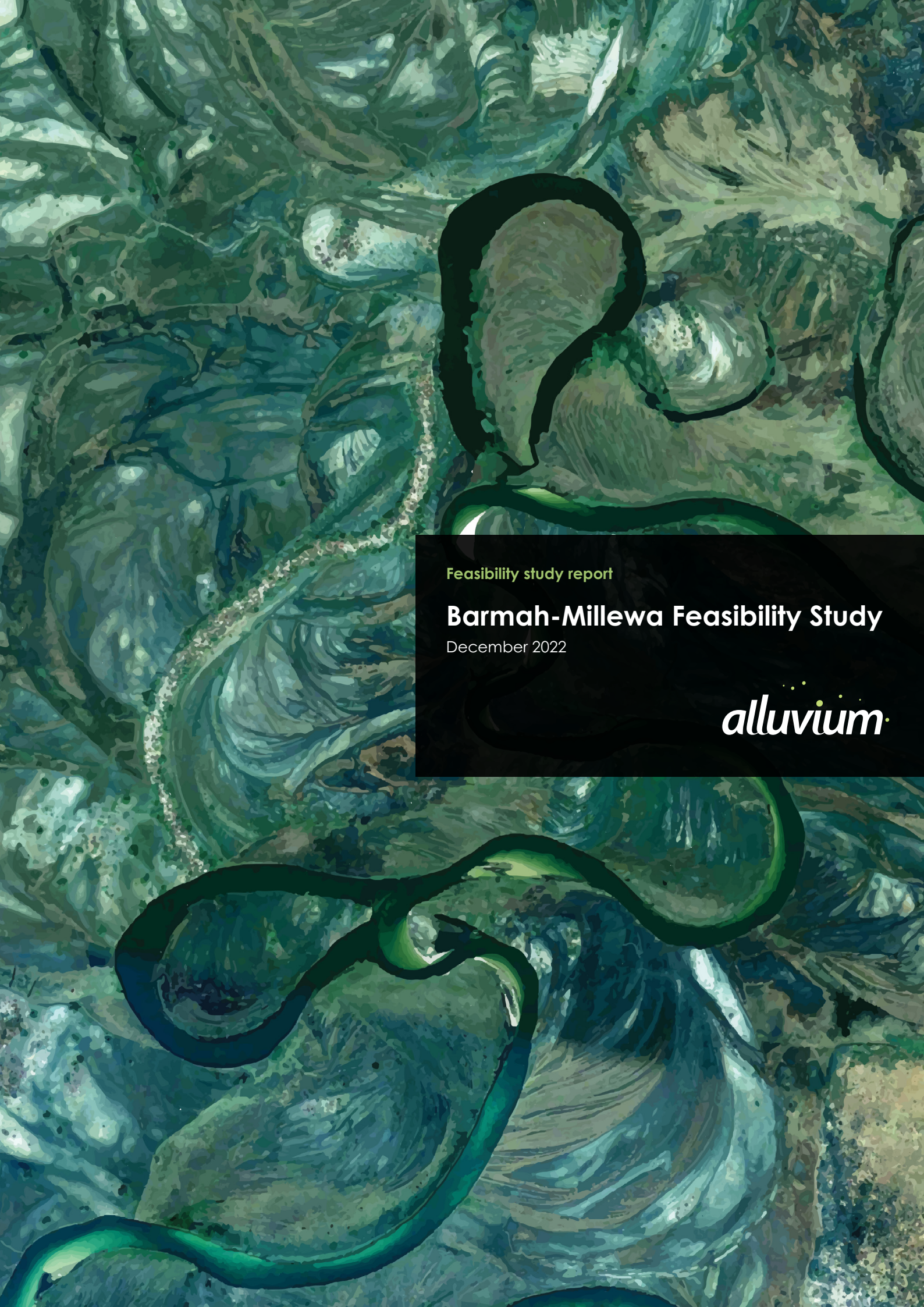

Feasibility study report

Barmah-Millewa Feasibility Study

December 2022

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Alluvium recognises and acknowledges the unique relationship and deep connection to Country shared by Aboriginal and Torres Strait Islander people, as First Peoples and Traditional Owners of Australia. We pay our respects to their Cultures, Country and Elders past and present.

Artwork by Vicki Golding. This piece was commissioned by Alluvium and has told our story of water across Country, from catchment to coast, with people from all cultures learning, understanding, sharing stories, walking to and talking at the meeting places as one nation.

This report has been prepared by Alluvium Consulting Australia Pty Ltd for the **Murray-Darling Basin Authority** under the contract titled '**Barmah-Millewa Feasibility Study**'.

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1 Problem statement

1.1 The Barmah-Millewa Reach

The River Murray System is Australia's largest regulated water supply system, providing around 4,000 GL of water entitlement valued at an estimated $20.3 billion to water consumers and environmental water holders.

The Barmah-Millewa Reach is a naturally occurring narrow section of the River Murray where it flows through the Barmah-Millewa Forest, between the towns of Tocumwal (NSW) and Barmah (Victoria).

In this reach, the west-flowing river meets the Cadell Fault and abruptly changes course, turning south. The Edward-Kolety River and floodplain channels leave the river at this point, diverting water away and returning further downstream near Balranald.

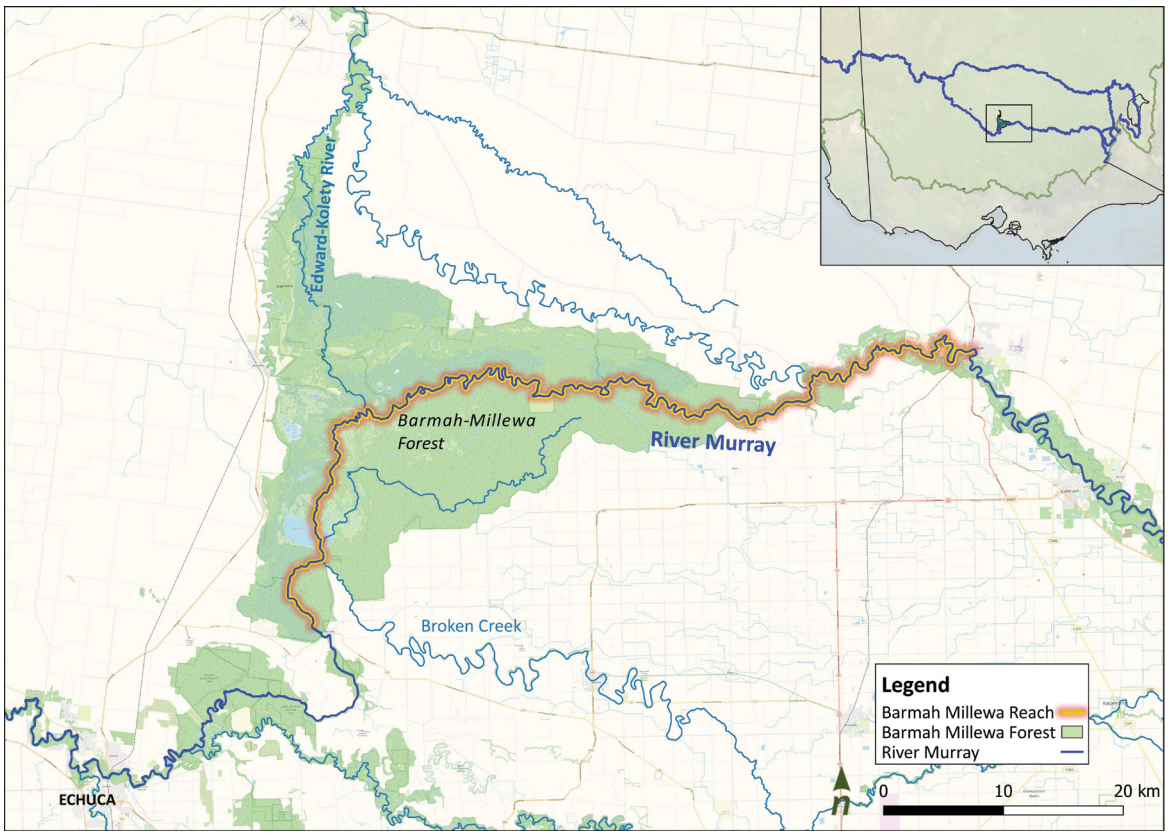
As a result, the River Murray naturally declines in width from 120m at Tocumwal to 40m below Picnic Point, before widening again. This section of the river has the lowest flow capacity of any stretch of the river downstream of Hume Dam, and poses challenges for water delivery to downstream users.

This section of the river is commonly referred to as the 'Barmah choke'.

The Barmah-Millewa Forest surrounds the river through the reach. The Barmah-Millewa Forest is the largest river red gum forest in Australia. The Barmah Forest is recognised as a site of international significance under the Ramsar Convention. Unseasonal flooding of the forest in summer and autumn has become more frequent as a result of river regulation. This unseasonal forest inundation has has contributed to a substantial loss of Moira Grass wetlands, a critical component of the site's Ramsar Ecological Character.

FIND OUT MORE

To find out more about the Barmah-Millewa Reach, please refer to information about 'The Barmah Choke' on the MDBA website.



Location of the Barmah-Millewa Reach of the River Murray

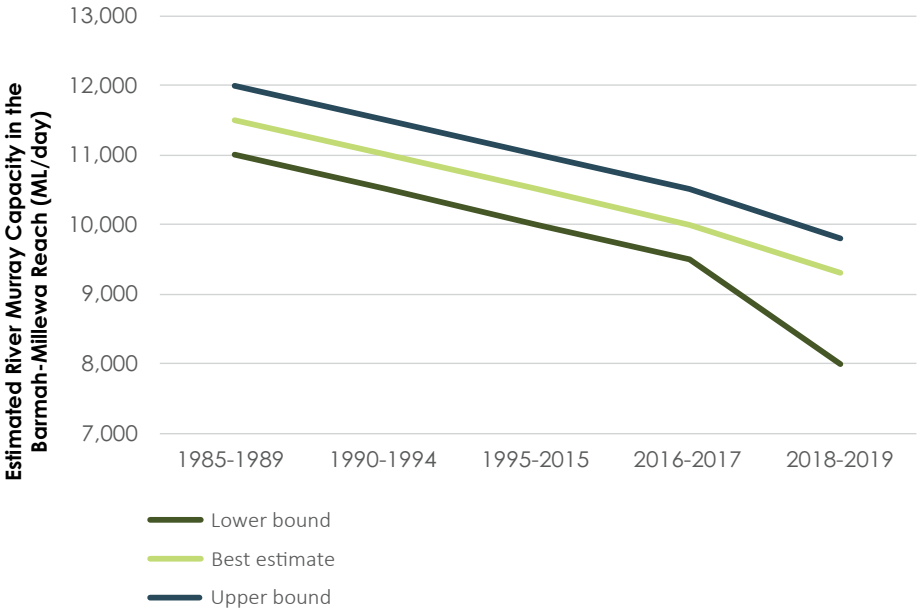
1 Problem statement (cont.)

1.2 Declining flow capacity

To avoid unseasonal flooding of the forest, flows in the river are now managed to contain the water within the riverbanks from January to April each year. Irrigation demands are highest at this time, meaning that high flows regularly need to be delivered through the reach for months on end during summer.

The height and flow of the river has been measured using stream gauges for decades. These records show that the capacity of the river has reduced by 20% (around 2,000 ML/day) over the past thirty years. The current flow capacity of the reach is around 9,200 ML/day, as measured downstream of Yarrawonga Weir.

This decline in the river capacity creates a challenge for operators to meet downstream water demands while avoiding unseasonal flooding of the surrounding forest.



The flow capacity in the Barmah-Millewa Reach has been reducing over the past few decades

1.3 Accelerated riverbank erosion

The challenge of supplying water demands with a declining capacity in the Barmah-Millewa Reach is made more difficult by accelerated rates of erosion of the riverbanks and levees. When the River Murray flows are high, water can break out over lower sections of the riverbank into floodplain channels. Bank erosion can remove sections of the natural levee and lower the sills that control the height at which water starts to flow into these floodplain channels.

The erosion of the levees and sills in the Barmah-Millewa Reach reduces the capacity of the river. This can result in unseasonal flooding of the forest and the need for river operators to further lower the operating height of flows in the river, decreasing flows to downstream reaches.

Erosion of the riverbank is a natural process as the river meanders across the landscape. However, in the Barmah-Millewa Reach, bank erosion has increased markedly since the commencement of river regulation. Recent surveys found that approximately 40% of the reach is affected by accelerated erosion.

The removal of large snags to increase the capacity of the river has also caused the river to run faster and in turn caused greater erosion. This is exacerbated by boat wake in some areas.

Riverbank erosion in the Barmah-Millewa Reach not only impacts on the flow capacity of the reach, but can also cause environmental degradation, damage to cultural heritage values, and deterioration of recreational qualities.

Accelerated erosion of the riverbanks in the Barmah-Millewa Reach

1.4 Sand is accumulating on the bed of the River Murray

The MDBA has engaged independent experts in geomorphology, stream management and river research to investigate the cause of the declining flow capacity. Together, these studies have determined that:

- **Historic mining and land use practices have caused an influx of sand into the River Murray.** The primary cause of the reduced flow capacity is from sand which has entered the river as a result of mining and land use changes. The sand has been transported into downstream reaches of the river prior to construction of the Yarrawonga Weir in the 1930s. It is estimated that there is currently more than 20 million m^3 of sand between Picnic Point and Yarrawonga Weir. This is the equivalent of around 13 Melbourne Cricket Grounds full of sand. Sediment from eroding riverbanks is making a relatively minor contribution to the volume of material accumulating in the bed of the river.
- **The accumulation of sand on the riverbed extends all the way to Echuca.** For almost the entire stretch of river from Yarrawonga to Echuca, there is a layer of sand on the riverbed, on average 1-2m thick.
- **The highest accumulation of sand is in the narrowest section of the River.** The sand is deepest at the outside of river bends, filling in scour holes, removing key habitat used by fish and other aquatic species. The highest concentrations of sand deposits have been found immediately downstream of where the Murray meets the Edward-Kolety River, where the river is at its narrowest. In-river surveys taken from 2019 to 2022 have shown that the greatest increase in sand thickness per year is occurring near Picnic Point, where an additional 10,000 m^3 of sand is accumulating in the bed each year.
- **The riverbed will continue to fill-up with sand.** It is estimated that 240,000 m^3 of sand is entering the reach each year as a result of legacy mining practices. The constrained channel capacity in the Barmah- Millewa Reach reduces the rate at which sediment moves down the river, meaning that more sand is getting deposited on the bed of the river in the reach than can flow through. It is estimated that around 80,000 m^3 of sand passes downstream each year, accumulating around 160,000m^3 within the reach.
- **The sand accumulating on the riverbed is reducing the already limited flow capacity of the river.** The layer of sand on the riverbed reduces the depth of the river, which decreases the capacity. In the narrowest sections of the reach, the river capacity has reduced by around 30 - 35%.
- **The flow capacity of the river will continue to decline if nothing is done.** If nothing is done to manage the sand in the reach there will be an ongoing loss of capacity as a result of the build-up of sand on the riverbed. Preliminary modelling is indicating that the flow capacity would reduce by a further 1,000 ML/day (or 10%) over the next ten years if no intervention works are undertaken.

FIND OUT MORE

To find out more about the studies into the declining flow capacity, please refer to the Sediment Management reports on the BMFS page of the MDBA website.

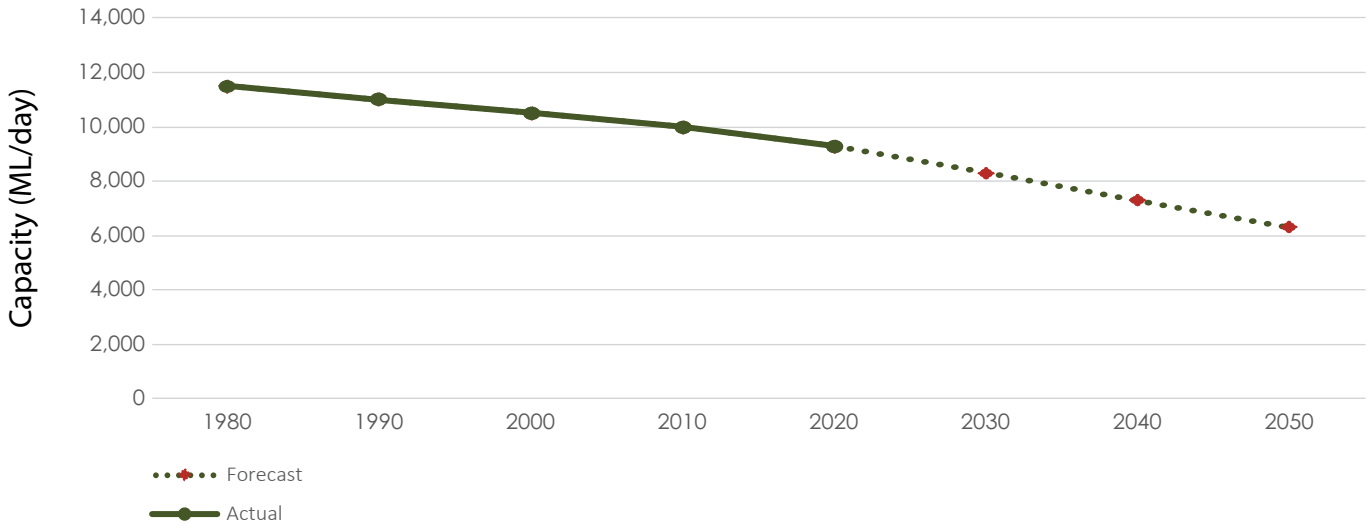
**Photograph showing sand visible at Fishermen's Bend, River Murray.
Photo credit: Streamology (2022).**

1 Problem statement (cont.)

1.5 Impacts of the accumulating sand and bank erosion

The build-up of sand on the riverbed and accelerated bank erosion is expected to cause a further decline in the flow capacity of the River Murray in the Barmah-Millewa Reach with up to a 25 – 35% reduction over the next 30 years. The declining capacity of the River Murray in the Barmah-Millewa Reach has significant implications to water users and communities along the river, including:

- Risk of water supply delivery capacity not meeting demand with implications for all downstream water users, including irrigated agriculture.
- Risk of impacts to environmental, cultural, and social values.
- Risk of an avulsion and the River Murray changing its course.



