DRAFT Belsar-Yungera Environmental Watering Plan Addendum to the Belsar-Yungera Environmental Watering Plan 2010

May 2020

VICTORIAN MURRAY FLOODPLAIN RESTORATION PROJECT

HEALTHY LANDSCAPES, STRONG COMMUNITIES

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List of abbreviations	
Abbreviation	**Full description**
AHD	Above Height Datum
ARI	Arthur Rylah institute
AWOC	After VMFRP works operation commencement
BSMS	Basin Salinity Management Strategy
BWS	Basin-wide Environmental Watering Strategy
CAMBA	China-Australia Migratory Bird Agreement
CEWH	Commonwealth Environmental Water Holder
CMA	Catchment Management Authority
DELWP	Department of Environment, Land, Water and Planning
DEPI	Department of Environment and Primary industry
DTF	Department of Treasury and Finance
EMF	Environmental Management Framework
EPBC	Environmental Protection and Biodiversity Conservation
EVC	Ecological Vegetation Class
EWMP	Environmental Water Management Plans
FFG	Flora and Fauna guarantee
GHD	Guttridge Haskins & Davey
GL	Gigalitre
GMW	Goulburn-Murray Water
JAMBA	Japan-Australian Migratory Bird Agreement
LMW	Lower Murray Water
LTWP	Long-Term Watering Plans
MCMA	Mallee Catchment Management Authority
MDBA	Murray-Darling Basin Authority
MDFRC	Murray-Darling Freshwater Research Centre
MER	Monitoring, evaluation and reporting
ML	Megalitre
PEA	Priority Environmental Assets
PEF	Priority Ecosystem Functions
PWOC	Prior to VMFRP works operation commencement
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
SDL	Sustainable Diversion Limit
SKM	Sinclair Knight Merz [consultant]
SWP	Seasonal Watering Proposal
TLM	The Living Murray
VEAC	Victorian Environmental Assessment Council
VEWH	Victorian Environmental Water Holder
VMFRP	The Victorian Murray Floodplain Restoration project
WRC	Water Regime Class
WRP	Water Resource Plan

1. Introduction

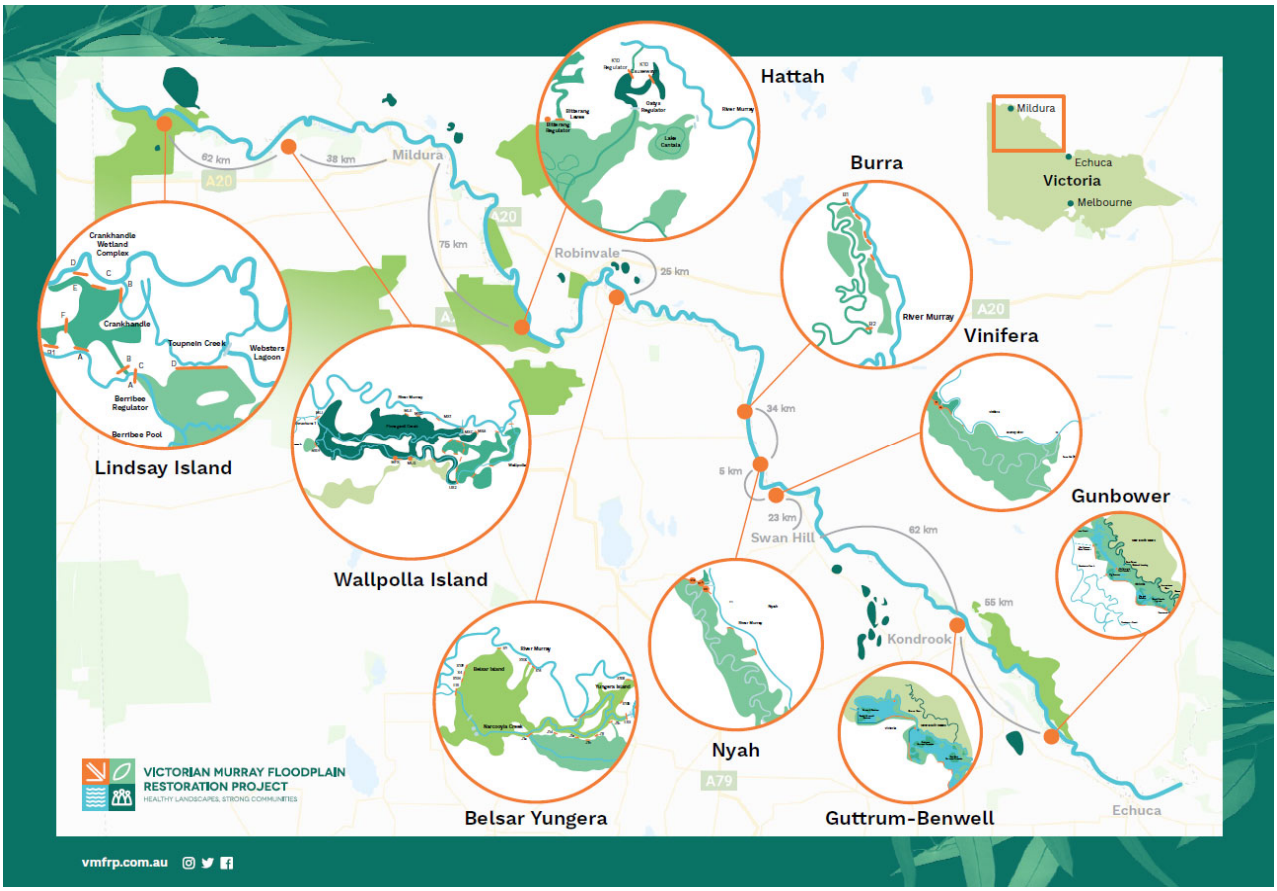
1.1 Victorian Murray Floodplain Restoration Project

The Victorian Murray Floodplain Restoration project (VMFRP) consists of nine discrete environmental works projects that aim to return 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 in coordination with existing infrastructure operation regimes (refer to Figure 1).

The inundation events will mimic the impact of natural flood events and aim to improve the condition of vegetation communities and provide habitat for native fish, birds, frogs, and reptiles.

The VMFRP is being implemented as part of meeting Victoria's obligations under the Murray-Darling Basin Plan (Commonwealth of Australia, 2012) in partnership with Lower Murray Water, Goulburn-Murray Water, Mallee CMA, North Central CMA, Parks Victoria and the Department of Environment, Land, Water and Planning (DELWP).

Figure 1: VMFRP project locations



1.2 Belsar-Yungera Project

The Belsar-Yungera Floodplain Complex is located approximately 30 km upstream of Euston Weir, near Robinvale in north-west Victoria.

The floodplain complex comprises Belsar and Yungera Islands, which are formed on anabranches of the River Murray, including Narcooyia, Bonyaricall and Yungera creeks. On the southern limit of the Belsar-Yungera floodplain lie two large ephemeral wetlands, Lakes Powell and Carpul, which currently rely on medium to high flows across the islands to fill (MCMA, 2014).

The Belsar-Yungera project lies largely in public land managed by Parks Victoria and includes Murray River Reserve and Lakes Powell and Carpul Nature Conservation Reserve. Some land in the southern part of the project area is private land managed for conservation purposes. The Belsar-Yungera Floodplain Management Project supports an array of flora and fauna as the site has complex and diverse habitat, due to the integration of the central river red gum and lower Murray floodplain environments.

The Belsar-Yungera floodplain is ecologically significant due to its proportion of high-value forest, woodland and wetland habitats, which support a number of nationally threatened species and other species of conservation significance (see Section 4).

The frequency and duration of inundation events of the floodplain complex has been influenced by the regulation of the River Murray. The flow regime of Narcooyia, Bonyaricall and Yungera creeks has also been altered by the use of these waterways to maintain a supply of irrigation water to landholders south of the complex. Due to these influences, the flow patterns of the three creeks have been significantly altered from the natural regime. The frequency, duration and extent of current inundation patterns have been significantly altered and are not sufficient to meet the needs of the floodplain ecosystem (MCMA, 2014).

Through the proposed works, this project will connect extensive areas of floodplain through tiered watering events. These works will make use of natural flow paths to increase the extent, frequency, and duration of inundation from either Basin Plan flows or pumping during low flood events. Watering will occur at a landscape scale, restoring ecosystem function for more than 2375 ha of highly valued floodplain, mimicking flows of 70,000 to 170,000 ML/d.

