such as trucks, excavators, and access equipment.

Importation of construction materials, including regulators and imported soils, will comply with Parks Victoria consent under Section 27 of the *National Parks Act* 1975 and the *Environment Protection Act* 2017 (due to commence on 1 July 2020).

A Construction Environmental Management Plan (CEMP) will be prepared for the works and will detail the measures to avoid and minimise impacts during construction. Once construction of regulators, containment banks and associated works are complete, all waste and spoil will be removed from the Construction Footprint and disposed of as required by the proposed CEMP.



3.5.1 Construction in the Murray River

There will be no construction of works within the Murray River. There is potential for decommissioning works in the Murray River associated with the block bank on Narcooyia Creek that separates the creek from the River. Additionally, works associated with suction lines for temporary pumps in Areas 1 and Area 3 will require suction lines to be placed in the Murray River.

3.5.2 Construction Footprint rehabilitation

Following completion of works, rehabilitation of construction areas will be undertaken in accordance with Parks Victoria consent under Section 27 of the *National Parks Act 1975*. General principles for site rehabilitation include:

- Use of locally indigenous plant species
- Placement of habitat logs
- Retention and reuse of topsoil
- Rock beaching using materials consistent with the local geological settings, where practicable

3.6 Key operational activities

The proposed works are designed to facilitate managed inundation of the floodplain over four different tiers (areas) at different operating levels. The proposed works include containment banks and regulators at the downstream end of the Inundation Areas, with smaller structures located along the edges of the floodplains and pumping into Lake Powell (and Lake Carpul). The sources of water for managed inundation will be:

- Gravity inflow from the Murray River through the ER3 Regulator
- Pumped inflow from the Murray River
- Gravity inflow via overland flow

The proposed works are intended to inundate areas of Belsar-Yungera with inflows from the Murray River or with additional pumping when required.

Flows enter the Belsar-Yungera system from the east along Narcooyia Creek after entering from the Murray River through the proposed ER3 regulator. Structures, ER3, ER1, and S7 isolate a large section of Narcooyia Creek from the Murray River and hold water up to 52.3 m AHD in Inundation Area 1. The downstream regulator at J1a in Inundation Area 2 is then used to retain water at an additional higher tier within the J1 creek area up to 52.9 m AHD. At high flows water passes through J1c and J1g regulators in Inundation Area 3 into J1 Creek.

Lake Powell and Lake Carpul regulators in Inundation Area 4 are designed to retain water within the lakes. Both lakes will be inundated by water pumped from Bonyaricall Creek through a two kilometre pipeline between the creek and Lake Powell. Lake Powell and Lake Carpul begin to fill from natural inflows greater than 100,000 ML/d.

During natural events and releases from managed events, water passing through the ER1 regulator travels west to re-join the Murray River.

The proposed structures will be operated to achieve environmental watering targets under four scenarios:

- Normal flow conditions (when no environmental watering is occurring) the water level in Narcooyia Creek will be managed by a fixed crest in one bay of ER1 and ER3 regulators, to maintain a minimum level of 48.35 m AHD to support irrigation diversions.
- Minor flood peaks Narcooyia / Bonyaricall Creek system will be operated as a through-flow system. When river levels exceed ER3 regulator's capacity, the Narcooyia Creek inlet and outlet regulators will be opened. This will meet the water level requirements of the Narcooyia Creek diverters while increasing channel velocity and providing free movement of aquatic fauna between the creek and the river.



- Moderate to large flood peaks Narcooyia / Bonyaricall Creek system will be operated to increase the duration of wetland floodplain inundation. Regulators at the perimeter of the ponded areas, including ER1, S1, S7 and ER3, will remain open as water levels rise to allow the system to fill. The regulators will be closed when river levels start to fall to store water at the target level, up to limits of the regulators: 52.3 m AHD at Area 1 and 52.9 m AHD and 53.3 m AHD in the J1 Creek system. Water will be detained to meet the duration requirements of environmental targets, then returned to the Murray River by opening ER1 regulators. ER3 regulator will be closed to restore the regulated pool in Narcooyia Creek for irrigation supply. Under these conditions, the fishway at ER1 regulator will be in operation to allow fish to enter and exit the Inundation Areas.
- Pumped events If peaks in river flow are too infrequent to meet environmental watering targets, part
 or all of the managed Inundation Area may be flooded by temporary pumping of water from the Murray
 River. Temporary pumps will be installed on the river bank to fill the primary Inundation Area and may
 be relifted to fill Lake Powell and Lake Carpul or the J1 Creek system. Pumping rates ranging between
 40 ML/ d of 200 ML/d are proposed.

3.7 Key decommissioning activities

The design life of the structures is 100 years. If the structures are no longer required at the end of life, all structures will be removed to a practical extent from Belsar-Yungera by the operator, and the area rehabilitated to the satisfaction of Parks Victoria.



4. Methods

4.1 Assessment areas

Throughout this document, the following terms are used to describe the project:

- **Development Footprint** this is the area that the project infrastructure will occupy and includes laydown areas to be used during construction. This does not includes tracks used for access during construction and operation.
- **Construction Footprint** encompasses the current design footprint of proposed structures (included in Development Footprint) plus an approximate 10 m buffer around proposed structures, 3 m buffer around containment banks, laydown areas and minor works sites, and a 5 m wide corridor along access track proposed to be used for construction and/or operation of the project (2.5 m either side of centreline for existing tracks). The Construction Footprint was assessed for native vegetation and listed threatened species and communities.
- Area of Investigation includes an additional buffer on the Construction Footprint and provides the basis for desktop investigations to identify environmental values relevant to construction of the project. It includes a 20 m buffer around the Development Footprint of proposed infrastructure (e.g. regulators, drop structures, pump stations, containment banks) and access tracks (10 m either side of centreline for existing tracks), 15 m buffer around the Development Footprint of minor work sites (e.g. blockage bank removals/modifications) and 10 m buffer around the Development Footprint of laydown areas.
- **Inundation Area** area of land subject to flooding during managed events, up to a specific design water level. The Inundation Area was subject primarily to a desktop assessment, with vegetation ground truthing undertaken in areas modelled to contain non-water dependent communities.
- **Study Area** the area within an approximate 10 km radius around the Area of Investigation and Inundation Area. This area was not surveyed in detail but is used for the desktop assessment of databases and provides a context to the proposed Construction Footprint and Inundation Area.