Change in the estimated River Murray capacity in the Barmah-Millewa Reach from sand accumulation

Risk to irrigated agriculture

A reducing flow capacity could impact all entitlement holders as a result of increased conveyance losses and shortfall risks. In addition, there is a particular risk to irrigated agriculture downstream of the Barmah-Millewa Reach. Consumptive water demand is highest during summer. This is the same time of year when flows are limited at the Barmah-Millewa Reach to avoid unseasonal flooding of the surrounding forest.

There is an inherent risk that there will be times when there is not enough capacity in the river to deliver water to irrigators in the time required, meaning that water orders may be rationed or not filled. This is known as a 'shortfall' event. With a limited and declining flow capacity in the Barmah-Millewa Reach, the risk of shortfall events occurring is increasing.

Water users downstream of Barmah-Millewa hold around 56% of the total water entitlement in the River Murray System. This includes irrigators, urban water authorities, and environmental water holders.

Irrigated agriculture in the semiarid lower Murray relies on water from the River Murray system to sustain the industry. Permanent horticultural plantings are highly susceptible to shortfall risks. Horticultural production in the lower Murray is valued at around $2.4 billion per year.

Over the past decade, around 975 GL on average has been delivered through the Barmah-Millewa Reach during summer when irrigation demands are highest. Around 83 GL (or 8%) of these flows have historically been delivered at above 8,300 ML/day through the reach. If the flow capacity in the next 10 years reduces by 1,000 ML/day, there is a risk that this volume of water could not be delivered when needed.

Based on this preliminary analysis, if the declining flow capacity leads to delivery shortfalls, the economic impact on irrigated agricultural production could be equivalent to around $200 million per year.

1 Problem statement (cont.)

Risk of impacts to environmental, cultural, and social values

The acceleration of bank erosion can cause:

- environmental degradation, such as trees falling into the river, a decline in bank habitat diversity, and worsened water quality.
- damage to and loss of cultural sites located on the riverbanks and floodplain, such as middens, burial sites and scar trees.
- a decline in the aesthetic and recreation values of the reach.

If sand continues to fill the bed of the river, deep pools will continue to fill in and smother habitat such as woody debris, changing the riverine environment. This has significant impacts for a broad range of native fish and other aquatic species by reducing species diversity, population abundance, and recruitment.

Ongoing sand accumulation and erosion of the riverbank would lead to more unseasonal (summer) flooding of the surrounding forest. Unseasonal flooding contributes to the loss of Moira Grass wetlands, can contribute to water quality issues, and increases water delivery losses.

Increased unseasonal flooding also limits access for recreation through the forest. This negatively impacts on camping, beekeeping, tourism businesses utilising the National Park, and fire suppression when floods block off access tracks. These impacts would be most significant during the Christmas and Easter peak visitation periods.

Risk of an avulsion and the River Murray changing its course

The likelihood, timeframe, and impact of the River Murray changing its course (known as an 'avulsion') is currently unknown.

Historical avulsions on the Murrindindi and Yea rivers in the Goulburn catchment (Victoria) have been attributed to sedimentation resulting from gold mining and land clearing. In these situations, the avulsion lagged behind the input of sand because of the time needed for the sand to be transported downstream.

Accelerated rates of sedimentation increase the likelihood that the main stem of the River Murray in the Barmah-Millewa Reach could change its course.

An avulsion of the River Murray would have severe environmental, social, economic, and cultural impacts across the river system.

1.6 Intervention measures

In 2021, a high-level assessment of the potential options for managing the accumulating sand on the riverbed was conducted.

This assessment determined that:

- a 'do nothing more' scenario would have considerable negative outcomes for environmental, social, cultural, and economic values.
- to effectively manage the issues, a range of intervention measures will be needed. These include physically removing sand from the riverbed, targeted works to prevent erosion causing new breakaways into the forest, and works to increase the capacity for bypassing water around the reach.

The analysis recommended that further investigations be undertaken to explore the options available, how effective they would be at managing the risks, and whether complementary packages of options or 'suites' may be required.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2 The Barmah-Millewa Feasibility Study

In response to the declining flow capacity, the increasing risks, and the recommendation that a range of intervention measures be investigated, the MDBA commissioned the Barmah-Millewa Feasibility Study (BMFS).

This feasibility study builds on work that has been undertaken by the MDBA over a number of years to investigate why the regulated capacity in the Barmah-Millewa Reach is declining. There are a range of studies and reports which have been prepared as part of this study.

This **Feasibility Study Report** provides an executive summary of the options, the key findings, and the potential next steps which governments may consider.

The **Options Summary Report** introduces each of the options, provides a summary of what they involve, how they could contribute to managing risk, what studies have been completed to date, and what future stages might involve.

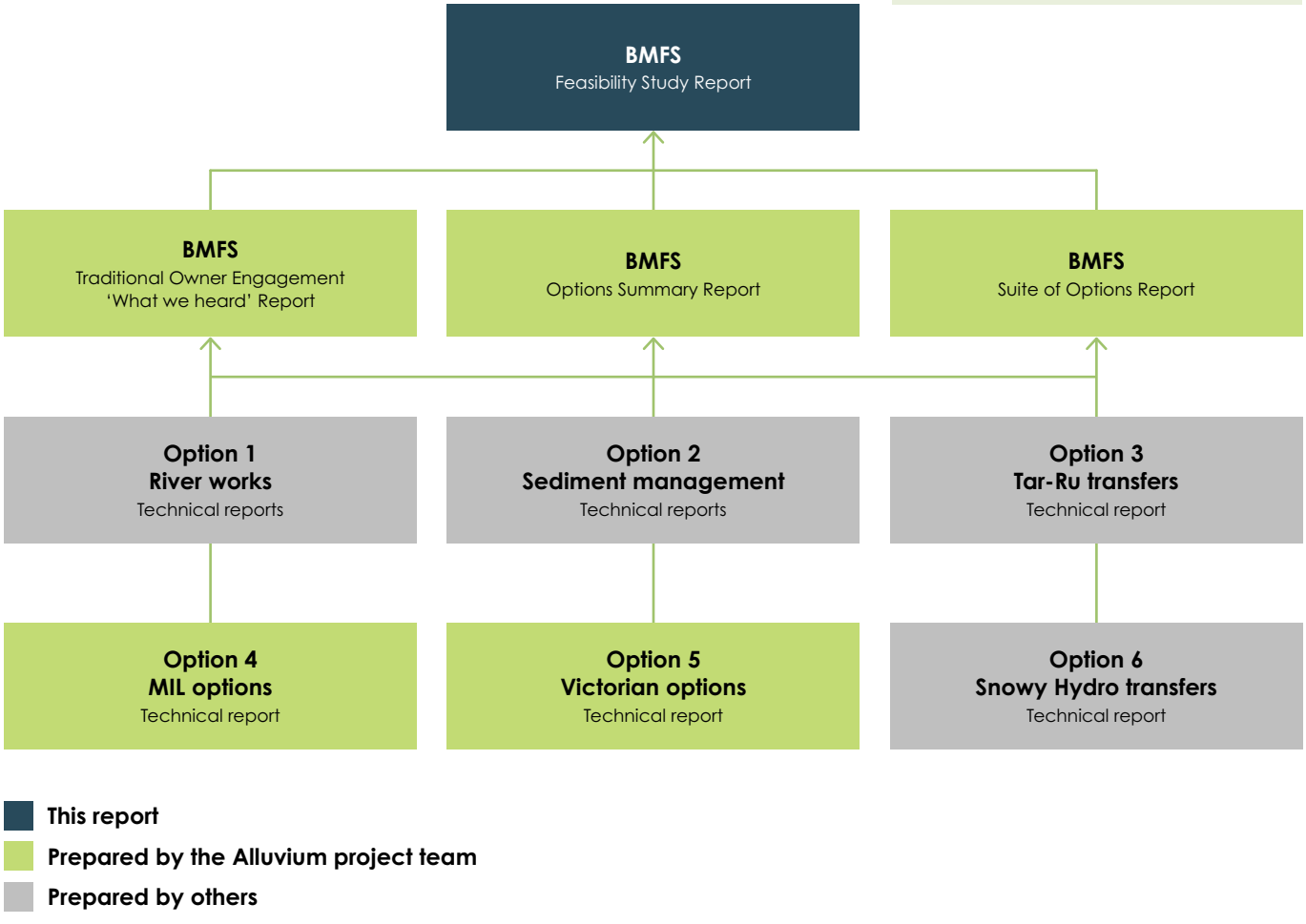
The **Suite of Options Report** assesses the relative merits for each of the individual options and how a range of options (or 'suites of options') may be needed to achieve the best outcomes.

The **Traditional Owner Engagement – 'What we heard' Report** provides an insight into the views of Traditional Owner groups on the options under consideration.

Technical reports have been prepared which investigate the likely scope, feasibility, and next stages of investigation for each of the options.

FIND OUT MORE

To find out more about the study and to read these reports, please refer to the MDBA website.



The various reports prepared as part of the Barmah-Millewa Feasibility Study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3 Benefits management plan

An initial version of a project Benefits Management Plan has been prepared to support the Feasibility Study. The initial version identifies the benefits sought from implementing the project and provides potential means for the measurement, realisation, and ownership of each benefit. The MDBA intends to progressively develop and update the Benefits Management Plan as the project moves into the next stages. This process ensures that the MDBA and its stakeholders can demonstrate the extent to which the outcomes sought from this project are being achieved and helps inform Basin governments decision on any further actions to be taken.

A summary of the benefits sought from the project is provided in this report for transparency. The benefits reflect the project objectives as set out in the project plan and terms of reference for the feasibility study. The timing of achieving the benefit and further development of the management plan, including consideration of any trade-offs between outcomes, is subject to a decision by Basin governments on whether to proceed with subsequent stages.

B001
Enhanced ability to avoid delivery shortfalls

Detailed description
Maintain or enhance the ability to meet peak demand downstream of the Barmah-Millewa Reach (managing delivery shortfalls)

Measurement (draft)
Likelihood of a shortfall event occurring due to short-term capacity

B002
Enhanced ability to avoid system shortfalls

Detailed description
Maintain or enhance the ability to deliver water downstream of the Barmah-Millewa Reach throughout the year (managing system shortfalls).

Measurement (draft)
Likelihood of a shortfall event occurring due to system-wide capacity

B003
Maintained or increased reliability of water delivery

Detailed description
Provide an improved level of confidence to downstream consumptive and environmental users in terms of reliability of water deliveries and environmental watering actions.

Measurement (draft)
% of water demand successfully delivered downstream of the reach

B004
More ecologically desirable flow regime

Detailed description
Provide greater opportunity for more desirable flow regimes to be delivered through the Barmah-Millewa region, including avoided undesirable inundation of the forest

Measurement (draft)
1. Regulated flow occurrence and volume which exceed the bankfull capacity of the reach from December to March (incl.)
2. Variability of the flow regime from December to March (incl.) e.g. % of time regulated events are within elevation bands below top of bank

B005
Reduced sedimentation

Detailed description
Reduce the localised environmental, social, and cultural impacts associated with the ongoing sedimentation of the river reach

Measurement (draft)
Sand quantities accumulating in the reach

B006
Reduced bank failure

Detailed description
Reduce the risks of bank failure at the Barmah-Millewa Forest protecting the significant environmental and cultural values of the forest floodplain

Measurement (draft)
1. River operating height required to avoid unseasonal flooding of the forest
2. Extent (km or no. of sites) of unmanaged active erosion that threatens levees and sills

B007
Improved environmental watering (River Murray)

Detailed description
Provide improved ability to deliver environmental watering actions along the Murray River.

Measurement (draft)
Metric to be developed with e-water holders

B008
Improved environmental watering (Edward-Kolety Wakool)

Detailed description
Further facilitate the delivery of environmental water into sites within the Edward/Kolety-Wakool system.

Measurement (draft)
Metric to be developed with e-water holders


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4 The options

There are six options which have been investigated as part of this Feasibility Study.

Options 4 (MIL system) and 5 (Victorian infrastructure) contain several sub-options as set out below.

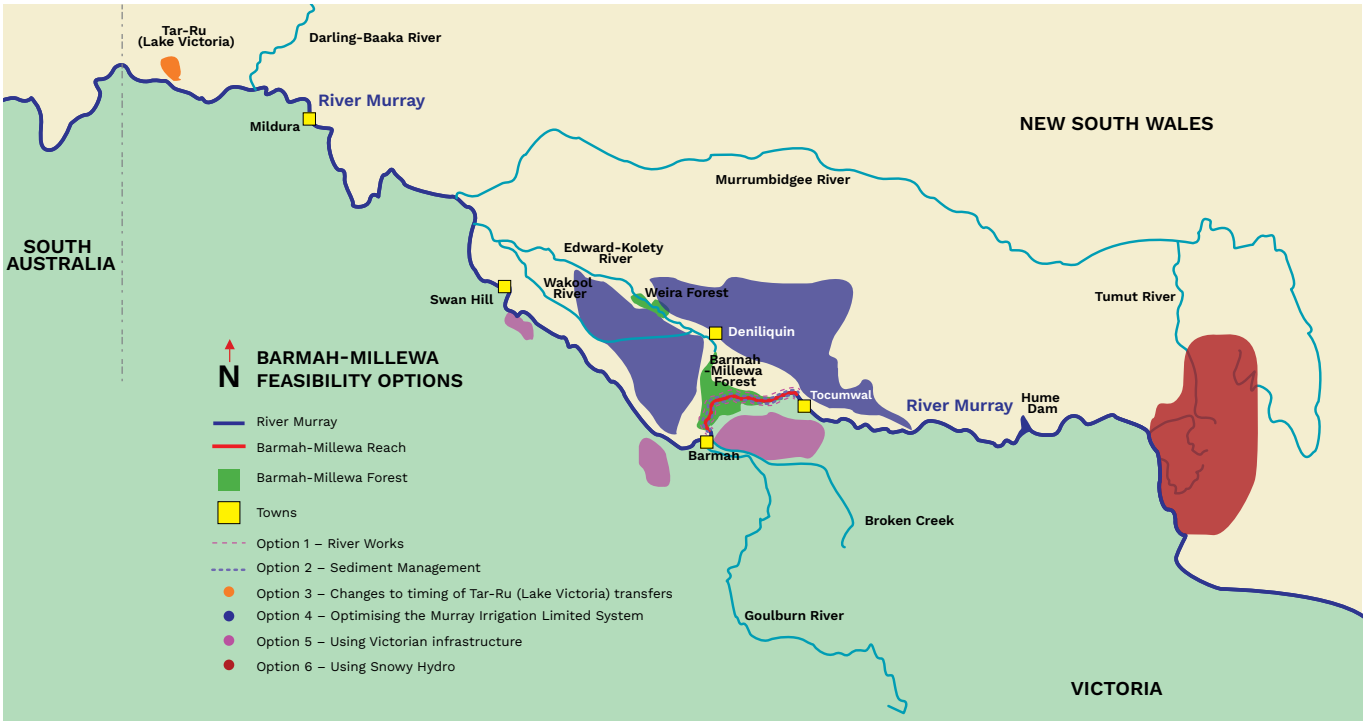
- **Option 1 - River works within the Barmah-Millewa Reach:** targeted river works to stabilise riverbanks and avoid new breakaways into the surrounding forest.
- **Option 2 - Sediment management:** selectively removing the sand from key locations of the riverbed.
- **Option 3 - Tar-Ru (Lake Victoria) transfers:** implementation of a risk-based framework for making decisions on the timings and source of water transfers to Tar-Ru (Lake Victoria).
- **Option 4 - Optimisation of the existing MIL system:** optimisation of the Murray Irrigation Limited (MIL) channel system to deliver water to bypass the Barmah-Millewa Reach.
  - **Option 4A.1:** Optimised use of MIL channel escapes (no works).
  - **Option 4A.2:** Optimised use of MIL channel escapes (upgrade works).
  - **Option 4B:** Perricoota Escape expansion.
  - **Option 4C:** Mulwala Canal extension.
- **Option 5 - Options for delivery through Victorian infrastructure:** using existing and new infrastructure in Victoria to bypass the Barmah-Millewa Reach or mitigate the risk of delivery shortfall.
  - **Option 5A:** Enhanced use of the Victorian Mid-Murray Storages.
  - **Option 5B:** Enhancement of the Murray Valley Irrigation Area outfalls.
  - **Option 5C:** Barmah bypass gravity channel.
  - **Option 5D:** Rochester 14 bypass channel.
- **Option 6 - Use of the Snowy Hydro Scheme to transfer Murray releases to the Murrumbidgee:** transferring River Murray releases from the Snowy to the Murrumbidgee River, for delivery to water users downstream of the Barmah-Millewa Reach.

Option assessment:

To provide a relative assessment for each of the individual options, each option was assessed against the time taken to implement the option, a multi-criteria analysis, a qualitative assessment, and cost.

