Amendment date: 28 June 2017

	Title of measure	**Flexible rates of fall in river levels downstream of Hume Dam**
	Proponent undertaking the measure	**Victoria/NSW**
	Type of measure	**Supply**
1.	**Confirmation**	
	Date by which the measure entered into or will enter into operation *Must be before 30 June 2024*	The rule changes will be operational by 30 June 2024.
	Confirmation that the measure is not an 'anticipated measure' *'Anticipated measure' is defined in section 7.02 of the Basin Plan to mean 'a measure that is part of the benchmark conditions of development'.*	Yes. It is a new project (not already included in the benchmark conditions).
	Confirmation that the proponent state(s) undertaking the measure agree(s) with the notification *Joint proposals will need the agreement of all proponents*	Yes (Victoria and NSW agree).
2.	**Details of the measure**	
	Capacity of the measure to operate as a supply measure *'Supply measure' is defined in section 7.03 of the Basin Plan to mean 'a measure that operates to increase the quantity of water available to be taken in a set of surface water SDL resource units compared with the quantity available under the benchmark conditions of development'.*	Yes. The project allows river operators to efficiently manage Hume release rates whilst demand for release is recessing. Therefore it would increase the quantity of water available to be taken compared with the quantity available under benchmark conditions of development.
3.	**Description of the works or measure**	
	Rule change to allow Hume releases to be reduced more quickly when flows have not been elevated for an extended period beforehand, with the water saved released at a different point in time or in a different flow pattern that would provide additional environmental benefits. The additional flexibility improves Hume Dam operational efficiency.	
4.	**Geographical location of the measure**	
	Hume Dam which is located approximately 27 kilometres east of the city of Albury, plus Murray River at Heywoods (at the foot of the dam) and Doctors Point (17 km downstream of Hume Dam).	
5.	**Details for representing the measure in the MDBA's assessment framework**	
	Under the Benchmark, MSM-Bigmod restricts river level changes at the downstream of Hume. To represent the proposal, the restrictions on rates of fall have been relaxed. This update allows the current modelling framework to calculate additional benefits to all users including the environment.	
6.	**Details for the representation of each operating strategy, policy or rule change proposed.**	
	The operating strategies to be adopted in the modelled assessment are as per the business case (**Attachment A**), and are as follows:	

Current policies or operational rules relavant to proposal

The current operating rule of maximum allowable fall in water level is to minimise the bank erosion along the River Murray below Hume Dam. The rule is defined at two locations as stated below:

- Maximum eight inch (200 mm) per day at Heywoods, and
- Maximum six inch (150 mm) per day at Doctors Point.

Proposed policies or operational rules for proposal

From January to May,

- Maximum rate of fall allowed is nine inch (225 mm) per day at Heywoods and Doctors Point
- Average rate of fall over 4 days retained at existing limit, as eight inch (200 mm) per day at Heywoods and six inch (150 mm) at Doctors Point.

The change would not apply to:

- From June to December and
- During low flows when flow at Doctors Point is less than 12,000 ML/d.

Mitigation strategies for third party impacts

The change would be subjected to monitoring as part of a two year pilot exercise to identify any adverse outcomes in terms of river bank stability. The following third party impacts have been identified:

1. Impacts on the ability of urban water authorities to extract water for supply: Concern was raised that changing the rate of release may affect the efficiency of off-take points for Urban water supplied by Albury City Council and North East Water. But the authorities confirmed that their priority concern is with overall low flows, not with the rate of change in the rate of flow. The proposed changes will not apply at flows below 12,000 ML/d.
2. Impacts on irrigator's ability to divert water for use: For private diverters the major third party risk is that their pump location is either stranded or swamped. The rate of fall is not a priority concern.
3. Impact on South Australia: South Australia is concerned to ensure that any changes does not affect their rights regarding flows and water quality at the border by reducing total flows in the system. The modelling and analysis confirms that the proposed change virtually has no impact on projected flows and average salinities to South Australia each month compared to the benchmark condition.

7. Representation of each operating strategy in the MDBA modelling framework

MSM and Bigmod has been modified to reflect the maximum allowable fall of nine inch at Heywoods and Doctors Point during January to May. The loss rate in MSM has been changed according to Table 4.2 in Jacobs (2015) to reflect the saving in operational loss due to the change in rate of fall, table below. In Bigmod the permissible rate of fall in relation to flow at that point has been changed to reflect the changed rate of fall at the two locations as per the proposed operational rules.

Month	Average monthly operational loss saving (GL)
January	1.8
February	0.5
March	0.7
April	0.6
May	0.9
June	0.0
July	0.0
August	0.0
September	0.0
October	0.0
November	0.0
December	0.0

The flow and rate of fall relationship at Doctors Point is shown below.

Flow (ML/d)	0	814	5060	9990	20000	25100
Permissible rate of fall in current model (ML/d/d)	0	606	1300	1600	2000	2100
Permissible rate of fall in proposed model (ML/d/d)	0	712	1664	2290	2850	2800
Height in river (mAHD)	0	1.44	2.16	2.67	3.48	3.89

The flow and rate of fall relationship at Heywoods is shown below.

Flow (ML/d)	0	1000	6000	10000	15000	20000	25100
Permissible rate of fall in current model (ML/d/d)	0	676	1620	2070	2300	2600	3000
Permissible rate of fall in proposed model (ML/d/d)	0	726	1895	2277	2600	2850	3300
Height in river (mAHD)	0	1.34	2.04	2.45	2.9	3.3	3.66

8. Spatial data describing the inundation extent associated with the operation of the measure

Not applicable.

9. Surface water SDL resource units affected by the measure

This measure identifies all surface water resource units in the Southern Basin region as affected units for the purposes of notifying supplying measures. The identification of affected units does not constitute an agreement between juristictions on apportioning the supply contribution, which will be required in coming months.

10. Details of relevant constraint measures

Not directly linked to constraint measures.

Attachments:

A	DELWP, 2015	Business case for flexible rates of fall in river levels downstream of Hume Dam - the six inch rule

Business case for flexible rates of fall in river levels downstream of Hume Dam - the six inch rule

A Sustainable Diversion Limit Adjustment Measure

A joint proposal prepared by the Department of Environment, Land, Water and Planning (Victoria) and the Office of Water (NSW)

Department of Environment, Land, Water & Planning
State Government Victoria

Acknowledgements

This business case was prepared by Alluvium Consulting Australia, RM Consulting Group and DG Consulting under contract from the Department of Environment, Land, Water and Planning (DELWP).

Significant advice and review was provided by representatives from a variety of other cross-jurisdictional agencies, including DELWP, Goulburn-Murray Water, Water NSW, North East Water and North East and Goulburn Broken Catchment Management Authorities.

Cover photos courtesy of Tony Crawford, NSW Office of Water and Mitercraft office supplies.

Contents

Glossary

AHD	Australian Height Datum
CMA	Catchment Management Authority
CMS	Constraints Management Strategy
DELWP	Department of Environment, Land, Water and Planning
EC	Electrical Conductivity
GL	Gigalitre (1,000,000,000 litres)
GST	Goods and Services Tax
ICC	Icon site Coordinating Committee
MEP	Monitoring and Evaluation Plan
MDBA	Murray-Darling Basin Authority
ML	Megalitre (1,000,000 litres)
NSW	New South Wales
SDL	Sustainable Diversion Limit
SDLAAC	Sustainable Diversion Limit Adjustment Assessment Committee
SFI	Specific Flow Indicator
SO&O	Specific Outcomes and Objectives
TLM	The Living Murray
WRP	Water Resource Plan

Executive summary

Operating rule change for SDL adjustment

This business case proposes to relax the current operating rules for the maximum rate of fall in river levels allowed downstream of Hume Dam due to regulated releases (the six inch rule). The outcome will be to deliver equivalent environmental outcomes as proposed in the Basin Plan with less water, so generating a possible Sustainable Diversion Limit (SDL) offset.

The proposal is an '*Operating Rule Change*' under the terms of the Phase 2 Assessment Guidelines for Supply and Constraint Measure Business Cases published by the SDL Adjustment Assessment Committee (SDLAAC).[1]

The six inch rule

Hume Dam is the major storage on the River Murray. Water is released from the dam to supply irrigation and environmental customers downstream. There are constraints on the rate at which that outflow can be reduced in order to minimise the risk of the bank slumping below the dam if the water level is reduced suddenly. The current operating rule limits the maximum daily rate of fall:

- At Doctors Point to six inches (150 mm)
- At Heywoods to eight inches (200 mm)

This risk management measure can generate two unintended adverse outcomes:

- It can result in excess water being released from Hume Dam, as dam releases cannot be scaled back quickly in response to a severe rainfall rejection event. If it is not possible to re-regulate that excess water, application of the rule will create a raised operational loss
- The excess flows can then result in un-seasonal flooding of the Barmah-Millewa Forest downstream of Yarrawonga Weir.

The proposal

Research suggests that bank slumping from a sharp rate of fall is not a material risk in the reach below Hume Dam. This business case therefore proposes a more flexible approach to the rate of fall allowed at times when the impact of un-seasonal watering is most severe for the Barmah-Millewa Forest and when rainfall rejection events are most likely to occur.

The proposed rule change would:

- Increase the allowed maximum daily rate of fall at both sites to nine inches (225 mm)
- Within an overall average rate of fall over four days equal to the current constraints
- Apply only during the period from January to May
- Not apply at times of low flows < 12,000 ML/day

The outcome should be a reduction in operational losses and in risks of un-seasonal watering of sites below Yarrawonga Weir.

[1] SDLAAC 2014. *Phase 2 Assessment Guidelines for Supply and Constraint Measure Business Cases*

Stakeholder engagement

A workshop of relevant cross-jurisdictional agencies was held (23 March 2015) to discuss the proposal and identify wider community stakeholders with an interest in the proposal.

Direct engagement with those stakeholder groups was not undertaken as part of this stage of the project. A targeted and coordinated engagement process is recommended that includes broader engagement on a wider suite of SDL adjustments in the Basin, rather than consultation on this specific proposal in isolation. This approach is recommended as the likely concerns of other groups relate to not just this one proposal, but the broader SDL adjustment process and the interaction with other proposed measures. The business case provides recommendations for the coverage of the engagement program that will need to be completed as a second stage of the proposal.

Costs

The costs to implement the proposed rule change are very modest, particularly in comparison to other proposals that require the construction of physical infrastructure to deliver environmental water to environmental assets.

The only costs that will need to be incurred will be those involved in completing a stakeholder engagement exercise to ensure community understanding and support for the proposals, and to update Murray-Darling Basin Authority (MDBA) water accounting procedures and tools.

It is suggested that this engagement is delivered as part of a wider regional exercise to consult on a suite of possible SDL adjustment initiatives. That would also help share costs over the wider exercise.

Impact assessment

A structured risk assessment was undertaken in line with the requirements of the Phase 2 Guidelines. This took account of the advice of an expert working group from across agencies, followed by a rigorous assessment process. The process identified a suite of potential risks covering a range of issues.

This business case reports on the assessment and modelling undertaken to analyse the likely extent of those potential impacts. Assessments confirmed that the proposed changes should generate outcomes that are at least neutral and in many cases broadly positive. The priority risks, concerns and outcomes are identified in Table 1.

Table 1. Priority risks, concerns and outcomes of the business case

Issue	Issue	Comment
River bank stability	That increased rates of fall will increase risks of bank slumping	MDBA has pilot study monitoring impact of proposal
Ecosystem health	That increased rates of fall may not enhance ecosystem health	Evidence from modelling and CMAs on benefits
Operational losses	That the operational losses cannot be adequately defined or captured	Modelling to confirm quantum of savings
Urban water offtakes	That increased rates of fall may impact on water off-take points	Contact with authorities to confirm limited impact
Project delivery	That landholders below the dam oppose the initiative	MDBA provides regular briefing for these partners

The business case advises that with adequate stakeholder engagement all outcomes are either positive or that residual risks are negligible or can be adequately mitigated.

Modelling demonstrates that the proposed rule change will reduce the volume of 'operational losses' involved in generating equivalent environmental outcomes compared to the benchmark modelling. This creates the potential for the rule change to make a positive contribution to a package of measures that could be assessed for SDL adjustment opportunities.

There are likely to be positive synergies between this proposal and the parallel initiative to re-schedule pre-releases from Hume Dam. However, any potential inter-dependencies between this supply measure and other measures cannot be formally ascertained until a final package of proposed supply measures is identified and modelled by the MDBA.

The business case also confirmed there was little interaction between this rule change and the proposal in the *Constraints Management Strategy*[2] to increase the maximum channel capacity downstream of Hume Dam from its current limit of 26,000 ML/day to close to 40,000 ML/day.

Governance and delivery

This business case has been developed as a joint proposal from Victoria and New South Wales (NSW). The detailed business case documentation has been prepared under the oversight of the Victorian Department of Environment, Land, Water and Planning (DELWP).

The operational rule change will require actions to be undertaken by the MDBA.

[2] MDBA 2013, Constraints Management Strategy 2013 to 2024. Licensed from the Murray–Darling Basin Au hority, under a Creative Commons Attribution 3.0 Australia Licence.

1. Introduction

1.1. SDL adjustments through operating rule changes

The Murray-Darling Basin Plan (Basin Plan) was prepared by the Murray-Darling Basin Authority (MDBA) and signed into law by the Commonwealth Minister for Water on 22 November 2012, under the Commonwealth *Water Act 2007*. The *Intergovernmental Agreement on Implementing Water Reform in the Murray Darling Basin* subsequently outlined the commitments and responsibilities of the participating jurisdictions and the program for putting the Basin Plan into action.

The Basin Plan sets legal limits on the amount of surface water that can be extracted from the Murray-Darling Basin (the Basin) for consumptive use from 1 July 2019 onwards. The sustainable diversion limits (SDLs) for surface water are currently set at a reduction of 2,750 GL on current extraction levels. That SDL value has been modelled to create a certain level of environmental outcome. Under the provision in Chapter 7 of the Basin Plan and in the *Intergovernmental Agreement on Implementing Water Reform in the Murray Darling Basin*, it was agreed that the Basin Plan should be able to achieve these environmental outcomes by improved use and management of the water, as well as by reducing current extraction levels. That would allow the SDL reduction to be adjusted, reducing impacts on regional communities.

The Basin Plan allows for up to 650 GL of the 2,750 GL SDL reduction to be accounted for through this improved use and management of environmental water. The jurisdictions in the Basin states and the MDBA have established an inter-jurisdictional committee, the SDL Adjustment Assessment Committee (SDLAAC), to manage this process and to evaluate proposed investments.