The location of these areas is shown in Figure 1 and Figure 2.

4.2 Desktop assessment

A review of available biodiversity databases was undertaken to identify terrestrial flora and fauna with potential to occur in the Area of Investigation and the Inundation Area. The review considered previous records, predicted occurrences of flora, fauna and vegetation communities, and an assessment of potential habitats from aerial imagery and native vegetation mapping.

The following databases and reports were used:

- The Commonwealth EPBC Act PMST¹
- Weeds of National Significance database²
- The Victorian Biodiversity Atlas (VBA), maintained by the DELWP³
- NatureKit. Spatial database maintained by DELWP, for native vegetation (Ecological Vegetation Class) mapping throughout Victoria⁴
- The Native Vegetation Information Management tool (NVIM), maintained by DELWP⁵

¹ http://www.environment.gov.au/epbc/protected-matters-search-tool (accessed on 10/02/2020)

² http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html (accessed 14/08/2019)

³ https://www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas (accessed on 14/08/2019)

⁴ http://maps.biodiversity.vic.gov.au/viewer/?viewer=NatureKit (accessed on 15/06/2020)

⁵ https://nvim.delwp.vic.gov.au/ (accessed on 14/08/2019)



- Hattah North and Belsar Yungera Islands Flora Census (Australian Ecosystems 2013)
- Fauna Survey. Hattah North & Belsar Yungera GHD (2014)
- Mallee Sustainable Diversion Limit: Belsar & Yungera Islands Flora & Fauna Assessment, Ecology Australia (2016)
- SDL Fish Management Plan Belsar-Yungera Management Plan prepared by DELWP (2018)

A VBA and PMST search was undertaken for the Study Area, which comprises a 10 km radius around the proposed construction areas and Inundation Area.

The results of the desktop assessment are presented in the likelihood of occurrence / impact tables contained in Appendix D (Construction Footprint and Inundation Area– Flora), Appendix E (Construction Footprint – Fauna) and Appendix F (Inundation Extent – Fauna).

4.2.1 Inundation Area mapping and impact assessment

The extent of inundation that will result following the proposed works has been modelled and considered in this report. The potential impact on native vegetation within the Inundation Area has been considered using:

- DELWP's modelled EVC mapping
- Rare and threatened species based on VBA records

An assessment was then undertaken to determine whether species are considered likely to occur within the modelled EVCs. If it was considered possible that a flora or fauna species may occur within the Inundation Area, an assessment has been made on whether any impacts are likely to be positive, neutral or detrimental.

4.3 Field Assessments

The results of a number of field assessments have been incorporated into this report, and a description of the methods for each of these is outlined below.

4.3.1 Targeted threatened flora assessments

Field surveys were undertaken from 7-11 October 2019 by R8 Botanist Greg Cranston and Ecologist Shelley Thompson. Fieldwork was undertaken in the newly proposed Construction Footprints at all locations, and targeted surveys for rare or threatened flora were conducted to update the results of previous assessments undertaken in the original Construction Footprints (GHD 2016).

The surveys involved the two Ecologists walking parallel linear transects 10 m apart over the extent of the Construction Footprints, with each ecologist having a 5 m field of view each side of the transect. Threatened flora species encountered were GPS marked and details recorded. Roadsides were done from a slow moving car, with threatened flora species observed again GPS marked and details recorded.

4.3.2 Flora species

An inventory of both native and non-native flora incidentally recorded in the Construction Footprints at each site, together with conservation status, origin and weed status was compiled (Appendix B and Appendix C). Observations were recorded of existing or potential threats, impacts and management requirements that may arise during construction.



4.3.3 Ground-truthing of modelled mapping within the Inundation Area

Field surveys were undertaken on 11-12 June 2020 by R8 Botanist Greg Cranston and Ecologist Shelley Thompson. The fieldwork was undertaken after a desktop review to identify locations within the proposed Inundation Area that contained modelled vegetation mapping (DELWP 2005) indicating the presence of nonwater dependent ecosystems, including Semi-arid Woodland and Mallee vegetation communities (0.59 ha), in addition to areas where there was no modelled EVC data (70.49 ha). These areas were dispersed throughout the Inundation Area, across over 50 discrete locations (individual points or clusters of points). These areas were accessed on foot, a determination was made of the EVC present in each of these intercept areas, and photos were taken of each location and the correct EVC mapped.

The purpose of this targeted field assessment was to determine presence or absence of non-water dependent ecosystems and did not include a Vegetation Quality Assessment, which is likely to be undertaken as to inform the project's native vegetation offset management strategy and/or as part of monitoring undertaken as part of the project's monitoring and evaluation framework currently being developed.

The extent of inundation that will result following the proposed works has been modelled and considered in this report. The potential impact on native vegetation within the Inundation Area has been considered using the results of the ground-truthing vegetation mapping assessment (see **Figure 6**), DELWP modelled EVCs, and potential impact on rare and threatened species has been based on VBA records and an assessment of whether species are likely to occur within the known or modelled EVCs to be inundated, and whether any impact is likely to be positive, neutral or detrimental.

4.3.4 Targeted Threatened Fauna Assessments

Field surveys were undertaken on 9, 17, 22 October 2019 and 19 November, 2019 by R8 Senior Zoologists Alex Holmes, Dan Eyles, Dr Richard Retallick and Ecologist Shelley Thompson. The surveys were conducted within the proposed Construction Footprints to confirm the condition and extent of fauna habitats and to conduct targeted surveys for threatened fauna known to occur in the Construction Footprints and broader area (Australian Ecosystems 2013, GHD 2013, GHD 2014, Ecology Australia 2016). Particular focus was given to the eastern subspecies of Regent Parrot (*Polytelis anthopeplus monarchoides*) which is well known from Belsar and Yungera Islands, has been recorded at a number of the Construction Footprints, and is listed as Vulnerable under both the National EPBC Act and Victorian FFG Act.