1.3 Content of Addendum

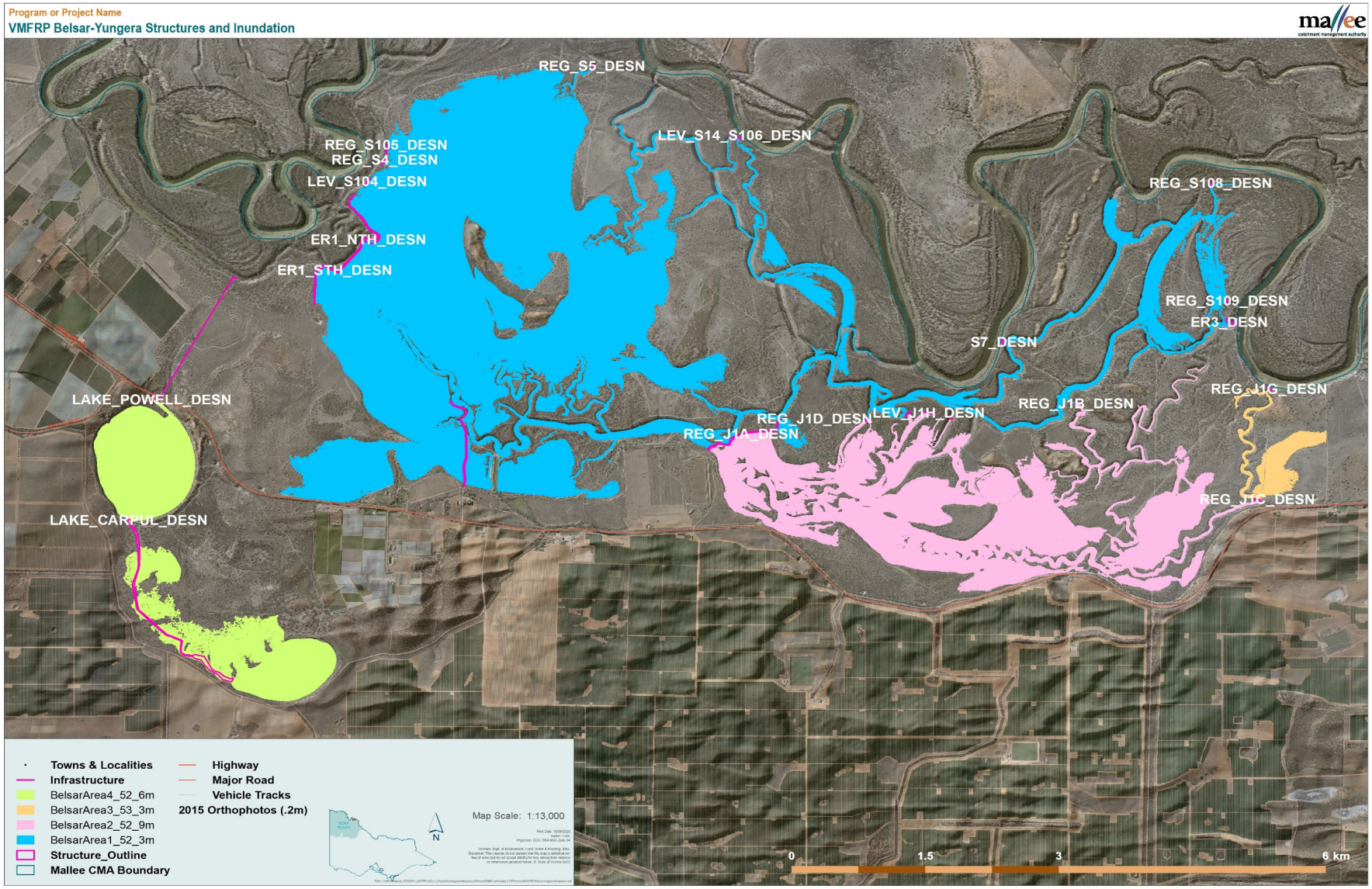
Environmental Water Management Plans (EWMPs) provide detailed management information at the waterway scale. They set out the environmental watering goals, ecological objectives, and the water-regime required to meet the ecological objectives. They are characterised by a long-term focus (i.e. more than 10 years) for rivers or wetlands identified by a catchment management authority in their regional Waterway Strategy as priorities for environmental watering.

In northern Victoria, EWMPs are a key reference for the long-term watering plans prepared for Basin Plan. The existing Belsar-Yungera EWMP (Stacey, 2010) provides context for the Belsar-Yungera water planning, monitoring and consultation process.

This addendum provides an update of the Belsar-Yungera EWMP and should be read in conjunction with the 2010 EWMP (Stacey, 2010) and the Belsar-Yungera Operating Plan prepared for the VMFRP works (VMFRP Project Team, 2020).

It identifies environmental objectives and targets (where appropriate), water delivery options and regimes for the Belsar-Yungera project

Figure 2: Belsar-Yungera: Proposed VMFRP structures and inundation extent



2. Planning context and legislative framework

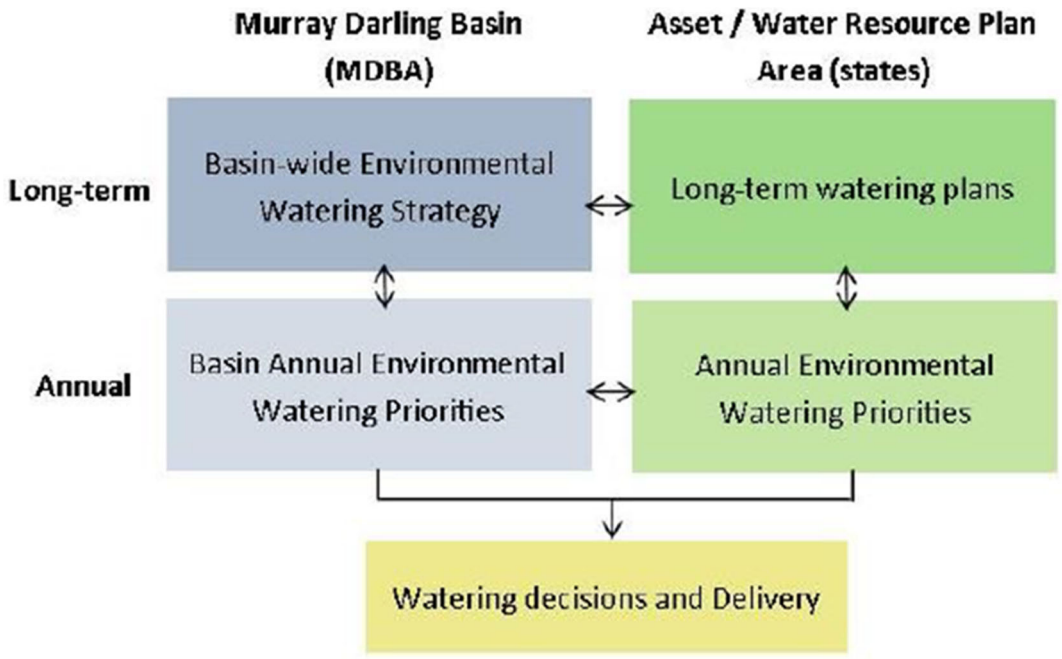
The Basin Plan establishes the legal and policy framework for the use of environmental water in the Murray-Darling Basin (Commonwealth of Australia, 2012).

The primary environmental goal of the Basin Plan is the protection and restoration of water dependent ecosystems and ecosystem functions in the Murray-Darling Basin, with strengthened resilience to a changing climate.

The Environmental Watering Plan of the Basin Plan (Chapter 8) sets out the overall environmental objectives for the water dependent ecosystems of the Murray-Darling Basin, the targets (schedule 7) by which to measure progress towards achieving those objectives and an Environmental Management Framework (EMF) for planned environmental water and held environmental water (Commonwealth of Australia, 2012).

This planning provides for both long-term and annual environmental water objectives, at both the Basin and a more localised scale, as shown in Figure 3.

Figure 3: The long-term and annual planning documents required under Basin Plan Chapter 8 'Environmental Watering Plan' (DELWP, 2015)



The EMF is intended to:

- Coordinate the planning, prioritisation and use of environmental water on both a long-term and an annual basis; and
- Enable adaptive management to be applied to the planning, prioritisation and use of environmental water; and
- Facilitate consultation, coordination and cooperative arrangements between the Authority, the Commonwealth Environmental Water Holder and Basin States (Commonwealth of Australia, 2012).

The long-term watering plan (LTWP) has been prepared by the Victorian Government in accordance with its obligations under the Basin Plan. LTWPs will assist planning for environmental water outcomes, to meet the Basin Plan objectives and targets, and the overall environmental objectives for water dependent ecosystems outlines in Part 2 of Chapter 8 of the Basin Plan.

