Vinifera Environmental Watering Plan Addendum to the Nyah and Vinifera Environmental Watering Plan 2015

March 2020

VICTORIAN MURRAY FLOODPLAIN RESTORATION PROJECT

HEALTHY LANDSCAPES, STRONG COMMUNITIES

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Author: Tickle, I., Report prepared for Victorian Murray Floodplain Restoration Project by Mallee CMA

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Mallee Catchment

Management Authority

www.malleecma.vic.gov.au
PO Box 5017 Mildura 3502
Telephone 03 5051 4377
Facsimile 03 5051 4379

Version	Prepared	Author	Reviewed
1	7.10.2019	Isabel Tickle	MCMA
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List of abbreviations	
Abbreviation	**Full description**
AHD	Above Height Datum
ARI	Arthur Rylah institute
AWOC	After SDL 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
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 SDL 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
WRP	Water Resource Plan

Introduction

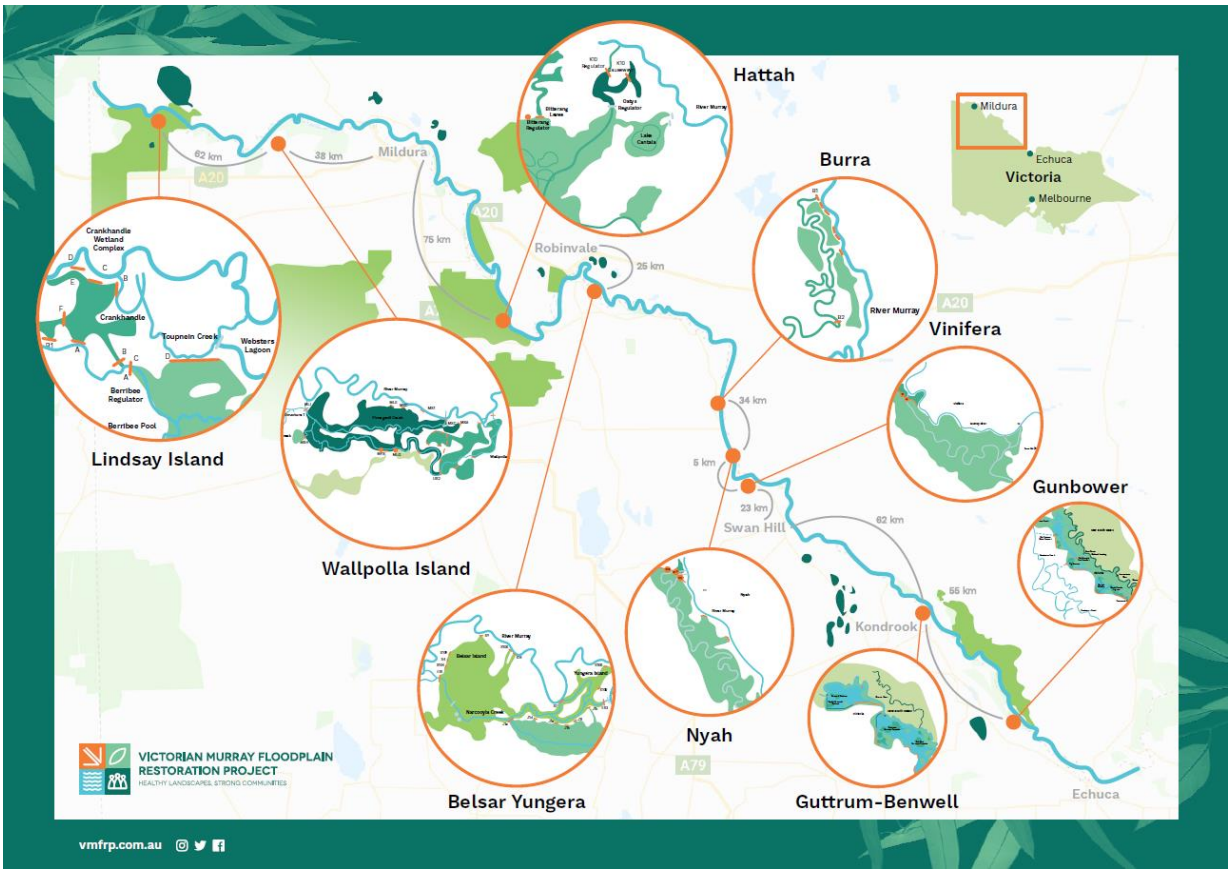
Victorian Murray Floodplain Restoration Project

The Victorian Murray Floodplain Restoration project (VMFRP) consists of nine discrete environmental works projects that aim to return an enhanced 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 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 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 Location

