REFERRAL OF A PROJECT FOR A DEACISION ON THE NEED FOR ASSESSMENT UNDER THE *ENVIRONMENT EFFECTS ACT 1978*

REFERRAL FORM

The *Environment Effects Act 1978* provides that where proposed works may have a significant effect on the environment, either a proponent or a decision-maker may refer these works (or project) to the Minister for Planning for advice as to whether an Environment Effects Statement (EES) is required.

This Referral Form is designed to assist in the provision of relevant information in accordance with the *Ministerial Guidelines for assessment of environmental effects under the Environment Effects Act 1978* (Seventh Edition, 2006). Where a decision-maker is referring a project, they should complete a Referral Form to the best of their ability, recognising that further information may need to be obtained from the proponent.

It will generally be useful for a proponent to discuss the preparation of a Referral with the Impact Assessment Unit (IAU) at the Department of Environment, Land, Water and Planning (DELWP) before submitting the Referral.

If a proponent believes that effective measures to address environmental risks are available, sufficient information could be provided in the Referral to substantiate this view. In contrast, if a proponent considers that further detailed environmental studies will be needed as part of project investigations, a more general description of potential effects and possible mitigation measures in the Referral may suffice.

In completing a Referral Form, the following should occur:

- Mark relevant boxes by changing the font colour of the 'cross' to black and provide additional information and explanation where requested.
- As a minimum, a brief response should be provided for each item in the Referral Form, with a more detailed response provided where the item is of particular relevance. Cross-references to sections or pages in supporting documents should also be provided. Information need only be provided once in the Referral Form, although relevant cross-referencing should be included.
- Responses should honestly reflect the potential for adverse environmental effects. A Referral will only be accepted for processing once IAU is satisfied that it has been completed appropriately.
- Potentially significant effects should be described in sufficient detail for a reasonable conclusion to be drawn on whether the project could pose a significant risk to environmental assets. Responses should include:
  - a brief description of potential changes or risks to environmental assets resulting from the project;
  - available information on the likelihood and significance of such changes;
  - the sources and accuracy of this information, and associated uncertainties.
- Any attachments, maps and supporting reports should be provided in a secure folder with the Referral Form.
- A USB copy of all documents will be needed, especially if the size of electronic documents may cause email difficulties. **Individual documents should not exceed 10MB as they will be published on the Department's website.**
- A completed form would normally be between 15 and 30 pages in length. Responses should not be constrained by the size of the text boxes provided. Text boxes should be extended to allow for an appropriate level of detail.

- The form should be completed in MS Word and not handwritten.

The party referring a project should submit a covering letter to the Minister for Planning together with a completed Referral Form, attaching supporting reports and other information that may be relevant. This should be sent to:

Postal address	Couriers
Minister for Planning	**Minister for Planning**
PO Box 500	**Level 16, 8 Nicholson Street**
EAST MELBOURNE VIC 8002	**EAST MELBOURNE VIC 3002**

In addition to the submission of the hardcopy to the Minister, separate submission of an electronic copy of the Referral via email to ees.referrals@delwp.vic.gov.au is required. This will assist the timely processing of a referral.

PART 1 PROPONENT DETAILS, PROJECT DESCRIPTION & LOCATION

1. Information on proponent and person making Referral

Name of Proponent:	Lower Murray Urban and Rural Water Corporation (LMW)
Authorised person for proponent: **Position:** **Postal address:** **Email address:** **Phone number:** **Facsimile number:**	Josh White Project Director – VMFRP PO Box 1438, Mildura VIC 3502 Josh.White@vmfrp.vic.gov.au 0400 697 304 n/a
Person who prepared Referral: **Position:** **Organisation:** **Postal address:** **Email address:** **Phone number:** **Facsimile number:**	Josh White Project Director VMFRP PO Box 1438, Mildura VIC 3502 Josh.White@vmfrp.vic.gov.au 0400 697 304 n/a
Available industry & environmental expertise: (areas of 'in-house' expertise & consultancy firms engaged for project)	**VMFRP** The VMFRP is a regional partnership model between Lower Murray Water (LMW), Goulburn Murray Water (GMW), the Mallee Catchment Management Authority (Mallee CMA), North Central Catchment Management Authority (North Central CMA) and Parks Victoria, set up to deliver the VMFRP works on behalf of the Department of Environment, Land, Water and Planning - Water (DELWP Water). **R8** Jacobs and GHD teamed in December 2018 to form a joint venture (R8 Joint Venture) to deliver an integrated program approach across all packages of work. Both Jacobs and GHD are large consultancies who are providing a comprehensive suite of technical consulting services to support the VMFRP. These services include planning and approvals, design, cultural heritage, terrestrial and aquatic ecology, landscape and visual, hydrology, geotechnical, survey and spatial amongst other services.

2. Project – brief outline

Project title:

Lindsay Island Floodplain Restoration Project

Project location: (describe location with AMG coordinates and attach A4/A3 map(s) showing project site or investigation area, as well as its regional and local context)

Location

The Lindsay Island Floodplain Restoration Project (the project) is located in north west Victoria, approximately 75 km west north west of Mildura and 30 km east of Renmark, South Australia. The project involves works to facilitate managed inundation of approximately 4,845 ha of high ecological value floodplain in Victoria, mostly located on Lindsay Island and floodplain areas south of the Lindsay River, including Lake Wallawalla. The Lindsay River diverges from the Murray River downstream of Lock 8 and re-joins the Murray River upstream of Lock 6, bypassing Lock 7. In order to engage inflows to the Lindsay River, operation of the project would involve raising water levels along the Murray River behind Lock 7, which would inundate some lower-lying billabongs and creeks on the New South Wales (NSW) side of the Murray River. Approximately 263 ha of inundation would occur in NSW, most of which would be within the Murray River, resulting in a total inundation area for the project of approximately 5,108 ha.

Lindsay Island is approximately 28 km long east to west and is enclosed by the Murray River in the north and the Lindsay River anabranch in the south, and is dissected by a number of creeks. Most notably, these include the 19 km long Mullaroo Creek, which diverges from the Murray River just upstream of Lock 7 and crosses Lindsay Island to connect with the Lindsay River just upstream of Berribee Homestead; and Toupnein Creek, which forms a loop diverging from the Murray River downstream of Lock 7 and re-joining the river upstream of the Lindsay River's downstream junction.

Lock 7 is pivotal to the hydrology of the local area because it controls the flow into Mullaroo Creek and the Lindsay River, as well as providing the hydraulic conditions that enable Lake Victoria (located 3.5 km north of Lock 7 in NSW) to drain by discharging directly downstream of Lock 7 through Rufus River (ARI, 2018). The Darling River discharges into the Murray River approximately 130 km upstream of Lock 7 (0.5 km upstream of Lock 10).

The project would involve managed inundation of six water management areas (WMAs):

- Berribee WMA (3,507 ha (Victoria), 263 ha (NSW)) – This WMA encompasses the Lindsay River east / upstream of a proposed regulator near Berribee Homestead, along with Mullaroo Creek and associated tributaries, Lake Wallawalla and the central parts of the Lindsay River floodplain north to Toupnein Creek (but not including the creek). Includes areas of NSW inundation. Except for Lake Wallawalla, this WMA is located on the northern side of Old Mail Road.
- Crankhandle WMA (Upper Tier (299 ha) and Lower Tier (17 ha)) – This WMA is located on the floodplain in the north west portion of Lindsay Island, north of the Lindsay River and extending to the Murray River, downstream of Berribee Homestead and the Berribee WMA, encompassing Billgoes and Scotties Billabongs.
- Crankhandle West WMA (Upper Tier (23 ha) and Lower Tier (72 ha)) – This WMA is located on the floodplain in the far north west portion of Lindsay Island, north of the Lindsay River but not extending to the Murray River, downstream of the Crankhandle WMA.
- Lindsay South WMA (140 ha) – This WMA is located on the floodplain south of the Lindsay River and north of Old Mail Road, connects to the Lindsay South Creek upstream of Wallawalla East WMA, on private land known as Neds Corner.

- Wallawalla East WMA (164 ha) – This WMA is located on the floodplain south of the Lindsay River and mostly north of Old Mail Road, connects to the Lindsay River downstream of Lindsay South WMA.
- Wallawalla West WMA (623 ha) – This WMA is located on the highest part of the floodplain west of Lake Wallawalla and south of Old Mail Road, connects to the Lindsay River via Lake Wallawalla.

Access for construction and operation of the project would be off Old Mail Road via the Berribee Homestead Track, Bridge Track, Neds Corner Road, Wallawalla Circuit Track and Berribee Tank Track. On Lindsay Island, the project would also use the Sandford Track, Kulkurna Cliffs Track and Channel Track.

Context

The majority of the project is located within the Murray-Sunset National Park managed by Parks Victoria, with some proposed works and inundation areas located on Crown land and freehold land private parcels in Victoria and NSW (see Section 9 of this referral). Within the Murray-Sunset National Park, the area of investigation for the BERR_D containment bank and regulator adjoins the Toupnein Creek Reference Area and part of the Wallawalla West WMA inundation area is located in the Lake Wallawalla Reference Area.

The project is not located within a Ramsar site, however Lindsay Island (along with floodplain areas south of the Lindsay River) and Lake Wallawalla are both listed as nationally important wetlands on A Directory of Important Wetlands in Australia. Lindsay Island is part of the Chowilla-Lindsay-Wallpolla Icon Site, one of six icon sites identified under the Murray-Darling Basin Ministerial Council's The Living Murray Initiative. The Riverland Ramsar site is located approximately 10 km downstream of the project in South Australia. The Murray Mallee – Calperum Station and Taylorville Station Commonwealth Heritage Listed place is located approximately 35 km downstream of the project of in South Australia.

The project is located entirely within the Victorian local government area of Mildura Rural City Council, except for the minor works and inundation located within the NSW local government area of Wentworth Shire Council. The project is located in the Mallee Catchment Management Authority (CMA) region and the Murray Scroll Belt bioregion.

Project terminology

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

- Development footprint - this is the area that the project infrastructure (e.g. regulators, drop structures, pump hardstands, containment banks, channels, spillways) would occupy based on the current design, along with currently identified construction laydown areas. No construction working buffer or access tracks are included in the development footprint.
- Construction footprint - this includes the development footprint of the project infrastructure as well as the land required to construct the infrastructure; and a 5 m wide corridor along existing/proposed access tracks. This is the area that has been used to assess potential impacts on ecology values and to calculate the extent of native vegetation removal for the project[1].
- Area of investigation - this includes the construction footprint, as well as a buffer around the construction footprint. This is the area that has been the basis of desktop investigations of land use and heritage values within this referral.
- Inundation area - area of land subject to flooding during managed events, up to a specific design water level.

[1] Although the construction footprint contains a 5 m wide corridor along access tracks, native vegetation removal calculations have assumed a 5 m wide corridor for minor works on existing tracks, and a 10 m wide corridor for more substantial works in existing tracks and for new tracks (see Section 12).

Reference to 'the project area' throughout this referral includes both the area of investigation / construction footprint and the inundation area.

Refer to **Attachment 1 – Project Overview Maps** and **Attachment 2 – Environmental Features Maps**.

Short project description (few sentences)**:**

The project aims to restore a more natural inundation regime and improve ecological condition across approximately 4,845 ha of high ecological value Victorian Murray River floodplain at Lindsay Island and Lake Wallawalla. By restoring a more natural inundation regime, the project aims to mimic the effect of prior to river regulation natural flood events, improving the condition of vegetation communities, and providing seasonal aquatic habitat for native fauna.

To facilitate environmental watering, the project involves the construction of a large regulator on the Lindsay River near Berribee Homestead, additional regulators, containment banks and channels across the floodplain to distribute and retain floodwaters, two drop structures into the Lindsay River and one drop structure into the Murray River to enable controlled release of managed floodwaters, three temporary pump hardstands, a permanent pump suction line from Lake Wallawalla, along with ancillary activities such as access track works. Operation of the project requires the Lock 7 weir pool to be raised to enable water to hydraulically fill the Berribee WMA. All other WMAs are filled from the inundation area of the Berribee WMA either by gravity release (Crankhandle, Crankhandle West) or pumping (Lindsay South, Wallawalla East, Wallawalla West).

3. Project description

Aim/objectives of the project (what is its purpose / intended to achieve?):

The project aims to restore a more natural inundation regime and improve ecological condition across approximately 4,845 ha of high ecological value Victorian Murray River floodplain comprising six water management areas:

- Berribee WMA (DWL 23.2 mAHD, inundation area 3,507 ha in Victoria)
- Crankhandle WMA (Upper Tier DWL 22.6 mAHD, inundation area 299 ha; Lower Tier DWL 21.6 mAHD, inundation area 17 ha)
- Crankhandle West WMA (Upper Tier DWL 22.2 mAHD, inundation area 23 ha; Lower Tier DWL 21.7 mAHD, inundation area 72 ha)
- Lindsay South WMA (DWL 24.4 mAHD, inundation area 140 ha)
- Wallawalla East WMA (DWL 25.2 mAHD, inundation area 164 ha)
- Wallawalla West WMA (DWL 24.7 mAHD, inundation area 623 ha).

Seven water regime classes comprised of 17 ecological vegetation classes (EVCs), have been specifically identified for restoration through this project as described by Ecological Associates (2014a), Mallee CMA (2014) and VMFRP (2020a): Watercourses, Semi-permanent Wetlands, Temporary Wetlands, Red Gum Forest and Woodland, Lignum Shrubland and Woodland, Black Box Woodland and Alluvial Plains. A summary of water regime classes and constituent EVCs within the managed inundation area is provided in the background/rationale section of this referral.

Ecological Associates (2014a) initially developed ecological objectives for the water regime classes identified for restoration by the project, along with ecological targets to measure progress towards achieving the ecological objectives. These ecological objectives and targets have been refined by Arthur Rylah Institute (ARI) as part of the development of the VMFRP Monitoring Evaluation and Reporting (MER) Framework (ARI, 2020) to provide more specific ecological objectives and targets against which progress

can be measured and to support quantification of the degree of environmental benefit expected from the project. The environmental objectives and targets align with the environmental objectives set out in Chapter 5 of the Basin Plan 2012 and the expected environmental outcomes set out in the Basin-wide Environmental Watering Strategy (Murray-Darling Basin Authority (MDBA), 2019).

A summary of the draft ecological objectives and targets for the project as refined by ARI (2020) based on the Ecological Associates (2014a) ecological objectives and targets is provided in **Table 1**. Some of the currently identified ecological objectives are potentially competing and therefore further refinement of ecological objectives may be required as the design and draft operating scenarios for the project are refined based on the further investigations proposed in Section 20 of this referral.

Table 1: Draft ecological objectives and targets for the project with reference to associated water regime class and Basin Plan objectives

Specific Ecological Objectives (ARI, 2020)	Ecological Targets (ARI, 2020)	Water Regime Class (Ecological Associates, 2014a)	Associated Basin Plan Objective
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 After Works Operation Commencement (AWOC).	River Red Gum Forest and Woodland Lignum Shrubland 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).
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 Prior Works Operation Commencement (PWOC) levels in any flood year within the first 10 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 10 years AWOC.		
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 10 years AWOC.		
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.		
Protect and restore mammal populations.	Giles' planigale total species abundance increases by 10% at each site from POWC levels within 10 years of AWOC.		
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 10 years AWOC.		

Fish			
Develop seasonal populations of small-bodied native fish.	Small-bodied native fish species are present every spring within the first 10 years AWOC. Four species in at least five wetlands.	Semi-permanent Wetlands Watercourses	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).
Maintain local populations of large-bodied native fish.	The population structure of large-bodied native fish is maintained when PWOC populations are compared with AWOC.		
Maintain migration of medium and small-bodied native fish to maintain populations.	Migration of medium and small-bodied native fish occurs between Lindsay River and the River Murray channel every year AWOC.		
Provide suitable habitat conditions for large-bodied native fish spawning.	Spawning of Murray Cod occurs in Lindsay River in all years where adults are present in the first 10 years AWOC.		
Waterbirds			
Maintain successful breeding for target species.	Any species of Anatidae or Rallidae successfully breeds every year in the first 10 years AWOC in at least five wetlands. Platform-building waterbirds breed in lignum shrublands on at least three occasions in the 10 years post AWOC. Cormorants or Nankeen Night-heron breed on at least three occasions in the 10 years post AWOC.	Semi-permanent Wetlands Temporary Wetlands River Red Gum Forest and Woodland Lignum Shrubland and Woodland Alluvial Plain	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).
Provide suitable habitat for thousands of waterbirds.	Total summer waterbird abundance exceeds 3,000 in at least three seasons in the 10 years AWOC.		
Frogs			
Develop seasonal populations of native frogs.	At least three native frog species are present in at least five wetlands every spring within the first 10 years AWOC.	Semi-permanent Wetlands	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).
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.	Temporary Wetlands River 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).

Source: VMFRP (2020a).

Smaller scale environmental watering has been undertaken at targeted locations across Lindsay Island since 2006 and has been the subject of extensive ecological monitoring (e.g. Henderson *et al.* 2008; Australian Ecosystems 2010a, 2010b, 2011; Robertson 2011; Huntley *et al.* 2016; Brown *et al*. 2017; Wood 2018; GHD 2018). Improvements in tree canopy health following environmental watering at Lindsay Island in 2006 are illustrated in **Figure 1**.

Figure 1: Example of past environmental watering contributing to the proposed objective to 'maintain the health of native trees' (Source: Parks Victoria, 2018)

In addition to the ecological benefits reflected by the draft ecological objectives and targets, the project is also expected to contribute to the following socio-economic benefits:

- Enhanced tourism and recreational opportunities by improving the health and condition of riverine landscapes that attract visitors to the region
- Improved health of wetlands and floodplain ecosystems valued by Traditional Owners
- Reduced requirements to buyback water from consumptive users (e.g. irrigators) and associated impacts on regional communities, while still contributing to achievement of the environmental objectives set by the Murray-Darling Basin Plan.

Background/rationale of project (describe the context / basis for the proposal, e.g. for siting):

Legislative and policy context

The Murray-Darling Basin Plan establishes the legal and policy framework for the use of environmental water in the Murray-Darling Basin and places a Sustainable Diversion Limit (SDL) on the water that can be extracted from the system for irrigation and other consumptive uses. The SDL is based on an assessment of the water that must be left in the system to maintain ecosystem health. To comply with the initial Basin Plan SDL, water must be purchased from existing entitlement holders and applied to environmental needs. However, the Basin Plan includes a mechanism to adjust the SDLs (i.e. the SDL may be increased if there are supply measures available that achieve an equivalent environmental benefit with less water).

Central to the SDL adjustment mechanism is a requirement that the environmental benefit of a proposed offset measure must exceed that of the base case (benchmark) scenario to justify an offset. Environmental benefit can be assessed in terms of how well the proposed measure addresses the Basin Plan's priorities for environmental water use, including, among other things, delivering benefits to ecosystems that are rare, near-natural or unique; provide vital habitat; support threatened species or communities; and support significant biodiversity.

In early 2019, the VMFRP secured funding from the Commonwealth government to progress engagement with communities and the development of detailed designs and approvals for nine projects designed to deliver water to floodplain ecosystems to directly address environmental water needs. The nine projects to be delivered are, listed in upstream to downstream order: Gunbower, Guttrum and Benwell, Vinifera, Nyah, Burra Creek, Belsar-Yungera, Hattah Lakes North, Wallpolla Island and Lindsay Island. Together, these projects 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 the modification of existing infrastructure designed and operated to mimic the impact of natural flood events and improve the ecological condition of floodplain ecosystems.

Rationale

To support the Business Cases for the seven VMFRP projects located in the Mallee CMA region and to justify the SDL offset mechanism, an environmental benefits assessment was prepared by Ecological Associates (2014a) to describe the ecological character of the floodplain systems; set objectives for the use of water (hydrological targets) to promote ecosystem function and health; and describe the contribution of each of the proposed SDL offset projects to achieving the ecological objectives. A copy of the *SDL Floodplain Watering Projects: Rationale and Outcomes Report* (October 2014) prepared by Ecological Associates is available on request. Subsequent to this assessment, Mallee CMA (2014) interpolated and applied the ecological objectives and hydrological targets established by Ecological Associates (2014a) to extend the environmental benefits of the project into an additional water management area at Wallawalla East.

As a proposed SDL offset, the project aims to deliver the environmental objectives under the Murray-Darling Basin Plan, using less water, by installing infrastructure that enables inundation of the floodplain under lower river flow conditions than would be necessary to generate natural flooding of a similar extent. Modelling by Water Technology (2016) indicates that each of the draft operating scenarios (see **Table 6**) is able to operate and deliver water to the floodplain, at river flows as low as 5,000 ML/day compared to river flows of 40,000 ML/day to 120,000 ML/day required to generate similar natural flooding extents. As such, the project would enable environmental water to be delivered to floodplain vegetation communities with less dependence on high river flows, which builds a level of resilience into the Lindsay Island floodplain system that would be particularly beneficial during long dry periods and under current climate change scenarios.

Further discussion of the floodplain hydrology, water regime classes targeted for restoration and proposed inundation regime for the Lindsay Island project is provided below.

Modified floodplain hydrology

Lindsay Island is situated along a heavily regulated reach of the Murray River, being located between Lock 8 upstream and Lock 6 downstream, with Lock 7 located on the Murray River adjacent to Lindsay Island. These regulation structures strongly influence the current hydrology of Lindsay Island and have done so for almost 100 years. The following provides a timeline of key regulation works undertaken around Lindsay Island:

- Late 1920s – Lake Victoria, a naturally occurring shallow lake on the Murray River floodplain in NSW, started being used for regulation and storage to control flows into South Australia
- 1926 – Construction of Lock 9 (for navigational purposes)
- 1930 (circa) – Construction of Lock 6 and Murtho Weir
- 1934 – Construction of Lock 7 (Lake Victoria outlet influence)
- 1935 – Construction of Lock 8 (for navigational purposes).

Lake Victoria is a major balancing storage on the NSW side of the Murray River, which stores water diverted from the Murray River above Lock 9 and releases water to the river just downstream of Lock 7. Releases can be up to 9,000 ML/day and can create a significantly higher flow below Lock 7 than above, which can cause

inundation in the west of Lindsay Island (Ecological Associates, 2014a). Lake Victoria is located approximately 3.5 km north of Lock 7 and drains into the Murray River via Rufus River.

The lower reaches of the Lindsay River, within approximately 30 km upstream of Lock 6, are significantly influenced by the Lock 6 weir pool. The Lock 6 weir pool has a normal operating level of 19.25 mAHD resulting in a backwater effect extending beyond the confluence of Mullaroo Creek with the Lindsay River (Mallee CMA, 2014), including the location of the proposed Berribee Regulator. The weir pool ponds water in the channels in the west of the island, particularly affecting the western parts of Lindsay River, Toupnein Creek and lower Mullaroo Creek (Ecological Associates, 2014a).

Lock 7, located adjacent to Lindsay Island and two river kilometres downstream of the Mullaroo Creek inlet, is pivotal to the hydrology of the local area because it controls the flow into Mullaroo Creek and the eastern part of Lindsay Island upstream of the Lock 7, as well as providing the hydraulic conditions that enable Lake Victoria to drain into the Murray River by discharging directly downstream of Lock 7 through Rufus River (ARI, 2018). Lock 7 has a normal operating full supply level at Lock 7 of 22.1 mAHD, with a normal operating range between 21.9 – 22.2 mAHD, and a normal weir pool extending 29 km upstream to Lock 8 (ARI, 2018).

Murray River flows at Lindsay Island have been altered significantly by storages, regulation and diversions on both the Murray and Darling Rivers (Ecological Associates, 2014a). Regulation has reduced the occurrence of high flows and created extended periods of low flows, delayed the onset of floods and reduced the frequency and duration of floods (Ecological Associates, 2007; SKM, 2004). Regulation has also resulted in a significant change to winter and spring flows as these flows are now captured in upstream storages and gradually released over summer, resulting in a relatively continuous, year-round flow (Mallee CMA, 2014). The changes in hydrology of the Murray River has compromised the water regimes experienced by the floodplain water regime class targeted for restoration by the project.

These alterations to flow and flooding regimes are having significant impacts on biodiversity and ecosystem processes in the rivers, wetlands and floodplains of the River Red Gum Parks, as floodplains and wetlands require periodic inundation to maintain the health of water-dependent ecosystems, particularly in providing suitable habitat conditions (Parks Victoria, 2018). Water requirements for healthy ecosystems depend on the minimum flood frequency and duration rather than rainfall (VEAC 2008). Alterations to waterways and localised flows caused by weirs, levees, pumps and other water regulation infrastructure, together with climate change, have resulted in most rivers in the River Red Gum Parks management area now being in poor condition (Parks Victoria, 2018).

As part of the planning to mitigate the adverse effects of altered floodplain hydrology, a detailed analysis of the frequency, extent and duration of flows in the Murray River was undertaken by Gippel (2014) to compare the natural flow regime (pre-regulation) with current (baseline) conditions. This analysis shows that for current conditions (see **Figure 2**):

- The frequency of flood events associated with a river flow of 20,000 ML/day or more has significantly decreased from natural conditions
- The frequency of river flows of 10,000 ML/day has significantly increased from natural conditions
- The duration of flood events associated with river flows between 10,000 ML/day and 80,000 ML/day has decreased from natural conditions with minimal change to the duration of flood events above 80,000 ML/day
- The interval between flood events associated with river flows greater than 90,000 ML/day has significantly increased.

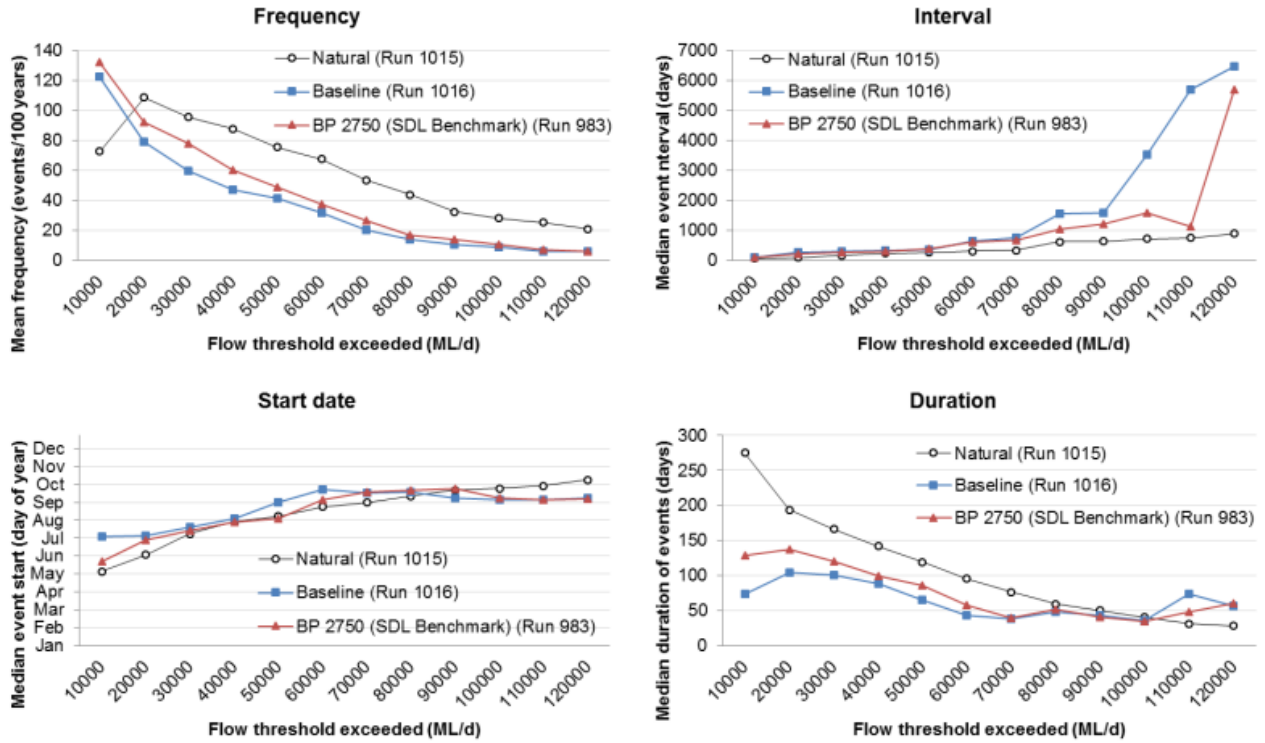

Figure 2: Comparison of frequency, interval, duration and start date at the SA Border of natural, baseline and Basin Plan 2750 (without measure) flow scenarios, over a 114-year model period[2]

Figure 2 also illustrates that although Basin Plan flows would contribute towards addressing current deficiencies in the environmental water requirements of the Lindsay Island floodplain compared to baseline conditions, the project is required to further bridge the gap between Basin Plan flows and the environmental water requirements of Lindsay Island floodplain.

Targeted water regime classes

As outlined in Section 3 (Aim/objectives of the project) of this referral, ecological objectives have been established to restore seven specific water regime classes on the Lindsay Island floodplain to address declining ecological condition caused by changes to natural flooding regimes and associated water deficiencies. The location of water regime classes as mapped at Lindsay Island by Mallee CMA (2014) is shown in **Figure 3**.

[2] Gippel, 2014.

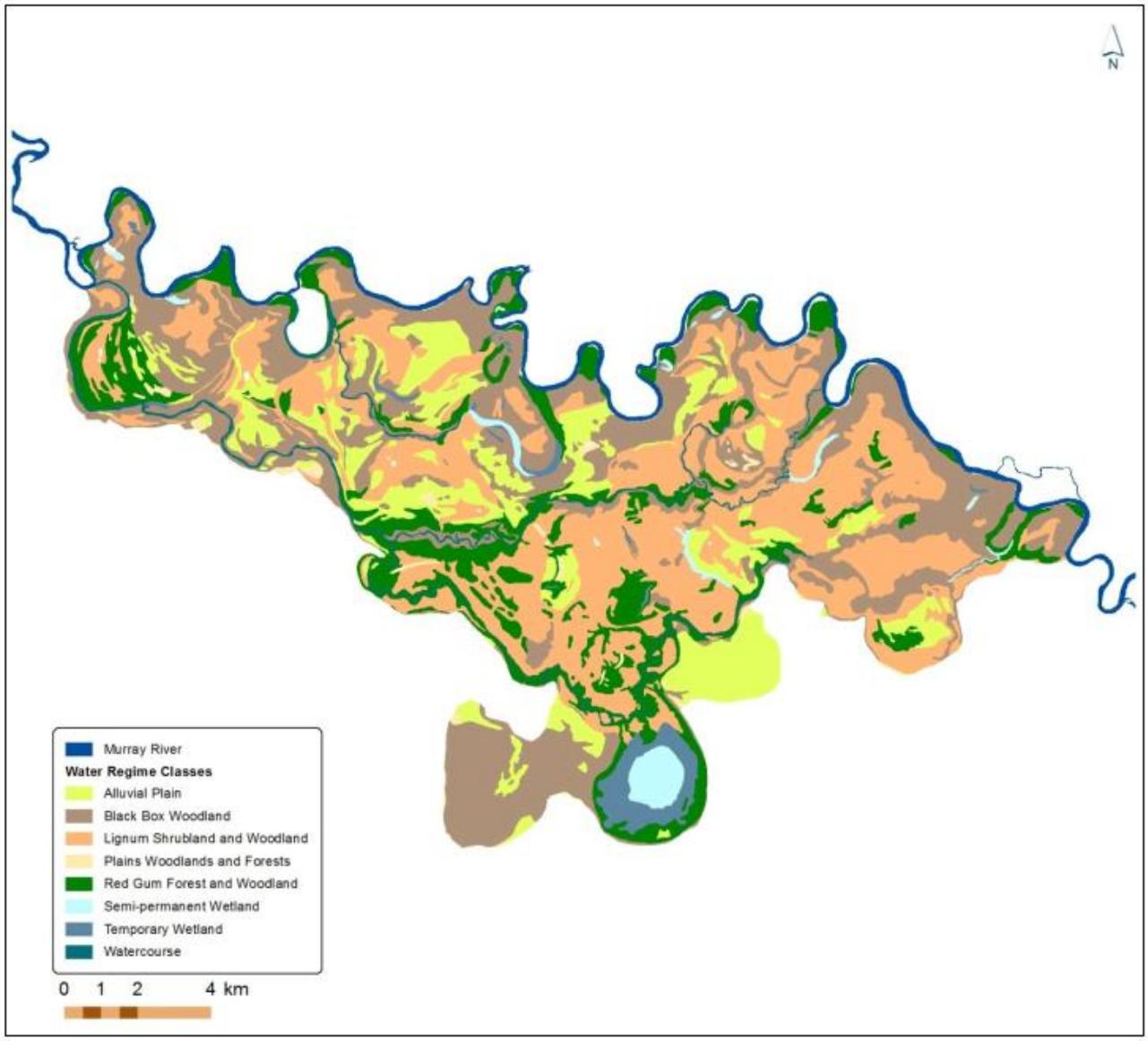

Figure 3: Location of water regime classes at Lindsay Island (Source: Mallee CMA, 2014)

A summary of EVCs modelled to occur in the proposed inundation area, and their associated water regime classes as defined by Ecological Associates (2014a) and Mallee CMA (2014), is provided in **Table 2**. Further description of EVCs within the proposed inundation areas is provided in **Attachment 3 – Flora and Fauna Assessment.**

Table 2: Summary of EVCs modelled within proposed inundation area and associated water regime classes

EVC name	Biodiversity conservation status	EVC area	Associated water regime classes[3]
EVC 97: Semi-arid Woodland[#]	Vulnerable	2.24	Plains Woodland and Forest
EVC 98: Semi-arid Chenopod Woodland[#]	Depleted	19.14	Plains Woodland and Forest
EVC 102: Low Chenopod Shrubland	Depleted	181.83	Alluvial Plain
EVC 103: Riverine Chenopod Woodland	Depleted	716.67	Black Box Woodland

[3] As identified by Ecological Associates (2014a) and/or Mallee CMA (2014).

EVC 104 Lignum Swamp	Vulnerable	163.80	Lignum Shrubland and Woodland
EVC 106: Grassy Riverine Forest	Depleted	5.72	Red Gum Forest and Woodland
EVC 107: Lake Bed Herbland	Vulnerable	197.50	Semi-permanent Wetlands
EVC 200: Shallow Freshwater Marsh	Vulnerable	19.34	Semi-permanent Wetlands Temporary Wetlands
EVC 806: Alluvial Plains Semi-arid Grassland	Vulnerable	656.80	Alluvial Plains
EVC 807: Disused Floodway Shrubby Herbland	Endangered	7.91	Temporary Wetlands
EVC 808: Lignum Shrubland	Least Concern	1,431.89	Semi-permanent Wetlands Lignum Shrubland and Woodland
EVC 810: Floodway Pond Herbland	Depleted	23.80	Semi-permanent Wetlands Temporary Wetlands
EVC 811: Grassy Riverine Forest/Floodway Pond Herbland Complex	Depleted	10.01	Red Gum Forest and Woodland
EVC 813: Intermittent Swampy Woodland	Depleted	814.72	Red Gum Forest and Woodland
EVC 818: Shrubby Riverine Woodland	Least Concern	237.36	Black Box Woodland
EVC 823: Lignum Swampy Woodland	Depleted	127.24	Lignum Shrubland and Woodland
EVC 993: Bare Rock/Ground	N/A	31.35	Watercourses Semi-permanent Wetlands
EVC 992: Water Body - Fresh	N/A	190.52	Watercourses
Area of unmapped EVC		270.22	
Total		**5,108.6**	

[#] Non-flood dependent EVCs.

As part of the flora and fauna assessments, targeted ground-truthing was undertaken in locations modelled as non-flood dependent EVCs (i.e. Semi-arid Woodland, Semi-arid Chenopod Woodland) or identified as unmapped in the modelled EVC layer (DELWP, 2019). Of the 270.22 ha identified as unmapped EVC, 261.68 ha was found to form part of the Murray River or nearby tributaries located in NSW and was deemed to constitute areas of waterbody. Only 8.52 ha of unmapped EVC was modelled to occur in areas containing vegetation in Victoria. These areas were ground-truthed, in addition to areas modelled as Semi-arid Woodland and Semi-arid Chenopod Woodland, and it was confirmed that no Semi-arid Woodland or Semi-arid Chenopod Woodland occurred in the inundation areas surveyed. Rather, the vegetation present in these areas was usually EVC 103 (Riverine Chenopod Woodland), EVC 808 (Lignum Shrubland) and occasionally EVC 806 (Alluvial Plains Semi-arid Grassland), which are located on alluvial terraces and are prone to flooding.

Proposed inundation regime

The project is proposed to deliver the operational flexibility and maximum design water levels identified, through the work by Ecological Associates (2007, 2014a), as required to satisfy the ecosystem water requirements of the EVCs / water regime classes targeted for restoration within the Lindsay Island

managed inundation area. The project proposes to inundate the Lindsay Island floodplain to varying levels across the six WMAs, replicating the extent of flooding that would occur at Murray River flows of between approximately 40,000 ML/day to greater than 120,000 ML/day (Mallee CMA, 2014).

Analysis presented in the Business Case (Mallee CMA, 2014), compares the frequency, interval and duration of flood events proposed for each water regime class targeted for restoration and used as the basis for developing the draft operating scenarios for the project ('proposed measure'), with flood events affecting these water regime classes under natural, baseline (current) and Basin Plan flows without the measure (i.e. the project) determined through modelling by Gippel (2014). This analysis shows that the proposed flood frequency, duration and timing of managed inundation events reflected in the draft operating scenarios (proposed measure) is more consistent with the natural (pre-regulation) flood frequency, duration and timing, see **Table 3**.

Table 3: Comparison of water regimes provided by natural, baseline, Basin Plan and the draft operating scenarios[4]

Threshold (ML/d)	Water Regime Class	Scenario	Frequency Mean (/100yrs)	Interval Median (days)	Duration Median (days)	Event Start Date Median (day of year, 1 Jan = 1)	Prevalence (% yrs with event)
30,000	Watercourse	With measure	95	245	120	244	95
		Natural	95.6	168	167	195	95
		Baseline	59.6	302	100	206	59
		Basin Plan 2750 without measure	78.1	270	121	200	76
40,000	Semi-permanent wetland	With measure	70	280	90	152	70
		Natural	87.7	237	142	215	89
		Baseline	47.4	338	88	221	48
		Basin Plan 2750 without measure	60.5	297	100	215	59
60,000	Temporary wetland	With measure	60	365	90	152	60
		Natural	67.5	305	95	241	72
		Baseline	31.6	631	43	272	39
		Basin Plan 2750 without measure	37.7	607	58	254	39
80,000	Red gum forest and woodland	With measure	40	670	60	244	40
		Natural	43.9	619	59	260	44

[4] Source: Mallee CMA (2014).

		Baseline	14	1557	48	267	31
		Basin Plan 2750 without measure	16.7	1030	51	270	50
80,000	Lignum shrubland and woodland	With measure	40	670	60	244	40
		Natural	43.9	619	59	260	44
		Baseline	14	1557	48	267	31
		Basin Plan 2750 without measure	16.7	1030	51	270	50
100,000	Black box woodland	With measure	30	850	60	152	30
		Natural	28.1	729	40	273	33
		Baseline	8.8	3532	35	253	27
		Basin Plan 2750 without measure	10.5	1592	34	257	29
120,000	Alluvial plains	With measure	20	1795	30	244	20
		Natural	21.1	888	28	288	25
		Baseline	6.1	6462	57	257	5
		Basin Plan 2750 without measure	6.1	5696	60	256	20

Main components of the project (nature, siting & approx. dimensions; attach A4/A3 plan(s) of site layout if available):

Status of project development

The project is designed to facilitate managed inundation across six water management areas (WMAs): Berribee WMA, Crankhandle WMA, Crankhandle West WMA, Lindsay South WMA, Wallawalla East WMA, and Wallawalla West WMA. Each WMA has a different target inundation water level and the areas are designed to cascade water to extend the inundation benefits by reusing water.

As described above, draft operating scenarios have been developed to more closely align the frequency, duration and timing of future flood events within the managed inundation area, with the natural (pre-regulation) frequency, duration and timing of flood events experienced by the targeted water regime classes within the managed inundation area. Draft operating scenarios are summarised in **Table 6** of the 'Key operational activities' section of this referral.

These draft operating scenarios and the project design would be subject to further assessment and refinement to further avoid and mitigate the potential impacts described in this referral. A summary of

further investigations or analysis proposed to be undertaken to inform refinements to the draft operating scenarios and project design, is provided in Section 20 of this referral.

Each of the main infrastructure components described below are contained within the current proposed construction footprint, which in conjunction with the proposed inundation area, has provided the primary basis for assessing potential impacts described in this referral. The design and location of some of these main infrastructure components may change as the design is refined to further avoid and mitigate potential impacts on environmental and heritage values during construction and operation of the project. Where a likely need for refinement of the main infrastructure components and associated construction footprint has already been identified, the general nature of proposed refinements has been described in the 'Brief description of key alternatives to be further investigated' section of this referral. The extent of the proposed inundation area described in this referral is indicative and may be subject to change in relation to the upstream extremities or boundaries.

Maps showing a summary of works as described in this section are provided in **Attachment 1 – Project Overview Maps**, along with maps of the inundation area and depth, access plans and water movement maps.

Berribee WMA

The Berribee WMA has a design water level of 23.2 mAHD and an inundation area of approximately 3,507 (Victoria) and 263 ha (NSW). The primary component of the project is a large regulator (BERR_A or Berribee Regulator) to be installed on the Lindsay River about 150 m downstream of Berribee Homestead and 5 km downstream of the confluence of Mullaroo Creek and the Lindsay River. Design of the Berribee Regulator includes provision for:

- Five, 2.0 m wide combination gate bays to allow a passing flow of 1000 ML/day during managed watering events in accordance with fish passage recommendations by ARI (2018)
- Seven, 4.9 m wide stoplog bays to provide flow capacity outside of managed watering events, including one bay to specifically enable navigable traffic (passing small boats (less than 3.5 m wide), kayaks and canoes)
- A single Category 1 Vertical Slot Fishway in the south abutment (upper slot 100W x 500H; central blockout 300H, bottom slot 350W x 700H) in accordance with fish passage recommendations by ARI (2018)
- A new access track and single lane bridge deck for vehicle access across the regulator
- Steel rail beams for movement of the rail-mounted excavator required to remove and install stop logs as required
- A 56 m long concrete hardstand for stoplog storage on the northern bank
- A secure, 50 m x 50 m compound on the northern bank for storage and operation / maintenance laydown (this permanent storage would be located on land used for construction laydown to avoid additional disturbance)
- Containment banks either side of the regulator.

The Berribee Regulator is considered as a dam that must comply with ANCOLD (Australian National Committee on Large Dams) guidelines. The structure would be designed and operated in accordance with applicable dam safety guidelines.

In addition to the Berribee Regulator, six structures are proposed around the northern perimeter of the Berribee WMA to retain water within the WMA as the proposed inundation level is higher than the Murray River downstream of Lock 7, Toupnein Creek and the Crankhandle floodplain at these locations. Proposed structures include:

- BERR_B and BERR_C – regulators in these containment banks control movement into floodrunners discharging to the Crankhandle and Crankhandle West WMAs. BERR_B containment bank is 100 m

long with a maximum height of 1.4 m and incorporates one 20 m spillway. BERR_C containment bank is 190 m long with a maximum height of 0.9 m and incorporates a 27 m spillway.

- BERR_D – is a 2.2 km long containment bank located along an existing track on the southern bank of Toupnein Creek that is designed to prevent retained environmental floodwaters from breaking into Toupnein Creek. The containment bank has a maximum height of 2.4 m, and incorporates three, 20 m long spillways and passing bays at approx. 250 m intervals. A small regulator is located on a floodrunner to convey flood flows.
- BERR_E and BERR_F – are containment banks designed to control flow in floodrunners flowing towards the Murray River below Lock 7, conveying flood flows and enabling drawdown of managed inundation events. BERR_E containment bank is 90 m long with a maximum height of 0.8 m and a 27 m long spillway, incorporates a small regulator and is located on an existing track. BERR_F containment bank is 120 m long with a maximum height of 2.7 m and a 10 m long spillway, incorporates a large regulator and is located on an existing track.
- BERR_G – is a 90 m long containment bank with a maximum height of 0.8 m that incorporates an un-gated culvert designed to enable operational access across a waterway on the Sandford Track, while allowing environmental water to enter the short arm of the creek to the west and allowing natural flood flows to pass.

Crankhandle WMA

The Crankhandle WMA comprises two tiers, with the upper tier having a design water level of 22.6 mAHD and an inundation area of approximately 299 ha and the lower tier having a design water level of 21.6 mAHD and an inundation area of approximately 17 ha. Managed inundation of the Crankhandle WMA is achieved via gravity releases from the Berribee WMA via Regulator BERR_B and requires inflows to the Berribee WMA to be sufficient to fill the Crankhandle WMA while also maintaining the inundation level in the Berribee WMA.

Nine structures are proposed around the perimeter of the Crankhandle WMA to retain water within the upper and lower tiers of the WMA, and a channel to improve connectivity to the Crankhandle West WMA. Proposed structures include:

- CR_A – a single containment bank (240 m long, maximum height 2.7 m, one 20 m long spillway) and large regulator structure to control flows that discharge into the Lindsay River.
- CR_B, CR_C and CR_D – three containment bank and regulator structures located on the northern perimeter of the WMA to control flows that interact with the Murray River:
    - CR_B containment bank (110 m long, maximum height 1.6 m, one 20 m long spillway) incorporates a small regulator
    - CR_C containment bank (250 m long, maximum height 1.4 m, one 20 m long spillway) incorporates a small regulator
    - CR_D containment bank (220 m long, maximum height 1.2 m, one 20 m long spillway) incorporates a small regulator. As CR_D is located close to the Murray River, a drop structure has been incorporated downstream to minimise erosion. The drop structure extends down the river bank to below the normal operating water level of Lock 6 (19.25 mAHD) and extends into NSW (Note: Further investigations are being undertaken to determine whether this drop structure is necessary or whether drawdown via CR_A (which discharges into the Lindsay River) provides adequate operational flexibility for the project).
- CR_E – a containment bank (360 m long, maximum height 1.5 m, one 20 m long spillway, passing bays at approx. 250 m intervals) and small regulator structure to control flows discharging to the lower tier.

- CR_F – a small containment bank (25 m long, maximum height 0.9 m, one 20 m long spillway) and small regulator structure at the downstream end of the channel (CR_G) to regulate flows being transferred to the Crankhandle West WMA.
- CR_G – a channel (15 m wide bed width, 1V:3H batters) to provide a more hydraulically efficient connection into the Crankhandle West WMA by lowering a saddle point separating Crankhandle from Crankhandle West to enable a flow of up to 50 ML/day.
- CR_H – a small containment bank (25 m long, maximum height 0.8 m, no spillway) to provide access to the CR_A structure.
- CR_I – a small spillway (20 m long, maximum height 0.3 m) to provide continuity of access to the north east of the Crankhandle wetland complex.

Crankhandle West WMA

The Crankhandle West WMA comprises two tiers, with the upper tier having a design water level of 22.2 mAHD and an inundation area of approximately 23 ha, and the lower tier having a design water level of 21.7 mAHD and an inundation area of approximately 72 ha. Managed inundation of the Crankhandle West WMA is achieved via gravity releases from the Crankhandle WMA via Regulator CR_F, and requires inflows to the Berribee WMA to be sufficient to fill the Crankhandle West WMA, while also maintaining the inundation level in the Crankhandle WMA and Berribee WMA.

Four structures are proposed around the perimeter of the Crankhandle West WMA to retain water within the upper and lower tiers of the WMA, and a channel is proposed to improve connectivity from the upper tier to the lower tier. Proposed structures include:

- CW_A – a containment bank (300 m long, maximum height 2.6 m, one 20 m long spillway, a short secondary containment bank to block a breakout) and small regulator structure located at the point where the lower tier discharges back into the Lindsay River via a proposed drop structure.
- CW_B1 – a containment bank (140 m long, maximum height 2.7 m, one 20 m long spillway) and large regulator located where natural flood flows either return to the Lindsay River or continue along the Crankhandle West complex, designed to either retain water at the design water level for the upper tier or allow flows to pass into either the lower tier or the Lindsay River via a proposed drop structure.
- CW_B2 – a containment bank (40 m long, maximum height 1.0 m, no spillway) and small regulator structure to regulate flows to the lower tier.
- CW_C – a small containment bank (25 m long) incorporating a short spillway (14 m long) located across a small breakaway to enable water to be retained at the design water level.
- CW_D – seven sections of channel (combined length 1.4 km, 5 m wide, average depth 250 mm, maximum depth 600 mm) to improve hydraulic efficiency through to the lower tier by lowering the invert of high points along the existing flow path to allow the design flow of 30 ML/day.

Lindsay South WMA

The Lindsay South WMA has a design water level of 24.4 mAHD and an inundation area of approximately 140 ha. Managed inundation of this WMA is achieved via pumping from the Lindsay South Creek at LS_C.

Three structures are proposed around the northern perimeter of the Lindsay South WMA to retain water within the WMA as the design water level (24.4 m AHD) is higher than the level of the Lindsay South Creek (23.2 m AHD – based on maximum Berribee WMA design water level) at these locations. Proposed works include:

- LS_A1 and LS_A2 – two containment banks (combined length 900 m, maximum height 1.6m, two 20 m long spillways, passing bays at approx. 250 m intervals) and small regulator located along the southern bank of the Lindsay South Creek to retain water at the design water level, convey flood flows and release managed floodwaters to the Lindsay South Creek on completion of a managed inundation

event (Note: Further investigations are being undertaken to determine whether additional erosion protection is required at this managed release location).

- LS_B – a containment bank (40 m long, maximum height 1.0 m, no spillway) and small regulator located on a small floodrunner to retain water at the design water level and convey flood flows. The regulator would also be used to convey pumped water from the Lindsay South Creek into the Lindsay South WMA during a managed event.
- LS_C – a pump hardstand (6 m x 6 m crushed rock pad) located adjacent to an existing track near LS_B to enable setup of temporary pumps to pump from the Lindsay South Creek into the Lindsay South WMA.

Wallawalla East WMA

The Wallawalla East WMA has a design water level of 25.2 mAHD and an inundation area of approximately 164 ha. Managed inundation of this WMA is achieved via pumping from the Lindsay River at WE_D. Four structures are proposed around the western and northern perimeter of the Wallawalla East WMA to retain water within the WMA as the design water level (25.2 mAHD) is higher than the Lindsay River (23.2 mAHD – based on maximum Berribee WMA design water level) at these locations. Proposed works include:

- WE_A – a containment bank (270 m long, maximum height 1.0 m, one 20 m spillway) and small regulator located on a small waterway that is the natural outlet for the wetland area, designed to retain water at the design water level, convey flood flows and release managed floodwaters to the Lindsay River on completion of a managed inundation event.
- WE_B – a containment bank (460 m long, maximum height 0.8 m, one 20 m spillway, passing bays at approx. 250 m intervals) required to prevent breakout flows back to the Lindsay River.
- WE_C – a containment bank (250 m long, maximum height 0.7 m, one 20 m spillway) required to prevent breakout flows back to the Lindsay River.
- WE_D – a pump hardstand (6 m x 6 m crushed rock pad) located adjacent to an existing track to enable setup of temporary pumps to pump from the Lindsay River into the Wallawalla East WMA. A single box culvert would also be installed across the existing track to convey pumped water into the WMA during a managed event.

Wallawalla West WMA

The Wallawalla West WMA has a design water level of 24.7 mAHD and an inundation area of approximately 623 ha. Managed inundation of this WMA is achieved via pumping from Lake Wallawalla via WW_B. Proposed works include:

- WW_A – a containment bank (800 m long, maximum height 2.0 m, one 20 m spillway, passing bays at approx. 250 m intervals) located partly along an existing access track before deviating off track to avoid significant vegetation and cultural heritage on the track alignment. Designed to hold water at the design water level for the WMA, which is higher than the level of Lake Wallawalla (23.2 m AHD) to the east.
- WW_A1 – a small regulator located within the WW_A containment bank on a waterway that is the natural outlet for the WMA area.
- WW_A2 – a small regulator located within the WW_A containment bank that is designed to convey pumped water from the WW_B pump infrastructure into the WMA during a managed event.
- WW_B – pump infrastructure at this site includes a pump hardstand (6 m x 6 m crushed rock pad) located adjacent to an existing access track near Regulator WW_A2, and a permanent sub-surface inlet pipeline extending from Lake Wallawalla, including an inlet sump. An access track may also be required along the pipeline alignment for maintenance of the inlet sump.

Regulator design

The following design philosophy for regulators has been applied:

- The regulating structures are designed to allow natural flows to pass unhindered, to and from the floodplain when the structures are not in use (fully open)
- The arrangement of regulating structures and containment banks have been developed to minimise the potential for erosion over the whole range of flow conditions
- The regulating structures would be designed to provide safe downstream fish passage in accordance with the fish passage recommendations (ARI, 2018).

A summary of design specifications for the proposed regulators is provided in **Table 4**.