The multi-criteria analysis (MCA) included consideration of water availability, environmental outcomes, delivery risk and social factors. MCA scores were derived for each option out of 10.

The outcomes of the option assessments are presented in the following pages.



The location of the six options considered as part of this Feasibility Study, relative to the Barmah-Millewa Reach.

4 The options (cont.)

Option 1 – River works within the Barmah-Millewa Reach

Background:

Accelerated riverbank erosion is an ongoing issue throughout the Barmah-Millewa Reach. When the riverbank erodes, it is at risk of slumping or breaking off in large sections into the river.

When River Murray flows are high, water can break out over lower sections of the riverbank into effluent channels, inundating the floodplain. Breakaway flows are a natural behaviour of distributary systems during winter floods. However, in the Barmah-Millewa Reach, they may occur during summer, as the river is regularly operated at near full capacity for much of its length during this season to meet downstream demands. The bank erosion can result in the loss of the sills in the effluent channels and the loss of the natural and man made levees that protect the forest from out of season (summer) inundation.

Assessments of the Murray riverbanks from Yarrawonga to Torrumbarry Weir undertaken over the last two decades have documented accelerated rates of bank erosion, with some reaches exhibiting more than 40% of banks to be eroding at accelerated rates. Recent surveys undertaken in February 2021 and May 2022 in the Barmah-Millewa Reach have found some sections of the bank had retreated by up to 1 m within the 1 year survey period.

Project concept:

This option proposes to undertake targeted works to minimise further loss of water from the main channel via breakaways. The works program will endeavour to temporarily prevent further loss of water delivery capacity by targeting sections of bank that are at high risk of slumping. However, the proposed isolated erosion control works are unlikely to provide a solution to the wider erosion issues in the river or fully address the declining flow capacity.

The works will not reinstate channel capacity but aim to minimise further loss by targeting sites at risk of bank failure that could result in increased loss of water in the adjoining forests. In the process, this will also address both loss of water to the forest and the undesirable summer inundation of low-lying areas of the forest. The works also have the potential to prevent the potential loss of cultural material located on the riverbank.

This project is being delivered as the Yarrawonga to Torrumbarry Interim River Works Program 2022 – 2027 (Y2T IRWP).

Scope of works:

Desktop investigations have identified a total of 243 current or potential breakout sites. Field verification was completed for all sites initially considered to be of Very High or High risk rating.

Following the field verification, 4 sites were confirmed as having a Very High risk rating, and 19 sites with a High risk rating. All sites considered to be Very High or High risk are located between Bullatale Creek and the Barmah Sand Dunes, a river distance of around 107 km. Most of the identified sites occur on the outside of meander bends.

The scoping report recommends that:

- 4 sites classed as Very High risk should be a very high priority for works.
- 19 sites classed as High risk should be a medium to high priority for works and monitoring.
- All other sites should not be a priority for works but should be monitored.

The works program involves undertaking localised and targeted works at each site, with the works generally involving:

- stabilisation of the riverbank (e.g., due to erosion or failed stabilisation works).
- reinforcement of the existing levees.
- reinforcement of existing vehicle tracks.
- installation of a regulator (if more cost effective than stabilisation and land manager accepts).
- removing failed or ineffective rock stabilisation, where this is found to be exacerbating bank erosion of adjacent bank area.

Next steps:

A works program is currently under development and, subject to approval. The works would be expected to commence from 2023 for a five-year period.

Preliminary stakeholder engagement with the Yarrawonga to Torrumbarry River Reach Stakeholder Group (YTRRSG) commenced from the second half of 2021. The group comprises government agencies, local community/council representatives, and Traditional Owners. The YTRRSG continues to meet and forms an important part of planning this works program.

A site identified as 'High risk' of potential breakaway within the Barmah-Millewa Reach

Flow	Time to implement	MCA score	Capital cost	Operational cost (50 years)
500 ML/day (avoided loss)	1 year	6.5	$4.5m	Nil

FIND OUT MORE

To read the technical studies which support this option, please refer to the BMFS page on the MDBA website.

4 The options (cont.)

Option 2 – Sediment management works

Background:

A range of preliminary investigations into the cause and consequences of declining channel capacity in the Barmah-Millewa Reach have been completed. These investigations have found that historic land use practices have caused an influx of sand into the River Murray between Yarrawonga and Picnic Point, which is reducing the already limited flow capacity of the river.

It is estimated that there is more than 20 million m^3 of coarse sand on the bed of the river between Yarrawonga to Picnic Point, including more than 8 million m^3 in the Barmah-Millewa Reach. Downstream of the Edward-Kolety River confluence, there is a significant increase in the average depth of the sand, including the section of the river where the flow capacity is at its lowest. Sand is continuing to move downstream in the Barmah-Millewa Reach, with approximately 240,000 m^3 entering the reach and approximately 80,000 m^3 leaving the reach each year.

A works program will likely involve the targeted and strategic removal of sand to help mitigate further decline in flow capacity and associated adverse outcomes. This would include works upstream to reduce the volume moving into the reach and removal of sand from targeted areas within the Barmah-Millewa Reach.

Project concept:

An options analysis for managing the sand determined that a 'do nothing' scenario would have considerable negative outcomes for environmental, social, cultural, and economic values.

This option proposes the targeted removal of sand from the bed of the River Murray between Yarrawonga and Echuca. The removal would target specific areas, likely including:

- Upstream of the Barmah-Millewa Reach, to reduce the volume of sand moving into the reach.
- Downstream of the Edward-Kolety River confluence (near Picnic Point), which has the greatest bed thickness of sediment, with an estimated 33% of the channel capacity filled with sand.

The objective of these works is to maintain or restore flow capacity of the river through the reach, in turn helping to mitigate potential adverse impacts including increased risk of shortfalls, as well as localised impacts on environmental, social, cultural, and economic values.

Scope of works:

Initial investigations have confirmed that removing the sand accumulating in the reach (around 160,000 m^3/year) is realistic. By way of comparison, the River Murray mouth dredging is removing 1,000,000 m^3/year. Due to the large volumes and extent of the sand, extraction would be ongoing over multiple years.

Sand would be extracted from the riverbed by loosening the materials, removing them from the riverbed to above the water, transporting the materials from the water to a disposal site, followed by the treatment and placement of the materials.

A range of equipment options have been investigated. The material would first be removed from the riverbed. The material would then be placed into a hopper where water is added to make a slurry. The slurry would then be pumped from the river to land, for transport through pipelines to a disposal site.

Modelling has shown that the flow capacity of the Barmah-Millewa Reach could be expected to further decline by around 1,000 ML/day over the next ten years if no sand removal works are undertaken.

Flow	Time to implement	MCA score	Capital cost	Operational cost (50 years)
1,000 ML/day (avoided loss)	5 years	6.0	$14.5m	$110.4m

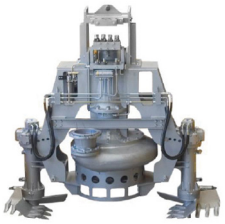
Pilot program:

A pilot program is proposed as part of the next steps, to provide an insight into the workability and practicality of the sand removal program.

The pilot program aims to remove sand from the bed of the river on a scale which is small enough such that it has no adverse impacts on environmental, cultural, or historical values.

For the pilot program, sand will be removed using a submersible pump attached to an excavator on a barge. The use of a submersible pump to remove the sand instead of an excavator bucket has been made in response to preferences expressed by Traditional Owners during consultation with the MDBA. The removed sediment will be transported to a near onshore disposal site via a pipeline to be drained and stored for further transport in geofabric bags.

The design for ongoing sand removal programs, including onshore disposal methods, will be informed by the pilot program outcomes.



Next steps:

Studies are currently underway to further investigate and scope the works for a sediment management program.

The outcomes from these studies will be collated into a final study report, which will then be considered by the MDBA and the joint governments to determine whether a business case should be developed. If a decision is made to proceed, the next stages of investigation would be expected to commence in 2023, including planning the pilot program.

A staged approach to the development of the project is being recommended. There would be several stages of work development, consideration, and approval, with community and Traditional Owner consultation extending for the entire time. Such a program may include:

- **Step 1:** Additional sampling for heavy metal concentrations at selected locations at Picnic Point and at the top of the Barmah-Millewa Reach (circa 2023).
- **Step 2:** Pilot program to assess effectiveness of equipment, environmental impacts and benefits, and measure how long it takes for the sand to fill in the area from which it is removed (circa 2024).
- **Step 3:** Business case development and implementation of an ongoing sand removal program at Picnic Point (circa 2025-2027).
- **Step 4**: Business case development and implementation of an ongoing sand removal program at the upstream extent of the Barmah-Millewa Forest Reach (2027-2029).

Each of the steps are dependent on further technical assessment, stakeholder consultation, securing of statutory approvals, and the approval and funding of the works by Ministerial Council.

FIND OUT MORE

To read the technical studies which support this option, please refer to the BMFS page on the MDBA website.

4 The options (cont.)

Option 3 – Tar-Ru (Lake Victoria) transfers

Background:

Tar-Ru (Lake Victoria) is a naturally occurring shallow freshwater lake with a capacity of approximately 677 GL. It is located approximately 60 km downstream of the Murray–Darling Junction in south-western New South Wales, close to the South Australian and Victoria borders.

The lake is operated in accordance with formal operating rules designed to minimise shoreline erosion to protect Aboriginal cultural heritage sites. It is filled so that the active storage is near or at full supply as late as possible in spring. The lake is then drawn down over summer and autumn to supply downstream demands. There is a target minimum active storage volume of 250 GL on the 31st of May. Filling recommences from the start of June each year.

Project concept:

Tar-Ru can be filled from either unregulated River Murray flows or by transferring water from Lake Hume. The general practice is to wait for unregulated inflows to fill Tar-Ru, in preference to Hume transfers, to reduce the potential risk of resource loss to upstream States from lost harvesting opportunities, spills from Tar-Ru, or conveyance losses.

Filling the lake has historically been a challenge in dry years, but since the mid-2010s, filling the lake in late spring and meeting the minimum reserve level in May has become a more frequent challenge. A scoping study commissioned by the MDBA showed that reduced tributary inflows, operational constraints and efficiencies, demands for water, and limits on Tar-Ru water level changes have meant that more transfers of water from Lake Hume have been needed to fill Tar-Ru.

While the study did not consider the BMFS or the objectives of this project, it does provide an insight into whether there could be an opportunity for changed operational practices to support both the filling of Tar-Ru and to take pressure off the Barmah-Millewa Reach during the summer period. This opportunity may arise if some Hume to Tar-Ru transfer volumes could be delivered in late spring to support the filling target, rather than occurring over the summer months.

This would support the BMFS objectives by either increasing the system capacity or by allowing reduced flows to be delivered through the reach during the summer months.

The risk in making early transfers is that there may be missed opportunities for harvesting unregulated flows. There is a potential opportunity to coordinate environmental water deliveries during the winter/spring period on top of early transfers. Early transfers, coordinated with environmental water deliveries could provide significant environmental benefits with the risk of foregone harvesting opportunities underwritten by the environmental water holders to reduce the risk of impacts on state water shares.

The investigation revealed only a limited number of years where the option provides a benefit that addresses the delivery risk. As such the option did not achieve a high MCA score. However the option does not require infrastructure, could be readily implemented and has potential to provide significant benefits for environmental water deliveries.

Flow	Time to implement	MCA score	Capital cost	Operational cost (50 years)
100 ML/day	4 years	2.3	$1.0m	Nil

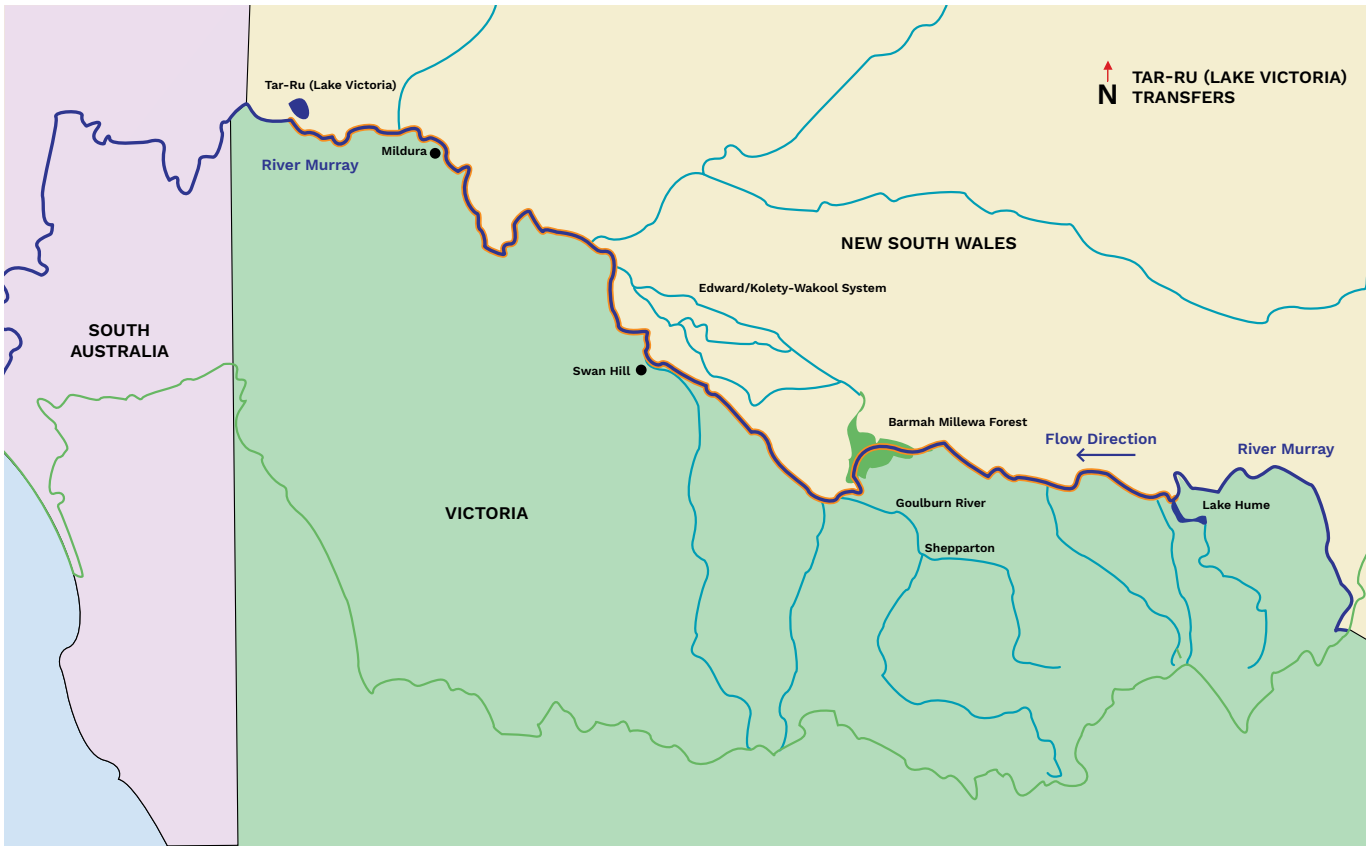
Scope of works:

Development of a risk-based framework for making decisions about the Hume to Tar-Ru transfers is proposed.

Next steps:

The next steps proposed for this option include:

- Developing a fit-for-purpose model for future investigations (using the Source Murray Model).
- Confirming or re-visiting the water resource management policies and procedures that influence the operation of Tar-Ru (Lake Victoria), to identify system operations that could be refined.
- Developing a risk-based framework for Hume to Tar-Ru (Lake Victoria) transfers using 'what if' scenario testing, to explore whether transfer rules can be modified to balance or minimize risks.
- Reporting and communicating the outcomes.
- Consultation with environmental water holders about the enhanced opportunity for environmental watering events from earlier transfers and the potential to underwrite the risk of foregone harvesting opportunities.



Tar-Ru (Lake Victoria) location map

FIND OUT MORE

To read the technical studies which support this option, please refer to the BMFS page on the MDBA website.

4 The options (cont.)

Option 4A.1– MIL Options – Optimised Escapes [no works option]

Background:

Murray Irrigation Limited (MIL) owns and operates a 2,700 km network of irrigation water supply channels. The main channel in the network, the Mulwala Canal, diverts water from the River Murray at Lake Mulwala, supplying the channel system network across the Southern Riverina Plain before outfalling into Edward-Kolety, Niemur, Wakool, Murray Rivers, and Billabong Creek through escapes. Much of the MIL system has been automated. Discussions with MIL and further investigations have revealed surplus delivery capacity in the MIL system.

The MIL channel system network contains approximately 70 escape structures that can outfall water to natural waterways to flow back to the River Murray System downstream of the Barmah-Millewa Reach.

Through engagement with MIL, WaterNSW and DPE, 20 of these escapes were identified as priority sites which could be used to bypass water around the Barmah-Millewa Reach.

Project concept:

This option involves increasing the use of the MIL escapes for the purpose of providing bypass flows around the Barmah-Millewa Reach.

The 'No Works' option requires no capital works to be performed.

The option investigated eight escapes which are all currently automated and are used for the delivery of environmental water or operational water on behalf of DPE or WaterNSW, respectively.

Engineering assessments determined that the MIL channel network and eight escapes have the capacity to deliver an additional 1,605 ML/day during summer. These flows would be in addition to existing system commitments.

Ecological assessments were undertaken to determine an ecologically tolerable flow regime in the natural waterways and to identify any limitations for additional releases from the outfalls. This assessment considered tolerable baseflow and fresh deliveries across the summer and winter/ spring seasons. The ecological assessments found that additional flows could be delivered from five of the eight outfalls investigated. Over the summer period, the average daily bypass flow was determined as 665 ML/day.