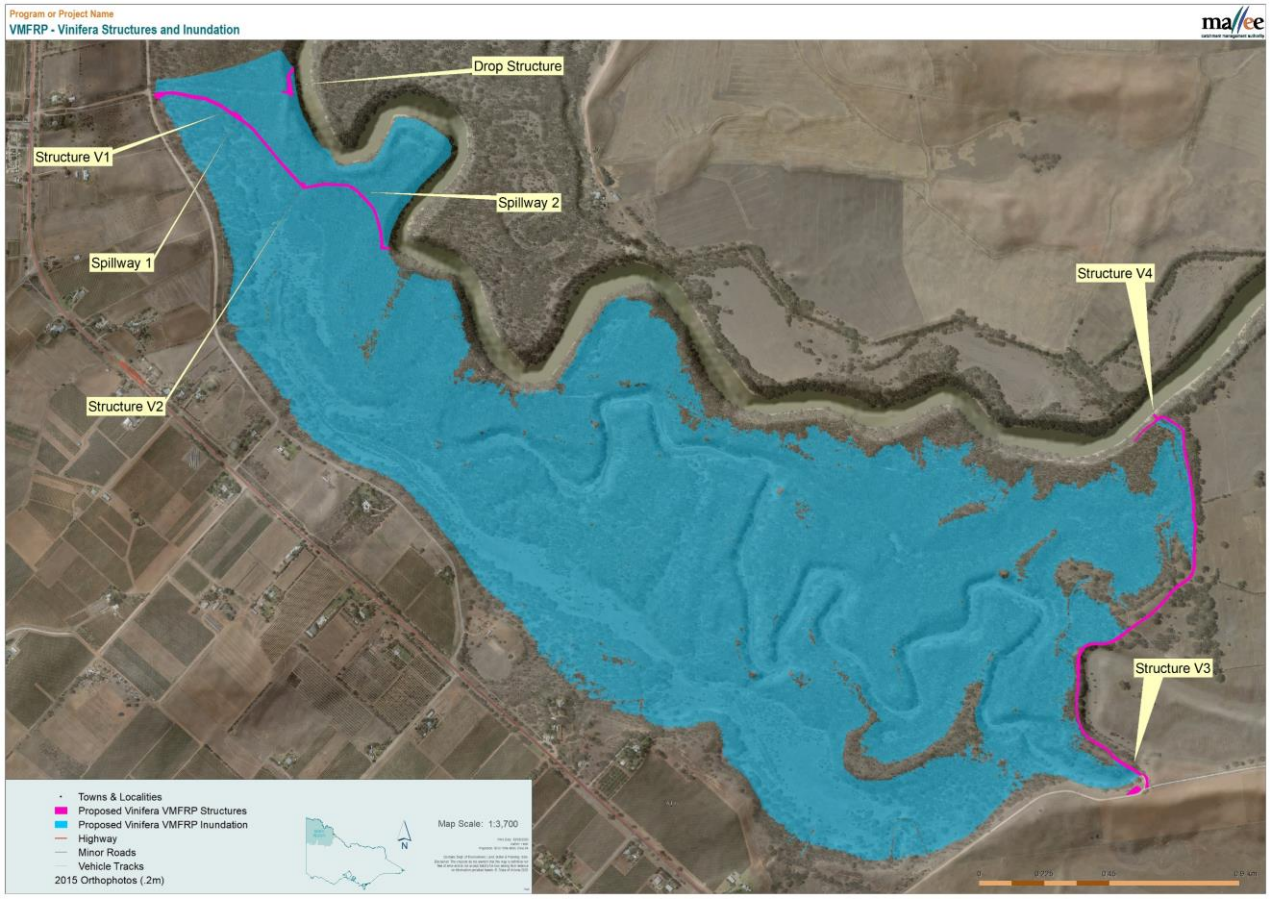


Vinifera Project

The Vinifera project is located 20 km north west of Swan Hill, in the Nyah Vinifera Regional Park on the western banks of the River Murray between Swan Hill and Nyah. This floodplain includes 637.92 ha of wetland, forest and woodland areas and includes Vinifera Creek, a seasonal anabranch of the River Murray.

The Park features extensive waterways, wetlands and inundation dependant woodlands that receive water from the River Murray via Vinifera Creek. The park supports a high diversity of flora and fauna species and ecological communities of national and Victorian conservation significance. The condition and productivity of Vinifera Park has declined as a result of the reduced flood frequency and durations.

Figure 2:VMFRP Structures and Inundation Extent



The Nyah VMFRP works will provide infrastructure to improve the frequency and duration of inundation, to reinstate a watering regime matched to the ecological requirements of the flora and fauna at Vinifera. The project will provide inundation of up to 353.5 ha of inundation dependant habitat with a water level of 64.4 m AHD (refer to Figure 2), requiring a volume of 2,743 ML (Mallee CMA, 2014). Analysis of the inundation flow equivalences shows that the proposed works will replicate inundation flows of up to 20,000 ML/d at the site.