The Basin states have developed a program to promote initiatives under these processes. SDLAAC has drawn up guidelines to help steer the drafting of business cases for such proposals.[3]

Five different forms of intervention have been identified in the guidelines:

- **Environmental works and measures at point locations**: Infrastructure-based measures to achieve the Basin Plan's environmental outcomes at specific sites along the river using less environmental water than would otherwise be required.
- **Water efficiency projects**: Infrastructure-based measures that achieve water savings by reducing water losses through, for example, modified wetland or storage management.
- **Operating rules changes:** Changes to policies and operating rules that lead to more efficient use of water and savings and contribute to achieving equal environmental outcomes with less water.
- **Physical constraint measures:** Ease or remove physical constraints on the capacity to deliver environmental water.
- **Operational and management constraint measures:** Changes to river management practices.

This business case covers one such initiative regarding the rules governing the maximum rate of fall in the River Murray below Hume Dam due to regulated releases. This is an 'operating rule change' that achieves equivalent environmental outcomes with less water providing an opportunity to deliver a Sustainable Diversion Limit adjustment. This business case has been prepared in accordance with the Phase 2 Assessment Guidelines (refer Appendix 1). It also meets the requirements of the Phase 1 Guidelines for Feasibility Studies (refer Appendix 2).

[3] SDLAAC 2014. *Phase 2 Assessment Guidelines for Supply and Constraint Measure Business Cases*

1.2. Terms of reference

This business case has been developed as a joint proposal from Victoria and NSW. The detailed business case documentation has been prepared under the oversight of the Victorian Department of Environment, Land, Water and Planning (DELWP). DELWP specified the terms of reference for this initiative as:

> *The proposed operating rule change is to increase operational flexibility by allowing an increased maximum rate of fall in river levels. Modelling work commissioned by DELWP demonstrated that relaxation of the 'six inch rule' could lead to improved environmental outcomes within the River Murray.*

This is an 'Operating Rule Change' under the terms of the SDLAAC Guidelines as it involves a proposal to change the operational rules, planning and practice for controls of releases from Hume Dam rather than the construction of works and measures. The outcome of this change will be to deliver equivalent environmental outcomes as proposed in the Basin Plan but with less water, so generating an SDL offset.

1.3. Background to the proposal

The Hume Dam is the major storage on the River Murray. Water is released from the dam to supply irrigation and environmental customers downstream. An operating rule was introduced to control the rate of reduction in releases from Hume Dam, shortly after its completion in 1936. The River Murray Commission opposed any suggestion to increase the rate of fall claiming that to do so would *"trigger very serious erosion of the river banks and substantial silting of the river bed"*[4].

The current operating rule limits the maximum daily rate of fall:

- At Doctors Point to six inches (150 mm)
- At Heywoods to eight inches (200 mm)

The current rule is therefore commonly referred to as "the six inch rule".

This risk management measure can generate two unintended adverse outcomes:

- It can result in excess water being released from the dam, as dam releases cannot be scaled back quickly in response to a severe rainfall rejection event. If it is not possible to re-regulate that excess then it creates a raised operational loss.
- The excess flows can also result in unseasonal flooding downstream of Yarrawonga Weir.

1.4. Defining the proposal

1.4.1. History and context

The priority concern for the River Murray Commission in 1940 was to maximise effective capture of flows and to minimise adverse effects on river form, in particular bank slumping, below the dam. Since then river management objectives have broadened to include ecological considerations. The Basin Plan and the Constraints Management Strategy (MDBA 2013) set a wider suite of aims which include promoting environmental outcomes through flow management.

A number of studies have been undertaken which suggest that the risks related to bank slumping may not be as great as originally assumed. Equally, the adverse impacts on the Barmah-Millewa Forest are now considered to be more important than when the rule was established.

[4] RMC (1947) File 1463, quoted in Earth Tech (2008), *River Murray Six Inch Rule Review*

1.4.2. The proposal

This business case proposes to relax the current constraints on the rate of reduction allowed in regulated releases from the dam. However, this relaxation is a prudent and balanced measure as:

- It permits an increase in the maximum daily rate of fall, but only within an average four day cap set at the current constraints.
- The relaxation only applies during the height of the irrigation season between January to May inclusive, when risks of rainfall rejection events are highest and when unseasonal impacts on the Barmah-Millewa Forest are greatest. This limits any potential increased risk of bank slumping during higher rainfall periods (from June to October) when the river bank is more likely to be saturated.
- The change will only be introduced after completion of the current two-year trial which includes detailed monitoring of bank condition to check for risks of increased slumping.
- Greater relaxation of the current constraints may be possible, however the proposal put forward has been selected as it addresses the key issues identified with the current rule, whilst taking a precautionary approach and minimising the potential for unintended consequences from higher rates of flow reduction.

Further details of the proposal are provided in Section 2 of this business case.

1.4.3. Interaction with other initiatives

The business case reviewed how far this proposal would interact with other, parallel SDL offset proposals. The assessment covered two classes of initiatives – the constraints strategy, and other operating rule changes and works and measures initiatives.

Constraints strategy

The MDBA released a Constraints Management Strategy (CMS) at the end of 2013, with a target of agreeing on proposals to address constraints by 2016. In recognition of this, the business case looked at how far any likely outcome of the constraints strategy would interact with this proposal.

One of the key constraints in the system is the maximum channel capacity downstream of Hume Dam. The CMS includes proposals to increase this capacity to 40,000 ML/day. The assessment suggests that there will be little interaction between the two initiatives as:

- the increased flow rates from the CMS will occur predominately during winter and spring (i.e. outside the application of the proposed rule change) and
- the six inch rule does not apply during flood flows.

Other operating rule changes and works and measures initiatives

There are clear interactions between this proposal and the parallel initiative to re-schedule pre-releases from Hume Dam.[5] However, any potential interdependencies for this supply measure and its associated SDL resource unit, in terms of other measures, cannot be formally ascertained at this time. This is because such interdependencies will be influenced by other factors that may be operating in connection with this site, including other supply/efficiency/constraints measures under the SDL adjustment mechanism, and the total volume of water that is recovered for the environment.

It is expected that all likely linkages and interdependencies for this measure and its associated SDL resource unit, including with any constraints measures, will become better understood as the full adjustment package is modelled by the MDBA and a final package is agreed to by Basin governments.

[5] DELWP (2015), *Business case for operating rule change to Hume Dam airspace management and pre-releases, an SDL adjustment measure*.

1.4.4. Eligibility

The business case demonstrates that the proposal meets the requirements for a supply measure under the Basin Plan. The project outlined in this business case is not an anticipated measure, or part of the benchmark conditions of development. It is therefore eligible for consideration under the SDL adjustment mechanism.

The proposal is a 'new measure' under Clause 3.4.1 of the Phase 2 Assessment Guidelines and so is eligible for Commonwealth Supply Funding as no funding has been provided or committed to-date by the Commonwealth or has already been approved by another organisation.

2. Proposal

2.1. Current operating rules

The current operating rule is concerned to minimise risks of bank slumping and erosion along the River Murray below Hume Dam. The control limits the rate of reduction in regulated releases from the dam, to minimise the risk that a saturated bank profile is left unsupported, promoting rotational failure.

The current rule is defined by reference to the maximum allowable rate of fall in the level of the river at two points below the dam:

- Eight inch (200 mm) per day reduction at Heywoods, at the foot of the dam, and
- Six inch (150 mm) per day reduction at Doctors Point, close to Wodonga.

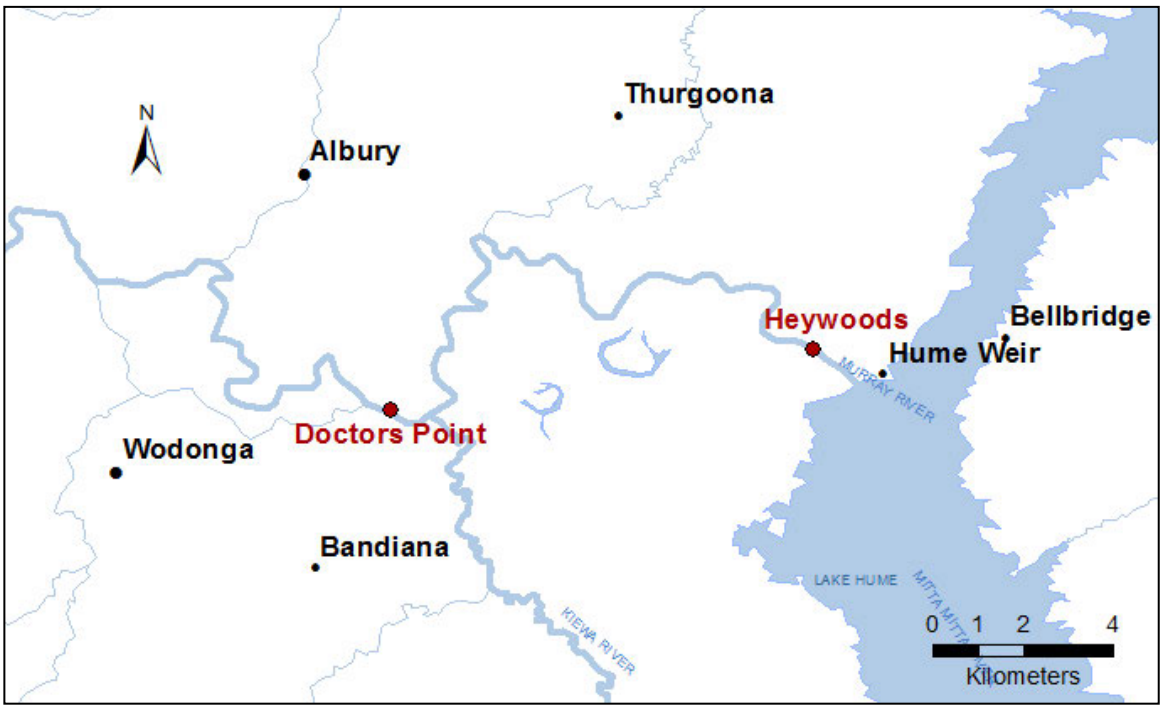

Figure 1. Location of control points for release rule

2.2. Balancing outcomes

The proposed operating rule change involves establishing an appropriate balance between four factors. On the positive side the proposed change should:

- Reduce operational losses - making more water available to generate planned environmental outcomes
- Reduce un-seasonal watering of wetlands and forests along the Murray below Yarrawonga Weir

On the other hand, the greater flexibility proposed could:

- Increase the risk of bank erosion with associated costs and impacts for riparian landholders and agencies
- Increase risks to other third parties - such as urban water authorities or land holders.

This business case reviews these potential outcomes.

2.3. An operational loss

A six inch maximum rate of fall in the river level at Doctors Point equates to a reduction in the regulated release from the dam of around 1,300 ML/day. That is, if the dam operator seeks to reduce releases from 11,000 ML/day down to 2,000 ML/day it would take seven days to achieve this reduction in order to meet the constraint of a maximum rate of fall at Doctors Point of six inches per day. Figure 2 provides a conceptual representation of the current controls and the proposed more flexible regime.

The supply pattern results in the release of around 25 GL of supply that is excess to demand. During the irrigation season it is difficult to re-regulate that flow in Lake Mulwala and the flow can create adverse ecological impacts downstream. The excess flow therefore represents an 'operational loss'.

Changing the rule would reduce this 'operational loss' and generate a water saving that could contribute to the general allocation pool and so be available for environmental watering programs at times of year when the flows provide environmental benefits.

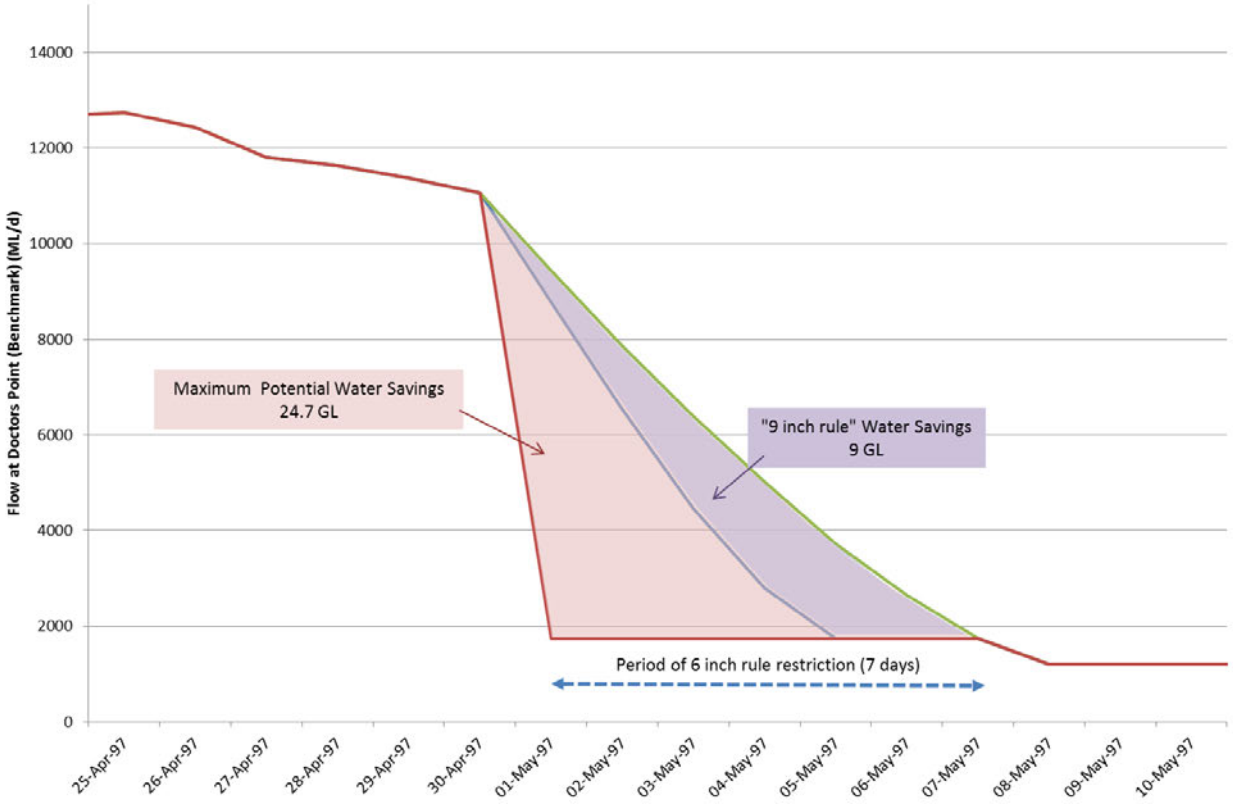

Figure 2. Conceptual representation of the operational loss that the six inch rule generates [6]

2.4. The driver for change - unseasonal watering

Flows from Hume Dam down to Yarrawonga Weir are largely re-regulated in Lake Mulwala to be diverted for irrigation supply in NSW and Victoria. The two main irrigation channels from Lake Mulwala are:

- The Mulwala Canal, on the New South Wales side, with a discharge capacity of up to 10,000 ML/day
- The Yarrawonga Main Channel, on the Victorian side, with a discharge capacity of 3,200 ML/day.