Over the winter/spring period, the average daily flow increases to around 1,400 ML/day.

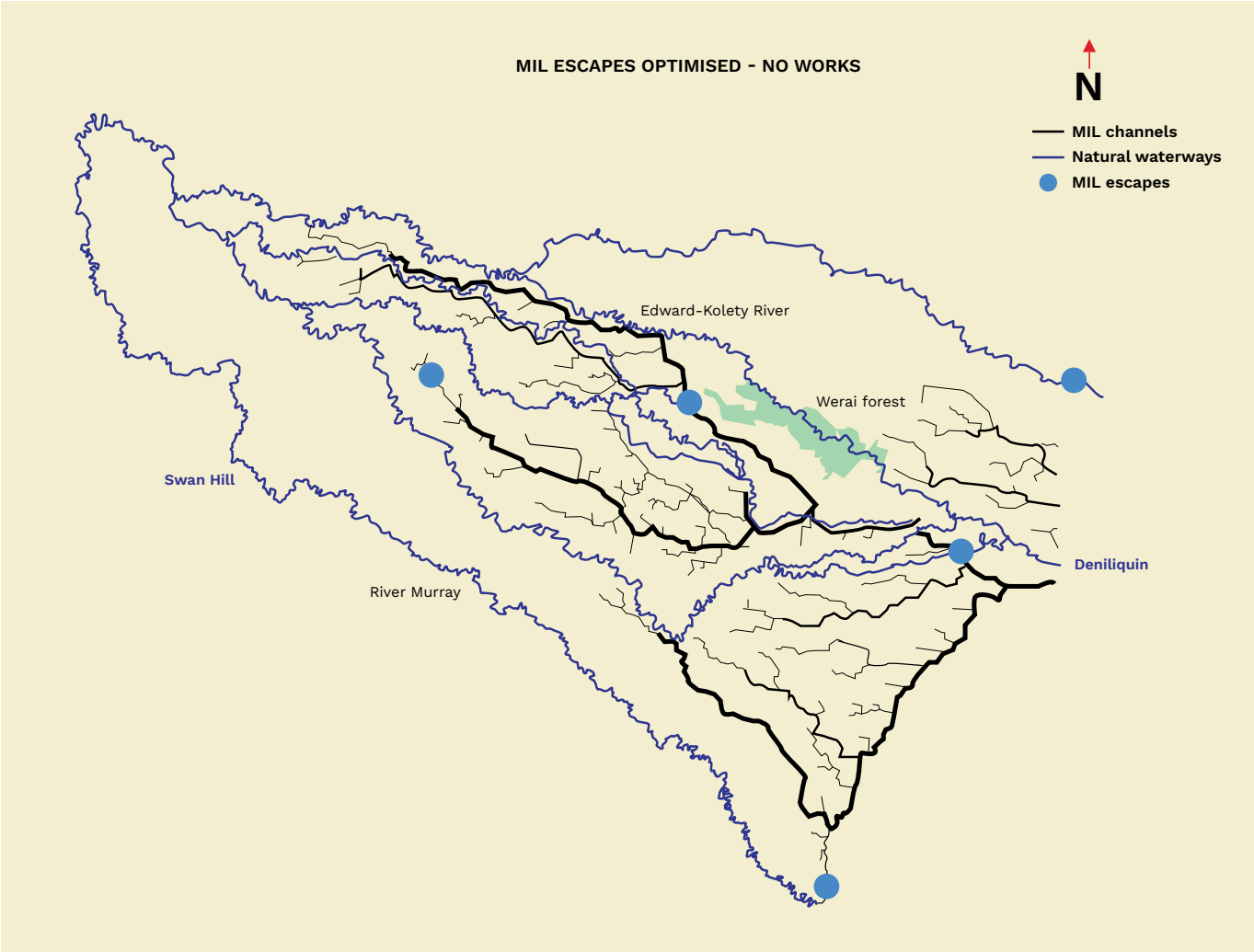
Scope of works:

The five escapes identified for use under this option include the Wakool Main Escape, Southern Escape, Northern Niemur Escape, Billabong Escape, and Perricoota Escape. The location of the escapes and the receiving waterways are shown on the following page.

Next steps:

The proposed next steps for this option would include:

- Further consultation with MIL around the escapes which would preferentially be used to deliver increased bypass water.
- Detailed conveyance loss assessments for each of the proposed delivery routes, including making actual deliveries with temporary gauging to record flows through the system and confirm losses.
- Further ecological assessments to better understand the opportunities to improve environmental outcomes with delivery of environmental flows through the region.
- Negotiation with MIL on the terms and conditions for increased access to the MIL channel network, including the volumetric delivery delivery charge, an assessment of the losses, and the form of agreement.



MIL Options – Optimised Escapes [no works option]

Flow	Time to implement	MCA score	Capital cost	Operational cost (50 years)
665 ML/day	1 year	5.8	$0.1m	$4.1m

FIND OUT MORE

To read the technical studies which support this option, please refer to the BMFS page on the MDBA website.

4 The options (cont.)

Option 4A.2 – MIL Options – Optimised Escapes [works option]

Background:

This option proposes upgrading the escapes to increase the amount of water that can bypass the Barmah-Millewa Reach via the MIL channel network.

Project concept:

Through discussions with MIL, WaterNSW and DPE, a total of 20 escapes were identified as sites which could potentially be used for this purpose.

Engineering assessments determined that the MIL channel network and escapes could be upgraded to deliver an additional 3,355 ML/day during summer (compared with current operation). These flows would be in addition to existing system commitments.

The ecological flows assessment was undertaken to determine an ecologically tolerable flow regime in the natural waterways and to identify any limitations for additional releases from the outfalls. This assessment considered tolerable baseflow and fresh deliveries across the summer and winter/spring seasons. The ecological assessments found that additional flows could be delivered from 14 of the 20 outfalls investigated. Over the summer period, the average daily flow was determined as 960 ML/day.

The flows would be delivered as a combination of baseflows and freshes over the summer period.

The 'Works Required' option involves upgrade works to eight outfalls and the increased use of six existing outfalls.

Upgrading the eight outfalls would cost around $18.5 million and take two years to complete.

Scope of works:

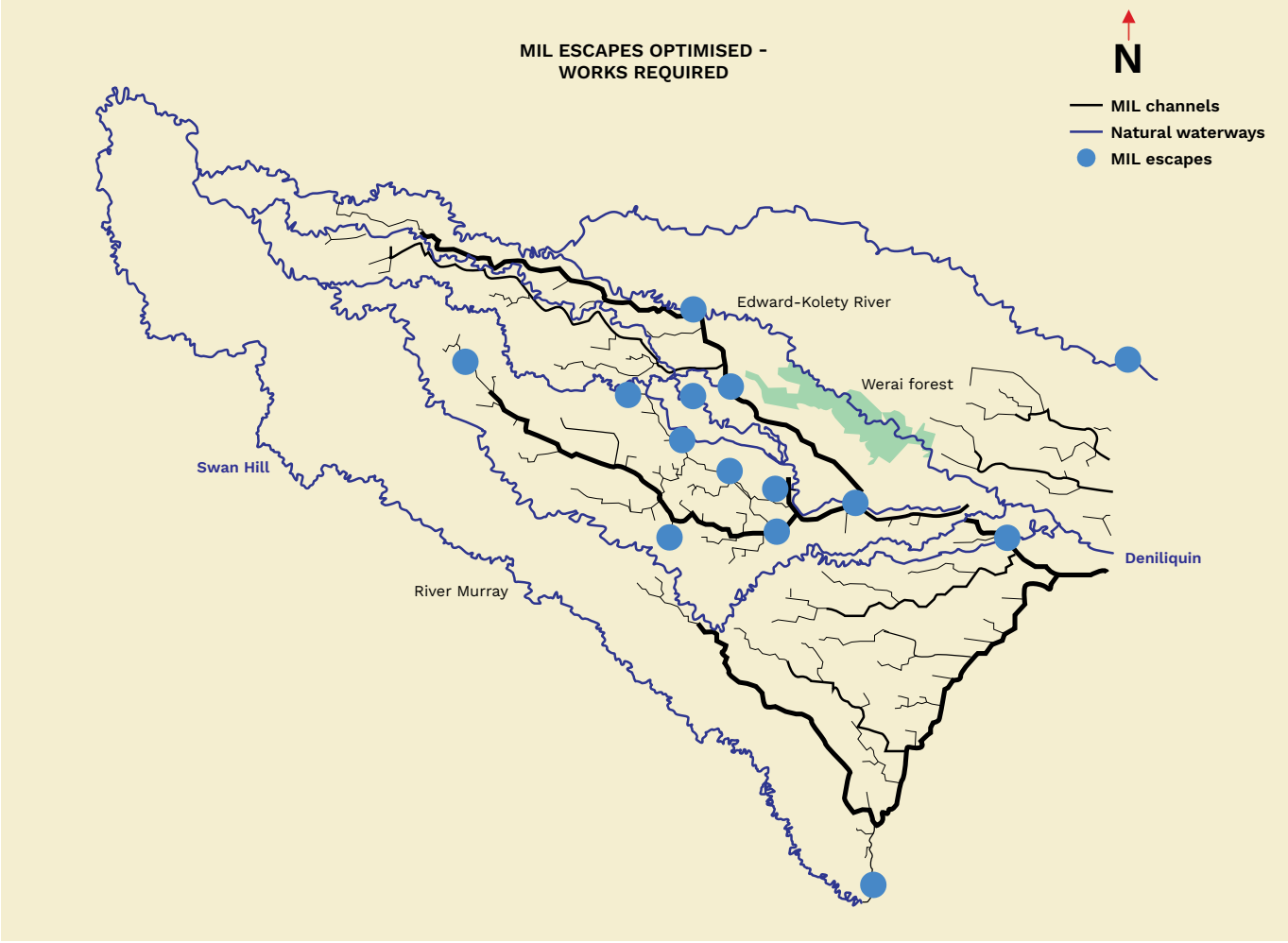
The 'Works Required' option proposes:

- Upgrades to the Wakool Main Escape, Southern Town Escape, Southern 27 Escape, Northern 4 Escape, Jimaringle 1 Escape, Jimaringle 3 Escape, Jimaringle Escape and Northern Branch Channel Escape.
- The increased use of the existing Southern Escape, Niemur Escape, Mascotte Escape, Jimaringle 11 Escape, Billabong Escape and Perricoota Escape.

Next steps:

In addition to the items listed for the enhanced use of the current escapes proposed under the 'no works' option, the next steps for this option would include:

- Engineering designs for the proposed asset upgrade works, including the escapes and channels which may be upgraded. This would also include an engineering assessment on the receiving natural waterways to identify any potentially affected assets which may need to have works undertaken to support the higher flow deliveries and manage potential impacts.
- Further ecological assessments to better understand the opportunities to improve environmental outcomes with the delivery of environmental flows through the region.
- Further analysis and discussions between stakeholders in regard to the acceptance and availability to use the surplus summer capacity within the Edward-Kolety River below Stevens Weir as a bypass opportunity.
- Engagement with key stakeholders on the process of selecting a final option or a series of options.



MIL Options – Optimised Escapes [works option]

Flow	Time to implement	MCA score	Capital cost	Operational cost (50 years)
960 ML/day	2 years	6.3	$18.5m	$10.4m

FIND OUT MORE

To read the technical studies which support this option, please refer to the BMFS page on the MDBA website.

4 The options (cont.)

Option 4B – MIL Options – Perricoota Escape expansion

Background:

The Perricoota Escape outfalls water from the Deniboota Canal to the River Murray via a 10 km escape channel.

The existing design capacity of the Perricoota Escape is 150 ML/ day. During the summer months, around 100 ML/day of this capacity is currently available for delivering bypass flows. This option explores undertaking upgrade works to the Deniboota Canal and the Perricoota escape to support bypass flows of up to 300 ML/day (i.e. an increase of 200 ML/day from the current available capacity).

Project concept:

Increasing the escape capacity to support bypass flows of 300 ML/ day would require works to approximately 10 km of the Deniboota Canal and associated infrastructure.

MIL have previously undertaken a desktop study, which investigated options to widen the existing Deniboota Canal to accommodate flows of 500, 1,000 and 1,500 ML/day. Based on preliminary engineering assessments and discussions with MIL operational staff, the Deniboota Canal under gravity would struggle during high River Murray summer flows to deliver more than 300ML/ day. Flows above this during a high river would break out from the escape channel into the Perricoota Forest, increasing losses and slowing delivery.

Accordingly, it is assumed that the upgrade works would provide the capacity to deliver an additional 200 ML/day.

Scope of works:

The Deniboota Canal would require widening of the existing channel by 10 m to a total channel width of 20 m.

The first 5.4 km of the 10 km upgraded section would need to be widened to accommodate the increased flow with no increase in bank height. The remaining 4.2 km of canal through to the Perricoota escape would require widening and the banks raised by approximately 0.6 m.

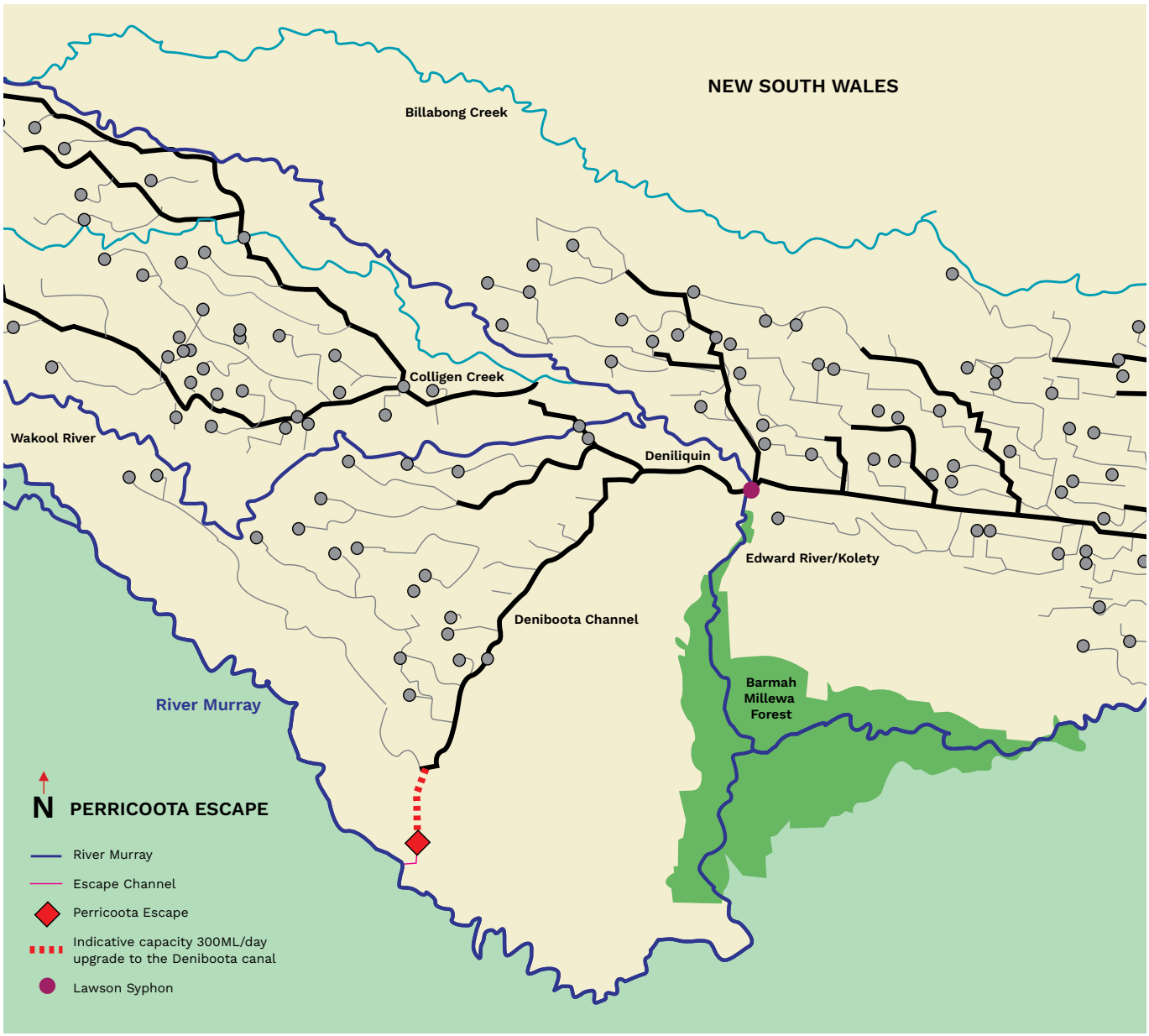
At the start of the channel expansion an existing major syphon would need to be upgraded and would involve constructing two additional large diameter pipes.

The other works require replacement of 12 irrigation outlets, 4 regulators and multiple bridges and crossings.

The existing 150 ML/day Perricoota Escape would need to be replaced with a 300 ML/day automated regulator.

Next steps:

The next step of development for this option would include a detailed engineering assessment to determine the viability of supplying additional flows, confirm the works required, identify the specifics for a preferred infrastructure solution, and update the associated costs and time to implement.



MIL Options – Perricoota Escape Expansion

Flow	Time to implement	MCA score	Capital cost	Operational cost (50 years)
200 ML/day	2 years	2.5	$24.5m	$7.9m

FIND OUT MORE

To read the technical studies which support this option, please refer to the BMFS page on the MDBA website.