A search of the VBA and PMST indicated that 52 threatened fauna species are either known or are predicted to occur within the construction area. Of the 52 species, 21 terrestrial species were considered to have the potential to occur in the construction areas based on habitat requirements and number and period since last recorded (Appendix E). These 21 species made up the target threatened species list for the surveys and include Apostlebird (*Struthidea cinerea*), Diamond Dove (*Geopelia cuneata*) Diamond Firetail (*Stagonopleura guttata*), Grey-crowned Babbler (*Pomatostomus temporalis*), Hooded Robin (*Melanodryas cucullata*), Major Mitchell's Cockatoo (*Lophochroa leadbeateri*), Painted Honeyeater (*Grantiella picta*), Regent Parrot (*Polytelis anthopeplus monarchoides*), Black Falcon (*Falco subniger*), Growling Grass Frog (*Litoria raniformis*), Carpet Python (*Morelia spilota metcalfei*) and other threatened waterbirds listed in Table 8.

The surveys included:

- Targeted surveys for the Nationally and State listed Regent Parrot and its potential breeding habitat, including using the prescribed Two Hour Point Survey (THPS) technique in areas of suitable habitat
- Recording all identified fauna, and their observed behaviour (e.g. feeding, roosting, breeding), abundance and conservation status
- Pest fauna posing a threat to native vegetation and/or fauna
- Active searching of appropriate habitats (logs, tree hollows, tussocks, deep litter etc.) and food plants (i.e. fruit and/or nectar bearing) for mammals, birds, reptiles and frogs and habitat assessments for threatened fauna
- Assessments of potentially suitable habitat for threatened fauna
- Migratory terrestrial or migratory wetland species were considered as part of this assessment



Survey methods and effort, and species targeted are summarised below in Table 1. It should also be noted that methods described in '*Survey guidelines for Australia's threatened birds, Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*' (Department of the Environment, Water, Heritage and the Arts 2010) were consulted and employed for Regent Parrot and Painted Honeyeater.

Survey Type	Survey Effort	Species targeted
Habitat assessment	Conducted over approximately 2-3 person- hours per site, investigating construction area through various survey methods	All
Regent Parrot Two- Hour Point Survey (THPS)	Targeting construction sites with potential habitat of large River Red-gum with hollows (Sites – ER1, ER3, S7, S108 and Bonyaricall Creek hard stand) with 37 separate Two-Hour Point Counts to detect Regent Parrot breeding activity	Regent Parrot
Bird Surveys	At least 2 x 20 minute, 2 ha diurnal surveys at each construction area (two ecologists distributed across sites undertaking survey concurrently). Approximately 25 surveys undertaken	All threatened but particularly: Apostlebird, Black Falcon, Diamond Firetail, Grey-crowned Babbler, Grey- fronted Honeyeater, Hooded Robin, Major Mitchell's Cockatoo, Painted Honeyeater, Regent Parrot, Square- tailed Kite, White-bellied Sea-eagle and threatened water birds.
Active searches	Conducted opportunistically by two ecologists concurrently at each construction area for a period of 30-60 mins. Approximately 22 surveys conducted	Carpet Python, Growling Grass Frog and all threatened species
Scat / hair / bone / skin / pellet analysis	Assessed / collected opportunistically	All
Opportunistic observations	Two ecologists over the entire survey period, including four 8-hour including travel to other construction areas inside of park Minimum of 64 person-hours of opportunistic observation	All

Table 1	Summar	y of surve	/ methods	and effort	employe	ed for Belsar	-Yungera	fauna survey
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Regent Parrot targeted nest surveys

The Regent Parrot is listed as threatened under the FFG Act and as Vulnerable under the EPBC Act. The Regent Parrot is a highly mobile species which typically nests within suitable hollows of River Red-gum, with the male initially travelling up to 20 km to forage within Mallee habitats, returning to feed the female (when incubating eggs) and later the nestlings. There are records of this species from across the Belsar-Yungera Area of Investigation, including at most of the proposed construction sites. Breeding activity has been confirmed in previous studies from the northern and eastern areas of Yungera Island along the Gearbox Loop Trail (Webster 2002, Webster 2004, Webster & Belcher 2005, Webster & Belcher 2008, GHD 2009, GHD 2013, and GHD 2014). Known Regent Parrot breeding habitat was identified close to the S108 Regulator site and Potential Regent Parrot breeding habitat was identified close to the ER1 South track raising and Bonyaricall Creek hard stand for the Lake Powell pump. These areas were all subsequently targeted for further investigation.



Surveys were completed on October 9, 17, 22 and November 19, 2019, using the Two Hour Point Survey (THPS) technique adapted from GHD (2009; 2017; 2018) and Robertson and Hurley (2010). Surveys were undertaken by two ecologists experienced in Regent Parrot survey and behaviour. The survey techniques are specific to the detection of Regent Parrot nesting activity and were developed and refined with the Living Murray Hattah Lakes Floodplain Management Project in recent years. Surveys were completed at observation points across each of the three Construction Footprints where suitable habitat was been identified for Regent Parrot nesting (**Figure 4**). At least five THPS were completed at each Construction Footprint containing potential nesting habitat (large old River Red-gums) during the survey period

Two Hour Point Surveys (THPS) are an effective technique to locate and confirm Regent Parrot nests. The technique was developed by GHD (2009) (One Hour Point Survey) and later tested and modified by Robertson and Hurley (2010) and involves experienced observers stationed quietly for two hours at each observation point. The locations of the THPS were selected so as to effectively cover all of the proposed development area and its immediate surrounds of the S108 Regulator site, ER1 South track raising and Bonyaricall Creek hard stand for the Lake Powell pump, all areas considered to have Potential Regent Parrot breeding habitat.

During the two (2) hour survey, the observer closely observes the trees and records all Regent Parrot activity in the immediate vicinity. During a THPS, the following information was documented as a minimum:

- Start and finish time
- Location (confirmed using GPS)
- Observer Name/s and number of observers
- Weather details
- Details of Regent Parrot activity

The priority was to record any behaviour that is most closely associated with Regent Parrot breeding activity, including:

- Use of hollows by male and/or female birds
- Adults feeding nestlings
- Copulation between individuals
- Hollow inspection
- Males feeding females
- Defending a tree or hollow by a pair of birds

Suspected breeding activity is documented and the position recorded using a handheld GPS. Nests are listed as 'confirmed' only using the strict criteria outlined below. Some behaviours described above are deemed insufficient on their own to 'confirm' nesting activity, they are indicative that nesting is likely to be occurring. As these surveys were completed very early in the breeding season for Regent Parrot, activity is likely to be beginning, nestlings are unlikely, and subsequent surveys at the same location may confirm the presence of a nest.