[6] The plot shows: the current six inch rule is shown as the green line; an alternative nine inch rule, is shown as the grey line (this is a daily limit without an averaging constraint); and an unconstrained reduction curve where the flow is reduced within one day (shown in red). Further information available in Jacobs (2015), *Preliminary Investigation on Improved Regulation of the River Murray under Future Demand Conditions*, Report for DELWP, Fig 3-2, p20

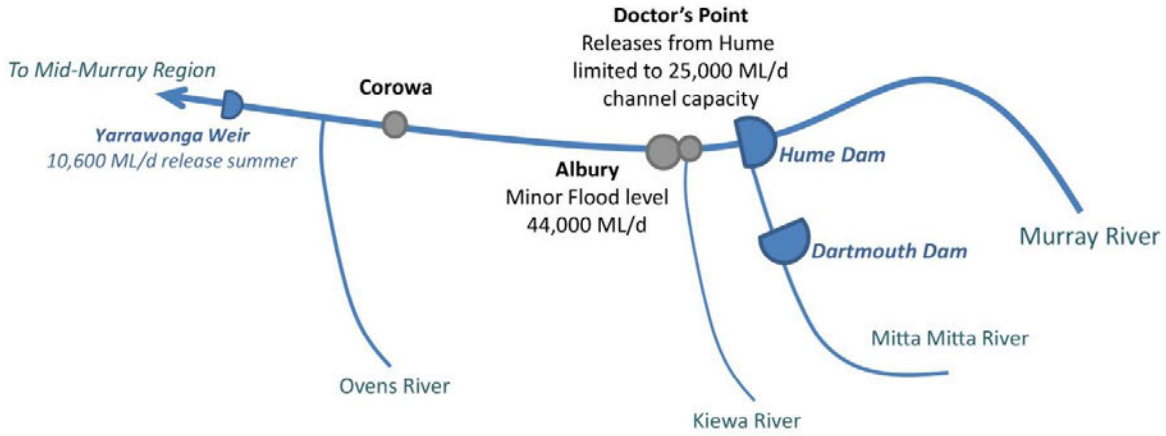

Figure 3. River Murray - Hume to Yarrawonga (source MDBA 2013)

The current constraints on the rate of fall at Hume Dam can result in excess flows downstream. This typically occurs after heavy rainfall during the irrigation season. The rainfall results in a significant reduction in ordered irrigation demand and also leads to higher tributary flows that can meet any residual demand. In the absence of the current controls, the preferred response to this reduced demand would be a sharp reduction in the rate of release from Hume Dam. However, the six inch rule at Doctors Point requires a slow and staged rate of reduction rather than a sharp cut-off. That can then result in excess flows down the Murray to Yarrawonga Weir.

Although Lake Mulwala has a nominal capacity of 118 GL, in practice 113 GL of this volume is 'dead' storage, as the Lake has to be maintained above this level to enable gravity diversion down the two irrigation channels. As a result, there is little airspace in Lake Mulwala during summer months to contain flood flows, so any surcharge beyond irrigation demand spills over Yarrawonga Weir down the Murray, potentially inundating the Barmah-Millewa Forest out of season. This disrupts drying cycles which are important for wetland and forest ecosystems.

There is no formal record of the frequency and duration of these unseasonal watering events. This study has therefore analysed the historical data from the flows recorded just below Yarrawonga Weir (gauging point #409025) to identify patterns that might reflect these excess flows.

The analysis took as a starting point that typical flows in the Murray downstream of Yarrawonga Weir during summer months are maintained at 10,000 ML/day. On this basis, the data was analysed to identify potential high-flow 'events' which were defined as:

- Days with flows above 10,600 ML/day
- During the period from January to May inclusive
- With a continuous period of 4 days or more (as this is the form of flooding that is most damaging)
- With a gap of more than seven days since the previous event (i.e. a run of consecutive days with high flows is defined as a single event until there is a gap of seven days below 10,600 ML/day)

The analysis generates the following pattern when analysed over the entire fifty-five year of the data from 1960 to 2015.

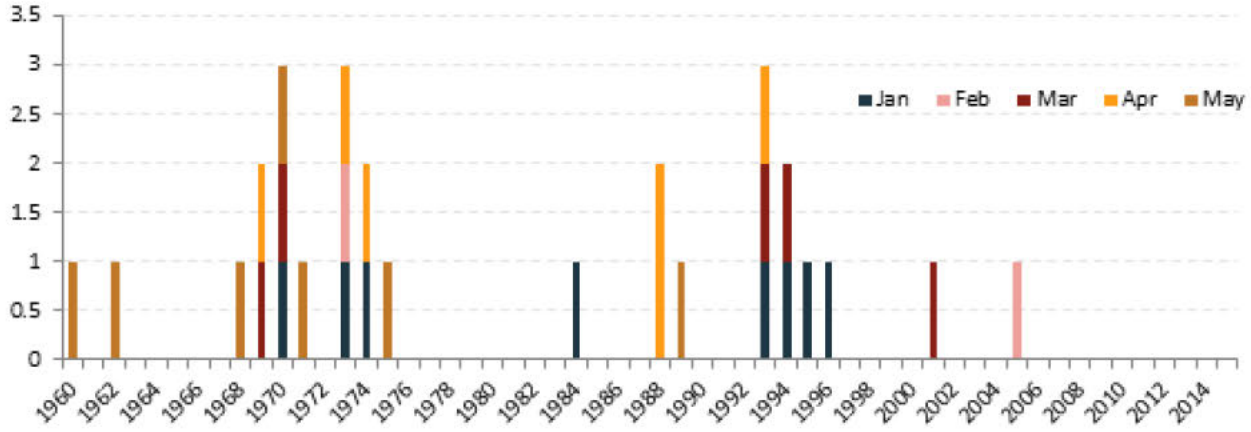

Figure 4. Number of events per year at Yarrawonga Weir (#409025), ≥4 days with flows above 10,600 ML/d

The analysis shows few high flow events before the major growth in irrigation from 1970, a concentration of incidents in two periods, i.e. from 1968 to 1976 and around 1994, but then few events after the drought took hold in 2000. The fifty-five year period of analysis identifies an average of 0.5 events per year, whereas targeting the higher risk twenty-five year period between 1969 and 1996 generates an average figure of 0.8 events a year.

The study also analysed the total number of days of unseasonal watering per year to give a sense of the scale of the potential inundation as the number of 'events' does not indicate the total length of the risk.

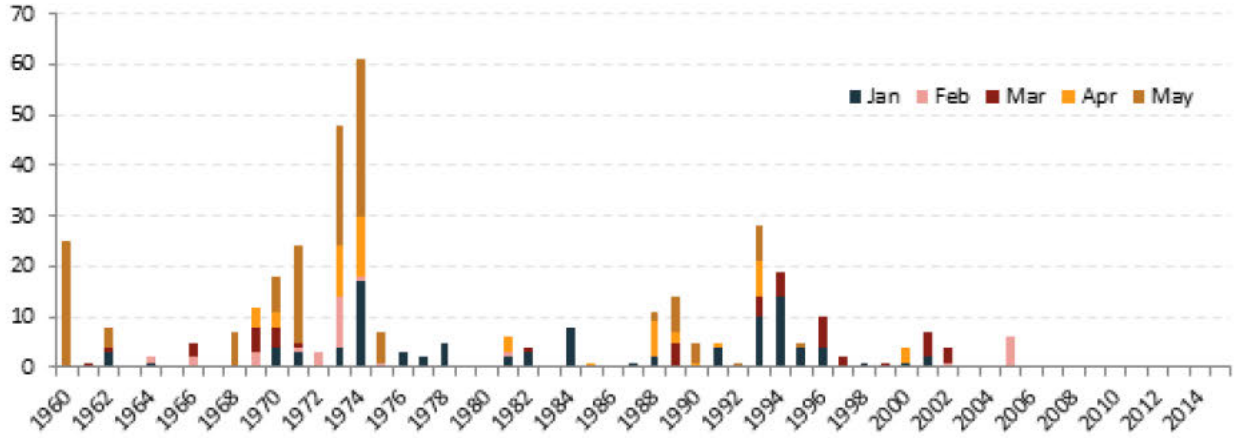

Figure 5. Number of days per year at Yarrawonga Weir (#409025), with flows above 10,600 ML/d

This shows a highly variable pattern, with an average of 7 days/yr with a flow above 10.6GL at Yarrawonga Weir between January and May, but with a peak of 61 days (i.e. nearly two months) in 1974 and many years with no such raised flows. There was a particular raised incidence of high flows in the period from 1969 to 1996, with an average of 11 days/yr.

Finally, an assessment was made of the number of ≥ 4 day high flow "events' that MSM-BigMod would calculate for the proposal as against the benchmark. This shows a reduction in the number of unseasonal events as a result of the proposed change.

Table 2-1. Unseasonal flooding events (DELWP (2015) modeled analysis)

Benchmark (23006)	Proposal (23007)
72	68

In the last five years, River Murray Operations has also taken steps to minimise the frequency and severity of such high flow events through:

- Anticipating rainfall rejection events and starting to reduce releases in advance of any reduction in demand. This reduces excess flows even within the existing six inch rule. The approach relies on access to better quality on-line, three and seven day weather forecasts from the Bureau of Meteorology
- Holding Lake Mulwala slightly lower due to the reduced overall irrigation demand, so creating airspace to capture and re-regulate some excess flows from Hume Dam and so minimise flows past Yarrawonga Weir.

Formalising an operational rule change to the current six inch rule should therefore codify and ensure enduring benefits by reducing average unseasonal watering events.

2.5. Bank erosion processes

Flows are released from Hume Dam during the irrigation season to transfer water downstream to Lake Mulwala and Yarrawonga Weir. The reach of the river between Hume and Yarrawonga is therefore largely used as a supply channel for irrigation, with releases from Hume Dam (and so flows in the river) adjusted to meet irrigation demand downstream, while meeting environmental requirements.

The following chart reports on the percentage of flows at Doctors Point by flow range during the irrigation season. This shows high variability in flows, with an upper bound of 25,000ML/day, but most days with flows between 10,000ML/day and 25,000ML/day. Most of the low flows (below 5,000ML/day) occur during April and May.

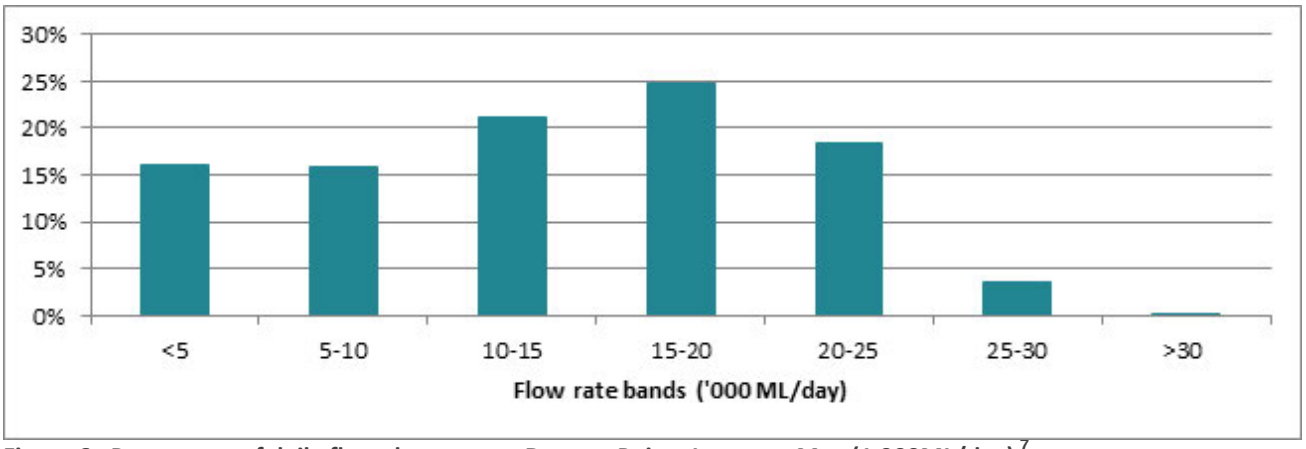

Figure 6. Percentage of daily flows by range at Doctors Point: January - May (1,000ML/day) [7]

The use of the reach below Hume Dam as a supply channel means that the river experiences high flows during summer months. There was concern that this continuity of high flows combined with the variability in flow rates could lead to bank erosion.

A variety of forms of bank erosion are recognised in the literature:

- *Fluvial entrainment*: The primary effect in river systems with high flows is 'fluvial entrainment' or scour, whereby the flow directly removes soil particles from the river bank. This tends to result in the parallel retreat of river banks on both sides and so widening of the river channel. This form of erosion is strongly evident along this reach of the Murray
- *Notching:* Consistent high flows can result in 'notching' at the wave-level of the river height. In due course, this can result in instability and cantilever failure if the crest of the bank eventually overhangs

[7] Project analysis of MDBA data for Site ID 409017, Site Name: Murray River at Doctors Point: Jan-May, 1960 - 2015

the river course. This form of erosion is evident along the reach of the Murray between Hume and Yarrawonga, especially where 'wake-boarding' is a popular recreational activity.

- *Slumping:* A third form of erosion involves 'slumping'. Here the mechanism involves rotational failure where a saturated river bank topples into the channel when it is no longer supported by the weight of water against the bank, following a rapid fall in the level of the river.

These concerns resulted in the setting of the rules over the maximum rate change that was allowed in the reduction of releases from Hume Dam.

More recent analysis has suggested that the third mechanism, 'slumping', may not be a major factor in erosion along this reach of the Murray, as the high particle size and permeability of the bank geology allow the near bank water table to rise and fall in sequence with the change in the river level.

It is also argued that the primary cause of bank instability for slumping is saturation of the water table from high rates of irrigation or flooding. Neither of these occur along this reach. A report on this review of the evidence was published by Earth Tech in 2008 and has prompted pilot studies by the MDBA (discussed further in Section 2.7). This proposal builds on that developing consensus.

2.6. Third party impacts

The change in the rules regarding the maximum rate of fall in the river level due to regulated releases could also potentially affect other water users, such as water authorities or private diverters. Section 3.5 confirms that discussions with relevant stakeholders has confirmed that the rate of fall does not impact on current off-takes.

2.7. Proposed operating rule change

The original six inch rule was established when the primary concern was to minimise risks of bank erosion. The Basin Plan and the Constraints Management Strategy now set a wider suite of aims which include promoting environmental flows and outcomes. The proposed rule change reflects the change in this set of objectives.

The evidence on the current rule suggests that the risks related to bank slumping are not as great as originally assumed, and that concerns on the adverse impacts on the Barmah-Millewa Forest are now greater than when the rule was established.