4 The options (cont.)

Option 4C – MIL Options – Mulwala Canal extension

Background:

The current delivery arrangement for the Wakool Irrigation District involves supplying water via the Edward-Kolety River, which is then diverted at Stevens Weir. Stevens Weir creates a weir pool which allows water to be diverted down the Colligen and Yallakool Creeks and the Wakool River. Colligen Creek is the main supply to MIL's Wakool Irrigation District via the Wakool Main Canal.

Project concept:

This option involves an extension of the Mulwala Canal from its current termination point at the Wakool Escape.

Originally, the concept of extending the Mulwala Canal to the Wakool Main Canal was investigated. This channel would then be used to supply some of the Wakool Main Canal demands, as opposed to using the Edward-Kolety River. This would provide surplus capacity in the Edward-Kolety River.

However, a capacity constraint on the Edward-Kolety River downstream of Stevens Weir was identified through discussions with Water NSW and our ecological assessments. This constraint recognises the risk of unseasonal inundation of the Werai Forest. The Edward-Kolety River below Stevens Weir is already at capacity during summer. Accordingly, there is limited opportunity to deliver bypass flows via the Edward-Kolety River.

Given this constraint on the Edward-Kolety River, the full extension of the canal to the Wakool Main Canal would provide no benefit from a water resource perspective, given any bypass water delivered in the Edward-Kolety River would still need to be diverted at Stevens Weir to avoid exceeding the downstream capacity constraints.

As such, the adopted option proposes a partial extension of the Mulwala Canal to the Yallakool Creek.

Scope of works:

Engineering assessments determined that sufficient capacity was available in the system to install a 200 ML/day pipeline to deliver flows into the Yallakool Creek system. This would require the installation of dual 1500 mm diameter concrete pipes for a length of 6.3 km.

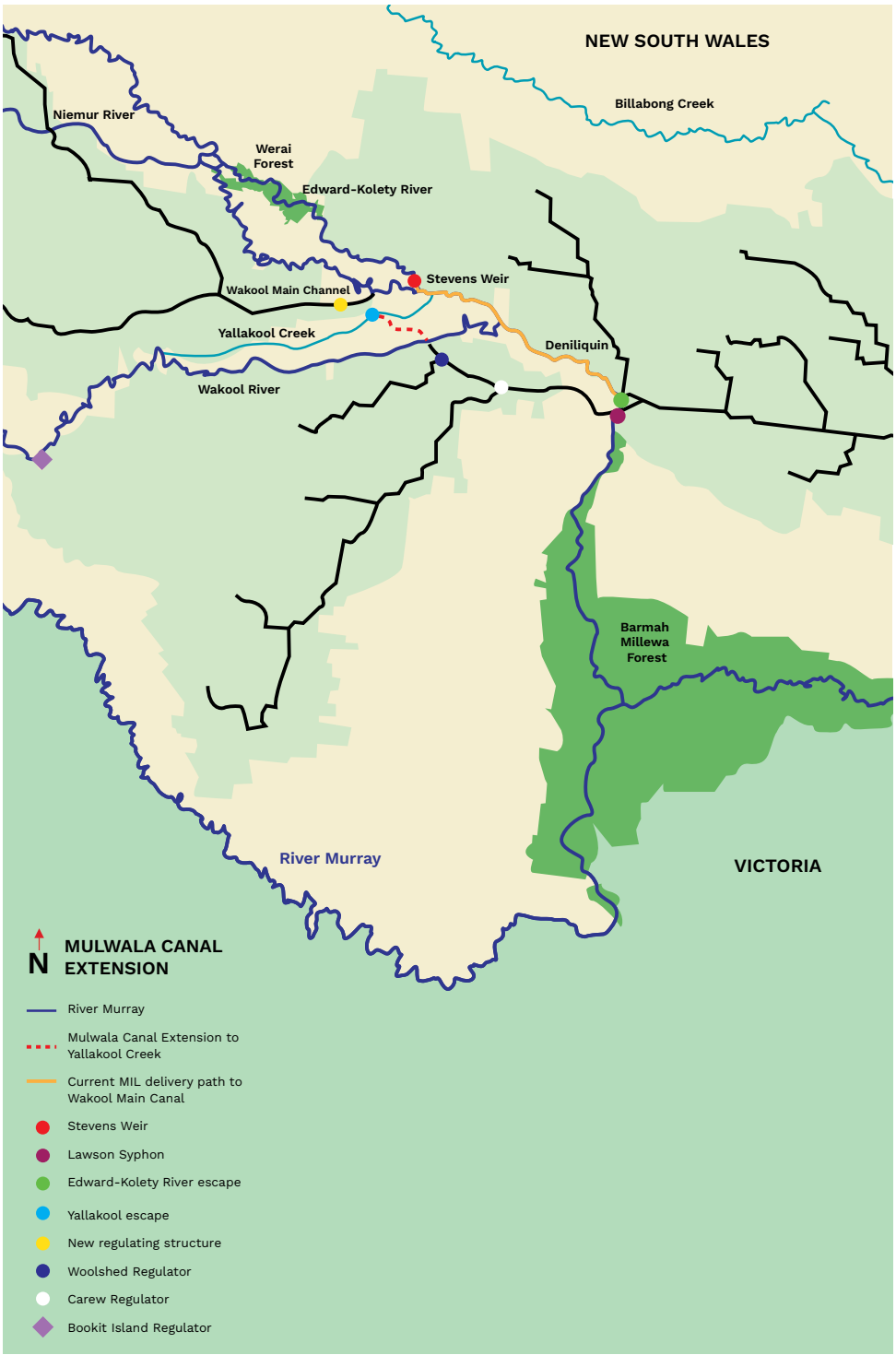
Ecological flows assessments were undertaken to determine an ecologically tolerable flow regime in the natural waterways and to identify any limitations for additional releases from the pipeline extension. The ecological assessment confirmed that the ecologically tolerable flow should be restricted to an average of around 185 ML/day due to capacity constraints in the Wakool River.

However, if there is an increased use of the MIL escapes as proposed in Option 4A, the additional ecologically tolerable flows that can be delivered from this option reduces to around 38 ML/day.

Next steps:

The next step of development for this option would include a detailed engineering and ecological assessment to investigate the potential options for supplying increased flows through this part of the MIL system and identify the specifics for a preferred infrastructure solution and confirm the associated costs and time to implement.

Flow	Time to implement	MCA score	Capital cost	Operational cost (50 years)
38 ML/day	2 years	2.5	$38.5m	$10.8m



MIL Options – Mulwala Canal extension

FIND OUT MORE

To read the technical studies which support this option, please refer to the BMFS page on the MDBA website.

4 The options (cont.)

Option 5A – Victorian Options – Enhanced use of the VMMS

Background:

The Victorian Mid-Murray Storages (VMMS) consist of four storages: Lake Boga, Lake Charm, Kangaroo Lake and Ghow Swamp. The VMMS are in north central Victoria, approximately 100 km downstream of the Barmah-Millewa Reach.

Water harvested into the VMMS can be returned to the River Murray to supplement flows to meet Victorian River Murray commitments or reduce releases from the upper Murray storages. Water can be supplied from Lake Boga, Kangaroo Lake, and Lake Charm for River Murray demand, with Ghow Swamp managed for supplying irrigation demands and minimising releases from upper storages for the Torrumbarry Irrigation Area.

For the purposes of this study, Ghow Swamp has not been investigated, recognising its existing role in supplying Victorian entitlements and local irrigator demands, and ongoing efforts to improve outcomes for social, cultural, and environmental values at the site.

Project concept:

This option considers increasing the use of Lake Boga, Kangaroo Lake and Lake Charm to support deliveries to the lower Murray.

While the VMMS already contribute to the objectives of the BMFS project, increasing the use of the storages is currently limited by several factors, including restrictions on discharge capacity, operational management practices, salinity management, social use conflicts, cultural heritage, constraints during re-filling, and irrigation channel demands. Enhancing the use of the VMMS would involve works and operational changes needed to use the storages more actively for managing demands and shortfall risks in the lower Murray.

With a combined active storage of 30 GL and a combined discharge capacity of around 1,000 ML/day which could be sustained over a 10-day period, the storages could be used to assist with managing potential delivery shortfalls.

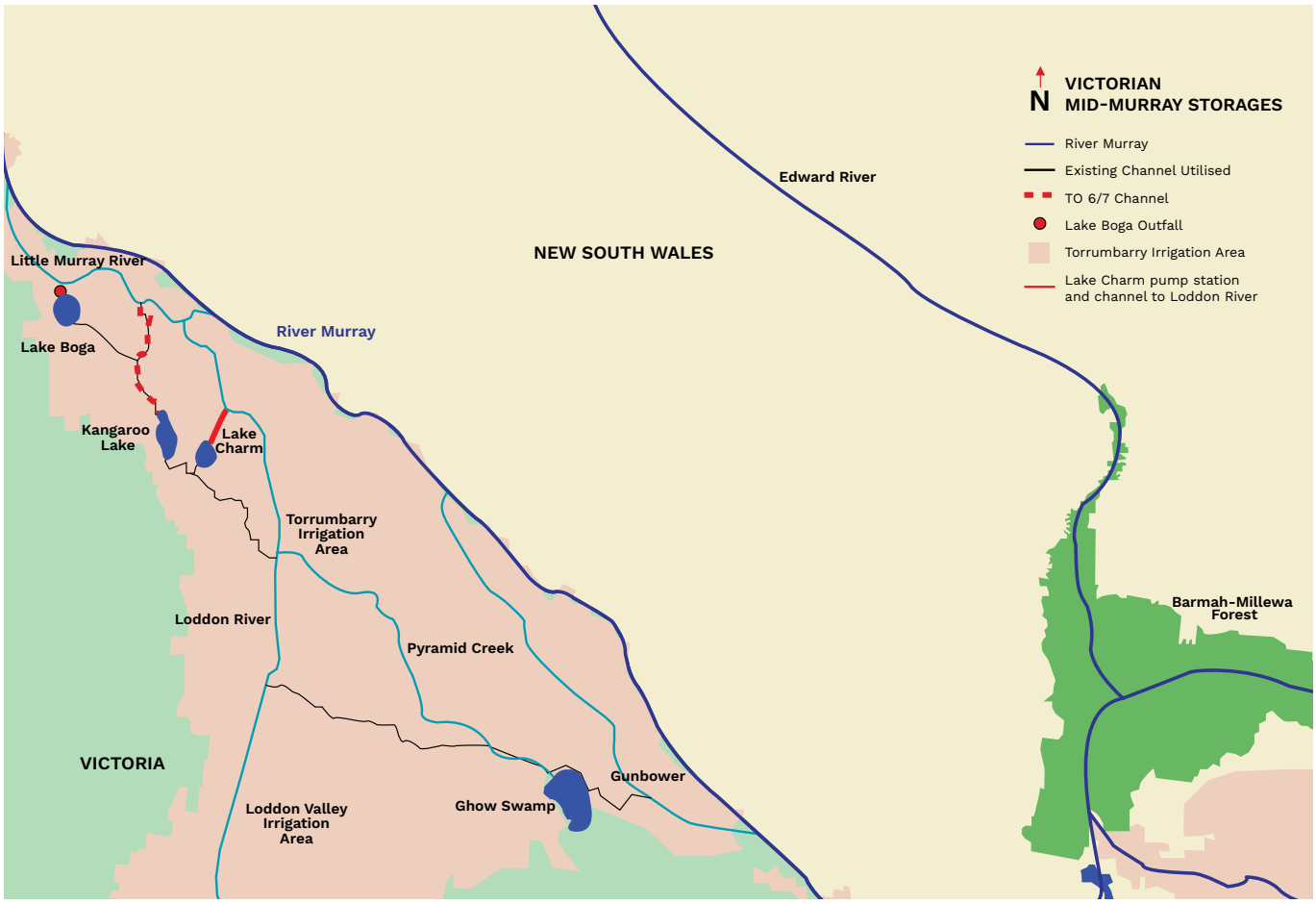
Scope of works:

The investigations and works that may be considered to enhance the use of the storages include:

- Works to reinstate discharge capacity of the storages, including de-silting and re-profiling of channels, removal of a sandbar near the Lake Boga outfall regulator, and construction of regulating structures and culverts.
- Enhanced operational arrangements to facilitate the more regular use of the storages, including operational models and coordinated operating arrangements to be developed to better support operators.
- Salinity management, including finalising release rules for the lakes as required to support the increased discharge of flows from the storages.
- Cultural heritage, including ongoing consultation with Traditional Owners on the management of the storages.
- Environmental studies to confirm additional studies or limitations regarding the changed operating levels and drawdown rates for the storages.

Next steps:

The next steps for this option would include consultation with Victorian agencies, system operators, Traditional Owners, local community, and irrigators, to explore and define the proposed changes in the use of the three storages. This would be followed by detailed engineering and operational investigations.



Victorian Options – Enhanced use of the VMMS

Flow	Time to implement	MCA score	Capital cost	Operational cost (50 years)
300 ML/day	2 years	8.8	$5.7m	$2.4m

FIND OUT MORE

To read the technical studies which support this option, please refer to the BMFS page on the MDBA website.

4 The options (cont.)

Option 5B – Victorian Options – MVIA outfalls enhancement

Background:

The channel system of the Murray Valley Irrigation Area (MVIA) diverts water from the River Murray at Lake Mulwala via the Yarrawonga Main Channel (YMC) to supply irrigators within the district. A number of the channels in the MVIA connect to the lower Broken Creek via outfall structures. The lower Broken Creek flows into the River Murray just below the Barmah-Millewa Reach. As a result, the MVIA channels can be used to bypass the Barmah-Millewa Reach.

There are seven existing outfalls which can be used to deliver bypass flows. These outfalls have a combined capacity of 180 ML/day. The outfalls have been fully utilised over summer in recent years, meaning that any increased use of the outfalls would require upgrade works to be undertaken.

Of the seven existing outfalls, four discharge directly into the highly regulated reaches of the lower Broken Creek, where operational flow capacity is highest over late spring to early autumn. These four outfalls were the subject of investigation for increasing the flow capacity.

Project concept:

This option proposes upgrade works to four channel outfalls to allow increased bypass flows to be delivered.

For these four outfalls, GMW advised that the current capacity was generally limited by the size of the outfall infrastructure. If the infrastructure were upsized, there would be available capacity in the upstream channels to supply the additional flows, based on current irrigation demand patterns over the summer period.

The potential to increase the bypass flow capacity from the MVIA into lower Broken Creek will be limited by the ecological flow tolerances of the creek. These flow tolerances are already currently met (or exceeded) by the delivery of intervalley transfers (IVT), existing bypass flows, and environmental flows. It is unlikely that the volume of River Murray bypass water could be increased from current practices, unless some of the IVT volumes are delivered by an ecologically tolerable alternate means, such as the Rochester 14 bypass option considered in this study.

The four outfalls considered by this option are labelled in orange in the accompanying figure.

Scope of works:

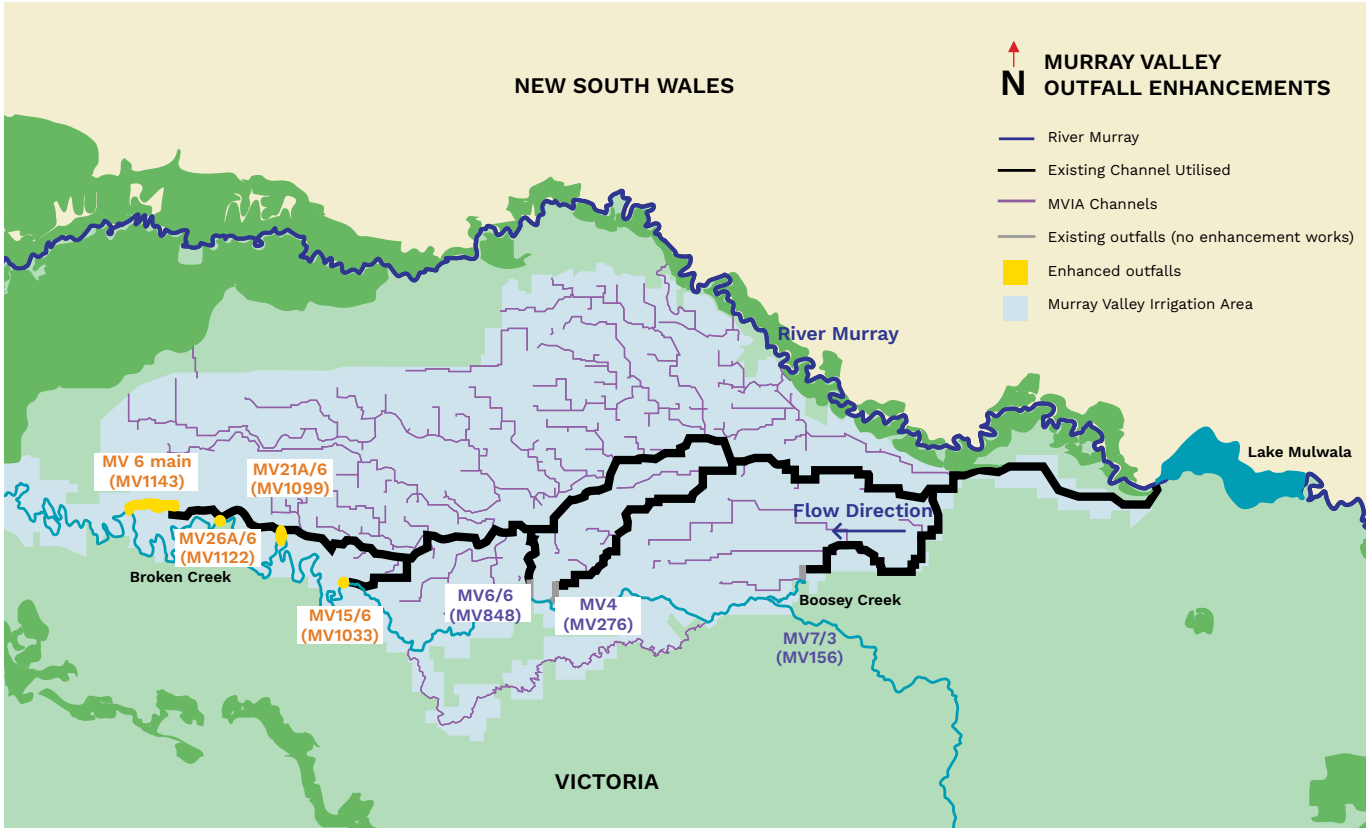
This option involves upgrade works to four existing outfalls from the MVIA into the lower Broken Creek.