Criteria used to confirm an active Regent Parrot nest

The criteria used to confirm that a hollow contains an active Regent Parrot nest are similar to those used and described previously by Webster and Belcher (2008) with later explanations provided from GHD (2009). Nesting is therefore said to be **confirmed** if any **one** or more of the following was recorded:

A male Regent Parrot is observed entering and/or leaving a hollow.

Note: Evidence indicating the presence of breeding can be confirmed by observing a male perched in a potential nest tree softly calling to a female who then emerges from a hollow and subsequently is fed by the male. Alternatively, observing a male escorting a female to a tree and the female entering a hollow and remaining inside after the male leaves the area is strong evidence of an active nest. Conclusive proof of nesting can be provided by direct observation of the hollow chamber revealing eggs or nestlings or observing nestlings at the entrance to a hollow.



A pair of Regent Parrots is observed entering and/or leaving a hollow.

Note: A pair of Regent Parrots observed aggressively defending a tree could potentially be defending a nest hollow. Observations suggest that the pair may perch near the nest hollow and defend the area from other birds / pairs of birds when these birds perch too closely. The defending pair of birds will sometimes perch in a nearby tree, but often appear to return to the same tree particularly when other birds approach. Close observation of these birds may eventually result in the observation of one or both birds attending the nest, although aggressive behaviour on its own is not sufficient to confirm an active nest.

Later in the breeding season both male and female Regent Parrots may leave the nest to forage prior to returning to feed their nestlings. The parents may feed the nestlings by briefly (5 -10 seconds) dipping their foreparts into the nest to feed the nestlings, which are often heard begging in between feeds.

A female is observed entering a hollow after being fed by a male.

Note: A female Regent Parrot that has been observed within a tree hollow (i.e. clearly visible and present within the hollow without leaving) for the duration of a THPC on at least two separate occasions could be deemed as occupying an active nest. It is considered highly unlikely that a female will be present within a hollow for a prolonged period of time unless she were brooding eggs / nestlings.

Nestlings are heard begging after an adult bird enters a hollow or is observed at the nest entrance.

Timing of surveys

Surveys should be undertaken during the breeding season for Regent Parrots (within the period of September to January, inclusive), with a preference for October through December, depending on seasonal conditions such as winter/spring rainfall. These surveys were completed through October and November, ideal times for survey.

Regent Parrot activity appears to be reduced during the middle (warmer) part of the day, therefore it is preferable to perform THPS from the early morning (sunrise) until no later than midday (or 11:00 am on hotter days). Temperatures during these surveys were mild throughout.

Field Equipment

The following field equipment was used for Regent Parrot surveys:

- Good quality binoculars for making detailed observations, determining sex of birds and checking for activity within nest hollows
- Global Positioning System (GPS) for recording the coordinates of nest trees and bird observations
- Compass for recording flight direction of birds
- Camera both compact digital with wide angle and telephoto capability (for photographs of nest trees), and an SLR with high quality telephoto lens (for photographs of Regent Parrots)

4.4 Permits

Surveys were completed in accordance with the R8 flora and fauna survey permit conditions issued under the *Wildlife Act 1975* and *National Parks Act 1975* Research Permits 10009193 and 10008653, administered by DELWP. One of the permit conditions requires that all fauna and flora data collected during the surveys are submitted to the Atlas of Victorian Wildlife database and the Victorian Biodiversity Atlas (which is also a condition of the data-sharing agreement between R8 and DELWP).

In addition, R8 has an operating Animal Ethics Committee (AEC). Approval to undertake the proposed survey methods was obtained from the R8 AEC prior to the commencement of field studies.



4.5 Nomenclature

4.5.1 Flora

Unless otherwise noted, common and scientific names for flora follow the VBA database (Version 3.2.5).

Flora conservation status was determined in accordance with the Commonwealth EPBC Act, the Victorian FFG Act, and the *Advisory List of Rare or Threatened Plants in Victoria* – 2014 (DEPI 2014).

Native vegetation is defined in the Victoria Planning Provisions as 'plants that are indigenous to Victoria, including trees, shrubs, herbs and grasses'. For the purpose of the *Guidelines for the removal, destruction or lopping of native vegetation* (DELWP 2017a), native vegetation is classified into two categories, a **Patch** of vegetation or a **Scattered Tree**:

A patch of native vegetation is either:

- An area of native vegetation where at least 25% of the total perennial understorey plant cover is native.
- Any area with three or more native canopy trees where the drip line of each tree touches the drip line of at least one other tree, forming a continuous canopy.
- Any mapped wetland included in the Current wetlands map (available on DELWP online mapping tools).

A scattered tree is a native canopy tree that does not form part of a patch.

Other forms of vegetation include:

Planted native vegetation, i.e. includes non-indigenous native species and areas of revegetation).

Scattered native plants, i.e. patches of vegetation dominated by introduced species where less than 25% of the total perennial understorey plant cover is native.

Non-native vegetation, i.e. vegetation that comprises entirely introduced flora species.

4.5.2 Fauna species and communities

Unless otherwise noted, common and scientific names for fauna follow the VBA database (Version 3.2.6).

Fauna conservation significance was determined in accordance with the Victorian FFG Act, DELWP's Advisory Lists (DSE 2009; DSE 2013) and the Commonwealth EPBC Act.

The EPBC Act and the FFG Act list a number of threatened fauna communities, at a national or state scale, respectively. Fauna communities known or potentially occurring within the Study Area are only considered if they are listed under one or more of these Acts.



5. Overview of existing conditions

The Belsar-Yungera Floodplain Restoration Project is located on the Murray River floodplain, approximately 30 kilometres upstream of the Euston weir, near Robinvale in north-west Victoria. The floodplain comprises Belsar and Yungera Islands, which are formed by anabranches of the Murray River including Narcooyia, Bonyaricall and Yungera Creeks, and Tonsing Island. Lake Powell and Lake Carpul, two ephemeral wetlands, are also located on the southern limit of the Belsar-Yungera floodplain (Mallee CMA, 2014) and combined with the Belsar and Yungera Island make a total floodplain complex area of 8,300 hectares.