As a result, it is proposed to introduce greater flexibility in the application of the operating rule regarding the maximum change in the rate of release from Hume Dam. Under the revised approach:

- From January to May inclusive, when the risk of rainfall rejection is highest and the adverse effect of unseasonal watering is greatest:
    - The maximum daily rate of fall allowed would be raised to nine inches (225mm) at both points
    - However, the average rate of fall over 4 days would be retained at the existing limits
- The change would not apply:
    - From June to December inclusive
    - During times of low flows less than 12,000ML/day at Doctors Point
    - During flood flows (when the current rule does not apply)

The change would also be subject to monitoring as part of a two year pilot exercise being run by the NSW Office of Water and the MDBA under the auspices of the Basin Officials Committee. This will identify any adverse outcomes in terms of river bank stability.

2.8. Costs

The costs to implement this proposed rule change are relatively modest, particularly in comparison to other proposals that require the construction of physical infrastructure to deliver environmental water to environmental assets.

Many of the costs will involve the commitment of staff resources from the MDBA and state agencies which will already be covered within existing budgets. The proposed change is already being implemented as a pilot exercise with the approval of the Basin Officials Committee. There should therefore be limited requirements to document the proposed arrangements. It is assumed that the costs of the two year pilot exercise will be funded from current authorised expenditure.

There are two major areas of activity associated with implementation of this proposed rule change. The first area of activity is to update the documentation of rules and the accounting system, involving the following specific tasks:

- Update and approve new release rules. It is assumed that preparation of any submissions to Basin Officials Committee to approve the rule changes would be covered by existing support resources and no additional costs will be incurred.
- Amend operational procedures to implement the new rules (largely done as part of these investigations and current MDBA trials).

The second area is consultation with stakeholder groups who have an interest in the outcomes of any changes in the six inch rule, and may be concerned about the potential for third party impacts.

Section 4 of this report details the stakeholders likely to be interested in this issue and the engagement processes that may need to be employed. For the purposes of cost estimation, it has been assumed that all consultation and engagement activities are directly managed and delivered by the MDBA and state agency staff. The key activities required for a comprehensive consultation program include:

- Design and production of consultation materials.
- Conducting a series of well-planned community engagement meetings. The number of meetings required will depend on the final form of the proposed rule change and how wider consultation processes on other SDL adjustments and Basin Plan implementation issues are managed. For the purposes of this estimate, it is assumed that up to 15 meetings may be required to engage concerned stakeholders.
- Managing enquiries and liaison with media etc.

Overall, it is estimated that a comprehensive consultation program delivered by MDBA and agency staff could cost in the order of [redacted]. These costs are summarised in Table 2-2.

Table 2-2. Projected implementation costs

Category	Activity	Cost ($'000s)
Update documentation and operational procedures	Staff salaries	[redacted]
Consultation	Staff salaries	[redacted]

	Goods and services	[redacted]
Total		[redacted]

Note: All costs are exclusive of Goods and Services Tax (GST)

These costs have been developed on the basis of a stand-alone consultation process for this proposal. However as noted in Section 4, it is recommended that consultation should occur as part of a broader engagement program addressing SDL adjustment processes and the interaction with other proposed measures. Under such a scenario, the consultation costs for this measure would be incorporated as part of the overall cost for the broader engagement program covering a number of proposals.

2.9. Operation date for proposal

The project can be implemented as soon as the package of SDL measures is approved by SDLAAC. It is assumed that all operating rule change projects, where possible, will be implemented in parallel to ensure minimum duplication of implementation activities including consultation with stakeholders. Implementation of the project is expected to require a maximum of three years total duration. The Phase 2 Guidelines indicate that by 30 June 2015 SDLAAC will determine the package of project proposals that will advance to Phase 3. Therefore, the measures are expected to enter into operation by 30 June 2018.

The expected implementation schedule for the projects is illustrated below (Figure 7). The implementation schedule outlined is highly conservative and includes a significant contingency allowance. The project could be fast-tracked if and as required by SDLAAC.

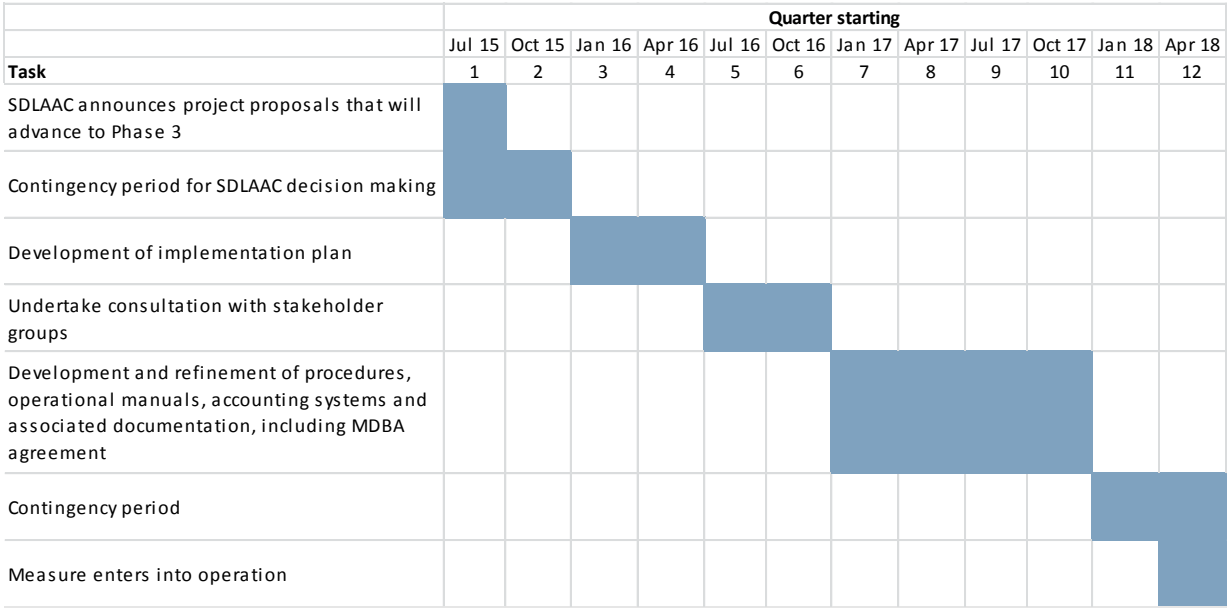

Figure 7. Proposed implementation timeframe for the project

3. Outcomes

3.1. Risk assessment overview

The Phase 2 Assessment Guidelines cover three risk categories:

- **Adverse ecological effects** (clause 4.4.2: If relevant, business cases need to include an assessment of potential adverse ecological impacts resulting from the operation of the proposed measure)
- **Impacts from the operation of the measure** (clause 4.7: All business cases need to include a risk assessment and risk management strategy for the proposed operating regimes or proposed operating rules changes)
- **Project development and delivery risks** (clause 4.11.4: The business case needs to include a risk assessment and risk management strategy for risks to project development and delivery)

The guidelines confirm that the business case will be assessed on the basis that:

- All significant project development and delivery risks and impacts have been identified, adequately described and analysed and robust treatments and mitigations proposed;
- The risk management strategy complies with the AS/NZS ISO 31000:2009 Risk management— Principles and Guidelines; and
- All residual risks are negligible or can be adequately mitigated.

The business case fully implements these requirements. This section of the business case sets out a generic risk management framework that has been applied across all impacts. The section covers the issues related to potential 'adverse ecological effects' and 'impacts from the operation of the measure'. The risks associated with 'project development and delivery' are dealt with below in Section 5.

3.2. Risk management framework

A risk assessment of the impacts of the proposed change was completed in line with AS/NZS ISO 31000:2009 (as required under the guideline requirements). This assessed both the likelihood of an event occurring and the severity of the outcome if that event occurred. This methodology generates a risk matrix in line with the AS/NZS ISO 31000:2009 standard. Table 3 shows the risk matrix and definitions used in this risk assessment.

Table 3. AS/NZS ISO 31000:2009 Risk prioritisation matrix

		Consequence			
Likelihood	Negligible	Minor	Moderate	Major	Extreme
Rare	Low	Low	Low	Moderate	High
Unlikely	Low	Low	Moderate	High	High
Possible	Low	Moderate	Moderate	High	Very High
Likely	Low	Moderate	High	Very High	Very High
Almost Certain	Moderate	Moderate	High	Very High	Very High

The risk assessment process comprised two main elements:

- **Expert panel:** A workshop was held with senior agency staff across jurisdictions representing the key constituencies with an interest in the proposal. That group reviewed the proposed operating rule change and agreed the primary issues to consider. Appendix 3 reports the outcomes of that workshop.
- **Professional judgement:** Members of the project team then made judgments on the range of risks and their likely characteristics in-line with AS/NZS ISO 31000:2009, informed by experience of working on similar projects related to environmental watering proposals.

The outcome was a listing of possible risks with a ranking based on the AS/NZS ISO 31000:2009 methodology and identification of recommended mitigation steps.

In each case the mitigation strategy comprised two main elements:

- Analysis and modelling to confirm that the evidence showed either neutral or positive outcomes
- Adequate community engagement to ensure understanding and contributions from affected stakeholders

The listing of the risks and the assessment of their significance is provided in Table 4 below. The risk level refers to the severity of the risk prior to the application of any mitigation actions. With these controls in place, the analysis that follows in this business case covering environmental outcomes (Section 3.3) and third party impacts (Section 3.45) demonstrates that any residual risk is acceptably low.

Table 4. Risk assessment listing and ranking

	Risk	Potential issue	Risk assessment (prior to mitigation)			Comment
			Likelihood	Consequence	Risk rating	
1	River bank stability	That increased rates of fall increase risks of bank slumping	Possible	Minor	Moderate	Section 3.4
2	Third party impacts	That increased rates of fall impact adversely on third parties	Unlikely	Minor	Low	Section 3.5
3	Ecosystem health	That increased rates of fall will not generate equivalent ecosystem values	Unlikely	Minor	Low	Section 3
4	Operational losses	That any reduction in the operational losses cannot be captured	Unlikely	Minor	Low	Section 3.3
5	Project delivery	That landholders below the dam oppose the initiative	Unlikely	Minor	Low	Section 5

The risk assessment identified few if any potential adverse effects from the proposal. The risk of additional bank slumping has been reviewed by independent scientists and a pilot study is currently underway with close scrutiny to monitor and report any material impacts.

3.3. Environmental outcomes

3.3.1. Context for the assessment

Appendix 8 of the Phase 2 Assessment Guidelines confirms that this section is concerned to minimise:

> *The risks associated with accurately understanding, predicting and delivering ecological objectives at the site, within the reach and to downstream locations.*

The primary intention of this section of the Phase 2 Assessment Guidelines is to ensure that the business case predicts and controls the impact of new structural works and measures on ecological systems. By contrast, this proposal merely involves an operating rule change, i.e. a relaxation of the current controls on the rate of fall of regulated releases from Hume Dam. As the proposed changes involve only changes in operating rules, there will be no risks regarding the construction of major works and measures.

The proposed change should generate two positive outcomes for ecosystem and environmental health:

- It should reduce the incidence of unseasonal watering in the Barmah-Millewa Forest; and
- It should reduce operational losses, thereby increasing the security of environmental entitlements.

Modelling has been undertaken to test the environmental outcomes that could be achieved from this proposal. The modelling has examined the environmental outcomes of the proposal in two principal ways:

- how the proposal affects the achievement of specific flow indicators (SFIs) over the long-term
- whether the proposal compromises any of the limits of acceptable change outlined in Schedule 6 (Section S6.07) of the Basin Plan.

The next section provides an overview of the environmental assets of the Murray system (Section 3.3.2) and is followed by a discussion of the results of modelling environmental outcomes at these assets (Section 0).

3.3.2. Environmental assets

The project is expected to affect the River Murray downstream of Lake Hume through to the mouth. This includes the following SDL resource units: NSW Murray (SS14), Victorian Murray (SS2), SA Murray (SS11). There are six key environmental assets between Lake Hume and the Murray Mouth. An overview of these assets is provided below (Table 5).

Table 5. Key environmental assets between Lake Hume and the Murray Mouth

Asset	Description
Barmah–Millewa Forest	The Barmah–Millewa Forest icon site is the largest river red gum forest in Australia. Located in New South Wales and Victoria, the forest covers 66,000 ha of wetlands, which is home to many threatened native plants and animals. It is also a significant breeding site for waterbirds and an important native fish habitat.
Gunbower–Koondrook–Perricoota Forest	Gunbower–Koondrook–Perricoota Forest icon site consists of two forests — Gunbower Forest and Koondrook–Perricoota Forest — that together comprise Australia's second largest river red gum forest. Located in New South Wales and Victoria, the combined Gunbower–Koondrook–Perricoota Forest covers around 50,000 ha; it is home to many threatened native plants and animals, and its wetlands are important breeding places for waterbirds and native fish.
Hattah Lakes	The Hattah Lakes icon site forms part of the 48,000 ha Hattah–Kulkyne National Park. Located in Victoria, this icon site includes over 20 semi-permanent freshwater lakes that support river red gum communities and a variety of native plants and animals. They are also important breeding places for waterbirds.

Asset	Description
Chowilla Floodplain and Lindsay–Wallpolla Islands	The Chowilla Floodplain component of this icon site covers over 17,000 ha across New South Wales, Victoria and South Australia. Because of its remote location, Chowilla is relatively unaffected by irrigation and other development and much of its natural character has been preserved. Included in this icon site are the Lindsay–Wallpolla Islands, including Mulcra Island, and their floodplains. Together this part of the icon site covers almost 20,000 ha and supports many threatened native plants, animals and fish species.
Lower Lakes, the Coorong and Murray Mouth	The Lower Lakes, Coorong and Murray Mouth icon site — where the River Murray meets the Southern Ocean — is in South Australia. Covering over 140,000 ha, it includes 23 different wetland types that range from very fresh water to saltier than the sea. As a complex estuarine environment, this site is one of 10 major Australian havens for large concentrations of wading birds and is recognised internationally as a breeding ground for many species of waterbirds and native fish.
River Murray Channel	The River Murray Channel is the main artery of the river. Extending over 2,000 km from the Hume Dam in Victoria to Wellington in South Australia, the channel links the forests, floodplains, wetlands and estuaries along the River Murray. It provides habitat for many native plants, fish and animals, while its banks support river red gum forests of high natural and cultural value.

3.3.3. Limits of acceptable change and specific flow indicators

Schedule 6 (Section S6.07) of the Basin Plan identifies the limits of acceptable change in score or outcome from the benchmark environmental outcomes (i.e. those achieved by the unadjusted SDL) that ensure environmental outcomes are maintained within identified limits. The limits of acceptable change are defined at the region and reach-scale.

For each region: no reduction in the benchmark scores, although some reductions in individual elements may be permitted if they are offset by increases in other elements.