As part of the development of the LTWPs for Water Resource Plan Areas, Basin states are required to identify priority environmental assets (PEAs) and priority ecosystem functions (PEFs) that can be supported with environmental water.

Belsar-Yungera provides important breeding sites for the Regent Parrot (*Polytelis anthopeplus monarchoides*) and high-quality fish habitat for Murray Cod (*Maccullochella peelii)* (MCMA, 2014).

Both of these species are listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC (Commonwealth of Australia, 1999)).

The site therefore meets the criteria for identifying an Environmental Asset in accordance with Schedule 8 of the Basin Plan (Commonwealth of Australia, 2012), and can be managed with environmental water, rendering it a PEA.

Objectives and targets relating to the criteria for which the PEAs and PEFs were identifies are to be documented in the LTWP for assets and to have regard to the Basin-wide Environmental Watering Strategy (BWS) environmental outcomes.

The objectives and targets set in this Addendum are consistent with Basin Plan objectives and have been aligned to the criteria for identifying PEAs and PEFs, the BWS outcomes and Schedule 7 targets.

3. Water management

The purpose of the Belsar-Yungera VMFRP project is to restore the integrity and productivity of the ecosystem by increasing the frequency, extent, and duration of floodplain inundation.

This will require the construction of regulating structures, a pipeline, track raising and temporary pumping to retain and regulate water over the floodplain.

The infrastructure has been designed to be operated in several possible flow regimes:

- Natural flood
- Flood capture
- Managed inundation – gravity release
- Managed inundation – pumped release

Constructed elements of the water management infrastructure include regulators, a pipeline, hardstands for temporary pumps and containment banks (GHD, 2017).

For more detail on the operating scenarios, refer to the *Belsar-Yungera Operating Plan* (VMFRP Project Team, 2020).

4. Ecological objectives and targets with associated inundation regimes and requirements

Ecological objectives, as summarised in the 2014 Business Case (MCMA, 2014), were developed for the Belsar-Yungera Floodplain Management Complex, drawing on a range of approaches and recommended lines of enquiry, including:

- The overarching objectives in Schedule 7 of the Murray-Darling Basin Plan (Commonwealth of Australia, 2012)
- The Basin-wide Environmental Watering Strategy (MDBA, 2014)
- A review of relevant literature including monitoring data from the TLM initiative (Henderson, et al., 2012; Henderson, et al., 2013; Henderson, et al., 2014)
- Desktop and field-based flora and fauna surveys (Australian Ecosystems, 2014; GHD, 2014)
- Ecological objectives identified in the report prepared by Ecological Associates (Ecological Associates, 2014)
- Site visits
- An ecological objectives workshop with an expert panel comprised of aquatic wildlife and restoration ecologists and key project stakeholders from DELWP and the Mallee CMA.

With the ecological component, being a significant part of the overall VMFRP (MER) program, Mallee CMA in collaboration with the Arthur Rylah Institute for the Environmental Research (ARI) is developing long-term monitoring strategies for the ecological component of the VMFRP.

As part of this undertaking, refinement of the ecological objectives and targets produced updates that were incorporated into the VMFRP specific ecological objectives and targets through an ecological objectives workshop with ARI and key project stakeholders from DELWP, Parks Victoria, North Central CMA and Mallee CMA.

The VMFRP specific ecological objectives and targets for each water regime class are outlined in Table 3.

The ecological objectives for Belsar-Yungera were developed with a view to enhance the conservation values of the site with the proposed works, inform the detailed design and operation of the works, and guide monitoring and evaluation.

4.1 Ecosystem type and biodiversity

The Belsar-Yungera Floodplain Complex is recognised as being ecologically significant as it provides a highly diverse ecotone where the riverine and lower Murray floodplain environments integrate.

This transition area is a mosaic of aquatic and terrestrial vegetation communities and habitat types which support a wide variety of flora and fauna species.

The complex also provides important longitudinal connection to the River Murray and its floodplains, creating essential biodiversity corridors to allow species dispersal between environments vital to their life cycles (MCMA, 2014).

Narcooyia Creek defines the southern extent of Belsar and Yungera Islands. The creek is 17km long and diverges from the River Murray upstream of Yungera Island and returns to the river downstream of Belsar Island. At the downstream end, the 6 km long Bonyaricall Creek branches from Narcooyia Creek. The islands and adjacent floodplain cover 8,200 ha and extend 14 km from east to west (Ecological Associates, 2014).

Lying near the western limit of the Murray Fans bioregion, the floodplain is one of the most downstream areas to feature frequently flooded low-lying river red gum forest and woodland. Meander loops along the

River Murray support wetland and forest complexes which provide complex habitat for woodland and wetland fauna including small native fish species, frogs, turtles and birds (Ecological Associates, 2014)

The environmental values of this floodplain coexist with a productive irrigated horticulture industry, located to the south of the complex.

Irrigation water is diverted from the River Murray into Narcooyia Creek where it is contained and delivered to irrigation properties predominantly by underground pipelines. The irrigation water supply function of Narcooyia Creek will continue under the proposed project.

The vegetation communities of the Belsar-Yungera Floodplain complex are distributed across the floodplain according to hydrological conditions, soil type and salinity gradients.

In Victoria vegetation mapping units known as Ecological Vegetation Classes (EVCs) are the standard unit for classifying vegetation types.

A total of 22 EVCs are present at the Belsar-Yungera site. Of these, 14 are inundation dependant. They are:

- Floodway Pond Herbland
- Grassy Riverine Forest
- Grassy River Forest/ Floodway Pond Herbland Complex
- Intermittent Swampy Woodland
- Lakebed Herbland – Vulnerable in the Murray Fans Bioregion
- Lignum Shrubland
- Lignum Swamp – Vulnerable in the Murray Fans Bioregion
- Lignum Swampy Woodland – Vulnerable in the Murray Fans Bioregion
- Riverine Chenopod Woodland
- Riverine Grassy Woodland – Vulnerable in the Murray Fans Bioregion
- Shallow Freshwater Marsh – Vulnerable in the Murray Fans Bioregion
- Shrubby Riverine Woodland
- Spike-sedge Wetland
- Water Body – Fresh