The floodplain complex is situated predominantly in the Robinvale Plains bioregion, with a small area within the western limit of the Murray Fans bioregion. Belsar-Yungera Islands are an integration of two environment types, the central River Red Gum forest and lower Murray floodplain. The project involves works to support inundation of 2,374 hectares of this regionally and internationally significant floodplain.

The Belsar-Yungera floodplain complex comprises a highly diverse natural environment, where the riverine and lower Murray floodplain environments integrate. The mosaic of aquatic and terrestrial vegetation communities support a wide variety of terrestrial and aquatic flora and fauna species. The complex also provides important longitudinal connection to the Murray River and its floodplains, creating essential biodiversity corridors to allow species dispersal between environments vital to their life cycles (Mallee CMA, 2014).

The vegetation of Belsar and Yungera Islands is dominated by Lignum Shrublands and Black Box Woodlands EVCs. River Red Gum Woodland and Forest EVC is present along watercourses and in meander loops along the Murray River. The vegetation of Lakes Powell and Carpul is distinctive, supporting Lake Bed Herblands EVC on the lake floor and Mallee and Woodland EVC present at the lake fringes (Ecological Associates 2014).

As described in Section 1.2 and summarised in Appendix A, extensive background information has been collected on the ecological values of the Belsar-Yungera floodplain complex over a number of years. These previous studies have been considered in preparing this report. To improve understanding of existing conditions additional targeted threatened species surveys and ground-truthing in the inundation area have been undertaken as part of this assessment.

The results of targeted threatened species surveys and ground-truthing assessment in the inundation area are presented in Section 6, and Section 7 of this report respectively.



6. Targeted Threatened Species Surveys

Targeted surveys for rare or threatened species were undertaken in October to December 2019 within the Construction Footprints, these areas contained intact native vegetation and it was considered possible that they supported suitable habitat of varying qualities for rare or threatened species.

6.1 Threatened flora assessment

6.1.1 Desktop Assessment and Likelihood of Occurrence

VBA and PMST searches identified 101 threatened flora species, including seven EPBC Act-listed flora species, and/or 21 FFG listed threatened flora species and/or 98 DELWP Advisory listed threatened flora species that have been recorded or have the potential to occur within 10 km of the Construction Footprints and Inundation Area. An additional two species listed under the DELWP Advisory list were identified in the field assessments; these species have been incorporated in the likelihood of occurrence and impact tables within this report.

Each of the 103 species were then assessed for their likelihood of occurrence within the Construction Footprint (Appendix D, Table 2), taking into account factors such as the habitat requirements of each species and comparing those to the habitats encountered within the Belsar-Yungera Construction Footprints, and also the number of recent records within the Study Area.

The 103 species were also assessed for their likelihood of occurrence within the Inundation Area. The modelled mapping within the Inundation Area indicated the potential presence of small patches of Semi-arid Woodland and Mallee Communities. These areas were ground truthed in June 2020 and found to be dominated by Black Box woodland and lignum communities. It is considered highly unlikely that Buloke Woodland and Mallee communities would be present in the Inundation Area in locations where water-dependent EVCs have been modelled as occurring. Therefore, a determination has been made in the likelihood of occurrence and impact for rare and threatened flora species within the Inundation Area, taking into account the absence of Semi-arid Woodland and Mallee vegetation/habitat. The results of this assessment are outlined in Appendix D, and summarised in Table 2.

	Construction Footprint	Inundation Area
Present	18	Not assessed
Possible	41	63
Unlikely	44	40
Total	103	102

Table 2 Overview of likelihood of occurrence assessments for rare or threatened flora

EPBC and FFG Act-listed flora

Twenty-six of the listed species identified in the desktop assessment as potentially occurring within the study area are listed under the EPBC Act and/or FFG Act. It is considered unlikely that 11 of these species will be present within the Construction Footprint or Inundation Area, and the remaining 15 species have either been identified during the field assessments of the Construction Footprint, or it is considered possible that they may occur within either the Construction Footprint and/or the Inundation Area due to the known or potential presence of suitable habitat.

Some species have been identified as 'possibly occurring' within the Construction Footprint and/or Inundation Area, but as having a low likelihood of being impacted. This has arisen in situations where even though preferred habitat is present (meaning likelihood of occurrence is possible), an impact on these species has been deemed as unlikely, as the species has not been recorded during targeted surveys at the appropriate time of the year. However, it should be noted that due to the prevailing drought conditions, the response of many ephemeral species has been muted, and absence during the 2016 and 2019 targeted surveys does not necessarily imply that the species is not present – it may still reside in the soil as underground tubers, rootstock or seed, waiting for appropriate moisture to trigger germination.

A detailed assessment of all of these species' likelihood is included in Appendix C, and Table 3 below summarises the results of the likelihood assessment for the 14 species that are known or considered likely/possible to occur within the Construction Footprint and/or Inundation Area.



Table 3 Summary of likelihood of occurrence assessments for EPBC and FFG listed flora species with the potential to occur

Scientific Name	Common Name	EPBC	FFG	VICADV	Habitat	Area of Investigation: Likelihood of Occurrence/Impact	Inundation Area: Likelihood of Occurrence/Impact
Acacia melvillei	Yarran		L	vu	Scattered through north-western Victoria, mostly along Murray River and its flood- plain, often in woodland (Walsh & Entwisle 1996).	Present. Recorded in low numbers during Spring 2019 surveys immediately adjacent to the Construction Footprint. Was also recorded in local area during Australian Ecosystems 2013 census surveys. Impact possible. Several individuals recorded in close proximity to proposed structures. It is recommended that the individuals observed are fenced off during construction to avoid impacting this species.	Possible. Could occur in Inundation Area. Impact: positive to neutral impact expected as the result of the operation of the project.
Acacia oswaldii	Umbrella Wattle		L	vu	Widespread but rather uncommon throughout north-western Victoria, mainly on calcareous soils or loam (Walsh & Entwisle 1996)	Present. Recorded in high numbers during Spring 2019 surveys. Was also recorded in footprints during Ecology Australia (2015) surveys and in local area during Australian Ecosystems (2013) census surveys. Impact possible. High number of individuals recorded in close proximity to proposed structures.	Possible . Could occur in Inundation Area. Impact: positive to neutral impact expected as the result of the operation of the project.
Allocasuarina luehmannii	Buloke		L	en	Usually growing in woodland with <i>Eucalyptus microcarpa</i> , on calcareous soils (Walsh and Entwistle, 1996)	Possible. Was not recorded in the broader 2013 flora census of the area, but was recorded in construction areas during the EA (2015) surveys. Was however not recorded in the most recent 2019 targeted surveys in the construction areas. Impact Unlikely. Not recorded in revised Construction Footprint during 2019 surveys and likely to have been seen if present.	 Possible. Suitable habitat unlikely to be present, but as it was recorded in the Construction Footprint in 2015, considered possible that it could occur in Inundation Area. Impact: positive to neutral impact expected as the result of the operation of the project.
Atriplex rhagodioides	Silver Saltbush		L	vu	In Victoria apparently confined to the Murray River floodplain in the far north west and recorded only from Natya area (between Swan Hill and Robinvale), Red Cliffs and Cowra. Fruits Mar., Oct. (Walsh & Entwisle 1996)	Possible. Suitable habitat was identified during survey, but not recorded in 2013, 2015 or 2019 surveys. Impact Unlikely. Not recorded in any previous surveys, unlikely to be impacted.	Possible. Could occur in Inundation Area. Impact: positive to neutral impact expected as the result of the operation of the project.