For each reach: limits of acceptable change are based on the specific flow indicators (SFIs) developed for each hydrologic indicator sites:

- Where the benchmark model run achieves or exceeds the target frequency range for a flow indicator, achievement of the target frequency range must be retained and the frequency result must not vary by more than 10% of the benchmark result
- Where the benchmark model run does not achieve the target frequency range for a flow indicator, the frequency result must not vary by more than 10% of the benchmark result, and not fall below the baseline model result
- Where the benchmark model run provides little improvement in frequency for a flow indicator (less than 50% progress toward the target range from the baseline model result), the frequency result must not vary by more than 15% of the benchmark result, and not fall below the baseline model result
- Where a supply measure or combination of measures can achieve the ecological outcomes sought by the plan as represented by an ecological target or targets, and a flow indicator or indicators and associated benchmark model results, then the three dot points above do not apply to that flow indicator or indicators.

For the Coorong, Lower Lakes, Murray Mouth—maintenance or improvement of the following:

- Lake Alexandrina salinity: less than 1500 Electrical Conductivity (EC) for 100% of the time and less than 1000 EC for 95% of days;
- Barrage flows: greater than 2000 GL per year on a three year rolling average basis with a minimum of 650 GL in any year, to be achieved for 95% of years
- Barrage flows: greater than 600 GL over any two year period, to be achieved for 100% of the time
- Coorong salinity: South Lagoon average daily salinity less than 100 grams per litre for 96% of days
- Mouth openness: Mouth open to an average annual depth of 1 metres (-1.0 m Australian Height Datum (AHD)) or more for at least 90% of years and 0.7 metres (-0.7 m AHD) for 95% of years
- For all base flows and fresh requirements within each reach: no reduction in outcomes achieved in the benchmark run.

Modelling of the River Murray system with the proposed changes in place found that the proposal does not result in any breach of the limits of acceptable change for the region (Table 6), the individual reaches (Table 7) and/or the Coorong, Lower Lakes and Murray Mouth (Table 8). This assessment is based on preliminary modelling by DELWP using MDBA modelling tools. The final assessment will depend on the formal modelling of the proposal by the MDBA as part of a package of measures.

> **These results confirm that the proposed change to the operating rules improves the environmental outcomes that are generated overall. By implication, the proposed change will allow equivalent environmental outcomes to those available under the benchmark conditions to be achieved with lower total water requirements.**

Once more experience is gained in the delivery of environmental water under the Basin Plan, further opportunities may be identified for improving and optimising the integration of this planned environmental allocation with other held entitlements. In the meantime, this rule change offers a positive contribution to a package of measures that could be assessed for SDL adjustment opportunities.

Table 6. Testing of limits of acceptable change for the region[8]

Limit of acceptable change	Benchmark (R23006)	Proposal (R23007)
Regional Ecological Elements Score	0.4989	0.4998

[8] DELWP (2015), Preliminary internal estimate based on MDBA scoring tool.

Table 7. Testing of specific flow indicators and limits of acceptable change for each reach (DELWP 2015)

						FREQUENCY			LIMITS OF CHANGE
	Indicator Description	Minimum consecutive days	Start month	End month	Target	Baseline (R845)	Benchmark (R23006)	Proposal (R23007)	Test result
MURRAY - BARMAH-MILLEWA FOREST									passed
B1	12.5 GL/d for 70 days	7	Jun	Nov	70 - 80 %	50%	78%	78%	passed
B2	16 GL/d for 98 days	7	Jun	Nov	40 - 50 %	30%	53%	53%	passed
B3	25 GL/d for 42 days	7	Jun	Nov	40 - 50 %	30%	46%	46%	passed
B4	35 GL/d for 30 days	7	Jul	Jun	33 - 40 %	24%	36%	36%	passed
B5	50 GL/d for 21 days	7	Jul	Jun	25 - 30 %	18%	17%	17%	passed^
B6	60 GL/d for 14 days	7	Jul	Jun	20 - 25 %	14%	11%	12%	passed^
B7	15 GL/d for 150 days	7	Jun	Dec	30%	11%	36%	36%	passed
MURRAY - GUNBOWER-KOONDROOK-PERRICOOTA									passed
G1	16 GL/d for 90 days	7	Jun	Nov	70 - 80 %	31%	67%	67%	passed
G2	20 GL/d for 60 days	7	Jun	Nov	60 - 70 %	34%	66%	66%	passed
G3	30 GL/d for 60 days	7	Jul	Jun	33 - 50 %	25%	39%	39%	passed
G4	40 GL/d for 60 days	7	Jul	Jun	25 - 33 %	11%	21%	21%	passed
G5	20 GL/d for 150 days	7	Jun	Dec	30%	7%	27%	27%	passed
MURRAY - HATTAH-KULKYNE LAKES									passed
H1	40 GL/d for 60 days	7	Jun	Dec	40 - 50 %	30%	46%	46%	passed
H2	50 GL/d for 60 days	7	Jun	Dec	30 - 40 %	19%	30%	32%	passed
H3	70 GL/d for 42 days	7	Jun	Dec	20 - 33 %	11%	18%	18%	passed
H4	85 GL/d for 30 days	7	Jul	Jun	20 - 30 %	10%	11%	11%	passed
H5	120 GL/d for 14 days	7	Jul	Jun	14 - 20 %	8%	9%	9%	passed
H6	150 GL/d for 7 days	7	Jul	Jun	10 - 13 %	5%	6%	6%	passed
MURRAY - RIVERLAND CHOWILLA FLOODPLAIN									passed
C1	20 GL/d for 60 days	60	Aug	Dec	71 - 80 %	43%	71%	71%	passed
C2	40 GL/d for 30 days	7	Jun	Dec	50 - 70 %	37%	57%	57%	passed
C3	40 GL/d for 90 days	7	Jun	Dec	33 - 50 %	22%	39%	39%	passed
C4	60 GL/d for 60 days	7	Jun	Dec	25 - 33 %	12%	26%	27%	passed
C5	80 GL/d for 30 days	7	Jul	Jun	17 - 25 %	10%	13%	13%	passed
C6	100 GL/d for 21 days	1	Jul	Jun	13 - 17 %	6%	8%	8%	passed
C7	125 GL/d for 7 days	1	Jul	Jun	10 - 13 %	4%	5%	5%	passed
MURRAY - EDWARD WAKOOL RIVER SYSTEM									passed
E1	1,500 ML/d for 180 days	1	Jun	Mar	99 - 100 %	96%	94%	94%	passed^
E2	5 GL/d for 60 days	7	Jun	Dec	60 - 70 %	39%	66%	66%	passed
E3	5 GL/d for 120 days	7	Jun	Dec	35 - 40 %	22%	33%	33%	passed
E4	18 GL/d for 28 days	5	Jun	Dec	25 - 30 %	15%	17%	18%	passed
E5	30 GL/d for 21 days	6	Jun	Dec	17 - 20 %	12%	12%	12%	passed
LOWER DARLING - LOWER DARLING FLOODPLAIN									passed
D1	7 GL/d for 10 days	10	Jan	Dec	70 - 90 %	51%	60%	60%	passed
D2	17 GL/d for 18 days	18	Jan	Dec	20 - 40 %	18%	22%	22%	passed
D3	20 GL/d for 30 days	30	Jan	Dec	14 - 20 %	10%	10%	10%	passed
D4	25 GL/d for 45 days	45	Jan	Dec	8 - 10 %	8%	8%	8%	passed
D5	45 GL/d for 2 days	2	Jan	Dec	8 - 10 %	8%	7%	7%	passed

Note 1. The frequency columns have been colour coded to show more frequent events in darker shades of green and less frequent events in lighter shades of green.

Note 2. ^The limits of change test result for B5, B6 and E1 indicates that these SFIs may not meet the requirements of subclause iii, as the frequency result falls below the baseline model result. However, in this case, the benchmark result also falls below the baseline result, while the proposal either meets or exceeds the baseline result, providing a positive outcome relative to the benchmark.

Table 8. Testing of limits of acceptable change for the Coorong, Lower Lakes and Murray Mouth (DELWP 2015)

	Indicator Description	Start month	End month	Target	FREQUENCY Baseline (R845)	Benchmark (R23006)	Proposal (R23007)	LIMITS OF CHANGE Test result
COORONG, LOWER LAKES, MURRAY MOUTH INDICATORS								passed
1	Lake Alexandrina salinity: Percentage of days that Lake Alexandrina salinity is less than 1,500 EC	Jul	Jun	100%	96%	100%	100%	passed
1	Lake Alexandrina salinity: Percentage of days that Lake Alexandrina salinity is less than 1,000 EC	Jul	Jun	95%	89%	100%	100%	passed
2	Barrage flows: Percentage of years that barrage flows are greater than 2,000 GL/yr (measured on a three year rolling average) with a minimum of 650 GL/yr	Jul	Jun	95%	75%	97%	97%	passed
3	Barrage flows: Percentage of years that barrage flows are greater than 600 GL for any two year period	Jul	Jun	100%	98%	100%	100%	passed
4	Coorong Salinity: South Lagoon average daily salinity 96th percentile (grams per litre)	Jul	Jun	100	112	65	65	passed
5	Mouth Openness: Percentage of years mouth open to an average annual depth of 1.0 meters (-1.0 m AHD) or more	Jul	Jun	90%	76%	95%	94%	passed
5	Mouth Openness: Percentage of years mouth open to an average annual depth of 0.7 metres (-0.7 m AHD) or more	Jul	Jun	95%	84%	97%	97%	passed

Note 1. The frequency columns have been colour coded to show events that exceed the target in green, and events that do not meet the target in orange.

Table 9. Net increase in number of years with successful events and maximum duration of dry spells for each SFI (DELWP 2015)

					NUMBER OF YEARS WITH SUCCESSFUL EVENTS			MAXIMUM DRY SPELL (YEARS)		
	Indicator Description	Minimum consecutive days	Start month	End month	Benchmark (R23006)	Proposal (R23007)	Net increase	Benchmark (R23006)	Proposal (R23007)	Net increase
MURRAY - BARMAH-MILLEWA FOREST										
B1	12.5 GL/d for 70 days	7	Jun	Nov	89	89	0	4	4	0
B2	16 GL/d for 98 days	7	Jun	Nov	60	60	0	6	6	0
B3	25 GL/d for 42 days	7	Jun	Nov	53	53	0	6	6	0
B4	35 GL/d for 30 days	7	Jul	Jun	41	41	0	14	14	0
B5	50 GL/d for 21 days	7	Jul	Jun	19	19	0	22	22	0
B6	60 GL/d for 14 days	7	Jul	Jun	13	14	1	24	22	-2
B7	15 GL/d for 150 days	7	Jun	Dec	41	41	0	9	9	0
MURRAY - GUNBOWER-KOONDROOK-PERRICOOTA										
G1	16 GL/d for 90 days	7	Jun	Nov	76	76	0	6	6	0
G2	20 GL/d for 60 days	7	Jun	Nov	75	75	0	6	6	0
G3	30 GL/d for 60 days	7	Jul	Jun	44	44	0	9	9	0
G4	40 GL/d for 60 days	7	Jul	Jun	24	24	0	21	21	0
G5	20 GL/d for 150 days	7	Jun	Dec	31	31	0	14	14	0
MURRAY - HATTAH-KULKYNE LAKES										
H1	40 GL/d for 60 days	7	Jun	Dec	52	52	0	9	9	0
H2	50 GL/d for 60 days	7	Jun	Dec	34	36	2	13	13	0
H3	70 GL/d for 42 days	7	Jun	Dec	21	21	0	22	22	0
H4	85 GL/d for 30 days	7	Jul	Jun	12	12	0	22	22	0
H5	120 GL/d for 14 days	7	Jul	Jun	10	10	0	22	22	0
H6	150 GL/d for 7 days	7	Jul	Jun	7	7	0	24	24	0
MURRAY - RIVERLAND CHOWILLA FLOODPLAIN										
C1	20 GL/d for 60 days	60	Aug	Dec	81	81	0	4	4	0
C2	40 GL/d for 30 days	7	Jun	Dec	65	65	0	9	9	0
C3	40 GL/d for 90 days	7	Jun	Dec	44	44	0	13	13	0
C4	60 GL/d for 60 days	7	Jun	Dec	30	31	1	13	13	0
C5	80 GL/d for 30 days	7	Jul	Jun	15	15	0	22	22	0
C6	100 GL/d for 21 days	1	Jul	Jun	9	9	0	22	22	0
C7	125 GL/d for 7 days	1	Jul	Jun	6	6	0	34	34	0
MURRAY - EDWARD WAKOOL RIVER SYSTEM										
E1	1,500 ML/d for 180 days	1	Jun	Mar	107	107	0	4	4	0
E2	5 GL/d for 60 days	7	Jun	Dec	75	75	0	4	4	0
E3	5 GL/d for 120 days	7	Jun	Dec	38	38	0	13	13	0
E4	18 GL/d for 28 days	5	Jun	Dec	19	20	1	22	22	0
E5	30 GL/d for 21 days	6	Jun	Dec	14	14	0	22	22	0
LOWER DARLING - LOWER DARLING FLOODPLAIN										
D1	7 GL/d for 10 days	10	Jan	Dec	68	68	0	7	7	0
D2	17 GL/d for 18 days	18	Jan	Dec	25	25	0	29	29	0
D3	20 GL/d for 30 days	30	Jan	Dec	11	11	0	29	29	0
D4	25 GL/d for 45 days	45	Jan	Dec	9	9	0	29	29	0
D5	45 GL/d for 2 days	2	Jan	Dec	8	8	0	29	29	0

Note 1. 'Successful events' are those that achieve the intended hydrologic conditions of each SFI. Given that a variety of other non-flow related factors influence whether an event achieves the intended ecological response, a hydrologically 'successful event' should not be interpreted as necessarily being an ecologically successful event.

3.4. River bank stability

The proposed rule change could result in increased bank erosion from slumping. This would adversely affect river health, landholders and the MDBA's budget for riparian management.

The original six inch constraint was introduced because of concerns around the potential impacts of releases from a proposed hydro-power station at Hume Dam, where flows can vary abruptly over time to match peaks in the electricity demand.

A series of studies have analysed the primary drivers of bank erosion in the reach below Hume Dam. This includes a major study by Earth Tech[9] and more recent work by the MDBA. These studies have identified that:

- The geomorphology of the bank demonstrates a predominance of large particle size, free-draining sandy soils. These soils are unlikely to maintain a saturated profile when the river level falls.
- The incidence of overbank floods and rainfall have fallen over the last fifty years, so the probability of a saturated bank profile is reduced, particularly in summer months, reducing slumping risks.
- The primary form of bank erosion in this reach is fluvial entrainment along the direction of travel driven by the energy embedded in the high flows in summer months. This elevated stream power results in parallel retreat of the banks, not in bank slumping.
- There is little evidence of rotational risks where the weight of a saturated, unsupported bank crest cracks parallel with the bank and then topples into the river.