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 Victorian, EWMPs are a key reference for the long-term watering plans prepared for the Basin Plan. The existing Nyah Vinifera EWMP (Mallee CMA, 2015) provides context for the Vinifera water planning, monitoring and consultation process.

This addendum provides an update of the Vinifera EWMP and should be read in conjunction with the 2015 EWMP (Mallee CMA, 2015) and the Operating Plan (VMFRP Project Team, 2020). The addendum identifies environmental objectives and targets (where appropriate), water delivery options and regimes for the Vinifera project (refer to Table 3).

Planning context and legislation framework

Basin Plan Environmental Management 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.

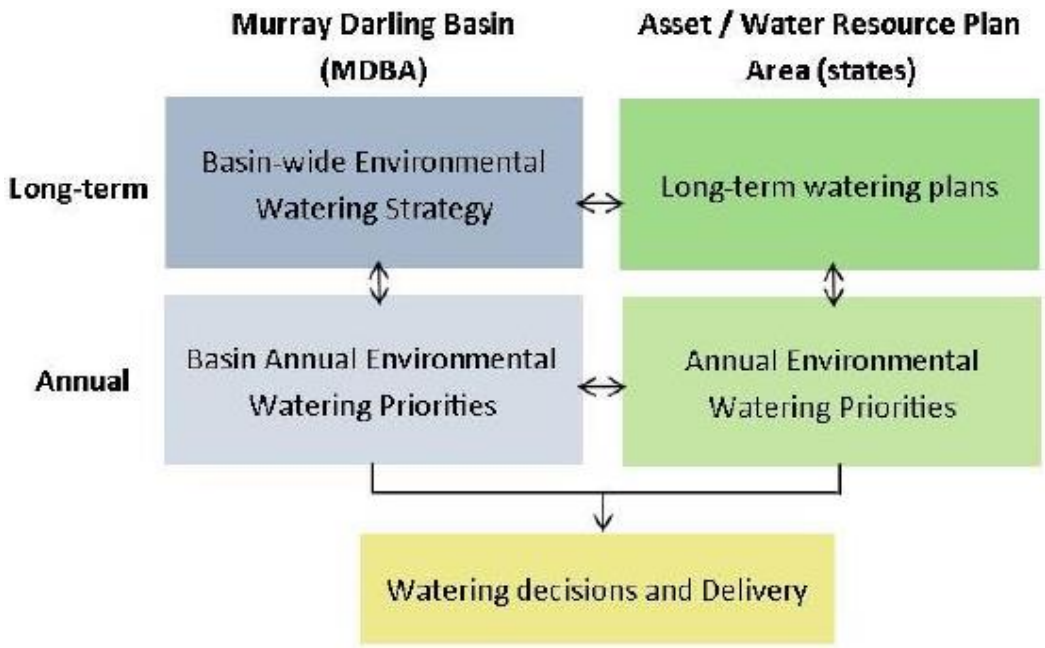


Figure 3: The long-term and annual planning documents required under Basin Plan Chapter 8 'Environmental Watering Plan' (DELWP, 2015)

The EMF is intended to:

- Coordinate the planning, prioritisation and use of environmental water on both a long-term and annual basis;
- 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.

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, in order 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 Long-Term Watering Plans (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.

Vinifera supports a population of Grey-crowned Babbler *(Pomatostomus temporalis)*, listed as endangered under the Flora and Fauna Guarantee Act (Victorian Government, 1988; Victorian Government, 2019). 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 identified 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.

Water management

The purpose of the Vinifera VMFRP project is to increase the frequency and duration of inundation to reinstate a watering regime matched to the ecological requirements of river red gum and other significant flora and fauna on the floodplain. This will require regulating structures and temporary pumping, (in the absence of suitable River Murray flows), to provide a more natural inundation regime.

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

- Natural flood
- Flood capture
- Managed inundation – gravity released
- Managed inundation – pumped releases

Constructed elements of the water management infrastructure include regulators, containment banks and overflow sills, as well as hardstands on which to place temporary pumps.

For more detail on the operating scenarios, refer to the Vinifera *Operation Plan* (VMFRP Project Team, 2020)

Ecological objectives and targets with associated inundation regimes and requirements

Ecological objectives, as summarised in the 2014 Business Case (Mallee CMA, 2014) , were developed for the Vinifera site, 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, 2013; 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 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 the Arthur Rylah Institute (ARI) and key project stakeholders from DELWP, 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 Vinifera 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.

