

# FINAL REPORT

## Benefit Cost Analysis of Modified Lake Mokoan Proposal

*Prepared for*

**Department of Sustainability and Environment**

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21 September 2007

43315854



BENEFIT COST ANALYSIS OF MODIFIED LAKE MOKOAN  
PROPOSAL

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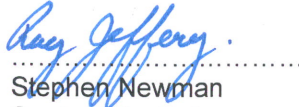


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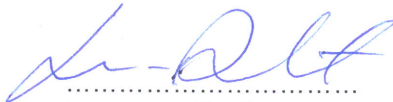
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Date: 21 September 2007  
Reference: 43315854  
Status: Final Report

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## Section 1

## Introduction

### 1.1 Background

In 2002 a number of options were identified by SKM for potential water savings through changes to the configuration and management of Lake Mokoan. URS then (2003) conducted an economic study, titled the "Lake Mokoan Study", of a number of these options which were based on three main proposals:

- revert the lake back to the original natural wetlands;
- reduce the size of the lake by constructing a partition and operating the lake under existing rules; and
- reduce the size of the lake and operating it as an annual water storage feature.

The economic study found that the preferred option was to decommission the lake and revert it to natural wetlands. Included in the decommissioning proposal was a number of strategies to reduce demand on the Broken System and reduce operational losses in order to reduce the impact of the loss of water storage on the reliability of water supply for irrigators.

Murrumbidgee Irrigation Limited (MIL) in collaboration with irrigators on the Broken System ("the proponents") are opposed to decommissioning of the lake and have devised an alternative design known as the "Modified Lake Mokoan" proposal.

### 1.2 Purpose of this report

The purpose of this report is to undertake an economic assessment of the benefits and costs of the Modified Lake Mokoan proposal (discussed in Section 3) and to compare these with the assessment made in 2003 of decommissioning Lake Mokoan. In the interests of efficiency, the assessment draws heavily on the research undertaken for the Lake Mokoan Study.

Since the Lake Mokoan Study (discussed in Section 2) was undertaken, the volumes of water savings and costs of decommissioning have been revised. This analysis therefore incorporates these changes into the assessment of the decommissioning option. It is beyond the scope of this project to reassess the non-market benefits and costs of decommissioning, other than to make adjustments for inflation. Additionally, environmental and heritage impacts are not within the scope of this assessment except where they affect recreational values.

## Section 2

# Decommissioning of Lake Mokoan

### 2.1 Description

The Lake Mokoan Study found that the preferred option for Lake Mokoan was to decommission it and re-establish Winton Swamp. The analysis of this option is described in detail in the Study and should be referred to for additional information.

The decommissioning of the lake involves draining the lake, fixing the outlet gates open, removing Hollands and Broken River Weirs, backfilling and revegetating the inlet and outlet channels, removing the channel structures, reinstating existing water supplies, rehabilitating the drained lake area and removing redundant community assets. It would also save the expenditure required for rehabilitation of the embankment.

In order to retain the current reliability of supply, four packages of reliability offsets have been identified. Two of these packages, "A" and "D" (described in Section 2.2), have been analysed as part of the decommissioning option.

### 2.2 Offsets

The Lake Mokoan Study found that decommissioning Lake Mokoan will reduce the storage capacity of the lake and potentially reduce the reliability of water supply from the Broken River System. To mitigate some of these impacts a number of reliability "offsets" have been devised. For a more complete description see SKM 2007.

The offsets that are common to both Option A and Option D are as follows:

- Tungamah Pipeline;
- Mawson/Burnbrae entitlement purchase;
- mid-Murray storage;
- offline storage within Broken Creek system;
- remote control and monitoring of Lake Nillahcootie;
- remote control and monitoring of Broken River weirs;
- remote control and monitoring of Broken Creek weirs;
- remote flow monitoring of catchment streams to enable greater operational efficiency;
- dynamic real time monitoring of irrigation diversion flow meters; and
- a rain rejection storage in the Lake Mokoan inlet channel.

Option A also has the following offsets:

- pump station and pipeline to supply irrigation diversions upstream of East Goulburn Main (EGM) Channel to Violet Town Boundary Road; and
- supply to Major Creek.

Option D also has the following offsets:

- pump station and pipeline to supply irrigation diversions upstream of EGM to Gowangardie weir; and
- supply of 1 GL of operational loss from EGM rather than Lake Nillahcootie.

## Section 2

# Decommissioning of Lake Mokoan

### 2.3 Benefits of decommissioning

The benefits of decommissioning were described in detail in the Lake Mokoan Study. Other than updated assessments of water savings, these benefits are unlikely to have changed substantially. No attempt has been made to re-evaluate these benefits, other than to adjust them to account for inflation over the past four years, at an assumed inflation rate of three percent per year. These benefits are briefly described below.

#### ***Water savings***

The Lake Mokoan Study made the assumption that water savings would primarily be used to improve environmental flows, based on the objectives of the 'Snowy Project' for which the Lake Mokoan Study is a part. The Study selected an average value of \$70 per ML per year for environmental flows, based on a range of values found in a number of studies. This value has been adjusted for inflation to a present day value of \$79 per ML per year using an approximate inflation rate of 3 percent per annum for this evaluation.

Included in the volume of water savings is evaporation savings and demand reductions and reduced operational losses as a result of offsets. Water savings are equal for both Option A and Option D.

Decommissioning Lake Mokoan will provide an estimated 53.5 GL per year in new environmental water made up of 47.5 GL per year of water savings (refer SKM, 2007, Table 8) and 6 GL of reliability offset entitlement purchases in the Goulburn and Murray irrigation systems.