Table 4: Summary of regulator design specifications

WMA	Regulator	Open / close / regulate flow	Proposed design (width (W) by height (H) in mm)	Proposed gates
Berribee	BERR_A	Regulate	Seven 4900W x 7600H Stoplog Bays, Five 2000W x 7600H Combination Gate Bays, Fishway Entrance	Dual-leaf combination gates on five bays nearest to fishway, and stoplogs on remaining seven bays. One stoplog bay to enable navigation to small recreational watercraft.
	BERR_B	Regulate	Two 1200W x 1200H Culverts	1200W x 1350H Penstock gates on the upstream headwall. Used to transfer water from Berribee WMA to Crankhandle WMA (Upper Tier).
	BERR_C	Regulate	Six 1200W x 600H Culverts	1200W x 750H Penstock gates on the upstream headwall.
	BERR_D	Open / Close	Three 1800W x 1800H Culverts	1800W x 2000H Penstock gates on the upstream headwall
	BERR_E	Open / Close	Two 1200W x 600H Culverts	1200W x 750H Penstock gates on the upstream headwall
	BERR_F	Open / Close	One 2000W x 3100H Bay	2000W x 2800H dual leaf gate on the upstream headwall
	BERR_G	Open	One 1200W x 1200H Culverts	No gates
Crankhandle	CR_A	Open / Close	Two 2000W x 3300H Bays	2000W x 3000H dual leaf gates on the upstream headwall. Potential use to drain Crankhandle (Upper Tier) WMA to Lindsay River.
	CR_B	Open / Close	Two 1200W x 1200H Culverts	1200W x 1350H Penstock gates on the upstream headwall.
	CR_C	Open / Close	Two 1200W x 1200H Culverts	1200W x 1350H Penstock gates on the upstream headwall.
	CR_D	Open / Close	Two 1200W x 900H Culverts	1200W x 1050H Penstock gates on the upstream headwall. Potential use to drain Crankhandle (Upper Tier) WMA to Murray River.
	CR_E	Open / Close	Two 1200W x 1200H Culverts	1200W x 1350H Penstock gates on the upstream headwall. Used to transfer water

				from Crankhandle WMA Upper Tier to Lower Tier.
	CR_F	Open / Close	Three 1200W x 900H Culverts	1200W x 1050H Penstock gates on the upstream headwall. Used to transfer water from Crankhandle WMA to Crankhandle West WMA
Crankhandle West	CW_A	Open / Close	One 1800W x 1800H Culverts	1800W x 2000H Penstock gates on the upstream headwall. Used to drain Crankhandle West (Lower Tier) WMA to Lindsay River.
	CW_B1	Open / Close	One 2000W x 3200H Bays	2000W x 2800H dual leaf gates on the upstream headwall. Used to drain Crankhandle West (Upper Tier) WMA to Lindsay River.
	CW_B2	Open / Close	Two 1200W x 600H Culverts	1200W x 800H Penstock gates on the upstream headwall. Used to transfer water from Crankhandle West WMA Upper Tier to Lower Tier.
Lindsay South	LS_A	Open / Close	Four 1200W x 1200H Culverts	1200W x 1350H Penstock gates on the upstream headwall. Used to drain Lindsay South WMA to Lindsay South Creek.
	LS_B	Open / Close	Two 1200W x 1200H Culverts	1200W x 1350H gates on the downstream headwall, with a customised connection for pumping operations.
Wallawalla East	WE_A	Open / Close	Six 1200W x 900H Culverts	1200W x 1050H Penstock gates on the upstream headwall. Used to drain Wallawalla East WMA to Lindsay River.
Wallawalla West	WW_A1	Open / Close	Four 1800W x 1800H Culverts	1800W x 2000H Penstock gates on the upstream headwall. Used to drain Wallawalla West WMA to Lake Wallawalla.
	WW_A2	Open / Close	One 1200W x 1200H Culverts	1200W x 1350H gates on the downstream headwall, with customised connection for pumping operations.

Pumping infrastructure

Proposed pump infrastructure includes three pump hardstand areas with associated regulators to convey pumped flows into the Lindsay South WMA, Wallawalla East WMA and the Wallawalla West WMA. The pump hardstand areas would enable the setup of temporary pumps to deliver environmental water into these WMAs when required. Temporary pumps would include a trailer-mounted diesel pump rig with a temporary delivery pipeline, and in the case of the Lindsay South WMA and Wallawalla East WMA, temporary suction pipelines. A permanent suction pipeline would be installed from Lake Wallawalla as part of proposed works at the Wallawalla West WMA.

The frequency and duration of pumping would depend on actual inundation events and the method to achieve environmental watering targets. However, a summary of estimated pumping volumes, duration and frequency based on current draft operating scenarios is provided in the 'Key operational activities' section of this referral.

Fish passage

The project includes provision for fish passage through regulator bays, across the spillways, and across the containment banks and natural ground when submerged.

The Berribee Regulator provides fish passage via a vertical slot fishway in the south abutment. The proposed fishway is designed to provide for upstream and downstream passage of small, medium and large fish (30-1400 mm long), along with eggs and larvae, during all hydrological scenarios. The Berribee Regulator design also maintains a 1,000 ML/day passing flow to provide suitable attraction for fish towards the fishway. A review of the Berribee Regulator design by ARI (2018) determined that the included design features satisfied key fish passage requirements for this location.

The design of all other regulators allows for passive fish passage directly through the regulator structure, but no specific fish passage structures. Medium to small regulator structures would be operated either in fully open or fully closed position. When water is released with the regulator gate in fully open position, fish have passage through the regulator both in managed release and natural flood scenarios. Structures have been designed to have flow velocities appropriate for fish passage. During watering events, fish would be able to move across all submerged areas.

Structures to be decommissioned

No redundant structures have been identified as requiring removal or decommissioning.

Ancillary components of the project (e.g. upgraded access roads, new high-pressure gas pipeline; off-site resource processing):

Boat ramps

To facilitate construction of the Berribee Regulator, an existing boat ramp on the southern bank of the Lindsay River downstream of the proposed regulator is proposed to be upgraded for use during construction and retained for public use following construction. Temporary barge launch/landing facilities would also be required on the northern and southern bank of the Lindsay River, most likely on the downstream side. The exact location of these facilities is yet to be confirmed but are intended to be located in existing disturbed areas within the area of investigation.

Access tracks and road upgrades

Access to the project area would be via a number of Parks Victoria managed tracks off Old Mail Road and across Lindsay Island. The Berribee Homestead Track would provide the main access to the Berribee Regulator construction area and would require Type 4 upgrading (see **Table 5**) to allow it to be accessible under all weather conditions. Prior to construction of the Berribee Regulator, Lindsay Bridge (also called Army Bridge), Bridge and Sandford Tracks would provide the main access to construction areas on Lindsay Island. Where required, Bridge and Sandford Track would be upgraded to a Type 4 track to allow access under all weather conditions. A temporary bridge may need to be installed across the Little Mullaroo Creek, which would be removed on completion of construction.

On completion of construction of the Berribee Regulator, access across the Lindsay River via the regulator would be restricted to the public.

The proposed access arrangements for construction and operation of the project are illustrated in the access plans contained in **Attachment 1 – Project Overview Maps** and would involve use of approximately 82 km of existing access tracks and construction of approximately 5 km of new track sections where indicated on the access plans. Typical requirements for works along the identified access tracks based on their purpose as shown on the access plans, are summarised in **Table 5**.

The area of investigation provides for a 20 m wide corridor along proposed access tracks for the purpose of desktop investigations, while the construction footprint provides for a 5 m wide corridor along the proposed access tracks. Provision for the location of standard passing bays would be required along some sections of access tracks. Some refinement of access track locations and extent of required access track works may be

required based on the outcomes of geotechnical investigations, cultural heritage assessment and ecological ground-truthing investigations. Where practicable, preference would be given to locating passing bays and track changes in existing disturbed areas and / or other locations to avoid or minimise impacts to environment and heritage values.

Table 5: Summary of access track purpose and indicative works requirements

Type	Purpose	Track / road	Length	Upgrade type	Requirements
1	Operational/maintenance/light construction - dry weather	Track	4.5 km (new) 31.9 km (existing)	Nil	Maintenance of an existing track to provide for construction or operational vehicles Establishment of unformed access for operational vehicles
2	Operational/maintenance/light construction through low lying areas - dry weather	Track	0.5 km (new) 18.5 km (existing)	Moderate	Regrading to create cross fall and match to existing longitudinal drainage with 50mm wearing course
3	Construction vehicle - dry weather	Track	N/A	Substantial	Regrading to create cross fall and match to existing longitudinal drainage with 200mm wearing course
4	Heavy construction vehicle - wet weather Operational/maintenance - wet weather	Track	32.5 km (existing)	All weather	Construction of new pavement with 150mm base course and 200mm wearing course
5	Public – dry weather Operational/maintenance – dry weather	Road	N/A	Minor	Regrading to create cross fall and match to existing longitudinal drainage
6	Public – wet weather Operational/maintenance – wet weather	Road	N/A	Substantial	Raising road elevation and reinstatement of road pavement in accordance with relevant authority standards

The project would use Old Mail Road for access during construction and operation. Old Mail Road is a dry weather unsealed road typically maintained in fair condition and managed by the Mildura Rural City Council. The road is currently inaccessible in very wet conditions. Old Mail Road crosses the entrance to Lake Wallawalla via a causeway having an approximate length of 1.8 km. The length of the causeway is unsealed (except for a short, sealed section at the western end which is designed as a spillway) and has a design surface of approximately 100 mm above the proposed inundation level in Lake Wallawalla. Further investigations are being undertaken to determine whether upgrades to the Wallawalla Causeway and Old Mail Road are required. The nature and extent of any upgrade requirement is dependent on the refinements to operating scenarios that are being further investigated as described elsewhere in this referral. The Wallawalla Causeway and Old Mail Road are not included in the current construction footprint (or area of investigation) for the project.

Power supply

No new power supply connections are required to facilitate operation of the project. Regulator structures would be operated manually and / or using truck-mounted hydraulic lifting equipment as required. Temporary pump infrastructure would be powered by self-bunded generators and diesel fuel storage imported to the site. The potential to use solar power to support any water level or other monitoring requirements is also currently being investigated.

Key construction activities:

General construction activities

General construction activities would include:

- Establishment of construction sites, including removal of vegetation, stripping and stockpiling of topsoil, establishing temporary laydown and access routes
- Construction / installation of new structures, including sheet-piling to install seepage cut-offs at the four large regulators (BERR_A) (Berribee Regulator), BERR_F, CR_A and CW_B1).

Construction would involve use of vehicles and machinery such as trucks, excavators, piling rigs, compaction plant, water carts, cranes and access equipment.

Importation of construction materials, including regulators and imported soils, would comply with Parks Victoria consent under Section 27 of the *National Parks Act 1975* and the future *Environment Protection Act 2017* (this was due to commence on 1 July 2020 but has been postponed until 1 July 2021 (or earlier by proclamation) due to the COVID-19 emergency.

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

Specific construction activities

Construction in the Lindsay River

Works within the bed and banks of the Lindsay River would be required for construction of the Berribee Regulator and proposed drop structures at Regulator CW_A and Regulator CW_B1.

The Berribee Regulator would extend across the full width of the Lindsay River. Berribee Regulator would require watercraft (such as a barge and boats) within the Lindsay River, together with concrete pumps and other specialised equipment to enable the construction of this very large structure.

The water level in the Lindsay River at the Berribee Regulator is set by the Lock 6 weir pool which is typically 19.25 mAHD. Design of the Berribee Regulator incorporates a permanent cut-off extending to 6 m below the structure foundation and approximately 16 m laterally past the end of the structure to provide seepage control and protection against piping and heave. These permanent cut-offs installed in the Lindsay River at Berribee Regulator would be constructed by sheet piling using barges and would function as cofferdams during construction of the regulator to enable dewatering of the work areas. It is proposed that the Berribee Regulator would be constructed in two parts so that part of the width of the Lindsay River would provide for passing flows and fish passage throughout construction of the regulator.

Dewatering of work areas, particularly for deeper excavations in the Lindsay River, is likely to necessitate the disposal of highly saline groundwater. Methods for managing the disposal of saline groundwater require further investigation (see Section 20). Construction of the Berribee Regulator is expected to occur over a period of 18-24 months and would likely require weekend and potentially night time works to complete within the required program.

The drop structures at Regulator CW_A and Regulator CW_B1 would extend down the river bank to below the normal operating water level (i.e. about 19.25 mAHD). Construction of these drop structures would involve excavating to 0.3 m deep so that the finished surface of the rock mattress is flush with the natural surface/bed. Lengths of 6 m x 2 m mattress would be fabricated on the bank, complete with geotextile and lifting points. These mattress lengths would then be lifted into place with a purpose-built lifting frame. Temporary cofferdams would likely be temporarily installed in the Lindsay River to allow the drop structure work sites to be pumped dry prior to construction. The temporary cofferdams would only extend into the Lindsay River as far as necessary to safely and efficiently construct the works. The temporary cofferdams

would not extend across the full width of the river and would therefore allow passing flows and fish passage to be maintained while works are being undertaken.

Construction in the Murray River

Works within the bed and banks of the Murray River would be required for construction of the drop structure at Regulator CR_D (if required), which would extend down the river bank to below the normal operating water level. Construction of the drop structure would involve excavating to 0.3 m deep so that the finished surface of the rock mattress is flush with the natural surface/bed. Lengths of 6 m x 2 m mattress would be fabricated on the bank, complete with geotextile and lifting points.

A temporary cofferdam would likely be installed in the Murray River to allow the work site to be pumped dry prior to construction. The temporary cofferdam would only extend into the Murray River as far as necessary to safely and efficiently construct the works. The cofferdam would not extend across the full width of the river and would therefore allow passing flows and fish passage to be maintained while works are being undertaken.

Cofferdams and dewatering

In addition to the temporary cofferdams required for construction works in the Lindsay River and Murray River, temporary cofferdams may also be required at a number of other sites along flow paths where necessary to prevent inundation of the work sites during rainfall or flood flows. Details of the type, location and extent of required cofferdams have not yet been determined but may include sheet piles and earthen embankments. Dewatering of work areas, particularly for deeper excavations, is likely to necessitate the disposal of highly saline groundwater.

Construction laydown areas

The proposed construction footprint includes a working area (approx. 10-20 m) around the development footprint for proposed infrastructure to accommodate movement of vehicles and machinery and some limited storage of equipment and materials.

Three large construction laydown areas are included in the current construction footprint near the Berribee Regulator, two on the southern side of the Lindsay River (including one at the Berribee Homestead) and one on the northern side of the Lindsay River (to be converted into the permanent storage compound). Following further investigations after defining the current construction footprint, it is considered unlikely that the project would use the area around Berribee Homestead for construction laydown or other construction purposes. However, potential impacts associated with construction laydown in this area are described in this referral for completeness. The two remaining sites identified near the Berribee Regulator would provide the primary location for site offices, vehicle parking, storage of equipment and materials, etc.

Additional smaller construction laydown areas are likely to be required at other work sites, particularly given the travel distances between many work sites and the primary work site at Berribee Regulator. Where practicable, these additional construction laydown areas would be located within the current construction footprint, however it is possible some additional area would be required for these activities outside the current construction footprint at some locations. Where this is necessary, preference would be given to locations in existing disturbed areas or other areas that avoid or minimise environmental and heritage impacts.

Temporary pump stations – construction water supply

Temporary pump stations are expected to be required at a number of locations to supply water for construction purposes including: dust suppression, moisture conditioning of embankment material, inclusion in any site concrete works, washdown of concrete trucks / equipment, and amenities.

VMFRP is in the process of confirming the need and identifying possible temporary pump station sites, with the objective of selecting locations as close as possible to the proposed construction areas, while also avoiding and minimising environmental and heritage impacts. The preferred pump sites would be based at locations immediately adjacent to proposed structures or at existing disturbed sites (such as Mullaroo and

Webster's Lagoon regulators). Where practicable, temporary pump station sites would be located within the current construction footprint.

Borrow pits / quarry sites

Construction of the project would require the import of material (clay for banks and rock for roads/tracks). Preliminary estimates indicate that approximately 95,000 cubic metres of clay fill and 7,000 cubic metres of rock fill may be required for construction of the project. VMFRP is in the process of identifying possible borrow pits to acquire clay fill material, with the objective of selecting locations on private land as close as possible to the project, while also avoiding and minimising impacts. Rock beaching for erosion protection would be sourced from existing commercial quarries.

As the location of quarry/borrow sites is yet to be confirmed, potential impacts associated with these activities have not yet been assessed nor approval triggers identified, and quarry/borrow sites are not included in the current construction footprint.

Concrete batching

Commercially sourced concrete for construction of the proposed works would be transported to the project area with no requirement for on-site concrete batching facilities.

Post-construction rehabilitation

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

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

Details of proposed rehabilitation would be included in the CEMP.

Key operational activities:

Inundation of the proposed water management areas requires the coordinated operation of the Lock 7 weir pool and the proposed Berribee Regulator. To achieve the maximum design water level (DWL) of 23.2 mAHD at Berribee WMA, the Lock 7 weir pool would need to be raised by up to 1.1 m above the normal operating level of 22.1 mAHD to provide the necessary driving head of water. All other WMAs are filled from the inundation area of the Berribee WMA either by gravity release (Crankhandle, Crankhandle West) or pumping (Lindsay South, Wallawalla East, Wallawalla West). An overview of operating activities in each WMA areas is provided in the following sections, with the draft operating scenarios presented in **Table 6**.

Lock 7 and NSW Inundation

Based on the draft operating scenarios, the water level at Lock 7 is proposed to be raised up to 23.2 mAHD about 3 years in each 10 year period (Berribee Maximum Scenario). In addition, under the Berribee Intermediate Scenario, Lock 7 is proposed to be raised above the normal level of 22.1 mAHD and potentially up to 23.1 mAHD in an additional 4 years in each 10 year period, with the actual water level required for each Berribee Intermediate event to be determined based on which water regime classes are being targeted by the watering event and the ecological outcomes to be achieved.

Raising the Lock 7 weir pool to a level of 23.2 mAHD would result in an inundation area of approximately 263 ha within NSW. This would include approximately 202 ha of inundation area within the Murray River extending to just upstream of Lindsay South Creek, and approximately 61 ha of inundation area within the Lock 7 Billabong, Horseshoe Billabong and a section of an anabranch on the northern side of the Murray River in NSW. For comparison, the proposed operating level of 23.2 mAHD at Lock 7 is 3.1 m lower than

the significant flood event of 1956 (26.3 mAHD), which is generally regarded as a 1 in 100 year event in this region, and 1.8 m lower than the most recent large flood event in 2016 (25.0 mAHD) (ARI, 2018).

During 2013/14, SA Water (as the operator of Lock 7) commissioned a stability review of Locks 1 to 10, which confirmed that the weir at Lock 7 had adequate factors of safety against sliding and overturning with the upstream weir pool at top of pier level, with a range of tail water depths (SA Water, 2014). It is understood that SA Water is currently undertaking a further assessment of potential impacts on the Lock 7 structure under various water levels as part of its periodic reviews, however the findings of this assessment are not yet available. VMFRP is consulting with SA Water in relation to this assessment.

VMFRP would consult with MDBA to identify the nature and extent of investigations required to determine potential operational impacts on the Lock 7 fishway, Lock 7 operations, and inundated land within NSW. As investigations are yet to be undertaken, the potential effects associated with operation of Lock 7 to facilitate the project are not assessed in detail in this referral. The further investigations proposed are summarised in Section 20 of this referral.

Berribee WMA

During filling, all structures bounding the Berribee WMA would be closed. During natural floods, the gates on all Berribee structures would be open, but may be closed at the flood peak to retain water on the floodplain, and possibly provide water for filling (or partially filling) surrounding WMAs depending on ecological objectives. Drawdown following a managed event commences with opening the Berribee Regulator or Lock 7, followed by progressively opening remaining structures to drain remaining floodplain water. For ecological objectives and to reduce scouring, the rate of drawdown would be managed to a range of 0.03 to 0.06 m/day within the upstream pool (R8, 2020a).

The following operating conditions apply to the Berribee WMA:

- DWL – 23.2 mAHD
- Inundation area – 3,507 ha (Victoria), 263 ha (NSW)
- Estimated volume of water required to fill to DWL – 35.3 GL, not including losses (Mallee CMA, 2014)
- Passing flow of 1000 ML/day through Berribee Regulator
- Inundation flow equivalence – 40,000 to 90,000 ML/day (Water Technology, 2014).

On Berribee WMA drawdown and in accordance with ecological outcomes, the two regulators on Lake Wallawalla would be closed to enable the lake to be operated separately from Berribee WMA.

Crankhandle WMA

The Crankhandle WMA would be filled by controlled releases from the Berribee WMA via Regulator BERR_B. During filling, the structures around the Crankhandle WMA would be closed, with inflows continuing for the planned watering duration to maintain the inundation at the target level. Inflows to the Berribee WMA would need to be sufficient to fill the Crankhandle WMA, as well as to maintain the inundation level in the Berribee WMA. CR_E is used to transfer water from the Upper Tier to the Lower Tier (Scotties Billabong). For ecological objectives and to reduce scouring, the rate of drawdown would be managed to a range of 0.03 to 0.06 m/day within the upstream pool (R8, 2020a). Managed inundation of the Crankhandle WMA Lower Tier is retained in the WMA and is not returned to the Murray River.

The following operating conditions apply to the Crankhandle WMA:

- DWL (Lower Tier) – 21.6 mAHD
- DWL (Upper Tier) – 22.6 mAHD
- Inundation area – 316 ha (299 ha upper tier, 17 ha lower tier)
- Estimated volume of water required to fill to DWL – 0.6 GL, not including losses (Mallee CMA, 2014)

- Estimated filling time – 12-15 days at 50 ML/d (depending on hydraulic constraints and losses)
- Inundation flow equivalence – 50,000 to 80,000 ML/day (Water Technology, 2014).

Crankhandle West WMA

The Crankhandle West WMA would be filled by controlled releases from the Crankhandle WMA via Regulator CR_F. During filling, the structures around the Crankhandle West WMA would be closed, with inflows continuing for the planned watering duration to maintain the inundation at the target level. Inflows to the Berribee WMA would need to be sufficient to fill the Crankhandle West WMA, as well as to maintain the inundation level in the Berribee WMA and the Crankhandle WMA. Regulator CW_B2 is used to transfer water from the Upper Tier to the Lower Tier (via Channel CW_D). On completion of a managed event, the Crankhandle WMA would be drained to the Lindsay River via either Regulator CW_A (Lower Tier) or CW_B1 (Upper Tier). For ecological objectives and to reduce scouring, the rate of drawdown would be managed to a range of 0.03 to 0.06 m/day within the upstream pool (R8, 2020a).

The following operating conditions apply to the Crankhandle West WMA:

- DWL (Lower Tier) – 21.7 mAHD
- DWL (Upper Tier) – 22.2 mAHD
- Inundation area – 95 ha (23 ha upper tier, 72 ha lower tier)
- Estimated volume of water required to fill to DWL – 0.3 GL, not including losses (Mallee CMA, 2014)
- Estimated filling time – 10-20 days at 30 ML/d (depending on hydraulic constraints and losses)
- Inundation flow equivalence – 50,000 to 80,000 ML/day (Water Technology, 2014).

Lindsay South WMA

Managed inundation of this WMA is achieved via pumping from the Lindsay South Creek which would only occur in conjunction with operation of the Berribee Regulator. During filling, the LS_A and LS_B structures would be closed, with pumped inflows continuing for the planned watering duration to maintain inundation at the target level. On completion of a managed event, this WMA would be drained to Lindsay South Creek via Regulator LS_A. For ecological objectives and to reduce scouring, the rate of drawdown would be managed to a range of 0.03 to 0.06 m/day within the upstream pool (R8, 2020a).

The following operating conditions apply to the Lindsay South WMA:

- DWL – 24.4 mAHD
- Inundation area – 140 ha
- Estimated volume of water required to fill to DWL – 1.1 GL, not including losses (Mallee CMA, 2014)
- Estimated pumping requirement – 20-30 days at 50 ML/d (depending on losses)
- Inundation flow equivalence – greater than 120,000 ML/day (Water Technology, 2014).

Wallawalla East WMA

Managed inundation of this WMA is achieved via pumping from the Lindsay River which would only occur in conjunction with operation of the Berribee Regulator. During filling, the WE_A structure would be closed, with pumped inflows continuing for the planned watering duration to maintain inundation at the target level. On completion of a managed event, this WMA would be drained to the Lindsay River via Regulator WE_A. For ecological objectives and to reduce scouring, the rate of drawdown would be managed to a range of 0.03 to 0.06 m/day within the upstream pool (R8, 2020a).

The following operating conditions apply to the Wallawalla East WMA:

- DWL – 25.2 mAHD

- Inundation area – 164 ha
- Estimated volume of water required to fill to DWL – 0.6 GL, not including losses (Mallee CMA, 2014)
- Estimated pumping requirement – 12-15 days at 50 ML/d (depending on losses)
- Inundation flow equivalence – greater than 120,000 ML/day (Water Technology, 2014).

Wallawalla West WMA

Managed inundation of this WMA is achieved via pumping from Lake Wallawalla which would only occur in conjunction with operation of the Berribee Regulator and the filling of Lake Wallawalla. During filling, the WW_A1 and WW_A2 structures would be closed with pumped inflows continuing for the planned watering duration to maintain inundation at the target level. Managed floodwaters would be retained in the WMA and not returned to Lake Wallawalla following a managed event.

The following operating conditions apply to the Wallawalla East WMA:

- DWL – 24.7 mAHD
- Inundation area – 623 ha
- Estimated volume of water required to fill to DWL – 2.8 GL, not including losses (Mallee CMA, 2014)
- Estimated pumping requirement – 30-40 days at 100 ML/d (depending on losses)
- Inundation flow equivalence – greater than 120,000 ML/day (Water Technology, 2014).

Draft operating scenarios

As discussed in the Background/rationale section of this referral, the draft operating scenarios presented in **Table 6** have been developed to more closely align the frequency, duration, timing and interval for inundation within each water management area with the frequency, duration, timing and interval of flooding under natural conditions (pre-regulation). The draft operating scenarios in conjunction with the proposed inundation areas, have provided the basis for assessing potential operational impacts described in this referral.

Further assessment and refinement of the draft operating scenarios and / or alternative measures is proposed to further avoid or mitigate some potential impacts identified in this referral, particularly the potential for impacts on the EPBC Act and FFG Act listed Murray Cod and Silver Perch. In addition, further assessment and refinement of draft operating scenarios is proposed in relation to maximising ecological benefits to vegetation communities and listed threatened species. A summary of further investigations or analysis proposed to be undertaken to inform refinements to the design and operation of the project, is provided in Section 20 of this referral.

Table 6: Summary of draft operating scenarios for each water management area

Water management area	Proposed frequency	Proposed duration	Proposed timing	Maximum interval between events	Water regime class
Seasonal Fresh	Annual	3 months	September to December	1 year	Watercourses
Berribee – Intermediate 22.1 mAHD to 23.1 m AHD	4 in 10 years (excludes Berribee - Maximum)	Maintain at target water level for 2 months (for 1 event) and 4.5 months (for 3 events). After 2 months, drawdown water levels to	June to February	3 years	Semi-permanent Wetlands Temporary Wetlands

(Flood Capture or Regulated)		Crankhandle WMA or the Lindsay River. Close existing Wallawalla Regulators when receding below 22.35 mAHD to retain water in Lake Wallawalla and allow to fall through evaporation and seepage.			
Berribee – Maximum 23.2 mAHD (Flood Capture or Regulated)	3 in 10 years	Maintain at target water level for 2 months. After 2 months, drawdown water levels to Crankhandle WMA or the Lindsay River. Close existing Wallawalla Regulators when receding below 22.35 mAHD to retain water in Lake Wallawalla and allow to fall through evaporation and seepage.	June to February	7.5 years	Semi-permanent Wetlands Temporary Wetland Red Gum Forest and Woodland Black Box Woodland Alluvial Plain
Crankhandle Upper: 22.6 mAHD Lower: 21.6 mAHD (Flood Capture or Regulated)	5 in 10 years	Maintain at target water level for 2.5 months, then drawdown water levels in Crankhandle (Upper Tier) to Crankhandle West WMA or Lindsay River (or Murray River). Water is retained in Crankhandle (Lower Tier) and allowed to fall through evaporation and seepage.	June to February	5 years	Temporary Wetlands Red Gum Forest and Woodland Lignum Shrubland and Woodland Black Box Woodland Alluvial Plain
Crankhandle West Upper: 22.2 mAHD Lower: 21.7 mAHD (Flood Capture or Regulated)	5 in 10 years	Maintain at target water level for 2.5 months, then drawdown water levels to Lindsay River.	June to February	5 years	Temporary Wetlands Red Gum Forest and Woodland Lignum Shrubland and Woodland Black Box Woodland Alluvial Plain
Wallawalla East 25.2 mAHD	2 in 10 years	Maintain at target water level for 1 month, then drawdown water levels to the Lindsay River.	September to February	15 years	Black Box Woodland Alluvial Plain

(Flood Capture or Pumped)					
Lindsay South 24.4 mAHD (Flood Capture or Pumped)	2 in 10 years	Maintain at target water level for 1 month, then drawdown water levels to the Lindsay South Creek.	September to February	15 years	Lignum Shrubland Black Box Woodland Alluvial Plain
Wallawalla West 24.7 mAHD (Flood Capture or Pumped)	2 in 10 years	Maintain at target water level for 1 month, then allow to fall through evaporation and seepage.	September to February	15 years	Black Box Woodland Alluvial Plain

Consistent with the seasonal watering proposal and planning process described in the Implementation section of this referral, actual operation of managed environmental watering events would be subject to the availability of water entitlements and climatic conditions, and consideration of the indicative watering regimes linked to achieving specific ecological objectives, which would be included in the Lindsay Island Operating Plan ultimately developed by LMW for approval by the MDBA.

Key decommissioning activities (if applicable):

The design life of the structures is 100 years. If the structures are no longer required at the end of life, all structures would be removed to a practical extent from the site by the operator, and the area rehabilitated to the satisfaction of Parks Victoria (and Trust for Nature for works on the Neds Corner property).

Is the project an element or stage in a larger project?

☒ No ☒ Yes If yes, please describe: the overall project strategy for delivery of all stages and components; the concept design for the overall project; and the intended scheduling of the design and development of project stages).

The project aims to build on existing environmental works constructed under The Living Murray (TLM) Environmental Works and Measures Program, with the aim of providing greater flexibility to manage environmental flows into the floodplain. Environmental works already constructed at Lindsay Island under the TLM program include:

- Installation of two regulators at the inlet to Lake Wallawalla (Wallawalla East Regulator, Wallawalla West Regulator) to replace existing structures (constructed 2006)
- Installation of the Websters Lagoon Regulator (constructed 2006)
- Lowering of the sills and installing two regulators at the northern and southern Lindsay River inlets (Lindsay North Regulator, Lindsay South Regulator) (constructed 2013)
- Replacing a degraded causeway in Mullaroo Creek with a new regulator (Mullaroo Regulator) and fishway (constructed 2015).

The TLM works at Lindsay Island were designed to provide more natural water regimes to the Lindsay River, Websters Lagoon and Lake Wallawalla while protecting the habitat values within the Mullaroo Creek. The fishway at Mullaroo Regulator is designed to be operational at a range of Murray River levels ranging from 21.6 mAHD (0.5 m below full supply level (FSL) at Lock 7) up to 23.37 mAHD (0.7 m above

FSL at Lock 7; Top of Piers) (ARI, 2018). The operational range of the Mullaroo Regulator fishway therefore exceeds the maximum DWL for the Berribee WMA and would therefore be capable of operating during the Berribee Maximum event.

The TLM works have standalone functionality but were designed as Stage 1 of the Lindsay Island Floodplain Restoration Project and as such, the existing structures are fully compatible with the proposed works. Managed inundation events using the proposed project infrastructure would involve coordinated operation of existing TLM infrastructure.

No further stages of works are currently proposed at Lindsay Island beyond the current project.

Is the project related to any other past, current or mooted proposals in the region?

☐ No ☒ Yes If yes, please identify related proposals.

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

The VMFRP is being implemented in partnership between LMW, GMW, Mallee CMA, North Central CMA, Parks Victoria and the DELWP, and is funded by the Commonwealth Department of Agriculture, Water and the Environment. LMW is the project proponent.

Further details of the VMFRP projects are available at: https://www.vmfrp.com.au/

Separate referrals are being prepared for each of the VMFRP projects under the Victorian *Environment Effects Act 1978* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

What is the estimated capital expenditure for development of the project?

The estimated capital cost of development, including all development, construction and management activities, is $73.9 million.

4. Project alternatives

Brief description of key alternatives considered to date (e.g. locational, scale or design alternatives. If relevant, attach A4/A3 plans):

Planning and design of the project has considered a range of alternatives to achieve the specific ecological objectives described in Section 3 (Aims/objectives of the project) of this referral. The proposed design is the result of detailed assessments drawing on extensive investigations at the site and overseen by ecological, hydrological, and engineering expert review panels. The preferred option was the result of three detailed options assessments in 2006, 2007 and 2012 as summarised below, and fundamentally underpinned the 2014 business case for this project. The project business case was approved within the Basin Plan process as part of a package of 36 SDL projects, which collectively achieve targeted environmental outcomes for the Murray-Darling Basin.

Further analysis and investigations undertaken to inform preparation of this referral have identified a need for some further refinements to the project design and draft operating scenarios. A summary of key areas of potential refinements is provided in the 'Brief description of key alternatives to be further investigated' section of this referral.

Key investigations that considered project design alternatives are summarised below.

Floodplain Options Investigation: Lindsay, Mulcra and Wallpolla Islands. Water Management Options, Ecological Associates 2006

In 2006, Ecological Associates was engaged to develop a set of ecological objectives for three Murray River Island Systems - Lindsay, Mulcra and Wallpolla Island. The report described the water regimes required to meet the ecological objectives and listed potential water management options available. Four water management options were investigated which looked at the Lindsay, Mulcra and Wallpolla Islands as one system. Each of the options is summarised in **Table 7** below.

Table 7: Summary of options investigated by Ecological Associates (2006)

Option	Description	Evaluation
1	Weir manipulations	• Raise Weir Pool at Lock 7, 8 or 9 • Lower Weir Pool at Lock 9 • Lower Weir Pool at Lock 7 and 8 – does not inundate significant areas of floodplain or wetlands. Option was not considered further.
2	Anabranch flow	• Lock 9 bypass – induce flow in the Wallpolla Creek system by allowing water to flow past Lock 9 in a regulated bypass channel • Re-location of Cullulleraine Pumps – induce flow in the Wallpolla Creek system by drawing water from the Cullulleraine diverters from within Wallpolla Creek • Improve flow and regulate flow at Stoney Crossing – the existing structure would be modified to allow greater flows to pass, to provide fish passage and to regulate flow • Improve flow in Upper Potterwalkagee Creek – increase flow and provide more control over flow around Lock 8 via the upper Potterwalkagee Creek • Improve flow around Lock 7 – increase flow through creeks around Lock 7 by removing blockages and providing more control over flow by regulating flow • Lower sill of the Lindsay River Extension – increase flow through Lindsay River Extension by lowering the bed level of the creek.
3	Regulate Anabranch Levels and Flow	• Regulate lower Potterwalkagee Creek – inundate the floodplain in the lower part of Mulcra Island • Regulate Lower Lindsay River – inundate the floodplain in the lower part of Lindsay Island.
4	Lower sills and regulate individual wetlands	• Increase inundation in wetlands by reducing the level at which they receive flow and constructing regulators to both detain and exclude water from wetlands.

The floodplain options assessment was a high-level scoping exercise which did not make recommendations about the preferred watering option. Instead, the report identified resource or knowledge gaps that would need to be filled in order to investigate the options further and identify a preferred option.

Floodplain Options Investigation: Lindsay, Mulcra and Wallpolla Islands, Ecological Associates 2007

In 2007, Ecological Associates conducted further investigations into floodplain water management options with the aim of refining the options identified in 2006. The report reviewed floodplain hydraulics, current and modified hydrology and hydrogeology, ecological values and associated environmental water requirements, and based on this information, identified priorities for water management and options to address water management priorities.

The highest priority for water management was identified to be Red Gum Forest and Red Gum Woodland WRC, which makes a key contribution to a large number of objectives and is significantly threatened by water-related threats. Although they contribute to fewer objectives, anabranches were the next highest priority as they are very important to the few objectives to which they relate. Semi-permanent and Temporary Wetland WRCs have a similar priority for water management, while the lowest priorities for management were identified as Black Box Woodland and Lignum Shrubland, as these WRCs make relatively smaller contributions to the ecological objectives and their water requirements are not as threatened as the other classes.

Twelve water management options were described for the Lindsay Island system to address the water management priorities, including floodplain and anabranch components as summarised in **Table 8**.

Table 8: Summary of water management options for the Lindsay Island system (Ecological Associates 2007)

Option	Description	Evaluation
1	Raise Lock 7	The objective of this option was to increase the extent of flowing watercourses / anabranches and to introduce water to wetlands by raising Lock 7 approximately 1.12 m above normal operating level (up to 23.32 mAHD) and was considered in conjunction with other works to regulate watercourses from downstream that would enable inundation of the floodplain. This option proposed an initial weir raising of 0.5 m to assess the effect of the change before considering larger manipulations. Raising Lock 7 without any other works was deemed to provide minimal environmental benefit as flows would remain within the banks of the watercourses which already flow (Upper Mullaroo Creek and Lindsay River), although it would slightly extend the distance that these creeks flow. Weir raising would not increase inflows to Lake Wallawalla.
2	Raise Lock 6	This option considered raising Lock 6 weir pool to inundate floodplain areas upstream and reviewed floodplain inundation levels of 19.25 m, 19.87 m, 20.0 m, 20.5 m, 21.0 m, 21.5 m and 22.0 m AHD. A level of 19.87 mAHD achieved no real change in wetland connectivity or floodplain inundation area, with wetland connectivity not increasing until water levels exceed 20.5 m to 21.0 m AHD. A level of 21.0 mAHD is required to begin inundation of floodplain areas in the lower Lindsay River system. This option was not considered further as a viable option for increasing floodplain inundation at Lindsay Island as raising the weir to greater than 21.0 mAHD was considered beyond the reasonable range for Lock 6 due to structural and Murray River depth reasons; and raising to lower levels achieved no floodplain inundation benefits.
3	Lower Lock 6	This option considered lowering water levels at Lock 6 to increase the head difference between Lock 7 and Lock 6, which generates flows through Mullaroo Creek and the Lindsay River, with the aim of extending the length of stream along which flow occurs. This option was not considered further as the length of extended stream flows achieved (1.6 km) compared to the recession of the weir pool (0.52 km) associated with lowering Lock 6 levels, was not sufficiently beneficial.
4	Lower Lindsay River weir and fish ladder	The objective of this option was to inundate the lower Lindsay Island floodplain by installing a weir structure on the Lindsay River downstream of “the Crankhandle” to hold water at an elevation close to the Lock 7 weir pool, which would facilitate upstream floodplain inundation, and introduce water to wetlands, including Lake Wallawalla during moderate flow events. The weir proposed to raise the minimum level of the lower Lindsay River from 19.25 m to 20.5 m AHD to increase flooding within the banks of the Lower Lindsay River and more readily allow inflow to the Crankhandle wetland. This would

		reduce the extent of the flowing habitat in the upper Lindsay River and Upper Mullaroo Creek to a minor degree. The weir would allow water levels to be raised up to 22 m AHD on a seasonal basis using a Murray River fresh (short pulse (about 2 weeks duration) of freshwater) but without extensive floodplain works, would not allow water to be retained longer than the duration of the fresh. This option was considered as a stand-alone option, or it could be designed as a component of the larger scale option to inundate the Lindsay River floodplain by diverting water from Lock 8.
5	Upper Mullaroo Creek weir and fish ladder	This option considered a weir on Mullaroo Creek approximately 5 km downstream of Mullaroo Bridge with the aim of promoting inundation of the surrounding floodplain and wetlands. This option was tested for weir levels between 19.25 m AHD (Lock 6) and 22.21 m AHD (Lock 7). At the maximum weir level of 22.21 m AHD (Lock 7) analysis of the LIDAR failed to show increased flooding outside the banks of the existing waterways. This option was not considered further as it would not be effective in increasing floodplain inundation and was likely to drown important Murray Cod habitat in Mullaroo Creek.
6	Lower Toupnein Creek regulator	This option considered a new regulator at a natural constriction on the channel of Toupnein Creek with the aim of promoting floodplain inundation during peaks in river flow. This option was not considered further as constructing a regulator on Toupnein Creek would stop the initial backwater flooding from the Murray River from extending up Toupnein Creek and reduce flooding overall, would not increase the flooding frequency for flows entering the upstream end of Toupnein Creek, and would form a barrier to fish passage.
7	Lower sills and regulate effluents in Upper Mullaroo Creek system	The objective of this option was to provide a regulated, continuously flowing stream habitat in the upper Mullaroo Creek system, providing fish passage between the Lock 6 and 7 weir pools and habitat for flow-dependent fauna, by constructing regulating structures on three effluents of the upper Mullaroo Creek and upper Lindsay River systems. Although a regulator would provide more flexibility in managing fish habitat and passage under a variety of future scenarios, this option was considered a lower priority given that fish were already able to pass between the creek and the river this location under current conditions (Engledow and Vilizzi 2006, in Ecological Associates, 2007).
8	Lower sills and regulate effluents in Upper Lindsay River system	The objective of this option was to provide a regulated, continuously flowing stream habitat in the upper Lindsay River system to provide fish passage between the Lock 6 and 7 weir pools and habitat for flow-dependent fauna by constructing regulating structures on three anabranches (Lindsay River North, Middle and South). Structures for Lindsay River Middle and South were not considered further due to the limited additional length of channel flow and habitat able to be created. Lindsay North had potential to increase flows to 280 ML/d at the normal weir level, while fish passage could be improved by replacing the current structure with a regulator capable of varying flow if Lock 7 were to be raised seasonally by 0.5 m.
9	Lower sills and regulate connection channels in the Upper Lindsay Wetland Complex	The objective of this option was to increase flood frequency and duration in upper Lindsay Wetland Complex by seasonal or periodic raising of Lock 7 weir pool by 0.5 m. However, at this level, the surrounding floodplain would not be inundated and pumping was considered to be less costly and a simpler alternative to achieve the objective.

10	Lower bed level of Lindsay River extension	The objective of this option was to maintain the health of riparian trees and to improve aquatic habitat by excavating to lower the bed level of the channel. The value of this option was considered questionable because lowering the bed would only benefit the watercourse itself, would not provide a flowing habitat, and the works were relatively high cost.
11	Lower and regulate sills to individual wetlands	This option considered modifying flow paths between watercourses and various wetlands with the aim of increasing opportunities to introduce water and control the wetland water regime, including works to lower or broaden flow paths, and install regulators. Sites that best met the effectiveness criteria for the works (based on hydrology of the source and physical characteristics of the flow path), were Wetland 33, Wetlands 24, 29, 32 and 34, the upper Mullaroo wetland complex, and the Crankhandle complex. Further consideration of this option was not ruled out by Ecological Associates (2007).
12	Inundate Lindsay Island floodplain	This option considered delivering water from the Lock 8 weir pool to the Lindsay Island floodplain by constructing a new 20 km channel along with up to 42 regulating structures with the aim of watering woodland areas on approximately 6,000 ha of the Lindsay Island floodplain. With a storage level of 24.6 mAHD and potential maximum operating water level of 25.69 mAHD (top of lock), Lock 8 could provide sufficient head to inundate woodland areas of Lindsay Island currently beyond the maximum possible operating level of Lock 7 of 23.32m AHD (top of lock). This option could interact with several other options described above.

The option with the greatest benefit for anabranches at Lindsay Island were associated with improving flows at Lindsay North (Option 8) where flow already occurs as works on Mullaroo Creek would improve shorter lengths of anabranch. The option with the greatest benefit for wetlands and floodplains at Lindsay Island was Option 12 as it potentially introduces water to a wide range of water regime classes in continuous areas of floodplain providing extensive, integrated habitat, followed by a weir on the lower Lindsay River (Option 4). Both of these options operate at low, regulated flows and can operate at any time, but Option 12 had a significantly higher capital cost and would require extensive works on private land (e.g. 20 km of channel through Trust for Nature's Neds Corner property). Only two significant options to improve flooding at individual wetland sites across Lindsay, Mulcra and Wallpolla Islands were identified in the study, neither of these being at Lindsay Island.

Lindsay Island Water Management Options Investigation – Part A Options Assessment (GHD 2012)

The aim of this study investigation was to identify and evaluate opportunities for large scale and integrated water management works and measures, prioritise these works and develop concept designs to inform project costs and other potential future project delivery requirements, recognising that previous options investigations were targeted at specific wetlands or areas of the floodplain.

Two groups of options were identified a part of this study: primary options and secondary options. Primary options comprise works which have a widespread impact in terms of the flooding extent achieved, generally requiring at least one main structure of larger size/higher cost. These options aimed to achieve large-scale inundation, maximising outcomes in terms of enhanced connectivity between floodplain elements, the floodplain and the Murray River. Hydraulic modelling was undertaken on key primary options to determine general system capabilities and characteristics, and to confirm the relationships of floodplain interconnections. Secondary options comprise a range of works, which would generally operate in conjunction with the primary options to target specific additional areas or enhance the transfer of flow around the system.

Primary options

Table 9 summarises the four primary options evaluated.

Table 9: Summary of primary options (GHD, 2012)

Option	Name	Description	Target inundation level	Inundation area
1	Lindsay River Environmental Regulator, Lower	Major regulating structure on Lindsay River adjacent to Berribee Homestead with vertical slot fishway. Minor works to manage breakouts such as: • Four regulator and crossing combination structures • One regulator structure • One levee, mostly shallow (0.55 m deep), 2.3 km long	23.2 mAHD	3,520 ha
2	Lindsay River Environmental Regulator, Middle	Major regulating structure on Lindsay River north of the Channel Track with vertical slot fishway. Minor works to manage breakouts such as: • Two regulator and crossing combination structures • One regulator structure • One levee, 1.1 to 0.5 m deep, 1 km long • One levee, mostly shallow (0.55 m deep), 2.3 km long	23.2 mAHD	3,360 ha
3	Lindsay River Environmental Regulator, Upper	Major regulating structures on Lindsay River near the main Island Crossing (mid-island) and another structure on the Mullaroo Creek, both with vertical slot fishways. Minor works to manage breakouts such as: • Two regulator and crossing combination structures • One regulator structure • One levee, average 0.3 m deep, 2.3 km long	23.2 mAHD	1,960 ha
4	Upper Lindsay and Mullaroo Flood Complex	Major regulating structures on Lindsay River (upstream of the Mullaroo Effluent confluence in Upper Lindsay Island, adjacent to local high point) and another structure on the Mullaroo Creek (1 km downstream of the confluence of Mullaroo and Little Mullaroo Creeks), both with vertical slot fishways. Minor works to manage breakouts such as: • Two regulator and crossing combination structures • Thirteen regulator structure • Eight levee, minor only	24.0 mAHD	1,480 ha

The assessment recommended the adoption of Primary Option 1, due mainly to having the largest inundation area and associated potential for environmental benefits. Primary Option 2 achieved a similar inundation area but was not preferred as the main regulator location was within an area of particular cultural heritage significance. Options 3 and 4 were not preferred due mainly to high cost compared to area benefitted by

inundation. All options were considered to have similar levels of risk in relation to salinity and ecological impacts (hollow-bearing trees, threatened species habitat, hydrodynamics of Mullaroo Creek and upper Lindsay River).

Secondary options

Preliminary assessments evaluated works across 23 wetland areas based on cost-effectiveness and ecological impact (area inundated, current condition, impacts on fish ecology). The assessment identified the following as the high priority wetlands: Crankhandle Wetland Complex, Crankhandle West (Lower Area), Lake Wallawalla, combined Toupnein Creek and Webster's Lagoon, Lake Wallawalla East, Lindsay South Effluent (Southern Wetland), Lake Wallawalla West, Upper Mullaroo Wetland Complex (Extended). Crankhandle West (Upper Area) and Crankhandle West (Middle Area) were identified as medium priority wetlands.

Further engineering and ecological investigations were recommended to further assess risks and benefits associated with the preferred primary and secondary options.

Lindsay Island Water Management Options Investigation – Part B Concept Development and Design (GHD 2013a)

This report presents conceptual designs for the priority works, as identified in the Part A – Options Assessment Report (GHD 2012). Concept designs were developed for Primary Option 1 (Berribee Regulator), including the secondary options enabled by inundation from the Primary Option (Lake Wallawalla, Upper Mullaroo Wetland Complex, Upper Lindsay Wetland Complex, Upper Lindsay East Wetland Complex, Lower Lindsay River - Southern Pocket East) along with other priority wetlands identified by the Mallee CMA (Crankhandle Wetland Complex, Crankhandle West (Upper Area), Wallawalla West, Wallawalla East, Lindsay South Effluent (Southern Wetland), North West Area of Lindsay Island).

Refinements made during concept design to address environmental and heritage risks identified for the options described in the Part A report included:

- Wallawalla West outlet regulator relocated further west to avoid potential archaeological sites
- Reduced top water level for Wallawalla East and Lindsay South to 25.3 mAHD to minimise the potential for inundation of Old Mail Road
- Reduced inundation level within northern Crankhandle West to reduce extent of levee bank works required along the Lindsay River.

An alternative mode of filling the Crankhandle West area is via pumping from either the Lindsay River or the Crankhandle Wetland Complex was also recommended to eliminate the need for the channel excavation and associated regulator works, although this pumping option has not been adopted at this stage.

The concept design noted that further refinement of the design would require detailed flora, fauna and cultural heritage assessment, to inform siting of works, with flora and fauna assessments to also include consideration of net gains. In relation to operations, GHD (2014) recommended that additional consultation and additional hydraulic modelling be undertaken to improve the current level of understanding of the potential changes to flow regimes and other hydrodynamic attributes as a result of operating the scheme, with the aim to:

- Confirm the flood inundation levels that can be achieved across the floodplain under a range of Murray River flow conditions;
- Confirm the potential changes to flow rates and velocities along Mullaroo Creek and Upper Lindsay River, and evaluate in context of the potential impacts on fish;
- Evaluate to what extent the structures at the offtake to Mullaroo Creek and the Upper Lindsay River can be used to manage flow regimes in theses streams; and
- Improve the current understanding of the impacts of raising the Lock 7 weir pool level on floodplain inundation along the Murray River, particularly in New South Wales.

Lindsay Island Sustainable Division Limit Adjustment Supply Measures - Advanced Concept Design Report (GHD, 2017a)

In 2017, SA Water engaged GHD to progress the advanced concept design for the SDL measures at Lindsay Island, building on the 2014 advanced concepts through incorporation of additional geotechnical investigations, development of fish passage criteria (Hames et al, 2014), computational fluid dynamics modelling of the fishway at Berribee Regulator, hydraulic and hydrology assessments (Water Technology, 2016), flora and fauna assessments (GHD, 2014a, GHD, 2016a), outcomes of sheet pile trials and seepage control options assessment, and constructability reviews.

Key revisions to the advanced concept design include:

- The geometrical layout of the fishway and fishway entrance arrangements were confirmed through computational fluid dynamics modelling resulting in a slightly larger structure and an additional gate in structure
- Refinement of structure arrangements and sizing based on hydraulic analysis
- A drilled sheet piled wall was determined the preferred cofferdam solution for Berribee Regulator (change from Bulka Bag option) based on further geotechnical investigations and temporary works workshop
- The depth of the permanent sheet pile cut-off was reduced, and upstream/downstream erosion cut-offs removed based on geotechnical investigations.
- Several sections of access tracks were modified based on ground-truthing by Mallee CMA to avoid or minimise impacts to large trees and / or known cultural heritage values.

No project alternative

One project alternative is to not undertake the project (i.e. 'do nothing'). This alternative has not been considered further as it would:

- Lead to ongoing deterioration of floodplain ecosystems in the targeted inundation area due to the reduced the frequency and duration of flood events entering these areas as a result of river regulation.
- Forego an opportunity to deliver long-term positive impacts to floodplain areas that are ecologically significant at a local, regional, and national level.

Brief description of key alternatives to be further investigated (if known)**:**

No alternatives to the project are being further investigated. As part of the project, further assessment is proposed to confirm key design and operational aspects in order to further avoid and minimise impacts.

Key design aspects for further investigation:

The design report (R8, 2020a) identifies the following infrastructure as requiring further design investigations / realignment to avoid identified cultural heritage values: WE_A containment bank and regulator, CR_G channel, BERR_F regulator and containment bank, WW_A containment bank, CR_D containment bank, CR_E containment bank, CW_C containment bank, CR_G channel, Parts of CW_D channel high points, section of Bridge Track, and a section of new access track between CR_A to CW_B1.

Other further design investigations, include:

- Possible requirement for drop structure at WE_A regulator
- WW_B permanent pipeline construction methods
- Possible relocation of drop structure CR_D to CR_A
- Possible upgrade requirement for Wallawalla Causeway
- Possible realignment of CW_A containment bank to avoid a number of large trees

- Realignment of LS_A1 containment bank to contain fully within national park (some sections currently extend into private land at Neds Corner)
- Possible automation of the inlet regulator on Mullaroo Creek to manage hydrodynamic habitat attributes.

Key operational aspects for further investigation:

- Further assessment and refinement of the draft operating scenarios is proposed to identify opportunities to avoid or minimise potential impacts on native fish, particularly Murray Cod and Silver Perch, associated with changes to hydrodynamic habitat attributes in Mullaroo Creek and the upper Lindsay River, while maximising environmental benefits to floodplain communities. This review would consider opportunities to maintain flowing habitat, as well as options to mitigate impacts such as amendments to the extent, frequency, duration and timing of watering events.

5. Proposed exclusions

Statement of reasons for the proposed exclusion of any ancillary activities or further project stages from the scope of the project for assessment:

No other ancillary activities or further project stages have been excluded from this assessment.

6. Project implementation

Implementing organisation (ultimately responsible for project, i.e. not contractor)**:**

LMW would be the implementing organisation responsible for managing construction of the project. LMW would also be primarily responsible for operation and maintenance of the environmental watering infrastructure, although it is likely that Parks Victoria staff would assist with operation and maintenance as required.

In order to minimise potential adverse environmental effects and maximise environmental benefits across the nine projects being undertaken as part of the VMFRP, existing frameworks for collaborative and adaptive environmental water management would be used. The Victorian Environmental Water Holder (VEWH) is the independent statutory body responsible for holding and managing environmental water entitlements on behalf of the State. VEWH administers the ongoing collaborative management of water available under environmental entitlements, which are used to improve the health of Victoria's rivers and wetlands and the native plants and animals that depend on them, through regulation of the river systems.

VEWH works collaboratively with a range of partners to plan the release and delivery of environmental water, including:

- Commonwealth Environmental Water Holder and the MDBA to access water held on behalf of the Commonwealth Government.
- Water authorities (e.g. LMW, GMW, SA Water) and waterway managers (e.g. Mallee CMA, North Central CMA) which oversee investigations to determine water requirements, undertake water planning and coordinate the delivery of water and monitoring programs that support a process of learning and adaptation.

Environmental watering at Lindsay Island would be undertaken in accordance with the VEWH's annual seasonal watering plan and in partnership between LMW, GMW, SA Water, the Mallee CMA and Parks Victoria.

Before a watering action can commence, a seasonal watering proposal must be prepared by the Mallee CMA and approved by the VEWH. Submissions for environmental water allocations are presented by the VEWH to the relevant water holders who subsequently prioritise the watering proposals against all other watering proposals. Once a watering action is approved, the VEWH ensures sufficient water is in the appropriate allocation bank account (ABA). This may require a transfer of water from one ABA to another. The VEWH would then issue a seasonal watering statement to the Mallee CMA allowing access to an allocation of water in the ABA. Once the seasonal watering statement is approved, a water order can be placed by Mallee CMA with GMW, enabling a diversion to commence.

Implementation timeframe:

Construction is currently scheduled to commence in late 2022 and is anticipated to be completed by mid-2024.

Proposed staging (if applicable):

No staging is proposed.

7. Description of proposed site or area of investigation

Has a preferred site for the project been selected?

☐ No ☒ Yes If no, please describe area for investigation.

If yes, please describe the preferred site in the next items (if practicable).