Ecosystem type and biodiversity

Vinifera Park is one of the most downstream areas of the central river red gum forests, lying near the western limit of the Murray Fans bioregion. It provides a unique ecological community where the semi-arid landscape and River Murray and its floodplain connect, providing an essential biodiversity corridor for fauna to move between environments vital to their life-cycles.

The project area supports several fauna species listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act, (Commonwealth of Australia, 1999)) including Regent Parrot (*Polytelis anthopeplus monarchoides*), Eastern Great Egret (*Ardea modesta*), Murray Cod (*Maccullochella peelii peelii*) and Growling Grass Frog (*Litoria raniformis*). For a full description of the flora and fauna found within the Nyah park, refer to the Nyah and Vinifera EWMP (Mallee CMA, 2015).

Since the production of the EWMP, fauna surveys were conducted at three sites within Vinifera by Australian Ecosystems in 2016 (Australian Ecosystems, 2016). These survey areas covered the main infrastructure sites for the Vinifera project. A total of 37 fauna species were observed, comprising

33 species of bird, three reptiles and one mammal. One species of bird, the Grey-crowned Babbler *(Pomatostomus temporalis)* is listed as endangered under the FFG Act. Seventy native vascular plant species, though 38 were introduced species. A single species listed as rare on the Department of Primary Industry Advisory List of Rare or Threatened Plants in Victoria (DEPI, 2014) was recorded – the Branching Groundsel *(Senecio cunninghamii var. cunninghamii*).

Management intervention has been in the Vinifera floodplain management unit with environmental watering events using temporary pumping infrastructure between 2005 and 2016. Anecdotal evidence indicated an increase in River Red Gum canopy health following these watering events. If this intervention is not continued the benefits from these watering events such as River Red Gum recovery may not be sustained and the floodplain will continue to become drier, resulting in reduced productivity, less carbon flux and reduced ecosystem functionality (Mallee CMA, 2015).

Current conditions

The forests and woodlands of the River Murray floodplain have been declining rapidly in condition over the past two decades. The decline is associated with increasing regulation of the River Murray and extended periods of drought (Cunningham, et al., 2011).

No ecological surveys have been undertaken since environmental watering has occurred at Vinifera. This section therefore relies on assessments undertaken up to 2016.

Within the Vinifera project area, the conditions of wetlands are in decline due to a lack of seasonal inundation (Ecological Associates, 2014) (Mallee CMA, 2014).

Under current conditions, the frequency of flow peaks between 10,000 ML/d and 17,500 ML/d has declined somewhat but the median duration of these events has declined even more. Flows of 10,000 to 15,000 ML/d, which would have occurred 100 times every 100 years under natural conditions, last 3 months rather than the 6-month median duration under natural conditions. At higher flows, the current frequency is lower than natural while the duration of events remains relatively unimpacted. The frequency of events that reach the upper extent of river red gum forest communities (25,000 ML/d) has almost halved from 72 events per 100 years to 37. However, the median duration of these events has only declined 87 days to 70 (Ecological Associates, 2015).

Seasonal wetland habitat has reduced and River Red Gums have colonised former wetlands as high river levels now only inundate wetlands briefly. The shorter duration of floods means that aquatic marshland vegetation is no longer supported and the understory has become dominated by seasonal floodplain herbs and grasses (Mallee CMA, 2015).

Reductions in flooding duration of Nyah Park has caused a decrease in tree density and canopy cover, resulting in a decline in forest productivity (Mallee CMA, 2014).

Vinifera Park has a sparse understory and reduced diversity and habitat value due to the alteration in the sites water regime. Structural habitat and food resource availability for species such as carpet python, swamp wallaby, grey-crowned babbler and other woodland species has also reduced (MCMA, 2014).

Vinifera features broad wetland depressions that retain water following flood recession. Persistent inundation is required to sustain the rich ecological values of Vinifera Park. The inundation is important as it supports marshland communities including spiny mudgrass, frogs and small fish that depend on permanent aquatic habitat; however inundation durations are now too short to sustain perennial aquatic

macrophytes, to prevent encroachment of red gum on swamp and wetland areas, and to significantly contribute to the breeding requirements of native fish or waterbirds (Mallee CMA, 2014).

The associated decline of wetland habitat has meant that the floodplain only provides opportunistic habitat for aquatic fauna when water is available. Further encroachment by trees has excluded waterbirds that depend on open water.

The altered water regime is considered the major threat for the target area and is the primary factor behind the development of this EWMP.

The Vinifera Floodplain Management Project will deliver a high magnitude of benefits, evidenced by previous environmental watering and will meet the outcomes and stated objectives of the Basin Plan.