The total environmental flow benefit achieved by implementing either of the decommissioning options is therefore 53.5 GL per year, with a total value of \$4.2 million per year. The capitalised value of these benefits is presented in Table 2-1.

#### ***Commercial Land Use***

The Lake Mokoan Study found that decommissioning the lake would allow approximately 2,590 hectares of land to the north east of Wintons Swamp, and 2,189 hectares to the south west, to be reclaimed for agricultural use. The likely uses were found to be predominately beef cattle in the north east with some cropping, and a mix of beef cattle, prime lambs, and cropping in the south west. The capitalised production values arising from this land were found to be \$1.77 million (four percent discount rate) and \$290,000 (eight percent discount rate). These values, after adjusting for inflation since the Study, are presented in Table 2-1.

#### ***Savings in water treatment costs***

The Lake Mokoan Study found that decommissioning the lake will eliminate the higher turbidity flows from the lake entering the Broken. The water treatment costs to mitigate these effects were found to be approximately \$63,000 per year. Avoidance of these costs is therefore a benefit of decommissioning. Allowing for inflation since the Study, this benefit amounts to \$71,000 per year. The capitalised value of this benefit is presented in Table 2-1.

#### ***Savings in costs of algal blooms***

The Lake Mokoan Study found that algal bloom problems would be mitigated as a result of decommissioning. The avoided cost of algal blooms was estimated to be approximately \$290,000 per year. After allowing for inflation the annual value of this benefit is approximately \$326,000. The capitalised value of this benefit is presented in Table 2-1.

## Section 2

## Decommissioning of Lake Mokoan

### ***Current management and operation costs avoided***

The operation of Lake Mokoan currently involves a number of costs which will no longer be incurred following decommissioning. These costs are approximately \$603,000 per year. The capitalised value of this benefit is presented in Table 2-1. It should be noted that decommissioning the lake will involve a different set of management and operation costs which are accounted for in Section 2.4 – costs of decommissioning.

### ***Recreational Benefits – Duck Hunting***

Although decommissioning Lake Mokoan will generally reduce recreational opportunities, the Lake Mokoan study found that the number of people duck hunting would increase by approximately 30 percent (780 hunting days) if the Lake were decommissioned, with a net economic value of about \$50 per hunting-day. It was estimated that the increase in net economic value of duck hunting from decommissioning would be approximately \$40,000 per year, with an additional gain in expenditure in the region of approximately \$56,000 per year. The total benefit equates to \$108,000 per year after allowing for inflation.

### ***Unquantified benefits***

As was the case with the Lake Mokoan Study, there are a number of benefits that have not been quantified. These include some recreation use benefits (such as walking and bird watching), indirect use benefits (such as nutrient assimilation), and any non-use benefits of a large area of re-instated wetlands.

### **2.3.1 Summary of benefits of decommissioning**

A summary of benefits of decommissioning are presented in Table 2-1. All benefits have been assessed over a fifty year period. Recreational benefits from duck hunting have been netted from the overall losses in recreational value (see Table 2-4) and have therefore not been included in the summary of benefits below.

**Table 2-1 Summary of benefits of decommissioning**

Item	PV at 4% (\$ million)	PV at 8% (\$ million)
Water Savings	90.5	51.6
Commercial land use (agriculture)	2.0	0.3
Savings in cost of water treatment	1.5	0.8
Savings in costs of algal blooms	6.7	3.7
Savings in management and operation costs	13.0	7.4
<b>TOTAL BENEFITS</b>	<b>113.7</b>	<b>63.8</b>

Section 2

Decommissioning of Lake Mokoan

2.4 Costs of decommissioning

A number of costs will be incurred as a result of decommissioning the lake. In addition to new capital and ongoing costs, decommissioning the lake will also result in losses of recreational activities that currently provide benefit to many Victorians. These costs are outlined below.

**Capital Costs**

The capital costs of decommissioning Lake Mokoan are presented in Table 2-2. Note that the capital costs for Option A and Option D are different due to the different reliability offsets used for these options.

**Table 2-2 Capital costs of decommissioning**

	Decommissioning Option A (\$ million)	Decommissioning Option D (\$ million)
<b>Decom/Rehab Costs:</b>		
Decommissioning Works	6.5	6.5
Lake Mokoan Rehabilitation	2.9	2.9
Supply to Lake diverters	10.7	10.7
<b>Sub-total for decommissioning/rehabilitation</b>	<b>20.1</b>	<b>20.1</b>
<b>Reliability Offsets</b>		
Tungamah S&D pipeline	17.0	17.0
Burnbrae entitlement	1.3	1.3
Remote control and monitoring	0.9	0.9
Metering	1.3	1.3
Rain Rejection Storage	2.1	2.1
Supply into Broken River downstream of EGM	1.0	1.0
Pipeline supply u/s of EGM to VT Boundary Road	2.4	n/a
Supply to Major Creek	2.1	n/a
Offline Storage within Broken Creek system	3.3	2.7
Supply of 1000 ML of operational loss from EGM	n/a	1.0
Pipeline supply upstream of EGM to Gowangardie	n/a	18.5
Additional entitlement purchase	7.0	1.8
<b>Subtotal for Reliability Offsets</b>	<b>38.4</b>	<b>47.6</b>
Mid-Murray Storage	10.8	10.8
Goulburn/Murray Reliability Entitlement Purchase	4.5	4.5
<b>TOTAL CAPITAL COSTS</b>	<b>73.8</b>	<b>83.0</b>

**Section 2**

**Decommissioning of Lake Mokoan**

**Ongoing Costs**

The ongoing (annual) costs arising from decommissioning are presented in Table 2-3. Capitalised costs are presented in Table 2-4.