The controls related to the change in the river height at Doctors Point only relate to changes that result from regulated releases from Hume Dam. The height of the river is also strongly affected by flows from the Kiewa which joins the Murray just upstream of Doctors Point. Flows in the Kiewa are highly variable in response to rainfall. This, in turn, creates highly variable flows at Doctors Point, with rates of rise and fall well above those that occur as a result of regulated flows from the Hume. There is no evidence of bank slumping around Doctors Point driven by these variable Kiewa flows.

These conclusions merit exploring the potential to relax the current controls, if that change can also generate positive ecosystem outcomes. The MDBA has obtained approval from the Basin Officials Committee to implement a two year trial of relaxed controls in line with this proposal, with a monitoring program to assess any impacts on bank erosion. That provides a well-structured process to validate the risks and benefits. The implementation of the proposed change will be informed by the outcomes of this study.

3.5. Third party impacts

Third party impacts arise when individuals, who were not involved in a decision by others to undertake an action, incur costs (or benefits) as a result of that action. Third party impacts, which are also sometimes called externalities, are often a point of concern in water resource management when transactions between two willing parties such as a water trade, may give rise to an impact on a "third-party" not involved in the transaction.

This section of the guidelines is concerned to predict and control the third party impacts from the operating rule change. The following potential third party impacts were raised through the review process and are assessed further below:

- Impacts on the ability of urban water authorities to extract water for supply
- Impacts on irrigators' ability to divert water for use
- Impacts on South Australia

[9] EarthTech (2008), *The River Murray Six Inch Rule*, for the MDBC.

3.5.1. Urban water supply

Two urban water authorities take water out of the Murray below the Dam for urban supply:

Albury City Council takes a total of 6.2 GL/yr with a maximum flow rate of 140 ML/day from three off-take points (Figure 8) upstream of Doctors Point at:

- Water Works Road;
- 1.3 km upstream of Water Works Road; and
- 4.2 km up stream of Water Works Rd.

North East Water has two off-takes:

- One at Wodonga Creek to supply Wodonga and surrounding districts with a total of 8.8 GL/yr at a maximum flow rate of 71 ML/day ; and
- One at Wahgunyah (opposite Corowa) to supply Rutherglen with 566 ML/yr.

Several of the assets on the river also exist to facilitate this urban supply by maintaining the main stem flows through preventing growth of side channels and billabongs, and to ensure depth of supply in the relevant channel, for example:

- Ryans Creek for Albury Council
- Wodonga Creek for NE Water

A concern was raised that changing the rate of release from Hume Dam might adversely affect the efficiency of these off-take points. Discussions with relevant senior staff in the authorities confirmed that their priority concern is with overall low flows, not with the rate of change in the rate of flow.[10] The proposed changes will not apply at flows below 12,000 ML/day.

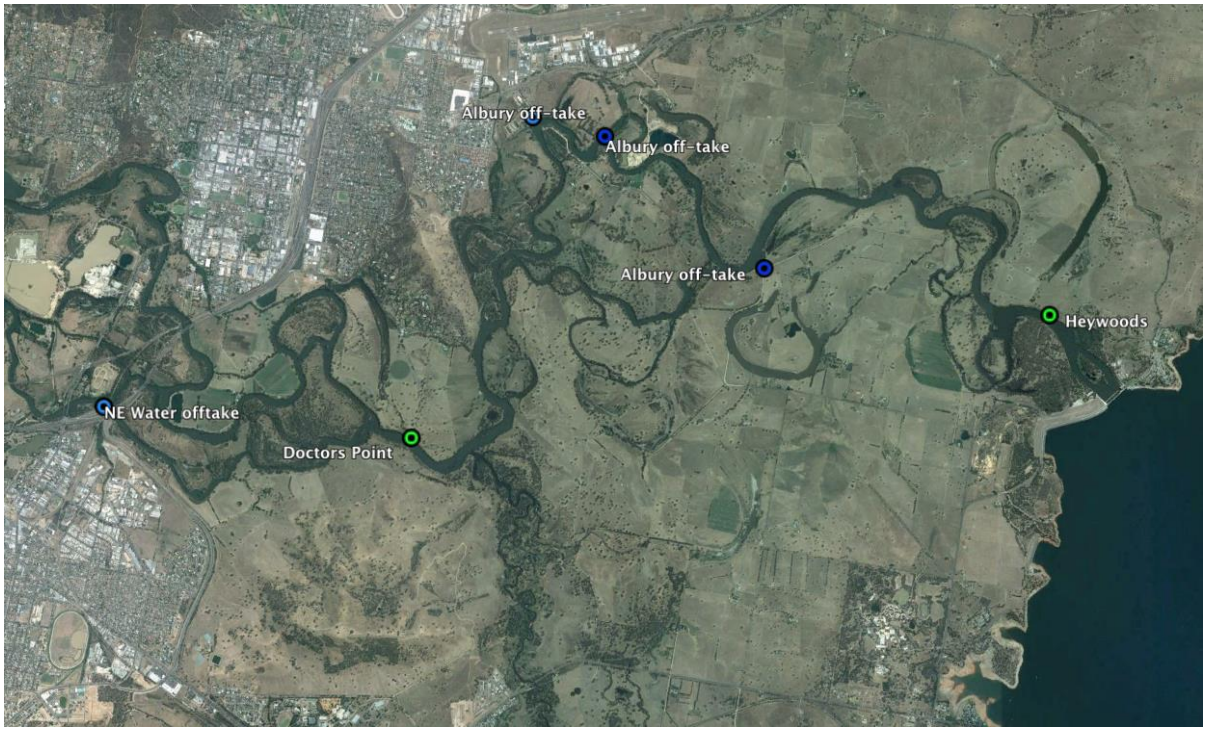

Figure 8. Location of urban supply off-takes close to Hume Dam

[10] Pers. Comm. (2015). [redacted], Albury City and [redacted].

3.5.2. Private diverters

Private diverters hold licences to take and use water directly from the river. The major third party risk is that their pump location is either stranded or swamped. The rate of fall is not a priority concern.

3.5.3. Flows to South Australia

South Australia has well-defined rights regarding flows and water quality at the border. South Australia is concerned to ensure that any change does not materially affect these rights by reducing total flows in the system.

The modelling and analysis confirms that the proposed change has virtually no impact on projected flows and average salinities to South Australia each month compared to the benchmark condition (Figure 9 and Figure 10). Both the benchmark and proposal outcomes for flow and salinity are positive when compared to the historic baseline conditions.

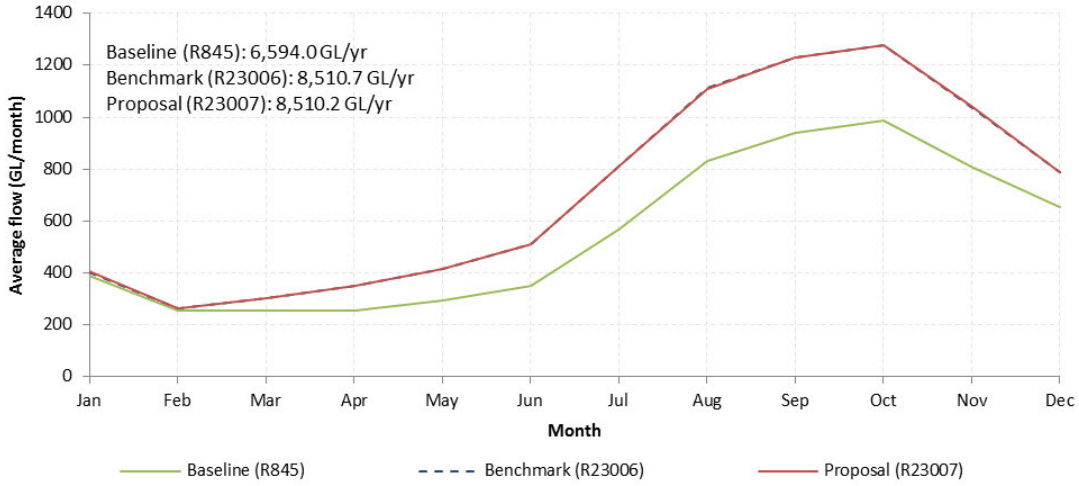

Figure 9. Average flow to South Australia each month

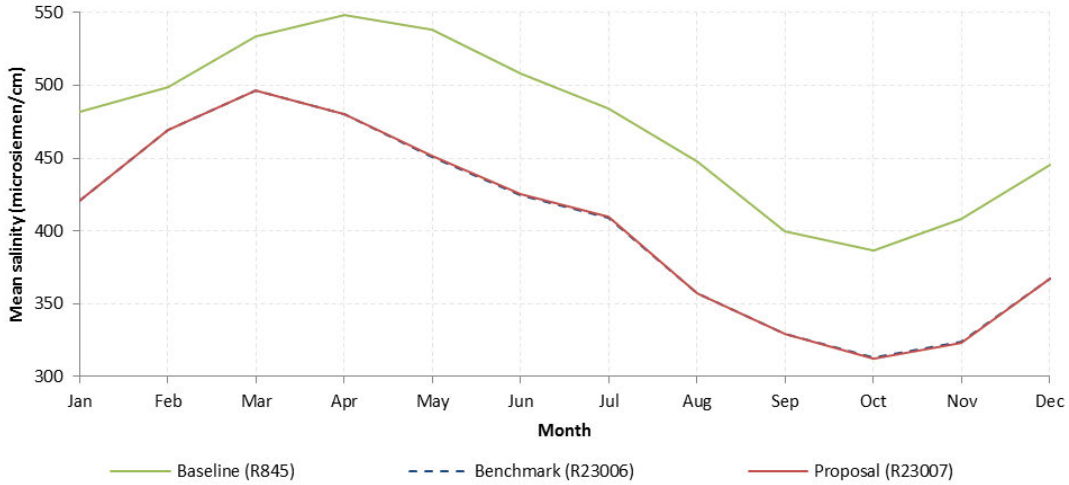

Figure 10. Mean salinity levels at Morgan each month

The annual 95th percentile salinity levels at Morgan are also very similar under the benchmark conditions and the proposed rule change. Both these options also exhibit substantial reductions in 95th percentile salinity levels when compared to the baseline conditions (Figure 11).

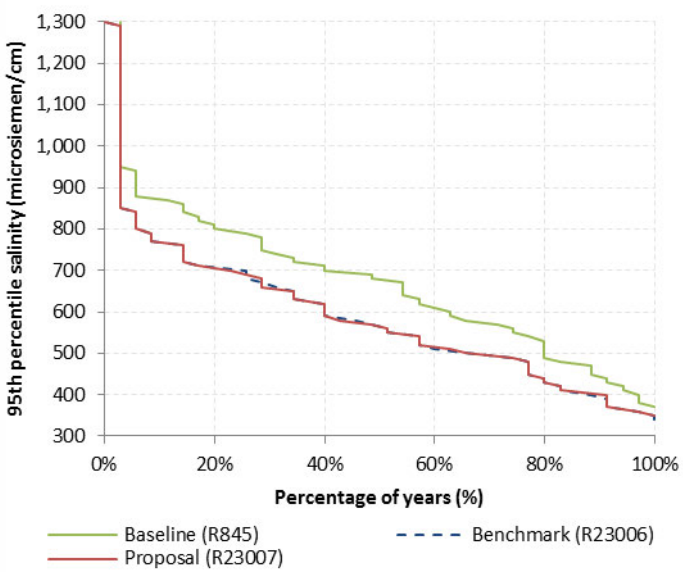

Figure 11. Percentage of years that the annual 95th percentile salinity level at Morgan exceeds a given level

Finally, South Australia relies on storage in Lake Victoria to ensure that its minimum passing flow targets are fully met. The final modelling confirmed that median storage levels in Lake Victoria in each month were almost identical to those in the benchmark model run (Figure 12).

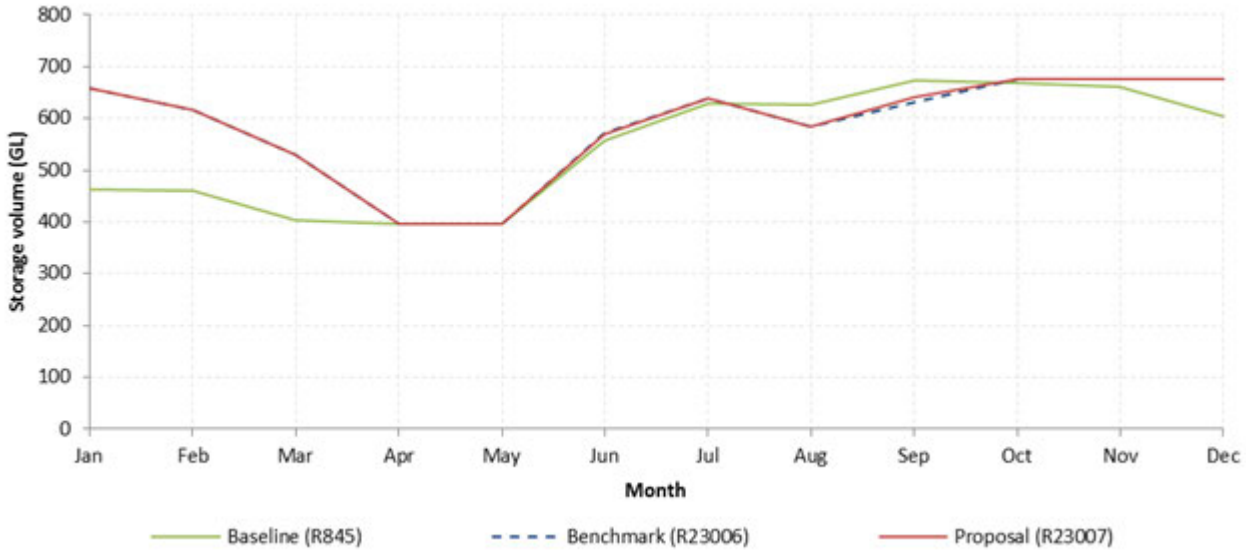

Figure 12. Median storage volume in Lake Victoria in each month

3.6. Outcomes conclusions

The assessment of the outcomes of the project suggests that the proposed change will generate greater environmental benefits than were estimated for the benchmark model (Tables 7, 8 & 9) while having negligible impact on the total volume available for entitlement reliability and the quality and quantity of flows to South Australia. Compared to benchmark conditions, the proposal will have a minimal or slightly positive impact on recreation, as implementation of the proposal reduces the likelihood of unseasonal watering impacting recreational access over the summer holiday period.