General description of preferred site, (including aspects such as topography/landform, soil types/degradation, drainage/ waterways, native/exotic vegetation cover, physical features, built structures, road frontages; attach ground-level photographs of site, as well as A4/A3 aerial/satellite image(s) and/or map(s) of site & surrounds, showing project footprint):

General

The project area is located in north west Victoria, approximately 75 km west north west of Mildura and 30 km east of Renmark, South Australia. The project area is mostly located within the Murray-Sunset National Park and is surrounded by the rural localities of Lindsay Point (to the west) and Neds Corner (to the east) in Victoria, and Rufus to the north in NSW. The southern extent of the project area lies approximately 10 km north of the Sturt Highway and extends north to the Murray River, which forms the Victoria/NSW state border. The western extent of the project area is located within approximately 10 km of the Victoria/South Australia state border. The Sturt Highway is a national highway and major road network link between Victoria and South Australia, and will provide regional access to the project area along with other key access roads such as Old Mail Road, which extends passes through the southern part of the project area, and Lindsay Point Road (South Australia).

The project area is generally well-separated from residential uses, with the nearest dwellings to the proposed works being:

- Three SA Water managed caretaker's dwellings located on land adjacent to Lock 7 in the north eastern part of the project area. The nearest construction site to these dwellings (other than track works) is the BERR_F containment bank and regulator located approximately 2.1 km to the west.
- Approximately 15 dwellings scattered along the northern bank of the Murray River in NSW, with the nearest dwelling being located approximately 1.0 km north of the construction site for the CR_D drop structure, regulator and containment bank.

- Approximately 15 dwellings located within the Lindsay Point irrigation area located to the west of the project area, with the nearest dwelling being located approximately 1.7 km west of the construction site for the CW_B1 drop structure, regulator and containment bank.

The nearest dwelling to the primary construction site at Berribee Regulator is located approximately 5 km to the west. A number of buildings are located at Berribee Homestead in closer proximity to this construction site, however these buildings are not currently unoccupied. Parks Victoria have advised that one of these buildings (the cottage) is used only infrequently and opportunistically by staff / contractors as an alternative to camping while working on Lindsay Island. The location of sensitive receivers is mapped in **Attachment 2 – Environmental Features Map**.

Geomorphology, topography and landform

The project area is located in the Murray Basin geological unit, predominantly within the Northern Riverine Plain geomorphic division and the sub-unit consisting of modern floodplains of the meander belt below plain level, with some parts of the Wallawalla East and Wallawalla West WMAs extending onto older alluvial plains without leveed channels (see **Attachment 2 – Environmental Features Maps**).

The project area is located in the Murray Scroll Belt bioregion, which is characterised by an entrenched river valley and associated floodplain, including lake complexes of numerous oxbow lakes, billabongs, ephemeral lakes, swamps and active meander belts, in which the Murray River forms a narrow valley where fluvial processes predominate within an otherwise aeolian-dominated landscape (DELWP, 2020a). Alluvium deposits from the Cainozoic period gave rise to the red brown earths, cracking clays and texture contrast soils (Dermosols, Vertosols, Chromosols and Sodosols) which support Alluvial-Plain Shrubland, Riverine Grassy Chenopod Woodland and Riverine Grassy Forest ecosystems.

Based on LiDAR derived digital elevation models used in the hydrological modelling for the project (Water Technology, 2014 & 2016), the topography of the Lindsay Island floodplain is relatively flat with levels ranging around 24 to 26 m AHD in the eastern parts of Lindsay Island, around 22 to 24 mAHD in the central and western parts of the island, and around 20 to 22 mAHD at Lake Wallawalla (see **Figure 4**).

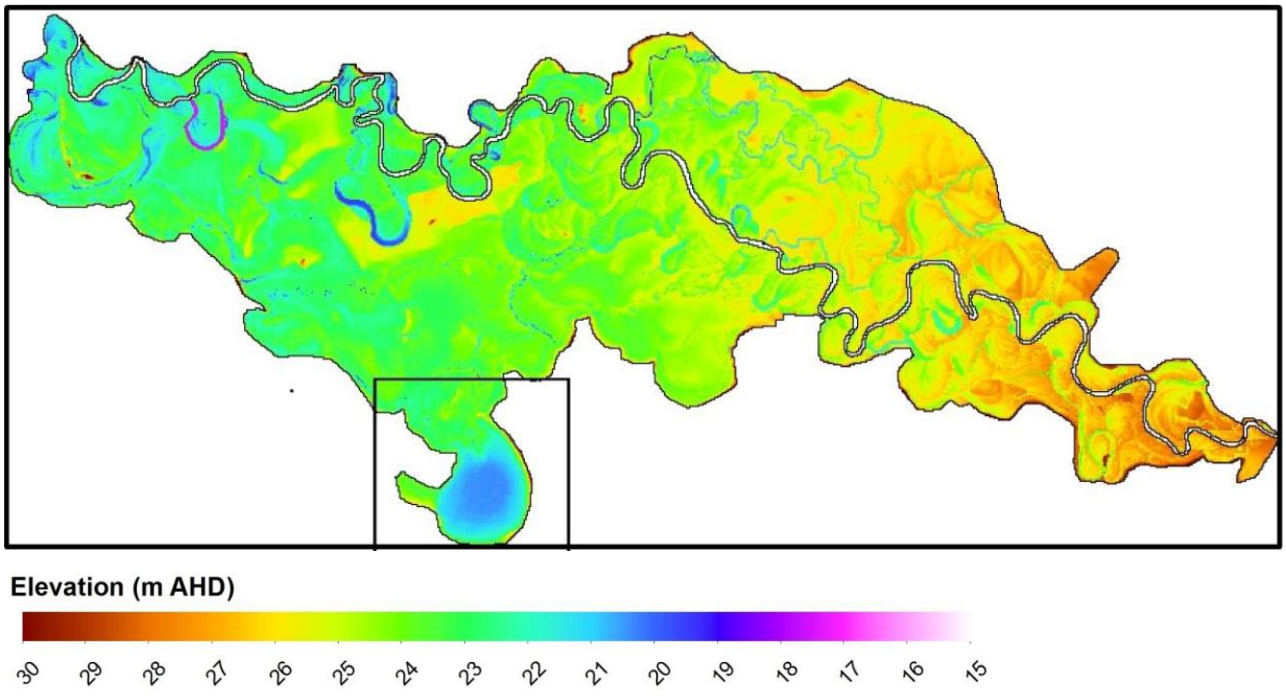

Figure 4: Extract of LiDAR digital elevation model for Lindsay Island floodplain (Source: Water Technology, 2014)

Waterways and Wetlands

Floodplain areas targeted for restoration by the project are mostly located on Lindsay Island. Lindsay Island is approximately 28 km long east to west and is enclosed by the Murray River in the north and the Lindsay River anabranch in the south. The project also involves targeted inundation of floodplain areas south of the Lindsay River, including Lake Wallawalla. The Lindsay River diverges from the Murray River downstream of Lock 8 and re-joins the Murray River upstream of Lock 6, bypassing Lock 7. In order to engage inflows to the Lindsay River, operation of the project would involve raising water levels along the Murray River behind Lock 7, which would inundate some lower-lying billabongs and creeks on the NSW side of the Murray River, mostly within the former Lake Victoria State Forest.

Waterways and wetlands within the project area or potentially affected by the project due to works being undertaken within or adjacent to the water bodies, or due to operational inundation or potential for direct/indirect discharges to the water bodies, include: the Lindsay River, Toupnein Creek, Mullaroo Creek, Little Mullaroo Creek, Lindsay South Creek, Lake Wallawalla and various wetlands across the Lindsay Island floodplain in Victoria, and the Murray River, an anabranch of the Murray River, Lock 7 Billabong and Horseshoe Billabong in NSW (refer to **Attachment 2 – Environmental Features Maps**).

The project is not located within a Ramsar site, however Lindsay Island (along with floodplain areas south of the Lindsay River) and Lake Wallawalla are both listed on A Directory of Important Wetlands in Australia (refer to **Attachment 2 – Environmental Features Maps**). The nearest Ramsar site is the Riverland Ramsar site, which is located approximately 10 km downstream of the project in South Australia. Lindsay Island is part of the Chowilla-Lindsay-Wallpolla Icon Site, one of six icon sites identified under the Murray-Darling Basin Ministerial Council's The Living Murray Initiative. The area of investigation intersects with eight wetlands listed on DELWP's current wetlands inventory (Wetland ID. 10175, 10185, 10172 (Lake Wallawalla), 10242, 10237, 10238, 10235, 10201) with 24 other DELWP current wetlands mapped within the inundation area. Two mapped wetlands in NSW are also located within the inundation area (refer to **Attachment 2 – Environmental Features Maps**).

The Lindsay Island floodplain is situated along a heavily regulated reach of the Murray River, being located between Lock 8 upstream and Lock 6 downstream, with Lock 7 located on the Murray River adjacent to Lindsay Island. These regulation structures strongly influence the current hydrology of Lindsay Island and have done so for almost 100 years since Lake Victoria (NSW) commenced being used for regulation and storage to control flows into South Australia. Refer to the background/rationale in Section 3 for a summary of relevant regulation structures. These regulation structures strongly influence the current hydrology of Lindsay Island.

Modelling of natural conditions (significant hydraulic structures removed, including Locks 6 and 7) by Water Technology (2014), indicates that flows onto the floodplain began to engage at Murray River flows of 40,000 ML/day and above while below this flow threshold, only major channels and cutoff meanders are inundated. At 40,000 ML/day Lake Wallawalla and the Crankhandle complex began to fill, with widespread floodplain inundation within Lindsay Island and Lake Wallawalla commencing at 60,000 ML/day, at which much of the Crankhandle and Crankhandle West WMAs, and the area just upstream of the proposed Berribee Regulator site are inundated. The Lindsay South and Wallawalla West WMAs begin to be inundated at 80,000 ML/day, with inundation continuing to increase with flow until the majority of floodplain is engaged, at about 120,000 ML/day. Mapping extracts showing the modelled extent of relevant flow thresholds under natural conditions from Water Technology (2014) are provided in **Attachment 2 - Environmental Features Maps**.

Under current conditions (significant hydraulic structures present, including Locks 7 and 8, and TLM structures), flood behaviour and inundation extents are very similar to natural conditions. The major difference between the natural and current condition scenarios is that the presence of Lock 7 and Lock 8 increase upstream water levels and flow through the Lindsay system at low Murray River flows up to around 40,000-50,000 ML/day. At these flows, little of the floodplain is engaged and therefore there is little difference visible in the inundation mapping so these maps are not included. Above this flow, the

locks are fully opened and do not present a significant barrier to flows, therefore the flood behaviour at high flows is very similar to the natural condition scenario.

Although the extent of flooding across the Lindsay Island floodplain under different Murray River flow thresholds is quite similar under natural and current conditions, analysis by Gippel (2014) has shown that the frequency, duration, timing and intervals of relevant flood events has been substantially altered by river regulation as illustrated in **Figure 2** and **Table 3** of this referral. This analysis shows that for current conditions:

- The frequency of river flows of 10,000 ML/day has significantly increased from natural conditions
- The frequency of flood events associated with a river flow of 20,000 ML/day or more has significantly decreased from natural conditions
- The duration of flood events associated with river flows between 10,000 ML/day and 80,000 ML/day has decreased from natural conditions with minimal change to the duration of flood events above 80,000 ML/day
- The interval between flood events associated with river flows greater than 90,000 ML/day has significantly increased.

These alterations to flow and flooding regimes are having significant impacts on biodiversity and ecosystem processes in the rivers, wetlands and floodplains that require periodic inundation to maintain the health of water-dependent ecosystems, particularly in providing suitable habitat conditions (Parks Victoria, 2018). Alterations to waterways and localised flows, together with climate change, have resulted in most rivers in the River Red Gum Parks now being in poor condition (Parks Victoria, 2018), with the 2010 stream condition scores for the project area being mostly rated very poor (see **Figure 5**).

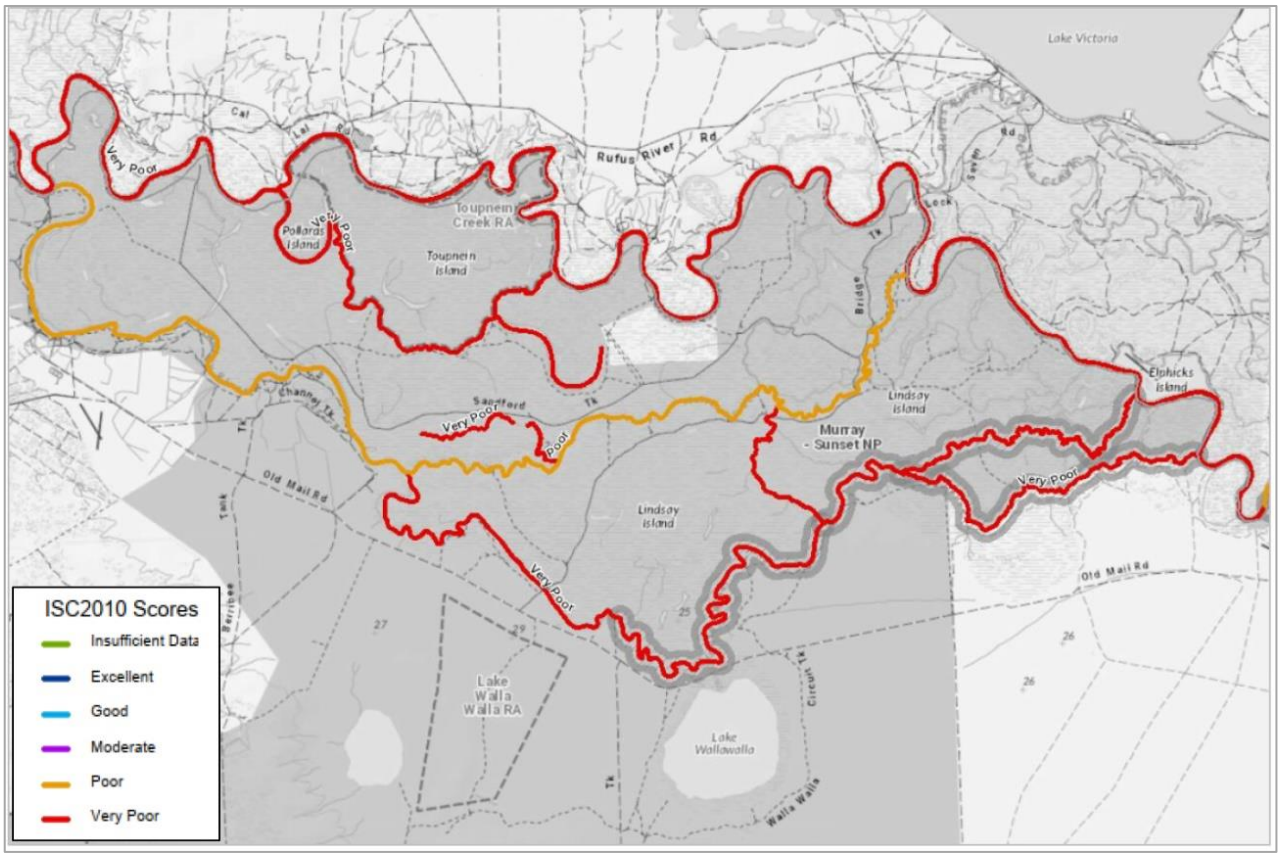

Figure 5: Extract of 2010 Index of Stream Condition Scores Mapping (Source: DELWP, 2020b)

Groundwater

The project area is situated within the Murray Geological Basin, which was infilled with sediments during the Tertiary and Quaternary period. A number of aquifer and confining (aquitard) units layer within the project area to form a complex structure. The hydrogeological units relevant to assessment of the project's potential effects, in order of depth, are (R8, 2020b):

- Coonambidgal Formation (aquitard) - Fine-grained recent Quaternary sedimentary deposit in the Murray Trench, consisting of silts and clays.
- Channel Sands (Monoman Formation) (aquifer) - Fine to medium-coarse grained Quaternary sedimentary deposit in the Murray Trench, consisting of predominantly of sand. Salinity is typically very saline.
- Blanchetown Clay (aquitard) - Quaternary clay unit, acting as a confining layer where present
- Loxton Parilla Sand (aquifer) - A Pliocene sands aquifer, predominantly sand with minor silt and clay. Localised cemented layers limit vertical flow in places. Salinity is typically very saline, generally more so than the Channel Sands.

Within the project area, the Blanchetown Clay is present in the north of Lake Wallawalla, most of the Wallawalla East WMA and a smaller part of the Lindsay South and Berribee WMAs. The remaining hydrogeological units are largely uniform across the project area.

Regional groundwater flow is to the south west (Thorne *et al.* 1992 in R8, 2020b). In the vicinity of the NSW inundation areas, groundwater flow is south towards the Murray River, with the hydraulic head from Lake Victoria driving flow through the saline Loxton Parilla Sand into the Monoman Formation (Channel Sands) and discharging into the Murray River (OoW 2013 R8, 2020b). Most waterways in the project area are thought to be losing streams (i.e. they lose water into the local groundwater system), except for stretches of the Murray River and Rufus River (NSW), which are thought to be gaining streams (R8, 2020b).

Groundwater levels are influenced by the lock levels of the Murray River close to the river, and also by evapotranspiration processes in the floodplain which drawdown the groundwater level. Mapping suggests the watertable sits predominantly between 3-6 m below ground surface across the project area, with shallower areas at Lake Wallawalla and the Mullaroo wetlands complex, and across the floodplain in local depressions (see mapping in **Attachment 4 – Groundwater Assessment**). The depth to groundwater is likely to be slightly deeper in the north-central Lindsay Island. Elevations of the watertable range between around 21.5 m AHD in the east to 18.5 m AHD in the west, and around 19.5-20 mAHD at Lake Wallawalla. Groundwater levels are known to rapidly decline moving away from the Murray River and other permanently pooled areas into the floodplain (SKM, 2010).

Groundwater levels show lengthy recessions from flood peaks. Based on a review of hydrographs for selected groundwater bores, it is likely that current groundwater levels are still recovering (decreasing) from the elevated levels of the 2010 floods, but are still significantly lower (1-1.5 m) than the peaks of the early 1990s before the Millennium drought (R8, 2020b). Groundwater levels in the NSW inundation areas would be very similar to the Murray River weir pool level at Lock 7, given the proximity of these areas to the river. In contrast to Victoria, where the watertable is lowered into the floodplain, groundwater in the vicinity of the NSW inundation areas is maintained by a driving hydraulic head from Lake Victoria to the north, and groundwater elevation is likely to increase away from the Murray River into NSW (R8, 2020b).

Groundwater recharge is via the Murray River, lower Lindsay River and Mullaroo Creek channels where they incise into the Channel Sands, and also vertical recharge from flooding and to a lesser extent rainfall, however the rate of vertical recharge is limited by the surface fine alluvium (Coonambidgal Formation; SKM 2010). Previous studies have used an estimated recharge rate to the watertable (vertical infiltration) of between 0.03 and 1 mm/day (Overton and Jolly, 2004; SKM 2002 in R8, 2020b), however recent investigations concerning salinity processes have considered 0.5 mm/day to be a reasonable estimate (SKM 2008 & 2014).

Salinity

Groundwater salinity is highly variable, with fresher flush zones evident close to waterways where there is regular flow. Groundwater salinity has been interpreted from mapping by Cullen et al. (2008) based on airborne electromagnetic (AEM) surveys and shows that most of the floodplain has very high groundwater salinity (i.e. 50,000 to 90,000 µS/cm), with the flush zones recording much fresher water quality, from around close to river quality (typically <200 µS/cm) to around 5,000 µS/cm (see Figure 3.9 of **Attachment 4 – Groundwater Assessment**). Groundwater salinity in the NSW inundation areas is mapped at between 35,000 to 50,000 µS/cm, however salinity is likely to be heavily impacted by the river flush zone.

Soil salinity in the saturated and unsaturated zones was also mapped by Cullen et al. (2008). Interpreted soil salt loads in the unsaturated soil profile across most of the inundation area are shown to be very high (over 100 t/ha/m) and over 200 t/ha/m in areas of central Lindsay Island, Crankhandle, Wallawalla West and Wallawalla East. Small sections of central-south Lindsay Island and Lindsay South areas have a very significant salt store in the saturated zone (above 200 t/ha/m). Refer to Figures 3.11 and 3.12 of **Attachment 4 – Groundwater Assessment.** Cullen et al. (2008) also identified the proposed inundation area as having a moderate to very high surface salinity hazard rating.

Beneficial uses of groundwater and potential effects are further described in Part 13 of this referral.

Vegetation and habitat

The ecological significance of the Lindsay Island floodplain complex is underpinned by its unique location, providing longitudinal connection to the Murray River and its floodplains, as well as lateral connection into the semi-arid Mallee environment (Mallee CMA, 2014). The complex is contiguous with the broader Murray-Sunset National Park, which extends 100 km to the south and encompasses 666,615 ha (Parks Victoria, 2018) and provides an essential biodiversity corridor allowing for species to move between environments vital to their life-cycles (Ecological Associates, 2014a).

The floodplain incorporates a diverse range of landforms, water bodies and vegetation communities including creeks, temporary anabranches, wetlands, woodlands and grasslands, providing a mosaic of habitat types. This, in turn, supports a vast array of fauna species including many rare and threatened species listed under the EPBC Act, FFG Act and Victorian Advisory Lists as described in Section 12. Lindsay Island has a high diversity of bird fauna with 196 bird species reported from the site, with Lindsay Island and Lake Wallawalla important as habitat for both nomadic and migratory waterbirds, supporting species listed under the Japan-Australia, China-Australia and Republic of Korea-Australia migratory bird agreements. The area provides refuge in times of drought in central and eastern Australia, and important waterbird breeding and feeding habitat during inundation events (Ecological Associates, 2014a). A survey of Lake Wallawalla when it was flooded in summer 2012 recorded 17 species and 244 individuals (Henderson et al, 2012 in Mallee CMA, 2014).

The project area provides important habitat for the EPBC Act and FFG Act listed Murray Cod, Silver Perch, Freshwater Catfish and other native fish species. Mullaroo Creek supports one of the most significant populations of Murray Cod in the lower Murray River and Victoria, which exhibits significantly better structure and abundances than populations found in any other Victorian system (Saddlier et al, 2008; Sharpe et al, 2009 in Mallee CMA, 2014). Lindsay Island also provides habitat for a range of reptiles and frogs, with 28 reptile species (five species of conservation significance) and six frog species recorded, including the EPBC Act listed Growling Grass Frog (GHD, 2014a). The bat fauna of Lindsay Island is diverse and almost entirely insectivorous, with nine species having been observed at the site (GHD, 2014a). Flooding maintains the high levels of canopy and understorey productivity required to attract insect prey while trees provide roosting habitat in bark, crevices and hollows.

Lindsay Island has a diverse flora assemblage and supports numerous vegetation communities and species of conservation significance. The island supports intact remnants of river red gum (*Eucalyptus camaldulensis*) forest and woodland associated with the many creeks and anabranches across the island (including Lindsay River, Mullaroo Creek, Little Mullaroo Creek and Toupnein Creek) and large areas of black box (*Eucalyptus largiflorens*) and lignum shrubland communities associated with the higher

elevated areas (Ecological Associates, 2014a). A flora census undertaken by Australian Ecosystems (2013) identified 228 native plant species, including 45 floodplain or wetland species that are rare or threatened under the Victorian Advisory List, including seven FFG Act listed species and one EPBC Act listed species (Striate Spike-sedge (*Eleocharis obicis*)). Inundation-dependent vegetation communities that now receive only infrequent seasonal flooding are showing significant signs of stress, including reduced canopy condition in the river red gum forests and black box woodlands, and limited regeneration of the aquatic understorey, allowing terrestrial plant species to dominate (Parks Victoria, 2018)

Further detail on the native vegetation communities, and flora and fauna present within the project area is provided in Section 8 and Section 12 of this referral.

Site area (if known):

Design of the project infrastructure is being refined as part of the design process and in response to environmental and cultural heritage studies. To allow flexibility for future design changes, an area of investigation of approximately 235 ha has been established.

The proposed inundation area is estimated to be approximately 5,108 ha, including 4,845 ha in Victoria and 263 ha in NSW (202 ha of which is within the Murray River). The extent of the proposed inundation area described in this referral is indicative with the most upstream extremeties and boundaries of the inundation still to be defined.

The current construction footprint has a total area of approximately 76 ha (which includes approximately 5 km of new access tracks and 82 km of existing access tracks, accounting for 47 ha of the current construction footprint area).

The construction footprint has provided the basis for native vegetation removal calculations described in Section 12 of this referral, and may change in response to design refinements. To the extent practicable, changes to the design and construction footprint would occur within the area of investigation.

The exact location of a small number of ancillary components and temporary construction activities is yet to be confirmed and some of these may be located outside of the construction footprint or area of investigation. Where this is the case, this has been noted in Section 3 of this referral.

Route length (for linear infrastructure) …… (km) **and width** …….. (m)

N/A

Current land use and development:

The majority of the project area is located in the Murray-Sunset National Park, which is one of the largest national parks in Australia, having an area of approximately 665,400 ha. The project area is located within the Lindsay Island Visitor Experience Area, which is managed by Parks Victoria to enable 'visitors to enjoy a remote river-based experience with minimal impact on natural and cultural values'. Recreational activities include fishing, kayaking and canoeing, and bird watching.

Designated camping areas are dispersed across Lindsay Island and around Lake Wallawalla, with most camping areas being located along the Murray River, Lindsay River or Mullaroo Creek. According to data supplied by Parks Victoria, the following park visitor sites are intersected by the area of investigation or inundation area:

- A small portion of the Berribee Camping Area at the western extent is located within the area of investigation associated with the Berribee Regulator
- The Lock 7 Boat Ramp Camping Area along the Murray River is located within the area of investigation associated with an access track
- Berribee Camping Area, Mullaroo Creek Access 1, 2, 3, 4, 5, 6 Camping Area, Mullaroo Creek Boat Ramp Camping Area, The Caravan Camping Area, Channel Track Camping Area, Mullaroo Creek Camping Area, Lindsay River Pump Shed Camping Area, Army Bridge Camping Area 1 and 2, Walla

Walla Track Camping Area, Little Mullaroo Creek Junction Camping Area and Circuit Track Camping Area are partly or wholly located within the proposed inundation area.

Part of the Wallawalla West WMA inundation area is located in the Lake Wallawalla Reference Area under the *Reference Areas Act 1978,* while the area of investigation for the BERR_D containment bank and regulator adjoins the Toupnein Creek Reference Area. These reference areas are managed to retain their 'natural state' and are part of the Murray-Sunset National Park. Also within the national park are a number of licenced apiary sites, with approximately 27 of these sites located within the project area. A small part of the project area extends onto a parcel of land reserved for water management purposes adjacent to Lock 7 on the Victorian side of the Murray River. This land is managed by DELWP and contains SA Water facilities, and is surrounded by the Murray-Sunset National Park.

The main parcel of private land within the project area, is located to the south of Lindsay River and is known as Neds Corner. Although included in the Farming Zone, this land is currently owned by Trust for Nature and managed for conservation purposes. A large parcel of private land is located in the central northern part of Lindsay Island between the Murray River in the north and Sandford Track in the south. This property does not contain any dwellings or other notable development (contains a caravan and a shed) and is not within the project area.

Most of the land in NSW within the proposed inundation area was formerly part of the Lake Victoria State Forest. However, due to the NSW *National Park Estate (Riverina Red Gum Reservations) Act 2010*, this land is no longer state forest and ownership of land within the boundaries of the former Lake Victoria State Forest is intended to be transferred to traditional owners. The land is currently being held by the Minister administering the NSW *National Parks and Wildlife Act 1974*.

Description of local setting (e.g. adjoining land uses, road access, infrastructure, proximity to residences & urban centres):

The project area is located on the Murray River floodplain in the north west corner of Victoria approximately 75 km west north west of the regional town of Mildura. Mildura has a population of around 33,000 people (ABS, 2016 in R8, 2020c) and is the largest settlement of the Sunraysia region. The western extent of the project area is located within approximately 10 km of the Victoria/South Australia border and is around 30 km from the South Australian regional town of Renmark. The project area is located in the rural localities of Lindsay Point, Murray-Sunset and Neds Corner. There is no township within these rural localities, however there are a number of dwellings at Lindsay Point. The nearest town to the project area is Paringa, a small town in the Riverland of South Australia. The town supports vineyards, almonds, citrus and stone fruit orchards, and is a tourist town, which acts as a base for houseboats and paddlesteamers.

Land to the east and south west of the Murray-Sunset National Park (including Lindsay Point) are within a Farming Zone. These areas support orchard farming of nuts (mostly almonds and pistachios). The Lindsay River downstream of the proposed Berribee Regulator provides water extraction points for irrigation water supply to the Lindsay Point irrigation area, however no licensed pump sites are located within the project area. The Berribee State Forest is located south west of the area of investigation.

In NSW, land surrounding the proposed inundation areas consists of rural zoned land. Lake Victoria is a dominant feature of the surrounding area in NSW and is located approximately 3.5 km north of Lock 7. The nearest settlement of dwellings to the proposed works and inundation in NSW is within the area of Rufus.

The nearest dwellings to the proposed works include:

- Three SA Water managed caretaker's dwellings located on land adjacent to Lock 7 in the north eastern part of the project area. The nearest construction site to these dwellings (other than track works) is the BERR_F containment bank and regulator located approximately 2.1 km to the west.

- Approximately 15 dwellings scattered along the northern bank of the Murray River in NSW, with the nearest dwelling being located approximately 1.0 km north of the construction site for the CR_D drop structure, regulator and containment bank.
- Approximately 15 dwellings located within the Lindsay Point irrigation area located to the west of the project area, with the nearest dwelling being located approximately 1.7 km west of the construction site for the CW_B1 drop structure, regulator and containment bank.

The nearest dwelling to the primary construction site at Berribee Regulator is located approximately 5 km to the west. A number of buildings are located at Berribee Homestead in closer proximity to this construction site, however these buildings are currently unoccupied, Parks Victoria have advised that one of these buildings (the cottage) may be used infrequently and opportunistically by staff / contactors as an alternative to camping while working on the Lindsay Island.

The project area lies between 10 km and 20 km north of the Sturt Highway and extends north to the Murray River. The Sturt Highway is the national highway of the area and major road network link between Victoria and South Australia.

Planning context (e.g. strategic planning, zoning & overlays, management plans):

A desktop land use planning assessment has been prepared and is provided in **Attachment 5** – **Land Use Planning Assessment.**

Mildura Planning Scheme

The project is situated within the Rural City of Mildura and is therefore subject to the provisions of the Mildura Planning Scheme.

Planning policy framework

The Planning Policy Framework relevant to the project under the planning scheme is discussed in Section 4.1 of **Attachment 5 – Land Use Planning Assessment**.

Zones and overlays

The following zones and overlay apply to the land in the project area:

- Public Conservation and Resource Zone (PCRZ)
- Farming Zone (FZ)
- Environmental Significance Overlay (Schedule 1 – Murray River Corridor) (ESO1)
- Land Subject to Inundation Overlay (LSIO)
- Bushfire Management Overlay (BMO).

Refer to **Attachment 5 – Land Use Planning Assessment** for further details.

Planning permit triggers

In accordance with the controls identified in **Table 10** the project would require planning approval in relation to:

- Use
- Buildings and works, including earthworks
- Removal, destruction or lopping of native vegetation.

Table 10: Summary of potential planning approval triggers

Mildura Planning Scheme	Planning approval trigger (Y/N/NA)		
Planning control	Use	Buildings and works	Vegetation removal
Clause 36.03 Public Conservation and Resource Zone (PCRZ)	Y	Y	NA
Clause 35.07 Farming Zone (FZ)	Y	Y	NA
Schedule to the Farming Zone	N	Y (including earthworks)	N
Overlays			
Clause 42.01 Environmental Significance Overlay (Schedule 1 – Murray River Corridor) (ESO1)	NA	Y	N
Clause 44.04 Land Subject to Inundation Overlay, Schedule to the Land Subject to Inundation Overlay (LSIO)	NA	Y	N
Clause 44.06 Bushfire Management Overlay (BMO)	NA	N	N
Particular provisions			
Clause 52.17 Native Vegetation	NA	NA	Y

Further discussion of these controlling provisions, including referral and notice requirements, is provided in **Attachment 5 – Land Use Planning Assessment.**

Relevant strategies and management plans

The following Mallee CMA strategies and plans provide land use and planning objectives and plans for action associated within the region that includes the investigation area:

- River Red Gum Parks Management Plan, July 2018
- Conservation Action Plan for River Red Gum Parks, December 2019
- Mallee Regional Catchment Strategy 2013-2019
- Mallee Waterway Strategy 2014-2022
- Mallee Floodplain Management Strategy 2018-2028
- Mallee Region New Irrigation Development Guidelines 2017
- Mallee Natural Resource Management Plan for Climate Change.

NSW planning framework

The following project components extend into the NSW local government area of Wentworth Shire:

- Construction of a drop structure downstream of Regulator CR_D to discharge floodwaters from the Crankhandle Upper Tier to the Murray River. The drop structure extends down the river bank to below the normal operating water level of Lock 6 (19.25 mAHD).
- Managed inundation associated with raising the Lock 7 weir pool, including increased water levels along the Murray River behind Lock 7 and potentially upstream to Lock 8, and inundation of lower-lying billabongs and creeks on the northern side of the Murray River (e.g. Lock 7 Billabong, Horseshoe Billabong, an anabranch of the Murray River).

Development in NSW is assessed in accordance with the provisions of the *NSW Environmental Planning and Assessment Act 1979* (NSW EP&A Act) and the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation). The EP&A Act institutes a system for environmental assessment, including

approvals and environmental impact assessment for proposed developments. The need or otherwise for development control is set out in environmental planning instruments.

The key environmental planning instruments identified as relevant to the project are:

- State Environmental Planning Policy (Infrastructure) 2007 (Infrastructure SEPP (NSW))
- State Environmental Planning Policy No. 44 – Koala Habitat Protection
- Murray Regional Environmental Plan No.2 – Riverine Land
- Wentworth Local Environmental Plan 2011.

The proposed construction of Drop Structure CR_D is defined as 'water reticulation system' and would occur on land that is zoned W1 Natural Waterways under the Wentworth Local Environmental Plan 2011. A review of these environmental planning instruments has determined that the construction of Drop Structure CR_D is permissible with the consent of the Wentworth Shire Council pursuant to Clause 126A of the Infrastructure SEPP (NSW) (see **Attachment 5 – Land Use Planning Assessment**). As such, these works would require approval under Part 4 of the EP&A Act. A development application would need to be submitted to Wentworth Shire Council as the consent authority and would need to be accompanied by a Statement of Environmental Effects addressing the relevant environmental planning instruments.

The proposed NSW inundation area is located on land that is zoned W1 Natural Waterways (i.e. along the Murray River), SP2 – Infrastructure, RU3 – Forestry, and RU1 – Primary Production under the Wentworth LEP. Impacts and potential approval requirements associated with changes to the operating regime of Lock 7 and the resultant inundation area in NSW have not yet been assessed. Further assessment, including consultation with Wentworth Shire Council and other NSW regulatory authorities, is required in relation to the potential approval requirements for the NSW inundation.

Local government area(s):

Mildura Rural City Council (Victoria)

Wentworth Shire Council (NSW) – Drop Structure CR_D and 263 ha of proposed inundation area only.

8. Existing environment

Overview of key environmental assets/sensitivities in project area and vicinity (cf. general description of project site/study area under section 7)**:**

The key environmental assets and sensitivities in the project area and vicinity, include:

<u>Land tenure / conservation purposes</u>

- The project area is mostly located within the Murray-Sunset National Park gazetted under the Victorian *National Parks Act 1975* and managed primarily for conservation and some recreational purposes. Part of the Wallawalla West WMA inundation area is located within the Lake Wallawalla Reference Area under the *Reference Areas Act 1978*, while the area of investigation for the BERR_D containment bank and regulator adjoins the Toupnein Creek Reference Area. These reference areas are managed to retain their 'natural state' and are part of the Murray-Sunset National Park.
- The NSW inundation areas are mostly located on land within the former Lake Victoria State Forest, which is currently being held by the Minister administering the NSW *National Parks and Wildlife Act 1974* pending transfer to the traditional owners in accordance with the NSW *National Park Estate (Riverina Red Gum Reservations) Act 2010*.

- The majority of the area of investigation and inundation area associated with the Lindsay South WMA is located on a freehold land parcel, adjoining the Murray-Sunset National Park and known as Neds Corner, which is owned by Trust for Nature (Victoria) and managed for conservation purposes.

Biodiversity

- The proposed construction footprint contains or has the potential to impact on approximately 105.89 ha of native vegetation, including 1,071 large trees. This native vegetation includes 87.33 ha of depleted EVCs, 7.60 ha of Vulnerable EVCs and 10.95 ha of Least Concern EVCs. No endangered EVCs are identified within the proposed construction footprint.
- The proposed construction footprint contains a small area (0.03 ha) of Semi-arid Chenopod Woodland (EVC 98) that corresponds with the EPBC Act listed Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions (Endangered) and the FFG Act listed Semi-arid Shrubby Pine-Buloke Woodland Community. Targeted ground-truthing at locations within the inundation areas modelled to contain Semi-arid Chenopod Woodland (EVC 98) and Semi-arid Woodland (EVC 97) that may correspond with these EPBC Act and FFG Act listed vegetation communities, confirmed that neither of these EVCs were presented at the modelled locations. While field assessments have not been undertaken across the entire inundation area, no other EPBC Act or FFG Act listed vegetation communities are likely to occur in the inundation areas based on the modelled EVCs.
- Two FFG Act listed fauna communities are considered to be present within the construction footprint and inundation area: Victorian Temperate Woodland Bird Community and Lowland Riverine Fish Community of the Southern Murray-Darling Basin. The FFG Act listed Victorian Mallee Bird Community is likely to occur in the vicinity but not within the construction footprint and inundation area, given no mallee habitats have been identified in these areas.
- A total of 102 listed threatened flora species have been recorded or assessed as having a possible or higher likelihood of occurrence in the construction footprint, including two EPBC Act listed species, 22 FFG Act listed species and 101 rare or threatened species on the DELWP Advisory List. Refer to Appendix E of **Attachment 3 – Flora and Fauna Assessment**). Eleven listed flora species have been identified within and/or adjacent to the proposed construction footprint, including four FFG Act listed species ((*Acacia oswaldii* (Umbrella Wattle), *Crinum flaccidum* (Darling Lily), *Eremophila bignoniiflora* (Bignonia Emu-bush) and *Eremophila maculata subsp. maculata* (Spotted Emu-bush)) and seven additional DELWP Advisory List species ((*Asperula gemelli* (Twin-leaf Bedstraw) (rare), *Atriplex lindleyi subsp. conduplicata* (Baldoo) (rare), *Atriplex nummularia subsp. omissa* (Old Man Saltbush) (rare), *Calotis cuneifolia* (Blue Burr-daisy) (rare), *Eremophila divaricata subsp. divaricata* (Spreading Emu-bush) (rare), *Senecio cunninghamii var. cunninghamii* (Branching Groundsel) (rare) and *Tecticornia triandra* (Desert Glasswort) (rare)).
- A total of 104 listed threatened flora species have been recorded or assessed as having a possible or higher likelihood of occurrence in the inundation area, including two EPBC Act listed species, 22 FFG Act listed species and 103 rare or threatened species on the DELWP Advisory List. Refer to Appendix E of **Attachment 3 – Flora and Fauna Assessment**). Although targeted flora surveys have not been undertaken throughout the inundation area, targeted ground-truthing in areas modelled as containing non-flood dependent EVCs in June 2020 recorded incidental observations of four flora species listed under the DELWP Advisory List within the inundation area (*Duma horrida subsp. horrida* (Spiny Lignum) (rare), *Eremophila divaricata subsp. divaricata* (Spreading Emu-bush) (rare), *Solanum lacunariun* (Lagoon Nightshade) (vulnerable) and *Tecticornia triandra* (Desert Glasswort) (rare)). An incidental observation of *Swainsona microphylla* (Small-leaf Swainson-pea) (rare) was also recorded on higher ground adjacent to the inundation area.
- The two EPBC Act listed flora species identified as having a possible occurrence in the proposed construction footprint and inundation areas are: *Eleocharis obicis* (Striate Spike-sedge) (Vulnerable) and *Lepidium monoplocoides* (Winged Peppercress) (Endangered). No EPBC Act listed flora species have been recorded in the construction footprint during three rounds of targeted surveys in 2013, 2015 and

2019, and therefore no EPBC Act listed species are considered likely to be present in these areas. No VBA records of any EPBC Act listed flora species occur within the inundation areas. Striate Spike-sedge was recorded by Australian Ecosystems (2013) along the eastern banks of Lake Wallawalla.

- A total of 27 listed threatened fauna species have been recorded or assessed as having a possible or higher likelihood of occurrence in the construction footprint, including five EPBC Act listed species, 27 FFG Act listed species and 23 rare or threatened species on the DELWP Advisory List. A total of 46 listed fauna species, have been recorded or assessed as having a possible or higher likelihood of occurrence in the inundation area, including nine EPBC Act listed species, 38 FFG Act listed species and 39 rare or threatened species on the DELWP Advisory List. Refer to Appendix D of **Attachment 3 – Flora and Fauna Assessment**).
- Thirteen listed fauna species have been detected during surveys undertaken between 2012 and 2020, or are otherwise known to be present in project area, including:
  - Giles' Planigale (*Planigale gilesi*) – FFG Act (Listed)
  - Growling Grass Frog (*Litoria raniformis*) – EPBC Act (Vulnerable), FFG Act (Listed), DELWP Advisory (endangered)
  - Murray Cod (*Maccullochella peelii peelii*) – EPBC Act (Vulnerable), FFG Act (Listed), DELWP Advisory (vulnerable)
  - Silver Perch (*Bidyanus bidyanus*) – EPBC Act (Critically Endangered), FFG Act (Listed), DELWP Advisory (vulnerable)
  - Freshwater Catfish (*Tandanus tandanus*) – FFG Act (Listed), DELWP Advisory (endangered)
  - Murray-Darling Rainbowfish (*Melanotaenia fluviatilis*) – FFG Act (Listed), DELWP Advisory (vulnerable)
  - Unspecked Hardyhead (*Craterocephalus stercusmuscarum fulvus*) – FFG Act (Listed)
  - Regent Parrot (*Polytelis anthopeplus monarchoides*) – EPBC Act (Vulnerable), FFG Act (Listed), DELWP Advisory (vulnerable)
  - Apostlebird (*Struthidea cinerea*) – FFG Act (Listed)
  - Great Egret (*Ardea alba modesta*) – FFG Act (Listed), DELWP Advisory (vulnerable)
  - Ground Cuckoo-shrike (*Coracina maxima*) – FFG Act (Listed), DELWP Advisory (vulnerable)
  - Hooded Robin (*Melanodryas cucullata*) – FFG Act (Listed)
  - Inland Dotterel (*Charadrius australis*) –DELWP Advisory (vulnerable).
- Of the listed fauna species assessed as having a possible or higher likelihood of occurrence in the project area, 11 species were assessed as potentially impacted during construction of the project (Growling Grass Frog, Murray Cod, Silver Perch, Broad-shelled Turtle, Carpet Python, De Vis' Banded Snake, Lace Monitor, Red-naped Snake, Murray-Darling Rainbowfish, Unspecked Hardyhead, Freshwater Catfish), with six of these species also assessed as potentially impacted during operation of the project (Broad-shelled Turtle, Murray Cod, Silver Perch, Freshwater Catfish, Murray-Darling Rainbowfish, Unspecked Hardyhead).
- Lindsay Island, specifically Mullaroo Creek and the Lindsay River, supports a nationally significant native fish community, with up to 12 native species present, including the threatened species Murray Cod, Silver Perch, Freshwater Catfish and a range of small-bodied native fish. Mullaroo Creek is recognised as one of the most valuable Murray Cod populations in the southern Murray-Darling Basin, due to it being a self-sustaining population with a broad size range and a relatively high abundance of large, mature Murray Cod. Mullaroo Creek retains a relatively high snag density and water velocities are significantly faster and stage heights less variable than would occur under natural conditions, providing the ideal conditions for Murray Cod, which would once have been present in the lower 800 km of the Murray River

but following river regulation and de-snagging are now found predominately within anabranches (ARI, 2018).

- Eleven listed migratory species have been identified through a PMST search as potentially occurring in the project area: Common Greenshank (*Tringa nebularia*), Common Sandpiper (*Actitis hypoleucus*), Curlew Sandpiper (*Calidris ferruginea*), Eastern Curlew (*Numenius madagascariensis*), Fork-tailed Swift (*Apus pacificus*), Grey Wagtail (*Motacilla cinerea*), Latham's Snipe (*Gallinago hardwickii*), Osprey (*Pandion haliaetus*), Pectoral Sandpiper (*Calidris melanotos*), Sharp-tailed Sandpiper (*Calidris acuminata*) and Yellow Wagtail (*Motacilla flava*). All eleven of these species were assessed as having a possible likelihood of occurrence within the inundation area but only the Fork-tailed Swift and Osprey were assessed as having a possible likelihood of occurrence within the construction footprint. When flooded, Lake Wallawalla is known to attract a regionally significant number of waterbirds, with listed migratory species known to utilise the lake including the Great Egret and Common Greenshank, both listed under both the Japan–Australia Migratory Bird Agreement (JAMBA) and China– Australia Migratory Bird Agreement (CAMBA), and the White-bellied Sea-eagle and Caspian Tern, both listed under the CAMBA (MDBC 2006).

<u>Waterways and wetlands</u>

- The project area contains the following water bodies: the Lindsay River, Mullaroo Creek, Little Mullaroo Creek, Lindsay South Creek, Lake Wallawalla, Scotties Billabong, Billgoes Billabong, Crankhandle Wetland and various un-named wetlands across the Lindsay Island floodplain in Victoria, and the Murray River, an anabranch of the Murray River, Lock 7 Billabong and Horseshoe Billabong in NSW. Construction of proposed infrastructure would occur in the Lindsay River, Murray River, Little Mullaroo Creek, Lake Wallawalla and Billgoes Billabong, with possible access track works across Lindsay River, Mullaroo Creek and the Crankhandle Wetland.
- The project area is not located within or adjacent to any wetlands listed under the Ramsar Convention. The nearest Ramsar listed wetlands comprise the Riverland Ramsar site located approximately 10 km downstream of the project area in South Australia, which is also part of the Riverland Wetland Complex listed on A Directory of Important Wetlands in Australia (DIWA). The majority of the project area is located within the DIWA listed Lindsay Island and Lake Wallawalla wetlands. There are eight DELWP mapped wetlands within the construction footprint (approximately 1.58 ha) and 24 DELWP mapped wetlands within the inundation areas. Lindsay Island is part of the Chowilla-Lindsay-Wallpolla Icon Site, one of six icon sites identified under the Murray-Darling Basin Ministerial Council's The Living Murray Initiative.

<u>Groundwater and salinity</u>

- The project area is characterised by groundwater levels generally between 3 to 6 metres below ground surface, and highly variable groundwater salinity. Most of the floodplain has very high groundwater salinity (i.e. 50,000 to 90,000 µS/cm). Fresher flush zones are evident close to waterways where there is regular flow, with groundwater salinity in these flush zones being close to river quality (typically <200 µS/cm) up to approximately 5,000 µS/cm. Groundwater salinity in the NSW inundation areas is mapped at between 35,000 to 50,000 µS/cm, however salinity is likely to be heavily impacted by the river flush zone in these areas and is therefore likely to be lower.
- The project area is characterised by very high soil salinity in the saturated and unsaturated zones. Interpreted soil salt loads in the unsaturated soil profile across most of the inundation area are very high (over 100 t/ha/m) and over 200 t/ha/m in areas of central Lindsay Island, Crankhandle, Wallawalla West and Wallawalla East, while small sections of central-south Lindsay Island and Lindsay South areas have a very significant salt store in the saturated zone (above 200 t/ha/m). The proposed inundation area has been identified as having a moderate to very high surface salinity hazard rating (Cullen et al., 2008).

<u>Heritage and native title</u>

- The project area is located in an area of Cultural Heritage Sensitivity. A draft Cultural Heritage Management Plan (CHMP) has been prepared for the project and identified 104 Aboriginal Places within the activity area (based on the area of investigation current at the time), consisting of stone artefacts, scarred trees, earth features (hearths), shell middens and ancestral remains. The draft CHMP is currently being updated to reflect changes to the area of investigation / activity area and associated potential for impacts on Aboriginal Places, including further standard and complex field assessments, and assessment of potential for impacts on Aboriginal Places within the inundation areas.
- The whole of the project area within Victoria is subject to a native title claim by the First Peoples of the Millewa-Mallee (VC2015/001) under the Commonwealth *Native Title Act 1993* and a request by the First Peoples of the Millewa-Mallee Traditional Owner Group to negotiate a Recognition and Settlement Agreement with the State of Victoria under the Victorian *Traditional Owner Settlement Act 2010*.
- There are no places listed on the Victorian Heritage Register (VHR), Victorian Heritage Inventory (VHI), Mildura Planning Scheme Heritage Overlay (HO), World Heritage List, National Heritage List or Commonwealth Heritage List located within or adjacent to the area of investigation. One unlisted potential historical heritage place (Berribee Homestead Complex) is located in the area of investigation. While not listed on any heritage registers/lists, the Berribee Homestead Complex has been assessed as having high local significance and was recommended for inclusion on the Mildura Planning Scheme heritage overlay (Bell, 2013a). A review of construction laydown requirements for the Berribee Regulator has determined that use of the area containing the Berribee Homestead Complex is not likely to be required and as such, this area is likely to be excluded from the final construction footprint to avoid direct impacts on this unlisted historical heritage place.
- There are no places listed on the VHR, HO, World Heritage List, National Heritage List or Commonwealth Heritage List located within the inundation area. Three listed historical heritage places have been identified within the inundation area, including two places listed on the VHI (Lindsay Creek North Ferry Crossing (VHI H7129-0001), Lindsay Creek South Ferry Crossing (VHI H7129-0002)) and one place listed on the non-statutory Register of the National Estate (RNE) (Lock and Weir No 7 (RNE101494)). An additional two unlisted potential historical heritage places (Berribee Station Barge and Baggot's Cattle Station) have also been identified in the inundation area.

<u>Landscape and zoning</u>

- The project area is identified by the Environmental Significance Overlay (Schedule 1 – Murray River Corridor) (ESO1) as having landscape values of local, regional, state, national and potentially international importance. The River Red Gum Parks Management Plan, July 2018 (Parks Victoria, 2018) indicates that Lindsay, Mulcra and Wallpolla Islands have been assessed as supporting visually significant landscapes and views, and nationally significant geological and geomorphological features (scroll plains, anabranch and channels).
- The project area is mostly included in the Public Conservation and Resource Zone, with a minor portion included in the Farming Zone, and is subject to an Environmental Significance Overlay (ESO1), Land Subject to Inundation Overlay and Bushfire Management Overlay under the Mildura Planning Scheme. Within NSW, a very small part of the construction footprint is zoned W1 - Natural Waterways under the Wentworth Local Environmental Plan 2011, while the NSW inundation area is zoned W1 - Natural Waterways, R3 – Forestry, RU1 – Primary Production and SP2 - Infrastructure.

<u>Soils</u>

- The project would involve construction works in areas containing potentially erosive / dispersive soils and potential acid sulphate soils as described in Section 14 of this referral.

9. Land availability and control

Is the proposal on, or partly on, Crown land?

☐ No ☒ Yes If yes, please provide details.

The project is located on both Crown land and freehold land in Victoria and NSW.

Almost all of the Crown land in Victoria is reserved under the *Crown Land (Reserves) Act 1978* for permanent national park (i.e. Murray-Sunset National Park), and is under the ownership and management of Parks Victoria. Murray-Sunset National Park is included in schedule 2 of the *National Parks Act 1975* and is managed by Parks Victoria in accordance with the *National Parks Act 1975* and the River Red Gum Parks Management Plan, July 2018 (Parks Victoria, 2018).

A small part of the area of investigation associated with an access track and a small area of inundation, extends onto a Crown land parcel adjacent to the Victorian side of Lock 7, which is reserved for temporary public purposes (water management) under the *Crown Land (Reserves) Act 1978* and is managed by DELWP. This Crown land parcel contains SA Water managed facilities.

A small part of the project area (one drop structure and approximately 263 ha of inundation area) is located on NSW Crown land. Most of this land is within the bed and banks of the Murray River, however some inundation would also occur on Crown land formerly part of the Lake Victoria State Forest, which has been reserved under Schedule 6 of the NSW *National Park Estate (Riverina Red Gum Reservations) Act 2010* for transfer to traditional owner management but is currently managed by the Minister administering the NSW *National Parks and Wildlife Act 1974* (NPW Act).

Further details of Crown land parcels affected by the project are provided in **Attachment 5 – Land Use Planning Assessment**.

Current land tenure (provide plan, if practicable):

The majority of the proposed works and inundation areas are located on Victorian Crown land within the Murray-Sunset National Park, except for:

- Most of the proposed works and inundation areas associated with the Lindsay South WMA, which are located on one parcel of private freehold land known as Neds Corner, owned by Trust for Nature (Victoria) and managed for conservation purposes
- A small area of proposed inundation and a short section of existing access track located on one parcel of Victorian Crown land reserved for public purposes (water management) adjacent to Lock 7, which contains SA Water managed facilities
- A section of the existing Berribee Homestead Track, which traverses one parcel of private freehold land and is proposed to be used for construction and operation of the project
- Parts of the proposed inundation area along Old Mail Road, which comprises a parcel of freehold land where it passes through the national park that is owned by the Mildura Rural City Council
- One drop structure (CR_D) located down the bank of the Murray River onto NSW Crown land and the NSW inundation area, which is located mostly within the Murray River along with some NSW Crown land currently managed by the Minister administering the NSW NPW Act, and one parcel of private freehold land in NSW.

Further details on land tenure is provided in **Attachment 5 – Land Use Planning Assessment**.

Intended land tenure (tenure over or access to project land):

The project does not propose any changes to current land tenure.

Other interests in affected land (e.g. easements, native title claims):

Native title

A search of the National Native Title Tribunal (NNTT) online register and maps shows:

- Native title claim VC2015/001 under the *Native Title Act 1993* is active over all of the land within the area of investigation and proposed inundation areas in Victoria. The claim was lodged by the First Peoples of the Millewa-Mallee on 10/8/2015 and accepted for registration. First Peoples of the Millewa-Mallee therefore have procedural rights in relation to any activities in this area that would extinguish or be inconsistent with native title rights and interests.
- Native title determination NPD2004/001 under the *Native Title Act 1993* applies to land in NSW along the Rufus River and over Lake Victoria in the vicinity of but not within the proposed inundation areas. The determination applies to the Barkandji (Paakantyi) People #11 and is dated 16/2/2004 and determined that Native Title does not exist on the land.
- Native title determination NCD2015/001 under the *Native Title Act 1993* applies to land in NSW adjacent to the Rufus River and Lake Victoria, in the vicinity of but not within the proposed inundation areas. The determination applies to the Barkandji Traditional Owners #8 (Part A) and is dated 16/6/2015 and determined that Native Title does exist over the entire determination area.
- Native title determination SCD2011/002 under the *Native Title Act 1993* applies to land along the Murray River in South Australia that is downstream of but not within the project area. The determination applies to the First Peoples of the River Murray & Mallee Region and is dated 18/11/2011 and determined that Native Title does exist in parts of the determination area.
- Indigenous Land Use Agreement NI2018/007 (Barkandji Interim Licences ILUA) was registered in 2018 to the Minister administering the NSW Crown Lands Act and relates to interim licences for extraction on land associated with Native Title determination NCD2015/001.
- Indigenous Land Use Agreement SI2011/025 (The River Murray Crown Lands ILUA) was registered in 2012 to the Attorney-General for the State of South Australia and relates to a large area of land in South Australia extending west from the Victorian and NSW borders, including the Murray River and floodplain.