**Table 2-3 Ongoing costs of decommissioning**

	Decommissioning Option A (\$'000 per year)	Decommissioning Option D (\$'000 per year)
<b>Offset Measures</b>		
Remote Control and Monitoring	24.8	24.8
Irrigation Flow Meters	39	39
Rain Rejection Storage - Inlet Channel	27.3	27.3
Supply Broken d/s of EGM	1	1
2 km Pipeline u/s from EGM	26.5	0
Major Ck Pipeline	35	0
Offline Storage 100ML	0	44
Offline Storage 200ML	50	0
6.5 km Pipeline u/s from EGM	0	103.3
7 km Pipeline d/s of Gowangardie	0	75.7
<b>Sub Total</b>	<b>203.6</b>	<b>315.1</b>
<b>Mokoan Diverter Pipeline</b>	0	0
Operation	53	53
Maintenance	53.3	53.3
Electricity	28	28
<b>Sub Total</b>	<b>134.3</b>	<b>134.3</b>
<b>Mokoan Retained Assets</b>		
Administration, general structure ops, water quality monitoring, surveillance, training, insurance	109	109
Maintenance of outlet, outlet channels, SCADA system, engineering support, office & depot costs and other general infrastructure costs	186	186
<b>Sub Total</b>	<b>295</b>	<b>295</b>
<b>TOTAL ANNUAL COSTS</b>	<b>632.9</b>	<b>744.4</b>

**Section 2**

**Decommissioning of Lake Mokoan**

**Loss of net economic value of recreation activities**

An objective exists to create new recreational opportunities following decommissioning under a proposal called the Mokoan Land Use Strategy. However, the plans for this are uncertain at this stage and have therefore not been included in this analysis.

**Recreational Fishing**

The Lake Mokoan Study found that Lake Mokoan currently supports approximately 5,000 fishing days per year with an approximate economic value of \$50 per fishing-day. It was assumed that approximately 40 percent of these were expended by locals. It was also found that local expenditure associated with recreational fishing was approximately \$40 per fishing-day.

It was estimated that the total loss in recreational fishing value from decommissioning was approximately \$105,000 per year, with a further loss of expenditure in the region of approximately \$120,000 per year. The total loss after allowing for inflation is therefore approximately \$254,000 per year.

**Yachting**

The Lake Mokoan Study found that the lake currently supports approximately 1,150 yachting days per year, with an average economic value of \$35 per yachting-day. Local expenditure was found to be approximately \$28 per yachting-day for members of the Lake Mokoan Yacht Club, and \$66 per yachting-day for non-local attending regattas.

It was estimated that decommissioning the lake would result in a loss in the net economic value of yachting of approximately \$40,000 per year, and an associated loss in expenditure in the local region of approximately \$45,000 per year. The total loss after allowing for inflation is therefore approximately \$96,000 per year.

**Water Skiing**

The Lake Mokoan Study found that Lake Mokoan currently supports approximately 400 skiing days per year, with an average economic value of \$68 per skiing-day. Local expenditure was found to be approximately \$50 per skiing-day.

It was estimated that decommissioning the lake result in a loss in the net economic value of water skiing of approximately \$18,000 per year. A further estimated \$7,000 per year in local expenditure was expected to occur. The total loss after allowing for inflation is therefore approximately \$28,000 per year.

**2.4.1 Summary of costs of decommissioning**

A summary of the costs of decommissioning assessed over a fifty year period are presented in Table 2-4.

**Table 2-4 Summary of costs of decommissioning**

	Decommissioning Option A		Decommissioning Option D	
	PV at 4% (\$ million)	PV at 8% (\$ million)	PV at 4% (\$ million)	PV at 8% (\$ million)
Capital costs	73.8	73.8	83.0	83.0
Ongoing costs	13.6	7.7	16.0	9.1
Loss of recreational value	5.1	3.5	5.1	3.5
<b>TOTAL COSTS</b>	<b>92.4</b>	<b>85.0</b>	<b>104.1</b>	<b>95.6</b>

Section 2

Decommissioning of Lake Mokoan

2.5 Benefit cost analysis

A summary of the benefits and costs of the two decommissioning options are presented in Table 2-5. All benefits and costs have been assessed over a fifty year period.

Table 2-5 Summary of benefits and costs of decommissioning

	Decommissioning Option A		Decommissioning Option D	
	PV at 4% (\$ million)	PV at 8% (\$ million)	PV at 4% (\$ million)	PV at 8% (\$ million)
<b>Benefits</b>				
Water Savings	90.5	51.6	90.5	51.6
Commercial land use	2.0	0.3	2.0	0.3
Savings in cost of water treatment	1.5	0.8	1.5	0.8
Savings in cost of algal blooms	6.7	3.7	6.7	3.7
Current mgmt. and operation costs avoided	13.0	7.4	13.0	7.4
<b>Total quantified benefits</b>	<b>113.7</b>	<b>63.8</b>	<b>113.7</b>	<b>63.8</b>
<b>Costs</b>				
Loss of net econ. value of recreational activities	5.1	3.5	5.1	3.5
<b>Capital Costs:</b>				
Decommissioning and rehabilitation costs	20.1	20.1	20.1	20.1
Construction costs for storage	n/a	n/a	n/a	n/a
Reliability Offsets	38.4	38.4	47.6	47.6
Mid-Murray storage	10.8	10.8	10.8	10.8
Goulburn/Murray reliability entitlement purch.	4.5	4.5	4.5	4.5
<b>Ongoing Costs:</b>				
Offset measures	4.4	2.5	6.8	3.9
Mokoan diverter pipeline	2.9	1.6	2.9	1.6
Mokoan Retained assets	6.3	3.6	6.3	3.6
<b>Total quantified costs</b>	<b>92.4</b>	<b>85.0</b>	<b>104.1</b>	<b>95.6</b>
<b>Net Present Value</b>	<b>21.2</b>	<b>-21.3</b>	<b>9.6</b>	<b>-31.9</b>

Option A and Option D are economic when benefits and costs are discounted at four percent, with Net Present Values (NPVs) of \$21.2 million and \$9.6 million respectively. However, these options become uneconomic when discounted at eight percent with NPVs of negative \$21.3 million and negative \$31.9 million respectively.