The Vinifera works consist of four regulators, two on the downstream end of Vinifera Creek and two on the upstream end, which enable inundation in the absence of flood water and be retained on the floodplain to a maximum of 64.4m AHD. The works enable 353.5 hectares of inundation dependent habitat to have an appropriate water regime reinstated, (MCMA, 2014).

A representation of the planned works and inundation at Vinifera is shown Figure 2. Analysis of the inundation flow equivalences shows that the proposed works will replicate inundation flows up to 20,000 ML/d at the site (Jacobs, 2016).

The works will provide flexibility to deliver a wide range of environmental watering events to meet the ecological objectives described in Table 3.

Through the proposed VMFRP structures, the area of water delivery will benefit the ecological values in the floodplain area using a total water volume of 2,743 ML (MCMA, 2014).

The proposed VMFRP works will facilitate significantly larger inundation events to the floodplain compared to previous environmental watering (Figure 4) and therefore deliver extended ecological benefits beyond those currently achievable.

Notably, the VMFRP works would provide for better management of the frequency and duration of inundation across the Vinifera floodplain system. It is expected that the ecological condition of Vinifera Floodplain will improve when the water regime better matches its ecological requirements.

Overarching ecological objectives

The overarching objective of water management at Vinifera is:

"to protect and restore the key species, habitat components and functions of the Vinifera Park ecosystem by providing the hydrological environments required by indigenous plant and animal species and communities" (Mallee CMA, 2014).

The ecological objectives for the NVinifera Park project 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 work, and guide monitoring and evaluation.

The overarching objectives will be achieved by using the proposed VMFRP infrastructure to better meet the water requirements of Vinifera Park. The proposed works will enable wide spread inundation of Vinifera Creek and adjoining wetlands and floodplain.

The works have been designed to operate under low River Murray flows (5,000 ML/d) and can be operated to protect this system through droughts (MCMA, 2014)

Predicted ecological benefits of inundation

Inundation maintains the integrity and productivity of floodplain habitats. Inundation promotes the germination of aquatic plants, which provide habitat for a range of aquatic fauna species including fish, invertebrates and frogs (Mallee CMA, 2013; Ecological Associates, 2014).

Inundation also helps to maintain the health of woodlands that provide important habitat like nesting sites and hollows for regent parrot and carpet python (Mallee CMA, 2013) 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 contributing to the energy requirements of the broader river system. Flowering attracts nectar-eating insects and birds and provides abundant insect prey for bats and the insectivorous birds (Ecological Associates, 2014).

Figure 4: Photo point VF10 - Showing condition improvement of Red Gum Swamp as a result of environmental watering (Above left:2015; Above right:2017)

Drawing upon the ecological response monitoring outcomes associated with Nyah Park and 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 Vinifera once permanent works can facilitate an appropriate water regime. (Mallee CMA, 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. This project provides a significant opportunity to improve and enhance the important ecological values of the Vinifera site.

The proposed supply measure will restore flooding frequency and duration to improve productivity of the creek, wetlands, swamp and red gum forest. It will contribute significantly to the feeding and breeding requirements of colonial nesting waterbirds. Frequent flooding of wetlands will maintain wetland sedgelands and support populations of small-bodied fish. Larger wetland areas will provide habitat for benthic herblands which in turn contribute to the habitat requirements of small-bodied fish and a wide variety of waterbirds (Mallee CMA, 2014).

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 (Mallee CMA, 2014; Ecological Associates, 2014).

Water Regime Class	Strategy	Ecological benefit (Mallee CMA, 2014, pp. 24-26)
Seasonal Wetland	Capture peaks in river flow by closing regulators on the flood recession Pump water into wetlands if peaks in river flow are too infrequent (Ecological Associates, 2014)	Watering will provide regular breeding habitat for waterbirds and will support the seasonal requirements of aquatic wetland fauna including native fish. Water levels should fall over summer and autumn to promote macrophyte growth over broad areas of the wetland bed and to promote mineralisation of organic matter. Adjacent trees will potentially demonstrate increased vigour, recruitment, therefore leading to an overall improvement in wetland health, maintenance of wetland buffers and maintenance of fauna habitats. Riparian shrubs will potentially demonstrate increased vigour in species such as lignum, and possibly also exhibit an increase in abundance and diversity. Understorey forbs and herbs will likely display an increase in diversity and abundance as inundation cycles promote regeneration and germination from the seed bank. In-channel macrophytes; flows convey seeds and propagules from water source into the wetland resulting in an increase in diversity and abundance of aquatic species. Water quality may also improve. Bank and channel edge macrophytes; flows convey seeds and propagules from water sources into the wetland resulting in an increase in diversity and abundance of emergent species. Water quality may improve, wetland banks will be stabilised and habitats for fauna will be provided.
Red Gum Swamp Forest	Capture peaks in river flow by closing regulators on the flood recession Pump water into wetlands if peaks in river flow are too infrequent (Ecological Associates, 2014)	Inundation of Red Gum Forest and Woodland provides temporary habitat for aquatic fauna, particularly vegetation-dependent fish. The habitat for terrestrial frogs, which is normally limited to the reeds fringing wetlands, will expand to the red gum understory. Burrowing frogs, which aestivate in the floodplain soil, will become active. Other wetlands species that will extend into the flooded woodland will include yabby, tortoises and water rat. Flooding events will support waterbird breeding. The trees provide nesting sites for waterbirds that breed over water. A range of other waterbird guilds will also breed.