All of the land within the area of investigation and proposed inundation areas in Victoria is also subject to a First Peoples of the Millewa-Mallee Traditional Owner Group request to negotiate a Recognition and Settlement Agreement (RSA) with the State of Victoria under the *Traditional Owner Settlement Act 2010*. The State's decision on whether to commence settlement negotiations is currently pending.

The location of relevant native title interests is shown in Figure 3.3 of **Attachment 5 – Land Use Planning Assessment.**

Easements

Two freehold land parcels containing sections of Old Mail Road are encumbered with easements, mostly for power supply along with water supply, drainage and carriageway purposes.

Further details on relevant encumbrances applying to land within the project area are provided in **Attachment 5 – Land Use Planning Assessment**. On initial review, it is not expected that the project would contravene the intentions of registered instruments on titles. It is however a requirement of the Crown Grant for 6578 Old Mail Road, Neds Corner that all affected parties be notified of the project.

10. Required approvals

State and Commonwealth approvals required for project components (if known):

The following Victorian State and Commonwealth assessments, notifications and approvals are likely to be required for the project:

Commonwealth

- Referral to the Minister for the Environment under the EPBC Act to determine whether the project is a controlled action requiring formal assessment and approval under the Act (concurrent to this referral)
- Notification of a 'future act' under the *Native Title Act 1993* (Cth) for activities on Crown land that may affect native title rights and interests
- Notification of the MDBA of a proposal which may affect the flow, use, control or quality of any water in the upper River Murray under clause 49 of Schedule 1 of the *Water Act 2007*.

Victoria

- Referral (this document) to the Minister for Planning (via DELWP) under the *Environment Effects Act 1978* to determine whether or not an Environment Effects Statement is required for the project
- A planning scheme amendment or planning permit under the Mildura Planning Scheme, pursuant to the *Planning and Environment Act 1987*
- A Cultural Heritage Management Plan developed in consultation with the First People of the Millewa-Mallee Aboriginal Corporation (FPMMAC) as the Registered Aboriginal Party for the project area and approved by Aboriginal Victoria under the *Aboriginal Heritage Act 2006* and *Aboriginal Heritage Regulations 2018*
- Consent from Parks Victoria under section 27 of the *National Parks Act 1975*
- A licence or lease from Parks Victoria under section 17 of the *Crown Land (Reserves) Act 1978*
- Consent from the Reference Areas Advisory Committee to undertaken managed inundation within the Lake Wallawalla Reference Area under the *Reference Areas Act 1978*
- Licence to take and use water (s51) and licence to construct works (s67) from Lower Murray Water under section 51 of the *Water Act 1989*
- Works on waterways permit from Mallee CMA under section 188 of the *Water Act 1989* and Mallee CMA By-law No.1 Waterways Protection 2014
- Permit to take protected flora on Crown land from DELWP under the *Flora and Fauna Guarantee Act 1988.*

Other legislation

Other environmental legislation of potential relevance to the project includes, but is not limited to:

Commonwealth

- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984.*

Victoria

- *Catchment and Land Protection Act 1994*
- *Environment Protection Act 1970* (or *Environment Protection Act 2017* post 1 July 2021)
- *Fisheries Act 1995*
- *Heritage Act 2017*

- *Land Act 1958*
- *Mineral Resources (Sustainable Development) Act 1990* (a Work Plan and/or Work Authority may be required for the borrow pits to be established for the project, however as borrow pit locations are not yet known this has not yet been assessed)
- *Road Management Act 2004*
- *Transport Integration Act 2010 and / or Marine Safety Act 2010*
- *Wildlife Act 1975.*

NSW

NSW approval requirements for the construction of Drop Structure CR_D are described in **Attachment 5 – Land Use Planning Assessment**. Further assessment, including further consultation with NSW regulatory authorities, is required in relation to the potential approval requirements for the NSW inundation. Potentailly relevant NSW legislation includes:

- *Biodiversity Conservation Act 2013*
- *Crown Lands Management Act 2016*
- *Environmental Planning and Assessment Act 1979*
- *Fisheries Management Act 1994*
- *Heritage Act 1977*
- *Maritime Safety Act 1998*
- *National Parks and Wildlife Act 1974*
- *Water Management Act 2000.*

Have any applications for approval been lodged?

☒ No ☒ Yes If yes, please provide details.

No applications for approval of the project have been lodged to date.

Approval agency consultation (agencies with whom the proposal has been discussed):

The VMFRP is managed by a partnership team comprised of LMW, GMW, North Central CMA, Mallee CMA and Parks Victoria. Each of these agencies are represented on the VMFRP Program Control Group, but also have a separate regulatory approvals function for the VMFRP projects. DELWP Water is the Program Owner. DELWP also has a separate regulatory approvals function for the VMFRP projects.

As part of broad stakeholder engagement activities undertaken between 2012 and 2014 to support the SDL Adjustment Lindsay Island Floodplain Management Project Business Case, Mallee CMA also consulted with Mildura Rural City Council, GMW, SA Water and Parks Victoria.

During 2015 to 2017, engagement activities were undertaken in the form of monthly Steering Committee meetings with Mallee CMA, MDBA, Parks Victoria, GMW and DELWP.

The VMFRP has since established a Technical Advisory Group – Regulatory Approvals Committee (Approvals TAG) to advise on regulatory approval requirements through the planning and design of the project. In addition to the partnership agencies, regulatory approval agencies currently represented on the Technical Advisory Group include:

- Aboriginal Victoria
- DELWP (Impact Assessment Unit, Planning, Regional)
- Department of Agriculture, Water and the Environment (DAWE).

An overview of the VMFRP projects was presented to the TAG at a meeting held on 8 August 2019.

In addition, a Design TAG operates concurrently which has representation from the following:

- DELWP
- GMW
- LMW
- Mallee CMA
- North Central CMA
- MDBA
- Parks Victoria
- SA Water.

Other agencies consulted:

In addition to the above, the following NSW regulatory approval agencies have been consulted with generally in relation to the VMFRP:

- NSW Department of Planning, Industry and Environment (NSW DPIE)
- NSW Natural Resources Access Regulator (NSW NRAR)
- NSW Department of Primary Industries (NSW DPI) Fisheries
- NSW National Parks and Wildlife Service (NSW NPWS).

PART 2 POTENTIAL ENVIRONMENTAL EFFECTS

11. Potentially significant environmental effects

Overview of potentially significant environmental effects (identify key potential effects and comment on their significance and likelihood, as well as key uncertainties):

An assessment of the potential construction and operational impacts of the project is provided in Sections 12 – 16 of this referral. Key potential effects and uncertainties are summarised below.

Potential impacts on native vegetation

Construction

Native vegetation within the proposed construction footprint has been subject to desktop and field assessment. Field assessment of native vegetation (habitat hectares) and large tree data is based on 2015 field assessments of the construction footprint current at that time. Some changes to the construction footprint have occurred since 2015 such that approximately 8.15 ha of the current construction footprint would require further assessment of native vegetation and large trees. Modelled EVC data has been used to estimate native vegetation and large tree impacts in this area, which is mostly located along access tracks.

Efforts have been made to avoid and minimise impacts to native vegetation throughout the project planning and design process and are described in Section 12 of this referral. Despite the measures taken to avoid and minimise impacts to native vegetation, it is not feasible to construct the required infrastructure without removing native vegetation. Requirements for vegetation removal would be further assessed and minimised through the detailed design process.

Approximately 105.89 ha of native vegetation, including 1,071 large trees is proposed to be impacted based on the current proposed construction footprint. This native vegetation includes 87.33 ha of depleted EVCs, 7.60 ha of Vulnerable EVCs and 10.95 ha of Least Concern EVCs. No endangered EVCs are identified within the proposed construction footprint. Within the total area of native vegetation impacts, there is 64.26 ha of native vegetation within, or with tree protection zones (TPZs) potentially impacted by, the construction footprint of proposed infrastructure, including 482 large trees. This includes 55.75 ha of depleted EVCs, 1.88 ha of Vulnerable EVCs and 6.62 ha of Least Concern EVCs. No endangered EVCs are identified within the construction footprint of proposed infrastructure. The construction footprint for proposed infrastructure is 28.86 ha, which includes a working buffer around proposed infrastructure and the temporary laydown areas at Berribee Regulator. The development footprint of permanent infrastructure based on the current design is 13.47 ha. This means there is scope within the remaining 15.39 hectares of construction footprint to further avoid or minimise native vegetation impacts through micro-siting working areas around infrastructure, and an opportunity for native vegetation to be reinstated in these working buffers and temporary laydown areas on completion of construction. The estimated vegetation removal area also assumes that vegetation located outside the construction footprint would be 'lost' where the TPZ of adjacent trees extends into the construction footprint. This is a conservative estimation of vegetation removal for the current construction footprint as a proposed assessment by a qualified arborist would identify opportunities for adjacent vegetation to be retained.

In addition to native vegetation impacts associated with the construction footprint of proposed infrastructure, there is 41.63 ha of native vegetation, including 589 large trees, within a 5 m wide corridor along sections identified for minor track works and a 10 m wide corridor along sections of new tracks and existing tracks requiring more substantial works. This includes 31.58 ha of depleted EVCs, 5.72 ha of Vulnerable EVCs and 4.33 ha of Least Concern EVCs. No endangered EVCs are identified within the construction footprint of access tracks proposed to be used by the project. The scope and requirement for works along access tracks is still to be confirmed and would be designed to avoid and minimise impacts on native vegetation and heritage values. For approximately 60% (or 50 km) of access tracks, track works would be limited to minor maintenance / upgrades of existing tracks to a width of 5 m, which in many instances is likely to only require lopping of branches for existing vegetation along the edges of tracks.

Assessment by a qualified arborist is proposed along existing and proposed access tracks to assess potentially impacted trees and to advise on methods by which they could be retained.

Infrastructure construction and access related impacts on the identified EVCs are relatively small when weighed against the ecological benefits to these EVCs that would be derived from environmental watering that reinstates more natural flooding patterns that meet their hydrological requirements. For example, approximately 7.21 hectares of the vulnerable Lignum Swamp (EVC 104) and 0.39 hectares of the vulnerable EVC Alluvial Plains Semi-arid Grassland (EVC 806) may be impacted by construction. Approximately 163.8 hectares of Lignum Swamp (EVC 104) and 656.8 hectares of Alluvial Plains Semi-arid Grassland (EVC 806) are modelled to occur in the inundation area and, as inundation dependent EVCs, are expected to receive long term benefits from environmental watering.

From a landscape perspective the proposed construction footprint, scattered across approximately 30 discrete sites or along the edges of access tracks, represents a comparatively small area within the approximately 15,000 hectares of largely intact vegetation across Lindsay Island and compared to the 4,845 ha inundation area targeted for restoration.

Operation

Vegetation communities within the inundation area have been identified based on modelled EVC data and targeted ground-truthing of areas modelled as non-flood dependent EVCs and gaps in EVC mapping.

The proposed inundation targets seven water regime classes, comprised of 17 EVCs, on the Lindsay Island floodplain for restoration: Watercourses, Semi-permanent Wetlands, Temporary Wetlands, Red Gum Forest and Woodland, Lignum Shrubland and Woodland, Black Box Woodland and Alluvial Plains. As discussed in Section 3 of this referral, the preferred frequency, duration and timing of flooding for each water regime class targeted for restoration by the project, has been determined through a series of studies undertaken by Ecological Associates (2006, 2007, 2014a and 2015) by analysing where each EVC associated with the water regime class occurred on the floodplain (mapped extent, elevation range) supported by hydrological modelling (Gippel, 2014, Water Technology, 2014 & 2016) to determine the Murray River flow threshold that would have flooded these elevation ranges under natural, pre-regulation conditions.

The majority of EVCs modelled to occur in the inundation area are inundation dependent and fall within the water regime classes identified for restoration through reinstatement of more natural flooding patterns that meet their water requirements. Two EVCs modelled to occur in the inundation area, are not inundation dependent: Semi-arid Woodland (EVC 97) and Semi-arid Chenopod Woodland (EVC 98). Targeted ground-truthing in June 2020 confirmed that these EVCs are not present within or immediately adjacent to the modelled locations within the inundation area. The vegetation present in these areas was usually found to be Riverine Chenopod Woodland (EVC 103), Lignum Shrubland (EVC 808) and occasionally Alluvial Plains Semi-arid Grassland (EVC 806), which are located on alluvial terraces prone to flooding, and fall within the water regime classes expected to benefit from environmental watering.

Arthur Rylah Institute (ARI) has developed a draft Monitoring, Evaluation and Reporting (MER) Plan designed to collect baseline condition data that would enable ongoing condition monitoring to be undertaken across the project area. This monitoring would facilitate measurement of the expected gains in the health and condition of native vegetation within the inundation area and inform adaptive management of environmental watering (e.g. changes to frequency, duration, timing of watering based on monitored ecological responses).

Additional details on the potential vegetation impacts are provided in Section 12 and in **Attachment 3 – Flora and Fauna Assessment** of this referral.

Potential impacts on listed threatened species and communities, and listed migratory species

The proposed construction footprint and adjacent areas has been subject to targeted flora and fauna surveys. Previous ecological studies (described in Section 12) were used to inform the additional targeted threatened flora and fauna surreys. Targeted flora surveys were undertaken in October 2019 and June

2020, and targeted fauna surveys were undertaken in November/December 2019 and January 2020. A desktop assessment of potential impacts on listed threatened species and communities, and listed migratory species has been undertaken for the inundation area.

Further vegetation assessments, including recording threatened flora species, are proposed at targeted sampling locations within the inundation areas to reduce uncertainties in relation to potential presence / impacts on threatened species and communities during operation of the project (see Section 20). In addition, further assessment is also proposed in some areas of vegetation adjacent to the proposed inundation area that have been identified as potentially impacted through near-surface salinisation (see **Attachment 4 – Groundwater Assessment**). These further assessments would inform assessment of the nature and extent of potential impacts from near-surface salinisation on native vegetation, threatened species and communities in these areas. If further assessment identifies that changes to soil or groundwater salinity would adversely impact native vegetation, then additional mitigation measures would need to be developed and implemented as a part of the project through the Environmental Water Management Plan (EWMP), Operating Plan and the draft VMFRP MER Plan.

Listed threatened flora communities

A small area (approx. 0.03 ha) of Semi-arid Chenopod Woodland (EVC 98) identified at the CW_B2 regulator and containment bank construction site in the Crankhandle West WMA, corresponds with both the EPBC Act listed threatened ecological community (Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions (Endangered)) and the FFG Act listed Semi-arid Shrubby Pine-Buloke Woodland Community. This area of Semi-arid Chenopod Woodland (EVC 98) is not within the construction footprint of the proposed regulator or containment bank, and is located on the opposite side of an existing access track to the proposed infrastructure. Significant track works are not anticipated to be required at this location and as such, it is likely that an arborist assessment combined with minor design refinements, would avoid impacts to this small area of Semi-arid Chenopod Woodland (EVC 98).

Targeted ground-truthing in areas modelled as Semi-arid Chenopod Woodland (EVC 98) or Semi-arid Woodland (EVC 97) in the inundation area has confirmed that vegetation in these areas is not consistent with these non-flood dependent EVCs or any listed threatened flora communities. Whilst the full extent of the inundation area was not assessed as a part of the EVC ground-truthing exercise, based on a desktop review of the available information and observations made during the fieldwork, it is considered unlikely that any listed flora communities are present within the proposed inundation area. As such, the project is not likely to have a significant adverse impact on any listed threatened flora communities through construction or operation.

Listed threatened fauna communities

Two FFG Act listed fauna communities are considered to occur within the construction footprint and inundation area: Victorian Temperate Woodland Bird Community (VTWBC) and Lowland Riverine Fish Community of the Southern Murray-Darling Basin (LRFC).

Given that Lindsay Island is comprised of largely intact vegetation, the proposed construction of floodplain infrastructure scattered across approximately 30 relatively small and discrete locations is unlikely to cause habitat fragmentation or remove important habitat for the FFG Act listed VTWBC. The reinstatement of a more natural hydrological regime for floodplain and wetland habitats, would also likely provide important future benefits to the resilience and persistence of the VTWBC, particularly under climate change scenarios of longer, drier conditions in a semi-arid environment.

The project has the potential to both positively and negatively impact the FFG Act listed LRFC, which includes as constituent species, the FFG Act listed Murray Cod, Silver Perch, Murray-Darling Rainbowfish, Unspecked Hardyhead and Freshwater Catfish that are known to occur in the project area. Operation of the project has the potential to restore semi-permanent wetlands that support small-bodied fish and to allow for protection of existing high value fish communities, including threatened fish species. However, operation of the larger inundation scenarios has the potential to impact on the fast-flowing habitat of the Lindsay-Mullaroo system, which would have a significant impact on an important population

of Murray Cod, along with Silver Perch, and impacts on other listed threatened fish species that form part of this listed community. Key to protecting the FFG Act listed LRFC, is the operation of the system to maintain the permanent fast-flowing habitats in Mullaroo Creek and the upper Lindsay River. The extent of impacts on the FFG Act listed LRFC would depend on the frequency, duration, timing and magnitude of reduced flow velocities in the Lindsay-Mullaroo system, which would be determined following further assessment and refinements to the draft operating scenarios.

Proposed mitigation measures to avoid or minimise impacts to threatened communities are described in Section 12 and would be further informed by the additional investigations described in Section 20 of this referral.

Listed threatened flora species

Desktop searches (VBA and PMST) identified 133 listed threatened flora species that have been recorded or are modelled to potentially occur within 10 km of the project area. Based on assessment of the habitat requirements for each species compared to the habitats encountered within the proposed construction footprint and inundation area:

- Two EPBC Act listed species, 22 FFG Act listed species and 101 rare or threatened species on the DELWP Advisory List have been recorded or assessed as having a possible or higher likelihood of occurrence in the construction footprint
- Two EPBC Act listed species, 22 FFG Act listed species and 103 rare or threatened species on the DELWP Advisory List have been recorded or assessed as having a possible or higher likelihood of occurrence in the inundation area.

Of these species, 11 listed flora species (including four FFG Act listed species and no EPBC Act listed species) were assessed as potentially impacted during construction of the project. The FFG Act listed species were *Acacia oswaldii* (Umbrella Wattle), *Crinum flaccidum* (Darling Lily), *Eremophila bignoniiflora* (Bignonia Emu-bush) and *Eremophila maculata subsp. maculata* (Spotted Emu-bush). Each of these species, along with the other seven DELWP Advisory List species, were recorded within or adjacent to the construction footprint during targeted surveys in 2019. Proposed mitigation measures to avoid or minimise impacts to these species are described in Section 12 of this referral.

The two EPBC Act listed flora species assessed as having a possible occurrence within the construction footprint and inundation area were: *Eleocharis obicis* (Striate Spike-sedge) and *Lepidium monoplocoides* (Winged Peppercress). Although some suitable habitat is present, these species were not recorded within the construction footprint during targeted flora surveys in 2013, 2015 or 2019 and are therefore unlikely to be impacted. If present in the inundation area, the reinstatement of a more natural wetting / drying regime is likely to be beneficial to these species persisting in the area, given their survival and potential breeding is dependent on a wetting phase.

Although targeted flora surveys have not been undertaken throughout the inundation area, targeted ground-truthing of vegetation in areas modelled as containing non-flood dependent EVCs has confirmed that these EVCs were not present and that vegetation in these areas, along with EVCs modelled to occur in the remaining inundation areas, comprise inundation dependent EVCs. As such, the reinstatement of a more natural hydrological regime to these vegetation communities is expected to be largely beneficial to listed flora species associated with the communities, which are considered to be the listed flora species most likely to occur in these areas. However, altering the hydrological regimes in the project area may cause minor negative impacts to some terrestrial species that have adapted to drier conditions, although impacts are likely to be short term; and it is considered unlikely that the proposed environmental watering would have a negative impact on the ongoing survival of any populations of listed flora that may be present in (or that may colonise) the inundation area.

Listed threatened fauna species

Desktop searches (VBA and PMST) identified 64 listed threatened fauna species that have been recorded or are modelled to potentially occur within 10 km of the project area. Based on assessment of

the habitat requirements for each species compared to the habitats encountered within the proposed construction footprint and inundation area:

- Five EPBC Act listed species, 27 FFG Act listed species and 23 rare or threatened species on the DELWP Advisory List have been recorded or assessed as having a possible or higher likelihood of occurrence in the construction footprint
- Nine EPBC Act listed species, 38 FFG Act listed species and 39 rare or threatened species on the DELWP Advisory List have been recorded or assessed as having a possible or higher likelihood of occurrence in the inundation area.

Thirteen listed fauna species have been recorded within the project area during surveys between 2012 and 2020 or are otherwise known to occur in the project area, including four EPBC Act / FFG Act listed species (Regent Parrot, Growling Grass Frog, Murray Cod, Silver Perch), eight additional FFG Act listed species (Giles' Planigale, Apostlebird, Great Egret, Ground Cuckoo-shrike, Hooded Robin, Murray-Darling Rainbowfish, Unspecked Hardyhead and Freshwater Catfish) and one species listed on the DELWP Advisory List only (Inland Dotterel). Of the listed fauna species known to occur or assessed as having a possible occurrence in the construction footprint, 10 FFG Act listed species (including three EPBC Act listed species) were assessed as potentially impacted during construction of the project, with six of these species also assessed as potentially impacted during operation of the project.

FFG Act listed species such as Carpet Python, Lace Monitor and Red-naped Snake were assessed as potentially impacted by construction, due mainly to the removal of habitat (hollow-bearing trees). Impacts on these species are not likely to be significant as these species are moderately mobile and suitable habitat is surrounding and widespread. The EPBC Act / FFG Act listed Growling Grass Frog, Murray Cod and Silver Perch, and FFG Act listed Broad-shelled Turtle, Murray-Darling Rainbowfish, Unspecked Hardyhead and Freshwater Catfish, were assessed as potentially impacted by construction, due mainly to cofferdam construction, dewatering works, and potential for sediment/ contaminant run-off from construction sites into wet areas. Impacts on these species during construction are not likely to be significant, although further assessment is required to determine the extent of impacts associated with construction of the Berribee Regulator (e.g. dewatering strategy, width/duration of temporary barriers across the Lindsay River). Proposed mitigation measures to avoid or minimise impacts to these species during construction are described in Section 12 of this referral.

During operation, most of the listed fauna species expected to occur in the inundation area are likely to benefit, with the Growling Grass Frog and Broad-shelled Turtle likely to benefit directly from expanded habitat when environmental water is present, and indirectly from improved habitat condition following environmental watering. Carpet Python, Lace Monitor and Red-naped Snake are also likely to benefit from improved habitat condition following environmental watering.

Listed fish species such as Murray-Darling Rainbowfish, Unspecked Hardyhead and Freshwater Catfish would likely benefit from restoration of semi-permanent wetland habitat in the inundation area, provided that drawdown of managed inundation events and operation of the Berribee Regulator fishway are appropriately managed to minimise the potential for stranding of these species on the floodplain, and to facilitate unrestricted movement and escape along the Lindsay River in the event of a blackwater event. Measures to reduce the risk of carp proliferation are also proposed to mitigate potential impacts on these species.

Minimisation of carp proliferation, managed drawdown, fishway operation and exit strategies to escape blackwater events are also important to mitigating potential impacts on the Murray Cod and Silver Perch. However, the operation of the Berribee Regulator for larger inundation areas (Berribee Maximum, higher level Berribee Intermediate) would reduce fast-flowing habitat in the Lindsay-Mullaroo system that supports a nationally important population of Murray Cod as well as the critically endangered Silver Perch, which is likely to significantly impact on these species. The extent of impacts on these listed fish species would depend on the frequency, duration, timing and magnitude of reduced flow velocities in the

Lindsay-Mullaroo system, which would be determined following further assessment and refinements to the draft operating scenarios.

Two other EPBC Act / FFG Act listed species known to occur or having a possible occurrence in the project area are the Regent Parrot and Painted Honeyeater. Construction works for the project would involve removal of native vegetation including large trees, which provide habitat for these species. Construction and operation of the project are however not considered likely to significantly impact on these species provided the recommended mitigation measures are implemented, given that:

- No known Regent Parrot nesting trees would be removed based on the findings of targeted nesting surveys in areas of potentially suitable breeding habitat within and adjacent to the construction footprint. Surveys using the 2-hr point count method (Robertson and Hurley 2010) were conducted within suitable habitat (large River Red Gum habitats along watercourses) within the breeding season in 2019 (R8, 2020d) and 2012 (GHD, 2013b). No nesting colonies were recorded during these surveys. An additional repeat survey within potential habitat surrounding proposed infrastructure is planned for September/October 2020. Two observations of nesting by Regent Parrots have been observed close to Lock 7 (near the mouth of the Mullaroo Creek) in 1983 and 1984, which are likely the same birds in the same tree as Regent Parrots are known to exhibit site fidelity. Presently, there are no known nesting colonies within or adjacent to the construction footprint or access tracks.
- These species are highly mobile and wide-ranging and suitable habitat is surrounding and widespread, while the removal of vegetation would be scattered across 30 relatively small, discrete sites or along the edge of mostly existing tracks in the context of extensive areas of largely intact native vegetation at Lindsay Island (over 15,000 ha) and the even more extensive Murray-Sunset National Park and Murray River corridor.
- Reinstatement of a more natural hydrological regime would likely benefit these species by improving the health and condition of floodplain vegetation, including large, old River Red Gum trees relied on by Regent Parrot for breeding.

The four other EPBC Act listed species identified as possibly occurring in the proposed inundation area are waterbirds and are therefore likely to benefit from more frequent inundation of wetlands and floodplain habitats. Other FFG Act listed species identified as possibly occurring in the proposed construction footprints or inundation areas are highly mobile bird species and moderately mobile reptile species that all have access to large areas of suitable habitat in the immediate surrounding areas in which to disperse. These species may experience some localised loss of habitat and temporary displacement or disturbance during construction, but any impacts are expected to be negligible.

Proposed mitigation measures to avoid or minimise impacts to threatened fauna species are described in Section 12 and would be further informed by the additional investigations described in Section 20 of this referral.

Listed migratory species

Eleven EPBC Act listed migratory species modelled to potentially occur within 10 km of the project area were considered to have a possible or higher likelihood of occurrence in the proposed inundation areas. Eight of these listed migratory species are wading shore-birds (Common Greenshank, Common Sandpiper, Curlew Sandpiper, Eastern Curlew, Pectoral Sandpiper, Sharp-tailed Sandpiper, Fork-tailed Swift, Latham's Snipe) and along with the two species of Wagtail (Grey and Yellow), are likely to benefit from the reinstatement of more frequent inundation of their preferred wetland and mudflat habitats in areas such as Lake Wallawalla.

Only two EPBC Act listed migratory species (Fork-tailed Swift and Osprey) were assessed as having a possible likelihood of occurrence within the construction footprints. These species may fly over the construction footprint whilst foraging, but are considered unlikely to be impacted, as both species are highly mobile, wide-ranging, and suitable habitat is surrounding and widespread. The other listed migratory species identified on the PMST were considered unlikely to occur within the construction

footprints during the time of the survey, mostly due to the lack of recent records and/or a lack of suitable habitat present. While suitable habitat for these mostly migratory wading shore-birds may be present in some construction footprints (e.g. Lake Wallawalla) when water is present, it is intended that construction works would be undertaken during dry periods when sufficient water to attract these species is unlikely to be present and therefore direct impacts on these species are unlikely to occur during construction.

There is potential for the introduction of environmental water to lead to an increase in feral predators (cats, foxes), herbivores (e.g. goats) and omnivores (e.g. pigs) due to the associated increase in floodplain productivity. Some of these species, such as feral cats, could potentially prey on waterbirds, woodland birds, small mammals, reptiles and frogs that may respond to environmental watering of wetlands and floodplain habitats. A pest animal management and control program, developed in consultation with Parks Victoria, would need to be implemented and funded to expand current pest control programs within the Murray-Sunset National Park to target increases in pest species during and following inundation events.

Additional details on potential impacts on listed threatened species and communities, and listed migratory species are provided in Section 12 and in **Attachment 3 – Flora and Fauna Assessment** of this referral.

Potential impacts on water environments

Surface water

Waterways and wetlands potentially affected by the project due to works being undertaken within or adjacent to the water bodies, or due to operational inundation or potential for direct/indirect discharges to the water bodies, include: the Lindsay River, Toupnein Creek, Mullaroo Creek, Little Mullaroo Creek, Lindsay South Creek, Lake Wallawalla and various wetlands across the Lindsay Island floodplain in Victoria, and the Murray River, an anabranch of the Murray River, Lock 7 Billabong and Horseshoe Billabong in NSW. The project area is not located within or adjacent to any wetlands listed under the Ramsar Convention. The nearest Ramsar listed wetlands comprise the Riverland Ramsar site located approximately 10 km downstream of the project area in South Australia, which is also part of the Riverland Wetland Complex listed on A Directory of Important Wetlands in Australia (DIWA). Lindsay Island and Lake Wallawalla are also both DIWA listed wetlands (separate listings). The majority of proposed construction works and managed inundation would occur within the boundary of these wetland listings, except for works at the Lindsay South WMA, Wallawalla East WMA, and most works at Wallawalla West WMA and on the southern side of the Lindsay River at Berribee Regulator.

Due to the separation distance to the three Ramsar sites located downstream of the Lindsay Island project, the relatively small volume of return flows expected from the project compared to the magnitude of flow in the Murray River, and assuming appropriately managed drawdown rates (rate of drawdown would be managed to a range of 0.03 to 0.06 m/day to reduce potential for scouring) and dilution flows are available at the time of discharge, a substantial or measurable change in the hydrological regime or water quality of downstream Ramsar sites is considered unlikely. Modelling of return flows from Lindsay Island has not yet been undertaken, but would be undertaken to inform the risk-based approach to management of environmental water delivery by the River Murray Operations Committee (RMOC).

Within the boundary of the DIWA listed Lindsay Island and Lake Wallawalla wetlands, five DELWP mapped wetlands may be impacted by construction of infrastructure, while a further three DELWP wetlands intersect existing access tracks proposed to be used/upgraded by the project. Construction works, including vegetation removal and associated disturbance, may directly affect approximately 1.58 ha of mapped wetlands. Twenty-four DELWP mapped wetlands are located within the inundation area and would be benefitted by the reinstatement of a more natural wetting and drying regime. Balanced against the relatively small area of potential wetland vegetation removal/disturbance, and considering the mitigation measures that would be implemented, it is unlikely that the project would lead to an extensive or major adverse effect on the health or biodiversity of these wetlands over the long term.

Although construction works are proposed to be undertaken during dry or low flow / rainfall periods, where practicable, potential exists for dewatering and runoff from construction sites to enter waterways including

the Lindsay River, Murray River, Toupnein Creek, Mullaroo Creek, Little Mullaroo Creek, Lindsay South Creek, Lake Wallawalla and various wetlands across the Lindsay Island floodplain. Other potential construction impacts on surface water environments include removal of vegetation and habitat features (e.g. snags) in wetlands and waterways, installation of temporary barriers (e.g. cofferdams) to enable construction of in-stream works potentially restricting movement of aquatic fauna, and construction of works causing bed and bank erosion and instability. Potential construction-related impacts on aquatic ecosystems identified for the project are typical of construction projects in riverine and floodplain environments and would be managed through a CEMP, including controls for managing erosion and sediment, storage of fuels and chemicals, dewatering and works in waterways, where required. Further assessment is proposed to address potential impacts on aquatic ecosystems associated with construction of the Berribee Regulator, including determining the acceptable width of restrictions in the river / duration for temporary construction barriers, and expected levels/volumes and effects of groundwater drawdown and disposal of saline groundwater during dewatering. Dewatering discharges would be undertaken in accordance with EPA requirements to mitigate potential impacts on aquatic ecosystems.

Operation of the project would affect the frequency, duration, timing and velocities of streamflows in the Lindsay River, Mullaroo Creek, Little Mullaroo Creek and Lindsay South Creek in Victoria, along with the Murray River (above and below Lock 7) and an anabranch of the Murray River in NSW. Modelling by Water Technology (2016) indicates that operation of the Berribee Regulator for the Berribee Maximum and higher level Berribee Intermediate scenarios would reduce flow velocities in the Mullaroo-Lindsay system compared to current conditions. A reduction in fast-flowing habitat within the Lindsay-Mullaroo system is likely to impact listed threatened fish species and communities as discussed above. Further assessment and refinement of operating scenarios is proposed to identify opportunities to avoid or mitigate these potential impacts, while still optimising inundation benefits for floodplain vegetation communities and habitats. The nature and extent of potential effects on streamflows and aquatic habitats would depend on the actual operating scenarios implemented, timing of events, and climatic and river flow conditions prior to, during and following managed inundation events.

Other potential operational impacts are typical of environmental watering projects and include construction of potential barriers to aquatic fauna movement (e.g. regulators), increased potential for carp proliferation and native fish stranding on floodplains, discharge water quality risks (e.g. blackwater, salinity) and changes to flows in the Murray River associated with delivery of environmental water to the Lindsay Island floodplain. Provided the proposed mitigation measures are implemented, along with appropriate planning, implementation, monitoring and adaptive management processes, these operational impacts are not likely to result in extensive or major effects on the health or biodiversity of aquatic ecosystems.

Any upstream or downstream hydrological changes or impacts in the Murray River associated with the delivery of environmental water to the Lindsay Island floodplain would be managed by the River Murray Operations Committee (RMOC) as part of their responsibility to oversee the operation of the Murray River. Further modelling of the cumulative change to flows in the Murray River as a result of the VMFRP program of works would be undertaken by the RMOC to inform the risk-based approach to management of environmental water delivery when the final composition of VMFRP projects are confirmed to proceed based on the outcomes of the approvals process.

Groundwater

Groundwater levels in the project area are generally between 3 to 6 metres below ground surface and are influenced by the lock levels of the Murray River close to the river, and also by evapotranspiration processes in the floodplain, which drawdown the groundwater level. Groundwater levels are known to rapidly decline moving away from the Murray River and other permanently pooled areas into the Victorian floodplain (SKM 2010). Groundwater in the vicinity of the NSW inundation areas is maintained by a driving hydraulic head from Lake Victoria to the north, and groundwater elevation is likely to increase away from the Murray River into NSW (R8, 2020b).

Groundwater salinity is highly variable, with fresher flush zones evident close to waterways where there is regular flow. Most of the floodplain has very high groundwater salinity (i.e. 50,000 to 90,000 µS/cm), with the flush zones recording much fresher water quality, from around close to river quality (typically <200 µS/cm) to around 5,000 µS/cm (Cullen et al., 2008). Groundwater salinity in the NSW inundation areas is mapped at between 35,000 to 50,000 µS/cm, however salinity is likely to be heavily impacted by the river flush zone. Interpreted soil salt loads from Cullen et al. (2008) indicate that soil salt loads in the unsaturated soil profile across most of the inundation area are very high (over 100 t/ha/m) and over 200 t/ha/m in areas of central Lindsay Island, Crankhandle, Wallawalla West and Wallawalla East; with a very significant salt store in the saturated zone (above 200 t/ha/m) for small sections of central-south Lindsay Island and Lindsay South areas. There is only one registered stock and domestic bore within 5 km of the project area and no registered irrigation bores in the vicinity. The absence of widespread groundwater use in the area is likely to be due to the high salinity of the regional aquifers and the proximity to fresh water from the Murray River and lower Lindsay River.

The project includes construction of some below-ground permanent structures. Based on the interpreted groundwater level across the project area, a number of the larger structures are likely to require excavations below the watertable and may require temporary dewatering of excavations during construction. Based on the current design, this is likely to include each of the four larger regulators (BERR_A, BERR_F, CR_A and CW_B1), with the most substantial structure below the watertable being the Berribee Regulator (BERR_A), which would be constructed across the Lindsay River. Groundwater (and surface water) in the immediate vicinity of the Berribee Regulator is estimated to be at the Lock 6 weir pool level (i.e. approximately 19.3 mAHD (average last 5 years)) with the excavated construction depth likely to be below both surface water and groundwater level.

Key potential groundwater effects associated with construction of proposed structures and works are:

- Potential for temporary, localised drawdown of groundwater levels from dewatering of construction excavations – not expected to significantly reduce groundwater availability to local ecosystems based on implementation of proposed mitigation measures.
- Disposal of saline waste groundwater from dewatering of construction excavations – not expected to significantly impact local ecosystems based on implementation of proposed mitigation measures.
- Potential for localised alteration of groundwater flow paths and levels from installation of permanent below-ground water barriers – not expected to significantly alter groundwater availability to local ecosystems based on implementation of proposed mitigation measures.

Potential impacts associated with dewatering activities, particularly at the Berribee Regulator, requires further assessment. This would include determining expected levels/volumes and effects of groundwater drawdown, which would then inform the dewatering strategy and methods of disposal of saline groundwater.

Key potential groundwater effects associated with operation of the project are:

- Potential for increased groundwater levels in inundated areas and some areas outside the managed inundation area to result in waterlogging if shallow groundwater persists in areas containing not flood-tolerant vegetation communities and species - further assessment (as outlined in Section 20) is required to fully understand this potential impact, with monitoring and adaptive management proposed to mitigate this potential impact. Within the managed inundation area, EVCs are flood tolerant and therefore unlikely to be affected by waterlogging from shallow groundwater.
- Potential for near-surface salinisation in some areas outside of the managed inundation area in the medium to long term - further assessment (as outlined in Section 20) is required to fully understand this potential impact, with monitoring and adaptive management proposed to mitigate this potential impact. Within the managed inundation area, local ecosystems may benefit from slight reductions in groundwater salinity. NSW inundation areas are anticipated to have less of a need for management with respect to near-surface salinisation but will be included in the adaptive management framework.

- Potential increase to nutrient load in soil profile and groundwater from flood waters - not expected to adversely impact local ecosystems.
- Potential for increased salt load in the Lindsay River downstream of the project area from mobilisation of salt from soil and groundwater to surface water (salt wash-off) potentially affecting water dependent ecosystems, and water quality for downstream irrigators - further assessment (as outlined in Section 20) is required to fully understand this potential impact, with monitoring and adaptive management proposed to partly mitigate this potential impact.
- Potential secondary impact to cultural values from near-surface salinisation and waterlogging – additional assessment is being undertaken (see Section 15.1 of this referral) to understand this potential impact and to identify management and mitigation measures if required.

These potential effects are not likely to be significant provided the proposed mitigation measures described in this referral are implemented. There is a level of uncertainty in relation to the nature and scale of these impacts which requires further assessment. In particular:

- Specific groundwater level and quality information is required for the site to form a baseline for the potential construction and operation impacts, as well as to monitor the effects of inundation outside of the inundation area. It is understood that one new groundwater monitoring bore was installed in mid-2020 (in Lindsay South area), however monitoring data from this site was not available at the time of this assessment. The remaining network of existing bores at Lindsay Island should be selectively included in the monitoring program. Existing groundwater bores with no available elevation information would need to be surveyed to enable groundwater elevation data to be gathered. Groundwater monitoring of mound rise targeting the identified 'areas of interest' and particularly 'areas of heighted interest' (see Section 13 and **Attachment 4 – Groundwater Assessment**), would allow for adaptive management of the project operations to minimise near-surface salinisation impacts on native vegetation and other assets.
- Salinity discharges and any associated changes or impacts in the Murray River as a result of planned inundation of the Lindsay Island floodplain would be considered and assessed on a cumulative basis by the Murray Darling Basin Authority (MDBA) through the protocols of the Basin Salinity Management 2030 Strategy (BSM2030). These protocols are yet to be finalised for floodplain restoration projects, but discharges from the Lindsay Island project would need to comply with these once finalised. This may involve the use of offsets or salinity credits from the Victorian salinity credit pool.

Potential impacts on land use and amenity

The project would not result in the permanent displacement of any residential or non-residential land uses, severance of residential access to community resources, or major adverse effects on the social or economic well-being of local or regional communities. Potential adverse effects on land use and amenity are mostly temporary and localised, and relating to temporary access disruptions and localised increases in noise, dust and traffic.

The project has the potential to result in increased traffic along local roads and park access tracks during construction (i.e. haulage of fill/spoil, delivery and removal of plant, workers travelling daily to/from site). Local road and track closures are expected throughout construction, and this has the potential to temporarily disrupt recreational access to parts of Murray-Sunset National Park, mostly at the western end of Lindsay Island where the majority of proposed structures are located, although Parks Victoria access to these areas would be maintained. Staggered closures of the primary access tracks would be undertaken to minimise these disruptions to public recreational access. Access would be maintained to SA Water facilities at Lock 7 and private land (no dwelling) within the national park, throughout construction. Construction of the Berribee Regulator would disrupt water-based recreational activities along the Lindsay River during construction; and on completion, the regulator would only allow passage for watercraft less than 3.5 m wide.

An estimated 14,000 traffic movements may be required over the duration of the construction phase, for transportation of fill / spoil, to and from the work sites for proposed structures (assuming truck and trailers, no reuse of spoil on site). Additional construction traffic would be associated with transportation of material for construction of access tracks (volumes yet to be determined), site establishment, plant and equipment deliveries and worker travel. The majority of estimated traffic movements for fill / spoil haulage are associated with construction of the structures in the Berribee, Crankhandle and Crankhandle West WMAs (approx. 12,000 movements) and would therefore use either the Berribee Homestead Track or Bridge Track to access the Berribee Regulator site and other sites across Lindsay Island.

Engagement would be undertaken with Parks Victoria to manage access disruptions within the Murray-Sunset National Park, including along the Lindsay River. A stakeholder management strategy would be prepared and implemented so that Parks Victoria is aware of the extent and timing of construction works and inundation events, and can plan accordingly (e.g. signage, notification to park users). Construction traffic would be managed through standard controls contained in a CEMP and Traffic Management Plan to mitigate impacts, including potential amenity effects along haulage routes.

During managed inundation events, areas of the Murray-Sunset National Park would not be accessible to the public due to water restricting access or to manage public safety risks, which may reduce opportunities for active and passive recreation and could also impact on licensed apiary sites. However, the project provides the opportunity for improved amenity and recreational opportunities either during or following inundation events. VMFRP would work with project partner Parks Victoria to evaluate the impacts and opportunities associated with site access and visitor use for varying levels of inundation. Further assessment would be undertaken in consultation with Parks Victoria, to identify opportunities to maintain or provide alternative access, where practicable.

Post-construction, project upgrades to park access tracks would improve access across the national park following rain and natural flood events; and would also provide Parks Victoria with an opportunity to undertake a track rationalisation process, with subsequent potential for benefits to native vegetation and cultural heritage.

The nearest residential dwellings to the construction footprint of proposed infrastructure are located approximately one kilometre from drop structure CR_D, on the NSW side of the Murray River. It is expected that construction would only be undertaken during the day time period, which would avoid night time construction noise impacts, except for dewatering pumping at cofferdams, which may be required overnight. Construction of the Berribee Regulator would require some weekend work. Some of the closest dwellings may experience some additional noise and dust, however these impacts would be managed through standard controls contained in a CEMP, including compliance with construction noise limits (which may require management measures such as installation of silences on dewatering pumps, limits to working hours at some locations or notification requirements). Preliminary noise modelling indicates that temporary pumping activities during environmental watering are not likely to exceed relevant Victorian or NSW noise criteria at sensitive receivers, although the location of sensitive receivers requires field verification.

The project objectives are consistent with both state and local planning policy, particularly in relation to the protection and enhancement of biodiversity, waterbodies, wetlands and significant landscapes of the area. Improving the health and condition of floodplain ecosystems also supports the economic development of the region, which is already focused on nature-based tourism activities.

Potential impacts on landscape values

The project would involve removal of native vegetation and alteration of landforms within areas supporting national, state and regional landscape values, specifically the Murray-Sunset National Park. Proposed vegetation removal would occur at approximately 30 discrete infrastructure locations scattered across the Lindsay Island floodplain and along the edge of mostly existing access tracks. This vegetation removal would occur in the context of more than 15,000 ha of largely intact vegetation across Lindsay Island and equates to less than 3% of the floodplain vegetation expected to benefit from restoration of a more natural flooding regime. The main components of the project involving alteration of landforms with the potential to

affect landscape values, would be the construction of containment banks, incorporating regulators and spillways, and excavation of channels. Detailed design of proposed structures would be sympathetic to the surrounding landscape and consistent with Parks Victoria requirements. In most instances, it is expected that visibility of the proposed structures would be partly screened by existing retained vegetation with views generally confined to areas in proximity to the structures. Rehabilitation of temporary construction working areas around permanent infrastructure provides further opportunities to enhance screening.

Assessment of the potential impacts on landscape values in this referral has been based on desktop analysis only. As such, there is some uncertainty on the nature and scale of impacts at specific locations and further assessment would need to be undertaken, including site inspections to determine the visual impact from public areas and view lines.

Potential impacts on heritage values

A draft Cultural Heritage Management Plan (CHMP) has been prepared for the project and identified 104 Aboriginal Places within the activity area (based on the area of investigation current at the time), consisting of stone artefacts, scarred trees, earth features (hearths), shell middens and ancestral remains. The draft CHMP identifies the impact on these Aboriginal Places and includes specific management conditions for identified Aboriginal Places where required, including recommending design refinements to avoid impacts to specific Aboriginal Places (notably, burial sites), which are currently being considered through the design process.

The draft CHMP is currently being updated to reflect changes to the activity area and associated potential for impacts on Aboriginal Places, including further standard and complex field assessments, and assessment of potential inundation impacts. Finalisation of the draft CHMP would be in accordance with the *Aboriginal Heritage Act 2006* and in consultation with the FPMMAC (which includes members of the *Ngintait* peoples). Although the First People of the Millewa-Mallee Aboriginal Corporation are now the Registered Aboriginal Party (RAP) for the area, there was no RAP for the activity area when the draft CHMP was commenced in June 2017 and therefore Aboriginal Victoria is responsible for evaluation and approval of the project CHMP.

There are no places listed on the Victorian Heritage Register (VHR), Victorian Heritage Inventory (VHI), Mildura Planning Scheme Heritage Overlay (HO), World Heritage List, National Heritage List or Commonwealth Heritage List located within or adjacent to the proposed construction footprint. However, one unlisted potential historical heritage place (Berribee Homestead Complex) is located in the construction footprint. While not listed on any heritage registers/lists, the Berribee Homestead Complex has been assessed as having high local significance and was recommended for inclusion on the Mildura Planning Scheme heritage overlay (Bell, 2013a). A review of construction laydown requirements for the Berribee Regulator has determined that use of the area containing the Berribee Homestead Complex would not be required and as such, this area is to be excluded from the final construction footprint to avoid direct impacts on this unlisted historical heritage place. Three listed historical heritage places have been identified within the inundation area, including two places listed on the VHI (Lindsay Creek North Ferry Crossing (VHI H7129-0001), Lindsay Creek South Ferry Crossing (VHI H7129-0002)) and one place listed on the non-statutory Register of the National Estate (RNE) (Lock and Weir No 7 (RNE101494)). An additional two unlisted potential historical heritage places (Berribee Station Barge and Baggot's Cattle Station) have also been identified in the inundation area. Further assessment, including site inspection, is required to determine the potential impact, including inundation impacts, on these places.

There is also a moderate potential for previously unrecorded historical heritage items to be present within the project area based on the background history of the area, which is an area of uncertainty. Site types most likely to be identified in the project area would be heritage places or archaeological sites associated with early agricultural or pastoral activities, logging, river shipping and water management practices. The presence of unlisted historic archaeological sites within the project area would be determined through

further historic heritage assessment, including a site inspection, and managed in accordance with the *Heritage Act 2017* (or NSW *Heritage Act 1977*).

Potential impacts arising from operation of Lock 7 weir pool

VMFRP has recently received advice from MDBA around the raising of the Lock 7 weir pool and how the proposed operating regime compares to the current operating regime. Impacts associated with changes to the operating regime of Lock 7 and the resultant inundation area in NSW have not yet been assessed. Further assessment is required of the potential for impacts associated with operation of Lock 7 for the project, including to further assess the extent of inundation resulting from raising of the Lock 7 weir pool and effects on Lock 7 fishway operation, as well as potential for impacts on environmental and heritage values within NSW.

Potential impacts associated with borrow pits / quarry sites

VMFRP are currently progressing a site selection process to identify potential borrow pit locations from which to source an estimated 95,000 cubic metres of clay fill material required for the project. Borrow pits would be located on private land, outside of Lindsay Island, and where practicable within previously cleared areas. The nature and extent of potential impacts and approval requirements associated with establishment of borrow pits / quarry sites are yet to be assessed. Environment and heritage values would be evaluated as part of the site selection process to avoid and minimise impacts. Approximately 7,000 cubic metres of rock fill is also required for construction of the project and would be sourced from existing commercial quarries.

12. Native vegetation, flora and fauna

12.1 Native vegetation

Is any native vegetation likely to be cleared or otherwise affected by the project?

☐ NYD ☐ No ☒ Yes If yes, answer the following questions and attach details.

What investigation of native vegetation in the project area has been done? (briefly describe)

A review of relevant databases and previous studies was undertaken as part of the Flora and Fauna Assessment – Lindsay Island (R8, 2020d) (refer to **Attachment 3 – Flora and Fauna Assessment**) to identify native vegetation and listed flora and fauna species with potential to occur in the project area, including the following sources:

- Protected Matters Search Tool (PMST) for the EPBC Act, maintained by DAWE[5]
- Weeds of National Significance database[6]
- Victorian Biodiversity Atlas (VBA), maintained by DELWP[7]
- NatureKit, maintained by DELWP[8], which includes modelled mapping of extant and pre-1750 Ecological Vegetation Classes (EVCs), current wetlands, location category mapping and known threatened species records
- Native Vegetation Information Management Tool (NVIM), maintained by DELWP[9]

[5] http://www.environment.gov.au/epbc/protected-matters-search-tool (accessed on 18/09/2019)
[6] http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html (accessed 09/01/2020)
[7] https://www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas (accessed on 17/09/2019)
[8] http://maps.biodiversity.vic.gov.au/viewer/?viewer=NatureKit (last accessed by GHD November 2019)
[9] https://nvim.delwp.vic.gov.au/ (accessed on 09/01/2020)

- NSW BioNet-Atlas database, maintained by NSW Department of Planning, Industry and Environment (DPIE)[10]
- eBird, an online database of bird distribution and abundance [web application] maintained by Cornell Lab of Ornithology, Ithaca, New York[11]
- Wildlife Profiles (2006). A *survey and risk assessment of terrestrial vertebrate fauna of the Murray Scroll Belt: Final report of a two-year field study conducted during Spring/Summer 2004-05 and Summer 2005-06, including a compilation of comparable historical data*. Report prepared for Parks Victoria and Mallee CMA.
- Australian Ecosystems (2010a). *Lindsay – Wallpolla Frog and Aquatic Vegetation Surveys 2009-2010*. Report prepared for Mallee CMA.
- Australian Ecosystems (2010b). *An analysis of 2005-2010 waterbird survey data for Lindsay – Wallpolla Islands and Hattah Lakes.* Report prepared for Mallee CMA.
- Australian Ecosystems (2013). *Lindsay Island Flora Census 2013*. Report prepared for Mallee CMA.
- GHD (2013b). *Preliminary Ecological Investigations and Targeted Regent Parrot Surveys*. Report prepared for Mallee CMA.
- GHD (2014a). *SDL Offsets Fauna Survey Lindsay Island*. Report prepared for Mallee CMA.
- GHD (2016a). *Lindsay Island SDL Project - Ecological Assessment*. Report prepared for Mallee CMA.
- ARI (2018). *SDL Fish Management Plan – Lindsay Island*. Report prepared for Mallee CMA.
- GHD (2019). *Floodplain Bat Study. Lindsay & Wallpolla Islands – October-December 2018*. Report prepared for Mallee CMA.

Attachment 3 – Flora and Fauna Assessment also describes the following fieldwork completed by R8 in late 2019 to mid-2020 to build on the findings of previous studies:

- Mapping the extent and condition of native vegetation within areas of the proposed construction footprint current at the time (surveys completed in October 2019) that were not assessed by GHD (2016a) due to changes in the construction footprint.
- Targeted surveys to assess the presence of threatened flora and fauna species listed under the EPBC Act and/or FFG Act within the construction footprint current at the time (flora surveys completed October 2019, fauna surveys completed October-November 2019, and January 2020).
- Targeted ground-truthing of EVCs within inundation areas modelled by DELWP (2019) as containing non-flood dependent EVCs (surveys completed June 2020).

As design has evolved since the additional vegetation mapping and targeted threatened species surveys were completed by R8 in October 2019 to January 2020, a small proportion (approx. 8.15 ha) of the current construction footprint has been subject to desktop assessment only, mostly along access tracks. In these areas, modelled EVC and habitat data has been used to inform assessment of impacts on native vegetation, listed threatened species and communities. Once the design process is able to finalise the construction footprint, a Vegetation Quality Assessment (VQA) (Habitat Hectares) would be undertaken in these areas to confirm the condition and extent of native vegetation in accordance with the *Guidelines for the removal, destruction or lopping of native vegetation* (DELWP, 2017a).

Further fieldwork would be carried out to address these gaps in vegetation assessments as indicated in Section 20 of this referral.

[10] http://www.bionet.nsw.gov.au/ (accessed June 2020)
[1111] https://ebird.org/home (accessed June 2020)

What is the maximum area of native vegetation that may need to be cleared?

☒ NYD Estimated area: 106 hectares (approx.)