Given the above analysis, Option A is preferred as it provides the highest NPV under both discount scenarios.

## Section 3

# Modified Lake Mokoan Proposal

### 3.1 Description

The Modified Lake Mokoan proposal involves partitioning the lake using natural contours of the Lake Mokoan site such that three main areas are created. The central area, the "Wetland Storage", functions as a permanent storage. To the east of this and separated by a constructed embankment is Greens Swamp, which would be retained as a natural wetland under this proposal. To the west of the Wetland storage is the Sergeants Swamp area which under the Modified Lake Mokoan proposal would be drained and traversed by a channel that connects the Wetland Storage to the existing Lake Mokoan outlet.

The proponents of the proposal claim that it provides a reliable water storage with water savings via reduced surface area of storages, allows for the restoration of significant areas of wetland, and continues to support recreational activities currently supported by Lake Mokoan.

### 3.2 Offsets

Offsets have been proposed under the Modified Lake Mokoan proposal to mitigate some of the reductions in supply reliability that will result from reconfiguration of Lake Mokoan. The proposed offsets are:

- Tungamah Pipeline;
- Mawson/Burnbrae entitlement purchase;
- mid-Murray storage;
- remote control and monitoring of Lake Nillahcootie;
- remote control and monitoring of Broken River weirs;
- remote control and monitoring of Broken Creek weirs;
- remote flow monitoring of catchment streams to enable greater operational efficiency; and
- a rain rejection storage in the Lake Mokoan inlet channel.

### 3.3 Benefits of the Modified Lake Mokoan proposal

The valuation of benefits of the Modified Lake Mokoan proposal draws on many of the assumptions and values used in the assessment of options in the previous Lake Mokoan Study. Where possible, benefits have been quantified in monetary terms and inflated to account for the time that has elapsed since these values were estimated in the original study. A more detailed explanation of the derivation of values used to quantify these benefits is provided in the above mentioned reference.

#### ***Water Savings***

The Lake Mokoan Study made the assumption that water savings would primarily be used to improve environmental flows, based on the objectives of the 'Snowy Project' for which the Lake Mokoan Study is a part. The Study selected an average value of \$70 per ML per year for environmental flows, based on a range of values found in a number of studies. This value has been inflated to present day value of \$79 per ML per year using an approximate inflation rate of 3 percent per annum for this evaluation.

The Modified Lake Mokoan proposal will provide an estimated 42.3 GL per year in new environmental water made up of 36.3 GL per year of water savings (refer SKM, 2007, Table 8) and 6 GL of reliability offset entitlement purchases in the Goulburn and Murray irrigation systems.

The present value of these water savings is presented in Table 3-1, based on a unit value of \$79 per ML per year.

## Section 3

# Modified Lake Mokoan Proposal

### ***Commercial Land Use***

Implementation of the Modified Lake Mokoan proposal will allow some area of land to be reclaimed for commercial uses after provision is made for land still inundated, re-established wetlands and wetland buffer zones. No indication is given of the amount of reclaimed land that will be available for commercial use. It has been assumed for this assessment that reclaimed land available for commercial use is approximately the same in area and value as the decommissioning option.

The amount of reclaimed land has therefore been assumed to be 4,779 hectares, which is made up of 2,590 hectares to the south and south west of the Wetland Storage, and 2189 hectares to the south of the Sergeants Swamp area.

The likely uses were found to be predominately beef cattle in the north east with some cropping, and a mix of beef cattle, prime lambs, and cropping in the south west. The capitalised production values arising from this land were found to be \$1.77 million (four percent discount rate) and \$290,000 (eight percent discount rate). When adjusted for inflation these values are as shown in Table 3-1.

### ***Reductions in Water Treatment Costs***

Shear stress modelling for Lake Mokoan (see Interim Report, URS 2003) showed the majority of high shear stress areas occurred in the northeast corner of the lake for all scenarios modelled, even at lower wind speeds. The establishment of a new eastern perimeter to the lake at the Spit Bank will excise this high shear stress zone from the lake and should help decrease the level of sediment resuspension and water column turbidity. The fetch across the lake (i.e. the distance travelled by prevailing winds) is a major contributing factor to wave action and this will effectively be halved by construction of the Spit Bank.

There is considerable uncertainty as to whether implementing the Modified Lake Mokoan would provide a water quality benefit.

It has been assumed that improvements in water quality and consequent reductions in water treatment costs would be similar to those investigated in Option 2B3 of the Lake Mokoan Study, which involved construction of a similar spit bank to create a shallow, permanent storage. It was determined that there was potential for long-term decrease in the annual treatment costs compared to the current \$63,000, and that implementation of option 2B3 would result in a 75% decrease. A similar decrease has therefore been adopted for the assessment of the Modified Lake Mokoan proposal. The present value of this cost saving, allowing for inflation since the study, is presented in Table 3-1.