Scientific Name	Common Name	EPBC	FFG	VICADV	Habitat	Area of Investigation: Likelihood of Occurrence/Impact	Inundation Area: Likelihood of Occurrence/Impact
Craspedia haplorrhiza	Plains Billy-buttons		L		Usually on heavy soils or loamy sands, particularly on floodplains and seasonally wet depressions. Flowers spring and early summer.	Possible. Suitable habitat was identified during survey, but not recorded in 2015 or 2019 surveys. Was recorded in local area during Australian Ecosystems (2013) census surveys. Impact Unlikely. Not recorded in previous surveys of the construction areas, unlikely to be impacted.	Possible. Could occur in Inundation Area. Impact: positive to neutral impact expected as the result of the operation of the project.
Cullen cinereum	Hoary Scurf-pea		L	en	Endangered in Victoria, known only from a few localities in the far north west of the state where it grows in moist depressions and on floodplains (Walsh & Entwisle 1996).	Possible. Suitable habitat was identified during survey, but not recorded in 2013, 2015 or 2019 surveys. Impact Unlikely. Not recorded in any previous surveys, unlikely to be impacted.	Possible . Could occur in Inundation Area. Impact: positive to neutral impact expected as the result of the operation of the project.
Cullen pallidum	Woolly Scurf-pea		L	en	Endangered in Victoria where known from very few collections in the far north west of the state, growing in deep sand (Walsh & Entwisle 1996).	 Present. Recorded in one location during the 2019 surveys. Also recorded in 2013 surveys. Impact possible. Small number of individuals recorded in close proximity to proposed structures. 	Unlikely. Suitable habitat (deep sands) unlikely to be in the Inundation Area.
Cullen tenax	Tough Scurf-pea		L	en	Widespread in Victoria but now much depleted from its former range and seldom collected. Generally grows in drier parts of the state in grassland and grassy woodland on heavy soils	 Present. Recorded from one main location during the 2019 surveys. Not recorded in the area previously. Impact possible. Small number of individuals recorded in close proximity to one proposed structure. 	Possible . Could occur in Inundation Area. Impact: positive to neutral impact expected as the result of the operation of the project.
Cyperus nervulosus	Annual Flat-sedge		L	en	Apparently confined in Victoria to the far north-west (Mildura, Hattah Lakes, and Robinvale) where occasional on damp sandy soil fringing receding water in lakes and watercourses (Walsh & Entwisle 1996).	 Possible. Suitable habitat was identified during survey, but not recorded in 2013, 2015 or 2019 surveys. Impact Unlikely. Not recorded in any previous surveys, unlikely to be impacted. 	Possible. Could occur in Inundation Area. Impact: positive to neutral impact expected as the result of the operation of the project.
Cyperus rigidellus	Curly Flat-sedge		L	en	Grows in ephemerally wet situations such as lake beds, floodways and roadside drains in the far north west (e.g. Hattah, Robinvale and Jeparit areas) (Walsh & Entwisle 1996).	 Possible. Suitable habitat was identified during survey, but not recorded in 2013, 2015 or 2019 surveys. Impact Unlikely. Not recorded in any previous surveys, unlikely to be impacted. 	Possible. Could occur in Inundation Area. Impact: positive to neutral impact expected as the result of the operation of the project.



Scientific Name	Common Name	EPBC	FFG	VICADV	Habitat	Area of Investigation: Likelihood of Occurrence/Impact	Inundation Area: Likelihood of Occurrence/Impact
Eremophila bignoniiflora	Bignonia Emu- bush		L	vu	In Victoria confined to the far north-west and considered endangered in this State. Found along river flats and in depressions in woodlands on heavy clay soils. (Walsh and Entwisle 1999)	Unlikely. This species is not cryptic and it is expected in will have been recorded during recent or previous surveys if it was present.	Possible. Could occur in Inundation Area. Impact: positive to neutral impact expected as the result of the operation of the project.
<i>Eremophila maculata</i> subsp. <i>maculata</i>	Spotted Emu-bush		L	r	In Victoria confined to the north-west, mainly in <i>Eucalyptus largiflorens</i> forests or woodlands on heavy clay soils.	 Present. Recorded during 2019 surveys. Also recorded during 2015 surveys on the construction areas. Impact possible. Low number of individuals recorded in close proximity to proposed construction areas. 	Possible. Could occur in Inundation Area. Impact: positive to neutral impact expected as the result of the operation of the project.
Isolepis congrua	Slender Club- sedge		L	vu	Recorded from cracking clay along the Murray River near Colignan and other seasonally wet areas at Mt Arapiles, near Donald, St Arnaud, Dadswell Bridge and Puckapunyal (Walsh & Entwisle 1996)	 Possible. Suitable habitat was identified during survey, but not recorded in 2013, 2015 or 2019 surveys. Impact Unlikely. Not recorded in any previous surveys, unlikely to be impacted. 	Possible. Could occur in Inundation Area. Impact: positive to neutral impact expected as the result of the operation of the project.
Swainsona phacoides	Dwarf Swainson- pea		L	en	Scattered in seasonally inundated habitats along the Murray Valley downstream from about Echuca (Walsh and Entwisle 1999).	Possible. Suitable habitat was identified during survey, but not recorded in 2013, 2015 or 2019 surveys. Impact Unlikely. Not recorded in any previous surveys, unlikely to be impacted.	Possible. Could occur in Inundation Area. Impact: positive to neutral impact expected as the result of the operation of the project.