Of the estimated 106 ha of native vegetation removal:

- There is 64.26 ha of native vegetation within, or with tree protection zones (TPZs) potentially impacted by the construction footprint of proposed infrastructure, including 482 large trees. The construction footprint for proposed infrastructure is 28.86 ha, which includes a working buffer around proposed infrastructure and the temporary laydown areas at Berribee Regulator. The development footprint of permanent infrastructure based on the current design is 13.47 ha. This means there is scope within the remaining 15.39 ha of construction footprint to further avoid or minimise native vegetation impacts through micro-siting working areas around infrastructure, and an opportunity for native vegetation to be reinstated in these working buffers and temporary laydown areas on completion of construction. The estimated vegetation removal area also assumes that vegetation located outside the construction footprint would be 'lost' where the TPZ of adjacent trees extends into the construction footprint. This is a conservative estimation of vegetation removal for the current construction footprint as a proposed assessment by a qualified arborist is likely to identify opportunities for adjacent vegetation to be retained.
- There is 41.63 ha of native vegetation, including 589 large trees, within a 5 m wide corridor along sections identified for minor track works and a 10 m wide corridor along sections of new tracks and existing tracks requiring more substantial works. The scope and requirement for works along access tracks is still to be confirmed and would be designed to avoid and minimise impacts on native vegetation and heritage values in consultation with Parks Victoria and Aboriginal Victoria. For approximately 60% (or 50 km) of access tracks, track works would be limited to minor maintenance / upgrades (e.g. grading and re-surfacing within the existing track formation or a 5 m wide formation, whichever is lesser), which may only require lopping of branches for existing vegetation along the edges of tracks. The estimated vegetation removal area for these tracks with minor works is considered conservative. For the remaining access tracks, including 5 km of new minor tracks and 32 km of major upgrades to existing tracks, the calculation of native vegetation removal impacts based on a 10 m wide corridor is considered to provide a less conservative but realistic estimate of likely native vegetation impacts.

Assessment by a qualified arborist is proposed along the required tracks, in conjunction with a project design/construction engineer, to confirm the extent of works required (if any), and the potential direct (through removal) or indirect (through encroachment of TPZs, or the removal of >30% of tree canopy) impacts to trees, and to advise on methods by which trees could be retained. The outcomes of this assessment would inform an updated native vegetation loss calculation.

The estimated area of native vegetation proposed to be removed for the project is based on the current construction footprint. As described in Section 3 of this referral, the location of some ancillary project components (borrow pits/quarry sites) and construction activities (temporary boat/barge landings, additional laydown areas) is yet to be determined. While the project intends to locate these activities either in the construction footprint (e.g. temporary boat/barge landings, additional laydown areas) or in existing cleared or disturbed areas (e.g. borrow pits/quarry sites), some additional native vegetation removal could be required for the project. Further assessment of native vegetation impacts would be undertaken once a final construction footprint has been determined.

How much of this clearing would be authorised under a Forest Management Plan or Fire Protection Plan?

☒ N/A……. approx. percent (if applicable)

Which Ecological Vegetation Classes may be affected? (if not authorised as above)

☒ NYD ☒ Preliminary/detailed assessment completed. If assessed, please list.

Construction footprints

Table 11 identifies the EVCs within the current construction footprint, including proposed access tracks, that would be potentially impacted by construction of the project. All potentially impacted native vegetation is located within the Murray Scroll Belt Bioregion.

Table 11: Area of EVCs potentially impacted by proposed works

EVC No.	EVC name	EVC conservation significance	Area (ha) potentially impacted[1]	
			Infrastructure	Tracks
98	Semi-arid Chenopod Woodland	Depleted	0.03	0.0013
101	Samphire Shrubland	Least concern	0.59	2.03
102	Low Chenopod Scrubland	Depleted	3.19	10.11
103	Riverine Chenopod Woodland	Depleted	22.45	11.26
104	Lignum Swamp	Vulnerable	1.49	5.72
106	Grassy Riverine Forest	Depleted	3.86	0.93
806	Alluvial Plains Semi-arid Grassland	Vulnerable	0.39	N/A
808	Lignum Shrubland	Least concern	0.14	0.89
810	Floodway Pond Herbland	Depleted	0.48	0.27
813	Intermittent Swampy Woodland	Depleted	11.46	2.65
818	Shrubby Riverine Woodland	Least concern	5.89	1.41
823	Lignum Swampy Woodland	Depleted	14.28	6.36
Total			**64.26**	**41.63**

1. Native vegetation impacts are mostly based on field surveys conducted by GHD in 2015 (GHD, 2016a) and R8 in late 2019 (R8, 2020d) (approx. 92% of the construction footprint) with the remaining 8.15 ha of construction footprint based on modelled EVC data.

Figure 5 in **Attachment 3 – Flora and Fauna Assessment** shows the location of EVCs mapped or modelled within the construction footprint, including access tracks.

Approximately 1.58 ha of native vegetation within the construction footprint is classified by DELWP as current wetlands. At the time of the field assessment, these areas were dry and had not received recent rainfall. As such, a VQA assessment was undertaken classifying these patches as the EVC modelled to be present and the modelled condition for these wetlands was adopted to inform creation of a Native Vegetation Removal (NVR) Report[12] for the project, where current wetlands intercepted the construction footprint.

Inundation areas

Table 12 identifies the EVCs that are modelled by DELWP (2019) to occur within the proposed inundation areas.

Table 12: Modelled EVCs within the proposed inundation areas

EVC No.	EVC name	EVC conservation significance	Modelled EVC extent (ha)
97	Semi-arid Woodland*	Vulnerable	2.24
98	Semi-arid Chenopod Woodland*	Depleted	19.14

[12] A formal NVR Report was not able to be produced by DELWP at the time of the request due to the size of the data set for Lindsay Island. As such, DELWP were required to process the data manually and provided relevant excel data files on 26 May 2020 in lieu of an NVR Report. As this process is being undertaken remotely by DELWP staff due to the effects of COVID-19, DELWP have indicated that they will prepare a final pdf NVR report once the construction footprint has been finalised.

102	Low Chenopod Shrubland	Depleted	181.83
103	Riverine Chenopod Woodland	Depleted	716.67
104	Lignum Swamp	Vulnerable	163.80
106	Grassy Riverine Forest	Depleted	5.72
107	Lake Bed Herbland	Vulnerable	197.50
200	Shallow Freshwater Marsh	Vulnerable	19.34
806	Alluvial Plains Semi-arid Grassland	Vulnerable	656.80
807	Disused Floodway Shrubby Herbland	Endangered	7.91
808	Lignum Shrubland	Least Concern	1,431.89
810	Floodway Pond Herbland	Depleted	23.80
811	Grassy Riverine Forest/Floodway Pond Herbland Complex	Depleted	10.01
813	Intermittent Swampy Woodland	Depleted	814.72
818	Shrubby Riverine Woodland	Least Concern	237.36
823	Lignum Swampy Woodland	Depleted	127.24
992	Water Body - Fresh	N/A	190.52
993	Bare Rock/Ground	N/A	31.35
-	Area of unmapped EVC		270.22
	Total		**5,108.06**

* Non-flood dependent EVCs.

Two non-flood dependent EVCs are modelled to occur within the proposed inundation area (i.e. Semi-arid Woodland, Semi-arid Chenopod Woodland). As described in **Attachment 3 – Flora and Fauna Assessment**, targeted ground-truthing was undertaken in locations modelled as non-flood dependent EVCs and confirmed that no Semi-arid Woodland or Semi-arid Chenopod Woodland occurred in the inundation areas surveyed.

Of the 270.22 ha identified as unmapped EVC, the majority was found to be unmapped because it is located in NSW with small areas in Victoria deemed to be waterbody. Only 8.52 ha of unmapped EVC was modelled to occur in areas containing vegetation in Victoria. Ground-truthing of this 8.52 ha of vegetation in Victoria was undertaken and confirmed that no Semi-arid Woodland (EVC 97) or Semi-arid Chenopod Woodland (EVC 98) was present in these parts of the inundation area. Vegetation in inundation areas surveyed as part of the targeted to ground-truthing was usually Riverine Chenopod Woodland (EVC 103), Lignum Shrubland (EVC 808) and occasionally Alluvial Plains Semi-arid Grassland (EVC 806), which are located on alluvial terraces and are prone to flooding. The location of areas targeted during the EVC targeted ground-truthing in the inundation areas is shown in Figure 6 of **Attachment 3 – Flora and Fauna Assessment.** The results of the targeted ground-truthing in inundation areas are shown in Figure 7 of **Attachment 3 – Flora and Fauna Assessment.**

The remaining EVCs modelled to occur in the proposed inundation areas are flood-dependent EVCs that have been identified through investigations by Ecological Associates (2007, 2014a) as being within water regime classes targeted for restoration by the project (see **Table 2**) based on assessed deficiencies in the current hydrological regime experienced by these EVCs compared to natural (pre-regulation) conditions. Each of these EVCs within the proposed inundation areas are expected to benefit rather than be adversely impacted by the delivery of environmental watering that meets their preferred hydrological regime.

While detailed assessment of the NSW inundation areas is yet to be completed, a desktop assessment indicates that of the approximately 263 ha of inundation area within NSW (mostly within the Murray River), there is approximately 129.2 ha of land modelled as containing native vegetation based on NSW State Vegetation Type Mapping (Western Region). Two vegetation communities have been modelled within these areas:

- River Red Gum – Lignum very tall open forest or woodland wetland on floodplains of semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion), Benson Class 11 (LM143): 128 ha

- Black Box - Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion), Benson Class 13: 1.2 ha.

Each of these communities consist of flood-dependent vegetation. A small area (0.0002 ha) of 'no native vegetation' (PCTID0) is modelled to occur in the NSW inundation area.

As discussed in Section 13 and **Attachment 4 – Groundwater Assessment** of this referral, there is potential for the project to result in near-surface salinisation, which could potentially impact on vegetation health, particularly outside of the inundation areas where vegetation would not benefit from the flushing of salts facilitated by the more regular flooding proposed within the managed inundation areas. Further assessment is required to understand the potential impacts on native vegetation associated with near-surface salinisation (see Section 20 of this referral).

Have potential vegetation offsets been identified as yet?

☒ NYD ☒ Yes If yes, please briefly describe.

As described above, approximately 106 hectares of native vegetation may require removal for construction of the project. **Attachment 4 – Flora and Fauna Assessment** contains a preliminary estimate of offset requirements.

Offsets would be sought in accordance with the requirements of the *Guidelines for removal, destruction or lopping of native vegetation* (DELWP, 2017a) or through an alternate arrangement agreed with the Secretary to DELWP, such as a conservation works exemption under Clause 52.17 of the Mildura Planning Scheme. The loss of native vegetation due to construction activities is proposed to be offset, at least in part, by the expected improvement in native vegetation quality in the inundation area resulting from environmental watering. The method for seeking a conservation works exemption or confirming this offset would be developed in consultation with DELWP. Any offset requirements that cannot be met through environmental watering would be purchased by the project.

Other information/comments? (e.g. accuracy of information)

NYD = not yet determined

12.2 Flora and fauna

What investigations of flora and fauna in the project area have been done?
(provide overview here and attach details of method and results of any surveys for the project & describe their accuracy)

As described above, **Attachment 3 – Flora and Fauna Assessment** contains a review of previous ecological studies undertaken for the project and updated database and mapping searches to identify flora and fauna potentially occurring in the project area. A summary of the methods and findings of previous ecological studies is provided in **Table 13**.

Table 13: Summary methods and findings of previous ecological studies

Methods	Key Findings
Wildlife Profiles (2006). ***A survey and risk assessment of terrestrial vertebrate fauna of the Murray Scroll Belt.***	
• Review of existing information	Two EPBC Act listed species:

• Fauna field surveys (ground dwelling vertebrates, pitfall trapping at 18 sites, bird surveys, nocturnal spotlight surveys targeting: Carpet Python, Growling Gras Frog, Hooded Scaly-foot, De Vis' Banded Snake and nocturnal birds • Recording of incidental observations.	• Regent Parrot - recorded at one site, unlikely to breed within the region. • Growling Grass Frog - two individuals recorded at one site. • High quality fauna habitats present across the study area.
Australian Ecosystems (2010a). *Lindsay – Wallpolla Frog and Aquatic Vegetation Surveys 2009-2010*	
Aquatic vegetation and frog populations surveyed in January 2010 at four wetlands at Lindsay Island (Scotties Billabong, Webster's Lagoon, Mullaroo Creek, Woodcutters Floodrunner (off Mullaroo Creek), to obtain information about the diversity, abundance and distribution of wetland flora that grew in response to watering and the diversity, abundance, distribution and breeding behaviour of frogs within the wetlands. Included analysis of frog call recordings.	Growling Grass Frog recorded at Scotties Billabong and Webster's Lagoon. Results of this study provide insights into how environmental water allocations can be planned and prioritised, however further study is required to refine when and how allocations should be made.
Australian Ecosystems (2010b). *An analysis of 2005-2010 waterbird survey data for Lindsay-Wallpolla Islands and Hattah Lakes.*	
Results were presented and interpreted for waterbird monitoring at sites in the far northwest of Victoria; including Lindsay Island. Waterbird surveys conducted at six sites across Lindsay Island floodplain.	Thirty waterbird species recorded, including four rare or threatened species: Australasian Shoveler, Freckled Duck, Hardhead and Pied Cormorant. The results of the wetland bird data suggest that the artificial delivery of environmental water allocations can attract and stimulate breeding behaviour in wetland birds, including a diversity of rare and threatened species.
Australian Ecosystems (2013). *Lindsay Island Flora Census 2013*.	
• Review of existing information • Flora field survey in November 2013 (30 m x 30 m quadrats position considered distribution, extent and relative uniformity of each EVC; projected foliage cover recorded for all overstorey and understorey species; photographs of each quadrat; representative photographs of each rare and threatened flora; recording of incidental fauna species) • Plant taxonomy (Flora Information System (DSE, 2012), consideration of the Census of Victoria Vascular Plants (Walsh and Stajsic, 2007)).	• 14 EVCs sampled, most widespread were: Riverine Chenopod Woodland, Low Chenopod Shrubland, Lignum Shrubland • Many areas highly degraded • 285 flora species recorded (228 indigenous, 57 exotic species) • 45 rare or threatened flora (DELWP Advisory List) • One EPBC Act listed species: *Eleocharis obicis* (Striate Spike-sedge) • Seven FFG Act listed species: *Swainsona greyana* (Hairy Darling-pea); *Swainsona phacoides* (Dwarf Swainson-pea); *Atriplex holocarpa* (Pop Saltbush); *Atriplex limbata* (Spreading Saltbush); *Atriplex rhagodioides* (Silver Saltbush); *Crinum flaccidum* (Darling Lily); *Eremophila bignoniiflora* (Bignonia Emi-bush). • Other frequently observed rare species included: *Wahlenbergia tumidifructa* (Mallee Annual-bluebell); *Asperula gemella* (Twin-leaf Bedstraw); *Senecio cunninghamii* var.

	cunninghamii (Branching Groundsel); *Tecticornia triandra* (Desert Glasswort); *Malacocera tricornis* (Goat Head). • Weed coverage usually low: three species classified as restricted under CaLP Act; a number of high and very high risk species under DSE Advisory List of Environmental Weeds; no weeds of National Significance (WONS) recorded.
GHD (2013b). *Preliminary Ecological Investigations and Targeted Regent Parrot Surveys*.	
• Review of existing information • Field surveys at 26 sites in September-October 2012 • Fauna field surveys (habitat assessments; targeted Regent Parrot nest surveys using standardised two hour point survey (THPS) at 10 sites; bird surveys with standard 20-min, 2-ha area search; nocturnal spotlight surveys targeting Growling Grass Frog, Carpet Python and nocturnal birds; recording of incidental observations). • Flora field surveys (targeted surveys of each site for rare or threatened flora species; flora species lists for sites; identify dominant EVCs within sites; assess broad condition of native vegetation).	• 298 fauna species identified by desktop assessment, including 52 listed rare or threatened species • Fauna field surveys: - 123 species (118 native, 5 exotic), including 7 amphibian species, 100 bird species, 8 mammal species (5 exotic), 8 reptile species - Two EPBC Act listed species: Regent Parrot at five of the 26 sites. Potential breeding habitat at some sites. - Growling Grass Frog recorded at one site. Potential to occur at 11 sites (noted that surveys occurred during a minor flood and shallow water present at a number of typically dry sites). • High quality fauna habitats present across the study area. • Flora field surveys: - 79 plant species recorded, no EPBC Act listed plants detected, 16 flora species of state conservation significance recorded - Most sites dominated by native vegetation, 13 EVCs of varying condition - No EPBC Act or FFG Act listed flora communities detected • Determined a Net Gain assessment was required. NOTE: The original Berribee Regulator location was further upstream on Lindsay River in area of large old River Red Gum trees with high potential for Regent Parrot nesting habitat. The regulator has since been moved to the present location in predominantly Black Box, which is lower quality habitat with very low chance of Regent Parrot breeding in this habitat.
GHD (2014a) *SDL Offsets Fauna Survey Lindsay Island.*	
• Review of existing information • Fauna field surveys in November 2013 (16 sites, ground-dwelling vertebrates; pitfall trapping using T-array and open buckets flush to the ground; baited Elliot traps; baited infrared motion-activated fauna camera traps; bird surveys: surveyed within 3 hours of sunrise and late afternoon, using standard 20-min 2-ha area search, detection method included observation or call; bat surveys: Anabat detectors for micro-bat calls with each call assigned a confidence rating, and harp-traps; nocturnal spotlight surveys	• 127 native fauna species recorded (93 bird species, 4 amphibian species, 8 terrestrial mammal species, 4 bat species and 18 reptile species) along with six exotic terrestrial mammal species. • Significant and listed species included: - An incidental record of EPBC Act listed Regent Parrot - Five bird species and one mammal species listed as threatened under FFG Act - Nine species of bird, two mammal species and one reptile listed under the DEPI Advisory List of Threatened Vertebrate Fauna in Victoria 2013

targeting Carpet Python, Growling Grass Frog and nocturnal birds • Recording of incidental observations.	- Potential records of EPBC Act listed *Nyctophilius corbeni* (Corben's long-eared bat).
GHD (2016a). *Lindsay Island SDL Project Ecological Assessment.*	
• Investigated a total area of 251.78 ha based on construction footprint current at the time • Review of existing information • Field survey in November - December 2015, including: habitat hectare assessments of all patches of native vegetation (including Large Old Tree mapping), flora species inventory, identifying and mapping of any threatened flora species or communities listed under the EPBC or FFG Acts, identifying presence of significant weed species, recording incidental fauna species supplemented with: diurnal bird surveys, spotlighting and installation of 12 remote sensing fauna cameras.	• Eleven EVCs, across 39 Habitat Zones identified • 117 native flora species recorded (including 14 species listed as threatened under FFG Act and/or DELWP Advisory List) and 27 introduced species recorded (including four weeds listed under CaLP Act) • A total of 2362 Large Old Trees (LOTs) identified and mapped • Lignum Swamp – Total habitat hectares 25.05 with EVC conservation status described as Vulnerable • 48 terrestrial fauna species recorded (44 indigenous species, four introduced species), including three fauna species of conservation significance.
ARI (2018). *SDL Fish Management Plan – Lindsay Island.*	
• Review of existing information. • Review of proposed SDL infrastructure and operation. • Review of existing ecological objectives and targets for the site. • Assessment of fish-related risks and provision of recommended fish-related opportunities for the site.	• Site has potential to support up to 12 native fish species. • Mullaroo Creek supports one of the most valuable native fish assemblages in the lower Murray Valley, especially the EPBC Act listed Murray Cod population. EPBC Act listed Silver Perch and FFG Act listed Freshwater Catfish also present. • The proposed Berribee Regulator would have floodplain benefits but under the full inundation scenario the fast water hydraulics of Mullaroo Creek and Lindsay River would be lost. A key objective should be to maintain current conditions where possible, to support the native fish community. • Floodplain currently not utilised often by the larger fish species. There is potential to restore wetlands that support a diversity of macrophytes, productive littoral zones and potentially small-bodied native fish at Webster's Lagoon and the Crankhandle wetlands complex. • The ability to pump water into Lake Wallawalla highlights an important fish opportunity: testing whether the lake can be managed as a Golden Perch nursery habitat.
GHD (2019). *Floodplain Bat Study. Lindsay and Wallpolla Islands – October-December 2018.*	
• 18 sites surveyed on Lindsay Island • Review of existing information • Field surveys: Anabat recording, harp trapping (32 harp-trap survey nights), bat call analysis and nocturnal spotlight surveys.	• 13 bat species recorded (all native, but none listed as threatened) • One species of regional significance recorded • Two recordings of Gould's Long-eared Bat (*Nyctophilus gouldi*), representing a 180 km range extension from previous recordings of this species. • Anabat surveys: 12 bat species positively identified.

The review of previous ecological studies and updated database searches was used to inform the additional targeted threatened flora surveys undertaken by R8 in October 2019, and targeted threatened fauna surveys undertaken by R8 in October / November 2019 and January 2020. The results of these surveys are described in **Attachment 3 – Flora and Fauna Assessment**. A summary of the results of updated desktop and field assessments undertaken for the project by R8, is provided in the following sections.

Have any threatened or migratory species or listed communities been recorded from the local area?

☐ NYD ☐ No ☒ Yes If yes, please:

- List species/communities recorded in recent surveys and/or past observations.
- Indicate which of these have been recorded from the project site or nearby.

Listed threatened flora

A desktop assessment identified 133 listed threatened flora species that have been recorded or are modelled to potentially occur within 10 km of the project area, including four EPBC Act listed species, 27 FFG Act listed species and 130 species listed as rare or threatened on the DELWP Advisory List.

Each of these species was assessed for their likelihood of occurrence, taking into account factors such as the habitat requirements of each species and comparing those to the habitats encountered within the proposed construction footprint and inundation area (see Appendix E of **Attachment 3 – Flora and Fauna Assessment**).

Of these listed flora species

- Two EPBC Act listed species, 22 FFG Act listed species and 101 rare or threatened species on the DELWP Advisory List have been recorded or assessed as having a possible or higher likelihood of occurrence in the construction footprint

- Two EPBC Act listed species, 22 FFG Act listed species and 103 rare or threatened species on the DELWP Advisory List have been recorded or assessed as having a possible or higher likelihood of occurrence in the inundation area.

No EPBC Act listed flora species were detected within or adjacent to the construction footprint during targeted surveys, but eleven rare or threatened flora species on the DELWP Advisory List, including four FFG Act listed flora species were detected during targeted flora surveys within and adjacent to the construction footprint in October 2019 (see **Table 14**.

Table 14: Rare or threatened flora species recorded during targeted surveys in October 2019

Scientific name	Common name	Status	Location of recent records
Acacia oswaldii	Umbrella Wattle	L, vu	11 individuals/clusters, including in construction footprint
Asperula gemella	Twin-leaf Bedstraw	r	>20 individuals/clusters scattered within the area of investigation, including in construction footprint
Atriplex lindleyi subsp. *conduplicata*	Baldoo	r	1 individual/cluster, in area of investigation but not in construction footprint
Atriplex nummularia subsp. *omissa*	Dwarf Old-man Saltbush	r	4 individuals/clusters, in area of investigation but not in construction footprint

Calotis cuneifolia	Blue Burr-daisy	P, r	>5 individuals/clusters scattered within the area of investigation, but not in construction footprint
Crinum flaccidum	Darling Lily	L, vu	5 individuals/clusters within area of investigation, outside but immediately adjacent to construction footprint
Eremophila bignoniiflora	Bignonia Emu-bush	L, vu	>10 individuals/clusters scattered within the area of investigation, including in construction footprint
Eremophila divaricata subsp. *divaricata*	Spreading Emu-bush	r	>20 individuals/clusters scattered within the area of investigation, including in construction footprint adjacent to an existing track
Eremophila maculata subsp. *maculata*	Spotted Emu-bush	L, r	1 individual/cluster within construction footprint adjacent to an existing track
Senecio cunninghamii var. *cunninghamii*	Branching Groundsel	r	>50 individuals/clusters scattered within the area of investigation, including in construction footprint
Tecticornia triandra	Desert Glasswort	r	>30 indviduals/clusters scattered within the area of investigation, including in construction footprint

Key: L = Listed under FFG Act, P = Protected under FFG Act, vu = listed as vulnerable under DELWP Advisory List, r = listed as rare under DELWP Advisory List.

In addition, the listed flora species in **Table 15** have been detected during previous surveys and were considered in the likelihood of occurrence / impact assessment (see Appendix E of **Attachment 3 – Flora and Fauna Assessment)**:

Table 15: Rare or threatened flora species recorded during previous flora surveys

Scientific name	Common name	Status	Presence known from
Acacia melvillei	Yarran	L, vu	Recorded by AE (2013), location not in construction footprint
Atriplex holocarpa	Pop Saltbush	L, vu	Recorded by AE (2013), location not in construction footprint
Atriplex limbata	Spreading Saltbush	L, vu	Recorded by AE (2013), location not in construction footprint
Atriplex pseudocampanulata	Mealy Saltbush	r	Recorded by AE (2013), location not in construction footprint
Atriplex rhagodioides	Silver Saltbush	L, vu	Recorded by AE (2013), location not in construction footprint
Bergia trimera	Small Water-fire	vu	Recorded by AE (2013), location not in construction footprint
Centipeda crateriformis subsp. compacta	Compact Sneezeweed	r	Recorded by AE (2013), location not in construction footprint

Centipeda thespidioides s.s.	Desert Sneezeweed	r	Recorded by AE (2013), location not in construction footprint
Eleocharis obicis	Striate Spike-sedge	VU, vu	Recorded by AE (2013), location not in construction footprint or area of investigation
Lawrencia spicata	Salt Lawrencia	r	Recorded by AE (2013), location not in construction footprint

Status: VU = listed as vulnerable under EPBC Act, L = Listed under FFG Act, vu = listed as Vulnerable under DELWP Advisory List, r = listed as rare under DELWP Advisory List.

Five listed flora species were detected within or adjacent to the inundation area through incidental observations during targeted ground-truthing of EVCs in June 2020:

- *Duma horrida* subsp. *horrida* (Spiny Lignum), rare
- *Eremophila divaricata* subsp. *divaricata* (Spreading Emu-bush), rare
- *Solanum lacunariun* (Lagoon Nightshade), vulnerable
- *Swainsona microphylla* (Small-leaf Swainson-pea), rare (found on higher ground outside the inundation area)
- *Tecticornia triandra* (Desert Glasswort), rare.

These surveys were rapid in nature, focusing on ground-truthing EVCs rather than identifying flora species within the broader inundation area, and the surveys were not undertaken at an appropriate time of year to undertake targeted surveys for many listed flora species.

Potential impacts on these species are discussed in the following sections.

Listed threatened fauna

A desktop assessment identified 64 listed threatened fauna species that have been recorded or are modelled to potentially occur within 10 km of the project area, including 18 EPBC Act listed species, 52 FFG Act listed species and 55 species listed as rare or threatened on the DELWP Advisory List.

Each of these species was assessed for their likelihood of occurrence, taking into account factors such as the habitat requirements of each species and comparing those to the habitats encountered within the proposed construction footprint and inundation area (see Appendix D of **Attachment 3 – Flora and Fauna Assessment**).

Of these listed fauna species

- Five EPBC Act listed species, 27 FFG Act listed species and 23 rare or threatened species on the DELWP Advisory List have been recorded or assessed as having a possible or higher likelihood of occurrence in the construction footprint
- Nine EPBC Act listed species, 38 FFG Act listed species and 39 rare or threatened species on the DELWP Advisory List have been recorded or assessed as having a possible or higher likelihood of occurrence in the inundation area.

The following EPBC Act and/or FFG Act listed fauna species were detected during targeted surveys between November 2019 and January 2020:

- Regent Parrot (*Polytelis anthopeplus monarchoides*) - EPBC Act (Vulnerable), FFG Act (Listed), DELWP Advisory List (vulnerable) - This species was observed on one occasion 100 m north east of

the proposed Berribee Regulator; and has previously been recorded in low numbers scattered across Lindsay Island.

- Great Egret (*Ardea alba modesta*) – FFG Act (Listed), DELWP Advisory List (vulnerable) – This species was recorded on two occasions, both within approximately 200 m of the proposed location of the Berribee Regulator.

In addition, the listed fauna species in **Table 16** have been detected during surveys undertaken between 2012 and 2020, or are otherwise known to be present in project area:

Table 16: Rare or threatened fauna species recorded during previous surveys or known to be present

Scientific name	Common name	Status	Presence known from
Planigale gilesi	Giles' Planigale	L	Recorded in inundation areas by GHD (2014).
Struthidea cinerea	Apostlebird	L	Recorded in inundation areas by GHD (2013) and GHD (2014).
Coracina maxima	Ground Cuckoo-shrike	L, vu	Recorded in inundation areas in 2019 on VBA.
Melanodryas cucullata	Hooded Robin	L	Recorded in inundation areas by GHD (2013) and GHD (2014).
Charadrius australis	Inland Dotterel	vu	Recorded in inundation areas by GHD (2014).
Litoria raniformis	Growling Grass Frog	VU, L, en	Recorded at BERR_D containment bank by GHD (2013).
Maccullochella peelii peelii	Murray Cod	VU, L, vu	Recorded on VBA in 2017 and well known from Lindsay River and Mullaroo Creek.
Bidyanus bidyanus	Silver Perch	CR, L, vu	Recorded on VBA in 2017 and well known from Lindsay River and Mullaroo Creek.
Melanotaenia fluviatilis	Murray-Darling Rainbowfish	L, vu	Known from area by ARI (2018).
Craterocephalus stercusmuscarum fulvus	Unspecked Hardyhead	L	Known from area by ARI (2018).
Tandanus tandanus	Freshwater Catfish	L, en	Known from area by ARI (2018).

Status: CR = listed as Critically Endangered under EPBC Act, VU = listed as Vulnerable under EPBC Act, L = Listed under FFG Act, en = listed as endangered under DELWP Advisory List, vu = listed as vulnerable under DELWP Advisory List, r = listed as rare under DELWP Advisory List.

Potential impacts on these species are discussed in the following sections.

Listed threatened ecological communities

The PMST identified one EPBC Act listed threatened ecological community with potential to occur within 10 km of the project area:

- Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions - Endangered.

This threatened ecological community can be analogous with Semi-arid Woodland (EVC 97) and Semi-arid Chenopod Woodland (EVC 98), which can also correspond with the FFG Act listed Semi-arid Shrubby Pine-Buloke Woodland Community.

A small area (approx. 0.03 ha) of Semi-arid Chenopod Woodland (EVC 98) identified at the CW_B2 regulator and containment bank in the Crankhandle West WMA corresponds with both the EPBC Act listed Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions and the FFG Act listed Semi-arid Shrubby Pine-Buloke Woodland Community.

Although Semi-arid Woodland (EVC 97) and Semi-arid Chenopod Woodland (EVC 98) are modelled to occur in the inundation area by DELWP (2019), targeted ground-truthing of the modelled locations of these EVCs confirmed the vegetation present did not comprise either of these EVCs or correspond with any listed threatened ecological communities as discussed in Section 12.1 of this referral. Whilst the full extent of the inundation area was not assessed as a part of the EVC ground-truthing exercise, based on a desktop review of the available information and observations made during the fieldwork, it is considered unlikely that any listed flora communities are present within the proposed inundation area.

Two FFG Act listed fauna communities are considered to occur within the construction footprint and inundation area:

- Victorian Temperate Woodland Bird Community (VTWBC) – This community is defined by a group of woodland dependent bird species, characteristically found in a range of woodland types, and over a broad geographic area. The geographic area is defined as the slopes and plains inland of the Great Dividing Range within Victoria. Riverine floodplains associated with the Murray River are not specifically included or excluded from the VTWBC description.

- Lowland Riverine Fish Community of the Southern Murray-Darling Basin – This community is associated with the lowland river reaches and associated floodplains of the Murray River tributaries in Victoria that drain the northern slopes of the Great Dividing Range, together with the lowland section and floodplain of the Murray River upstream of the South Australian border. The community is defined by a suite of native fish species that is typical of and largely restricted to this geographical area, including the five FFG Act listed fish species known to occur in the project area (Murray Cod, Silver Perch, Murray-Darling Rainbowfish, Unspecked Hardyhead, Freshwater Catfish).

The Victorian Mallee Bird Community (VMBC) has also been identified as potentially occurring in the vicinity of the project area, and is defined by a suite of 20 bird species that are almost completely restricted to habitat that is dominated by mallee, which distinctly characterises their distribution within Victoria. As mallee habitats have not been observed within the proposed construction footprint or inundation areas, it is unlikely that this community is present.

Potential impacts on these listed communities are discussed in the following sections.

Listed migratory species

A desktop assessment identified eleven EPBC Act listed migratory species that have been recorded or are modelled to potentially occur within 10 km of the project area, including Common Greenshank (*Tringa nebularia*), Common Sandpiper (*Actitis hypoleucus*), Curlew Sandpiper (*Calidris ferruginea*), Eastern Curlew (*Numenius madagascariensis*), Fork-tailed Swift (*Apus pacificus*), Grey Wagtail (*Motacilla cinerea*), Latham's Snipe (*Gallinago hardwickii*), Osprey (*Pandion haliaetus*), Pectoral Sandpiper (*Calidris melanotos*), Sharp-tailed Sandpiper (*Calidris acuminata*) and Yellow Wagtail (*Motacilla flava*).

All eleven of these species was assessed as having a possible likelihood of occurrence within the inundation area but only the Fork-tailed Swift and Osprey were assessed as having a possible likelihood of occurrence within the construction footprint (see Appendix D of **Attachment 3 – Flora and Fauna Assessment**).

Potential impacts on these listed migratory species are discussed in the following sections.

If known, what threatening processes affecting these species or communities may be exacerbated by the project? (eg. loss or fragmentation of habitats) Please describe briefly.

Potentially threatening processes are listed in accordance with Section 10 of the FFG Act. Threatening processes from this list that have the potential to be exacerbated by construction and/or operation of the project include:

Construction

- Loss of hollow-bearing trees from Victorian native forests
- The spread of *Phytophthora cinnamomi* from infected sites into parks and reserves, including roadsides, under the control of a state or local government authority
- Increase in sediment input into Victorian rivers and streams due to human activities
- Input of toxic substances into Victorian rivers and streams
- Alteration to the natural flow regimes of rivers and streams
- Prevention of passage of aquatic biota as a result of the presence of instream structures
- Removal of wood debris from Victorian streams.

Operation

- Predation of native wildlife by the introduced Cat, *Felis catus*.
- Predation of native wildlife by the introduced Red Fox *Vulpes vulpes*.
- Soil degradation and reduction of biodiversity through browsing and competition by Feral Goats (*Capra hircus*)
- Increase in pest animals (honeybees, goats, cats, pigs)
- Alteration to the natural flow regimes of rivers and streams
- Limitation / restriction of fish passage from instream structures
- Introduction of environmental weeds.

Measures to manage these impacts are outlined in the 'mitigation' section below and in **Attachment 6 – Draft Environmental Management Framework**.

It should also be noted that without intervention through works such as those proposed in the project, due to current water diversion and extraction practices, climate change and resultant lack of inundation of floodplain areas, it is likely that most areas of floodplain would continue to deteriorate in condition, and many areas would cease to function as floodplain and become semi-arid woodlands or shrublands, with a resultant loss of many ecological characteristics, and flora and fauna species which are dependent to a greater or lesser extent on these areas. The reinstatement of a more natural flooding regime would function on a large scale to directly reduce or prevent some of the FFG Act listed threatening processes identified above, including: alteration to the natural flow regimes of rivers and streams; degradation of native riparian vegetation along Victorian rivers and streams; habitat fragmentation as a threatening process for fauna in Victoria; loss of hollow-bearing trees from Victorian native forests; reduction in biodiversity resulting from Noisy Miner populations in Victoria; and wetland loss and degradation as a result of change in water regime. Current water management and extraction practices would likely continue to exacerbate these FFG Act listed threatening processes.

Are any threatened or migratory species, other species of conservation significance or listed communities potentially affected by the project?

☒ NYD ☒ No ☒ Yes If yes, please:

- List these species/communities:

- Indicate which species or communities could be subject to a major or extensive impact (including the loss of a genetically important population of a species listed or nominated for listing) Comment on likelihood of effects and associated uncertainties, if practicable.

Listed threatened flora

Of the listed flora species assessed as having a possible or higher likelihood of occurrence in the construction footprint, 11 species (including four FFG Act listed species and no EPBC Act listed species) were assessed as potentially impacted during construction of the project (see **Table 17**).

Although targeted flora surveys have not be undertaken throughout the inundation area, targeted ground-truthing of vegetation in areas modelled as containing non-flood dependent EVCs (i.e. Semi-arid Woodland, Semi-arid Chenopod Woodland) in June 2020, has confirmed that no Semi-arid Woodland or Semi-arid Chenopod Woodland was present in the inundation areas surveyed, and that vegetation in these areas comprises EVCs associated with alluvial terraces and prone to flooding. As such, the reinstatement of a more natural hydrological regime to these vegetation communities is expected to be largely beneficial to listed flora species associated with the communities, which are considered to be the listed flora species most likely to occur in the inundation areas. Potential impacts could arise in the event that water regimes are not aligned to the requirements of the vegetation communities or listed threatened species. Part of the process of refining the draft operating scenarios would involve further assessment of ecological benefits and potential impacts (including potential impacts on listed flora species) associated with the proposed operating regime, which would inform development of the final operating regime as well as monitoring, evaluation and reporting requirements.

Table 17: Listed flora species assessed as potentially impacted by the project

Scientific name	Common name	Status	Likelihood of occurrence / impact
Acacia oswaldii	Umbrella Wattle	L, vu	**Present.** Eleven individuals/clusters recorded within the construction footprint and the broader area of investigation during the 2019 surveys. **Impact Possible.** Installation of individual shrub No-Go zones would be needed to avoid impact on this species.
Asperula gemella	Twin-leaf Bedstraw	r	**Present.** Recorded within the construction footprint and the broader area of investigation during the 2019 surveys (>20 individuals/clusters scattered). **Impact Likely.** Scattered within proposed construction footprints and unlikely to be entirely avoidable.
Atriplex lindleyi subsp. *conduplicata*	Baldoo	r	**Present.** A single specimen was recorded during 2019 surveys within the area of investigation (but not within the construction footprint). **Impact Possible.** If the proposed construction footprint changes this species has the potential to be impacted by the proposed works.
Atriplex nummularia subsp. *omissa*	Dwarf Old-man Saltbush	r	**Present.** Recorded during 2019 surveys within the area of investigation (but not within the construction footprint) (4 individuals/clusters). **Impact Possible.** If the proposed construction footprint changes this species has the potential to be impacted by the proposed works.
Calotis cuneifolia	Blue Burr-daisy	r	**Present.** Recorded during 2019 surveys within the area of investigation (but not within the construction footprint) (>5 individuals/clusters).

			Impact Possible. If the proposed construction footprint changes this species has the potential to be impacted by the proposed works.
Crinum flaccidum	Darling Lily	L, vu	**Present.** Recorded at several locations within area of investigation during 2019 surveys (5 individuals/clusters) as well as previous surveys, some immediately adjacent to construction footprint. **Impact Possible.** Recorded immediately adjacent to the construction footprint. Installation of No-Go zones would be needed to avoid impact on this species.
Eremophila bignoniiflora	Bignonia Emu-bush	L, vu	**Present.** Recorded during the 2019 targeted surveys within the construction footprint and the broader area of investigation (>10 individuals/clusters scattered). **Impact Likely.** Scattered within proposed construction footprints and unlikely to be entirely avoidable.
Eremophila divaricata subsp. *divaricata*	Spreading Emu-bush	r	**Present**. Recorded during the 2019 targeted surveys within the construction footprint and the broader area of investigation (>20 individuals/clusters scattered). **Impact Possible.** Recorded within the construction footprint on the edge of an existing access track. Review and refinement of track upgrade requirements and/or installation of No-Go zones may avoid impact on this species.
Eremophila maculata subsp. *maculata*	Spotted Emu-bush	L, r	**Present.** Recorded during the 2019 targeted surveys within the construction footprint (1 individual/cluster). **Impact Possible.** Recorded within the construction footprint on the edge of an existing access track. Review and refinement of track upgrade requirements and/or installation of No-Go zones may avoid impact on this species.
Senecio cunninghamii var. *cunninghamii*	Branching Groundsel	r	**Present**. Recorded during the 2019 targeted surveys within the construction footprint and the broader area of investigation (>50 individuals/clusters scattered). **Impact Likely.** Scattered within proposed construction footprints and unlikely to be entirely avoidable.
Tecticornia triandra	Desert Glasswort	r	**Present**. Recorded during the 2019 targeted surveys within the construction footprint and the broader area of investigation (>30 individuals/clusters scattered). **Impact Likely.** Scattered within proposed construction footprints and unlikely to be entirely avoidable.

Status: L = Listed under FFG Act, vu = listed as vulnerable under DELWP Advisory List, r = listed as rare under DELWP Advisory List.

Two EPBC Act listed flora species were assessed as having a possible occurrence within the construction footprint: *Eleocharis obicis* (Striate Spike-sedge) (VU, vu), and *Lepidium monoplocoides* (Winged Peppercress) (EN, L, en). Potential impacts on the two EPBC Act listed flora species assessed as having a possible occurrence in the proposed construction footprint have been considered in relation to the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* under the EPBC Act. These assessments are contained in Appendix G of **Attachment 3 – Flora and Fauna Assessment**, and determined that:

- The construction and operation of the project is not likely to have a significant adverse impact on the EPBC Act listed Striate Spike-sedge – This species was recorded in 2013 along the eastern banks of Lake Wallawalla, outside the proposed construction footprint and area of investigation. There are no

records of this species in the vicinity of the project area on the VBA (nearest registered record is over 150 km away near Manangatang). Although some suitable habitat is present, this species was not recorded within the construction footprint during targeted flora surveys in 2013, 2015 or 2019. If present in the inundation area, the reinstatement of a more natural wetting / drying regime would result in Lake Wallawalla becoming more reliably ephemeral, which would likely be beneficial to this species persisting in the area, given the survival of this species and potential breeding is dependent on a wetting phase.

- The construction and operation of the project is not likely to have a significant adverse impact on the EPBC Act and FFG Act listed Winged Peppercress – Although there is a historic record of this species to the west of the national park from 1948, this species has not been recorded within 10 km of the project area since this time. Although some suitable habitat is present, this species was not recorded within the construction footprint during targeted flora surveys in 2013, 2015 or 2019. Although this species has not been recorded in the area for over 70 years, if it were present in the inundation area, the reinstatement of a more natural wetting / drying regime would likely be beneficial to this species persisting in the area.

The remaining listed flora species identified as possibly occurring due to the presence of some suitable habitat within the construction footprints, were not considered likely to be impacted on the basis that three rounds of targeted surveys of the construction footprint in 2013, 2015 and 2019 have not detected the presence of these species.

Listed threatened fauna

Of the listed fauna species assessed as having a possible or higher likelihood of occurrence in the construction footprint, 11 species (including 10 FFG Act listed species and three EPBC Act listed species) were assessed as potentially impacted during construction of the project, with six of these species also assessed as potentially impacted during operation of the project (refer to **Table 18**).

Table 18: Listed fauna species assessed as potentially impacted by the project

Species	Status	Construction footprint	Inundation area
Growling Grass Frog (*Litoria raniformis)*	VU, L, en	**Present**. Recorded in 2012 (GHD, 2013b) at the BERR_D containment bank construction footprint near Toupnein Creek while minor flooding was occurring. This species has potential to occur at any construction sites when water is present. Potential aquatic habitat within the Murray and Lindsay Rivers, Mullaroo and Little Mullaroo Creeks. **Impact Possible**. Localised impacts possible, due to cofferdam construction, dewatering works, and potential for sediment/ contaminant run-off from construction sites into wet areas.	**Present**. Recorded in 2012 (GHD, 2013b) at the BERR_D containment bank construction footprint near Toupnein Creek while minor flooding was occurring. This species has potential to occur across the inundation area when water is present. Potential aquatic habitat within the Murray and Lindsay Rivers, Mullaroo and Little Mullaroo Creeks and all of floodplain when wet from localised rain, river flows or environmental watering. **Impact Unlikely.** Species likely to benefit from environmental water when present, and indirectly from improved habitat condition following environmental watering.
Broad-shelled Turtle (*Chelodina expansa)*	L, en	**Possible.** This species is known from the local area and may occur in waterways and waterholes, especially those that are permanent	**Possible.** This species is known from the local area and may occur in waterways and waterholes, especially those that are permanent and have aquatic vegetation, including the Murray River. Suitable habitat

		and have aquatic vegetation, including the Murray River. **Impact Possible**. Localised impacts possible, due to cofferdam construction, dewatering works, and potential for sediment/ contaminant run-off from construction sites into wet areas.	expected to increase during environmental watering. **Impact Possible.** Species likely to benefit directly from expanded habitat when environmental water is present, and indirectly from improved habitat condition following environmental watering.
Carpet Python (*Morelia spilota metcalfei)*	L, en	**Possible.** Suitable habitat present at all construction sites. **Impact Possible**. Localised impacts possible due to removal of habitat / hollow-bearing trees. As this species is moderately mobile and suitable habitat is surrounding and widespread, impact not likely to be significant.	**Possible.** Suitable habitat present across the inundation area. **Impact Unlikely.** Species likely to benefit from environmental water when present, and indirectly from improved habitat condition following environmental watering.
De Vis' Banded Snake (*Denisonia devisi)*	cr	**Possible.** Suitable habitat present at all construction sites. **Impact Possible**. Localised impacts possible due to removal of habitat / hollow-bearing trees. As this species is moderately mobile and suitable habitat is surrounding and widespread, impact not likely to be significant.	**Possible.** Suitable habitat present across the inundation area. **Impact Unlikely.** Species likely to benefit from environmental water when present, and indirectly from improved habitat condition following environmental watering.
Lace Monitor (*Varanus varius)*	L, en	**Possible.** Suitable habitat present at all construction sites. **Impact Possible**. Localised impacts possible due to removal of habitat / hollow-bearing trees. As this species is moderately mobile and suitable habitat is surrounding and widespread, impact not likely to be significant.	**Possible.** Suitable habitat present across the inundation area. **Impact Unlikely.** Species likely to benefit from environmental water when present, and indirectly from improved habitat condition following environmental watering.
Red-naped Snake (*Furina diadema)*	L, vu	**Possible.** Suitable habitat present at all construction sites. **Impact Possible**. Localised impacts possible due to removal of habitat / hollow-bearing trees. As this species is moderately mobile and suitable habitat is	**Possible.** Suitable habitat present across the inundation area. **Impact Unlikely.** Species likely to benefit from environmental water when present, and indirectly from improved habitat condition following environmental watering.

		surrounding and widespread, impact not likely to be significant.	
Murray Cod (*Maccullochella peelii peelii)*	VU, L, vu	**Present.** This species is well known from the Murray and Lindsay Rivers and Mullaroo Creek, and suitable habitat is present in wetlands and creeks throughout the Lindsay Island complex. **Impact Possible.** Impacts possible due to cofferdam construction, dewatering works, and potential for sediment/contaminant run-off from construction sites into wet areas. Highest potential for impacts isduring construction of the Berribee Regulator across the Lindsay River. Construction of the Berribee Regulator is likely to extend over 18 months, including during breeding season (Sep-Dec).	**Present.** This species is well known from Lindsay River and Mullaroo Creek, and suitable habitat is present in wetlands and creeks throughout the Lindsay Island complex. **Impact Likely.** Operation of the project under larger inundation scenarios (i.e. Berribee Maximum and Intermediate) has the potential to reduce hydraulic complexity in the Lindsay-Mullaroo system by reducing water velocities in the system, which could reduce the availability of core habitat for Murray Cod during breeding season (Sep-Dec). Refer to discussion below for further details. Provision of fish passage at the Berribee Regulator fishway and passive fish passage at other regulators would allow for fish to exit to the Murray and Lindsay Rivers, provided a suitable drawdown regime is implemented and regulators/fishways are operated to an appropriate standard, particularly so as to enable escape during anoxic blackwater events. Retention of water on the floodplain at locations where drawdown is not proposed (Wallawalla West, Lake Wallawalla and Crankhandle Lower Tier) has the potential to impact fish that cannot escape during drying of the wetlands, however it is unlikely that significant numbers of Murray Cod would inhabit these wetland locations.
Silver Perch (*Bidyanus bidyanus)*	CR, L, vu	**Present.** This species is known from the area and suitable habitat present in waterways, including Lindsay River, Mullaroo Creek and the Murray River. **Impact Possible.** Impacts possible due to cofferdam construction, dewatering works, and potential for sediment/contaminant run-off from construction sites into wet areas. Highest potential for impacts is during construction of the Berribee Regulator across the Lindsay River. Construction of the Berribee Regulator is likely to extend over 18 months,	**Present.** Species is known from the area and suitable habitat present in waterways, including Lindsay River, Mullaroo Creek and the Murray River. **Impact Likely.** Operation of the project under larger inundation scenarios (i.e. Berribee Maximum and Intermediate) has the potential to reduce hydraulic complexity in the Lindsay-Mullaroo system by reducing water velocities in the system, which could reduce the availability of suitable habitat for Silver Perch during breeding season (Sep-Feb). Refer to discussion below for further details. Provision of fish passage at the Berribee Regulator fishway and passive fish passage at other regulators would allow for fish to exit to the Murray and Lindsay Rivers, provided a suitable drawdown regime is implemented and regulators/fishways are operated to an

		including during breeding season (Sep-Feb).	appropriate standard, particularly so as to enable escape during anoxic blackwater events. Retention of water on the floodplain at locations where drawdown is not proposed (Wallawalla West, Lake Wallawalla and Crankhandle Lower Tier) has the potential to impact fish that cannot escape during drying of the wetlands, however it is unlikely that significant numbers of Silver Perch would inhabit these wetland locations.
Murray-Darling Rainbowfish (*Melanotaenia fluviatilis)*	L, vu	**Present**. This species is known from the area and suitable habitat present in wetland and waterways within the Lindsay Island complex. **Impact Possible.** Impacts possible due to cofferdam construction, dewatering works, and potential for sediment/contaminant run-off from construction sites into wet areas. Highest potential for impacts is during construction of the Berribee Regulator across the Lindsay River. Construction of the Berribee Regulator is likely to extend over 18 months.	**Present.** This species is known from the area and suitable habitat present in wetland and waterways within the Lindsay Island complex. **Impact Possible.** Operation of the project to restore semi-permanent wetland habitat in the Crankhandle wetlands complex would likely benefit this species provided the timing, frequency and duration of inundation satisfies the recommended flow regime (ARI, 2018). Provision of fish passage at the Berribee Regulator fishway and passive fish passage at other regulators would allow for fish to exit to the Murray and Lindsay Rivers, provided a suitable drawdown regime is implemented and regulators/fishways are operated to an appropriate standard, particularly so as to enable escape during anoxic blackwater events. Retention of water on the floodplain at locations where drawdown is not proposed (Wallawalla West, Lake Wallawalla and Crankhandle Lower Tier) has the potential to impact fish that cannot escape during drying of the wetlands.
Unspecked Hardyhead (*Craterocephalus stercusmuscarum fulvus)*	L	**Present**. This species is known from the area and suitable habitat present in wetland and waterways within the Lindsay Island complex. **Impact Possible.** Impacts possible due to cofferdam construction, dewatering works, and potential for sediment/contaminant run-off from construction sites into wet areas. Highest potential for impacts is during construction of the Berribee Regulator across the Lindsay River. Construction of the Berribee Regulator is likely to extend over 18 months.	**Present**. This species is known from the area and suitable habitat present in wetland and waterways within the Lindsay Island complex. **Impact Possible.** Operation of the project to restore semi-permanent wetland habitat in the Crankhandle wetlands complex would likely benefit this species provided the timing, frequency and duration of inundation satisfies the recommended flow regime (ARI, 2018). Provision of fish passage at the Berribee Regulator fishway and passive fish passage at other regulators would allow for fish to exit to the Murray and Lindsay Rivers, provided a suitable drawdown regime is implemented and regulators/fishways are operated to an appropriate standard, particularly so as to

			enable escape during anoxic blackwater events. Retention of water on the floodplain at locations where drawdown is not proposed (Wallawalla West, Lake Wallawalla and Crankhandle Lower Tier) has the potential to impact fish that cannot escape during drying of the wetlands.
Freshwater Catfish (*Tandanus tandanus)*	L, en	**Present**. This species is known from the area and suitable habitat present in wetland and waterways within the Lindsay Island complex. **Impact Possible.** Impacts possible due to cofferdam construction, dewatering works, and potential for sediment/contaminant run-off from construction sites into wet areas. Highest potential for impacts is during construction of the Berribee Regulator across the Lindsay River. Construction of the Berribee Regulator is likely to extend over 18 months.	**Present**. This species is known from the area and suitable habitat present in wetland and waterways within the Lindsay Island complex. **Impact Possible.** Operation of the project to restore semi-permanent wetland habitat in the Crankhandle wetlands complex would likely benefit this species provided the timing, frequency and duration of inundation satisfies the recommended flow regime (ARI, 2018). However, a loss of flowing habitat in Mullaroo Creek, where the species is known to inhabit, during large inundation events may impact the species. Provision of fish passage at the Berribee Regulator fishway and passive fish passage at other regulators would allow for fish to exit to the Murray and Lindsay Rivers, provided a suitable drawdown regime is implemented and regulators/fishways are operated to an appropriate standard, particularly so as to enable escape during anoxic blackwater events. Retention of water on the floodplain at locations where drawdown is not proposed (Wallawalla West, Lake Wallawalla and Crankhandle Lower Tier) has the potential to impact fish that cannot escape during drying of the wetlands.

Status: CR = listed as Critically Endangered under EPBC Act, VU = listed as Vulnerable under EPBC Act, L = Listed under FFG Act, cr = listed as critically endangered under DELWP Advisory List, en = listed as endangered under DELWP Advisory List, vu = listed as vulnerable under DELWP Advisory List, r = listed as rare under DELWP Advisory List.

EPBC Act listed fauna

Potential impacts on each of the three EPBC Act listed species assessed as potentially impacted by the proposed construction and / or operation of the project in **Table 18** have been considered in relation to the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* under the EPBC Act. These assessments have also been undertaken for other EPBC Act listed species identified as present or possibly occurring in the construction footprint (Regent Parrot, Painted Honeyeater) or in the inundation area (Regent Parrot, Painted Honeyeater, Australasian Bittern, Australian Painted Snipe, Eastern Curlew, Curlew Sandpiper) but not considered likely to be impacted by the project.

These assessments are contained in Appendix H of **Attachment 3 – Flora and Fauna Assessment**, and determined that:

- Construction and operation of the project is not likely to have a significant adverse impact on the Growling Grass Frog, Regent Parrot, Painted Honeyeater, Australasian Bittern, Australian Painted

Snipe, Eastern Curlew, Curlew Sandpiper provided the recommended mitigation measures are implemented, given that:

- No known Regent Parrot nesting trees would be removed based on the findings of targeted nesting surveys in areas of potentially suitable breeding habitat within and adjacent to the construction footprint. Surveys using the 2 hr point count method (Robertson and Hurley 2010) were conducted within suitable habitat (large River Red Gum habitats along watercourses) within the breeding season in 2019 (R8, 2020d) and 2012 (GHD, 2013b). No nesting colonies were recorded during these surveys. An additional repeat survey within potential habitat surrounding proposed infrastructure is planned for September/October 2020. Two observations of nesting by Regent Parrots have been observed close to Lock 7 (near the mouth of the Mullaroo Creek) in 1983 and 1984, which are likely the same birds in the same tree as Regent Parrots are known to exhibit site fidelity. Presently, there are no known nesting colonies within or adjacent to the construction footprint or access tracks.