### ***Reductions in Algal Blooms***

With good water management and the potential for reduced turbidity there may be some reduction in frequency of algal blooms. The uncertainty associated with such a result is high. For the purposes of this analysis, the same assumptions for algal bloom reductions used in option 2B1 of the Lake Mokoan Study have been applied here. The annual costs of algal blooms have therefore been assumed to be reduced by 25 percent from the current annual costs identified in the Lake Mokoan Study of \$290,000. This equates to a reduction of \$72,500. The present value of this cost saving, allowing for inflation since the study, is presented in Table 3-1.

### ***Current management and operation costs avoided***

By definition, managing and operating Lake Mokoan involves significant costs that would be avoided by implementing the Modified Lake Mokoan proposal. The avoidance of these costs is therefore a benefit of the Modified Lake Mokoan proposal. It should be noted that the Modified Lake Mokoan proposal will involve a different set of management and operation costs which are accounted for in Section 3.4 – costs of the Modified Lake Mokoan proposal.

**Section 3**

**Modified Lake Mokoan Proposal**

Accordingly, it has been assumed that the level of management and operation costs avoided are similar to those used in Option 2B1 of the Lake Mokoan Study, which amount to \$526,000 per year, or \$603,000 after allowing for inflation since the study.

The present value of operation and maintenance costs that would be avoided by the Modified Lake Mokoan proposal are presented in Table 3-1.

**Recreational Benefits – Duck Hunting**

The Lake Mokoan Study found that the number of people duck hunting would increase by approximately 30 percent (780 hunting days) if the Lake were decommissioned, with a net economic value of about \$50 per hunting-day. It also found that a similar increase would result from implementation of Option 2B1, which involved the construction of a deep permanent storage via a Spit Bank similar to that proposed in the Modified Lake Mokoan proposal, but without the additional partition to the west. Given this finding, it is reasonable to assume that duck hunting numbers would increase by the same amount under the Modified Lake Mokoan proposal.

It is therefore expected that implementing the Modified Lake Mokoan proposal would result in an increase in the net economic value of duck hunting of approximately \$39,000 per year.

Local expenditure was found to be approximately \$73 per hunting-day in the Lake Mokoan Study. The increase in local expenditure from duck hunting under the Modified Lake Mokoan proposal would be worth approximately \$57,000 per year.

After allowing for inflation, the recreational benefits for duck hunting from the Modified Lake Mokoan proposal are approximately \$108,000 per year.

**Unquantified benefits**

As was the case with the Lake Mokoan study, there are a number of benefits that have not been quantified. These include some recreation use benefits (such as walking and bird watching), indirect use benefits (such as nutrient assimilation), and any non-use benefits of a large area of re-instated wetlands.

**3.3.1 Summary of benefits of the Modified Lake Mokoan proposal**

A summary of benefits of implementing the Modified Lake Mokoan proposal are presented in Table 3-1. All benefits have been assessed over a fifty year period. Recreational benefits from duck hunting have been netted from the overall losses in recreational value (see Table 3-4) and have therefore not been included in the summary of benefits below.

**Table 3-1 Summary of benefits of the Modified Lake Mokoan proposal**

Item	PV at 4% (\$ million)	PV at 8% (\$ million)
Water Savings	71.6	40.8
Commercial land use (agriculture)	2.0	0.3
Savings in cost of water treatment	1.1	0.6
Savings in costs of algal blooms	1.7	0.9
Savings in management and operation costs	13.0	7.4
<b>TOTAL BENEFITS</b>	<b>89.3</b>	<b>50.0</b>

Section 3

Modified Lake Mokoan Proposal

3.4 Costs of the Modified Lake Mokoan proposal

A number of costs will be incurred as a result of decommissioning the lake under the Modified Lake Mokoan proposal. In addition to new capital and ongoing costs, decommissioning the lake will also result in losses of recreational activities that currently provide benefit to many Victorians. These costs are outlined below.

**Capital Costs**

The capital costs of decommissioning Lake Mokoan are presented in Table 3-2.

**Table 3-2 Capital costs of the Modified Lake Mokoan proposal**

	Costs (\$ million)
<b>Decom/Rehab Costs:</b>	
Decommissioning Works	0.5
Lake Mokoan Rehabilitation	1.5
Supply to Lake diverters	8.0
<b>Sub-total for decommissioning/rehabilitation</b>	<b>10.0</b>
Storage embankments	38.3
Spit Bank Embankment	11.4
Flood Pumping	2.3
Outlet Structure	1.8
Sergeants Swamp outlet channel	3.8
Spillways	2.4
<b>Sub-total for Modified Lake Mokoan storage</b>	<b>59.9</b>
<b>Reliability Offsets</b>	
Tungamah S&D pipeline	17.0
Burnbrae entitlement	1.3
Remote control and monitoring	0.9
Metering	1.3
Rain Rejection Storage	2.1
Supply into Broken River downstream of EGM	0.0
Pipeline supply u/s of EGM to VT Boundary Road	0.0
Supply to Major Creek	0.0
Offline Storage within Broken Creek system	0.0
Supply of 1000 ML of operational loss from EGM	0.0
Pipeline supply upstream of EGM to Gowangardie	0.0
Additional entitlement purchase	0.0
<b>Subtotal for Reliability Offsets</b>	<b>22.6</b>
Mid-Murray Storage	10.8
Goulburn/Murray Reliability Entitlement Purchase	5.5
<b>TOTAL CAPITAL COSTS</b>	<b>108.8</b>

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**Modified Lake Mokoan Proposal**

**Ongoing Costs**

The ongoing (annual) costs of the Modified Lake Mokoan proposal are presented in Table 3-3. Capitalised costs are presented in Table 3-4.