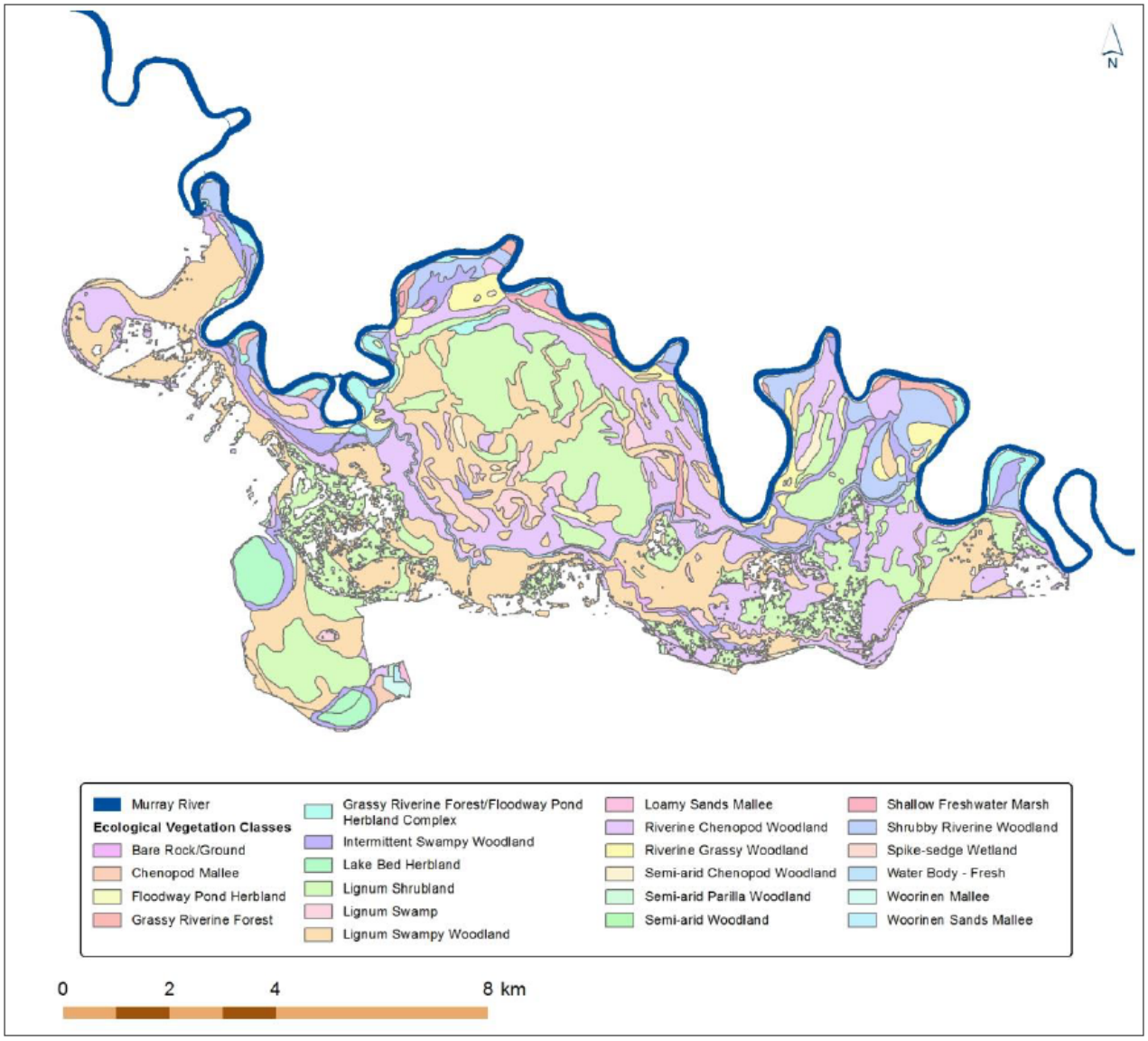


Figure 4: Ecological Vegetation Classes present at the Belsar-Yungera site (MCMA, 2014)

The combined floodplain and terrestrial flora of Belsar-Yungera is diverse with over 630 flora species known to occur at or near the site, of which 124 are of conservation significance (Victorian Government, 1988; Commonwealth of Australia, 1999; DEPI, 2014; Victorian Government, 2019).

The high diversity of plants is related to the proximity of contrasting Mallee and floodplain vegetation. A survey conducted by Australian Ecosystems in 2014 recorded 57 species identified on the Victorian Advisory List of Rare or Threatened Plants in Victoria (VROT (DEPI, 2014)).

In 2016 Ecology Australia recorded 22 VROT plant species within the Belsar-Yungera site and considered 42 additional VROT species to have a moderate or higher likelihood of occurring (Ecology Australia, 2016).

Lying near the western limit of the Murray Fans bioregion, this floodplain complex is ecologically significant due to its proportion of high-value forest, woodland and wetland habitats, which provide important resources for a number of EPBC listed species such as the regent parrot (*Polytelis anthopeplus monarchoides*), growling grass frog (*litoria raniformis*) and Murray cod (*Maccullochella peelii*). Among the most important values at the complex are the intact remnants of river red gum (*Eucalyptus camaldulensis*), black box (*Eucalyptus largiflorens*) and lignum (*Duma florulenta*) communities associated with Lakes Powell and Carpul and Bonyaricall Creeks (MCMA, 2014).

Belsar-Yungera has a high number of fish species, with eight native species reported from Narcooyia Creek and Bonyaricall Creek (Ecological Associates, 2014). Bonyaricall Creek provides slow-flowing shallow water with fringing reed beds that supports several small-bodied fish species., while Narcooyia Creek is permanently inundated and provides complex habitat including deep holes and woody debris. It features habitat for the EPBC listed Murray cod (*Maccullochella peelii*) as well as the freshwater hardyhead (*Craterocephalus stercusmescarum fulvus*) and golden perch (*Macquaria ambigua*). (MCMA, 2014)

Yungera Island is one of the largest breeding colonies for the EPBC listed regent parrot. The birds utilise areas of river red gum forest and woodland that are close to waterways and contain large numbers of healthy, large, old, hollow-bearing trees.

Semi-permanent wetland habitat within the complex includes several deep, frequently inundated wetlands including Yungera Creek and the Carp Hole. These wetlands received inflows almost naturally under natural (unregulated) conditions and remained inundated most of the time (Gippel, 2014). A variety of wetland plants rely on sustained seasonal inundation. Reliably inundated habitat provides a refuge from which species such as a growling grass frog can disperse to other floodplain habitat during inundation and provide reliable breeding sites for waterfowl and other wetland birds (MCMA, 2014).

For a full list of the flora and fauna sound within the Belsar-Yungera area, refer to the Belsar-Yungera EWMP (Stacey, 2010).

4.2 Current conditions

As of 2014, the condition of the Belsar-Yungera Floodplain Complex has declined due to altered flow regimes, altered inundation patterns and low flow conditions of the early 2000s. The alteration in water regime is adversely affecting riparian, floodplain and aquatic vegetation, as well as impacting on native fish populations and other fauna (MCMA, 2014).

Index of Wetland Condition assessments conducted in 2010 demonstrate that Lake Carpul would have received an excellent condition score if the hydrological regime of the lake were addressed. Instead, the lake was determined only to be in good condition. The condition of Lake Powell was moderate as there was less than 50% of critical life form groups present, in addition to the shared hydrological issues with Lake Carpul (DELWP, 2020)

Index of Stream Condition (ISC) assessments conducted in 2010 (DEPI, 2010) demonstrate Narcooyia Creek to be in poor condition. Bonyaricall and Yungera Creeks were not assessed.

Lakes Powell and Carpul are known to have previously recorded a high number of inundation dependent threatened species. Flora surveys conducted in 2009 indicate that up to 26 inundation-dependent threatened species were missing from the beds of Lake Powell and Carpul and the complex's other wetlands. While this is not uncommon in the drought conditions experienced at this time, encroachment of drought-tolerant community could threaten the diversity of these lakes if long period occur between inundation. If the lakes and wetlands receive more frequent inundation this would significantly enhance species diversity. (MCMA, 2014)

During flora and fauna survey in 2016, Ecology Australia assessed one or more quality zones for each EVC totalling 23 site assessments. Vegetation condition ranged from 35% to 84 % of pre-European condition (Ecology Australia, 2016).

The flora surveys outlined that the health, extent and species diversity of inundation-dependent EVCS was low in areas that had not experienced recent inundation and the wetland condition contained stressed canopy in addition to the risk of encroachment of a drought tolerant community. (MCMA, 2014)

The current inundation patterns across the Belsar-Yungera complex are not sufficient to meet the ecological requirements of the complex's flora and fauna. This is evident from the poor tree condition in the mid to lower Narcooyia Creek valley and the IWC assessments (Ecological Associates, 2014).

A 2009 fish survey identified numerous impediments in the complex's waterways that inhibit fish movement between the River Murray and the complex. This restriction of movement of the Narcooyia Creek native fish population (consisting of eight species) with the River Murray, prevents the completion of vital life cycles. It also inhibits fish access to the complex's resources as emigration into the complex's waterways is impeded (GHD, 2009).

To prevent catastrophic ecosystem collapse at the complex, an emergency environmental watering program was initiated in 2005-2006 as an immediate response to the complex's poor condition. Over three years, environmental water was delivered to low lying wetlands and creek lines on crown and freehold land via portable pumps and contained with temporary earthen containment banks (MCMA, 2014).

Environmental watering of Lakes Powell and Carpul in 2011-2012, broke an 18-year absence of inundation in the lakes. The ecological response of the watering was immense; waterbird activity at the lakes was supported for the first time since 1993 and the vegetation surrounding the lakes improved in condition, as shown by Figure 5, Figure 6, and Figure 7; Lake Carpul water bird activity in 2016 Figure 8.

Figure 5: Lake Carpul in 2011 before environmental watering (MCMA, 2014)

Figure 6: Lake Carpul in 2012 after environmental watering (MCMA, 2014)

Figure 7: Water birds in Lake Powell in 2012 after environmental watering (MCMA, n.d.)

Figure 8: Water birds in Lake Carpul in May 2016 after environmental watering (MCMA, n.d.)

Based on the response to environmental watering observed at Belsar-Yungera, it is expected that the ecological condition of the complex will improve when the water regime better matches its ecological requirements.

The proposed VMFRP works would facilitate significantly larger inundation events and would reach areas that have not been inundated during past watering activities. This would therefore deliver extended ecological benefits beyond those currently achievable (MCMA, 2014).

4.3 Overarching ecological objectives

The overarching objective of water management at Belsar-Yungera is:

"to protect and restore the key species, habitat components and functions of the Belsar-Yungera ecosystem by providing the hydrological environments required by indigenous plant and animal species and communities." (MCMA, 2014)

The ecological objectives for Belsar-Yungera complex were developed with a view to enhance the conservation values of the site with the proposed works, inform the detailed design and operation of the works and guide monitoring and evaluation (MCMA, 2014).