- These species are highly mobile and wide-ranging and suitable habitat is surrounding and widespread, while the removal of vegetation would be scattered across 30 relatively small, discrete sites or along the edge of mostly existing tracks in the context of extensive areas of native vegetation at Lindsay Island (over 15,000 ha) and the even more extensive Murray-Sunset National Park and Murray River corridor

- Reinstatement of a more natural hydrological regime would likely benefit these species by improving the health and condition of floodplain vegetation, including large, old River Red Gum trees relied on by Regent Parrot for breeding; and expanding ephemeral habitat suitable for Growling Grass Frog during environmental watering events.

- Construction of the project is not likely to have a significant adverse impact on Murray Cod and Silver Perch provided the recommended mitigation measures are implemented to maintain adequate fish passage during construction, avoid construction of in-stream works during breeding season, and manage water quality risks associated with dewatering, erosion and sediment runoff from construction sites.

- Operation of the project has the potential to cause a significant impact on a nationally important population of Murray Cod as well as Silver Perch due primarily to the potential for larger inundation events to reduce the availability of permanent, fast-flowing habitat in the Mullaroo-Lindsay system.

The primary pathway for potential impacts on these species during operation of the project is associated with operation of the Berribee Regulator to retain water within the Berribee WMA at levels that would reduce flow velocities in Mullaroo Creek and the upper Lindsay River to below the flow velocities preferred by Murray Cod and to a lesser extent, Silver Perch. Hydrodynamic modelling under a range of operating scenarios was undertaken by Water Technology (2016) and analysed by ARI (2018) to identify operating conditions that would reduce flow velocities below the thresholds required to support Murray Cod.

ARI (2018) identified that operation of the Berribee Maximum scenario at the level, frequency, duration and timing assessed, posed a very high risk to hydraulic habitat in the Lindsay-Mullaroo system and provided recommendations to limit operation of this scenario to reduce the level of risk, although this would remain high. ARI (2018) also identified that operation of the Berribee Intermediate scenario at the level, frequency, duration and timing assessed, posed a high risk to hydraulic habitat in the Lindsay-Mullaroo system and provided recommendations to modify operation of this scenario, which was considered to reduce this risk to low. It should be noted that the Berribee Intermediate scenario assessed by ARI (2018) had a level of 21.7 mAHD (at Berribee Regulator) and 22.6 mAHD (at Lock 7). The currently proposed operating regime for Berribee Intermediate is based on levels ranging from 22.1 mAHD to 23.1 mAHD. The Berribee Maximum scenario was originally assessed at 23.2 mAHD. As

such, the Berribee Intermediate assessment by ARI (2018) is likely to have an understatement of risk and under the current draft operating regime. The higher level Berribee Intermediate events could be considered of equivalent risk to the Berribee Maximum scenario. The potential for impacts on Murray Cod and Silver Perch therefore remains a significant risk that needs to be addressed through further assessment, refinement of operating scenarios and potentially other mitigation measures. Further discussion of the key findings and recommendations by ARI (2018) are contained in **Attachment 3 – Flora and Fauna Assessment**.

Other FFG Act listed fauna

In addition to the Growling Grass Frog, Murray Cod and Silver Perch, which are also EPBC Act listed and therefore discussed above, seven other FFG Act listed species have been assessed as potentially impacted by the project:

- Broad-shelled Turtle (*Chelodina expansa*)
- Carpet Python (*Morelia spilota metcalfei*)
- Lace Monitor (*Varanus varius*)
- Red-naped Snake (*Furina diadema*)
- Murray-Darling Rainbowfish (*Melanotaenia fluviatilis*)
- Unspecked Hardyhead (*Craterocephalus stercusmuscarum fulvus*)
- Freshwater Catfish (*Tandanus tandanus*).

Potential impacts to the FFG Act listed fish species (Murray Cod, Silver Perch, Murray-Darling Rainbowfish, Unspecked Hardyhead, Freshwater Catfish) and the Broad-Shelled Turtle during construction would be localised and associated with cofferdam construction (potential barriers to fish passage, noise and vibration), dewatering works (drawdown and saline water management), and potential for sediment/contaminant run-off from construction sites into wet areas. The potential for impacts is highest during construction of the Berribee Regulator across the Lindsay River, which is likely to extend over at least 18 months. Construction of the project is not likely to have a significant adverse impact on these species provided the recommended mitigation measures are implemented to maintain adequate fish passage during construction, avoid high impact in-stream construction activities (i.e. sheet piling) during breeding season, and manage water quality risks associated with dewatering, erosion and sediment runoff from construction sites.

Operation of the project to restore semi-permanent wetland habitat in the Crankhandle wetlands complex would likely benefit FFG Act listed fish species, particularly small-bodied, generalist fish species, provided the timing, frequency and duration of inundation satisfies the recommended flow regime (ARI, 2018). However, a loss of fast-flowing habitat in the Lindsay-Mullaroo system during larger inundation scenarios is likely to impact large-bodied FFG Act listed fish species known to inhabit this system, including the Murray Cod, Silver Perch and Freshwater Catfish. Key to protecting FFG Act listed species (specifically Murray Cod but also Silver Perch and Freshwater Catfish) will be to operate the system to maintain the integrity of permanent fast-flowing hydraulics of core aquatic habitats in Mullaroo Creek and the upper Lindsay River. Recommended measures to maintain fast-flowing habitat for the Murray Cod and Silver Perch, and to otherwise mitigate potential impacts on these EPBC Act listed species, would also mitigate potential impacts on Freshwater Catfish.

Provision of fish passage at the Berribee Regulator fishway and passive fish passage at other regulators would allow for fish to exit to the Murray and Lindsay Rivers, provided a suitable drawdown regime is implemented and regulators/fishways are operated to an appropriate standard. Retention of water on the

floodplain at locations where drawdown is not proposed (Wallawalla West, Lake Wallawalla and Crankhandle Lower Tier) has the potential to impact fish that cannot escape during drying of the wetlands.

The FFG Act listed Broad-shelled Turtle is likely to benefit from expanded habitat when environmental water is present and indirectly from improved habitat condition following environmental watering. There is some potential for impacts to this species associated with entrainment via temporary pumping and passage through structures, however these impacts are not likely to be significant provided the recommended mitigation measures are implemented.

Potential impacts on the FFG Act listed Carpet Python, Lace Monitor and Red-naped Snake would be localised, limited to the construction phase and associated with the removal of habitat, particularly hollow-bearing trees and large woody debris. These impacts are not likely to be significant given these species are moderately mobile, suitable habitat is surrounding and widespread, and effective mitigation measures are relatively standard and well-understood, including minimising hollow-bearing tree removal, pre-clearance surveys, salvage and deployment of habitat features. These species are likely to benefit indirectly from the improved condition of floodplain vegetation and the health of large trees following environmental watering.

Other FFG Act listed species identified as possibly occurring in the proposed construction footprints or inundation areas are highly mobile bird species and moderately mobile reptile species that all have access to large areas of suitable habitat in the immediate surrounding areas in which to disperse. These species may experience some localised loss of habitat and temporary displacement or disturbance during construction but are not likely to be impacted. Although the project would require removal of approximately 106 ha of native vegetation, this is scattered across more than 30 relatively small and discrete construction sites for proposed structures, or along the edge of mostly existing access tracks, and would occur within the 15,000 ha of largely intact vegetation on Lindsay Island and more broadly within the extensively vegetated landscapes of the Murray-Sunset National Park and Murray River corridor. Each of these species are also unlikely to be adversely impacted by periodic inundation given these species either have a broad foraging/dispersal range (e.g. Giles' Planigale, Diamond Dove, Ground Cuckoo-shrike) or would have the ability to continue utilising floodplain habitats during inundation (e.g. Growling Grass Frog, Carpet Python, Painted Honeyeater).

Listed threatened ecological communities

Flora communities

A small area (approx. 0.03 ha) of Semi-arid Chenopod Woodland (EVC 98) identified at the CW_B2 regulator and containment bank construction site in the Crankhandle West WMA, that corresponds with both the EPBC Act listed Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions (Endangered) and the FFG Act listed Semi-arid Shrubby Pine-Buloke Woodland Community, may be impacted by the proposed construction works. This area of Semi-arid Chenopod Woodland (EVC 98) is not within the construction footprint of the proposed regulator or containment bank, and is located on the opposite side of an existing access track to the proposed infrastructure. This access track is only required to be a minor Type 1A access (for construction purposes only) and therefore significant track works are not anticipated to be required at this location. As such, it is considered likely that the arborist assessment combined with minor design refinements, would avoid impacts to this small area of Semi-arid Chenopod Woodland (EVC 98).

As noted in the preceding section, targeted ground-truthing in areas modelled as Semi-arid Chenopod Woodland (EVC 98) or Semi-arid Woodland (EVC 97) has confirmed that vegetation in these areas is not consistent with these non-flood dependent EVCs or any listed threatened flora communities. No other EVCs modelled to occur in proposed inundation areas correspond with any listed threatened flora communities. As such, the project is not likely to have a significant adverse impact on any listed threatened flora communities through construction or operation.

Fauna communities

Given that Lindsay Island is comprised largely of intact vegetation, the proposed construction of floodplain infrastructure scattered across approximately 30 relatively small and discrete locations, is unlikely to impact on habitat connectivity or remove important habitat for the FFG Act listed VTWBC. The reinstatement of a more natural hydrological regime for floodplain and wetland habitats, would also likely provide important future benefits to the resilience and persistence of the VTWBC, particularly under climate change scenarios of longer, drier conditions in a semi-arid environment.

The project has the potential to both positively and negatively impact the FFG Act listed Lowland Riverine Fish Community of the Southern Murray-Darling Basin, which includes the FFG Act listed Murray Cod, Silver Perch, Murray-Darling Rainbowfish, Unspecked Hardyhead and Freshwater Catfish discussed earlier in this section. Potential impacts and recommended mitigation measures to avoid or minimise impacts on this FFG Act listed fish community are consistent with those described for the constituent EPBC Act and FFG Act listed fish species. Operation of the project has the potential to restore semi-permanent wetlands that support small-bodied fish and to allow for protection of existing high value fish communities, including threatened fish species. Key to protecting EPBC Act and FFG Act listed species (Murray Cod, Silver Perch) and therefore the FFG Act listed Lowland Riverine Fish Community of the Southern Murray-Darling Basin, is the operation of the project to maintain the permanent fast-flowing hydraulics of core aquatic habitats in Mullaroo Creek and the upper Lindsay River.

Listed migratory species

Eleven EPBC Act listed migratory species modelled to potentially occur within 10 km of the project area were considered to have a possible or higher likelihood of occurrence in the proposed inundation areas, including Common Greenshank, Common Sandpiper, Curlew Sandpiper, Eastern Curlew, Fork-tailed Swift, Grey Wagtail, Latham's Snipe, Osprey, Pectoral Sandpiper, Sharp-tailed Sandpiper and Yellow Wagtail. Eight of these listed migratory species are wading shore-birds, and along with the two species of Wagtail (Grey and Yellow), are likely to benefit from the reinstatement of more frequent inundation of their preferred wetland and mudflat habitats in areas such as Lake Wallawalla, which is known to attract a regionally significant number of waterbirds when flooded, including the Common Greenshank and other listed migratory and threatened waterbirds (MDBC 2006). Specifically, reinstatement of a more natural flooding regime would contribute to increased productivity of the wetland communities, and increased vegetation diversity and structure from more dominant drought-tolerant species, which would likely improve breeding, foraging and refuge resources for listed migratory species, in particular the Common Greenshank and Sharp-tailed Sandpiper.

Only two EPBC Act listed migratory species, Fork-tailed Swift and Osprey, were assessed as having a possible likelihood of occurrence within the construction footprints. These species may fly over the construction footprint whilst foraging, but are considered unlikely to be impacted, as both species are highly mobile, wide-ranging, and suitable habitat is surrounding and widespread. The other listed migratory species identified on the PMST were considered unlikely to occur within the construction footprints during the time of the survey, mostly due to the lack of recent records and/or a lack of suitable habitat present. While suitable habitat for these mostly migratory wading shore-birds may be present in some construction footprints (e.g. Lake Wallawalla) when water is present, it is intended that construction works would be undertaken during dry periods when sufficient water to attract these species is unlikely to be present and therefore direct impacts on these species are unlikely to occur during construction.

Potential impacts on EPBC Act listed migratory species have been considered in relation to the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* under the EPBC Act (see Appendix J of **Attachment 3 – Flora and Fauna Assessment**).

Is mitigation of potential effects on indigenous flora and fauna proposed?

☒ NYD ☒ No ☒ Yes If yes, please briefly describe.

Design

The following mitigation measures have been and would continue to be implemented during the completion of the design phase to avoid or minimise impacts to native vegetation, threatened flora/fauna and communities as identified through the various ecological surveys undertaken for the project:

- The current design has located structures (e.g. containment banks and regulators) mostly on existing vehicle tracks and other previously disturbed areas. The containment banks would continue to be used as vehicle access tracks. Some containment banks deviate from existing vehicle tracks where necessary to avoid significant Aboriginal cultural heritage values or large trees located along existing tracks. These structures were sited to minimise impacts to large trees and other known environmental and heritage values.
- The current design has minimised the footprint of containment banks by:
  - Adopting the minimum bank height (freeboard) necessary to maintain safety and functionality, after considering wear and wave impacts
  - Adopting the minimum bank crest width necessary for road safety based on track design speed
  - Adopting the steepest batter slope that still meets embankment stability and road safety requirements (3H:1V)
- The current design has selected passing bay locations to avoid large trees where feasible to still meet safe sight distance requirements.
- To the extent practicable, refine the design / construction footprint utilising the existing ecological values mapping to avoid the small area (0.03 ha) of Semi-arid Chenopod Woodland (EVC 98) near the CW_B2 regulator and containment bank in Crankhandle West WMA as this vegetation meets the criteria to be considered the EPBC Act listed Buloke Woodlands of the Murray Darling Depression Bioregion, and the FFG Act listed Semi-arid Shrubby Pine-Buloke Woodland Community.
- To the extent practicable, refine the design / construction footprint utilising the existing ecological values mapping to avoid and minimise impacts to listed flora species identified adjacent to existing tracks (e.g. *Eremophila maculata subsp. maculata* and *Acacia oswaldii*) and to minimise removal of large, hollow-bearing trees.
- For infrastructure proposed in densely treed areas, particularly those locations identified as containing potential Regent Parrot breeding habitat (Berribee Regulator (BERR_A) on the Lindsay River, BERR_D containment bank near Toupnein Creek, BERR_E regulator at Little Mullaroo Creek West and BERR_F regulator at Little Mullaroo Creek) assessment by a qualified arborist is recommended to assist in micro-siting infrastructure to avoid or minimise removal of large, hollow-bearing trees.
- Any changes to regulator designs, which have currently satisfied the fish passage recommendations by ARI (2018), are to be evaluated / informed by an appropriately qualified fish ecologist to ensure appropriate provision is made for fish passage.

Construction

The following mitigation measures are proposed to avoid and minimise impacts on the identified threatened flora, fauna and community values during construction:

- Develop and implement a Construction Environmental Management Plan (CEMP) for the construction phase to manage potential direct and indirect impacts of construction on the environment. The CEMP would be audited during and following the construction process to check that works have been conducted appropriately.
- Develop and implement a Flora and Fauna Management Plan as part of the CEMP to manage impacts to flora and fauna values, particularly threatened species and communities. The Flora and Fauna Management Plan would include the following requirements:

- The avoid, minimise and offset protocol in the *Guidelines for the removal, destruction or lopping of native vegetation* (DELWP, 2017a) is to be followed for determining the construction footprint at each site (i.e. make every effort to avoid threatened flora species loss as a high priority)
- Areas of remnant native vegetation to be retained are to be delineated from those areas to be removed as 'no-go zones', to avoid encroachment into areas of retained vegetation
- Existing disturbed areas or areas of non-native vegetation are to be used for laydowns and stockpiling
- All vehicles and plant must only operate on designated access tracks and in areas marked as parking areas or construction zones
- Potential impacts to tree root zones are to be managed during construction, with tree protection fencing/barriers where instructed by a qualified arborist
- Establish work zones for each site to avoid 'sensitive' habitats (including areas containing threatened flora). This is to be implemented through an initial briefing of construction works crews by a qualified ecologist and subsequent planning of safe work distances and establishment of each site
- Temporary fencing is to be erected around 'sensitive' areas to indicate areas to avoid during construction
- For the protection of threatened flora:
    - Species listed under the FFG Act and EPBC Act not permitted to be removed, are to be fenced off (e.g. with temporary one metre high orange barrier mesh medium-heavy weight) prior to construction commencing
    - Fencing is to be checked on a weekly basis and the population monitored by a qualified ecologist on a monthly basis
    - All staff onsite are to be made aware through inductions and/ or signage of the presence of threatened species and how to identify the species.
    - If any threatened flora species additional to those already identified in site plans are found within the construction area a qualified ecologist is to be notified. The number and location of individuals is to be recorded and DELWP is to be advised
- Pre-clearance surveys are to be undertaken 24 hrs prior to removal of any patch of native vegetation or hollow-bearing tree.
- Avoid hollow bearing tree removal during the breeding season of hollow-dependant species where possible. Where this is not practical, pre-clearance surveys are to be undertaken by a suitably qualified ecologist during the breeding season.

- Develop and implement an Aquatic Fauna Management Plan as part of the CEMP to manage impacts to aquatic values (with emphasis on threatened fish and turtle species present in the vicinity) and addressing any construction activities that could lead to entrapment of fauna or temporary loss of habitat (e.g. due to the use of cofferdams and dewatering). The Aquatic Fauna Management Plan should include the following requirements:
    - If the capture, handling or translocation of fish or turtles is required during construction (e.g. dewatering work sites) or operation of the project, persons undertaking these activities are required to hold the appropriate permit or licence under the *Fisheries Act 1995*. Any capture of fish must be carried out by a qualified aquatic ecologist.
    - To reduce the likelihood of impacts to threatened fish, the following mitigation measures should be adopted during construction of the Berribee Regulator:

  - Construction works are to be planned / scheduled to minimise the time required to construct the works so as to minimise the length of time for potential barriers to aquatic fauna movement.
  - Temporary cofferdams (permanent seepage cutoffs) in the Lindsay River at Berribee Regulator are to be constructed by sheet-piling using barges, with consideration given to the timing of pile-driving placement and the pile-driving method to minimise impacts to threatened fish present within the Lindsay River. The pile-driving method should, if feasible, use a vibrating hammer above the water line to install sheet piles. Timing of sheet-piling or other high impact construction activities in the Lindsay River during the spawning season for threatened fish species (generally October to February) is to be avoided were practicable. Construction during spawning season has the potential to impact fish present, but the magnitude of impact is unclear as impacts of noise and vibration on freshwater fish are largely unknown. If high impact in-water construction activities such as sheet-piling are required during the spawning season, further assessment of potential noise and vibration impacts should be undertaken to identify potential impacts and additional mitigation measures if required, and the lowest impact piling method is to be employed during these periods.
  - Constructability investigations to date indicate that the Berribee Regulator is able to be constructed in two parts to enable the Lindsay River to remain open to provide for passing flows and hence fish passage throughout construction of the regulator. Further assessment should be carried out to confirm that these passing flows would provide for fish passage in terms of resulting depth and flow velocity.
  - Removal of submerged woody habitat should be avoided where practicable, and if not avoidable, any submerged woody habitat removed should be placed back in the same waterway, as close to its original location as possible.

- Standard vehicle hygiene measures are to be implemented to prevent the spread and introduction of weed species, particularly the weeds of national significance and noxious weeds listed under the *Catchment and Land Protection Act 1994* (CaLP Act), and to prevent the spread or transmission of Chytrid Fungus as per Murray et al (2011).
- On completion of works, temporary construction areas are to be rehabilitated to the satisfaction of Parks Victoria or the relevant landowner/manager. Site rehabilitation measures may include:
  - Temporary tracks required for construction only are to be closed off by log placement to enable revegetation
  - Re-spreading of stored topsoil stripped at commencement of works across disturbed areas, followed by monitoring to assess germination in the following year
  - Appropriate weed control measures at the site following the works
  - If the site is not naturally recolonised by locally indigenous species following construction, planting of locally indigenous species appropriate to that particular position in the landscape may be undertaken in the following year
  - Ground debris that is temporarily removed to allow construction activities, is to be reinstated.

Operation

Refinement of operating scenarios

As described in Section 3 of this referral, the draft operating scenarios used as the basis for assessment of environmental effects in this referral and associated specialist reports were developed to more closely align the frequency, duration and timing of future flood events within the managed inundation area, with the natural (pre-regulation) frequency, duration and timing of flood events experienced by the targeted

water regime classes within the managed inundation area. However, although river regulation has contributed to water deficiencies and declining ecological condition across much of the Murray River floodplain due to the reduced frequency and duration of moderate to large flood events, the operation of Lock 7 and associated weir pool has contributed to the creation of modified hydraulic conditions in the Lindsay-Mullaroo system at Lindsay Island, which supports a significant native fish population, including nationally listed threatened species such as Murray Cod and Silver Perch (ARI, 2018). Specifically, these fish communities are supported by perennial stable flows of approximately 1,000 ML/day from Lock 7 and fast-flowing reaches, particularly in Mullaroo Creek, along with the presence of high quality and abundant snags in the Lindsay River and Mullaroo Creek (ARI, 2018).

Assessments undertaken for the project, including the Lindsay Island SDL Fish Management Plan (ARI, 2018) as discussed in **Attachment 3 – Flora and Fauna Assessment**, have identified that larger inundation scenarios for the Berribee WMA (e.g. Berribee Maximum, higher level Berribee Intermediate) would reduce the availability of fast-flowing habitat in the Lindsay-Mullaroo system, most notably the upper Mullaroo Creek, which is considered important habitat for Murray Cod, Silver Perch and other native fish species. Operation of these larger events at a frequency and duration that exceeds the resilience thresholds for the local native fish population, has been identified by ARI (2018) and R8 (2020d) as likely to adversely impact on the native fish, including Murray Cod and Silver Perch.

As such, refinement of the draft operating scenarios and / or alternative measures are required to further avoid or mitigate potential impacts on the EPBC Act and FFG Act listed Murray Cod and Silver Perch. Further analysis of ecological and hydrological investigations, and the recommendations contained in the Lindsay Island SDL Fish Management Plan (ARI, 2018), is proposed in order to optimise the draft operating scenarios. A summary of further investigations or analysis proposed to be undertaken to inform refinements to the draft operating scenarios, is provided in Section 20 of this referral.

Key recommendations for refinement of operating scenarios to enhance outcomes for threatened fish species by ARI (2018) which would be considered in the further assessment, include:

- Reduce the frequency of the Berribee Maximum inundation scenario (e.g. to 1 in 10 years), do not implement after an anoxic blackwater event, limit duration (e.g. 6 weeks), and avoid overlap with Murray Cod spawning season (e.g. preferred timing May-July).
- Reduce the frequency of the higher level Berribee Intermediate inundation scenario (e.g. to 4 in 10 years), do not implement after an anoxic blackwater event, limit duration (e.g. 8 weeks), and avoid overlap with Murray Cod spawning season (e.g. preferred timing May-July), avoid consecutive year operation.

<u>Other mitigation measures for operation</u>

The following additional mitigation measures are recommended to avoid or minimise impacts on the identified threatened flora, fauna and community values during operation:

- To minimise the risk of native fish stranding on floodplains during drawdown, implement slow drawdown to allow fish to migrate from floodplain
- To minimise the risk of increased carp populations, which may impact native fish species present within the complex, implement operating plans that include:
    - Implementing a winter fill regime
    - A native fish exit strategy designed to strand carp
    - Drying of wetlands with high carp density
- Fishways are to be operated to appropriate standards to reduce the risk of restricting fish passage, particularly for the purpose of allowing escape from blackwater events

- Implement pest animal management and control within the inundation area (and ideally surrounding areas), however this may require Parks Victoria to expand current pest control programs within the park to target these areas during inundation events.

Other information/comments? (e.g. accuracy of information)

Information is not currently available to enable a full assessment of the potential impacts on species and communities associated with the proposed operation of Lock 7 to facilitate managed inundation for the project, including potential impacts on species and communities possibly occurring within the NSW inundation areas. In particular, an assessment of the functionality of the Lock 7 fishway for the raised weir pool levels required to facilitate the project under the draft operating scenarios would be needed to inform an assessment of potential impacts on aquatic species and ecosystems.

13. Water environments

Will the project require significant volumes of fresh water (e.g. > 1 Gl/yr)?

☒ NYD ☒ No ☒ Yes If yes, indicate approximate volume and likely source.

The project proposes to inundate approximately 4,845 ha of the Lindsay Island floodplain complex in Victoria to varying levels across six WMAs, replicating the extent of flooding that would occur at Murray River flows of between approximately 40,000 ML/day to greater than 120,000 ML/day (Mallee CMA, 2014).

The project aims to deliver the environmental objectives under the Murray-Darling Basin Plan, using less water, by installing infrastructure that enables inundation of the floodplain under lower river flow conditions than would be necessary to generate natural flooding of a similar extent. Modelling by Water Technology (2016) indicates that each of the draft operating scenarios is able to operate and deliver water to the floodplain, at river flows as low as 5,000 ML/day compared to river flows of 40,000 ML/day to 120,000 ML/day required to generate similar natural flooding extents.

Water use would vary from year to year depending on natural inflows and previous flooding history. The volume of water required to fill each of the WMAs based on the proposed design water levels are (Mallee, CMA, 2014):

- Berribee WMA – 35.3 GL
- Crankhandle WMA – 0.6 GL
- Crankhandle West WMA – 0.3 GL
- Lindsay South WMA – 1.1 GL
- Wallawalla East WMA – 0.6 GL
- Wallawalla West WMA – 2.8 GL.

This water would be sourced from existing environmental water entitlements[13] via the VEWH.

The volume of water taken in pumped watering events (e.g. Lindsay South, Wallawalla East and Wallawalla West WMAs) would be measured and accounted for separately from events created by weir pool manipulations. For these events, independent contractors are engaged and use temporary pumps equipped with flow meters certified in accordance with the National Framework for Non-Urban Water

[13] Includes environmental water entitlements already held by the Murray-Darling Basin Authority, the Commonwealth Environmental Water Holder and the Victorian Environmental Water Holder.

Metering (VMFRP, 2020b). Pumped volumes are recorded and reported by the contractor to Mallee CMA, and then provided to GMW and VEWH.

Will the project discharge waste water or runoff to water environments?

☐ NYD ☐ No ☒ Yes If yes, specify types of discharges and which environments.

Construction

Although construction works are proposed to be undertaken during dry or low flow / rainfall periods where practicable, potential exists for dewatering and runoff from construction sites to enter waterways including the Lindsay River, Murray River, Toupnein Creek, Mullaroo Creek, Little Mullaroo Creek, Lindsay South Creek, Lake Wallawalla and various wetlands across the Lindsay Island floodplain. Construction works would be managed in accordance with a CEMP, including controls for managing erosion and sediment, storage of fuels and chemicals, dewatering and works in waterways, where required. Specific consideration would be given to managing dewatering of the Berribee Regulator construction site, which has the potential to generate a relatively large volume of potentially saline groundwater that would require disposal.

Further dewatering assessment is proposed to determine the volume and quality of groundwater likely to require disposal during dewatering of the Berribee Regulator and other wet construction sites, which would include the three drop structures (works within the Lindsay River and Murray River) and excavations for other structures potentially intercepting groundwater. Where extracted water quality meets EPA discharge limits to protect relevant beneficial uses specified by the SEPP (Waters), dewatering of construction sites would likely discharge to the nearest waterway (e.g. Lindsay River). Alternative treatment and disposal methods would need to be considered where further assessment indicates that extracted water would not comply with EPA discharge requirements. NSW EPA requirements would apply to any discharges to the Murray River.

Operation

On completion of a managed environmental watering event, regulators would be opened and a portion of the inundation water volume (not including infiltration and evaporation losses) would drain back to the Murray River (below Lock 7, above Lock 6) via the Lindsay River and Lindsay South Creek, Mullaroo Creek and Little Mullaroo Creek. The draft operating scenarios propose to retain some managed floodwaters on the floodplain, mostly within wetlands such as Lake Wallawalla and Scotties Billabong (Crankhandle WMA Lower Tier) along with the Wallawalla West WMA. Return water quality and quantity would be monitored as part of the Operating Plan.

Potential impacts to water environments, including those associated with wastewater or runoff are described in the responses below.

Are any waterways, wetlands, estuaries or marine environments likely to be affected?

☐ NYD ☐ No ☒ Yes If yes, specify which water environments, answer the following questions and attach any relevant details.

Waterways and wetlands potentially affected by the project due to works being undertaken within or adjacent to the water bodies, or due to operational inundation or potential for direct/indirect discharges to the water bodies, include: the Lindsay River, Toupnein Creek, Mullaroo Creek, Little Mullaroo Creek, Lindsay South Creek, Lake Wallawalla and various wetlands across the Lindsay Island floodplain in Victoria, and the Murray River, an anabranch of the Murray River, Lock 7 Billabong and Horseshoe Billabong in NSW.

The project area is not located within or adjacent to any wetland listed under the Ramsar Convention. The nearest Ramsar listed wetlands comprise the Riverland Ramsar site located approximately 10 km downstream of the project area in South Australia, which is also part of the Riverland Wetland Complex listed on A Directory of Important Wetlands in Australia (DIWA).

Lindsay Island and Lake Wallawalla are also both DIWA listed wetlands (separate listings). The majority of proposed works would occur within the boundary of these wetland listings, except for works at the Lindsay South WMA, Wallawalla East WMA, and most works at Wallawalla West WMA and on the southern side of the Lindsay River at Berribee Regulator.

The area of investigation intersects with eight wetlands listed on DELWP's current wetlands inventory (Wetland ID. 10175, 10185, 10172 (Lake Wallawalla), 10242, 10237, 10238, 10235, 10201) with 24 other DELWP current wetlands mapped within the inundation area. Two mapped wetlands in NSW are also located within the inundation area.

Maps showing the location of these waterways and wetlands are provided in **Attachment 2 – Environmental Features Maps**.

Are any of these water environments likely to support threatened or migratory species?

☐ NYD ☐ No ☒ Yes If yes, specify which water environments.

The project area and potentially affected water environments are likely to support listed threatened and migratory species as described in Section 12 of this referral and **Attachment 3 – Fauna and Flora Assessment**.

Are any potentially affected wetlands listed under the Ramsar Convention or in 'A Directory of Important Wetlands in Australia'?

☐ NYD ☐ No ☒ Yes If yes, please specify.

The project area is not located within or adjacent to any wetlands listed under the Ramsar Convention, however the Protected Matters Search Tool administered by DAWE identifies three Ramsar listed wetlands downstream of Lindsay Island: Riverland (50-100 km), Banrock Station Wetland Complex (100-150 km) and The Coorong and Lakes Alexandrina and Albert Wetland (200-300 km). The Riverland Ramsar site, which is also part of the DIWA listed Riverland Wetland Complex, is located approximately 10 km downstream of the project area along the Murray River within South Australia (refer to **Attachment 2 – Environmental Features Maps**). The majority of the project area is located within the DIWA listed Lindsay Island and Lake Wallawalla (separate DIWA listings).

Potential for effects on downstream Ramsar and DIWA listed wetlands

Due to the separation distance to the three Ramsar sites located downstream of the Lindsay Island project and the relatively small volume of return flows expected from the project compared to the magnitude of flow in the Murray River, no substantial or measurable change in the hydrological regime of any downstream Ramsar site is expected to occur.

Impacts to water quality at the downstream Ramsar sites could arise as a result of return flows entering the Murray River from the Lindsay Island floodplain during or following a managed environmental watering event. The nearest Ramsar site that could be affected by degraded water quality resulting from insufficiently diluted return flows to the Murray River from the Lindsay Island floodplain is the Riverland Ramsar site. Return water quality and quantity would be monitored and managed as part of the Operating Plan to mitigate the risk of a substantial or measurable change in the water quality of floodplain wetlands within the Riverland Ramsar site.

It is also likely that any potential impacts could be mitigated against by the controlled release of return flows to the Murray River. However, modelling of return flows from the Lindsay Island project has not yet been undertaken to confirm this, but would be undertaken to inform the risk-based approach to management of environmental water deliver by RMOC.

Potential for effects on the DIWA listed Lindsay Island and Lake Wallawalla

Lindsay Island and Lake Wallawalla are separately listed under the DIWA. Within the boundary of the DIWA wetlands, eight DELWP mapped wetlands intersect the area of investigation. Five of these DELWP

mapped wetlands may be impacted by construction of infrastructure, while the remaining wetlands intersect existing access tracks proposed to be used/upgraded by the project. Construction activities have the potential to temporarily or permanently impact existing wetlands with the DIWA listed Lindsay Island and Lake Wallawalla.

Potential construction impacts, that would be managed in accordance with a CEMP, include:

- Physical disturbance, and temporary / permanent wetland vegetation clearance where upgrades of existing roads and construction of infrastructure is undertaken
- Water quality impacts from dewatering works (including disposal of saline groundwater) and possible runoff of sediment and contaminants from construction activities into wet areas
- Creation of temporary barriers to fish passage
- Introduction or spread of invasive weeds, impacting upon the health of wetland and floodplain vegetation communities.

Twenty-four DELWP mapped wetlands are located within the inundation area only and would be benefitted by the reinstatement of a more natural wetting and drying regime. Some areas of vegetation within the boundary of the DIWA listed Lindsay Island and Lake Wallawalla may be affected by near-surface salinisation. These areas are identified in **Attachment 4 – Groundwater Assessment** and are generally confined to relatively small areas, adjacent to but not within the inundation area, where shallow saline groundwater and high soil salt stores are present. Further assessment of hydrogeological change under proposed operating scenarios and vegetation communities present in these areas is required to determine the extent of potential impacts (see Section 20 of this referral).

Noting that the areas of individual wetlands within the proposed construction footprint are relatively small (approx. 1.58 ha) and considering the mitigation measures that would be implemented (as identified in the 'mitigation' section below) and **Attachment 6 – Draft Environmental Management Framework**, it is unlikely that the project would lead to an extensive or major effect on the health or biodiversity of these wetlands over the long-term.

Could the project affect streamflows?

☒ NYD ☒ No ☒ Yes If yes, briefly describe implications for streamflows.

The purpose of the project is to reinstate a more natural hydrological regime to the Lindsay Island floodplain through manipulation of the Lock 7 weir pool and construction of infrastructure within waterways and across the floodplain to distribute, retain and release floodwaters. Operation of the project would affect the frequency, duration, timing and velocities of streamflows in the Lindsay River, Mullaroo Creek, Little Mullaroo Creek and Lindsay South Creek in Victoria, along with the Murray River (above and below Lock 7) and an anabranch of the Murray River in NSW.

Modelling by Water Technology (2016) indicates that operation of the Berribee Regulator for the Berribee Maximum and higher level Berribee Intermediate scenarios would reduce flow velocities in the Mullaroo-Lindsay system compared to current conditions, while also enabling the frequency, duration and timing of flood events to be more closely aligned with natural conditions. As noted in Section 12, a reduction in fast-flowing habitat within the Lindsay-Mullaroo system has the potential to impact listed threatened fish species. Further refinement of operating scenarios is proposed to avoid or minimise these potential impacts. The nature and extent of potential effects on streamflows would depend on the actual operating scenarios implemented, and climatic and river flow conditions prior to, during and following managed inundation events.

Upstream or downstream hydrological changes in the Murray River associated with the delivery of environmental water to the Lindsay Island floodplain would be managed by the RMOC as part of their responsibility to oversee the operation of the Murray River, which is managed by the MDBA on behalf of the relevant state and commonwealth governments. Delivery of environmental water in the Murray River system is undertaken by the RMOC in accordance with a risk-based approach to minimise impact to river

users and the Commonwealth Environmental Water Holder's Framework for Determining Commonwealth Environmental Water Use (CEWO 2013). This framework requires environmental watering to consider the potential environmental risk, including downstream environmental risk that may result from applying environmental water, and measures that may be taken to minimise those risks. The waterway managers and water authority would also work with the RMOC to ensure that the planning and delivery of environment water delivery is undertaken to achieve ecological objectives and to minimise adverse impacts on river hydrology, which would be informed by a monitoring program.

Further modelling of the cumulative change to flows in the Murray River as a result of the VMFRP program of works would be undertaken by the RMOC to inform the risk-based approach to management of environmental water delivery when the final composition of VMFRP projects are confirmed to proceed based on the outcomes of the approvals process.

Could regional groundwater resources be affected by the project?

☐ NYD ☐ No ☒ Yes If yes, describe in what way.

Potential effects from project construction

Key potential groundwater effects associated with construction of proposed structures and works are:

- Potential for temporary, localised drawdown of groundwater levels from dewatering of construction excavations – not expected to significantly reduce groundwater availability to local ecosystems based on implementation of proposed mitigation measures.
- Disposal of saline waste groundwater from dewatering of construction excavations – not expected to significantly impact local ecosystems based on implementation of proposed mitigation measures
- Potential for localised alteration of groundwater flow paths and levels from installation of permanent below-ground water barriers – not expected to significantly alter groundwater availability to local ecosystems based on implementation of proposed mitigation measures.

These potential effects are discussed further below.

Groundwater drawdown / waste groundwater disposal during dewatering

The project includes construction of some below-ground permanent structures. Based on the interpreted groundwater level across the project area, a number of the larger structures may require excavations below the watertable and require temporary dewatering of excavations during construction. Based on the current design, this is likely to include each of the four larger regulators (BERR_A, BERR_F, CR_A and CW_B1), with the most substantial structure below the watertable being the Berribee Regulator (BERR_A) to be constructed across the width of the Lindsay River. Construction of concrete piers below the regulator would extend to about 12 mAHD across the river channel (approx. 80 m wide), with sheet-pile cutoffs extending below this elevation. Groundwater (and surface water) in the immediate vicinity of the Berribee Regulator is estimated to be at the Lock 6 weir pool level (i.e. approximately 19.3 mAHD (average last 5 years)) meaning the excavated construction would be below both surface water and groundwater level.

While water management (e.g. dewatering) would be required to control both surface water and groundwater intrusion to the works area, the location of the Berribee Regulator significantly reduces the potential for impacts to groundwater. This is because the surface water in the immediate vicinity of the excavations would provide a constant water source to replace extracted groundwater and groundwater is also much fresher at this location than in the floodplain. Any net change to groundwater levels around these works is expected to be negligible.

Dewatering would also be required to manage groundwater ingress into smaller excavations extending below the watertable, however these works are likely to be able to be managed through standard techniques (e.g. small sump pump in open excavations) with negligible impact to the local groundwater system. Any impact to groundwater level from dewatering works is expected to be temporary (i.e. months

to a year) and physically localised (i.e. potentially within tens of metres from the structure). Further mitigation of this potential effect could be achieved by planning construction to minimise total volume and rate of groundwater extracted for construction purposes, and providing watering for any ecosystems that may be impacted by lowered groundwater levels.Overall, the potential impacts to local water dependent ecosystems from changes to the watertable level from dewatering of project excavations are expected to be negligible.

Disposal of groundwater from dewatering activities has some potential to impact terrestrial and aquatic ecosystems, depending on the water quality and method of disposal. Disposal of groundwater extracted from excavations therefore requires careful management, particularly in areas away from the flush zones of rivers where background groundwater quality is highly saline (groundwater very close to the Murray River or lower Lindsay River is expected to be only slightly more saline than river water). Based on implementation of the proposed mitigation measures, including avoiding disposal to land and compliance with EPA requirements for discharge to waters, impacts on terrestrial and aquatic ecosystems are expected to be negligible.

Alteration of groundwater flow paths

Permanent below-ground structures that extend a few metres below the watertable, could also result in localised alteration of groundwater flow paths. This is most likely to occur in the vicinity of the Berribee Regulator and other large regulators (BERR_F, CR_A, CW_B1), which incorporate permanent sheet-pile cutoffs that are designed to disrupt groundwater flow below and around the waterway channel, so as to reduce bypass of channel barrier structures. These impermeable barriers extend across the watercourse / flow path. This impediment to groundwater flow is expected to back up groundwater on the upstream side of the structure, slightly raising groundwater levels upstream, and reducing groundwater levels slightly downstream of the structure. The impact to groundwater would extend out around the sides of the structure, likely within tens of metres, in a similar flow pattern to what occurs around locks in the Murray River but on a smaller scale.

The impact of this process is predominantly dependent on the presence of surface water at the site. In areas where there is permanent or semi-permanent surface water (e.g. the lower Lindsay River where the Berribee Regulator is planned), the significant structure being installed is considered unlikely to adversely impact aquatic and terrestrial ecosystems. This is because of the presence of surface water generating a flush zone into the groundwater of less saline water, which would likely extend upstream and to the edges of the structure, mitigating the potential for rise in saline groundwater in the short term.

In areas adjacent to permanent or semi-permanent surface water, such as where Regulators CR_A and CW_B1 are planned, the potential impact is likely to be greater but still low. These structures are proposed in typically dry watercourses within around 100 m of the lower Lindsay River and are of significantly smaller scale / depth compared to the Berribee Regulator. Because the structures sit within the flush zone of the river, any groundwater backing up behind them would be much less saline than across the floodplain and is unlikely to have a significant adverse effect on local water dependent ecosystems due to near-surface salinisation.

In areas away from permanent or semi-permanent surface water, such as where Regulator WW_A1 is planned to separate Lake Wallawalla from the floodplain to the west, the impact mechanism is likely to be similar, but the freshening effect of the surface water flush zone is significantly less or not present. Outside of flood events, if groundwater is flowing toward Lake Wallawalla locally, it would likely back up behind the structure and potentially raise groundwater levels in the floodplain to the west of the lake. Groundwater salinity in this area is estimated at between 35,000 – 50,000 µS/cm. These areas, while localised, have a higher requirement for adaptive management to mitigate near-surface salinisation.

The potential for proposed structures to cause localised alteration of groundwater flow paths is lessened by the flat groundwater gradient across the site, which means that any backing up of groundwater behind structures would likely only cause a small head increase to groundwater levels upstream of the structures.

Potential effects from project operation

Key potential groundwater effects associated with operation of the project are:

- Potential for increased groundwater levels in inundated areas and some areas outside the managed inundation area to result in waterlogging if shallow groundwater persists in areas containing not flood-tolerant vegetation communities and species - further assessment (as outlined in Section 20) is required to fully understand this potential impact, with monitoring and adaptive management proposed to mitigate this potential impact. Within the managed inundation area, EVCs are flood tolerant and therefore unlikely to be affected by waterlogging from shallow groundwater.
- Potential for near-surface salinisation in some areas outside of the managed inundation area in the medium to long term - further assessment (as outlined in Section 20) is required to fully understand this potential impact, with monitoring and adaptive management proposed to mitigate this potential impact. Within the managed inundation area, local ecosystems may benefit from slight reductions in groundwater salinity. NSW inundation areas are anticipated to have less of a need for management with respect to near-surface salinisation but will be included in the adaptive management framework.
- Potential increase to nutrient load in soil profile and groundwater from flood waters - not expected to adversely impact local ecosystems
- Potential for increased salt load in the Lindsay River downstream of the project area from mobilisation of salt from soil and groundwater to surface water (salt wash-off) potentially affecting water dependent ecosystems, and water quality for downstream irrigators - further assessment (as outlined in Section 20) is required to fully understand this potential impact, with monitoring and adaptive management proposed to partly mitigate this potential impact.
- Potential secondary impact to cultural values from near-surface salinisation and waterlogging – additional assessment is required to understand this potential impact and to identify management and mitigation measures if required.

These potential effects are discussed further below.

Saline groundwater mound rise

As the floodplain is flooded (natural and managed), the floodwater infiltrates into the soil and into the watertable, causing a rise in the groundwater level under the flooded area. The raised groundwater level under the flooded area causes a mound in the groundwater and pushes groundwater out into the surrounding area, raising groundwater levels in areas that are not flooded. The amount of groundwater rise in and around the flooded areas is dependent on the duration the water is held at flood levels, as well as soil type, depth to groundwater, and other hydrogeological and physical parameters. Although this is a natural process, by increasing the frequency and duration of floodplain inundation to more closely align with the natural (pre-regulation) frequency and duration, operation of the project has the potential to contribute to groundwater mound rise following sustained managed inundation events.

An increase in groundwater levels has the potential to cause waterlogging and near-surface salinisation that could adversely affect vegetation where tolerances are exceeded. As vegetation types within the proposed inundation are flood tolerant and often rely on periods of inundation for optimal health, the potential for rising groundwater levels to harm vegetation within the inundation areas through waterlogging is low but would require monitoring and adaptive management to avoid potentially harmful waterlogging. Vegetation within the proposed inundation area is also unlikely to be significantly impacted by near-surface salinisation because of the salt flush and wash off effect associated with more regular inundation of these areas with lower salinity river water.

Areas of vegetation potentially susceptible to impacts from near-surface salinisation would be those areas located just outside the proposed inundation areas that are not flushed but are affected by groundwater mound rise, and particularly those areas with already shallow groundwater (<5 m), significant groundwater salinity and soil salt stores. Mapping of these ‘areas of interest’ for near-surface salinisation is provided in **Attachment 4 - Groundwater Assessment**, along with ‘areas of heightened interest’ which

meet these same criteria but which may also contain groundwater-dependent EVCs that may be sensitive to changing groundwater level and salinity. Areas of heightened interest for near-surface salinisation include patches:

- East of Crankhandle West WMA
- Around Crankhandle WMA
- Around Lindsay Island (Berribee WMA)
- South west of Wallawalla East WMA
- South of Lake Wallawalla
- North of Lindsay South WMA.

Areas with existing groundwater depth below 5 m were considered unlikely to be affected by changing salinity from the project works as the groundwater in these areas is too deep for the likely mound rise to reach sensitive depths for near-surface salinisation or impact relevant EVCs. Further investigations and monitoring (see Section 20), refinement of operating scenarios and adaptive management through the EWMP and Operating Plans, are proposed to reduce uncertainty and to further mitigate potential impacts of near-surface salinisation.

Salt wash-off

Groundwater mound rise that occurs near waterways can cause saline groundwater to flow into the creeks and rivers and impact on surface water quality. A process called salt wash-off, where the floodwater picks up salt entrained in the shallow soil profile and washes it into waterway upon flood recession, is also known to deliver significant quantities of salt in environments such as Lindsay Island. The impact to surface water quality is temporary (weeks to months), but can be significant to downstream users (e.g. irrigators at Lindsay Point if the salt load occurs during irrigation season) and the Murray River. The MDBA governs salt load delivery to the Murray River under a salinity accountability framework which tracks salinity credits and debits to the river. The threshold for entry onto Register A under the framework is +/-0.1 µS/cm impact to Murray River salinity.

Salt impact on the Murray River was considered extensively in SKM (2014), although based on a different watering program and so the conclusions from SKM (2014) cannot be directly applied to the current project. However, SKM (2014) concluded that planned environmental watering of Lindsay Island and Lake Wallawalla had the potential to increase the salinity in the Murray River at Morgan in South Australia (the standard measurement point) by approximately 7 µS/cm electrical conductivity (EC), which suggests that salt load generated by the project has the potential to require deliberate consideration as a form of salinity debit under the MDBA framework. Salinity discharges and associated changes or impacts in the Murray River as a result of planned inundation of the Lindsay Island floodplain, would be considered and assessed on a cumulative basis by the MDBA through the protocols of the Basin Salinity Management 2030 Strategy (BSM2030). These protocols are yet to be finalised for floodplain restoration projects, but discharges from the Lindsay Island project would comply with these once finalised. This may involve the use of offsets or salinity credits from the Victorian salinity credit pool.

To assist in the monitoring of all potential groundwater impacts, VMFRP installed new monitoring bores within the proposed inundation area in April 2020. These monitoring bores would be integrated into the existing Mallee CMA monitoring network and monitoring program, with monitoring and ongoing assessment of risks to occur consistent with the Basin Salinity Management 2030 Strategy (MDBMC, 2015). This would assist in setting the pre-scheme baseline.

Could environmental values (beneficial uses) of water environments be affected?

☒ NYD ☒ No ☒ Yes If yes, identify waterways/water bodies and beneficial uses (as recognised by State Environment Protection Policies)

The waterways and water bodies within the project area are located within the SEPP (Waters) Murray and Western Plains surface water segment. Wetlands within the project area are located within the SEPP (Waters) Lakes and Swamps surface water segment. In addition to these segments, surface waters within the Murray-Sunset National Park are included in the Aquatic Reserves segment. Schedule 2, Table 3 of SEPP (Waters) identifies beneficial uses of inland waters within the Murray and Western Plains and the Lakes and Swamps segments as including:

- Water dependent ecosystems and species that are slightly to moderately modified (or largely unmodified in Aquatic Reserves)
- Human consumption after appropriate treatment where water is sourced for supply in accordance with the special water supply catchments area set out in Schedule 5 of the *Catchment and Land Protection Act 1994* or the *Safe Drinking Water Act 2003*
- Agriculture and irrigation (not in Aquatic Reserves)
- Human consumption of aquatic foods
- Aquaculture where the environmental quality is suitable and an aquaculture licence has been approved in accordance with the *Fisheries Act 1995*
- Industrial and commercial (applies to the Murray and Western Plains segment only, and not in Aquatic Reserves)
- Water-based recreation (primary, secondary contact and aesthetic enjoyment)
- Traditional Owner cultural values
- Cultural and spiritual values.

The SEPP (Waters) identifies beneficial uses of groundwater based on Total Dissolved Solids concentrations. The interpreted groundwater salinity at the project area indicates that the project area falls mostly within Segment F. The following groundwater beneficial uses are protected in the project area under the SEPP(Waters):

- Water dependent ecosystems and species
- Potable mineral water supply
- Agriculture and irrigation (irrigation)
- Agriculture and irrigation (stock watering)
- Industrial and commercial
- Water-based recreation (primary contact recreation)
- Traditional Owner cultural values
- Cultural and spiritual values
- Buildings and structures
- Geothermal properties.

There is only one registered stock and domestic bore within 5 km of the project area and no registered irrigation bores in the vicinity (see **Figure 6**). The stock and domestic bore (8003691) is located approximately 3.5 km west of the Crankhandle West WMA. The bore was constructed in 2008 and is screened 23-32 m below ground level and is therefore likely to be sourcing water from the regional Loxton Parilla Sand aquifer. The absence of widespread groundwater use in the area is likely to be due to the

high salinity of the regional aquifers and the proximity to fresh water from the Murray River and lower Lindsay River.

Figure 6: Location of licenced bore 8003691 relative to proposed inundation area

Potential effects on beneficial uses of groundwater are expected to be either beneficial or negligible (see Table 4.2 of **Attachment 4 – Groundwater Assessment**).

Potential effects on surface water environments are discussed in the following sections.

Could aquatic, estuarine or marine ecosystems be affected by the project?

☒ NYD ☒ No ☒ Yes If yes, describe in what way.

Construction

Potential construction impacts on aquatic ecosystems are temporary and generally localised in nature. The implementation of appropriate construction methodologies and measures documented within a project CEMP would address the following identified risks:

- Removal of vegetation and habitat features (e.g. snags) in wetlands and waterways to construct works (construction footprint contains less than 1.6 ha of DELWP mapped wetlands)
- Installation of temporary barriers (e.g. cofferdams) to enable construction of in-stream works potentially restricting movement of aquatic fauna
- Temporary drawdown of groundwater levels during construction (dewatering excavations) potentially reducing water availability for groundwater dependant ecosystems
- Discharging/dewatering poor quality water into receiving waters (high turbidity, salinity)
- Erosion and loss of topsoil causing water quality impacts
- Construction works and structures causing bed and bank erosion and instability
- Rainfall and flood events causing a pollution event and runoff

- Spills, leaks, poor handling of fuels, oils and other chemicals causing soil/water contamination.

Operation

Potential impacts on aquatic ecosystems during operation of the project include:

- Operation of the Berribee Regulator for the Berribee Maximum and higher level Berribee Intermediate scenarios would reduce flow velocities in the Mullaroo-Lindsay system compared to current conditions, which would reduce the availability of fast-flowing habitat within the Lindsay-Mullaroo system. Depending on the frequency, duration and timing of these events and associated reduction in fast-flowing habitat, an important native fish community, including listed threatened fish species (Murray Cod and to a lesser extent Silver Perch, Freshwater Catfish) could potentially be significantly impacted (see Section 12 for further information).
- Installation of regulators in waterways and wetlands could create barriers to movement of aquatic fauna reducing access to feeding and breeding habitat, and limiting migration or spawning opportunities. Regulating structures have been designed to provide suitable passage based on the fish community present as proposed by this project (see Section 3).
- Water manipulations associated with environmental watering (similar to natural floods) can lead to suspension of sediments and / or organic matter causing elevated nutrients, high turbidity and / or low dissolved oxygen (DO) levels, which could reduce food sources and result in toxic algal blooms potentially impacting on wetland communities, aquatic fauna and waterbirds on the floodplain or downstream waterways (if released).
- Inability to discharge poor water quality during a managed inundation event due to downstream impacts (e.g. increases in instream salinity), could result in impacts on floodplain vegetation (due to extended inundation) or formation of blackwater / algal blooms.
- Discharge of saline groundwater could increase the salinity of the water in the Murray River and have cumulative impacts. Any impact would be considered and assessed on a cumulative basis by the MDBA through the protocols of the Basin Salinity Management 2030 Strategy (BSM2030).
- Carp may breed in response to environmental watering (similar to natural floods). Excessive carp numbers could adversely impact aquatic ecosystems, including the health and diversity of wetland vegetation, native fish and other aquatic fauna.
- Stranding and isolation of fish on floodplains could occur through sudden changes in water levels and/or new barriers preventing native fish from escaping during flood recessions.
- Changes in flows in the Murray River associated with delivery of environmental water to the Lindsay Island floodplain. The RMOC oversees management of flows in the Murray River.

Further assessment of these potential impacts is proposed as described in Section 20.

Is there a potential for extensive or major effects on the health or biodiversity of aquatic, estuarine or marine ecosystems over the long-term?

☐ No ☒ Yes If yes, please describe. Comment on likelihood of effects and associated uncertainties, if practicable.

Design and construction

Design of the project has been developed to limit the number and footprint of structures in waterways and floodrunners to the minimum necessary to facilitate inundation to the water levels established to achieve the project's ecological objectives. This approach has minimised the extent of aquatic habitat removal required and minimised potential barriers to movement of aquatic fauna. Regulating structures have been designed to satisfy the fish passage requirements specified in the SDL Fish Management Plan – Lindsay Island (ARI, 2018), including provision of a fishway and maintenance of 1,000 ML/day passing flows at the Berribee Regulator.