**Table 3-3 Ongoing costs of the Modified Lake Mokoan proposal**

	Ongoing Costs (\$'000 per year)
<b>Offset Measures</b>	
Remote Control and Monitoring	24.8
Rain Rejection Storage - Inlet Channel	27.3
Embankments - Spit	105.0
Embankments - Sargeants	0.0
Active Cell O/L tower	10.0
Active Cell O/L conduit	0.0
Outlet Channel from Active Cell	50.0
Wetland Flood Pump - Maintenance	15.0
Wetland Flood Pump - Operation	22.2
Wetland O/L	10.0
Spillways	15.0
<b>Sub Total</b>	<b>279.3</b>
<b>Mokoan Diverter Pipeline</b>	
Operation	53.0
Maintenance	41.0
Electricity	29.8
<b>Sub Total</b>	<b>123.8</b>
<b>Mokoan Retained Assets</b>	
Administration, general structure ops, water quality monitoring, surveillance, training, insurance	141.7
Maintenance of inlet channel	58.1
Maintenance of existing embankment, additional access tracks and fences etc	40.0
Maintenance of outlet, outlet channels, SCADA system, engineering support, office & depot costs and other general infrastructure costs	186.0
Mgmt & Admin (Grazing)	2.0
Dam Safety Review	30.0
<b>Sub Total</b>	<b>457.8</b>
<b>TOTAL ANNUAL COSTS</b>	<b>860.8</b>

## Section 3

## Modified Lake Mokoan Proposal

### **Recreational value**

Lake Mokoan is currently host to a range of recreational activities. Changes to the configuration of Lake Mokoan proposed under the Modified Lake Mokoan design will have impacts on these activities, particularly fishing, yachting, water skiing and duck hunting.

### **Recreational Fishing**

The Lake Mokoan Study found that Lake Mokoan currently supports approximately 5,000 fishing days per year, with an approximate economic value of \$50 per fishing-day. It was assumed that approximately 40 percent of these were expended by locals. It was also found that local expenditure associated with recreational fishing was approximately \$40 per fishing-day.

The implementation of the Modified Lake Mokoan proposal would involve an approximate 80 percent reduction in permanent lake volume and 75 percent reduction in surface area. There is insufficient information to know whether a recreational fishery would be viable. It has been assumed for this assessment that recreational fishing will remain, however, such a large decrease in volume and area is expected to impact on stocking rates and the quality of recreational fishing available.

For this assessment we have assumed that locals keep fishing (2,000 fishing days per year), as do one-third of the remaining 3000 fishing days by non-locals, but suffer a 20 percent reduction in economic value due to crowding and reduced catch-rates. The remaining 2,000 fishing days are expended annually at alternative sites with a 30 percent reduction in economic value. The total loss in net economic value of recreational fishing is therefore approximately \$60,000 per year, which equates to \$68,000 after inflation.

It is assumed that half of those that seek alternative sites remain in the local region (such as Lake Mulwala, Lake Nillahcootie, and near-by rivers) and continue to spend money in the local region. The remaining 1,000 seek sites outside of the local region, resulting in a loss of local annual expenditure of \$40 per fishing-day spent outside the region. The total loss of expenditure associated with recreational fishing is therefore approximately \$40,000 per year, or \$45,000 after inflation.

Note that estimated reductions in both the net economic value and expenditure are less under the Modified Lake Mokoan proposal than would occur under Option 1 of the Lake Mokoan study, but greater than would occur under Option 2B1 (which involved a smaller reduction in permanent storage size).

### **Yachting**

The Lake Mokoan study found that the Lake currently supports approximately 1,150 yachting days per year, with an average economic value of \$35 per yachting-day. Local expenditure was found to be approximately \$28 per yachting-day for members of the Lake Mokoan Yacht Club, and \$66 per yachting-day for non-local attending regattas.

The Modified Lake Mokoan proposal results in a reduction in permanent lake area from 7,880 hectares to 1,950 hectares – a 75 percent reduction. This will have significant implications on the future of local yachting and could potentially result in the eventual demise of yachting on the lake.

There is considerable uncertainty in estimating these impacts. It has been assumed for this analysis that the two regattas held on the lake per year would be lost (approx. 400 yachting days), with a further 50 percent reduction in the remaining yachting days by Club members. This would result in a total loss of 775 yachting days with a total recreational value of \$27,125 per year.

Local expenditure associated with yachting is assumed to reduce by \$37,000 in proportion with the loss of 775 yachting days.

After allowing for inflation, the total loss of recreational value associated with yachting is therefore assumed to be approximately \$72,000 per year.

**Section 3**

**Modified Lake Mokoan Proposal**

**Water Skiing**

The Lake Mokoan study found that Lake Mokoan currently supports approximately 400 skiing days per year, with an average economic value of \$68 per skiing-day. Local expenditure was found to be approximately \$50 per skiing-day.

As was the case for yachting, the loss of 75 percent of surface area of the Lake has significant consequences for water skiing activities. It is assumed that 75 percent of local week-day water skiing (105 skiing days) would be lost. Of the remaining 295 skiing days, approximately half (150 skiing days) would use substitute sites such as Lake Nihlacootie and Mulwala with a 30% loss in economic value, while the remaining 145 ski days would be spent skiing the Intermediate Cell with a loss in net economic value of 50 percent. The resulting net economic recreational loss would therefore be approximately \$15,000 per year.