This will be achieved by using infrastructure to better meet the water requirements of the floodplain ecosystem. The proposed works will enable widespread inundation of Belsar-Yungera islands, the adjoining floodplain, as well as Lakes Powell and Carpul. The works have been designed to operate in conjunction with Basin Plan flows but will also allow use of temporary pumps under low River Murray flows and will therefore protect this wetland system through droughts (MCMA, 2014).

4.4 Predicted ecological benefits of inundation

Inundation maintains the integrity and productivity of waterway and floodplain habitats. It promotes germination of aquatic plants, which provide habitat for a range of aquatic fauna species including fish, invertebrates and frogs (Ecological Associates, 2014). Inundation also helps maintain the health of woodlands that provide important habitat like nesting sites and hollows for regent parrot and carpet python (*Morelia spilota metcalfei*) and promotes the growth of trees and triggers flowering.

Increased rates of tree growth provide organic matter to the floodplain system, which promotes productivity and as floodwaters recede this material also enters the River Murray.

This inflow contributes to the energy requirements of the broader river system (Ecological Associates, 2014). Flowering attracts nectar-eating insects and birds and provides abundant insect prey for bats and insectivorous birds.

Delivery of environmental water to Lakes Powell and Carpul in 2011-12 enabled the ecological functionality of the lakes to be protected until permanent works can reliably deliver water to the Lakes.

Resources to support waterbird activity were provided in abundance for the first time in 18 years and the condition of fringing river red gum and black box improved. Aquatic vegetation establishment was extensive which assisted in rejuvenating the lakebed seed bank.

Drawing upon ecological response monitoring outcomes associated with large-scale watering of the Hattah Lakes through The Living Murray (TLM) works, it is expected that the observed trend of improved ecological condition would also occur at the Belsar-Yungera complex once permanent works reliably deliver water. This assumption is made due to similar nature of the EVCs, WRCs, conditions and requirements of both the Belsar-Yungera and Hattah Lakes (MCMA, 2014).

These results provide a high level of confidence that the implementation of the proposed supply measure and its associated watering regime will provide the expected benefits.

The anticipated ecological benefits that are expected for each water regime class as a result of the project are outlined in Table 1.

Table 1: Water regime class, strategy and ecological benefits (Ecological Associates, 2014; MCMA, 2014)

Water regime class	Strategy	Ecological benefit
Semi-permanent Wetlands	Capture peaks in river flow in Yungera Creek wetlands and wetlands associated with Narcooyia Creek by closing regulators on the inundation recession. Pump water into wetlands if peaks in river flow are not available.	Stimulation of seed bank upon inundation leads to greater diversity and abundance of wetland flora during inundation and on recession of floodwaters. This will provide foraging and breeding habitats for wetland birds and frogs. Riparian shrubs; increased vigor in species such as lignum, and possibly also exhibit an increase in abundance and diversity. Adjacent trees; increased vigor, recruitment, overall improvement in wetland health, maintenance of wetland buffers and maintenance of fauna habitats. Stimulate the growth of aquatic and emergent wetland vegetation, in turn providing habitat for frogs, waterbirds and fish. Maintenance and enhancement of fauna habitat values and periodic breeding opportunities for wetland species.
Red Gum Forest and Woodland	Protect and restore the inundation of red gum forest and woodland.	Maintenance and enhancement in condition of river red gum communities. Regular inundation events promote aquatic and grassy woodland vegetation, woody debris, submerged aquatic vegetation and other prey habitats. Improved quality and extent of habitat for a wide range of native species, including threatened species, e.g. regent parrot and other species such as carpet python and lace monitor.
Lignum shrubland and woodland	Protect and restore inundation to lignum shrublands.	Inundation of lignum shrubland extends habitat for aquatic floodplain fauna, e.g. fish, reptiles and frogs. Inundated lignum is used as a platform by nesting waterbirds including ibis and spoonbill. Floodwater draining from lignum will carry dissolved and particulate carbon as well as algae and invertebrates will contribute to the food web of the river channel.
Black Box Woodland	Protect and restore inundation to black box woodland.	Maintenance and enhancement in condition of floodplain black box woodland communities.

		Recruitment, maintaining a diverse age structure, including maturation and development of hollows, maintaining habitat in the long-term for native fauna species. Diverse tree age structure and a complex understory plant community are required by carpet python and other vertebrate fauna.
Floodplain Lakes – Lake Powell and Lake Carpul	Protect and restore inundation to floodplain lakes	Stimulate the growth of aquatic and emergent wetland vegetation, providing habitat for frogs, waterbirds and fish. Maintenance and enhancement of fauna habitat and periodic breeding for wetland species (e.g. frogs and waterbirds). Inundated wetlands provide productive food for small fish, waterbirds, frogs and turtles. Lakes Powell and Carpul are important habitat and support breeding by blue-billed duck, musk duck, hard head and freckled duck. Drying wetland beds support a range of wetland herbs. Sustained dry periods expose a muddy herbland on the lakebed. Small wading birds such as ruddy turnstone and red-necked stint will feed on macro-invertebrates in shallow water and mud. Fish-eating birds and carrion feeders, including white-bellied sea-eagle feed on stranded fish.

4.5 Specific objectives and targets

Specific VMFRP ecological objectives have been developed to provide some quantification on the degree of environmental benefit expected from the Belsar-Yungera project based on the key water-dependent values of the Belsar-Yungera complex (refer to Table 3). The objectives are consistent with those of the Belsar-Yungera EWMP (Stacey, 2010) and will contribute to achieving the environmental objectives set out by the Basin Plan (Commonwealth of Australia, 2012). The Basin Plan objectives are attached as Appendix 1 Basin Plan Objectives.

Table 2 shows the association and progression of the ecological objectives from the Belsar-Yungera EWMP 2010 to the current ecological objectives set by Arthur Rylah Institute to be delivered by the VMFRP.

Table 2: Specific objectives established for Belsar-Yungera. This table shows the progression of ecological objectives from 2010 to 2020 (Ecological Associates, 2014; Arthur Rylah Institute, 2020; Stacey, 2010; MCMA, 2014).

Ecological Associates Rational & Outcomes 2014 (Ecological Associates, 2014), Belsar &Yungera Business Case (Mallee CMA, 2014)	Belsar & Yungera Environmental Watering Plan (Stacey, 2018)	VMFRP Specific Objectives 2020 (Institute, 2020)
Restore and enhance habitat linkages between the river and Narcooyia Creek for Murray cod and other native fish	Improve fish passage in Narcooyia Creek	1. Maintain migration of medium and small-bodied native fish to maintain populations
Restore and enhance native fish habitat by improving the productivity of riparian zones and wetlands	NA	1. Increase native habitat for local populations of fauna by increasing the extent of wetland and riparian vegetation 2. Maintain seasonal populations of medium and small-bodied native fish
Restore and enhance semi-permanent wetlands capable of supporting growling grass frog	NA	Support metapopulations of growling grass frogs
Maintain lignum shrubland as a frequently flooded and productive habitat for fish and waterbirds	Increase understorey productivity	1. Reduce high threat exotic plant cover 2. Maintain plant cover and diversity of target native vegetation groups 3. Maintain threatened native flora presence 4. Maintain successful breeding for platform-building waterbirds

Restore and enhance floodplain productivity to maintain resident populations of vertebrate fauna including carpet python and bats	1. Improve River Red Gum health 2. Improve tree recruitment on floodplain	1. Maintain the health of native trees 2. Increase abundance of native woodland birds 3. Increase the abundance of bats as an indicator species of increased resources resulting from increased floodplain productivity 4. Increase the abundance of carpet pythons as an indicator species of increased resources resulting from increased floodplain productivity
Intermittently provide productive lake habitat for hundreds of waterbirds	Improve nesting habitat in flooded trees bordering creeks and Lakes	1. Provide reliable native foraging and breeding habitat for waterbirds 2. Provide habitat for 100s of waterbirds at least once in every 5 years
Contribute to the carbon requirements of the River Murray channel ecosystem	NA	Contribute to the carbon requirements of the River Murray channel ecosystem to support system productivity.