Construction of the project is unlikely to result in extensive or major effects on the health or biodiversity of aquatic ecosystems provided the proposed mitigation measures are implemented, along with any additional measures recommended by the further investigations proposed for the project. Potential construction-related impacts on aquatic ecosystems identified for this project are typical of construction projects in riverine and floodplain environments and would be managed through a CEMP. Further assessment is specifically recommended to address potential impacts on aquatic ecosystems associated with construction of the Berribee Regulator, including assessing passing flows for restrictions in the river / duration for temporary construction barriers, and effects of groundwater drawdown and disposal of saline groundwater during dewatering.

Operation

Reinstatement of a more natural hydrological regime that improves the health and condition of floodplain vegetation communities, and facilitates more frequent connectivity between riverine and floodplain habitats, would contribute to improved productivity in aquatic ecosystems with the potential to deliver major and long-term benefits to the health and biodiversity of aquatic ecosystems.

However, larger inundation scenarios (Berribee Maximum and higher level Berribee Intermediate) that reduce flow velocities in the Mullaroo-Lindsay system below a certain threshold, have the potential to result in major adverse effects on an important native fish community, depending on the frequency, duration and timing of these inundation events. Further assessment and refinement of operating scenarios is proposed to identify opportunities to avoid or mitigate these potential impacts, where possible, while still optimising inundation benefits for floodplain vegetation communities and habitats.

Other potential operational impacts are typical of environmental watering projects and are unlikely to result in extensive or major effects on the health or biodiversity of aquatic ecosystems provided the measures contained in the following 'mitigation' section are implemented, along with appropriate planning, implementation, monitoring and adaptive management processes.

Refer to Section 20 for a list of studies proposed to further assessment potential impact uncertainties identified in this section.

Is mitigation of potential effects on water environments proposed?

☒ NYD ☒ No ☒ Yes If yes, please briefly describe.

Design

- Continue to further minimise the construction footprint of structures within and adjacent to waterways and wetlands
- Minimise the depth and extent of cofferdams
- Maximise constructability away from waterways (e.g. by using pre-cast elements).

Construction

The following mitigation measures are proposed to avoid and minimise impacts on water environments during construction of the project:

- Develop and implement a CEMP, including erosion and sediment control plans, dewatering and water quality management plans, weed and pest hygiene protocols to minimise potential impacts on water environments and associated ecosystems
- Minimise the total volume and rate of groundwater extracted for construction purposes, including through dewatering - plan construction to minimise duration of works at sites requiring dewatering, provide make-up of offset water for affected vegetation during construction
- Develop and implement a dewatering strategy, that minimises the volume of potentially saline groundwater requiring disposal, does not involve disposal of saline groundwater to land, and outlines

control measures and monitoring requirements to ensure compliance with the SEPP (Waters) and EPA discharge requirements

- Develop and implement a construction methodology for temporary construction barriers across the Lindsay River to maintain adequate passing flows for movement of fish and other aquatic fauna, and to avoid water quality risks
- Rehabilitate construction sites following completion of works to the satisfaction of Parks Victoria.

Operation

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

- Review and refine draft operating scenarios and / or develop alternative measures to avoid or mitigate potential impacts on the native fish community of the Lindsay-Mullaroo system, particularly the EPBC Act and FFG Act listed Murray Cod and Silver Perch, while also enabling the frequency, duration and timing of floodplain inundation to be more closely aligned with natural conditions
- 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. Ensure dilution of low DO water by managing outflow rates and river flows: delay outflows if river flows are too low
- Integrate water management with other sites in seasonal water planning process. Maintain good relationships with other water managers
- Engage with the MDBA to determine the mechanism for accounting for the potential salt load impact on Murray River water quality from project operation
- Tailor watering regimes to provide competitive advantage for native fish over carp. Drying 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. These practices are currently being implemented by Mallee CMA across other environmental watering sites to manage these risks
- Monitor 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
- Plan and monitor environmental watering events to avoid peak groundwater mound salt outflow coinciding with irrigation season.
- Monitor vegetation in areas surrounding inundation areas for signs of potential waterlogging and implement adaptive management (e.g. revising operating schedules) to mitigate impacts if vegetation is considered at risk.
- Monitor groundwater levels and quality prior to, during and after an inundation event to monitor development of groundwater mounds within the areas identified as potentially impacted by near-surface salinisation. Implement adaptive management, potentially including additional watering of

these areas or amending operational schedules (e.g. reduce frequency/duration), to mitigate impacts if identified.

- To minimise risks associated with pest plants:
    - Time water manipulations to drown seedlings, minimise growth, germination and seed set. Time water manipulations to promote native species
    - Control 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.
- To minimise risks associated with barriers to fish passage:
    - Design and operate regulating structures to satisfy fish passage requirements including those described in the SDL Fish Management Plan (ARI, 2018) (see Section 3)
    - Continue 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.

Other information/comments? (e.g. accuracy of information)

14. Landscape and soils

14.1 Landscape

Has a preliminary landscape assessment been prepared?

☒ No ☐ Yes If yes, please attach.

Is the project to be located either within or near an area that is:

- **Subject to a Landscape Significance Overlay or Environmental Significance Overlay?**

☐ NYD ☐ No ☒ Yes If yes, provide plan showing footprint relative to overlay.

The majority of the project area is located within an Environmental Significance Overlay (Schedule 1 – Murray River Corridor) (ESO1) under the Mildura Planning Scheme (see **Attachment 5 – Land Use Planning Assessment).** The ESO1 affects public and private land in non-urban areas and is defined by the Land Subject to Inundation Overlay or 100 m from the Murray River, whichever is greater.

The ESO1 statement of environmental significance recognises *the Murray River as an asset of national and state significance…..* and the River's contribution to *environmental, economic, social, recreational and tourist functions. It is a common strategy, at all levels of government, that the River must be protected and enhanced. Unlike NSW, there is very little private land with frontage to the Murray River in Victoria……The Murray River (on the Victorian side) is one of the few major rivers in the world retaining unimpeded access for most of its length…….Threatening processes occur at various locations along the river system* and *include erosion, changed hydrological regimes, native vegetation decline, pollution of ground and surface water, groundwater accession and salinisation and soil acidity, and adverse effects on the quality of land and water habitats……...The remaining native riverine forests, woodlands and wetlands that adjoin the waterway of the Murray River are critically important for the maintenance of water quality, biodiversity, wildlife habitat and scenic beauty* and that *it is the visual and landscape qualities of this environment that are the basis for the demand for tourist and recreation development……..*

Most relevant to landscape values, the ESO1 environmental objectives aim:

To specifically address land degradation processes including erosion, native vegetation decline, pollution of ground or surface water, groundwater accession, salinisation and soil acidity, and adverse effects on the quality of land and water habitats and *to ensure that buildings are sited a sufficient distance from the Murray River so as to protect the scenic landscape of the riverine corridor*, amongst other things.

The ESO1 decision guidelines specifically reference compliance with the *Siting and Design Guidelines for Water Diversion Works on or across Crown land*, which provide guidance specific to the siting, design and mitigation of all works and water diversions structures along the Murray River.

The project area is not subject to a Significant Landscape Overlay.

- **Identified as of regional or State significance in a reputable study of landscape values?**

☒ NYD ☒ No ☒ Yes If yes, please specify.

As noted in the response above, the project area is located in the ESO1, which identifies the Murray River and its environs as being of local, regional, state, national and potentially international significance.

The River Red Gum Parks Management Plan, July 2018 (Parks Victoria, 2018) indicates that three landscape assessment studies by DELWP in 2015 for the Lower Murray, Central Murray and Goulburn Murray, and Upper Murray identified the Chowilla Floodplains and Lindsay, Mulcra and Wallpolla Islands as supporting visually significant landscapes and views, and nationally significant geological and geomorphological features (scroll plains, anabranch and channels).

- **Within or adjoining land reserved under the *National Parks Act 1975*?**

☒ NYD ☒ No ☒ Yes If yes, please specify.

The majority of the project area is located within the Murray-Sunset National Park, a gazetted national park under Schedule 2 of the *National Parks Act 1975.* The Murray-Sunset National Park is managed by Parks Victoria primarily for ecosystem conservation and recreation purposes. The River Red Gum Parks Management Plan, July 2018 (Parks Victoria, 2018) applies to management of that part of the Murray-Sunset National Park containing the project area[14]. Specific to landscape values, one of the goals of the River Red Gum Parks Management Plan, July 2018 is that: 'The River Red Gum Parks landscapes and geological features are preserved and protected from avoidable damage', and the management plan sets out a number of strategies to achieve this objective.

Part of the proposed inundation area at Wallawalla West WMA is located in the Lake Wallawalla Reference Area while part of the area of investigation adjoins the Toupnein Creek Reference Area. These reference areas are proclaimed under the *Reference Areas Act 1978* to be managed as areas where human interference is minimised so that, as far as practicable, the only long-term change results from natural processes. As part of the Murray-Sunset National Park, these reference areas are managed under the River Red Gum Parks Management Plan, July 2018.

- **Within or adjoining other public land used for conservation or recreational purposes?**

☒ NYD ☒ No ☒ Yes If yes, please specify.

The majority of the area of investigation and inundation area associated with the Lindsay South WMA is located on a freehold land parcel, adjoining the Murray-Sunset National Park and known as Neds Corner. This freehold land parcel is owned by Trust for Nature (Victoria) and is a former cattle grazing property that is now managed for conservation purposes.

As described in **Attachment 5 – Land Use Planning Assessment,** the Murray River which runs along the northern boundary of the Lindsay Island floodplain, is used for a range of recreational purposes. Section 15 of this referral provides further details of the recreational activities undertaken within this area.

[14] The remainder of the Murray-Sunset National Park is managed under the Mallee Parks Management Plan, September 1996.

Is any clearing vegetation or alteration of landforms likely to affect landscape values?

☒ NYD ☒ No ☒ Yes If yes, please briefly describe.

The project would involve the removal of approximately 106 ha of native vegetation as described in Section 12 and **Attachment 3 – Flora and Fauna Assessment** of this referral. Proposed vegetation removal would occur at approximately 30 discrete infrastructure locations scattered across the Lindsay Island floodplain complex and along the edge of mostly existing access tracks. Most of the dispersed infrastructure locations would have an individual vegetation removal area of less than 0.3 ha, with more extensive clearing areas around the Berribee Regulator, BERR_D containment bank and regulator, CW_D channel and the proposed infrastructure for Wallawalla West WMA. This vegetation removal would occur within the context of more than 15,000 ha of largely intact vegetation across Lindsay Island and more broadly, within the extensive areas of vegetation within the 666,615 ha Murray-Sunset National Park and along the Murray River corridor. Generally, proposed vegetation removal would occur in existing disturbed area of lower quality vegetation.

The main components of the project involving alteration of landforms with the potential to affect landscape values, would be the construction of containment banks, incorporating regulators and spillways, and excavation of channels to contribute to the distribution, retention and release of floodwaters during managed inundation events. Containment banks would mostly be constructed by raising existing access tracks with some containment banks being constructed off-track alignments to avoid environmental or cultural heritage values, or to block low points to achieve the design water levels. Approximately 9 km of containment banks would be constructed at 25 sites scattered across the Lindsay Island floodplain complex. The maximum containment bank height would be approximately 2.7 m at the three large regulators (BERR_F, CR_A and CW_B1), however most containment banks would have an average height of less than 1.0 m. The maximum length of a single containment bank would be approximately 2.2 km for the BERR_D containment bank along the southern side of Toupnein Creek.

The most visually prominent project components are likely to be:

- Berribee Regulator – a large regulator extending across the full width of the Lindsay River, and including supporting containment banks on both sides of the River (see **Figure 7**). The Berribee Regulator would be most visible to park visitors using the Berribee Camping Area, visiting the Berribee Homestead Complex, and those engaging in water-based recreation activities on and along this section of the Lindsay River.
- Drop Structure CW_A – located on the bank of the Lindsay River in the Crankhandle West WMA, which is most likely to be visible from the Lindsay River Camping Area on the opposite bank of the Lindsay River, and those engaging in water-based recreation activities on and along this section of the Lindsay River.
- Drop Structure CW_B1, Regulator CW_B1 (large) and associated containment bank – located on the bank of the Lindsay River in the Crankhandle West WMA, which is most likely to be visible from the Lindsay River Camping Area on the opposite bank of the Lindsay River, and those engaging in water-based recreation activities on and along this section of the Lindsay River. This structure is unlikely to be visible to dwellings given the separation distance of 1.6 km and presence of intervening topography and vegetation to the nearest dwelling located on farming land on the southern bank of the Lindsay River at Lindsay Point.
- Regulator CR_A (large) and associated containment bank – located on the bank of the Lindsay River in the Crankhandle WMA, and most likely to be visible from the Crankhandle Bend Camping Area on the opposite bank of the Lindsay River, and those engaging in water-based recreation activities on and along this section of the Lindsay River.
- Drop Structure CR_D – located on the southern bank of the Murray River, and potentially visible from Kulkurna Homestead on the northern NSW river bank, which has views across and along the Murray River. Potentially screening vegetation is likely to be limited to that immediately surrounding the

dwelling and proposed drop structure itself, however this combined with the separation distance of approximately 1 km and low profile of the drop structure, is likely to reduce the impact of this structure on scenic views from the dwelling.

- Containment Bank and Regulator BERR_D (2.2 km long, 2.4 m maximum height) – located along an existing track along the southern side of Toupnein Creek, which is most likely to be visible from park visitors undertaking recreational activities along Toupnein Creek.
- Containment Bank WW_A, which diverts from an existing track along the western side of Lake Wallawalla to avoid cultural heritage values and Pipeline WW_B and/or associated access track, which is extends into the bed of Lake Wallawalla. While the containment bank may be visible from the Wallawalla Track / Wallawalla Circuit Track, and from park visitors undertaking recreational activities around Lake Wallawalla, the pipeline would be sub-surface and therefore not visible from these areas.
- Shallow excavated channels would be constructed in the Crankhandle WMA and Crankhandle West WMA, including Channel CR_G (one section, 15 m wide, 200 m long) and Channel CW_D (5 m wide, seven sections totalling 1.4 km long). Although low-lying features, these channels are mostly located through undisturbed areas and may therefore affect the scenic values of the otherwise largely undisturbed landscape. However, these channels would not appear too different from existing access tracks across the island, would be visible only from sufficiently elevated viewpoints, which are likely to be limited. It is expected these channels would not remain particularly noticeable in the landscape in the long term due to their relatively shallow depth and the regrowth of vegetation over time, however further assessment, including site inspections are proposed.

The Mullaroo Regulator constructed in 2015 on Mullaroo Creek as part of the TLM works and measures, provides an example of how large regulators such as BERR_F, CR_A and CW_B1 integrate within the floodplain landscape (see **Figure 8**).

Figure 7: Visual representation of the Berribee Regulator presented in Business Case (Mallee CMA, 2014) based on concept design

Figure 8: Existing Mullaroo Regulator installed in 2015 along Mullaroo Creek as part of TLM works provides an example of a large regulator in the Lindsay Island floodplain context

Some of the smaller regulator structures located along or near to existing access tracks may also be visible to park visitors, mostly while driving along these tracks. However, it is expected that views would be partly screened by existing retained vegetation and generally confined to areas in proximity to the structures. **Figure 9** provides an example of how a small regulator and associated containment bank appears from along a track.

Figure 9: Existing Wallawalla East Regulator constructed in 2006 as part of TLM works is an example of a small regulator as viewed from Old Mail Road in the Lindsay Island floodplain context

Overall, provided the mitigation measures described in the following section are implemented for proposed structures, the project is expected to have a positive effect of improved health of landscape values for surrounding riverine and floodplain environments. This conclusion recognises and balances the localised impacts of the enabling infrastructure against the expected benefits of restoring a more natural inundation regime to approximately 4,845 ha of Lindsay Island floodplain vegetation communities and habitats in Victoria. For this reason, the project is considered to be consistent with the environmental objectives of ESO1 and the management strategies of the River Red Gum Parks Management Plan, which recognise the importance of hydrological regimes in protecting the scenic landscapes that maintain

the recreational and tourism values of the Murray-Sunset National Park. Parks Victoria is part of the VMFRP partnership and is responsible for management of the Murray-Sunset National Park.

Is there a potential for effects on landscape values of regional or State importance?

☐ NYD ☐ No ☒ Yes Please briefly explain response.

As described above, the project would involve removal of native vegetation and alteration of landforms within areas supporting national, state and regional landscape values, specifically the Murray-Sunset National Park. However, areas of proposed native vegetation removal and landform alteration are scattered across approximately 30 discrete sites, mostly in existing disturbed areas (e.g. along existing access tracks). On balance, in the context of the 4,845 ha of floodplain vegetation communities proposed to benefit from the project, it is considered that the project would not have a significant adverse effect on landscape values of national, state or regional importance.

Further, it is recognised that the project seeks to restore a more natural inundation regime consistent with the management strategies outlined in the River Red Gum Parks Management Plan, which recognise that ensuring appropriate hydrological regimes is critical to protecting the scenic landscapes that maintain the recreational and tourism values of the parks and reserves covered by the management plan.

Is mitigation of potential landscape effects proposed?

☐ NYD ☐ No ☒ Yes If yes, please briefly describe.

The following measures are proposed to mitigate potential landscape effects:

Design measures

- Siting of proposed structures primarily along or immediately adjacent to existing access tracks and other previously disturbed areas to minimise the removal of native vegetation and other construction impacts
- Limit the extent of ground disturbance and native vegetation removal, particularly large old trees, to the minimum extent necessary
- Design of proposed structures is to be sympathetic to the surrounding landscape and consistent with Parks Victoria requirements, and the Siting and Design Guidelines for Water Diversion Works on or across Crown land (DNRE, undated) referenced under the Mildura Planning Scheme.

Site reinstatement

- Following construction works, soil is to be reinstated to mimic the contours of the site prior to construction, unless the aim of construction was to alter the land profile (e.g. waterway, channel excavations). The following methods are proposed to be followed:
    - Photographs of the site taken prior to works should be consulted
    - Where soil has been compacted due to construction works, and is not required to maintain structural integrity of works, then the soil should be ripped with narrow tynes to a depth of 50 mm. Ripping that involves the mixing of soil profiles is to be avoided
    - Subsoil is to be reinstated first, with separate horizons restored in layers consistent with the surrounding soil profile. Any remaining subsoil should be removed and disposed of off-site, or at a site within the reserve under direction from Parks Victoria / the land manager.
    - Vegetation (through natural regeneration) should be established as soon as possible after soil reinstatement to prevent risks of erosion
- Topsoil should not be compacted when reinstated. All topsoil should be used in site reinstatement.

Operation

During the operational phase, inundation events would be managed in accordance with operational guidelines informed by detailed hydrodynamic modelling and ecological investigations and adapted as required in response to proposed monitoring and evaluation frameworks to support achievement of the identified ecological objectives for the project.

Other information/comments? (eg. accuracy of information)

Note: A preliminary landscape assessment is a specific requirement for a referral of a wind energy facility. This should provide a description of:

- The landscape character of the site and surrounding areas including landform, vegetation types and coverage, water features, any other notable features and current land use;
- The location of nearby dwellings, townships, recreation areas, major roads, above-ground utilities, tourist routes and walking tracks;
- Views to the site and to the proposed location of wind turbines from key vantage points (including views showing existing nearby dwellings and views from major roads, walking tracks and tourist routes) sufficient to give a sense of the overall site in its setting.

14.2 Soils

Is there a potential for effects on land stability, acid sulphate soils or highly erodible soils?

☒ NYD ☒ No ☒ Yes If yes, please briefly describe.

Geology and soils overview

The Geological Survey of Victoria Mildura 1:250,000 map sheet identifies the following geological units for the project area (GHD, 2017):

- Coonambidgal Formation – Fine-grained recent Quaternary sedimentary deposit in the Murray Trench, consisting of silts and clays.
- Monoman Formation – Fine to medium-coarse grained Quaternary sedimentary deposit in the Murray Trench, consisting predominantly of sand.
- Woorinen Formation – Aeolian fine dune sand, that can be locally remobilised / reworked to cover younger formations.
- Blanchetown Clay – Quaternary clay unit, acting as a confining layer where present.
- Parilla Sand – Pliocene sands, predominantly sand with minor silt and clay. Localised cemented layers.

The Lindsay River is underlain by the Parilla Sand unit, which forms a hard, ferruginous surface at river bed level and underlies the river banks at depth. Above the Parilla Sands are younger Quaternary-aged sediments, which form the banks of the river and differ on each side (see **Figure 10**).

Preliminary geotechnical investigations were undertaken for the project in 2012 to develop an understanding of the subsurface conditions, followed by subsequent investigations in 2014 to inform the advanced concept design (GHD, 2014b) and again in 2015/16 to collect additional information at the site of the Berribee Regulator and other regulating structures in the Berribee and Crankhandle West WMA (GHD, 2017b). Additional geotechnical works are proposed by VMFRP to supplement these previous investigations.

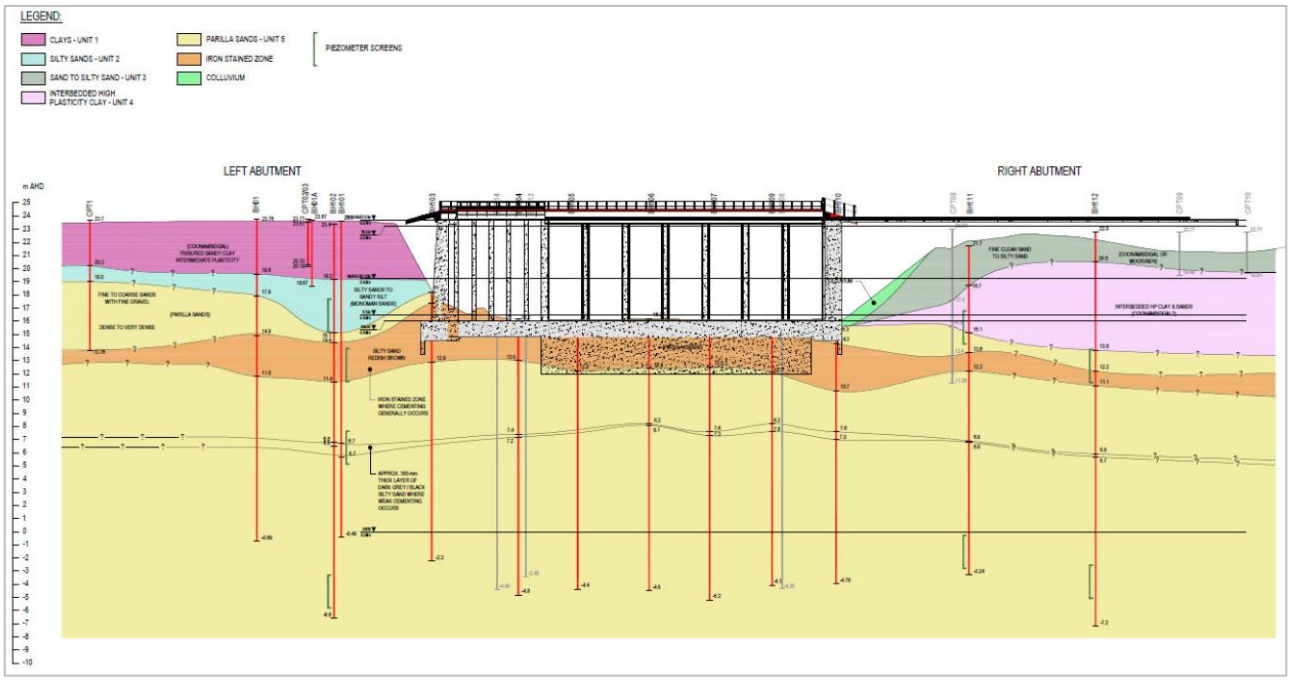

Figure 10: Geotechnical model for Berribee Regulator across Lindsay River (Source: R8, 2020a)

Preliminary geotechnical investigations were undertaken for the project in 2012 to develop an understanding of the subsurface conditions, followed by subsequent investigations in 2014 to inform the advanced concept design (GHD, 2014b) and again in 2015/16 to collect additional information at the site of the Berribee Regulator and other regulating structures in the Berribee and Crankhandle West WMA (GHD, 2017b). Additional geotechnical works are proposed by VMFRP to supplement these previous investigations.

Based on geotechnical investigations undertaken to date, ground conditions at the four large regulator sites are summarised below (GHD, 2017b and R8, 2020a):

Berribee Regulator

- At the proposed regulator site, the Lindsay River has cut into the Coonambidgal Formation and down to the Parilla Sands. The surface of the Parilla Sands has been found to be heavily cemented with ferricrete cementing. Cementing is generally contained with a 2 to 4.6 m (approx.) thick zone at the river bed surface. Within the cementing zone, the layers are interbedded with non-cemented silty sand in what are believed to be non-continuous layers. Below the cementing zone the sands are found to be dense to very dense and generally alternating between fine sand and coarse sand bands with changes between the bands.
- Seepage analysis for the permanent cutoff for the Berribee Regulator indicates that a 6 m deep cutoff under the structure foundation would provide sufficient protection against piping and heave while limiting the risk of mobilising saline water from the deep aquifer underlying the site. The cutoff would need to extend into the abutments beyond the regulator structure.
- The base of the fishway slab is expected to mainly be founded on Monoman Sands. This geotechnical unit should provide a suitable foundation for the slab, however a small amount of excavation and backfill replacement may be required if loose sands are present at the foundation base.
- There is a risk of loose fine sand of the Woorinen Formation, identified in the right abutment, collapsing on inundation and this needs to be considered when estimating settlement. These materials are proposed to be removed and replaced where they are located beneath the right abutment slab, in order to reduce the risk of differential due to collapse settlement upon saturation.

- As the regulator and abutments are founded on the Parilla Sands, a large component of settlement is anticipated to occur during construction.

BERR_F, CR_A and CW_B1 Regulators and Containment Banks

- Similar ground conditions at each site comprised of stiff to very stiff clay or sandy clay, over loose to medium dense sand, over very loose to loose sand.
- Seepage control under and around the regulator is required to avoid high seepage gradients that could result in piping failure or blowout of the foundations and also to reduce uplift to improve stability. A sheet-pile cutoff at the structure has been included in the design.
- Some loose sands are present so liquefaction poses a potential risk.

Recommendations for the design of structures in response to geotechnical conditions identified to date, were considered in the design of the project. The Lindsay Island geotechnical reports can be provided on request.

Acid sulphate soils

No site-specific acid sulphate soil (ASS) investigations have been undertaken for the project at this stage. A review of CSIRO's Australian Soil Resource Information System (ASRIS) mapping has identified that the project is located within an area of 'extremely low probability of ASS occurring', with a level 4 confidence (provisional classification, inferred from surrogate data with no ground verification) (CSIRO, 2008) (see **Figure 11**).

The MDBA have undertaken a regional hazard assessment of ASS throughout the Murray Darling Basin (MDBA, 2011). The results of this assessment in the region closest to the area of investigation are shown in **Figure 12**. This shows that that floodplain sediments in the Mildura to Wentworth area (approximately 70 km east of the area of investigation) have a high to moderate potential of exhibiting an ASS hazard.

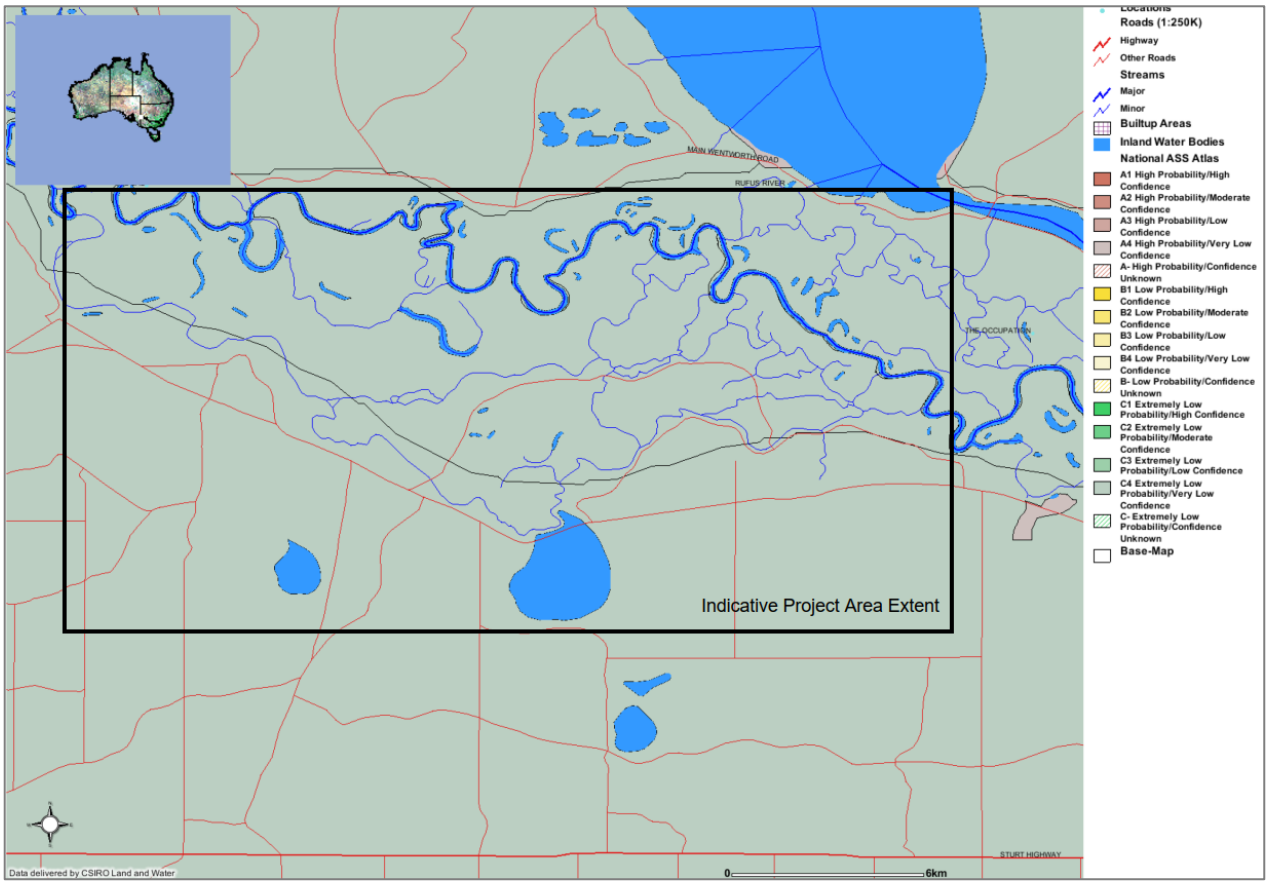

Figure 11: ASRIS acid sulphate soils mapping of project area (CSIRO, 2008)

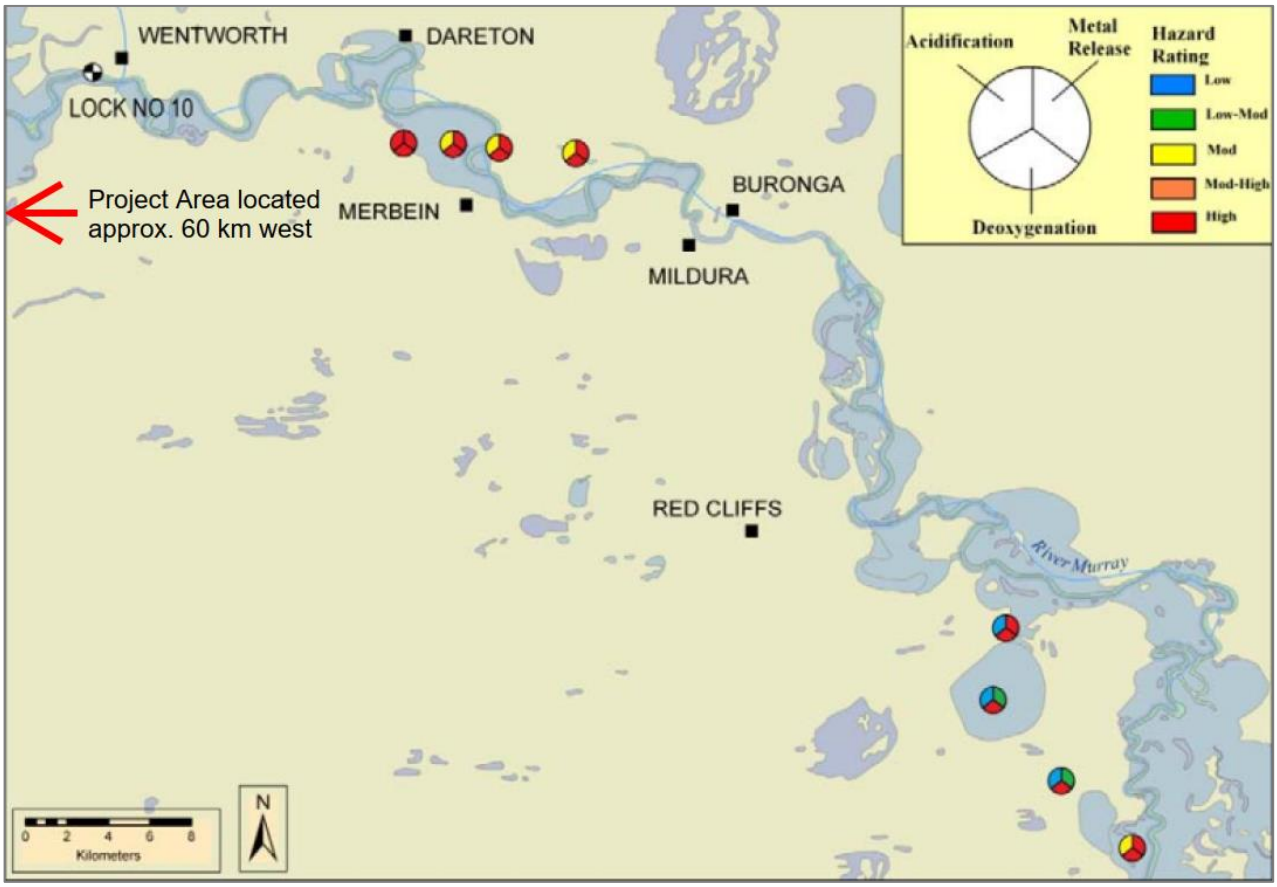

Figure 12: Acid sulphate soils risk mapping near project area (MDBA, 2011)

A high-level review of geomorphological, vegetation and groundwater conditions in the area of investigation based on data from BoM (2020) and VVG (2020) suggest that ASS materials may be present due to the presence of wetlands and waterlogged areas, vegetation tolerant of salt, acid and/or waterlogged conditions, and groundwater levels <3 m below ground surface. This is consistent with previous investigations in the region which indicate ASS hazards are commonly present. Given this, it is considered that ASS materials may be present in the area of investigation and that these may be disturbed by project activities such as excavation and changes to watertable levels in response to augmented watering regimes.

Prior to commencement of construction, a site ASS inspection would be undertaken including:

- Visual assessment of morphology
- Visual assessment of surface water and hydrology
- Visual assessment of vegetation
- Examination of surface soils and soil profile (including soil pH and pH after peroxide addition).

Based on the findings of the site inspection, the necessity of soil sampling and laboratory analysis would be determined. If potential ASS are identified and disturbance cannot be avoided, an ASS management plan would be developed to minimise potential effects on surrounding soils, vegetation and water environments.

Are there geotechnical hazards that may either affect the project or be affected by it?

☐ NYD ☐ No ☒ Yes If yes, please briefly describe.

Highly variable and dispersive soils occur throughout the project area. The main geotechnical hazards (and mitigation measures) include:

Construction

- Soil erosion – mitigated by construction planning and implementation of an erosion and sediment control plan (part of the CEMP)

Operation

- Soil erosion in waterways and in the vicinity of regulating structures – mitigated through the use of rock armouring and drop structures, and control of drawdown rates (to reduce scouring (and risk of native fish stranding) drawdown would be managed to a range of 0.03 to 0.06 m/day within the upstream pool)
- Soil erosion at containment banks (e.g. wave action, overbank flows) – mitigated through selection of appropriate fill material (e.g. low to medium plasticity clay to sandy clay with low dispersivity), design and placement of spillways, compaction and rock armouring where required
- Piping through embankments and around structures – mitigated by appropriate material selection and construction techniques, 'keying in' of structures, sheet-pile cutoffs extending to an appropriate depth and lateral extent at each of the large regulators
- Settlement of structures – mitigated by appropriate foundation design, removal of inferior foundation material.

In addition, prior to commencing works the contractor would be required to prepare a CEMP outlining measures to identify and avoid or manage disturbance of potential ASS, an erosion and sediment control plan and a dewatering management plan (if required).

Other information/comments? (eg. accuracy of information)

15. Social environments

Is the project likely to generate significant volumes of road traffic, during construction or operation?

☒ NYD ☐ No ☐ Yes If yes, provide estimate of traffic volume(s) if practicable.

Construction

Planning for construction activities (including the temporary closure of tracks and camp sites and/or traffic management controls of access tracks) would be undertaken by LMW and the construction contractor in conjunction with Parks Victoria and SA Water prior to any works being undertaken.

Construction traffic would be associated with the following activities:

- Haulage of fill/spoil and concrete to/from the proposed construction sites via existing tracks from Old Mail Road
- Delivery and removal of plant as required, including excavators, truck and trailers, graders, rollers and forklifts

- Workers travelling daily to and from site, anticipated to mostly be from Renmark to the west or Mildura to the east.

An estimated 14,000 traffic movements may be required over the duration of the construction phase, for transportation of fill / spoil, to and from the work sites for proposed structures (assuming truck and trailers, no reuse of spoil on site). Additional construction traffic would be associated with transportation of material for construction of access tracks (volumes yet to be determined), site establishment, plant and equipment deliveries and worker travel. The majority of estimated traffic movements for fill / spoil haulage are associated with construction of the structures in the Berribee, Crankhandle and Crankhandle West WMAs (approx. 12,000 movements) and would therefore use either the Berribee Homestead Track or Bridge Track to access the Berribee Regulator site and other sites across Lindsay Island.

Construction would predominantly occur during the daytime, with the exception of some potential evening or night works for the Berribee Regulator. Construction traffic and associated effects would be managed through standard controls contained in a CEMP and Traffic Management Plan to mitigate impacts.

Discussion of potential social effects associated with temporary track closures that may be required during construction is provided in the responses below.

Operation

Traffic generated during operation of the project would be minimal and limited to maintenance vehicles (e.g. mostly 4WDs). This would include a 4WD utility with a mobile generator, which operators would use to open and close the regulator gates as required, using a hand-held actuator. Operation of the Berribee Regulator would involve the use of an excavator with rail track connection, brought to site as required, to install/remove stop logs.

Prior to commencement of a temporary pumping event at the Lindsay South, Wallawalla East or Wallawalla West WMAs, a truck would be required to access the site to deliver the temporary pumps. Access to these pump sites would be required by trucks to refuel pumps and other maintenance/operation vehicles during a managed inundation event.

Discussion of potential social effects associated with temporary track closures that may be required during operation is provided in the responses below.

Is there a potential for significant effects on the amenity of residents, due to emissions of dust or odours or changes in visual, noise or traffic conditions?

☒ NYD ☐ No ☐ Yes If yes, briefly describe the nature of the changes in amenity conditions and the possible areas affected.

Nearest sensitive receivers

The nearest dwellings to proposed infrastructure construction sites are:

- A dwelling located near the Lindsay Point irrigation area, which is located approximately 1.7 km west of the construction footprint for the CW_B1 drop structure, large regulator and containment bank. This dwelling is also the nearest dwelling to the primary construction site at the Berribee Regulator and is located approximately 5.2 km west of the construction footprint for the Berribee Regulator. An additional six or seven dwellings at the Lindsay Point irrigation area are also located within approximately 6 km of the Berribee Regulator construction site.
- A dwelling located at Kulkurna Cliffs on the NSW side of the Murray River, which is located approximately 1 km north of the construction footprint for both the CR_D drop structure, regulator and containment bank and the CR_E regulator and containment bank. This dwelling is also the nearest dwelling to the north of the primary construction site at the Berribee Regulator and is located approximately 5.8 km north of the construction footprint for the Berribee Regulator. An additional two

or three dwellings located on the NSW side of the Murray River are located within approximately 6 km of the Berribee Regulator construction site.

- Three caretaker dwellings managed by SA Water and located near Lock 7 (Victorian side), are located approximately 2.2 km east of the construction footprint for the BERR_F large regulator and containment bank. These dwellings are located more than 15 km from the construction footprint at Berribee Regulator.

The Berribee Homestead Complex contains the nearest buildings (managed by Parks Victoria) to proposed infrastructure construction sites and is located within approximately 140 m of the construction footprint for the Berribee Regulator. Although the homestead contains buildings historically used for accommodation, these buildings are unoccupied and are unlikely to be occupied prior to or during construction due to their deteriorating condition. Parks Victoria staff / contractors may infrequently and opportunistically use the existing cottage as an alternative to camping while working on Lindsay Island.

Consideration of potential amenity effects on these dwellings during construction are discussed below.

During the operational phase, the main source of noise would be associated with operation of temporary pumps at the Lindsay South, Wallawalla East and Wallawalla West WMAs. The nearest dwelling to the temporary pump sites is located in NSW, approximately 3.4 km north east of the Lindsay South temporary pump site, with the nearest dwelling in Victoria located approximately 4.4 km south east of the Lindsay South temporary pump site.

Due to the extent of the national park to the south of the project area, significant separation distance exists to the nearest dwellings in this direction and no amenity effects are anticipated in this direction during construction or operation of the project.

Construction

Noise

Construction works would generally be limited to normal working hours (Monday to Friday 7:00am to 6:00pm, Saturday 7:00am to 1:00pm). Some weekend and/or evening works may be required, particularly for construction of the Berribee Regulator, which could potentially also require night time works. The construction period for the overall project is approximately 24 months, including a construction period for the Berribee Regulator of approximately 18 months.

A preliminary assessment of construction noise from the project shows that works performed during normal working hours are predicted to comply with the relevant noise criteria (75 dB(A)) at all sensitive receivers except for one of the two historic buildings at Berribee Homestead near the Berribee Regulator. Given this building is generally unoccupied, no significant noise impacts to sensitive receivers are expected as a result of works during normal working hours. VMFRP would liaise with Parks Victoria as a project partner, to determine if / when staff or contractors may need to use the existing cottage at Berribee Homestead, and where required implement measures to mitigate potential effects of construction noise.

Noise levels at five sensitive receivers are predicted to exceed the weekend and evening noise criteria for the first 18 months of construction (45 dB(A)), including the three caretaker dwellings at Lock 7 (62, 62, and 54 dB(A)) and the two unoccupied historic buildings at Berribee Homestead (69 and 79 dB(A)). In addition, two sensitive receiver locations (at Kulkurna Cliffs in NSW) near the CR_D drop structure, regulator and containment bank, would slightly exceed the evening and weekend noise criteria after 18 months of construction (40 dB(A)), with predicted noise levels at these receivers of 41 and 45 dB(A).

Weekend and/or evening works are likely to be required for construction of the Berribee Regulator only. As construction noise from the Berribee Regulator does not contribute to the weekend and evening noise criteria exceedances at the three Lock 7 caretaker dwellings or the two dwellings at Kulkurna Cliffs in NSW, and the two historic buildings at Berribee Homestead are generally unoccupied, no significant noise impacts to sensitive receivers are expected as a result of works during weekend and evening hours, provided these works are limited to occurring at the Berribee Regulator. As above, VMFRP would liaise

with Parks Victoria as a project partner, to determine if / when staff or contractors may need to use the existing cottage at Berribee Homestead, and where required implement appropriate measures to mitigate potential effects of construction noise.

If weekend or evening works are required outside normal working hours at other work sites, mitigation measures may be required for works at the CW_B1, CR_D and CR_C work sites, which have been identified through the modelling to contribute to minor exceedances of weekend and evening criteria at sensitive receivers. Preliminary modelling has indicated that if night time works are required at the Berribee Regulator, no exceedances of night time noise criteria are predicted to occur except at the two generally unoccupied historic buildings at Berribee Homestead.

Dewatering pumping at cofferdams may be required overnight. Impacts associated with this construction activity would need to be managed through standard controls contained in a CEMP, including compliance with construction noise limits (which may require management measures such as installation of silences on dewatering pumps).

Additional dwellings located along roads and tracks to be used by construction traffic, may also experience a temporary increase in noise and dust during the construction period. These potential effects are typical of construction projects and are therefore well understood and able to be managed through standard controls contained in a CEMP and Traffic Management Plan.

The noise mitigation measures contained in the draft Environmental Management Framework would be implemented throughout the construction phase, as appropriate.

Vibration

Due to the proximity of the Berribee Homestead Complex to construction works for the proposed the Berribee Regulator, further assessment of the potential for vibration impacts on the historic features of this complex is proposed. Of the works being undertaken, sheet-piling cutoffs and cofferdam construction, regulator construction, new access track construction, concrete hardstand construction, steel rail beam construction for stop logs, construction and compaction for the storage compound, and containment bank construction at the Berribee Regulator site all have potential to generate vibration. Based on the recommended safe working distances for vibration intensive equipment to avoid cosmetic damage as specified in the Construction Noise Strategy (Transport for NSW, 2017) (e.g. 2-20 m for vibratory pile driver, 25 m for 18-tonne vibratory roller) and a separation distance of more than 100 m between the historic buildings and proposed Berribee Regulator, significant vibration impacts are not expected.

Operation

Noise

Temporary pumping would be required approximately 2 years in every 10 year period at the Lindsay South, Wallawalla East and Wallawalla West WMAs. The duration of each pumping event would be approximately 30-40 days at Lindsay South WMA, 12-15 days at Wallawalla East WMA, and 30-40 days at Wallawalla West WMA.

Preliminary noise modelling has been undertaken using Computer Aided Noise Abatement (CadnaA) Version 2020-MR1 noise modelling software to predict the effects of operational noise from the temporary pumping sites. Findings are provided below:

- Predicted noise levels from the operation of the temporary pumps running simultaneously during a pumped inundation event are predicted to comply with the strictest noise criteria of 32 dB(A) under the *Noise from Industry in Regional Victoria (NIRV): Recommended maximum noise levels from commerce, industry and trade premises in regional Victoria* (EPA Victoria, 2011) at all Victorian sensitive receiver locations and the strictest noise criteria of 35 dB(A) under the New South Wales Noise Policy for Industry (NPI, 2017) at all NSW sensitive receiver locations.
- The highest predicted noise level at a sensitive receiver location was 11 dB(A).

Due to these modelled noise levels, no specific mitigation has been recommended. As the exact pumps to be used have not yet been selected, this would need to be confirmed and, if required, mitigation measures adopted to comply with noise criteria for the actual type and capacity of pumps to be used.

Vibration

It is not expected that any notable vibration would occur during operation of the project. Temporary pumps would be on pneumatic-tyred trailers isolating them from the ground. Vibration from such a unit would be expected to be localised to within 10 m of the unit. Operational activities at the Berribee Regulator, including installing and removing stop logs, is not expected to generate any notable vibration.

Is there a potential for exposure of a human community to health or safety hazards, due to emissions to air or water or noise or chemical hazards or associated transport?

☐ NYD ☒ No ☐ Yes If yes, briefly describe the hazards and possible implications.

The proposed construction activities are located within the Lindsay Island floodplain, with the nearest habitable dwellings separated by approximately 1 km from project structures. Potential adverse effects on local communities during the construction phase would most likely be limited to increases in noise, dust and traffic associated with transport between Renmark / Mildura and the construction sites.

A Traffic Management Plan would be developed to minimise potential risks to communities along haulage routes associated with a temporary increase in heavy vehicle traffic during construction. Stakeholder engagement activities would also continue throughout the construction phase to manage issues raised by local communities.

Is there a potential for displacement of residences or severance of residential access to community resources due to the proposed development?

☐ NYD ☒ No ☐ Yes If yes, briefly describe potential effects.

The project would not displace any residences or sever residential access to community resources as the works are located at discrete sites within the Murray-Sunset National Park. No permanent closures of existing roads or access tracks are proposed as part of the project.

During construction, access to the western parts of Lindsay Island, including parts of Sandford Track, would be closed to the public for the duration of construction works due to the large number of structures and traffic movements proposed on this part of the island. Parks Victoria would continue to have access to the western parts of Lindsay Island throughout construction. The Berribee Boat Ramp and associated tracks would also be closed to the public throughout construction of the Berribee Regulator but would be re-opened to the public in an upgraded condition following completion of works. Access restrictions (e.g. traffic control, delays) would apply along Bridge Track during the construction phase due to increased traffic volumes and upgrade works along this track. Access to SA Water facilities and private land on Lindsay Island would be maintained throughout construction, but with some restrictions. Temporary closures of other tracks within the park may be required and would be managed in consultation with Parks Victoria. Old Mail Road would not be closed during construction but may be subject to traffic management controls. Access plans showing the location of tracks proposed to be used during construction and operation of the project are provided in **Attachment 1 – Project Overview Maps**.

Road and track closures have the potential to disrupt recreational access to the Murray River and other parts of the Murray-Sunset National Park, although staggered closure of the key access tracks would be undertaken to minimise these disruptions. Engagement would be undertaken with Parks Victoria to manage access disruptions within the Murray-Sunset National Park and a stakeholder management strategy prepared and implemented so that Parks Victoria is aware of the extent and timing of construction works, and can plan accordingly (e.g. signage, notification to park users).

During managed inundation events, areas of the Lindsay Island floodplain and Murray-Sunset National Park, may not be accessible to the public due to water restricting access or to manage public safety risks, which may reduce opportunities for active and passive recreation and could also impact on licensed

apiary sites. The inundation area accounts for approximately 30% of the Lindsay Island floodplain and less than one percent of the total area of Murray-Sunset National Park. Access to other parts of the park would be managed by Parks Victoria. Further assessment would be undertaken in consultation with Parks Victoria, to identify opportunities to maintain or provide alternative access, where practicable. Restricted access to Lock 7 and private land within Lindsay Island via the Berribee Regulator, would be available to SA Water and the private landholder during a managed inundation event.

Are non-residential land use activities likely to be displaced as a result of the project?

☐ NYD ☒ No ☐ Yes **I**f yes, briefly describe the likely effects.

The Lindsay Island floodplain is managed for multi-use values, including conservation, recreation and cultural values. Recreational uses include fishing, camping, kayaking, canoeing, bird and wildlife watching, photography, horse riding, motor biking and four-wheel driving. Designated camping areas are dispersed across Lindsay Island and around Lake Wallawalla, with most camping areas being located along the Murray River, Lindsay River or Mullaroo Creek. No designated camping areas or other recreational facilities are located within the permanent footprint of proposed infrastructure. Two camping areas (Berribee and Lock 7 Boat Ramp Camping Areas) are located within or immediately adjacent to the construction footprint (or access track) and may have restricted use during construction.

Construction of the Berribee Regulator would limit access along this section of the Lindsay River to watercraft less than 3.5 m width, which would have passage through the navigable bay incorporated into design of the regulator. It is understood that some larger boats, including houseboats, occasionally use the lower Lindsay River between the downstream confluence with the Murray River and Lindsay Bridge. Lindsay Bridge is approximately 12 km upstream of the proposed Berribee Regulator and currently prevents boat access further upstream along the upper Lindsay River. Following construction of the Berribee Regulator, movement of these larger vessels would be restricted to the section of the Lindsay River downstream of the Berribee Regulator. An existing boat ramp downstream of the Berribee Regulator that is currently in poor condition, is proposed to be upgraded for use during construction and is intended to be retained for public use on completion of construction. This boat ramp would be temporarily closed to public use during construction of the Berribee Regulator.

The main parcel of private land within the area of investigation and proposed inundation area, is located to the south of Lindsay River and is known as Neds Corner. Although included in the Farming Zone, this former grazing property is currently owned by Trust for Nature and is managed for conservation purposes. No current farming activities would be displaced from this property by the project.

Twenty-seven licensed apiary sites are located within the area of investigation and/or inundation area. None of these sites are located within the development footprint of permanent infrastructure and are therefore not expected to be permanently displaced by the project. One apiary site is located within the construction footprint and would require at least temporary relocation during construction. Although bees rely on an adequate water source to thrive and it is expected that the objectives of the project would increase the regularity and reliability of flowering, some temporary displacement or disruption of access to existing hives located within the inundation area may occur.

No land use activities are expected to be permanently displaced by the project. Temporary restrictions on access and recreational activities within the Lindsay Island floodplain may occur during construction and managed inundation events as described in the following section.

Do any expected changes in non-residential land use activities have a potential to cause adverse effects on local residents/communities, social groups or industries?

☐ NYD ☐ No ☒ Yes If yes, briefly describe the potential effects.

Potential effects on non-residential land use activities are not expected to be significant, but may include:

- Temporary disruptions to access to SA Water's facilities adjacent to Lock 7, private land and infrastructure (possibly one pump site), recreational and commercial activities (apiary) within the Murray-Sunset National Park and along the Murray River during construction and managed environmental watering.
- Temporary disruptions to recreational boating access along the Lindsay River during construction of the Berribee Regulator and managed environmental watering.
- Possible temporary disruption to irrigation water quality flows at existing irrigation pumping sites along the Lindsay River during construction of in-stream works at Berribee Regulator. As irrigation water is drawn from the Lock 6 weir pool, in which levels are not proposed to be altered for construction of the project, access to irrigation water supply would not be affected.
- Temporary displacement of apiary sites (currently one) located within the construction footprint and possible disruption to other apiary activities during construction.
- Periodic inundation of private land zoned for farming and rural purposes but mostly used for conservation purposes during managed environmental watering events.
- Potential for amenity effects (increased noise, dust etc.) from construction on residents in close proximity to access roads and tracks during construction.

These potential impacts are likely to be either temporary and/or undertaken subject to agreements with the potentially affected landowners/managers or asset owners. Managed inundation of private land would only occur if the necessary flood easements / agreements are obtained with affected landowners, in which case it would be considered that appropriate measures have been agreed with the landowners to mitigate potential impacts to their satisfaction. At this stage, the project has obtained in-principle written agreement from the owners of Neds Corner and verbal support from two of the three owners of property within the NSW inundation area.

The project would not involve any permanent closure of existing access tracks or other facilities that are currently available for public use within the Murray-Sunset National Park. Construction of the Berribee Regulator would limit boating traffic along this section of the Lindsay River to watercraft less than 3.5 m wide that would be able to use the proposed navigable bay.

Temporary closures of camping areas within the inundation area would be required during managed inundation events, with the location and duration of closures required dependent on the targeted watering level during the event. Potentially affected camping areas located partly or wholly located within the proposed inundation area include: Berribee Camping Area, Mullaroo Creek Access 1, 2, 3, 4, 5, 6 Camping Area, Mullaroo Creek Boat Ramp Camping Area, The Caravan Camping Area, Channel Track Camping Area, Mullaroo Creek Camping Area, Lindsay River Pump Shed Camping Area, Army Bridge Camping Area 1 and 2, Walla Walla Track Camping Area, Little Mullaroo Creek Junction Camping Area and Circuit Track Camping Area.

Although temporary disruptions to access and activities within the Lindsay Island floodplain would likely occur during construction and managed inundation events, implementation of the project is expected to improve the condition of vegetation communities and associated habitats within the proposed inundation areas, which would contribute to improved park user experiences in the longer term.