6.1.2 Threatened and protected flora recorded during the 2019 surveys

No EPBC Act-listed flora species were recorded during the current surveys, however five species listed as threatened under the FFG Act were recorded (see Table 4). Eighteen flora species listed as rare or threatened in Victoria under the DELWP Advisory list of rare and threatened flora were also recorded. The location of significant populations of rare or threatened species identified during surveys at the site are shown in Appendix G.

•	•	•	
Species Name	Common Name	Status	Location of recent records
Acacia melvillei	Yarran	P, L, v	3 individuals/clusters (Page 8, 9 and 13 Figure 4)
Acacia oswaldii	Umbrella Wattle	P, L, v	>30 individuals/clusters scattered within the investigation area (Figure 4)
Asperula gemella	Twin-leaf Bedstraw	r	>10 individuals/clusters (Page 1, 4, 6 and 7 Figure 4)
Asperula wimmerana	Asperula	r	3 individuals/clusters (Page 5 and 7 Figure 4)
Atriplex lindleyi subsp. conduplicata	Saltbush	r	>15 individuals/clusters (Page 17 Figure 4)
Atriplex pseudocampanulata	Fan Saltbush	r	>10 individuals/clusters scattered within the investigation area (Figure 4)
<i>Chenopodium desertorum</i> subsp. <i>rectum</i>	Frosted Goosefoot	V	5 individuals/clusters (Page 1 and 2 Figure 4)
Cullen pallidum	Woolly Scurf-pea	P, L, e	3 individuals/clusters (Page 1 Figure 4)
Cullen tenax	Tough Scurf-pea	P, L, e	7 individuals/clusters (Page 7 and 13 Figure 4)
<i>Duma horrida</i> subsp. <i>horrida</i>	Spiny Lignum	r	>15 individuals/clusters (Page 2 Figure 4)
<i>Eremophila divaricata</i> subsp. <i>divaricata</i>	Spreading Emu- bush	P, r	>30 individals/clusters scattered within the investigation area (Figure 4)
<i>Eremophila maculata</i> subsp. <i>maculata</i>	Spotted Emu-bush	P, L, r	>10 individuals/clusters scattered within the investigation area (Figure 4)
Frankenia serpyllifolia	Bristly Sea-heath	r	>20 individuals/clusters (Page 1 and 2 Figure 4)
Malacocera tricornis	Goat-head	r	>15 individuals/clusters scattered within the investigation area (Figure 4)
Minuria denticulata	Woolly Minuria	P, r	1 individual/cluster (Page 14 Figure 4)
Minuria integerrima	Smooth Minuria	P, r	3 individuals/clusters (Page 4 and 14 Figure 4)

Table 4 Summary of threatened nota recorded during 2013 Survey	Table 4	Summar	y of threatened	flora recorded	during 201	9 surveys
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Species Name	Common Name	Status	Location of recent records
Picris squarrosa	Picris	P, r	>1 individual/cluster (Page 12 Figure 4)
Sclerolaena patenticuspis	Copperburr	r	>5 individuals/clusters scattered within the investigation area (Figure 4)

Key: L (Threatened under the FFG Act), P (Protected under the FFG Act). V (Vulnerable under VROTS), e (Endangered under VROTS), r (Rare under VROTS)

6.2 Significant weed species

Thirteen significant weeds were identified within the study area. Eleven of these are CaLP *Act*-listed weed species (including one WONS), and two of these are listed only as WONS:

- Asparagus officinalis (Asparagus), Restricted
- Asphodelus fistulosus (Onion Weed), Restricted
- Carthamus lanatus (Saffron Thistle); Restricted
- Cirsium vulgare (Spear Thistle); Restricted
- Dittrichia graveolens (Stinkwort); Restricted
- Echium plantagineum (Patterson's Curse); Restricted
- Emex australis (Spiny Emex); Regionally Controlled
- Lycium ferocissimum (African Box-thorn), Regionally Controlled / WONS
- Marrubium vulgare (Horehound), Restricted
- Opuntia ficus-indica (Indian Fig), WONS
- Opuntia spp. (Prickly Pear), WONS
- Xanthium occidentale (Noogoora Burr), Regionally Controlled
- Xanthium strumarium spp. agg. (Noogoora Burr aggregate), Regionally Controlled

Mitigation measures to prevent the spread of these species (and any other WONS or CaLP Act listed weed species) will need to be incorporated into a CEMP.

6.3 Threatened fauna assessment – desktop results

6.3.1 Desktop assessment and likelihood of occurrence

VBA and PMST searches identified 52 threatened fauna species that have been recorded or have the potential to occur within the Study Area. Of these species, 21 are listed under the EPBC Act, 32 are listed under the FFG Act, and 30 are DELWP Advisory listed threatened species. Several species may be listed under one or more of these Acts/Advisory Lists.

Each of these species has been assessed for their likelihood of occurrence and potential for impact within the Construction Footprints (Appendix E) and Inundation Area (Appendix F), taking into account factors such as the habitat requirements of each species and comparing those to the habitats encountered within the Belsar-Yungera Construction Footprints, and also the number and frequency of records within 10 km of these areas.



6.4 Threatened fauna assessments – field results

One EPBC Act Listed species and two additional FFG Act listed species were recorded from the targeted fauna surveys. The Regent Parrot (*Polytelis anthopeplus monarchoides*) is listed as Vulnerable under the EPBC Act, and is also listed under the FFG Act and as vulnerable under the DELWP Advisory list of threatened vertebrate fauna. This species was regularly observed across Belsar and Yungera Islands and a total of 102 individuals were recorded. The FFG Act listed Major Mitchell's Cockatoo (*Lophochroa leadbeateri*) and Square-tailed Kite (*Lophoictinia isura*) are both also listed as vulnerable under the DELWP Advisory list, and were recorded on two occasions each. A summary of all fauna species recorded during the surveys are provided in Appendix M, with results of the Regent Parrot Two Hour Point Surveys shown in detail in Appendix N and summarised below.