Table 3: Specific objectives and targets established for Belsar-Yungera and the relevant water regime classes. This table also shows the contribution of each specific objective to Basin Plan objectives (Arthur Rylah Institute, 2020; Commonwealth of Australia, 2012; Ecological Associates, 2014; MCMA, 2014; Stacey, 2018)

SDL Belsar & Yungera Business Case Specific objectives 2014	**VMFRP MER Area** (Institute, 2020)	**VMFRP Specific Objectives 2020** (Institute, 2020)	**VMFRP Ecological Targets 2020** (Institute, 2020)	**Expected Functional Outcomes from intermediate inundation events** (Mallee CMA, 2014)	**Water Regime Class** (Mallee CMA, 2014)	**Associated Basin Plan Objective**
Restore and enhance habitat linkages between the river and Narcooyia Creek for Murray cod and other native fish	Fish	Maintain migration of medium and small-bodied native fish to maintain populations.	Migration of medium and small-bodied native fish occurs between Narcooyia Creek and the River Murray channel every year AWOC.	**Water Course** ▪ More than 10 adult Murray cod in Narcooyia Creek migrate to and from the River Murray channel at least once per year. ▪ The average lateral extent of aquatic macrophyte vegetation on the banks of Narcooyia Creek will increase by 100% from 2015 to 2030. ▪ The December projected plant cover exceeds 50% in at least 30 ha of wetland habitat connected to Narcooyia Creek by 2030. **Semi-permanent Wetlands**	Water Courses	8.05(2), 8.05(3), 8.06(3), 8.06(4), 8.06(5), 8.06(7), 8.06(6), 8.06(7), 8.07(2), 8.07(3), 8.07(6).
Restore and enhance native fish habitat by improving the productivity of riparian zones and wetlands	Fish	Maintain seasonal populations of medium and small-bodied native fish.	Local populations of medium and small--bodied native fish do not decline below PWOC levels in Narcooyia Creek.		Water Courses Semi-permanent Wetlands	8.05(2), 8.05(3), 8.06(3), 8.06(4), 8.06(5), 8.06(7), 8.06(6), 8.06(7), 8.07(2), 8.07(3), 8.07(5), 8.07(6).
	Vegetation	Increase native habitat for local populations of fauna by increasing the extent of wetland and riparian vegetation.	The extent of native aquatic and semi-aquatic macrophyte vegetation within and fringing floodplain wetlands and watercourses increases from PWOC levels within ten years AWOC.			
Restore and enhance semi-permanent wetlands capable of supporting growling grass frog	Frogs	Support metapopulations of growling grass frogs	Record the presence of growling grass frog in at least two wetland sites in all inundated years AWOC.		Semi-permanent Wetlands	8.05(2), 8.05(3), 8.06(3), 8.06(4), 8.06(5), 8.06(7), 8.06(6), 8.06(7), 8.07(2), 8.07(3), 8.07(5), 8.07(6).

Maintain lignum shrubland as a frequently flooded and productive habitat for fish and waterbirds	Vegetation	Reduce high threat exotic plant cover	High threat+ exotic plants make up <5% of total extant vegetation cover in all sampled locations in all years AWOC.	▪ The average lateral extent of aquatic macrophyte vegetation on the banks of Narcooyia Creek will increase by 100% from 2015 to 2030. ▪ The December projected plant cover exceeds 50% in at least 30 ha of wetland habitat connected to Narcooyia Creek by 2030. ▪ More than 1 ha of dense sedgeland is present in at least 2 wetland sites by 2030. ▪ These sedgelands are completely dry no more than 6 months in the period from 2020 to 2030.	Lignum Shrubland and Woodland	8.05(2), 8.05(3), 8.06(3), 8.06(4), 8.06(5), 8.06(7), 8.06(6), 8.06(7), 8.07(2), 8.07(3), 8.07(5), 8.07(6).
		Maintain plant cover and diversity of target native vegetation groups	Plant cover and diversity within each previously recorded Plant Functional Group does not decline by more than 25% from PWOC levels in any flood year within the first ten years AWOC			
		Maintain threatened native flora presence	>90% of threatened flora species previously recorded continue to occur within the site in all flood years AWOC.			
	Birds	Maintain successful breeding for platform-building waterbirds.	Platform-building waterbirds breed on at least 4 occasions within 10 years of AWOC	**<u>Red Gum Forest and Woodland</u>**		
Restore and enhance floodplain productivity to maintain resident populations of	Vegetation	Maintain the health of native trees.	At least 75% of surveyed trees with 'healthy' canopy condition within ten years AWOC.	▪ Total bat abundance to increase by 25% from 2015 levels by 2030. ▪ The average annual carbon load (dissolved and particulate) to the	Red Gum Forest and Woodland	8.05(2), 8.05(3), 8.06(3), 8.06(4), 8.06(5), 8.06(7), 8.06(6), 8.06(7), 8.07(2), 8.07(3), 8.07(5), 8.07(6).

vertebrate fauna including carpet python and bats	Birds	Increase abundance of native woodland birds	Native woodland bird abundance increases by 10% from PWOC levels within 10 years of AWOC.	River Murray from Belsar and Yungera for the period 2025 to 2035 is double 2015 to 2020 levels. **Lignum shrubland and woodland** ▪ Platform-building waterbirds to breed in lignum shrublands on at least four occasions between 2025 and 2035. ▪ Total bat abundance to increase by 25% from 2015 levels by 2030. ▪ The average annual carbon load (dissolved and particulate) to the River Murray from Belsar and Yungera for the period 2025 to 2035 is double 2015 to 2020 levels. **Black Box Woodland** ▪ Total bat abundance to increase by 25% from 2015 levels by 2030. ▪ The average annual carbon load (dissolved and particulate) to the	Lignum Shrubland and Woodland Black Box Woodland	
	Bats	Increase the abundance of bats as an indicator species of increased resources resulting from increased floodplain productivity	Total bat activity increases by 25 % from PWOC levels within 10 years AWOC", quantifying the target level of restoration for bat populations in the region			
	Reptiles	Increase the abundance of carpet pythons as an indicator species of increased resources resulting from increased floodplain productivity.	Total carpet python abundance increases by 10% from PWOC levels within ten years AWOC.			
Intermittently provide productive lake habitat for hundreds of waterbirds	Vegetation	Provide reliable native foraging and breeding habitat for waterbirds.	Suitable waterfowl breeding habitat extent is maintained in all years in the first ten years AWOC.		Floodplain Lakes	8.05(2), 8.05(3), 8.06(3), 8.06(4), 8.06(5), 8.06(7), 8.06(6), 8.06(7), 8.07(2), 8.07(3), 8.07(5), 8.07(6).
	Birds	Provide habitat for 100s of waterbirds at least once in every 5 years	Total summer waterbird abundance at both Lake Powell and Lake Carpul to exceed 500 on at least 2 occasions within 10 yrs of AWOC			

Contribute to the carbon requirements of the River Murray channel ecosystem	Carbon requirements	Contribute to the carbon requirements of the River Murray channel ecosystem to support system productivity.	Floodplain inundation results in a net increase in carbon (dissolved and particulate) to the River Murray, given carbon and water volumes within floodplain inflows and outflows, in all managed flow years.	River Murray from Belsar and Yungera for the period 2025 to 2035 is double 2015 to 2020 levels. **Floodplain Lakes - Lake Powell and Lake Carpul** ▪ Total summer waterbird abundance at Lake Powell Island to exceed 500 on at least two occasions between 2025 and 2035. ▪ Total summer waterbird abundance at Lake Carpul to exceed 500 on at least one occasion between 2025 and 2035.	Red Gum Forest and Woodland Lignum Shrubland and Woodland Black Box Woodland	8.05(2), 8.05(3), 8.06(2), 8.06(3), 8.06(5), 8.06(7), 8.06(6), 8.06(7), 8.07(2), 8.07(3), 8.07(4), 8.07(5), 8.07(6).

PWOC = Prior to works operation commencement, AWOC = After works operation commencement

Ecological targets have also been developed to measure progress towards the specific ecological objectives. It is anticipated that these targets will be tested and refined once the infrastructure is operational. The targets describe an ecological outcome or process and are:

- Quantitative and measurable
- Time-bound, and
- Justified by existing site data or scientific knowledge

4.6 Operating Scenarios

The Belsar-Yungera works have been designed to replicate key components of the natural hydrology of the system. The infrastructure has been designed to operate in several possible flow regimes consistent with the requirements set out in the Business Case (MCMA, 2014). Transitioning between scenarios is possible and provides a high level of operational flexibility when delivering planned watering events or responding to natural inflows. Water will be delivered to the Belsar-Yungera Floodplain Management Unit using gravity and occasional temporary pumping as required, as further described in Table 4. The works will provide for the inundation of up to 2374 ha of floodplain.

Table 4: Belsar-Yungera operating scenarios (Ecological Associates, 2015; Jacobs, 2017).