The upgrade works generally involve the construction of new regulating structures, de-silting and re-profiling of outfall channels, new discharge structures, upgraded access and road crossings, and erosion protection works in the lower Broken Creek.

Any additional delivery of River Murray bypass water would require the equivalent reduction in Goulburn IVT commitments being delivered through the lower Broken Creek, to avoid ecologically unacceptable changes in the flow regime for the creek. The Goulburn IVT commitments would need an alternate means of being supplied to the River Murray, such as the Rochester 14 channel option being considered in this study. Changing the means of delivering the Goulburn IVT commitments could require amendments to policy. Accordingly, it is expected that using such an alternate arrangement could take around five years to implement.

Next steps:

The next steps would involve consultation and negotiation with GMW for increased delivery of bypass flows, followed by detailed engineering investigations and securing the statutory approvals required to upgrade the channel outfalls.



Victorian Options – MVIA outfalls enhancement

Flow	Time to implement	MCA score	Capital cost	Operational cost (50 years)
110 ML/day	5 years	0.5	$2.1m	$1.4m

FIND OUT MORE

To read the technical studies which support this option, please refer to the BMFS page on the MDBA website.

4 The options (cont.)

Option 5C – Victorian Options – Barmah bypass gravity channel

Background:

This option proposes the augmentation and extension of an existing channel to extend from Lake Mulwala to the River Murray near the township of Barmah. The channel would be used to gravitate water around the Barmah-Millewa Reach.

There are several existing channels in this area which are used by GMW to supply customers in the Murray Valley Irrigation Area (MVIA). Constructing a large channel along the alignment of an existing channel would likely be more practical than a new alignment. None of the existing channels in the MVIA discharge directly to the River Murray, so a section of new channel would be required to connect the channel network to the River Murray.

For the purposes of feasibility investigation, an indicative alignment was selected to follow the MV 5 channel, which is supplied from Lake Mulwala via the Yarrawonga Main Channel (YMC) and MV 2 channel.

Project concept:

Initial investigations and consultation with Goulburn-Murray Water (GMW) indicated that, based on demand in recent years and long-term trends in the GMID, there is significant under-utilisation and therefore available capacity in the YMC and MV 2 channels. These are large channels with significant infrastructure.

Of the existing channels in the MVIA, the MV 5 and MV 9/6 channels are closest to the River Murray. Both channels have a similar length between their location and the River Murray (around 15 km), have similar design capacities, and are around 100 km in channel length from the Yarrawonga Main Channel (YMC) offtake structure to the end of the channel. For the purposes of this exercise, the MV 5 alignment was selected as the indicative alignment for investigation. If this project were to proceed to further stages of development, a detailed option assessment considering potential alignments should be undertaken to confirm a preferred alignment.

The indicative alignment follows the MV 5 channel, which is supplied from Lake Mulwala via the YMC and MV 2. The channel would require a 19 km extension from the end of the current channel system to link to the River Murray.

Scope of works:

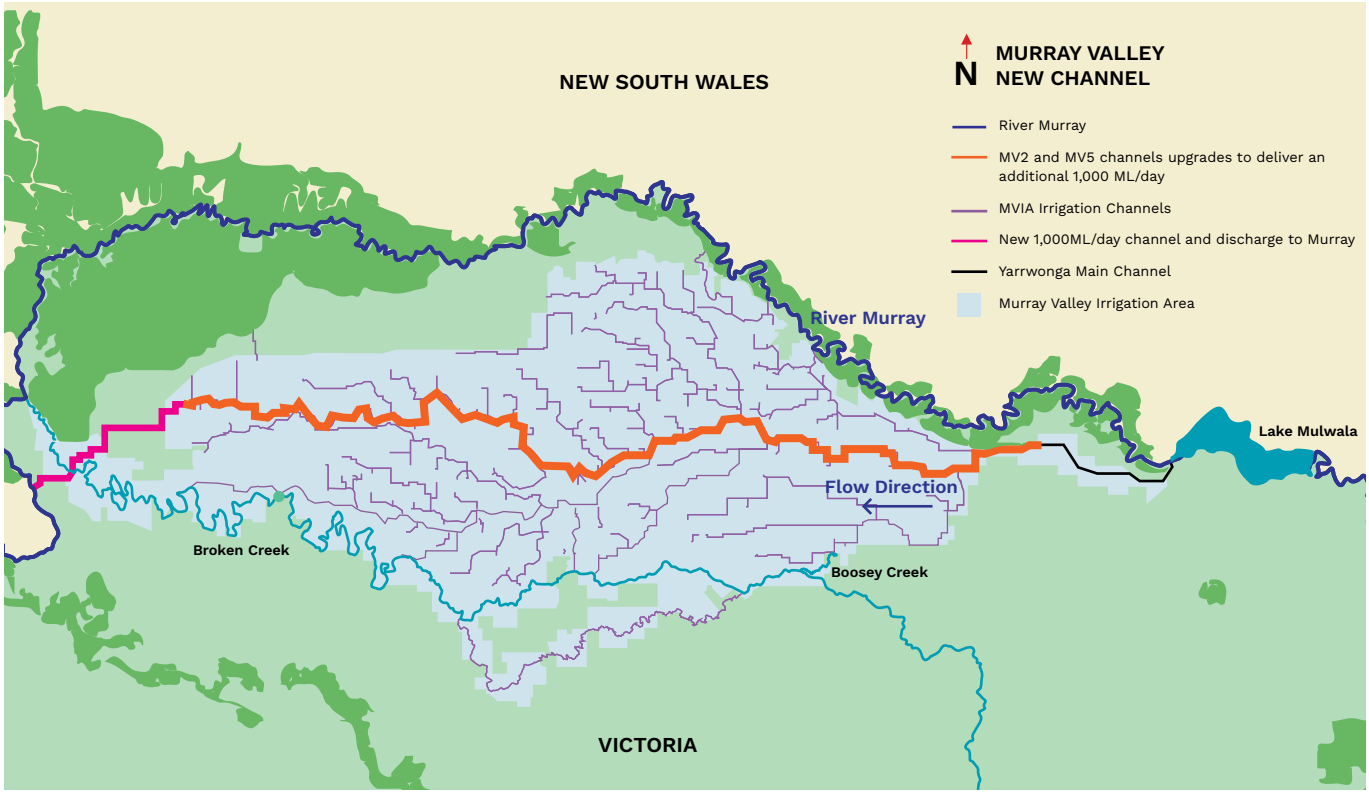
The existing spare capacity in the YMC was determined by looking at actual flow volumes delivered in 2021-22 and comparing this to the existing size of the channel and regulators. This determined that there is reliably around 1,000 ML/day of spare capacity in the upper reaches of the channels available. The size of a bypass channel was set to access this volume.

Preliminary engineering investigations determined this option would require:

- 70 km of existing channel to be re-constructed to increase the capacity.
- 20 km of new large channel to be constructed.
- 155 irrigation outlets to be relocated.
- 94 D&S services to be relocated.
- 72 regulators to be upgraded.
- 111 bridges and other structures to be upgraded.

Next steps:

The next steps would involve an options investigation to analyse potential flows, alignments, and work requirements, alongside consultation with system operators and key project stakeholder groups. This would support the development of a business case for investment consideration.



Victorian Options – Barmah bypass gravity channel

Flow	Time to implement	MCA score	Capital cost	Operational cost (50 years)
1,000 ML/day	8 years	3.8	$601.7m	$173.2m

FIND OUT MORE

To read the technical studies which support this option, please refer to the BMFS page on the MDBA website.

4 The options (cont.)

Option 5D – Victorian Options – Rochester 14 bypass channel

Background:

The Goulburn system delivers water from the Goulburn headworks to meet demands in the Murray system. The actual volumes that are delivered from the Goulburn to the Murray vary year-to-year depending on allocations and the uptake of opportunities to trade out of, and back into, the Goulburn. In most years there is at least 100 GL delivered, and in some years, there could be up to around 300 GL, consistent with the Goulburn-Murray trade rule.

Currently, the capacity to deliver Goulburn commitments to the Murray when pressure on the Barmah-Millewa Reach is greatest (i.e., over the peak irrigation season in summer) is limited by the ecological tolerances of the lower Goulburn River, lower Broken Creek, and Campaspe River.

Trade opportunities from Goulburn are limited to volumes that can be delivered within the ecological tolerances of the tributaries. This means that when there is full uptake of trade out of the Goulburn, the capacity of the Victorian tributaries is fully utilised during the peak demand period.

Project concept:

This option considers creating an alternative delivery pathway for the delivery of Goulburn commitments to the River Murray. This alternate pathway could be used during summer, when pressure on the Barmah-Millewa Reach is greatest and there is the highest risk of delivery shortfalls in the lower Murray.

Increasing the capacity to deliver Goulburn commitments to the Murray during the peak demand period (without exceeding ecological tolerances) could help reduce the risks of Murray system shortfalls and offset some of the reduced delivery capacity through the Barmah-Millewa Reach. This would directly contribute to the objectives of the Barmah-Millewa Feasibility Study.

One alternate pathway for delivering Goulburn IVT commitments to the Murray would be the construction of a larger channel between the Waranga Western Channel (WWC) and the River Murray, such as along the alignment of the existing GMW Rochester 14 (RO 14) channel.

There is an existing irrigation channel and pipeline for much of this alignment which would be re-constructed to deliver additional capacity, as well as a new section of channel which would extend through to discharge into the River Murray.

This option would only be used to support the delivery of current inter-valley trade volumes out of the Goulburn and would not create additional trade opportunity.

Scope of works:

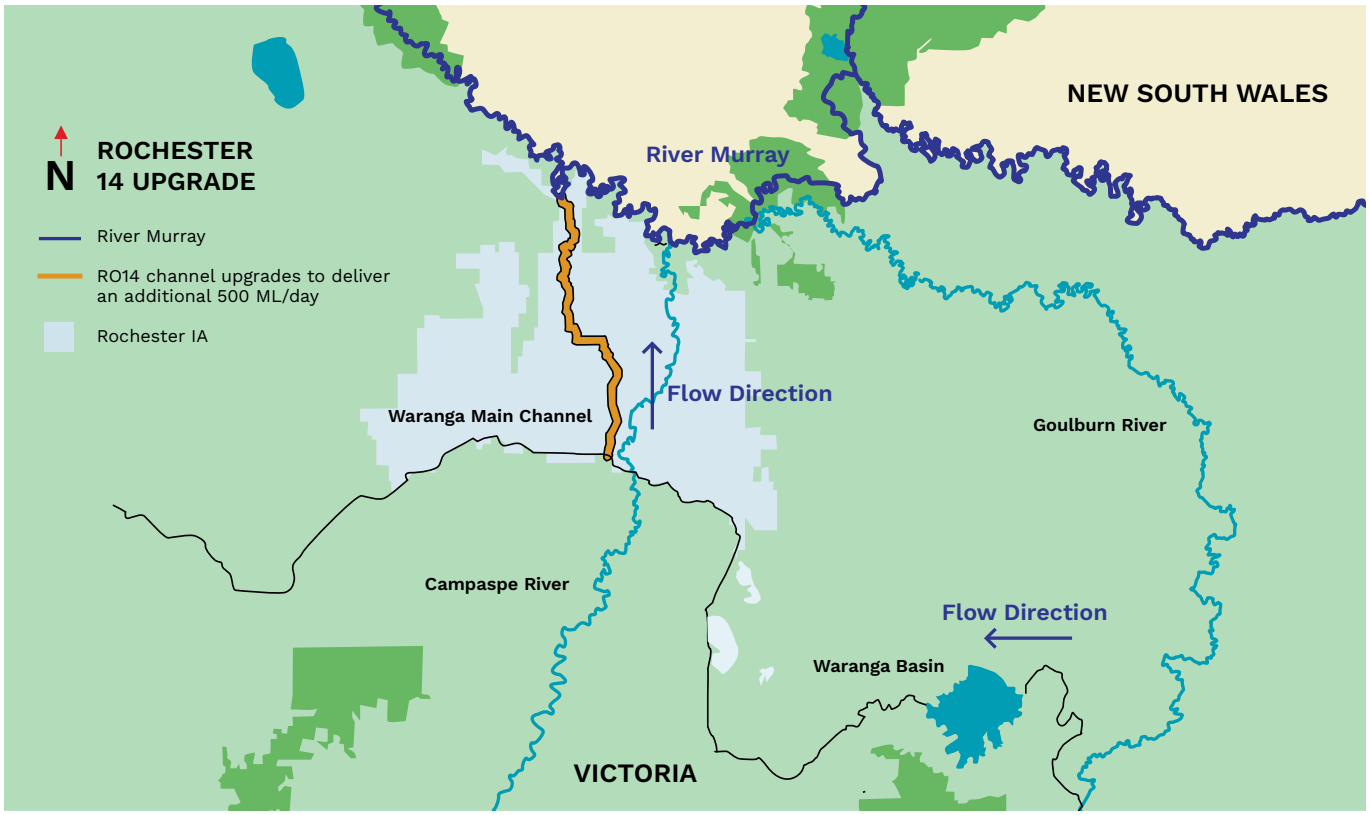
GMW provided capacity and flow data for all structures on the WWC between Waranga Basin and the RO 14 offtake channel, including the Campaspe River syphon and five regulators. Analysis of the demand patterns during the 2021-22 water year over summer indicates that there is spare capacity in the system which could reliably provide for delivering an additional 500 ML/day flows for this option.

Preliminary engineering investigations determined this option would require:

- 28 km of channel to be re-constructed to increase the capacity.
- 12 km of existing pipeline to be replaced with a channel.
- 114 irrigation outlets to be relocated.
- 129 D&S services to be relocated.
- 42 regulators to be upgraded.
- 43 bridges and other structures to be upgraded.

Next steps:

The next steps would involve an options investigation to analyse potential flows, alignments, and work requirements, alongside consultation with system operators and key project stakeholder groups.



Victorian Options – Rochester 14 bypass channel

Flow	Time to implement	MCA score	Capital cost	Operational cost (50 years)
500 ML/day	5 years	4.3	$165.7m	$49.3m

FIND OUT MORE

To read the technical studies which support this option, please refer to the BMFS page on the MDBA website.

4 The options (cont.)

Option 6 – Snowy Hydro transfers

Background:

The Snowy Scheme is a hydroelectric power generation scheme located in the upper catchments of the Murray, Murrumbidgee, and Snowy Rivers. The scheme harvests water from the upper catchments into dams and generates electricity by releasing water through power turbines into the Murray and Murrumbidgee Rivers or tributaries of these rivers.

The scheme is divided into two power generation systems:

- **Snowy-Murray Development,** which generates power from flows primarily released into the Murray catchment.
- **Snowy-Tumut Development,** which releases flows into the Murrumbidgee catchment.

Lake Eucumbene and Tantangara Reservoir store water for both the Snowy-Murray and Snowy-Tumut Developments. These storages are physically interlinked through tunnels. Water can be supplied to either catchment, meaning that inter-valley transfers between the Murray and Murrumbidgee are physically possible.

Project concept:

This option proposes the use of the Snowy Scheme to transfer some River Murray releases, that would normally be delivered via Hume Dam, instead to the Murrumbidgee River for delivery back to the River Murray, near Euston. Using this option would reduce the need to supply regulated water through the capacity restricted Barmah-Millewa Reach.

There are two flow routes that could be used to supply the Murray inter-valley transfer into the regulated Murrumbidgee River system, being the Tumut River and the upper Murrumbidgee River.

There are numerous and complex considerations associated with inter-valley transfers and the various delivery routes, including potential foregone energy production costs to Snowy Hydro, Tumut River environmental impacts, and Murrumbidgee River environmental impacts.

Murrumbidgee weir pools opportunity

The Redbank, Maude, Hay and Tombullen Weirs are located on the lower Murrumbidgee River within relatively close proximity to the River Murray. The weirs are operated to re-regulate surplus flows to deliver ordered water and maintain flow targets at Balranald. There may be an opportunity for the weir pools to supply water to the River Murray to avoid a delivery shortfall event.

This opportunity should be considered alongside the Snowy transfers option in any next stages of investigation.

Scope of works:

The volume of inter-valley Murray to Murrumbidgee transfer required would vary from year to year, based on several inter-linked factors that include water availability, climatic conditions, tributary inflows downstream of the Barmah-Millewa Reach, and specific operational requirements such as transfers to Tar- Ru (Lake Victoria).