6.4.1 Regent Parrot two-hour point surveys (THPS) summary

Thirty-seven targeted surveys for Regent Parrot nests using the standardised THPS method (**Figure 4Error! Reference source not found.**) were completed at Construction Footprints identified as containing habitat with potential for Regent Parrot nesting – specifically large River Red-gum trees with hollows (Table 5). During the combined 74 hours and 37 THPS of surveys completed across the five key Construction Footprint areas, much Regent Parrot activity was observed, with birds regularly resting in trees and moving through, in and out of the area, no behaviour conducive to breeding was observed. Nor were any young Regent Parrots (notable due to their short tails and drab plumage) observed within the survey areas during all surveys. Results of the surveys are provided in detail in Appendix N.

Across all targeted threatened fauna surveys 10 separate records of a total of 102 Regent Parrots were recorded (Appendix N). This species was found to be widespread, and was regularly observed throughout the broader area, including while travelling to and between survey sites.

Site	Date and number of THPS	Total THPS
ER1	9/10/19 (x2). 17/10/19 (x2). 19/11/19 (x4).	8
ER3	9/10/19 (x2). 17/10/19 (x2). 22/10/19 (x3). 19/11/19 (x4).	11
S7	17/10/19 (x2). 22/10/19 (x3).	5
S108	9/10/19 (x2). 17/10/19 (x2). 22/10/19 (x3).	7
Bonyaricall Creek hard stand	9/10/19 (x2). 19/11/19 (x4).	6
TOTAL		37

Table 5 Summary of results of Regent Parrot THPS

6.4.2 ER1 Levee

Extensive surveys of the ER1 Levee site (e.g. GHD 2013, GHD 2016, Ecology Australia 2016, and the current surveys) recorded the EPBC Act listed Regent Parrot passing through and around the Construction Footprint regularly. Eight targeted surveys for nesting of this species across the Construction Footprint did not record any likely or potential nesting activity. Two individuals of the FFG Act and DELWP Advisory-listed Major Mitchell's Cockatoo (*Lophochroa leadbeateri*) were also observed passing through this site.

The many large trees with hollows throughout this Construction Footprint and surrounding area also provide important habitat for many native species, likely including threatened species such as Lace Monitor (*Varanus varius*) and potentially Carpet Python (*Morelia spilota metcalfei*).



6.4.3 ER3 Regulator

Extensive surveys of the E3 Regulator site (e.g. GHD 2013, GHD 2016, Ecology Australia 2016, and the current surveys) recorded the EPBC Act listed Regent Parrot passing through and around the Construction Footprint regularly. Eleven targeted surveys for nesting of this species across the Construction Area did not record any likely or potential nesting activity. Two individuals of the FFG Act and DELWP Advisory listed Square-tailed Kite (*Lophoictinia isura*) were also observed hunting across this site.

The many large trees with hollows throughout this Construction Footprint and surrounding area also provide important habitat for many native species, likely including threatened species such as Lace Monitor (*Varanus varius*) and potentially Carpet Python (*Morelia spilota metcalfei*).

6.4.4 S7 Regulator

Numerous surveys of the S7 Regulator (e.g. GHD 2013, GHD 2016, Ecology Australia 2016, and the current surveys) recorded the EPBC Act listed Regent Parrot passing through and around the Construction Footprint regularly. Five targeted surveys for nesting of this species across the Construction Area did not record any likely or potential nesting activity.

The many large trees with hollows throughout this Construction Footprint and surrounding area also provide important habitat for many native species, likely including threatened species such as Lace Monitor (*Varanus varius*) and potentially Carpet Python (*Morelia spilota metcalfei*).

6.4.5 S108 Regulator

Extensive surveys of the S108 Regulator site on the Gearbox Loop Track (e.g. GHD 2013, GHD 2016, Ecology Australia 2016, and the current seven surveys) recorded the EPBC Act listed Regent Parrot passing through and around the Construction Footprint regularly. Seven targeted surveys for nesting of this species across the Construction Footprint did not record any likely or potential nesting activity. One FFG Act and DELWP Advisory-listed Square-tailed Kite (*Lophoictinia isura*) was also observed hunting across this site.

The many large trees with hollows throughout this Construction Footprint and surrounding area also provide important habitat for many native species, likely including threatened species such as Lace Monitor (*Varanus varius*) and potentially Carpet Python (*Morelia spilota metcalfei*).

6.4.6 Bonyaricall Creek hard stand

Numerous surveys of the Bonyaricall Creek hard stand site (e.g. GHD 2013, GHD 2016, Ecology Australia 2016, and the current six surveys) recorded the EPBC Act listed Regent Parrot passing through and around the Construction Footprint regularly. Six targeted surveys for nesting of this species across the Construction Footprint did not record any likely or potential nesting activity. The FFG Act and DELWP Advisory-listed Major Mitchell's Cockatoo (*Lophochroa leadbeateri*) was also recorded at this site.

The many large trees with hollows throughout this Construction Footprint and surrounding area also provide important habitat for many native species, likely including threatened species such as Lace Monitor (*Varanus varius*) and potentially Carpet Python (*Morelia spilota metcalfei*).

6.4.7 Other Construction Footprints across the Area of Investigation

Fauna habitat assessments and opportunistic surveys were completed across all Construction Footprints and the broader Area of Investigation while travelling between sites. All of these areas were observed to provide a wide range of fauna habitat values that whilst important to native species, were not considered likely to be important for threatened fauna species. Higher quality fauna habitats (e.g. large hollow-bearing trees) were not observed at any of these sites, and these areas are considered likely to only provide habitat for more common species, as recorded during all surveys (Appendix N).



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Figure 4: Threatened Flora and Fauna species in area of investigation at Belsar Yungera



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Figure 4: Threatened Flora and Fauna species in area of investigation at Belsar Yungera

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VMFRP



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Legend				
Threatened Flora Species				
	Acacia oswaldii			
	Malacocera tricornis			
	Development Footprint			
	Construction Footprint Tracks			
	Construction Footprint Structures			
	Area of Investigation			
	Railway			
	Major Road			
	Minor Road			
	Channel / Drain			
	Watercourse Stream			
	Waterbody			
	Wetland Swamp			
	Reserve			

Spatial Reference Name: GDA 1994 MGA Zone 55 Datum: GDA 1994

IS297701



DATA SOURCES

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