Scenario	Pre-conditions	Structure Operation	Maximum design inundation level (m AHD) (Jacobs, 2017)	Preferred Frequency	Threshold (depth, level or discharge)	Holding Duration	Preferred Timing	Maximum Interval Between Events	Water Regime Class Targeted
Narcooyia Through flow (seasonal Fresh) (Scenario 1)	River levels exceed 48.51 m AHD at Narcooyia Creek inlet (approx. 7,000 ML/d)	Narcooyia Creek inlet and outlet regulators are opened as long as threshold exceeded.	48.41	Any opportunity	River levels exceed 48.51 m AHD at Narcooyia Creek inlet	As long as possible	At all times	N/A	Watercourse
Capture Low Flood Peak (Scenario 2)	Capture can occur when discharge at Euston exceeds 20,000 ML/d. Peaks up to 40,000 ML/d represent a low flood peak	Regulators ER1, S7 and ER3 are closed when the flood peak starts to recede. Regulators are opened to release water when flood duration target is met.	50.84	8 years in 10	Levels equivalent to 40,000 ML/d	4 of these events to last more than 3 months 4 of these events to last more than 4 months	June to November with longer events continuing up to February	2.5 years	Semi-permanent Wetlands

Pump to Low Floodplain Area (Scenario 4)	None	Regulators ER1, S7 and ER3 are closed. Water is pumped into storage area. Regulators are opened to release water when flood duration target is met.	As above	As above	As above	As above	As above	As above	As above
Capture Moderate Flood Peak (Scenario 3)	Peaks between 40,000 and 70,000 ML/d represent a moderate flood peak	Regulators ER1, S7 and ER3 are closed when the flood peak starts to recede. Regulators are opened to release water when flood duration target is met.	52.3 m AHD at Regulator ER1	6 years in 10	70,000 ML/d	4 of these events to last 6 weeks 2 of these events to last 12 weeks	June to November, with longer events continuing up to February	7.5 years	Semi-permanent wetlands Red Gum Forest and Woodland Lignum Shrubland and Woodland Black Box Woodland
Pump to Intermediate Floodplain Areas (Scenario 4)	None	Regulators ER1, S7 and ER3 are closed. Water is pumped into storage area. Regulators are opened to release water when flood duration target is met.	As above	As above	As above	As above	As above	As above	As above
Capture High Flood Peak (Scenario 3)	River discharge exceeds approximately 100,000 ML/d	Regulators J1a and J1c are closed when the flood peak starts to recede. Regulators are opened to release water when flood duration target is met	52.9 m AHD at regulator J1a and 53.3m AHD at regulator J1c	4 years in 10	Approximately 100,000 ML/d	1 month	September to February	10 years	Semi-permanent wetlands Red Gum Forest and Woodland Lignum Shrubland and Woodland Black Box Woodland

Pump to High Floodplain Areas (Scenario 4)	None	Regulators J1a and J1c are closed. Water is pumped into storage area. Regulators are opened to release water when flood duration target is met	As above	As above	As above	As above	As above	As above	As above
Capture Lake Flood Water (Scenario 2)	Discharge at Euston exceeds 170,000 ML/d	Lake regulators are open on rising hydrograph. Regulators are closed when flood peak starts to recede. Water is released from lake regulator when flood duration target is met	52.6m AHD	1 year in 20	Flood to 52.6m AHD	20 to 60 days at a maximum threshold. Detain water at natural still level after that	Any time	20 years	Lignum Shrubland and Woodland Black Box Woodland Floodplain Lake
Pump to Floodplain Lakes (Scenario 4)	None	Lake regulator is closed. Water is pumped to the lakes. Regulator is opened when flood duration target is met.	As above	As above	As above	As above	As above	As above	As above

5. Environmental Monitoring

The effectiveness of the proposed managed inundation will primarily be monitored and reported through the monitoring, evaluation, and reporting (MER) strategies and protocols set by the Mallee CMA.

During the development of the Business Case a monitoring and evaluation plan for Belsar-Yungera was prepared for by Ecological Associates (Ecological Associates, 2014).

Mallee CMA, with the Arthur Rylah Institute for Environmental Research (ARI), is in the process of updating the 2014 Ecological Associates MER and developing long-term monitoring strategies for the ecological component of the VMFRP. These strategies and protocols will build upon experience and lessons learned through the ongoing Hattah Lakes TLM MER program.

These provide a routine process to:

- Establish a robust program logic to define the correlation between works and other inputs and identified outputs and ecosystem outcomes. This provides the basis for a suite of quantifiable ecological targets that are relevant to Belsar-Yungera
- Monitor progress against those targets on a regular basis
- Evaluate the implications of the results for the operational parameters of the scheme
- Amend and adjust the operational arrangements to optimise performance and outcomes

Monitoring data is required to plan watering events, to optimise water delivery, to manage risks and to refine ecological objectives. The evaluation process involves analysing collected data and improving operations accordingly.

Monitoring and evaluation will focus on the effects of local watering actions and include:

- Evaluating water use
- Measuring ecological outcomes
- Refining conceptual models and improving knowledge
- Managing risk

The Belsar-Yungera VMFRP MER plan will identify the agencies responsible for commissioning, reviewing and acting on monitoring data. The linkages back to decision-making will be described in the detailed MER plan.

Initial monitoring will provide a baseline of the existing status of the ecological objectives and outcome monitoring will measure progress towards these objectives and their targets. This information will inform the ongoing operations at the site. Over time the results of the outcome monitoring will test assumptions and monitoring data will assist with refining conceptual models and ecological objectives. Measures for each ecological objective of the Belsar-Yungera VMFRP project are detailed in Table 3 (Arthur Rylah Institute, 2020). Monitoring data will identify emerging hazards and enable operation decisions to minimise risks.

Surface water flow and water quality monitoring will be implemented to ensure the water volume used and the water quality impacts of the project are recorded to appropriate standards and that informs management and operations.

Groundwater monitoring will also be implemented to ensure salinity risks are appropriately managed.

The final MER approach for this project will be informed by broader intergovernmental arrangements for Basin-wide monitoring and evaluation under the Basin plan (Commonwealth of Australia, 2012). This measure is expected to contribute to the achievement of outcomes under two key Chapters of the Plan,

namely: (i) the delivery of ecological outcomes under Chapter 8; and (ii) under Chapter 10, meeting the relevant sustainable diversion limit/s (SDLs), which must be complied with under the state's relevant water resource plan/s (WRPs) from 1 July 2019.

Both Chapter 8 and Chapter 10 of the Basin Plan are captured under the Murray-Darling Basin Authority's (MDBA) own monitoring and evaluation framework. Once specific Basin plan Chapters commence within a state, the state must report to the MDBA on relevant matters. This will include five yearly reporting on the achievement of environmental outcomes at an asset scale in relation to Chapter 8, and annually reporting on WRP compliance in relation to Chapter 10.

The participation in MDBA's reporting and evaluation framework will effectively allow for progress in relation to this project to be monitored, and for success in meeting associated ecological objectives and targets to be assessed.

6. Operational Risks and Mitigation Measures

6.1 Ecological, Cultural Heritage and Socio-Economic Threats

Ecological Assessments and a Cultural Heritage Management Plan are being undertaken as part of the project.

Shared operational risks associated with environmental watering are managed through an annual workshop with DELWP that Mallee CMA participates in. This process includes discussion of risk learnings of from the previous year, risk assessment for the coming year, and improving risk management processes.

In addition to the above measures, a monitoring, evaluation, and reporting (MER) framework is being put together for the VMFRP project that includes ecological, cultural, and socio-economic outcomes of managed inundation events at the VMFRP sites.

6.2 Impact on Salinity, Water Environments, and Fish Passage

The in-river salinity impacts (at Morgan, South Australia) potentially caused by the proposed actions at Belsar-Yungera were assessed relative to a base case scenario by SKM (SKM, 2014).

The assessment concluded that the magnitude of the salinity impacts of the proposed watering scenarios was insignificant. The largest component of the salinity impact is associated with the displacement of groundwater due to diffuse recharge following inundation, but the impact is insignificant. This calculation is considered conservative as it assumes uniformly high salinity and assumes a significant percentage of the recharged water is returned the Murray River (SKM, 2014).

SKM (SKM, 2014) expects that successive watering events would create negligible increases in salt store. They recommend that if any larger impact occur with time, these could be offset by a less frequent operation and/or reduced duration of watering events (SKM, 2014).

Based on the uncertainty of the inundation events on salinity over time, SKM have recommended a monitoring program. This would comprise of groundwater and surface water monitoring. The MCMA monitors an existing network of bores within the Belsar-Yungera vicinity and undertakes a long-term salinity monitoring program to assess the impact of inundation events on groundwater levels and groundwater quality.

To assist in the monitoring of salinity impacts of Belsar-Yungera inundation the VMFRP, with assessment and recommendations from SKM (SKM, 2014) and Jacobs (Jacobs, 2019), has proposed new bores within the proposed project inundation area.