Red Gum Forest and Woodland	Capture peaks in river flow by closing regulators on the flood recession Pump water into forest if peaks in river flow are too infrequent (Ecological Associates, 2014)	Increasing the duration of flooding events while maintaining a high flooding frequency can restore the habitat valued of Red Gum forest. Longer events will contribute to the breeding requirements of waterbirds while shorter events will provide foraging habitat and breeding opportunities for resident aquatic fauna. A higher density of vegetation on the forest floor will contribute to the habitat requirements of terrestrial fauna. It will provide forage and shelter for swamp wallaby and a source of prey and physical habitat for carpet python. High levels of insect productivity will sustain local bat populations.
Black Box Woodland	Capture peaks in river flow by closing regulators on the flood recession Pump water into forest if peaks in river flow are too infrequent (Ecological Associates, 2014)	High levels of productivity will follow inundation as elevated soil moisture promotes the growth and flowering of understorey grasses, shrubs and trees. The abundant food, including forage, insects, nectar and seeds will support breeding by many floodplain fauna. Inundation also maintains the propagules of water-dependent plants, such as *Eleocharis acuta*, which grows from drought-tolerant rhizomes when inundated and *Marselia drummondii* which grows from drought-tolerant spores.

Specific objectives and targets

Specific VMFRP ecological objectives have been developed to provide some quantification on the degree of environmental benefit expected from the proposed supply measures based on the key water-dependent values of Vinifera (refer to Table 3). The objectives are consistent with those of the Nyah and Vinifera EWMP (Mallee CMA, 2015) (refer to Table 2) and will contribute to achieving the environmental objectives set out by the Basin Plan (Commonwealth of Australia, 2012). A summary of the Basin Plan is attached as Appendix 1.

Table 2: VMFRP Specific objectives established for Vinifera. This table shows the progression of ecological objectives from 2014 to 2020 (Ecological Associates, 2014) (Mallee CMA, 2015) (Arthur Rylah Institute, 2020)

Ecological Associates Rational & Outcomes 2014 (Ecological Associates, 2014), Vinifera Business case (Mallee CMA, 2014)	Nyah and Vinifera Environmental Watering Plan (Mallee CMA, 2015)	VMFRP Specific Objectives 2020 (Arthur Rylah Institute, 2020)
Restore the vegetation structure of wetland plant communities	Restore the vegetation structure of wetland plant communities	Restore the vegetation structure of wetland plant communities to predominantly treeless systems. Restore the native aquatic and semi-aquatic macrophytes communities in seasonal wetlands and anabranches.
Re-establish resident populations of frogs and small fish	Restore resident populations of frogs and small fish	Develop seasonal populations of small-bodied native fish. Restore seasonal populations of native frogs.
No objectives specified. Included for Nyah only as Vinifera inundation footprint does not offer this refuge.	Providing seasonal feeding and reproductive opportunities for riverine fish species	No objectives specified. Included for Nyah only as Vinifera inundation footprint does not offer this refuge.
Provide reliable breeding habitat for waterbirds, including colonial nesting species	Provide reliable breeding habitat for waterbirds, including colonial nesting species	Maintain successful breeding for target species.

		Provide reliable native foraging and breeding habitat for waterbirds.
Restoring floodplain productivity to maintain resident populations of vertebrate fauna including carpet python, sugar glider and grey-crowned babbler	Restoring floodplain productivity to maintain resident populations of vertebrate fauna including carpet python, sugar glider and grey-crowned babbler	1. Increase the abundance of bats as an indicator species of increased resources resulting from increased floodplain productivity. 2. Sugar Glider was also identified as a target species for monitoring at Vinifera Floodplain sites. However, examination of the records held on the Victorian Biodiversity Atlas and the Atlas of Living Australia revealed this species does not occur in these areas. Sugar Gliders are a common species that is readily detected using standard fauna surveys techniques, so its absence is most likely due to the habitat being unsuitable for viable populations. This species is therefore considered to be a very low priority for monitoring at these sites and will not be considered further here. 3. Increase the abundance of reptiles as an indicator species of increased resources resulting from increased floodplain productivity. 4. Maintain the health of native trees. 5. Maintain threatened native flora presence. 6. Maintain plant cover and diversity of target native vegetation groups. 7. Reduce high threat exotic plant cover. 8. Increase the abundance of native woodland birds.
Contribute to the carbon requirements of the River Murray channel ecosystem	Contribute to the carbon requirements of the River Murray channel ecosystem	ARI to provide