It is assumed that local expenditure would be lost along with the loss of the 105 weekday skiing days, but would remain for the remaining 295 skiing days. The loss of expenditure is therefore expected to be approximately \$5,250 per year.

After allowing for inflation, the total loss of recreational value associated with yachting is therefore assumed to be approximately \$23,000 per year.

**3.4.1 Summary of costs of the Modified Lake Mokoan proposal**

A summary of the costs of the Modified Lake Mokoan proposal are presented in Table 3-4. All costs have been assessed over a fifty year period.

**Table 3-4 Summary of costs of the Modified Lake Mokoan proposal**

	PV at 4% (\$ million)	PV at 8% (\$ million)
Capital costs	108.8	108.8
Ongoing costs	18.5	10.5
Loss of recreational value	4.5	3.2
<b>TOTAL COSTS</b>	<b>131.8</b>	<b>122.6</b>

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Modified Lake Mokoan Proposal

3.5 Benefit cost analysis

A summary of the benefits and costs of the Modified Lake Mokoan proposal is presented in Table 3-5. All benefits and costs have been assessed over a fifty year period.

Table 3-5 Summary of benefits and costs of the Modified Lake Mokoan proposal

		MLM Proposal	
		PV at 4% (\$ million)	PV at 8% (\$ million)
<b>Benefits</b>			
	Water Savings	71.6	40.8
	Commercial land use	2.0	0.3
	Savings in cost of water treatment	1.1	0.6
	Savings in cost of algal blooms	1.7	0.9
	Current mgmt. and operation costs avoided	13.0	7.4
	<b>Total quantified benefits</b>	<b>89.3</b>	<b>50.0</b>
<b>Costs</b>			
	Loss of net econ. value of recreational activities	4.5	3.2
<b>Capital Costs:</b>			
	Decommissioning and rehabilitation costs	10.0	10.0
	Construction costs for storage	59.9	59.9
	Reliability Offsets	22.6	22.6
	Mid-Murray storage	10.8	10.8
	Goulburn/Murray reliability entitlement purch.	5.5	5.5
<b>Ongoing Costs:</b>			
	Offset measures	6.0	3.4
	Mokoan diverter pipeline	2.7	1.5
	Mokoan Retained assets	9.8	5.6
	<b>Total quantified costs</b>	<b>131.8</b>	<b>122.6</b>
<b>Net Present Value</b>		<b>-42.5</b>	<b>-72.6</b>

The Modified Lake Mokoan proposal is extremely uneconomic using both four and eight percent discount rates. Using a four percent discount rate the Net Present Value of the Modified Lake Mokoan proposal is negative \$42.5 million. The NPV is negative \$72.6 million using the higher discount rate of eight percent.

Section 4

Comparison of options

4.1 Option comparison

A summary of the benefits and costs of all options is presented in Table 4-1. Also presented are the Net Present Values of each option and Threshold Costs for each option – the maximum cost at which each option can be economic. All benefits and costs have been assessed over a fifty year period.

Table 4-1 Benefit cost analysis of options

	Decommissioning Option A		Decommissioning Option D		MLM Proposal	
	PV at 4% (\$ million)	PV at 8% (\$ million)	PV at 4% (\$ million)	PV at 8% (\$ million)	PV at 4% (\$ million)	PV at 8% (\$ million)
<b>Benefits</b>						
Water Savings	90.5	51.6	90.5	51.6	71.6	40.8
Commercial land use	2.0	0.3	2.0	0.3	2.0	0.3
Savings in cost of water treatment	1.5	0.8	1.5	0.8	1.1	0.6
Savings in cost of algal blooms	6.7	3.7	6.7	3.7	1.7	0.9
Current mgmt. and operation costs avoided	13.0	7.4	13.0	7.4	13.0	7.4
<b>Total quantified benefits</b>	<b>113.7</b>	<b>63.8</b>	<b>113.7</b>	<b>63.8</b>	<b>89.3</b>	<b>50.0</b>
<b>Costs</b>						
Loss of net econ. value of recreational activities	5.1	3.5	5.1	3.5	4.5	3.2
<b>Capital Costs:</b>						
Decommissioning and rehabilitation costs	20.1	20.1	20.1	20.1	10.0	10.0
Construction costs for storage	n/a	n/a	n/a	n/a	59.9	59.9
Reliability Offsets	38.4	38.4	47.6	47.6	22.6	22.6
Mid-Murray storage	10.8	10.8	10.8	10.8	10.8	10.8
Goulburn/Murray reliability entitlement purch.	4.5	4.5	4.5	4.5	5.5	5.5
<b>Ongoing Costs:</b>						
Offset measures	4.4	2.5	6.8	3.9	6.0	3.4
Mokoan diverter pipeline	2.9	1.6	2.9	1.6	2.7	1.5
Mokoan Retained assets	6.3	3.6	6.3	3.6	9.8	5.6
<b>Total quantified costs</b>	<b>92.4</b>	<b>85.0</b>	<b>104.1</b>	<b>95.6</b>	<b>131.8</b>	<b>122.6</b>
<b>Net Present Value</b>	<b>21.2</b>	<b>-21.3</b>	<b>9.6</b>	<b>-31.9</b>	<b>-42.5</b>	<b>-72.6</b>
<b>Threshold Cost</b>	<b>113.7</b>	<b>63.8</b>	<b>113.7</b>	<b>63.8</b>	<b>89.3</b>	<b>50.0</b>

The preferred option is Option A with a Net Present Value (NPV) of \$21.2 million when discounted at four percent. When discounted at eight percent, Option A becomes negative with an NPV of negative \$21.3 million. Total costs would need to be reduced to \$63.8 million (a reduction of \$21.3 million) for this option to become economic under an eight percent discount rate.