These will be integrated into the existing MCMA monitoring network and monitoring program. Monitoring and ongoing assessment of risks will occur consistent with the Basin Salinity Management Strategy (MDBA, 2015). In addition to the regular groundwater monitoring, Mallee CMA will manage the monitoring of surface water quality within the Belsar-Yungera Floodplain Complex, during operations. These monitoring activities are critical to verify modelled salinity impacts and to provide timely advice for management of any water quality issues arising during operation of the works.

The following mitigation measures are proposed to minimise and avoid impacts on water environments, salinity, and fish passage during operation of the project:

- Continue to undertake water quality monitoring before, during and after watering events to inform adaptive management strategies and real-time operational decision making.
- Commence watering as early as possible to move organic matter off the floodplain while temperatures are low. Maintain a through-flow where possible in other areas to maximise exchange rates and movement of organic material. Monitor dissolved oxygen and water temperature to identify hypoxic areas to inform consequence management.
- Schedule watering events to make use of dilution flows where possible and optimise timing of releases of water back into the River Murray. Ensure dilution of low dissolved oxygen water by managing outflow rates and river flows: delay outflows if river flows are too low; dispose of hypoxic water by pumping to higher wetlands where possible; agitate water using infrastructure to increase aeration.
- Integrate water management with other sites in seasonal water planning process. Maintaining good relationships with other water managers.
- Tailor watering regimes to provide competitive advantages for native fish over carp. Dry wetlands that contain carp. Manage drawdown following managed events to provide triggers for native fish to move off the floodplain, and where possible, strand carp.
- Mitigation measures would be implemented to minimise risks associated with barriers to fish passage, including:
    - Design of regulating structures to satisfy fish passage requirements.
    - Continuing to build on knowledge and understanding through current studies relating to fish movement in response to environmental watering and cues to further develop and refine a fish exit strategy.
- Monitor the salinity of ground and surface water salinity before, during and after watering events to inform management and ensure sufficient volumes are available for mitigation such as:
    - Diluting saline groundwater discharge with sufficient river flows.
    - Diluting saline water on the floodplain by delivering more fresh water to these areas.
    - Reduce the frequency and/or extent of planned watering events if sufficient volumes not available.

6.3 Risks associated with structures

The owner and operator have responsibility for management of risks to the integrity of the structures themselves. These risks are managed through operation of the structures within their design capabilities, monitoring of structural integrity and through maintenance.

Risk frameworks are being put together for the management and operation of the structures and will be confirmed during Stage 2 works.

7. Community Consultation Communication

All VMFRP sites are covered by one Community Communication and Engagement Strategy. As part of the strategy, a Stakeholder Engagement and Communication Plan was developed to ensure awareness among all stakeholders and the wider community of the Belsar-Yungera Floodplain Complex managed inundation operations

The VMFRP Stakeholder Engagement & Communication Plan is attached as Appendix 2 and will be updated as appropriate as part of the Stage 2 works for the Belsar-Yungera project.

The Site Manager, LMW and Mallee CMA are committed to establishing and maintaining strong relationships within the local community during watering operations. A vital tool in the consultation is structured engagement with the community through engagement with key stakeholders and advisory groups.

8. Indigenous Engagement

Indigenous stakeholders are consulted to ensure the Indigenous community has an opportunity to provide input into water management and a chance to raise and identify their cultural and spiritual links to Belsar-Yungera These stakeholders are representatives of each of the Aboriginal parties who have a vested interest in the Belsar-Yungera area.

Indigenous consultation is managed via the Mallee CMA Indigenous Facilitator and through the Mallee CMA Aboriginal Reference Group. This group provides a valuable single source for Indigenous engagement, advice, input, and recommendation.

The reference group has Indigenous representatives who ensure that cultural heritage and values are considered and incorporated by the Site Manager and Mallee CMA. The representatives also distribute information about Site management into the Aboriginal communities.

The development of an Indigenous engagement framework will be developed during Stage 2 works.

9. Adaptive Management and Reporting

A comprehensive risk management strategy will be developed for the Belsar-Yungera project. This strategy will cover ecological and socio-economic aspects to provide a structured and coherent approach to risk management for the life of the project (i.e. construction and operation).

Risk assessment and management is not a static process. Regular monitoring and review of the risk management process is essential to ensure that:

- Mitigation measures are effective and efficient in both design and operation
- Further information is obtained to improve the risk assessment
- Lessons are learnt from events (including near misses), changes, trends, successes and failures
- Risk treatments and priorities are revised considering changes in the external and internal context, including changes to risk criteria and risk itself
- Emerging risks are identified.

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Appendix 1 Basin Plan Objectives

Chapter 8 - Part 2: Overall environmental objectives for water-dependent ecosystems

Section:

8.05 (2). To protect and restore a subset of all water-dependent ecosystems in the Murray-Darling Basin ensuring that:

a. Declared Ramsar wetlands that depend on Basin water resources maintain their ecological character; and

b. Water-dependent ecosystems that depend on Basin water resources and support the lifecycles of species listed under the Bonn Convention, China-Australia Migratory Bird Agreement (CAMBA), Japan-Australian Migratory Bird Agreement (JAMBA) or Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) continue to support those species; and

c. Water-dependent ecosystems are able to support episodically high ecological productivity and its ecological dispersal.

8.05 (3). To protect and restore biodiversity that is dependent on Basin water resources by ensuring that:

a. Water-dependent ecosystems that support the life cycles of a listed threatened species or listed threatened ecological community, or species treated as threatened or endangered (however described) in State law, are protected and, if necessary, restored so that they continue to support those life cycles; and

b. Representative populations and communities of native biota are protected and, if necessary, restored.

8.06 (2). That the water quality of Basin water resources does not adversely affect water-dependent ecosystems and is consistent with the water quality and salinity management plan.

8.06 (3). To protect and restore connectivity within and between water-dependent ecosystems including by ensuring that:

a) The diversity and dynamics of geomorphic structures, habitats, species and genes are protected and restored; and

b) Ecological processes dependent on hydrologic connectivity:

(i) longitudinally along watercourses; and

(ii) laterally between watercourses and their floodplains (and associated wetlands); and

(iii) vertically between the surface and subsurface;

c) The Murray Mouth remains open at frequencies, for durations and with passing flows, sufficient to enable the conveyance of salt, nutrients and sediments from the Murray-Darling Basin to the ocean; and

d) The Murray Mouth remains open at frequencies, and for durations, sufficient to ensure that the tidal exchanges maintain the Coorong's water quality within the tolerance of the Coorong ecosystems' resilience; and

e) The levels of the Lower Lakes are managed to ensure sufficient discharge to the Coorong and Murray Mouth and help prevent river bank collapse and acidification of wetlands below Lock 1, and to avoid acidification and allow connection between Lakes Alexandrina and Albert, by:

(i) maintaining levels above 0.4 metres Australian Height Datum for 95% of the time, as far as practicable; and

(ii) maintaining levels above 0.0 metres Australian Height Datum all of the time; and

f) Barriers to the passage of biological resources (including biota, carbon and nutrients) through the Murray-Darling Basin are overcome or mitigated

8.06 (4). That natural processes that shape landforms (for example, the formation and maintenance of soils) are protected and restored.

8.06 (5). To support habitat diversity for biota at a range of scales (including, for example, the Murray-Darling Basin), riverine landscape, river reach and asset class).

8.06 (6). To protect and restore ecosystem functions of water-dependent ecosystems that maintain population (for example recruitment, regeneration, dispersal, immigration and emigration) including by ensuring that;

a) Flow sequences, and inundation and recession events, meet ecological requirements (for example, cues for migration, germination and breeding); and

b) Habitat diversity that supports the life cycles of biota of water dependent ecosystems (for example habitats that protect juveniles from predation) is maintained.

8.06 (7). An objective is to protect and restore ecological community structure, species interactions and food webs that sustain water-dependent ecosystems, including by protecting and restoring energy, carbon and nutrient dynamics, primary production and respiration.

8.07 (2). That water-dependent ecosystems are resilient to climate change, climate variability and disturbances (for example, drought and fire).

8.07 (3). To protect refugia in order to support the long-term survival and resilience of water-dependent populations of native flora and fauna, including during drought to allow for subsequent re-colonisation beyond the refugia.

8.07 (4). To provide wetting and drying cycles and inundation intervals that do not exceed the tolerance of ecosystem resilience or the threshold of irreversible changes.

8.07 (5). To mitigate human-induced threats (for example, the impact of alien species, water management activities and degraded water quality).

8.07 (6). To minimise habitat fragmentation.

Appendix 2: VMFRP Stakeholder Engagement & Communication Plan