Table 3: VMFRP Specific objectives and targets established for Vinifera 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) (Mallee CMA, 2014)

SDL Vinifera 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** (Mallee CMA, 2014)	**Water Regime Class** (Mallee CMA, 2014)	**Associated Basin Plan Objective**
Restore the vegetation structure of wetland plant communities	Vegetation	Restore the vegetation structure of wetland plant communities to predominantly treeless systems.	New River red gum encroachment absent from SWPs in all years AWOC.	**Seasonal Wetlands** Described in Table 2: Water regime class, strategy and ecological benefits. **Red Gum Swamp Forest** Described in Table 2: Water regime class, strategy and ecological benefits. **Red Gum Forest and Woodland** Described in Table 2: Water regime class, strategy and ecological benefits.	Seasonal Wetlands Red Gum Swamp Forest Red Gum Forest and Woodland	8.05(2), 8.05(3), 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).
		Restore the native aquatic and semi-aquatic macrophytes communities in seasonal wetlands and anabranches.	The projected foliage cover of native aquatic and semi-aquatic macrophytes exceeds 50% in seasonal wetlands and anabranches in December when flooded by ten years AWOC; and that cover is comprised of at least 5 species.			
Re-establish resident populations of frogs and small fish	Fish	Develop seasonal populations of small-bodied native fish.	Small-bodied native fish species are present every spring within the first ten years AWOC; four species in all wetlands.		Seasonal Wetlands Red Gum Swamp Forest Red Gum Forest and Woodland	8.05(2), 8.05(3), 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).
	Frogs	Restore seasonal populations of native frogs.	At least three frog species are present in all wetlands every spring in the first ten years AWOC.			

Provide seasonal feeding and reproductive opportunities for riverine fish species	**Fish**	No objectives specified. Included for Nyah only as Vinifera inundation footprint does not offer this refuge.	No targets specified. Included for Nyah only as Vinifera inundation footprint does not offer this refuge.	**Black Box Woodland** Described in Table 2: Water regime class, strategy and ecological benefits.	No water class regime identified.	No basin plan objective identified.
Provide reliable breeding habitat for waterbirds, including colonial nesting species	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.		Seasonal Wetlands Red Gum Swamp Forest Red Gum Forest and Woodland Black Box Woodland	8.05(2), 8.05(3), 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).
	Birds	Maintain successful breeding for target species.	Any species Anatidae or Rallidae successfully breeds every year in the first 10 years AWOC. Cormorants or Nankeen Night-heron breed on at least 6 occasions in the 10 years AWOC.			
Restoring floodplain productivity to maintain resident populations of vertebrate fauna including carpet	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.		Red Gum Forest and Woodland Black Box Woodland	8.05(2), 8.05(3), 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).

python, sugar glider and grey-crowned babbler		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.			
		Maintain the health of native trees.	At least 75% of surveyed trees with 'healthy' canopy condition within ten years AWOC.			
	Birds	Increase the abundance of native woodland birds.	Total native woodland bird abundance increases by 10% from PWOC levels within 10 years AWOC.			
	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.			
	Mammals	Sugar Glider was also identified as a target species for monitoring at Vinifera Floodplain sites. However, examination of the records held on the Victorian Biodiversity	NA			

		Atlas and the Atlas of Living Australia revealed this species does not occur in these areas. Sugar Gliders are a common species that is readily detected using standard fauna surveys techniques, so its absence is most likely due to the habitat being unsuitable for viable populations. This species is therefore considered to be a very low priority for monitoring at these sites and will not be considered further here.				
	Reptiles	Increase the abundance of reptiles 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.			

Contribute to the carbon requirements of the River Murray channel ecosystem		ARI to provide	ARI to provide		Red Gum Swamp Forest Red Gum Forest and Woodland Black Box Woodland	8.05(2), 8.05(3), 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

Operating Scenarios

The Vinifera works have been designed to replicate key components of the natural hydrology of the system. The infrastructure has been designed to be operated in several possible flow regimes consistent with the requirements set out in the Business Case (Mallee CMA, 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 Vinifera floodplain area using gravity and occasional temporary pumping when required, as further described in Table 4. The works will provide for the inundation of up to 353.5 ha of floodplain.