Is mitigation of potential social effects proposed?

☒ NYD ☒ No ☒ Yes If yes, please briefly describe.

The constructing authority (LMW) would work closely with Parks Victoria, SA Water and other interested groups to minimise disruption to park users and commercial operations during construction and managed inundation events. A stakeholder and community engagement strategy would be developed and implemented during the construction and operation phases to disseminate information regarding

proposed road, track or park facility closures in a timely and readily available manner to interested parties to minimise disruption. The stakeholder and community engagement strategy is to include:

- Continued engagement with potentially affected private landowners regarding planned environmental watering events and outcomes, to obtain flood easements or agreements prior to commencing operations that may involve managed flooding of private land
- Continued engagement with SA Water regarding maintenance of access and operation of Lock 7 and Mullaroo Regulator during construction and managed environmental watering
- Engaging with potentially affected private land and asset owners, water licence holders to determine potential impacts and associated mitigations required during construction and operation of the project
- Engaging with apiary licence holders in conjunction with Parks Victoria as the public land manager, to identify opportunities to temporarily or permanently relocate the affected apiary site/s if they cannot be avoided during construction, and to minimise disruption to apiary activities during managed inundation events

In addition, the following mitigation measures would apply to the project:

Design measures

- Provision for infrastructure (e.g. gates) where suitable to facilitate temporary restrictions on public access along certain access tracks during higher risk periods (e.g. flooding) and to provide Parks Victoria with operational flexibility to restrict access to parts of the park where deemed necessary to provide rest and recovery from visitation
- Provision for infrastructure (e.g. gates) to restrict public access across the Berribee Regulator to authorised personnel from Parks Victoria and LMW following completion of the construction phase.

Traffic management plan

- A Traffic Management Plan would be prepared and approved in accordance with the *Road Management Act 2004* and implemented. The plan would be prepared by a suitably qualified and experienced traffic engineer.
- The contractor would liaise with the land manager and the relevant Council in the preparation of the Traffic Management Plan. Evidence of this consultation would form part of the plan.
- Site access points and roads are to be located so as to minimise the impact on nearby residences, cultural heritage sites and flora and fauna habitat
- All vehicles and plant would only operate on existing tracks and in areas marked as parking areas or construction zones
- Deliveries to the site are to be scheduled to minimise disruptions to local amenity and traffic.

Nearby residents and landholder notifications

- Notify affected residents and landholders of changes to traffic conditions and access to property for duration of the works. Nearby residents are to be notified at least seven days in advance of works commencing of the nature, duration, and hours of work if they are likely to be impacted by construction activities (i.e., due to noise, vibration, access, traffic).

Noise management plan

- Prepare and implement a Noise Management Plan as part of the CEMP that includes appropriate measures to minimise noise and vibration consistent with EPA publications: Noise Control Guidelines (EPA Publication 1254,) and Environmental Guidelines for Major Construction Sites (EPA Publication 480) and AS 2436 Guide to Noise Control on Construction Maintenance and Demolition Sites. The Noise Management Plan should consider controls such as:

- Substituting noisy activities with an alternative process where available
- Restricting times when noisy work is carried out
- Consultation with affected residents
- Schedule deliveries to the site so that disruption to local amenity is minimised
- Notifying the land owner/manager and nearby residences of any planned and unavoidable out of hours works at least five days in advance

- All construction plant and equipment used on the works would, in addition to other requirements, be:
  - Fitted with properly maintained noise suppression devices in accordance with the manufacturer's recommendations
  - Be maintained and operated in accordance with manufacturer's recommendations
  - Switched off when not in use
- All noise and vibration complaints are to be investigated and corrective actions implemented as required.

Temporary pumping

Measures to avoid exceedance of the noise criteria would be employed during pumping (such as adjusting the equipment used) to achieve compliance with the criteria in *Noise from Industry in Regional Victoria (NIRV): Recommended maximum noise levels from commerce, industry and trade premises in regional Victoria* (EPA Victoria, 2011), where required. (Note: No exceedance of noise criteria is predicted for temporary pumping activities).

Other information/comments? (e.g. accuracy of information)

15.1 Cultural heritage

Have relevant Indigenous organisations been consulted on the occurrence of Aboriginal cultural heritage within the project area?

☐ No If no, list any organisations that it is proposed to consult.

☒ Yes If yes, list the organisations so far consulted.

The First People of the Millewa-Mallee Aboriginal Corporation (FPMMAC) are the Registered Aboriginal Party (RAP) for the project area (since December 2018). FPMMAC identify with the *Latji Latij, Ngintait, Nyeri Nyeri* and *Wergai* peoples.

At the time the Notice of Intent to commence the CHMP was submitted on 13 June 2017, there was no RAP for the project area. However, FPMMAC were the RAP applicants for the area. FPMMAC are represented on Lindsay Island by the *Ngintait* peoples.

A draft CHMP was prepared for the project in 2018 in consultation with the *Ngintait* peoples. The draft CHMP is currently being updated and is likely to be complete in mid-2021, and is being prepared in further consultation with the FPMMAC (including the *Ngintait* peoples as members of FPMMAC). As the CHMP was commenced when there was no RAP for the project area, Aboriginal Victoria are the evaluators for the CHMP for this project under the *Aboriginal Heritage Act 2006*.

A due diligence assessment under the NSW *National Parks and Wildlife Act 1974* (NPW Act) and in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South*

Wales (DECCW, 2010), is to be prepared for the proposed works and inundation within NSW. If in the event that the due diligence assessment identifies a requirement for an Aboriginal Heritage Impact Permit (AHIP), consultation would be undertaken in accordance with the requirements of Clause 60 of the NSW *National Parks and Wildlife Regulation 2019*.

What investigations of cultural heritage in the project area have been done?

(attach details of method and results of any surveys for the project & describe their accuracy)

- Lindsay Island Sustainable Diversion Limits, Draft Complex Cultural Heritage Management Plan No. 15083 (drafted in 2018 (Jacobs, 2018) and currently being updated by R8):
  - A Notice of Intent (NOI) to prepare a CHMP was lodged with Aboriginal Victoria on 13 June 2017.
  - VMFRP are currently undertaking stakeholder consultation, associated fieldwork and development of the CHMP.
  - The CHMP is currently scheduled to be completed in mid-2021.
  - A summary of previous archaeological investigations that informed the draft CHMP is provided in **Table 19**.

Table 19: Summary of archaeological investigations referenced in draft CHMP

Author / Title **Study / Investigation**	**Location / Survey Type**	**Landform**	**Results**
Blackwood, Sir R. & K.N.G. Simpson 1973 'Attitudes of Aboriginal Skeletons excavated in the Murray Valley Region between Mildura and Renmark'	Chowilla Floodplain: Lindsay Island (Sites 19A, B, C); Lake Wallawalla (Site 18); Lake Victoria, Wallpolla Island. Foot Survey	Floodplain and source-bordering dunes	72 skeletons excavated at 7 sites in Murray Valley and 1 at Lake Victoria. Aged 4K-6Ky BP.
Sinnott, P.J. n.d. Chemical Methods Used for Determination of Fluorine, Phosphorus and Nitrogen in Fossil Bones from West of Mildura, Australia	Murray Valley, west of Mildura, associated with Chowilla Project Academic Paper		16 fossil specimens, not identified as human although some identified to megafaunal species tested for base elements.
Sandison, A.T. 1973 Palaeopathology of Human Bones from Murray River Region between Mildura and Renmark, Australia.	Central Murray between Mildura and Renmark Academic Paper		Further to Blackwood & Simpson. Mostly fragmented and incomplete specimens compared with Murray Black Collection. Very little evidence of common diseases or malnutrition, or trauma. Severe tooth-wear evident, presumably from nature of diet. Dental caries not seen.
Coutts, P.J.F. 1977 Aboriginal Prehistory in North Western Victoria	North Western Victoria Desktop		General information about the Aboriginal prehistory in NW Victoria up to 1977.
Clark, D.J. 1987 Investigation of Aboriginal sites at Lake Wallawalla and Lindsay Island, Northwest Victoria	Specific locations at Lake Wallawalla and Lindsay Islands Foot survey	Lunette on Lake Wallawalla Source-bordering dune on Lindsay Island	80 exposed skeletal remains noted, in addition to shell middens, earth features, scarred trees and artefact scatters on Lindsay Island (Shell Midden on Mullaroo Creek dated 3580+/-70y BP).

Pardoe, C. 1988 Prehistoric Aboriginal cemeteries of the River Murray: a report on the study of burial locations in southeast Australia			General Information booklet
Pardoe, C. 1989 Archaeology of the Western Lindsay Island Meander Scroll	Discontinuous meander scroll comprising a series of dunes, western Lindsay Island Foot survey	Source-bordering dunes	Burials, shell middens and dinner camps, hearths, artefact scatters
Pardoe, C. & M. Grist 1989 Traces of the Aboriginal past at Lindsay Island, Northwest Victoria			General information booklet for the Sunraysia and District Aboriginal Co-operative
Luebbers, R. & I. Ellender 1991 An assessment of archaeological Aboriginal sites in the northwest of Victoria	Northwest Victoria Desktop with some verification survey		Incomplete draft report. 3800 registered sites in Northwest Victoria
Luebbers, R. 1991 Proposal for the protection of Aboriginal cemeteries excavated in Victoria by the Chowilla Project	Seven ancient Aboriginal cemeteries in NW Victoria: Lake Wallawalla, Keera Station, Lindsay Island	Dunes and lunettes	Makes recommendations for management
Grist, M. 1995 An archaeological Investigation in the 'no stone saga' of far north west Vitoria: a study of the Berribee Quarries in the landscape.	Berribee quarries, Berribee Station, Northwest Victoria. Survey	Upper level floodplain and rocky outcrop	Detailed analysis of two silcrete quarry locations and the potential distribution of material from these loci.
Kelton, J. 1996 Lindsay Island and Lake Wallawalla Aboriginal cultural heritage plan of management, Lindsay Island and Lake Wallawalla, Murray Sunset National Park, Northwest Victoria	Lindsay Island 15,760 ha Sample method – lineal, parallel transect strategy (113.1ha surveyed) Foot survey	Edges of billabongs and oxbows, perennial river banks and creek banks, ephemeral drainage line banks and beds, playa lake banks, sand dunes, floodplains – seasonally flooded, open woodlands and non-flooded open woodlands	72 Aboriginal places identified: 42 scarred trees, 3 middens, 1 mound, 3 burials, 5 open artefact scatters, 16 hearth sits, 2 isolated artefact occurrences
Hyett, J. & D. Rhodes 2001 Wallpolla Island and Lindsay Island: Archaeological Desktop Study	Wallpolla and Lindsay Islands Desktop	Floodplain	At the time, 187 sites had been recorded on Lindsay island and 11 sites on Wallpolla Island. Burials, scarred trees, middens and hearths are the most prevalent. Recommended field investigations.
Edmonds, V. 2004a Indigenous cultural heritage assessment: Lindsay and Wallpolla Islands Water Management Investigations	Lindsay and Wallpolla Islands – proposed regulator locations Foot survey	Floodplain, creek crossings	4 sites located on Wallpolla Island – 2 scarred trees, 1 shell midden and 1 hearth complex

Edmonds, V. 2004b Indigenous cultural heritage assessment: Proposed culvert replacement, Lake Wallawalla, Northwest Victoria.	Lake Wallawalla Foot survey	Floodplain	2 Aboriginal places identified during the survey – scarred tree and artefact scatter
Hill, J. 2006 Lithic Utilisation in the Central Murray Valley: the distributional archaeology of surface material.	Central Murray Valley – Berribee Survey		Known silcrete and chert quarry material from Berribee investigated for distribution and distance decay modelling
Bell, J. 2011 Construction of regulator structures and associated infrastructure, Northern and Southern Effluents of Lindsay River, Lindsay Island. CHMP 11104	Lindsay Island – northern and southern effluents and access tracks Desktop, standard and complex assessments	Floodplain and dunes	A total of 53 new Aboriginal places were identified, including 98 individual features, including scarred trees, artefact scatters, shell middens, hearth features and human remains
Bell, J. 2013 Lindsay Island Floodplain, Northwest Victoria. Due Diligence Assessment	Lindsay Island Floodplain and Lake Wallawalla Desktop and brief site inspection	Floodplain and dunes	Identified 73 new places. Recommended the preparation of a CHMP.
Wood, A., J. Fiddian, S. Vick, M. Thompson & D. Freedman 2013 Mullaroo Track Upgrade, Regulator and Fishway Replacement, Lindsay Island	Mullaroo Creek, Lindsay Island Desktop, Standard and Complex Assessments	Floodplain, meander belt plains, source-bordering dunes	34 new sites recorded during standard assessment, including scarred trees, artefact scatters and hearth remnants. Complex assessment included 2 x 1m^2 test pits and 34 shovel probes. No cultural heritage identified in sub-surface context. Mostly disturbed contexts with low potential
Flemming, K., P. Kucera, B. Watson & M. Filihia 2014 Old Mail Road, Road Rehabilitation Works, Stage 9 – Yelta and Wargan.	Old Mail Road Desktop, Standard and Complex Assessments	Lunettes, source-bordering dunes, floodplain	13 new sites recorded (artefact scatters, hearths, shell deposits & ancestral remains). 4 test pits and 34 shovel probes investigated.
Pardoe, C. 2014 Conflict and Territoriality in Aboriginal Australia: Evidence from Biology and Ethnography	Central Murray River Academic Paper		Examines the possibility of corroborating skeletal and ethnographic evidence for warfare and violence in Aboriginal Australia using historical evidence from 1850s and skeletal evidence from last 10K years.
Iasiello, R. 2015 Summary for Coroner	Northwest Victoria: Lindsay Island, Lake Wallawalla, Mulcra Island, Belsar-Yungera Floodplain Foot survey based on reports of ancestral remains		Parks Victoria and Aboriginal Victoria survey of exposed ancestral remains on Parks Victoria land in Northwest Victoria
Filihia, M., P. Kucera & K. Flemming 2015 Old Mail Road Rehabilitation Works Stage 9 – Yelta and Wargan Salvage Excavation	Old Mail Road Salvage Excavation		Only surface artefacts associated with the 10 sites on road, specified in recommendations of CHMP 12799 were salvaged. Further material identified recorded, registered and salvaged also.

			Pre-contact and post-contact materials identified.

- Wallpolla Island and Lindsay Island: Archaeological Desktop Study (2001) prepared by Hyett and Rhodes:
  - Consisted of an archaeological desktop study of Wallpolla Island and Lindsay Island.
  - Historical assessment was desktop only based on data obtained from heritage registers and Heritage Victoria.
  - Identified two VHI-listed sites on Lindsay Island, both relating to a punt crossing of the Lindsay River situated near Berribee Homestead: Lindsay Creek North Ferry Crossing (H7129-0001) and Lindsay Creek South Ferry Crossing (H7129-0002). Noted that these sites are regarded as of historic significance, being the most substantial ferry crossing remains found during a study of river shipping in the area.
  - Produced a predictive model which suggested that: historic archaeological sites relating to river shipping may be found along the major streams in the area; and sites relating to prior non-Aboriginal use of the land in the pastoral industry and timber-getting may be found across all landforms.
- Mallee Environmental Watering Projects, Lindsay Island Floodplain, Northwest Victoria: Due Diligence Assessment Historical Archaeology (2013a) prepared by Jo Bell Heritage Services Pty Ltd:
  - Consisted of a historic due diligence assessment to identify historic archeological values within 100 m of proposed structures (current at the time (GHD, 2012)), and included desktop and fieldwork.
  - Identified that the study area had not previously been systematically assessed for historical archaeological sites.
  - Desktop assessment identified no historical heritage places listed on the Victorian Heritage Register (VHR) or Victorian Heritage Inventory (VHI) within 100 m of a proposed structure, with the only listed places in the vicinity being the Lindsay Creek North Ferry Crossing (H7129-0001) and Lindsay Creek South Ferry Crossing (H7129-0002) located just outside the 100 m study radius of the Berribee Regulator.
  - Field assessment in February 2013 identified two historic archaeological sites not listed on heritage registers within 100 m of a proposed structure (Berribee Station Barge and the North West Lindsay Punt Landing), and one other historic archaeological site in proximity but more than 100 m from a proposed structure (Berribee Homestead Complex).
  - No further areas of potential archaeological sensitivity were identified within 100 m of the proposed structures.
- Victorian Murray Floodplain Restoration Project, Lindsay Island Historical Heritage Desktop Assessment (2020) prepared by R8, which:
  - Consisted of a desktop assessment of historical heritage values within the current project area.
  - Identified no listed historical heritage places within the area of investigation, but did identify one unlisted potential historical heritage place within the area of investigation: Berribee Homestead Complex.
  - Identified three listed historical heritage places within the inundation area (Lindsay Creek North Ferry Crossing (VHI H7129-0001), Lindsay Creek South Ferry Crossing (VHI H7129-0002) and Lock and Weir No 7 (RNE101494).

- Identified two unlisted potential historical heritage places within the inundation area: Berribee Station Barge and Baggot's Cattle Station.
- Described the North West Lindsay Punt Landing (identified by Bell, 2013a) as being located approximately 370 m west of the inundation area and 1.3 km west of the area of investigation.
- Concluded there is a moderate potential for previously unidentified historical heritage to be present within the project area.
- Recommended that a Historical Heritage Assessment be undertaken for the project, which should include field survey to identify further historic archaeological sites and unidentified historical heritage places.
- Provided recommendations specific to the listed and non-listed historical heritage places as identified in the sections below.

Is any Aboriginal cultural heritage known from the project area?

☒ NYD ☒ No ☒ Yes If yes, briefly describe:

- Any sites listed on the AAV Site Register
- Sites or areas of sensitivity recorded in recent surveys from the project site or nearby
- Sites or areas of sensitivity identified by representatives of Indigenous organisations

In 2018, a draft CHMP was prepared for the project (current at that time) in consultation with the *Ngintait* peoples. This involved both standard and complex assessment of the activity area, which was based on the concept design for the project as at 2016/17. Since then, as outlined in Section 4, the project design has changed and the draft CHMP prepared in 2018 is being updated to reflect the current design for the project. Further standard and complex assessment of the current area of investigation (which is the CHMP activity area) is currently being undertaken and would continue until late 2020. A summary of key findings from the 2018 draft CHMP is provided below:

Desktop and standard assessment

The desktop assessment identified that the activity area is located in the Murray Basin geographic area and has a long history of Aboriginal occupation and use, with 541 previously recorded in the geographic region. The activity area is located in the Murray-Sunset National Park, which remains largely intact, and has only been slightly disturbed through past grazing use and present-day recreational activities, mainly track construction. The desktop assessment identified 33 previously recorded Aboriginal Places within 50 m of the activity area, including artefact scatters, burials, shell middens, earth features (both mounds and hearths), scarred trees and low-density artefact distributions (or LDADs, formerly called isolated artefacts). The desktop assessment found that some Aboriginal Places are represented by a complex of features (containing multiple cultural components). The desktop assessment indicated that the activity area had high archaeological sensitivity due to its largely unaltered natural state and the density of Aboriginal Places previously recorded within the geographic region.

The desktop assessment found that Aboriginal Places are expected anywhere along the watercourses (ephemeral and permanent) on Lindsay Island, and that a wide range of Aboriginal Place types are likely to be found (Jacobs, 2018). Dunes and lunettes within the Riverine Floodplain land system are highly sensitive areas likely to contain a wide range of Aboriginal Place types and are especially sensitive for ancestral human remains. Remnant mature native eucalypt species, especially along the internal watercourses, are highly sensitive for cultural scarring (Jacobs, 2018).

During the standard assessment, ground surface visibility was deemed good, with 613 individual Aboriginal objects recorded: 513 stone artefacts, 51 earth features, 46 scarred trees and 3 shell middens. This resulted in 79 new Aboriginal Places recorded and 25 re-inspected Aboriginal Places (already recorded). The results of the desktop and standard identified the need for complex assessment, with the

standard assessment identifying the Aboriginal cultural material mostly likely to be discovered during excavations as: shell midden material, hearths (burnt clay), chert or silcrete stone artefacts and ancestral human remains.

Complex assessment

During the complex assessment a total of 30 mechanical test pits, 15 test pits, and 215 shovel test pits were excavated. Additional cultural material from Aboriginal Places recorded or re-inspected during the standard assessment was discovered during the complex assessment, indicating sub-surface contexts for these Aboriginal Places, however, no additional Aboriginal Place registrations resulted from the complex assessment.

The results of the complex assessment were found to be generally consistent with the predictions made in the desktop and standard assessments as to the type and density of Aboriginal cultural material likely to be found on Lindsay Island and the surrounding Berribee landscape. Stone artefacts were identified in surface and subsurface contexts, however substantial sub-surface deposits do not exist even where there are substantial surface scatters.

The complex assessment found: 104 Aboriginal Places within the activity area, consisting of stone artefacts, scarred trees, earth features (hearths), shell middens and ancestral remains. The draft CHMP, currently being updated, identifies the impact on these Aboriginal Places and includes specific management conditions for identified Aboriginal Places where required, along with general management recommendations relating to induction training, salvage methods and stakeholder engagement, and procedures for unexpected 'finds' of potential Aboriginal cultural material. The draft CHMP also recommends design refinements to avoid impacts to specific Aboriginal Places (including ancestral remains sites), and these are currently being considered through the design process.

Are there any cultural heritage places listed on the Heritage Register or the Archaeological Inventory under the *Heritage Act 1995* within the project area?

☐ NYD ☐ No ☒ Yes If yes, please list.

A desktop historical heritage assessment has been prepared and is provided in **Attachment 7 – Historical Heritage Assessment.**

Findings from the desktop assessment (R8, 2020e) determined that there are no places listed on the VHR, VHI, World Heritage List, National Heritage List or Commonwealth Heritage List within the area of investigation or construction footprint. However, one unlisted potential historical heritage place (Berribee Homestead Complex) is located in the area of investigation and construction footprint.

The Berribee Homestead Complex, while not listed on any heritage registers has been assessed as having high local significance and was recommended for inclusion on the Mildura Planning Scheme heritage overlay (Bell, 2013a). This place includes outbuildings (homestead, manager's cottage, woolshed, stockyards, garage and engine shed, stables and harness shed and meat safe). The desktop assessment (R8, 2020e) notes that a construction laydown area has been identified at the location of the Berribee Homestead Complex and that there is potential for the project to impact on the historic significance of this heritage place if construction activities were to occur in this area. However, a review of construction laydown requirements for the Berribee Regulator has determined that use of the area containing the Berribee Homestead Complex is not likely to be required and as such, this area is likely to be excluded from the final construction footprint to avoid direct impacts on this unlisted historical heritage place.

Figure 13: Cottage at Berribee Homestead - although in the assessed construction footprint, works impacting on the heritage features of this place would be avoided

The desktop assessment has identified three listed historical heritage places within the proposed inundation area (Lindsay Creek North Ferry Crossing (VHI H7129-0001), Lindsay Creek South Ferry Crossing (VHI H7129-0002) and Lock and Weir No 7 (RNE101494)) and an additional two unlisted potential historical heritage places (Berribee Station Barge and Baggot's Cattle Station):

- **Lindsay Creek North Ferry Crossing** – listed on the VHI. The physical location of this crossing is on the north bank of the Lindsay River near Billgoes Billabong. The physical remains of the site consist of the remnants of the crossing mechanism, consisting of a pulley, piping, wire rope and wooden piles. The remains of an unidentified ferry are nearby.
- **Lindsay Creek South Ferry Crossing** – listed on the VHI. The physical location of the crossing is on the south bank of the Lindsay River near Berribee Homestead Complex. The physical remains of the site consist of a cutting in the bank and several piles. The remains of an unidentified ferry are nearby.
- **Lock and Weir No 7** – included on the Register of the National Estate which is a non-statutory listing. The physical location of the Lock and Weir No 7 is situated at the end of Lock Seven Road on the Murray River. This comprises an operational lock and weir on the Murray River, with the lock and weir system designed to raise the water level to improve navigability of the river via the lock.
- **Berribee Station Barge –** The physical location of the Berribee Station Barge is on the south bank of the Lindsay River, to the northeast of Berribee Homestead Complex. The barge comprises the remains of a sunken barge, with a little of the bow remaining above water; it is unlikely that there would be any archaeological deposits associated with the place.
- **Baggot's Cattle Station** - The physical location of the Baggot's Cattle Station was situated adjacent to the Lindsay River, north of Lake Wallawalla. The station is in an area that appears to contain a sand dune which it is understood has been the subject of recent revegetation.

Further assessment is proposed to determine the potential impact on these places. **Attachment 7 - Historical Heritage Assessment** contains further information on the historical and heritage context of these sites.

Assessment of aerial imagery and a review of relevant historical heritage assessments indicates there is moderate potential for previously unidentified historical heritage to be present within the project area. Site types most likely to be found in the project area include places or archaeological sites associated with early agricultural or pastoral activities, logging, river shipping, and water management practices.

Is mitigation of potential cultural heritage effects proposed?

☒ NYD ☒ No ☒ Yes If yes, please briefly describe.

Aboriginal Cultural Heritage

- The draft CHMP would be finalised for the project in consultation with the FPMMAC (which includes members of the *Ngintait* peoples) for evaluation and approval by Aboriginal Victoria, and is likely to include specific management conditions for identified Aboriginal Places where required, along with general management recommendations relating to induction training, salvage methods and stakeholder engagement, and procedures for unexpected 'finds' of potential Aboriginal cultural material.
- As part of the CHMP, altered hydrological and hydrogeological conditions within the inundation areas would be assessed. This would inform the assessment of impacts to Aboriginal cultural heritage as a result of inundation activities. The inundation assessment would be staged to assess:
    - Hydrological change resulting from the operation of the infrastructure, relative to how the area currently floods and the benefits and risks that are associated with the changes in flooding regime. Hydrological change assessment would consider each of the operating phases; filling, holding and emptying. The assessment would focus on changes in velocity, shear stress, water depths and inundation extents across the floodplain areas.
    - Geomorphological change, which would include assessment of possible erosion risk areas and capacity of soil types to withstand shear stresses.
    - Hydrogeological change, this would consider potential effects on areas with elevated potential for cultural heritage from groundwater mound rise and near-surface salinisation
    - Review of the high impact areas (if any) resulting from these changes and review of the cultural heritage values which may be impacted.
- The significance of potential impacts to Aboriginal cultural heritage values, including Aboriginal Ancestral Remains, within the inundation area would be assessed in terms of scale, extent, duration and intensity (magnitude) of change in values detailed above. The results of the inundation assessment would be used to develop impact mitigation measures which would be included as management conditions in the CHMP. The development of CHMP management conditions would involve consultation with the FPMMAC (which includes members of the *Ngintait* peoples), Aboriginal Victoria, the Victorian Aboriginal Heritage Council and the Ancestral Remains Unit within the Office of the Victorian Aboriginal Heritage Council.

Historical Heritage

The following mitigation measures are currently proposed:

Further historical heritage investigations and consultation

- Further historical heritage investigations are to be undertaken to identify risks to listed and potentially unrecorded historical heritage features within the project area, including:

- Background historical heritage research to identify potential for unlisted historical heritage places to occur within the NSW inundation area if advice from MDBA identifies that the project would require changes to current approved operating conditions for Lock 7.
- A site inspection by a qualified archaeologist to determine the exact location and archaeological potential at each of the currently listed historical heritage places and unlisted potential historical heritage places identified in the project area by the desktop assessment or subsequent research.
- An assessment of potential impacts on identified historical heritage places during construction and operation of the project, including potential for erosion impacts at heritage places within the inundation areas through analysis of the hydrological and geomorphological conditions.
- Consultation with Heritage Victoria to determine the consent requirements for the VHI-listed Lindsay Creek North and South Ferry Crossing sites.
- Consultation with Heritage Victoria and the NSW Department of Premier and Cabinet (Heritage) to discuss any assessment requirements for the Lock and Weir No 7 site (based on the nature of project changes to current approved operating conditions for Lock 7).
- Consultation with Mildura Rural City Council and Heritage Victoria to determine registration status and consent requirements for Berribee Station Barge and Baggot's Cattle Station.

A copy of this report (once completed) is to be kept on site and on file with the project records. All contractors and/or project staff are to be made aware of the heritage status of the heritage places in the project area prior to works taking place.

Construction management – Berribee Homestead Complex

- If construction works or laydown are proposed within or adjacent to the Berribee Homestead Complex:
  - a site inspection by a qualified archaeologist and further consultation with Mildura Rural City Council is to be undertaken to ascertain the conditions, heritage significance and status of the Berribee Homestead Complex and associated management conditions
  - protective barrier fencing is to be erected between the construction areas and the Berribee Homestead Complex (homestead, manager's cottage, woolshed, stockyards, garage and engine shed, stables and harness shed and meat safe) to avoid impacts to the heritage fabric of this place, with protective fencing to maintained for the duration of construction.
- Prior to commencing construction, an assessment of potential for vibration during construction of Berribee Regulator to impact on the heritage fabric of the Berribee Homestead Complex is to be undertaken, and any management and monitoring recommendations implemented.

Unexpected discoveries of archaeological sites

- All historical archaeological sites in Victoria older than 75 years are protected by the *Heritage Act 2017*, whether they are recorded on the VHI or not. It is an offence to knowingly or negligently deface, damage, or otherwise interfere with an archaeological site without obtaining the appropriate consent from the Executive Director of Heritage Victoria. Under Section 127 of the *Heritage Act 2017*, if an archaeological site is discovered during construction or excavation on any land, the person in charge of the construction or excavation must as soon as practicable report the discovery to HV. If any unexpected archaeological sites are uncovered during construction works, the following procedure must be followed:

  STOP

  - Stop any activity which may impact on the discovery

- Ensure that other people working in the area are aware of it and have also stopped work in the area
- Protect the artefacts or site by erecting temporary fencing or another suitable barrier.

ADVISE

- A supervisor or the cultural heritage consultant must be consulted if they are on site
- Supervisors are to advise Heritage Victoria where the discovery was made and provide a description or photograph of the discovery.

MANAGE

- Heritage Victoria, the onsite heritage consultant or supervisor would advise on how to manage the discovery
- Management of the discovery may involve protection, recovery, recording or removal of the artefacts or features and is likely to require a consent to damage under the *Heritage Act 2017* from Heritage Victoria.

- In NSW, the *Heritage Act 1977* protects relics which are defined as: '*Any deposit, artefact, object or material evidence that relates to the settlement of the area that comprises NSW, not being Aboriginal settlement; and is of State or local heritage significance*'. If an archaeological relic is discovered in NSW during construction or excavation on any land, the person in charge of the construction or excavation must as soon as practicable report the discovery to Wentworth Shire Council and the Department of Premier and Cabinet (Heritage).

Heritage induction training

- Historical heritage awareness training should be completed as part of the site induction for all personnel and/or contractors prior to the commencement of construction works to ensure:
  - An understanding of where all heritage places are located within the project area
  - An understanding of the potential heritage places that may be impacted during the project
  - The procedures required to be undertaken in the event of discovery of historical heritage material, features or deposits, or the discovery of human remains
- If an archaeological site is discovered during construction or excavation, the person in charge of the construction or excavation must as soon as practicable report the discovery to Heritage Victoria.
- A copy of historical heritage assessment report should be kept onsite and on file with the project records. All contractors and/or project staff should be made aware of the heritage status of the heritage places in the project area prior to works taking place.

Other information/comments? (eg. accuracy of information)

16. Energy, wastes & greenhouse gas emissions

What are the main sources of energy that the project facility would consume/generate?

- ☒ Electricity network. If possible, estimate power requirement/output
- ☒ Natural gas network. If possible, estimate gas requirement/output
- ☒ Generated on-site. If possible, estimate power capacity/output
- ☒ Other. Please describe.

Please add any relevant additional information.

No permanent power supply is required to operate the proposed environmental watering works. Temporary diesel-powered pumps would be brought to site and located at the Lindsay South, Wallawalla East and Wallawalla West WMAs, when required.

The frequency and duration of water pumping at each WMA would depend on actual inundation events and the method to achieve environmental watering targets. A summary of the estimated temporary pumping frequency, duration and water volumes for the project is provided in **Table 20**.

Table 20: Summary of estimated pumping requirements

Pumping parameters	Lindsay South WMA	Wallawalla East WMA	Wallawalla West WMA
Water quantity pumped Note 1	1,500 ML	750 ML	4,000 ML
Frequency of pumping events	2 in 10 years	2 in 10 years	2 in 10 years
Duration of pumping events	20 – 30 days	12 – 15 days	30 – 40 days
Pumping rate (approximate)	50 ML/day	50 ML/day	100 ML/day

Note 1: The water quantities to be pumped represent the maximum expected pumping volumes calculated based on pumping for the maximum number of days in above table at the maximum rate in the above table. These pumped water quantities are higher than the fill volumes of the respective WMAs as they include allowances for losses via seepage and evaporation.

All regulator gates would be operated manually or with a portable actuator brought to site as required, with no permanent electricity supply required for this operation. Electricity or hydraulic power generation would be via a trailer or utility tray mounted generator.

Fishway gates would comprise sidewinder gates, which are operated manually or with equipment brought to site, with no permanent electricity supply required for this operation.

What are the main forms of waste that would be generated by the project facility?

- ☒ Wastewater. Describe briefly.
- ☒ Solid chemical wastes. Describe briefly.
- ☒ Excavated material. Describe briefly.
- ☒ Other. Describe briefly.

Please provide relevant further information, including proposed management of wastes.

The main waste streams generated by construction works include:

- Excess spoil
- Cleared vegetation
- Concrete waste / wash-out
- Saline water from dewatering work sites
- General building and miscellaneous wastes such as packaging, off cuts, excess materials
- Worker's waste such as packaging, containers, food scraps, etc.

As part of the CEMP, the contractor would be required to prepare a spoil and waste management plan demonstrating compliance with the *Environment Protection Act 1970* (and *Environment Protection Act 2017*) and EPA Publication 480: Environmental Guidelines for Major Construction Sites.

Excavated materials which are unsuitable for use or which are excess to the needs of construction (i.e. spoil) would be disposed of off-site unless otherwise approved by Parks Victoria or the land manager, and managed in accordance with the *Environment Protection Act 1970* and other relevant legislation.

Subject to approval from Parks Victoria, cleared native vegetation not containing pest plant propagules would be mulched and stockpiled within the designated construction footprint for reuse in rehabilitation of construction or extraction areas. Where directed by Park Victoria, cleared vegetation containing hollows would be salvaged and placed in appropriate locations within the national park, with some larger logs potentially used for re-snagging in aquatic habitats.

Dewatering of excavations is likely to require the disposal of saline groundwater, which would need to comply with the SEPP (Waters) and the *Environment Protection Act 1970* requirements for discharges to waters, mostly to the Lindsay River downstream of Berribee Regulator. NSW EPA requirements would apply to any discharges to the Murray River. As groundwater salinity may be considerably higher than the river water, and may contain elevated iron and ammonia concentrations, as well as temperature differences, some treatment of groundwater may be required to meet EPA requirements prior to discharge to the river or alternative disposal methods would need to be used. Further assessment of groundwater extraction during construction, dewatering quality and treatment options is required prior to finalising dewatering plans (see Section 20).

No significant volumes of waste would be generated during operation of the project.

What level of greenhouse gas emissions is expected to result directly from operation of the project facility?

- [x] Less than 50,000 tonnes of CO_2 equivalent per annum
- [ ] Between 50,000 and 100,000 tonnes of CO_2 equivalent per annum
- [ ] Between 100,000 and 200,000 tonnes of CO_2 equivalent per annum
- [ ] More than 200,000 tonnes of CO_2 equivalent per annum

Please add any relevant additional information, including any identified mitigation options.

The estimated Scope 1 GHG emissions[15] for each pump event are approximately 72 t CO_2-e for Lindsay South WMA, 65 t CO_2-e for Wallawalla East WMA and 347 t CO_2-e for Wallawalla West WMA.

Although the pumped events are expected to occur in only 2 years in every 10 years, it is possible that all of the pumped flood events may occur in the same year. As a result, the maximum total Scope 1 CO_2-e emissions expected for any year is approximately 500 t CO_2-e/year.

Greenhouse gas emissions associated with operation of regulator and fishway gates have not yet been estimated, but are not likely to be significant as these are discrete events rather than ongoing operations.

The estimated combined GHG emissions for operation of the project are significantly less than the 200,000 t CO2-e per annum trigger for a referral as set out in the *Ministerial Guidelines for Assessment of Environment Effects under the Environment Effects Act 1978* (Department of Sustainability and Environment, 2006). The 200,000 t CO_2-e per annum referral trigger is for emissions directly attributable to operation of the project (i.e. Scope 1 emissions).

The estimated emissions are also significantly less than the annual reporting threshold of 25,000 t CO_2-e for individual facilities under the *National Greenhouse and Energy Reporting Act 2007* (Cth).

[15] Any Scope 1 emissions associated with the construction phase of the project (e.g. fuel use from site vehicles) were excluded from this calculation. Similarly, embodied emissions of construction materials (e.g. embodied emissions from the construction of concrete and steel), are Scope 3 emissions and were excluded from the calculation. This section of the referral requires consideration of the potential for the project to exceed the annual NGERs reporting thresholds which incorporate Scope 1 and 2 emissions only.

17. Other environmental issues

Are there any other environmental issues arising from the proposed project?

☒ No ☐ Yes If yes, briefly describe.

In addition to the potential impacts described in this referral, the raising of Lock 7 weir pool to facilitate managed inundation would also result in inundation of areas within NSW, as well as raising the water level in the Murray River upstream of Lock 7. VMFRP has received advice from MDBA around the raising of the Lock 7 weir pool and how the proposed operating regime compares to the current regime.

Impacts associated with the operating regime of Lock 7 and the resultant inundation area in NSW have not yet been assessed. Further assessment would be carried out of the potential for impacts associated with operation of Lock 7 for the project, including to further assess the extent of inundation resulting from raising of the Lock 7 weir pool, potential impacts associated with the more frequent and sustained higher Murray River levels, implications for operation of the Lock 7 fishway, as well as potential for impacts on environmental and heritage values within NSW.

18. Environmental management

What measures are currently proposed to avoid, minimise or manage the main potential adverse environmental effects? (if not already described above)

☒ Siting: Please describe briefly

☒ Design: Please describe briefly

☒ Environmental management: Please describe briefly.

☐ Other: Please describe briefly

Add any relevant additional information.

Draft Environmental Management Framework

A draft Environmental Management Framework (EMF) has been prepared for the VMFRP program containing an overview of:

- Project description – location, environmental context, project objectives, construction and operational activities
- Roles and responsibilities for implementation of environmental management during construction and operation of the program
- An overview of related environmental management documentation and associated approval processes (e.g. CEMP, CHMP, EWMP, Operating Plans, etc)
- An overview of relevant legislation and statutory approval requirements
- The approach to identifying and evaluating potential risks to environmental values during construction and operation of the project
- Environmental management measures to avoid or mitigate environmental impacts
- Monitoring, reporting and auditing requirements to inform adaptive management.

A copy of the draft EMF is provided in **Attachment 6 – Draft Environmental Management Framework**. The draft EMF includes the general mitigation measures for construction and operation of the project that would be undertaken to avoid and minimise impacts on the environment. The draft EMF would evolve as the project assessment and approvals process progresses, including the addition of project-specific

environmental management requirements for the Lindsay Island project identified in the various 'mitigation' sections of this referral or through proposed further investigations.

Design and construction

The project has been progressively developed over an extended period of time, with a number of design options considered. During this process, opportunities to mitigate impacts on environment and heritage values have been identified and considered. The design process is ongoing and would include further refinements, including those identified in this referral and the draft EMF, to avoid and mitigate impacts on environment and heritage values.

In accordance with the draft EMF, the contractor would be required to prepare a Construction Environmental Management Plan (CEMP) for the project, including:

- The project's environmental management system, procedures and processes, including all project forms and registers
- A project environmental risk assessment and control program
- Clear delegation of responsibilities (i.e. within the contractor's project team)
- Project legislative requirements
- Details of approvals, permits, agreements and/or licences for the various stages of work
- Relevant environmental procedures and work instructions
- An environmental inspection/monitoring program and inspection checklist
- Worksite specific plans
- A checklist that demonstrates that each requirement of the draft EMF has been addressed in the preparation of the CEMP.

Operation

The primary environmental management documentation for managing adverse environmental effects and maximising environmental benefits during operation of the project would be the:

- Environmental Water Management Plan
- Operating Plan.

Environmental Water Management Plan (EWMP)

A preliminary draft EWMP has been developed for the project that:

- Aligns with the Environmental Watering Plan prepared by the MDBA in accordance with Chapter 8 of the Murray-Darling Basin Plan
- Provides the framework for water planning, monitoring and consultation processes
- Identifies environmental objectives and targets, water delivery options and regimes.

This would be refined in response to further environmental studies and the project approvals process.

The preliminary draft EWMP has been subject to an external review process with key stakeholders including, MDBA, LMW, VEWH, CEWH, GMW, DELWP and Parks Victoria.

The EWMP for the project would update the current Lindsay-Wallpolla Environmental Water Management Plan, February 2012 (MDBA, 2012) as this facilitates integrated planning and management of environmental watering activities delivered by existing (TLM) and proposed (VMFRP) works across the whole of the Lindsay-Wallpolla icon site (Note: Although the Chowilla Floodplain in South Australia is part of the same icon site, a separate EWMP applies to that component due to the different jurisdiction).

Operating Plan

A preliminary draft Operating Plan has been developed to provide the framework for operation of the Lindsay Island environmental watering works to meet key ecological objectives and comply with relevant legislative requirements (e.g. *Water Act 2007* (Cth), s52-54 of Murray-Darling Basin Agreement). This would be refined in response to further environmental studies and the project approvals process. The Operating Plan outlines:

- Governance arrangements for managed inundation activities
- Roles and responsibilities of partner agencies
- Decision-making protocols for prior to, during, and after watering events
- Operational risks and mitigation strategies
- Water measurement arrangements
- Communication and consultation requirements
- Links to related documents.

The preliminary draft Operating Plan has been subject to an external review process with key stakeholders including, MDBA, LMW, VEWH, CEWH, GMW, DELWP and Parks Victoria.

The Operating Plan does not prescribe particular watering events and would be a 'living document' that would be further refined and updated over time if legislation changes or operations in the major river systems require it. As the asset owner, Lower Murray Water would be responsible for developing an Operating Plan prior to commencing operation of the project.

19. Other activities

Are there any other activities in the vicinity of the proposed project that have a potential for cumulative effects?

☐ NYD ☐ No ☒ Yes If yes, briefly describe.

For the purpose of this referral, cumulative impacts have primarily been considered at this stage in relation to other VMFRP projects due to the similar nature of their activities and potential impacts. The potential for cumulative effects is generally associated with:

- Salinity impacts associated with saline water discharge to the Murray River and compliance with the Basin Salinity Management Strategy targets for Morgan.
- Removal of large, hollow-bearing trees and associated habitat for threatened species such as Regent Parrot, Carpet Python, and Lace Monitor from river red gum and black box communities along the Murray River floodplain.
- Removal of native vegetation and associated habitat from similar EVCs across multiple sites due to the need to locate proposed infrastructure at certain elevations on the floodplain and potential impacts on bioregional conservation status of particular EVCs.

Further assessment of potential cumulative effects, including consultation with Mildura Rural City Council, Wentworth Shire Council (NSW) and Renmark Paringa Council (South Australia) around other projects proposed in the vicinity, would be carried out as design development and environmental investigations are advanced.

20. Investigation program

20.1 Study program

Have any environmental studies not referred to above been conducted for the project?

☐ No ☒ Yes If yes, please list here and attach if relevant.

Environmental studies undertaken for the project are either described in the relevant sections of the referral or are listed in the references section.

Has a program for future environmental studies been developed?

☐ No ☒ Yes If yes, briefly describe.

Further investigations

Further investigations proposed for the project to address potentially significant impacts and key uncertainties described in this referral include:

- To address impact uncertainties in relation to the proposed operation of Lock 7 and NSW inundation areas:
  - Continue engagement between VMFRP and MDBA to define project-related operational actions not within the scope of current approved operating conditions for Lock 7 that could generate potential impacts
  - Review and confirm hydrological modelling of the extent of inundation associated with raising the Lock 7 weir pool to 23.2 mAHD and ongoing water delivery to South Australia.
  - Based on confirmed inundation extents and operational changes, undertake assessments of potential impacts on environmental and heritage values (in Victoria and NSW) for areas and/or operational activities not already assessed.
- To address impact uncertainties in relation to native vegetation, listed threatened species and communities:
  - Review hydrodynamic modelling and ecological investigations that informed development of the project ecological objectives and draft operating scenarios, relative to recommendations to mitigate impacts on the hydraulic habitat attributes supporting the important native fish community of the Lindsay-Mullaroo system. This review would involve members of the project's Expert Review Panel (including fish ecologists, terrestrial ecologists, hydrologists, design engineers).
  - Review and refine draft operating scenarios to avoid or minimise, where possible, the risk of significant impacts on the important native fish community of the Lindsay-Mullaroo system, particularly the Murray Cod, Silver Perch and other listed threatened fish species; while optimising ecological benefits to floodplain vegetation communities and habitats.
  - Undertake further assessment of fish passage requirements for during the construction of the Berribee Regulator to minimise risks to listed threatened fish species and water quality.
  - Undertake targeted vegetation assessment at representative sample sites within the inundation area to supplement the current desktop assessments with field data, to enhance understanding of likely presence/absence of species and to inform the vegetation condition monitoring program (and offset strategy / conservation exemption).
  - Undertake targeted vegetation assessments within areas outside the inundation area that are identified as areas of interest and areas of heightened interest for potential near-surface salinisation in **Attachment 4 – Groundwater Assessment** to determine presence of listed

threatened species or communities, and the potential susceptibility of flora species and communities to impacts from near-surface salinisation. These assessments would also inform baseline condition monitoring.

- Undertake an arborist assessment to confirm potential impacts to large trees within and adjacent to the construction footprint and along access tracks, and advise on methods by which large trees could be retained.
- Once the design process is complete and the construction footprint has been finalised, undertake a Vegetation Quality Assessment (VQA) (Habitat Hectares) in areas of the construction footprint not assessed to date, to confirm the condition and extent of native vegetation in accordance with the Guidelines.

- To address impact uncertainties in relation to the cultural and historical heritage values:
  - Finalise the draft CHMP in accordance with the *Aboriginal Heritage Act 2006* and *Aboriginal Heritage Regulations 2018*, including additional desktop and field assessments, consultation with the FPMMAC (which includes members of the *Ngintait* peoples), and an inundation assessment, informed by hydrological and geomorphological modelling, as described in Section 15.1 of this referral.
  - Undertake a due diligence assessment under the NSW *National Parks and Wildlife Act 1974* (NPW Act) and in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW, 2010) for the proposed works and inundation within NSW to identify if there is a requirement for an Aboriginal Heritage Impact Permit (AHIP). This assessment would include consultation in accordance with the requirements of Clause 60 of the NSW *National Parks and Wildlife Regulation 2019*.
  - Undertake a historical heritage assessment, including desktop and field assessment, to identify risks to listed and potentially unrecorded historical heritage places within the project area, including archaeological sites under the *Heritage Act 2017* and archaeological relics under the NSW *Heritage Act 1977*, with a heritage impact assessment undertaken where historical heritage places are identified.
- To address impact uncertainties relating to groundwater/salinity:
  - Undertake survey of existing groundwater monitoring bores currently with no available elevation information to enable groundwater elevation data to be gathered.
  - Undertake monitoring of relevant existing and proposed groundwater monitoring bores to compile groundwater level and quality information, to provide a baseline for monitoring during construction and operation of the project to inform adaptive management of potential impacts.
  - Undertake groundwater monitoring of mound rise targeting areas of interest and in particular areas of heightened interest (see **Attachment 4 – Groundwater Assessment**), prior to construction to gather baseline and then operational data. This would allow for adaptive management of the project operations to minimise the potential for native vegetation and other assets to be impacted by near-surface salinisation.
  - Undertake further assessment of dewatering activities to determine groundwater extraction volumes, predicted drawdown during construction, dewatering water quality and treatment/disposal options to inform development of dewatering plans.
- To address impact uncertainties in relation to the landscape values:
  - Undertake a site inspection to determine the potential for visual impact from public areas and view lines, and where necessary, undertake an assessment of the nature and scale of impacts and develop additional mitigation measures to avoid or minimise potential impacts.
- To address impact uncertainties relating to soils:

- Prior to commencement of construction, the contractor would be required to undertake an ASS investigation and if potential ASS are identified and disturbance cannot be avoided, an ASS management plan would be developed to minimise potential effects on surrounding soils, vegetation and water environments.

- To address impact uncertainties relating to borrow pits / quarry sites:
  - Assessment of environment and heritage values would be undertaken to inform site selection, and to determine the nature and extent of potential impacts and approval requirements associated with establishment or expansion of borrow pits / quarry sites for use by the project.

In addition to these investigations, hydrological changes in the Murray River upstream and downstream of the project area associated with delivery of environmental water to the project and return flows would be assessed through MDBA modelling once the package of proposed SDL measures is confirmed, and adaptively managed through refinement of Operating Plans and EWMPs as well as through the existing environmental water accounting frameworks under the Basin Plan.

Salinity discharges and any associated changes or impacts in the Murray River as a result of managed inundation of the Lindsay Island floodplain would be considered and assessed on a cumulative basis by the MDBA through the protocols of the Basin Salinity Management 2030 Strategy (MDBMC, 2015). These protocols are yet to be finalised for floodplain restoration projects, but discharges from the Lindsay Island project would need to comply with these once finalised. This may involve the use of offsets or salinity credits from the Victorian salinity credit pool.

Monitoring, evaluation and reporting

The effectiveness of the proposed supply measure and its operation would primarily be monitored and reported on through the Mallee CMA's well-established monitoring, evaluation and reporting strategies and protocols. These strategies and protocols build upon experience and lessons learned through the ongoing, long-term ecological monitoring programs undertaken within the SDL project area, including The Living Murray (TLM) program, which includes condition and intervention monitoring across several sites in the Mallee region (including Lindsay Island). The Mallee CMA has been implementing and coordinating the local, annual TLM Monitoring, Evaluation and Reporting Framework process since 2006.

These strategies and protocols 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
- Utilise monitoring data to plan watering events, optimise water delivery, manage risks and refine ecological objectives. The evaluation process involves analysing collected data and improving operations accordingly.

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

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

A monitoring and evaluation plan was previously developed for the project by Ecological Associates (2014b). The monitoring and evaluation plan identifies the agencies responsible for commissioning, reviewing and acting on monitoring data. The linkages back to decision-making are described in the

detailed plan. A new draft Monitoring, Evaluation and Reporting Framework was recently funded by the project and was completed in June 2020. This framework would aim to establish a social, heritage and environmental benchmark and monitoring programme to demonstrate the ongoing benefits of the project.

Initial monitoring would provide a baseline of the existing status of the ecological objectives and outcome monitoring would measure progress towards these objectives and their targets. This information would inform the ongoing operations at the site. Over time, the results of the outcome monitoring would test assumptions and assist with refining conceptual models and ecological objectives. Monitoring data would identify emerging hazards and enable operational decisions to minimise risk through the adaptive management framework incorporated into Operating Plans and Environmental Water Management Plans.

The final Monitoring, Evaluation and Reporting Framework approach for this project would be informed by broader intergovernmental arrangements for Basin-wide monitoring and evaluation under the Basin Plan. This project 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) meeting the relevant SDLs under Chapter 10, which must be complied with under the relevant State water resource plan/s (WRPs) from 1 July 2019.

Both Chapter 8 and Chapter 10 of the Basin Plan are captured under the MDBA's 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 would 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.

VMFRP is satisfied that its participation in the MDBA's reporting and evaluation framework would 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.

This approach closely aligns with agreed arrangements under the Basin Plan Implementation Agreement, where implementation tasks are to be as streamlined and as cost-effective as possible.

20.2 Consultation program

Has a consultation program been conducted to date for the project?

☐ No ☒ Yes If yes, outline the consultation activities and the stakeholder groups or organisations consulted.

The Mallee CMA worked with key stakeholders and interested community groups to develop the concept for the Lindsay Island Floodplain Restoration Project over a period from 2012 to current. Consultation activities would continue throughout the duration of the project.

Communication and engagement activities conducted have included:

- More than 200 face-to-face briefing sessions, meetings, presentations, on-site visits and consultations, engaging more than 500 people, which is reflective of the wide range of project stakeholders.
- Fact sheets, media releases, electronic communication (website, emails, newsletters), brochures and correspondence.

This direct approach to engagement has helped capture the views and local knowledge of key stakeholders and community members to directly integrate these into the project, including from:

- Aboriginal stakeholders including the First People of the Millewa-Mallee Aboriginal Corporation (including members of the *Ngintait peoples*);

- Materially-affected land owners and managers such as Parks Victoria, SA Water, Trust for Nature (Neds Corner), NSW NPWS and the owners of Wingille Station in NSW;
- Adjacent private landholders (including the sourcing of clay borrow sites);
- Lindsay Point irrigators;
- Regional Development Australia, Regional Development Victoria – Loddon Mallee and Mildura Regional Development;
- Local government (Mildura Rural City Council and Renmark Paringa Council);
- Community and user groups including: Trust for Nature, Sunraysia Branch Victorian Apiarists Association, Sunraysia Riverwatch, Murray Offroad Adventures, Discover Mildura, Lindsay Point Landcare Group and Meringur Pioneer Settlement.

Information regarding the Lindsay Island project is published on the VMFRP website:

https://www.vmfrp.com.au/wp-content/uploads/2019/07/VMFRP_FactSheet_A4_Lindsay_Island_0319_02.pdf

Has a program for future consultation been developed?

☒ NYD ☒ No ☒ Yes If yes, briefly describe.

Targeted, tailored consultation would continue to be conducted with key stakeholders in accordance with VMFRP's Stakeholder Engagement and Communication Plan throughout the project, aligning to project milestones, assessments and approvals processes where necessary and/or appropriate. This includes further face-to-face briefings, presentations, site visits and regular project updates via mail-outs and newsletters.

In particular, VMFRP would develop and implement a Consultation Plan outlining the approach to engagement through the planning approvals process. This plan would identify the range of interested stakeholders, outline the mechanisms to inform individuals and groups who could be affected and provide opportunities for input to identify issues of concern and potential effects, as well as get feedback from stakeholders on project construction options and/or potential mitigation measures.

Broader engagement via traditional and social media, community events and information displays would also continue.

Authorised person for proponent:

I, ……Josh White……(full name),

……Project Director – VMFRP……(position), confirm that the information contained in this form is, to my knowledge, true and not misleading.

Signature _____

Date 14 August 2020

Person who prepared this referral:

I, ……Josh White……(full name),

……Project Director - VMFRP……(position), confirm that the information contained in this form is, to my knowledge, true and not misleading.

Signature _____

Date 14 August 2020

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