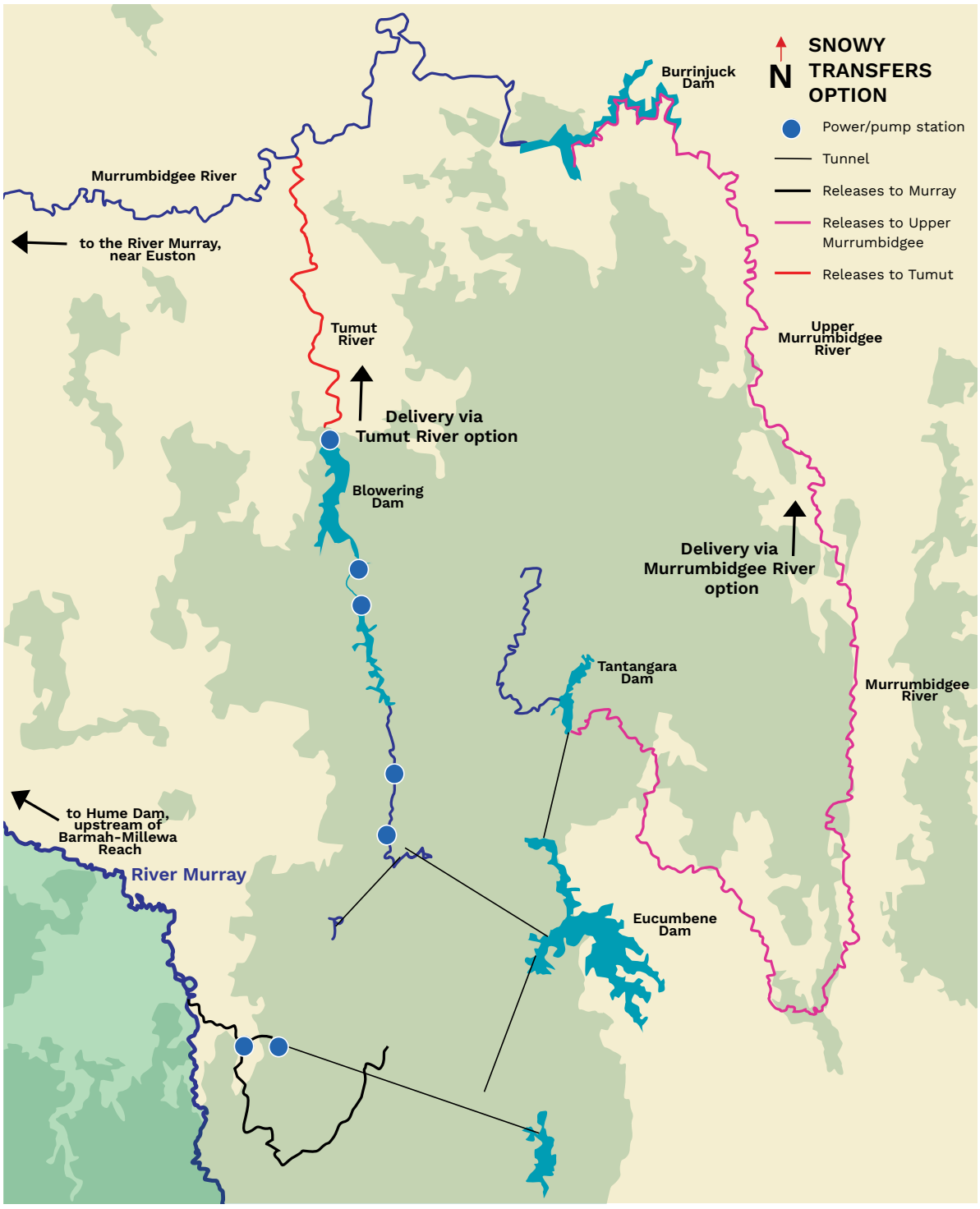
Initial investigations suggest that an annual intervalley transfer of 50 GL/year (nominally 500 ML/day delivered over 100 days) would provide River Murray system river operators with a useful buffer to manage potential system shortfalls.

Next steps:

This option would require several complex issues to be scoped, detailed, and agreed by several parties. The proposed next stages of development would likely involve:

- An options assessment and preparation of a concept proposal.
- Presentation of the concept proposal to Government stakeholders.
- Preliminary negotiations with Snowy Hydro.
- Detailed water resource management and operational change assessment.
- Development of detailed arrangements.
- Execution of agreements and program implementation.

Flow	Time to implement	MCA score	Capital cost	Operational cost (50 years)
500 ML/day	4 years	2.5	$5.0m	Variable



Snowy Hydro transfers

FIND OUT MORE

To read the technical studies which support this option, please refer to the BMFS page on the MDBA website.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5 Consultation

Input on the project and the options was sought from key stakeholder groups throughout the development of the feasibility study.

Stakeholder consultation was ongoing during the development of the various options and the feedback received has informed the assessment for each of the options and consideration of next steps.

Stakeholder engagement on capacity, deliverability and issues surrounding restriction though the Barmah-Millewa Reach has been ongoing for some years. Feedback from Traditional Owners and communities was taken on board and has shaped the study. It has influenced the selection of options for further investigation and has provided valuable insights into community values and sensitivities.

The BMFS sits within a broader context of several inter-related projects, water policy, the Basin Plan, river operational rules, and governance.

It has been important to be mindful that concerns, perceptions and perspectives developed via exposure to other projects and initiatives, may affect the lens through which stakeholders and community groups consider BMFS information such as options and suites of options.

Repeated water reforms over the past 20 years along with the crippling Millennium drought have taken a huge toll on the river communities in the southern connected Basin. Consultation burnout and, in some areas, a serious distrust of Government agencies prevails. Stakeholder groups, in particular Traditional Owners, have a very strong connection with the River Murray but have been excluded from decisions around the future management of the River and water resources.

The MDBA has been working hard to rebuild trust through communication and engagement work on several parallel projects including the Capacity and Shortfall Program.

The engagement approach

The BMFS Team's approach to stakeholder engagement is built upon the International Association for Public Participation's spectrum. The spectrum identifies that there are different levels of engagement from "informing" through to "empowering". The BMFS sought to consult, involve and collaborate with key stakeholders to deliver a well-informed feasibility study that was strengthened by subject matter expertise from local stakeholders.

The BMFS Team relied mostly on written materials to consult with stakeholders, supporting in-person and online meetings. The engagement tools and resources relied upon to ensure local insights inform the BMFS included;

- BMFS fact sheets
- BMFS options overview and assessment approach
- BMFS maps
- Stakeholder emails and phone calls
- Face to Face meetings (landowner properties / on Country)
- Virtual meetings and workshops

Engagement with operators and technical specialists

There are many water projects along the River systems in the Murray-Darling Basin. Often the stakeholders are common across a number of projects and the BMFS Team have been mindful to respect the time and attention stakeholders may be able to provide in the context of competing priorities.

The BMFS Team relied on existing data and site visits to inform which options should be assessed. Initially, some stakeholders, such as system operators, were engaged directly to provide data to inform the collation of the initial options list, with minimal burden on broader stakeholder groups.

Once an initial options list was established, engagement was expanded to include those stakeholders who could provide feedback specific to the options that would most benefit from their insight.

The BMFS is overseen by a Technical Oversight Committee (TOC) made up of members with expertise in water management and/or policy. Chaired by the MDBA Senior Director of River Modernisation, TOC members are from government organisations across NSW, VIC, SA and the Commonwealth and represent a diverse range of technical and policy perspectives to ensure the BMFS is a robust and well considered resource for the MDBA. The BMFS Team has engaged the TOC throughout the development of the BMFS Feasibility Study to review the insights garnered and benefit from subject matter expertise across the industry.

5 Consultation (cont.)

Engagement with Traditional Owners

Where possible, the project team has undertaken in-person meetings with Traditional Owner groups.

Engagement is ongoing and will continue beyond the 2022 Feasibility Study period. As options or suites of options proceed, the MDBA and Basin states will continue to engage with Traditional Owners, to inform and consult on more detailed plans for addressing capacity issues in the Barmah- Millewa Reach and the associated social, cultural and environmental impacts and benefits.

The objectives of the in-person meetings with Traditional Owner groups were to:

- Present information about the BMFS and overall project objectives
- Provide information about individual options and the concept of suites of options (combining a number of options together)
- Discuss with the group their values in the region and for the River Murray system, and how particular options may impact such values
- Receive feedback from groups about any preferences for options and feedback or concern on an option, and to represent these views to the MDBA as a part of this study
- Build and maintain relationships for ongoing engagement

In-person meetings were held with:

- Deniliquin Local Aboriginal Land Council (LALC)
- Cummeragunja Local Aboriginal Land Council (LALC)
- Joint Indigenous Group
- Yarkuwa Indigenous Knowledge Centre
- Yorta Yorta Nation Aboriginal Corporation
- Bangerang Aboriginal Corporation

Discussion with groups was wide-ranging and allowed a number of voices to be heard – some in agreement with each other, and some in opposition.

There was a general recognition of the important need to address the issue of reduced capacity in the reach itself – not only for economic and social reasons (to secure food production and employment), but also for environmental and cultural values. One group expressed the view that sediment removal works in the Barmah-Millewa Reach should only be for environmental and cultural reasons – and not to address issues of capacity.

A Traditional Owner Engagement 'What we heard' report has been prepared. This report captures the range of views we heard during these meetings.

Engagement with Community

Building on the relationships MDBA have been developing with community over recent years, the BMFS Team relied on written materials to support face to face and online engagement efforts. Engagement insights offered a range of perspectives and generally confirmed a collective interest in balancing environmental outcomes with maintaining capacity. The focus of communities shifted depending on where along the Murray engagement was undertaken, highlighting the need for specific customised engagement in different communities.

Once complete, the BMFS will be considered via a decision-making process involving entities including representatives of the Australian and jurisdictional levels of governments, MDBA, Technical Oversight Committee, and the next stages determined by the Ministerial Council.

WHAT WE HEARD

To find out more about Traditional Owner perspectives on the project and the individual options, please refer to the 'Traditional Owner Engagement: What we heard' Report available on the MDBA website.


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6 Individual option assessment

The relative merits for each of the options were assessed in four parts:

- **Part 1:** Implementation readiness (time).
- **Part 2:** Multi-criteria analysis against (scorable) project objectives
- **Part 3:** Qualitative assessment (non-quantified)
- **Part 4:** Cost effectiveness

The multi-criteria assessment included scoring each option against a set of weighted criteria including water availability, environmental, water delivery and social metrics.

Traditional Owner perspectives and cultural value considerations were separately captured in the 'what we heard' report. As such, the option assessment should be considered in the context of the perspectives provided through this engagement.

The options were prioritised based on their flow capacity, MCA assessment, cost effectiveness, and qualitative considerations.

Priority 1 options were identified to have the greatest potential to address the project objectives and should be considered first. Priority 3 options were identified to be of lowest priority and should be considered last.

No.	Option	Bypass flow equiv.	Part 1 Time	Part 2 MCA	Part 3 Qualitative	Part 4 Cost	Priority
		ML/day	Years	Weighted	Non-scored	$k/ML over 100 days	
1	River works	500[1]	1	6.5	✓	9.0	1
2	Sediment management	1,000[1]	5	6.0	!	124.9	1
3	Tar-Ru transfers	100	4	2.3	!	10.0	2
4A.1	MIL escapes (no works)	665	1	5.8	✓	6.4	1
4A.2	MIL escapes (works)	960	2	6.3	✓	60.2	1
4B	Perricoota Escape expansion	200	2	2.5	!	162.2	3
4C	Mulwala Canal extension	38	2	2.5	✓	1,298.7	3
5A	VMMS	300	2	8.8	!	27.0	1
5B	Murray Valley outfalls	110	5	0.5	!	31.2	2
5C	New bypass channel	1,000	8	3.8	✓	774.9	3
5D	Rochester 14 channel	500	5	4.3	✓	429.9	2
6	Snowy Hydro transfers	500	4	2.5	!	N/A	3

[1] options assessed as mitigating against potential future losses in flow capacity

FIND OUT MORE

To find out more about the assessment of the individual options, please refer to the Suites of Options Report.

To find out more about Traditional Owner perspectives on the project and the individual options, please refer to the 'Traditional Owner Engagement: What we heard' Report

Reports are available on the MDBA website.


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7 The suites of options

There are eight benefits sought from the Barmah-Millewa Feasibility Study. None of the individual options can adequately address all of these benefits. Accordingly, combinations (or 'suites') of options need to be developed. There are a range of different options which could be considered for maintaining or reinstating the flow capacity in the Barmah-Millewa Reach.

7.1 Option suites

'Do nothing'

In this scenario, no intervention works or measures are implemented in response to the sand accumulation and the declining flow capacity in the reach. As such, sand will continue to accumulate on the riverbed.

This 'do nothing' scenario assumes that the flow capacity of the Barmah-Millewa Reach will continue to decline by 100 ML/day per year over the next 10 years as a result of sand aggradation, and an additional 500 ML/day as a result of bank erosion resulting in the river being operated to a lower height.

Suite 1 – maintain current capacity

This scenario reflects undertaking the works required to maintain the current flow capacity through the Barmah-Millewa Reach. In this scenario, intervention works or measures are scoped as required to minimise or halt ongoing loss in capacity as a result of the sand accumulated in the reach.

Suites 2 to 4 – reinstate flow capacity

This scenario reflects undertaking works to reinstate flow capacity in the River Murray. In these scenarios, the works are scoped as required to minimise or halt ongoing loss in capacity in the reach and, in addition, restore system capacity by implementing bypass options.

The options to reinstate the flow capacity are:

- **Suite 2.** Reinstatement of around 500 ML/day (to 9,700 ML/day) of equivalent bypass capacity
- **Suite 3.** Reinstatement of around 1,000 ML/day (to 10,200 ML/day) of equivalent bypass capacity
- **Suite 4**. Reinstatement of around 1,500 ML/day (to 10,700 ML/day) of equivalent bypass capacity

Suite 5 – 'Do everything'

This scenario reflects implementing all options under consideration.

Any additional capacity beyond historical flows would only be accessed for the delivery of environmental water and not used to create trade opportunity.

7.2 Compiling the suites

Suites of options were compiled based on the prioritisation of the individual options.

The river works and sediment management options were prioritised as they are the only measures which directly target the source of decline in river capacity through the Barmah-Millewa Reach.

The enhanced use of the Victorian Mid-Murray Storages was prioritised as it is the only option which can be used to respond to hot weather in the lower Murray and deliver relatively high volumes at short notice.

The increased use of channel escapes in the MIL channel network was the top priority measure for increasing capacity to bypass water around the Barmah-Millewa Reach.

The other options were considered for the higher flow options in accordance with the option priority order.

Note that some of the options are considered necessary if the benefits of the project are to be achieved. That is, if these options are not implemented, then the problem statement cannot be addressed.

These necessary options include:

- **Option 1** (riverbank works) will be required as part of any option suites, to ensure that the project benefit of reducing the risk of bank failure at the Barmah-Millewa Forest can be met (B006).
- **Option 2** (sediment management) will be required as part of any option suites, to ensure that the project benefit of reducing localised environmental impacts associated with the ongoing sedimentation of the reach is met (B005).
- **Option 5** (enhanced use of the VMMS) will be required as part of any option suites, to ensure that the project objective of maintaining or enhancing the ability to meet peak demands downstream of the Barmah-Millewa Reach can be met (B001).

7.3 Assessing the suites

The suites were assessed using a Decision Making Framework which was developed for the MDBA by the Independent Expert Panel for Capacity Project Review.

Each of the suites were assessed against water resource availability, environmental conditions, delivery risks, and river community considerations. The table on the next page shows each of the suites and how they performed against the assessment criteria.

7 The suites of options (cont.)

			Annual system capacity (ML/day)	System capacity (rounded, ML/day)	Option suites 'Do nothing'	Suite 1	Suite 2A MIL only	Suite 2B MIL & Vic	Suite 3	Suite 4	Suite 5
					Ongoing decline	Maintain current capacity	Reinstate +500 ML/ day	Reinstate +500 ML/ day	Reinstate +1,000 ML/ day	Reinstate +1,500 ML/ day	'Do everything'
Do nothing					-1,500	-1,500	-1,500	-1,500	-1,500	-1,500	-1,500
Implementation timeframe capacity loss						-500	-500	-500	-500	-500	-500
Option 1	1	Riverworks	500	500		500	500	500	500	500	500
Option 2	2	Sediment removal	1,000	1,000		1,000	1,000	1,000	1,000	1,000	1,000
Option 3	3	Tar-Ru[1]	100	100			[1]	[1]	[1]	100	100
Option 4 MIL	4A.1	Existing outlets	665	650		500	650	500	650	650	650
	4A.2	Upgraded outlets	295	350			350		350	350	350
	4B	Perricoota Escape	200	200						200	200
	4C	Mulwala	38	50						50	50
Option 5	5A	VMMS[2]	0	0		Delivery shortfalls[2]	Delivery shortfalls[2]	Delivery shortfalls[2]	Delivery shortfalls[2]	Delivery shortfalls[2]	Delivery shortfalls[2]
	5B	Vic outfalls	110	150						150	150
	5C	Barmah channel	1,000	1,000							1,000
	5D	RO channel	500	500				500	500	500	500
Option 6	6	Snowy[3]	500	500			[3]	[3]	[3]	[3]	500
Change from current					**-1,500**	**0**	**500**	**500**	**1,000**	**1,500**	**3,000**
Bypass capacity					**7,700**	**9,200**	**9,700**	**9,700**	**10,200**	**10,700**	**12,200**

Construction and O&M costs ($)	-	$141 m	$171 m	$357 m	$382 m	$472 m	$1,325 m
Construction and O&M costs per ML/day bypass capacity	-	**$95 k/ML**	**$85 k/ML**	**$178 k/ML**	**$153 k/ML**	**$157 k/ML**	**$294 k/ML**

Decision-Making Framework Assessment Outcomes							
Water Availability Assessment	NR 3	NR 3	NR 3	NR 3	NR 3	NR 2	NR 2
Environmental Conditions Assessment	NR 2	NR 3	NR 3	N	PR 3	PR 3	PR 2
Delivery Risk Assessment	NR 1	N	PR 3	PR 2	PR 2	PR 2	PR 1
River Communities Assessment	NR 2	N	N	N	N	N	PR 3

Positive Risk 1	**Option provides a very positive opportunity**
Positive Risk 2	**Option provides a medium opportunity**
Positive Risk 3	**Option provides a low potential opportunity**
Neutral	**Option provides no risk impact or is n/a**
Negative Risk 3	**Option presents a low risk potential**
Negative Risk 2	**Option presents a medium risk potential**
Negative Risk 1	**Option presents a high risk potential**
Not assessed	**Option unable to be assessed**

[1]: While the Tar-Ru option is brought into the suite of options relatively later in this assessment, there are potentially significant outcomes in some years at a relatively low cost achievable by implementing this option. Governments may elect to include this option in earlier suites than shown.