4. Stakeholders

4.1. Engagement process

All agencies materially affected by the proposal have been consulted in the development of this business case. These agencies include:

- Murray-Darling Basin Authority *
- Water NSW *
- Office of Environment and Heritage (NSW) *
- Department of Environment, Land, Water and Planning (Victoria) *
- NSW National Parks and Wildlife Service *
- Parks Victoria *
- Department of Environment (Commonwealth) *
- Department of Environment, Water and Natural Resources (South Australia) *
- Victorian Environmental Water Holder *
- North East Catchment Management Authority (CMA) *
- Goulburn Broken Catchment Management Authority (CMA)
- Goulburn-Murray Water *
- North East Water
- Albury City Council - water supply

A workshop held on 23 March 2015 (at DELWP Attwood) with state and Commonwealth agencies (agencies noted with an * above were invited to attend). All other entities were subsequently consulted on the proposals. The workshop attendees identified both the potential risks of this proposal and interested stakeholder groups.

Due to the scope and scale of the proposal (operational rule changes), the drafting of the business case did not include a detailed consultation process with local landholders and interest groups. Engagement undertaken to date has involved consultation with key agencies and providing information about the proposal to other interested parties.

It is prudent, given the larger scale of this SDL adjustment measure (as opposed to a works measure for example), to undertake further consultation with other interested groups following approval of this business case. This approach is recommended as the likely concerns of other groups relate to not just this one proposal, but the broader SDL adjustment process and the interaction with other proposed measures. A targeted and well-planned engagement process that includes broader engagement on the topic of SDL adjustment in the Basin is recommended if this measure is to proceed beyond this business case.

It is recommended that the MDBA engages further with key stakeholders, in collaboration with partners in SDLAAC. The cost of this engagement is dealt with in Section 2.6. Costing includes:

- Development of detailed engagement plan
- Meetings with interested groups
- Meetings with agencies

4.2. Stakeholder map

Table 10 lists the interested stakeholders with an interest in this proposal. Engagement with all stakeholders listed is proposed following approval of this business case.

Table 10. Map of agencies, groups and individual stakeholders with an interest in the SDL adjustment proposal, including their interface with proposal and potential areas of concern

Stakeholder	Role / responsibility	Interface with the proposal	Likely areas of concern	Awareness of proposal
Murray-Darling Basin Authority	Operations planning Constraints management Hydrological modelling Water policy	River operator TLM coordinator / icon site management Waterway management – bank protection Six Inch Rule trial manager	Impacts on state water shares Operational planning and management of Lake Hume Achievement of ecological outcomes Impact on bank stability	Consulted in development of business case
NSW Office of Water	Water policy/planning and water resource allocation.	Water resource manager	Impacts on NSW water users and riparian communities	Consulted in development of business case Co-sponsor of proposal
Water NSW	Local storage operations	Water manager	Impacts on other water users	Consulted in development of business case
NSW Maritime	Transport issues related to boating	Management of boating issues	Concerns about river flows and heights	To be engaged following approval of business case
Goulburn Broken CMA	Waterway manager – Goulburn Broken catchment (Victoria)	Environmental water planning Barham-Millewa site management	Achievement of ecological outcomes	Consulted in development of business case
North-East CMA	Waterway manager - Upper Murray	Impacts on riverine and riparian ecosystems	Achievement of ecological outcomes	Consulted in development of business case
Goulburn-Murray Water	Storage operator, Victorian water entitlements and allocation	Allocations, water planning, accounting	Impacts on Victorian water allocations / entitlements,	Consulted in development of business case

Stakeholder	Role / responsibility	Interface with the proposal	Likely areas of concern	Awareness of proposal
			Accounting	
Office of Environment and Heritage (NSW)	NSW Environmental policy/planning	Environmental water planning	Achievement of ecological outcomes Interface with other environmental water use	Consulted in development of business case
NSW National Parks and Wildlife Service	Barmah-Millewa Forest land manager (NSW)	Land manager	Site management implications Achievement of ecological outcomes	Consulted in development of business case
Parks Victoria and Yorta Yorta Nations Aboriginal Corporation (joint managers)	Barmah-Millewa Forest land manager (Vic)	Land manager	Site management implications Achievement of ecological outcomes	Aware of proposal To be engaged following approval of business case
Department of Environment (Commonwealth)	Support management of commonwealth environmental water portfolio	Environmental water planning	Achievement of ecological outcomes Interface with other environmental water use	Consulted in development of business case
Department of Environment, Water and Natural Resources (South Australia)	Management of water and environment (South Australia)	Water planning Downstream water user	Implications of proposal on downstream assets and water supply (quantity and quality)	Consulted in development of business case
Commonwealth Environmental Water Holder	Management of commonwealth environmental water portfolio	Environmental water planning	Achievement of ecological outcomes Interface with other environmental water use	Aware of proposal
Victorian Environmental Water Holder	Management of environmental water entitlements (Vic)	Environmental water planning	Achievement of ecological outcomes	Consulted in development of business

Stakeholder	Role / responsibility	Interface with the proposal	Likely areas of concern	Awareness of proposal
			Interface with other environmental water use	case
Environment groups: • Environment Victoria • Goulburn Valley Environment Group	Environmental advocates	Ecological outcomes at a local, reach and basin-scale	Achievement of ecological outcomes	To be engaged following approval of business case
Local action groups: • River Murray Action Group (Bullatale and Wakool) • Hume/Yarrawonga Advisory Committee	Local community advocates	Represent local community	Third party impacts of proposal	Aware of proposal To be engaged following approval of business case
Irrigation groups: • Murray Irrigation • Southern Riverina Irrigators • Goulburn-Murray Water, Water Services Committees	Irrigator advocates	Impacts on irrigator water rights at a local, reach and basin-scale	Interface with irrigation water demand Share of storages Flooding impacts	Aware of proposal To be engaged following approval of business case
Roads and Maritime NSW	Water vessel safety – River Murray	Potential change to river operations – rate of fall	Impacts on maritime safety	To be engaged following approval of business case
Local State & Federal members	Local community advocates	Represent local community	Third party impacts of proposal	To be engaged following approval of business case
Indigenous Groups	Advocate for indigenous water and cultural interest	Changes to watering on sites of indigenous significance	Impacts on indigenous land and water use	To be engaged following approval of business case

5. Project delivery

5.1. Project delivery risks

The overarching approach and methodology for the risk assessment requirements of the Phase 2 Assessment Guidelines are set out in Sections 3.1 and 3.2. That also reports on the review of risks related to adverse ecological impacts and risks from operation of the measure. This section reports on the risks related to the development and delivery of the project.

Appendix 8 of the Guidelines confirms that the primary risks anticipated for 'Project development and delivery' are:

- design risks
- risks to project completion on time
- the risk of project failure
- the inability to deliver the project within budget.

These risks are applicable where major infrastructure is required to implement works and measures. However, these risks are largely immaterial for this proposal as the business case involves an operating rule change.

The main sources of risk for this project are associated with the effective engagement with stakeholders and the provision of appropriate information to resolve any concerns associated with potential third-party impacts. Section 4 outlines a proposed stakeholder engagement strategy. The implementation of that strategy is outside the terms of this business case.

The minor project development and delivery risks are described in more detail, together with the proposed mitigation actions in Table 11. The proposed mitigation actions are expected to reduce all identified risks to acceptably low levels.

Table 11. Risk assessment and mitigation actions

	Risk	Potential issue	Risk assessment (prior to mitigation)			Mitigation actions
			Likelihood	Consequence	Risk rating	
1	Failure to engage effectively	Key stakeholders are not engaged in information/consultation processes, resulting in opposition to proposed changes such that project doesn't proceed.	Likely	Moderate	Medium	Well-designed stakeholder engagement program, including the following features: • Landholders below Hume Dam directly invited to participate in engagement process • Timing designed to facilitate attendance by interested parties. • Alternative opportunities to provide feedback offered to any key stakeholders that can't attend interactions.
2	Community opposition to measures	Community members are not convinced that proposals are sound/without unacceptable impacts and project is opposed.	Possible	Moderate	Medium	Communication and consultation information/interactions carefully designed to clearly communicate issues: • Advice/input gained from experienced agency staff on likely key issues and material designed to clearly address possible questions/concerns. • Leaders of key farmer organisations and community environmental groups briefed on proposals to identify issues and ensure a "no-surprises" approach. • MDBA trial of proposed rule will provide evidence base to address potential concerns about negative impacts.
3	Project delivery	Detailed development of design of operational changes cannot be undertaken in a timely fashion, so project fails to proceed with other measures.	Possible	Moderate	Medium	• Roles and responsibilities for project development and implementation clearly assigned within MDBA and jurisdictions. Project manager assigned to manage delivery program. • Integration of consultation with wider programs for SDL adjustment and constraints program will minimise calls on staff time for stakeholder engagement and ensure project advances in parallel with other elements of a "package"

5.2. Legal and regulatory requirements

This rule change can be implemented once a package of SDL measures is approved under the provisions set out in the Basin Plan and the Intergovernmental Agreement on Implementing Water Reform in the Murray Darling Basin (2013).

As detailed in Section 3, the proposed rule change is consistent with the provisions of the Murray-Darling Basin Agreement and does not affect any other river operational practices. The key changes that would be required to implement the rule change are:

- The current six inch rule arrangements are documented in the Specific Outcomes and Objectives (SO&O) included within the Objectives and Outcomes for river operations in the River Murray System document. The new rule would require amendments to SO&O 2.2, which would need approval from Basin Officials Committee.
- Detailed procedures and manuals will need to be updated to reflect the approved rule change. It is expected that these changes will fall within the delegated authority of MDBA senior officers.

It is not anticipated that there will be any significant legal or regulatory approval barriers to implementation of this rule change, once the change has been adopted as an SDL adjustment measure. Much of the necessary implementation planning has been done as part of the MDBA trial of the proposed rule change, and Basin Officials Committee has already approved a temporary amendment to the relevant SO&O to enable the trial to proceed.

5.3. Governance and project management

This operational rule change will require actions to be undertaken by and within the MDBA, so it is appropriate that the MDBA should assume project management responsibilities for implementing the change once it has been approved as an SDL adjustment measure.

This rule change has similarities to other rule change processes that are frequently undertaken by the Operations Group. The usual model for managing these changes is for the Water Liaison Working Group to monitor project progress and provide advice to the MDBA on issues that may arise, under the overarching oversight of the Basin Official Committee which will exercise formal governance responsibilities in relation to approval of specific rule changes affecting river operations. This well-developed governance process, which is codified through the Agreement and O&O document, is an efficient, effective approach to overseeing the implementation of the proposed rule change.

5.4. Monitoring and evaluation

The proposed relaxation of the controls over the rate of reduction will be subject to close monitoring by the NSW Office of Water as part of the terms of the pilot study authorised by the Basin Officials Committee. This ensures that the final arrangements will draw on the practical experience of the two-year trial over 2014/15 and 2015/16. The proposed relaxation will be amended if any evidence comes to light about additional bank slumping risks.

Once implemented, the key monitoring and evaluation requirements are to ensure that the approved rule change is being followed in accordance with the approved provision in the O&Os and the operating procedures, and that it is working as intended to minimise risks to bank condition.

The O&O document already incorporates provisions for an annual independent review of the MDBA's performance in river operations activities and that their compliance with the general and specific outcomes and objectives for river operations practices have regard to any matters that are relevant.

This annual review should confirm that the management of releases from Lake Hume is being undertaken in accordance with the proposed rule change. In conjunction with monitoring of bank condition undertaken as part of the River Murray Works Program by NSW Department of Primary Industries and the MDBA, the review process will support continuous improvement of operational practices, which occur as the MDBA reviews and reports on its own performance and then addresses any recommendations arising from the independent review.

More broadly, the final monitoring and evaluation plan (MEP) for this operating rule change will be informed by broader intergovernmental arrangements for Basin-wide monitoring and evaluation under the Basin Plan. This measure is expected to contribute to the achievement of outcomes under two key Chapters of the Plan, namely:

i) the delivery of ecological outcomes under Chapter 8; and

ii) under Chapter 10, meeting the relevant sustainable diversion limit/s, which must be complied with under the states' relevant water resource plan/s (WRPs) from 1 July 2019.

While the MDBA has specific responsibilities regarding evaluation of outcomes at the Basin scale, the states are responsible for reporting on relevant matters once implementation of specific Basin Plan Chapters commences within a state. With regard to this supply measure, this will include five yearly reporting on environmental outcomes at an asset scale (Chapter 8), and annually reporting on WRP compliance (Chapter 10). Victoria's participation in the MDBA's monitoring and evaluation framework will effectively allow for outcomes under both Chapters to be effectively assessed and reported.

This approach closely aligns with agreed arrangements under the *Basin Plan Implementation Agreement*, where implementation tasks are to be as streamlined and cost-efficient as possible.

6. Conclusion

This business case proposes a relaxation to the operating rules for controls on the rate of reduction of releases of regulated flows from Hume Dam.

The intention is to:

- enhance environmental outcomes by reducing unseasonal watering of Barmah-Millewa Forest
- increase opportunities for environmental watering by reducing operational losses, at the same time as
- minimising any risks to bank erosion from slumping.

The modelling shows that with the proposed rule change in place, improved environmental outcomes can be achieved compared to the benchmark modelling, utilising the same 2,750 GL of environmental water recovery. This creates the potential for this rule change to make a positive contribution to a package of measures that could be assessed for SDL adjustment opportunities.

Modelling has identified that third party impacts are immaterial. Equally, flows across the border to South Australia meet current and projected values in terms of flow and water quality.

The project will be low cost to implement as a rule change and is subject to robust governance and project management controls.

The business case recommends that a comprehensive stakeholder engagement exercise is rolled-out to ensure community understanding and support for the proposals and minimise risks of local opposition.

7. References

DELWP (2015), Preliminary internal estimate based on MDBA scoring tool.

EarthTech (2008), *The River Murray Six Inch Rule,* for the MDBC

Jacobs (2015), Preliminary Investigation on Improved Regulation of the River Murray under Future Demand Conditions, Report for DELWP.

MDBA 2012. Hydrologic modelling to inform the Basin Plan: Methods and results, Feb 2012.

MDBA 2014. The Living Murray story - The Living Murray icon sites. Webpage available at http://www.mdba.gov.au/media-pubs/publications/living-murray-story/contents/tlm-icon-sites.

SDLAAC 2014. Phase 2 Assessment Guidelines for Supply and Constraint Measure Business Cases

Appendices

Appendix 1. Summary of response to the Phase 2 Assessment Guidelines

This section confirms how this business case delivers against each of the relevant requirements of the SDLAAC Stage 2 Guidelines. The following table lists the requirements and then records where the issue is dealt with in this business case.