Table 4: Vinifera operating Scenarios (Ecological Associates, 2015) (Jacobs, 2016)

Scenario	Pre-conditions	Structure Operation	Maximum design inundation level (m)	Preferred Frequency	Threshold (depth, level or discharge)	Holding Duration	Preferred Timing	Maximum Interval Between Events	Water Regime Classes Targeted
Capture Low Flood Peak	River levels exceed 15,000 ML/d	Close upstream and downstream regulators when the flood peak starts to recede. Regulators are opened when flood duration target ls met.	63.56	9 years in 10	River discharge exceeds 15,000 ML/d	4 to 6 months	June to February	2.5 years	Seasonal Wetlands
Pump to Low Floodplain Areas	None	Upstream and downstream regulators are closed. Water is pumped into storage area. Regulators are opened when flood duration target is met.		9 years in 10	River discharge exceeds 15,000 ML/d	4 to 6 months	June to February	2.5 years	Seasonal Wetlands

Capture Moderate Flood Peak	River levels exceed 17,500 ML/d	Close upstream and downstream regulators when the flood peak starts to recede. Regulators are opened when flood duration target is met.	64.15	9 years in 10	River discharge exceeds 17,500 ML/d	6 of these events to last more than 4 months. 3 of these events to last more than 7 months	July to February	5 years	Seasonal Wetlands Red Gum Swamp Forest
Pump to Moderate Floodplain Areas	None	Upstream and downstream regulators are closed. Water is pumped into storage area. Regulators are opened when flood duration target is met.		9 years in 10	River discharge exceeds 17,500 ML/d	6 of these events to last more than 4 months. 3 of these events to last more than 7 months	July to February	5 years	Seasonal Wetlands Red Gum Swamp Forest
Capture High Flood Peak	River levels exceed 20,000 ML/d (approximately equivalent to 64.2 m AHD)	Close upstream and downstream regulators when the flood peak starts to recede. Regulators are opened when flood duration target is met.	64.92	9 years in 10	River discharge exceeds 20,000 ML/d	5 of these events to be 4 months long 4 of these events to be 6 months long	July to February	5 years	Seasonal Wetlands Red Gum Swamp Forest Red Gum Forest and Woodland
Pump to High Floodplain Areas	None	Upstream and downstream regulators are closed. Water is pumped into storage area.		9 years in 10	River discharge exceeds 20,000 ML/d	5 of these events to be 4 months long	July to February	5 years	Seasonal Wetlands

		Regulators are opened when flood duration target is met				4 of these events to be 6 months long			Red Gum Swamp Forest Red Gum Forest and Woodland

Environmental Monitoring

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

A monitoring and evaluation plan for Vinifera was prepared for the site by Ecological Associates (Ecological Associates, 2014).

Mallee CMA, with the Arthur Rylah Institute for Environmental Research (ARI), is 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 the specific site
- 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 Vinifera 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 Vinifera VMFRP 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. 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.

Operating Risks and Mitigation Measures

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 process 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.

Impact on Salinity, Water Environments and Fish Passage

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

The assessment concluded that the magnitude of the salinity impacts of the proposed watering scenarios was negligible or 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 uniform salinity and assumes a significant percentage of the recharged water is returned the Murray River (SKM, 2014).

SKM (SKM, 2014) expects that multiple managed inundation events will raise groundwater levels which may increase the salt load impact on the floodplain and river system.

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 Mallee CMA monitors an existing network of bores within the Vinifera 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 Vinifera inundation the VMFRP, with assessment and recommendations from SKM (2014) and (Jacobs, 2019), has proposed new bores within the proposed project inundation area.

These will be integrated into the existing Mallee CMA 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 Park, 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 Vinifera Creek. 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. Maintain good relationships with other water managers.
- Tailor watering regimes to provide competitive advantage 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 including those described in the Vinifera Fish Management Plan (Arthur Rylah Institute, 2020).

- 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.

Risks Associated with Pest plants and Animals

Mitigation measures would be implemented to minimise risks associated with pest plants and animals, including:

- Timing water manipulations to drown seedlings, minimise growth, germination and seed set. Time water manipulations to promote native species.

- Controlling current populations and eradicate/control new infestations via existing management strategies (e.g. Parks Victoria pest management action plans/strategies). Support partner agencies to seek further funding for targeted weed control programs if necessary.

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.

Community Consultation Communication

The Vinifera Park Site has a Community Communication and Engagement Strategy. A Stakeholder Engagement and Communication Plan was developed to ensure awareness amongst all stakeholders and the wider community of the Vinifera Park environmental watering 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 Nyah Park project.

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

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 Vinifera. These stakeholders are representatives of each of the Aboriginal parties who have a vested interest in the Vinifera 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.

Adaptive Management and Reporting

A comprehensive risk management strategy will be developed for the Vinifera 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 in light of 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

(attached)