[2]: The enhanced use of the Victorian Mid-Murray Storages (VMMS) is most likely to contribute to delivery shortfall events (i.e., by releasing large volumes over a short period) and not relied on for additional system capacity, therefore it has not been assigned a flow in the suites of options. The storages could deliver around 10 GL over a 10-day period to manage potential shortfall event.

[3]: The potential use of weirs in the lower Murrumbidgee River to reduce the risk of a delivery shortfall in the River Murray may warrant inclusion of a limited Snowy transfer option in these suites

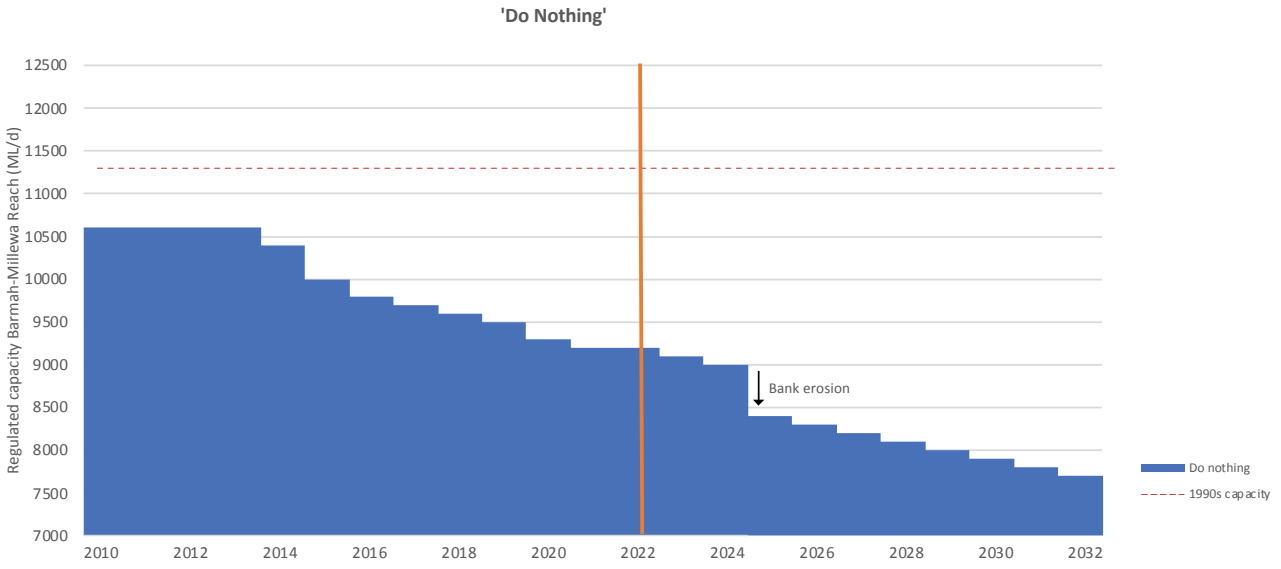
7.4 Time to implement the options

To understand the potential bypass flow capacity of the Barmah-Millewa Reach and how it may change over time under the different suites, potential timelines showing the expected equivalent flow capacity of the reach were produced from 2010 to 2032.

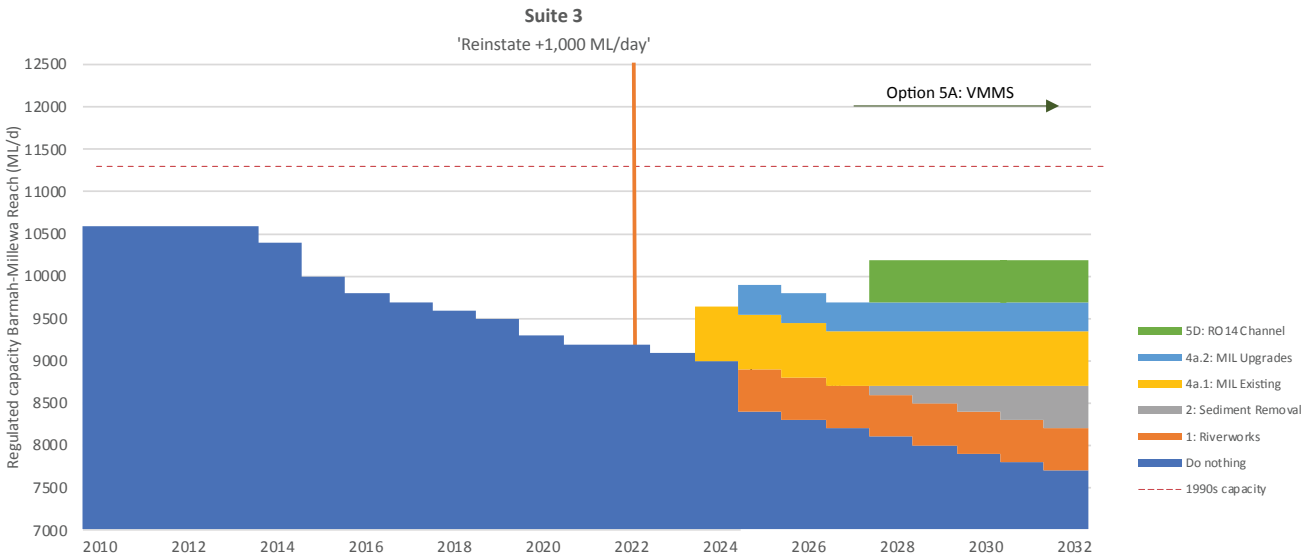
These graphs show how the flow capacity would be expected to decline under a 'do nothing' scenario, and how this can be offset by implementing some or several of the options. Charts are shown for the 'do nothing' and 'reinstate +1,000 ML/day' (as an example) below.

The 'do nothing' graph assumes a 500 ML/day reduction occurs in around 2024 as a result of erosion causing a new breakaway into the forest. The timing of this event is entirely arbitrary, but considered realistic, noting that a 500 ML/day reduction in flow rate corresponds to operating the river around 200mm lower.

'Do Nothing'



Suite 3: 'Reinstate +1,000 ML/day'



7 The suites of options (cont.)

The following observations were made with respect to the potential options that Governments could consider.

The 'do nothing' scenario scores the poorest of any option

- If no intervention measures are taken, all domains (water availability, environmental conditions, delivery risks, and river communities) are expected to have further negative impacts.
- The 'do nothing' scenario scores the poorest in the environmental conditions, delivery risk, and river community domains of any suite assessed. If no intervention measures are taken, there is a 'high risk' potential (NR1) for managing delivery shortfall risks to irrigators and the environment over the next 10 years.
- The 'do nothing' scenario scores relatively well in the water availability domain, as the bypass options generally result in additional conveyance losses being incurred. However, the differences in the assessment are relatively minor (from NR3 to NR2).
- While there are no direct costs associated with the 'do nothing' scenario, the continual decrease in flow capacity in the Barmah-Millewa Reach would be expected to increase the risk of shortfall events. Over the next 10 years, the declining flow capacity could affect more than $200 million per annum of irrigated agriculture in the lower Murray. Impacts would also be expected on environmental condition, social values, cultural values, and reliability of entitlements.
- The Capacity Policy Working Group has identified that it is likely that a significant shortfall event would result in long-term damage to relationships between the jurisdictions and the ability to develop and implement good water policy for a considerable period.

'Holding the line' can significantly offset the risk of further impacts on environmental, social, and cultural values - but it requires several options to achieve this

- The 'maintain current capacity' suite substantially offsets the risks of doing nothing, including delivery risk to irrigators and environmental water holders (from high risk to neutral), impacts on environmental condition (from medium risk to low risk) and impacts on river communities (from medium risk to neutral).
- To maintain the current capacity and achieve the objectives of the BMFS, the riverbank works, sediment management, enhanced use of the Victorian Mid-Murray Storages, and some bypass options are needed.
- The riverbank works and sediment management options are necessary to ensure that the environmental and social outcomes targeted by this study are supported.
- The enhanced use of the VMMS is necessary to improve the ability for river operators to respond to potential delivery shortfall events in the lower Murray.
- The increased use of the MIL escapes provides the best means available for increasing the system capacity and helps to 'hold the line' by offsetting the sand aggradation which is expected to occur while the mitigation options are being investigated and designed.

There is merit to further exploring bypass options in both NSW and Victoria

- There are options in NSW and Victoria which could be considered to achieve equivalent flow outcomes.
- Upgrading MIL escapes (option 4A.2) would provide the same bypass capacity at a relatively lower cost and better value-for-money than equivalent options in Victoria (option 5D).
- However, the Rochester channel option (option 5D) provides a better opportunity to achieve environmental outcomes, through delivering Goulburn trade commitments to the Murray with reduced pressure on important natural waterways including the Goulburn River and Broken Creek.
- The beneficial outcomes from these options can be combined to provide step-change, as seen in the assessment of Suite 3 (reinstate +1,000 ML/day), where both the environmental conditions and delivery risk domains move to improved outcomes.
- The increased volume of flows bypassing the reach using these options however increase water losses.
- There appears to be merit in further exploring these options. Having NSW and Victorian options under further investigation would also allow the MDBA and the joint governments to best manage risks and achieve commercial outcomes by having multiple options available under different scenarios and avoiding a reliance on only one option.

The 'do everything' scenario scores the most positive – but at significant cost

- The 'do everything' scenario scores the best in the environmental conditions, delivery risk, and river community domains of any suite assessed.
- The 'do everything' scenario scores the poorest regarding water availability, as using a wide range of significant infrastructure to bypass the reach would increase water losses, in turn affecting entitlement holders and potentially impacting State water shares.
- In addition, the capital and operational costs for implementing all the options is around 2 – 3 times poorer value for money than other suites.

Traditional Owner perspectives must be considered in addition to this assessment

- Traditional Owner perspectives on this project and the various options have been collected through discussions and collated into a 'what we heard' report.
- It was not considered appropriate for cultural values or Traditional Owner perspectives to be quantitatively assessed as part of the suite assessment.
- Accordingly, in considering the options, the suites, and this project, we recommend that the Traditional Owner engagement report be read in conjunction with this report.
- Further engagement with Traditional Owners should form an important activity included in any additional development stage of this project.

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FIND OUT MORE

To find out more about the assessment of the suites options, please refer to the Suites of Options Report.

To find out more about Traditional Owner perspectives on the project and the individual options, please refer to the 'Traditional Owner Engagement: What we heard' Report.

Reports are available at the BMFS page on the MDBA website.


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8 Next steps

8.1 Context

As set out in this study report, there are a wide range of potential options and suites of options which could be implemented to address the ongoing decline in flow capacity and associated impacts.

An assessment of the relative merits and risks associated with these options and suites has been undertaken to provide information which decision makers can consider when determining an appropriate course of action.

The specific scope of the next steps for the development of this project are subject to this decision.

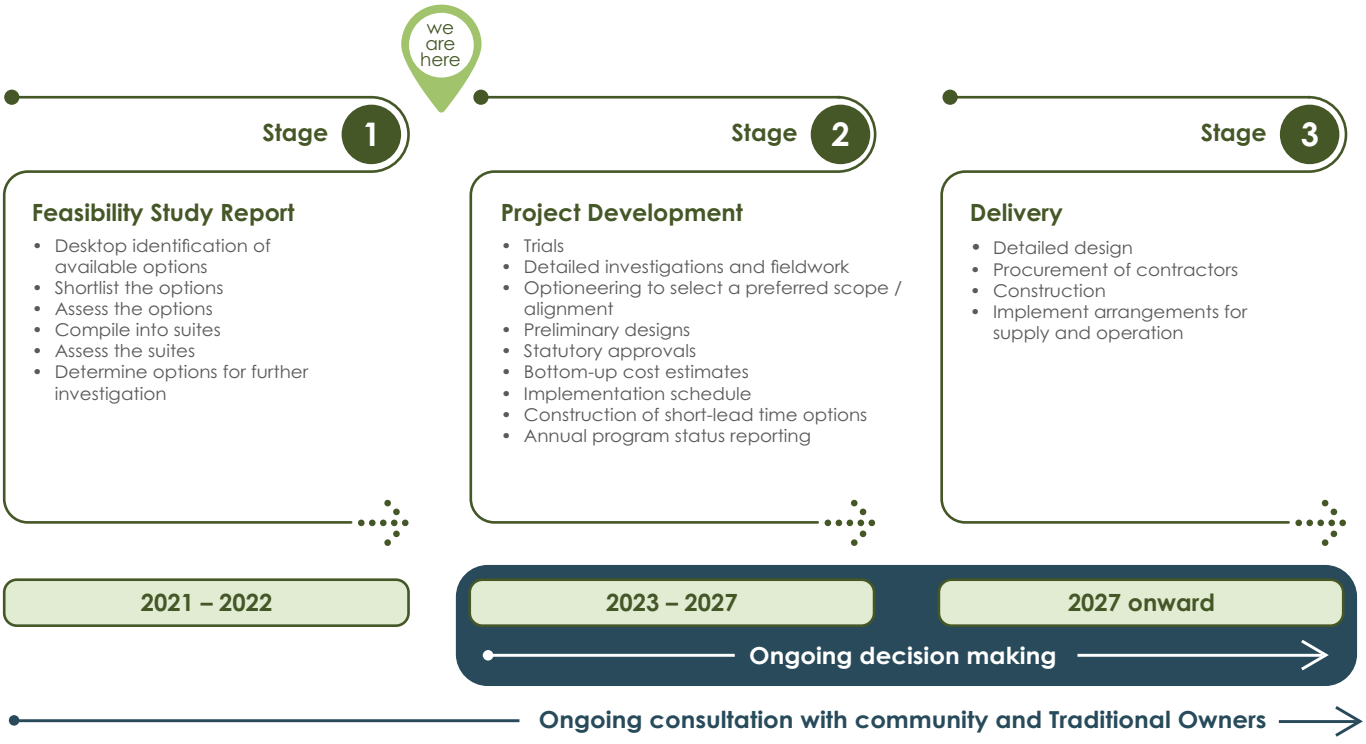
8.2 Next stages of development

All options considered in this study are currently at a feasibility level of development. That is, the options have generally been explored at a conceptual level only, with checks completed to ensure that they could be feasibly implemented.

If a decision is taken to further explore the options, then further investigations, designs and consultation would need to be prepared for each option. This would allow the relative merits of the options to be considered in detail and a decision taken around which options should be implemented (and funded).

The potential suites of options range from implementing none of the measures ('do nothing') through to implementing all measures ('do everything').

A decision about which of the options should proceed to the next stages of development will be made by the Basin governments. At a program-scale, there are generally three stages of development - this feasibility study report, the project development, and detailed design and delivery. Consultation with Traditional Owners and communities will be continuous and extend through all of these stages.



8 Next steps (cont.)

8.3 Budget and schedule

The Basin governments will make a decision on which of the options to take into the next stages of development.

The budget and time required to develop and implement the project varies between the options as shown in the figure below. There will be several decision points for each option, with consultation continuous throughout.

		Stage 1 Feasibility study			Stage 2 Development		Stage 3 Implementation	
No.	**Description**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**
Priority 1 Options (Suite 1 & 2A)								
1	River works	**Erosion protection works** $4.5 M					**Review**	
2	Sediment management	**Sampling & pilot** $3.0 M		**Business Case** $4.0 M		**On-shore works** $7.5 M	**Sediment removal**	
4A.1	MIL escapes (no works)	**Negotiation** $0.1M	**Trials**	**Bypass flows**				
4A.2	MIL escapes (works)	**Negotiation, Design & Approvals** $1.5 M		**Build** $17.0 M	**Bypass flows**			
5A	Enhanced use of VMMS	**Negotiation, Design & Approvals** $0.75 M		**Build** $5.0 M	**Usual practices**			
Priority 2 Options (Suite 2B & 3)								
3	Tar-Ru transfers	**Risk framework development** $1.0 M				**Usual practices**		
5D	Rochester 14 channel	**Concept Development** $3.0 M	**Design, Approvals** $12.2 M		**Build** $150 M		**Bypass flows**	
5B	Enhanced use of MVIA outfalls	**Negotiation, Design & Approvals** $0.3 M				**Build** $1.7 M	**Bypass flows**	
Priority 3 Options (Suite 4 & 5)								
4B	Perricoota Escape expansion	**Negotiation, Design & Approvals** $3.0 M		**Build** $21.5 M	**Bypass flows**			
4C	Mulwala Canal extension	**Negotiation, Design & Approvals** $3.2 M		**Build** $35.3 M	**Bypass flows**			
5C	New gravity channel	**Concept Development** $4.0 M	**Prelim Design** $11.1 M	**Detailed Design & Approvals** $59.3 M		**Build** $527.6 M		
6	Snowy transfers	**Concept Development** $1.0 M	**Investigation, Policy Changes** $4.0 M			**Bypass flows**		

▲ Decision Point

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