Table 12. Concordance - Stage 2 Guidelines and business case

Guidelines section	Heading	Requirement	Business case section
3.1.1	Supply measure definition	Defines the requirements for supply measures to: • operate to increase the quantity of water • achieve equivalent environmental outcomes with a lower volume of water • have no detrimental impacts	2, 3.3 & 3.4
3.1.2	Measures not included in the benchmark conditions of development	Confirm that the measure was not in the benchmark conditions of development	1.4.4
3.2	Constraint measure requirements	Defines application of guidelines to constraint measure initiatives	Not applicable to this business case
3.3	Operational by June 2024	The measure must be capable of entering into operation by 30 June 2024	1.4.4
3.4.1	The measure is a 'new measure'	Confirm the measure has not received funding or have funding approved	1.4.4
3.4.2	Compliance with the purposes of the Water for the Environment Special Account	Defines funding eligibility for constraint measure initiatives	Not applicable to this business case
4.1	Project details	Key project details and overview	2
4.2	Ecological values of the site	Description of the ecological values of the site	3.3
4.3	Ecological objectives and targets	Confirm objectives and targets	3.3
4.4.1	Anticipated ecological benefits	proposed outcomes from the investment	3.3

Guidelines section	Heading	Requirement	Business case section
4.4.2	Potential adverse ecological impacts	Assessment of potential adverse impacts	3.3
4.5.1	Current hydrology and proposed changes	Clear articulation of current and proposed hydrology	3.3
4.5.2	Environmental water requirements	Water requirements of new inundated areas	3.3
4.6	Operating regime	Explanation of the role of each operating scenario	2.7
4.7	Assessment of risks and impacts of the operation of the measure	Assessment of risks and mitigation options	3.1
4.8	Technical feasibility and fitness for purpose	Evidence that the project infrastructure is technically feasible	Not applicable to this rule change business case
4.9	Complementary actions and interdependencies	Confirm interaction with other initiatives	1.4
4.10	Costs, Benefits and Funding Arrangements	Detailed costing and listing of benefits	2.8, 3.6
4.11.1	Stakeholder management strategy	Confirm stakeholder list and stakeholder management strategy	4.1, 4.2
4.11.2	Legal and regulatory requirements	Legal and regulatory requirements	5.2
4.11.3	Governance and project management	Governance and project management	5.3
4.11.4	Risk assessment of Project Development and Delivery	Risks from project development and delivery	5.1
Appendix 6	Summary of key evaluation criteria	Listing of evaluation criteria and Guideline reference	All
Appendix 8	Categories of risk and impact that should be considered in business case development	Categories of risk and impact that should be considered in business case development	3 & 5.1

Appendix 2. Summary of response to the Phase 1 Assessment Guidelines

Guidelines section	Heading	Requirement	Business case section
2.2.2	Description of Proposal	The proponent will need to provide a description of the proposal	2.7
2.2.3	Qualitative Estimate of the Potential Supply Contribution	The proponents will include a qualitative estimate of the potential supply contribution	2.3
2.2.4	Anticipated Environmental Benefits	The proponents will need to describe the likely environmental benefits resulting from the proposal	3.3
2.2.5	Approvals	A proponent must list the likely approvals required for their proposal and the estimated timeframes to obtain each approval	5.2
2.2.6	Potential Risks to the Environment and Third Parties	Proponents should include a preliminary identification and description of the potential adverse environmental and third party impacts	3.3, 3.4, 3.5
2.2.7	Links to Other Proposed Measures	The proponent must provide a preliminary description/assessment of links to other measures and the nature and level of dependency/synergy	1.4.3
2.2.8	Complementary Actions Required to Support the Proposal	The proponent must identify any complementary actions that are required to support the proposal	1.4.3
2.2.9	Potential Risks to Project Delivery	Proponents should provide a preliminary list, description and assessment of the potential risks to project delivery	5.1
2.2.10	Costs and Funding	The proponent must provide an estimate of capital cost and in addition indicate whether there would be ongoing costs associated with operation and maintenance post construction	2.8
2.2.11	Consultation and Engagement	A proponent must identify key stakeholders and an approach to consultation	4.1

Appendix 3. Detailed assessment of matters raised by South Australia

Environmentally Sustainable Level of Take (ESLT) flow and salinity indicators for Coorong, Lower Lakes and Murray Mouth	Baseline (845)	Benchmark (23006)	Proposal (23007)
Average salinity (g/L) in Coorong southern lagoon over model period	62	41	41
Maximum salinity (g/L) in Coorong southern lagoon over model period	291	90	90
Max period (days) salinity in Coorong southern lagoon is greater than 130 g/L	323	0	0
Proportion of years salinity in Coorong southern lagoon < 100 g/L	82%	100%	100%
Average salinity (g/L) in Coorong northern lagoon over model period	29	21	21
Maximum salinity (g/L) in Coorong northern lagoon over model period	148	48	48
Max period (days) salinity in Coorong northern lagoon is greater than 50 g/L	604	0	0
Proportion of years 3 year rolling average barrage flow greater than 1,000 GL/y	91%	99%	99%
Proportion of years 3 year rolling average barrage flow greater than 2,000 GL/y greater than 95%	79%	98%	98%

Lakes metrics	Baseline (845)	Benchmark (23006)	Proposal (23007)
% days Lake Albert salinity exceeds 2000 EC	6%	0%	0%
% days Lake Alexandrina salinity exceeds 1000 EC	11%	0%	0%
% days Lake Alexandrina level below 0.4 m	18%	4%	4%

Appendix 4. Minutes of workshop - 23 March 2015

Minutes

Meeting	Stakeholder engagement workshop
Date	Monday 23 March 2015
Project	Development of business case for SDL adjustments – Improved Regulation of the River Murray
Attendees	[redacted]
Apologies	[redacted]
Distribution	Meeting attendees

Item	Notes
Introduction	-
Background to the business case [redacted])	Thank you for input to the last two business cased (Hume airspace, BMEWFA). Tight turn around and good, timely feedback. Both business cases will be forwarded to SDLAAc for consideration. Will keep stakeholders informed. The proposal for discussion at the workshop has two components– look at operational loss, not transmission loss. Two components: - Flexible rates of fall in river levels downstream of Hume Dam - Improved River Murray Operational Loss Today's objectives: Objective for component 1. To seek input into the preparation for a business case for the flexible rates of fall in river levels downstream of Hume Dam. Objective for component 2. To discuss the characteristics of the River Murray operational loss in recent years in order to gain a better understanding of the factors which have contributed to the improvement in system operational losses.
Component 1.	Flexible rates of fall in River Levels Downstream of Hume Dam
Preliminary modelling [redacted])	Background to proposal 1. REFER TO SLIDES 6 inch rule has been in place almost 60 years.
Key issues identification [redacted])	Five key issues: 1. Operational loss Driver is rainfall rejection. Ordering practice is important. In the past they used to run Mulwala at FSL to meet peak demands. But now that doesn't happen they are running it lower. "Take the 4 day forecast to the bank". Therefore they are more flexible in operational management. Changes in operating practice. For the business case we are looking at the model loss – changes from benchmark and baseline. Hard to tease out the 6inch rule component – BigMOD is a daily model and MSM is a monthly model. It is a small component of the bigger operational loss. Does the model do the rule justice?? Change to 6 inch rule is small part of total ops loss in MSM – hard to identify uniquely. Not a loss to the system if harvested in Lake Victoria, etc. Ross – re-timing of the water. Have used this as the principle in the Murrumbidgee. Water where and when it matters. Its an opportunity to re-time water to better meet needs. 2. Bank slumping Earth Tech study. Trigger for the study – hydro power generation feasibility on Hume. Found that primary driver of bank erosion is fluvial entrainment. Rotational failure is not observed. Report suggests that you can take a less conservative approach to rate of fall. Biggest issue is notching. Potential benefits of flow variability is reduction in notching.

	MDBA trials. Trialling what DELWP are proposing for SDL adjustment. Suggest that it might still be quite conservative. 4-5 monitoring stations (NSW OoW). Two year trial. This summer and next summer. Hard to test when dry and hot. More of an issue when prolonged wet. MDBA spends quite a bit on bank protection works. Need to make sure that they don't increase these works and $$ required for waterway management. 3. Ecosystem outcomes Unseasonal flooding of Barmah-Millewa. And also unseasonal inundation of floodplain wetlands. Hume-Yarrawonga modelling – wetland inundation (Jacobs doing this at the moment for NECMA). Potential to get positive result from reduction in floodplain wetland inundation. 4. Third party impacts SA – changes to operational rules can mean a reduction in inflows to Lake Victoria. Water supply offtakes – Albury City Council, NE Water. Office of Water – not heard of any concerns. Can follow up in the development of the business case. 5. Preferred option The proposal isn't that bold. BOC suggested - should be trialling above 25,000ML/d too. Above 25,000 is at flood ops. How is >25,000 treated in the proposed rule change? 6. Other?? SA issues: Would like to see how this proposal might change flows in volume and timing. How will it impact on entitlement flow? Does it change SA storage right? Are there any water quality and salinity impacts to SA? Changing when water is being delivered – is there any detriment to downstream environmental assets? Would the SDL adjustment method pick up any of the in channel ecosystem assets? How do the DELWP propose to ensure that this change is enduring – change to O&O? creation of entitlement??
Clarify and prioritise issues [redacted])	What do we need to address in the business case? - Aim of the proposal is to keep water out of BM - Storms are a key influence – what does this look like under climate change? - Hard to identify the ops loss in the monthly model - Not a loss if harvested in Lake Victoria - Opportunity to re-time water to better meet environmental needs - Current trial collecting data – learning - Waterway management is a big $$ cost in this reach. Must ensure proposal does not impact on efforts and increase spending - Need to understand watering of floodplain wetlands – outputs from 2D modelling - Could affect SA storage rights - There are currently no constraints on flow > 25,000. How is this treated in the rule change? - How does this rule change interact with CMS 40,000 ML/d change - Is Jan-May period aligned fully with BMF negative impacts? - Water quality impacts - Are any environmental outcomes downstream of BMF affected? Local, in channel impacts. - How is the rule change locked in? change to SO&O, creation of entitlement? Preference is SO&O - How does the proposal link to the other SDL proposals? Authority will consider the whole package of proposals. In the business case we identify the potential interactions with other measures and the broad level of influence that this proposal might have on other proposals. - Local community concerns about bank slumping.
Stakeholder mapping	*Groups to engage prior to submission of business case:*

[redacted])	Environmental managers: Goulburn Broken CMA [redacted]), Parks NSW ([redacted]), OEH [redacted]), North East CMA, VEWH, Parks Victoria. Urban water authorities: North East Water. Engage with them through GMW [redacted]). *Groups to engage through broader consultation of business case packages:* Hume to Yarrawonga Advisory Group – Chair: [redacted]. Group is an MDBA formed group. Membership comprises Councils, landholders, MRAG. Aware of the trial. Murray River Action Group (MRAG). Chair – [redacted]. Main concern for this group is flooding risk. Aware of the proposal through HYAG. NSW Office of Water works group. Source of knowledge. Undertake monitoring for the trials. Know about proposal. Murray Local Land Services – unsure of the direct concern. Linked through NSW interagency communications. Water NSW. [redacted]). Engaged through the trials. No further engagement required at this stage. Diverters: North East Water, Albury City Council, individual irrigators. Engage with water users through GMW [redacted]). Generally concerned about a rapid rate of rise. Would probably welcome a faster rate of fall. Maritime NSW – water safety/boating on R Murray. Not aware of proposal. Southern Riverina Irrigators – potentially conflicting views – keen to maximise SDL offset. Environment groups: Environment Victoria, Goulburn Valley Environment Group. Potential positive environmental outcomes. A good news story.
Component 2:	Improved River Murray Operational Loss
Overview / background [redacted]	Refer to Slides. The concept of operational loss is not considered in actual operations as it is implicitly included within other key assumptions such as travel times, rainfall forecasts, inflow etc. It is a modelling construct as it needs to take into account all operational decisions to mimic reality. Where it factors into operations is in water balance, explaining the annual review of river ops. Operators don't think about it separately in their forward planning, it is part of the decisions they make to manage uncertainty in operational planning. Assume that PPMs are all in place. Jurisdictions sought early assurances in relation to the key issues, as this would influence SDLAACs decision about progression of the project/s from Phase 1 to Phase 2. Victoria were going to consider whether to separate the two projects or continue with them together for Phase 1 and 2 of the SDL adjustment mechanism.
Mapping out changes that have influenced operational loss	Points coloured blue were identified as 'enduring changes'. The points coloured **blue, bold and underlined** as the key influences in operational loss change. Pre-2000: Cap, NSW carryover, NSW water sharing plans, unbundling of water rights, shift from ongoing growth in entitlements, Cap (now SDL) started to be taken seriously 2000-2001: - establishment of Murray BEs - drought influencing operations. 10 years of lower inflows - water started moving from consumptive to environment. Smaller pool of water available. - Modernisation and management of losses - **Change in operations culture** [redacted]) 2002-2003: - Change in cap due to more accurate measurements in MIL - **System improvements – provide improved feedback, information availability. Systems still improving beyond 2015.** - First sub water right allocation. Shifted focus on water use/ availability. Increase focus on outfall reduction. 2004-2005:

	- NWI – transparency - Improved orders by irrigators – system/processes - Inter-valley transfers – accounts used as a risk management tool for R Murray ops. - Users accept tighter ops and risk of shortfalls - Shepparton modernisations – 65-85% efficiency. Created into entitlements. - Operators err on the side of caution. And it is politically OK to do so. 2006-2007: - Drought changed the planning horizon - Temporary works – isolating wetlands, i.e. Euston Lakes, Lake Bonney. Tier 2&3 water management. - Increased communications through Water Liaison Working Group. Particularly around orders. Greater understanding of user behaviour. - Push on compliance – diverters - **Increased focus on water accounting. NWI, transparency, accountability.** - **Increase in water value on the allocation market.** - 2007 carryover introduced in Victoria – changed forecast for how people would use water. Users might not choose to use it. 2008-2009: - First multi-site environmental watering trial. Different to standard ops practice. All water accounted for, lower loss. - Use of longer term forecast. Forecast improved. Operates and water users have more confidence in quality of data. - Kiewa – improved frequency of data input to decision making - IRORG – reviews of river ops. - Establishment of CEWH, MDBA 2010 onwards: - **Environmental water holding.** CEWH water delivered. Big orders, but different flexibility to irrigators. Delivery is assigned to environmental accounts, not as a loss (transmission and operations) - User getting better at forecasting. E.g. Sunraysia, NSW water corps. Modernising their infrastructure (metering) trend over the last few decades
Key issues	Should this be reflected in a change to the benchmark model? 2000-2009 operator behaviours What is the 'lock in' process that will enable a claim of permanent change? How do you make it an enduring change? What is the quantum of the ops change? How does it impact on reliability? SA storage rights? Does ops loss currently create environmental benefit? How does it meet the Phase 2 guidelines? What benefits does change in ops loss deliver? Re-timing, flexibility? Who, and how, does the saving benefit? What is the real evidence that system management of operations loss has changed? Risk-quantum trade off for volume of any savings in ops loss. What entitlement mix would you be looking at?
Wrap up	Workshop attendees in agreement – as mapped out by these minutes – that leading up to and following the millennium drought period there has been significant water reform and also a shift in river operational practice. Further investigation and work is required by DELWP and the project team to progress the proposals and address the 'key issues' that were identified at workshop.

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