Option D is the next best option after Option A and is economic under a discount rate of four percent with an NPV of \$9.6 million. Under an eight percent discount rate, however, Option D is uneconomic with an NPV of negative \$31.9 million. For this option to become economic under an eight percent discount rate, total costs would need to be reduced to \$63.8 million (a reduction of \$31.9 million).

The Modified Lake Mokoan proposal is the least economic of the options analysed with an NPV of negative \$42.5 million using a four percent discount rate and negative \$72.6 million using an eight percent discount rate. Total costs would need to be reduced to \$89.3 million (a reduction of \$42.5 million) for the Modified Lake Mokoan proposal to become economic under a four percent discount rate. Under an

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Comparison of options

eight percent discount rate, costs would need to be reduced to \$50.0 million (a reduction of \$72.6 million) for this option to become economic.

4.2 Sensitivity testing

Value of water savings

The value of water savings used for this analysis (\$79/ML/yr) has assumed no change in the value of environmental flows since the 2002 Lake Mokoan Study other than inflation. It is likely that the increased scarcity of water over this period has increased the value of environmental flows. A study recently undertaken for the Victorian Environment Assessment Council found that improved flows in the River Murray would result in net benefits of between approximately \$45 and \$190 per megalitre per year, with an average of approximately \$115 per megalitre per year.

The State Government has also implied a value for water savings through its willingness to pay for water savings projects. These have ranged between approximately \$360 and \$4,900 per ML as a present (capitalised) value, with a median of approximately \$1,500 per megalitre. As an annualised value using a discount rate of four percent over fifty years, this equates to approximately \$70 per megalitre per year (\$120 per megalitre per year at eight percent). This is comparable to the value used in this analysis.

It is informative to see the results of the analysis if the average value for environmental flows of \$115 per ML per year found in the VEAC study is employed. These results are presented in Table 4-2.

Table 4-2 BCA with increased value of water savings (\$115/ML/yr)

	Decommissioning Option A		Decommissioning Option D		MLM Proposal	
	PV at 4% (\$ million)	PV at 8% (\$ million)	PV at 4% (\$ million)	PV at 8% (\$ million)	PV at 4% (\$ million)	PV at 8% (\$ million)
<b>Benefits</b>						
Water Savings	132.2	75.3	132.2	75.3	104.5	59.5
Commercial land use	2.0	0.3	2.0	0.3	2.0	0.3
Savings in cost of water treatment	1.5	0.8	1.5	0.8	1.1	0.6
Savings in cost of algal blooms	6.7	3.7	6.7	3.7	1.7	0.9
Current mgmt. and operation costs avoided	13.0	7.4	13.0	7.4	13.0	7.4
<b>Total quantified benefits</b>	<b>155.3</b>	<b>87.5</b>	<b>155.3</b>	<b>87.5</b>	<b>122.2</b>	<b>68.7</b>
<b>Costs</b>						
Loss of net econ. value of recreational activities	5.1	3.5	5.1	3.5	4.5	3.2
<b>Capital Costs:</b>						
Decommissioning and rehabilitation costs	20.1	20.1	20.1	20.1	10.0	10.0
Construction costs for storage	n/a	n/a	n/a	n/a	59.9	59.9
Reliability Offsets	38.4	38.4	47.6	47.6	22.6	22.6
Mid-Murray storage	10.8	10.8	10.8	10.8	10.8	10.8
Goulburn/Murray reliability entitlement purch.	4.5	4.5	4.5	4.5	5.5	5.5
<b>Ongoing Costs:</b>						
Offset measures	4.4	2.5	6.8	3.9	6.0	3.4
Mokoan diverter pipeline	2.9	1.6	2.9	1.6	2.7	1.5
Mokoan Retained assets	6.3	3.6	6.3	3.6	9.8	5.6
<b>Total quantified costs</b>	<b>92.4</b>	<b>85.0</b>	<b>104.1</b>	<b>95.6</b>	<b>131.8</b>	<b>122.6</b>
<b>Net Present Value</b>	<b>62.8</b>	<b>2.4</b>	<b>51.2</b>	<b>-8.2</b>	<b>-9.6</b>	<b>-53.9</b>

The ranking of options is unchanged by the increase in the value of water savings, with Option A still clearly the preferred option followed by Option D. Both decommissioning options are economic under a

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**Comparison of options**

four percent discount rate, with NPVs of \$62.8 million and \$51.2 million respectively, while the MLM proposal is uneconomic with an NPV of negative \$9.6 million.

**Entitlement Prices**

The current scarcity of water has meant that prices of entitlements are higher than was used in this analysis. There is uncertainty as to whether the higher prices currently experienced will be temporary or more permanent. The Department of Sustainability and Environment have indicated that if current prices persist, the cost of purchasing entitlements would need to be adjusted by the amounts indicated in Table 4-3.

**Table 4-3 Analysis including purchase entitlement adjustments**

	Decommissioning Option A		Decommissioning Option D		MLM Proposal	
	PV at 4% (\$ million)	PV at 8% (\$ million)	PV at 4% (\$ million)	PV at 8% (\$ million)	PV at 4% (\$ million)	PV at 8% (\$ million)
Total benefits	113.7	63.8	113.7	63.8	89.3	50.0
Total costs (without entitlement adjustments)	92.4	85.0	104.1	95.6	131.8	122.6
Entitlement purchase adjustments	10.0	10.0	11.9	11.9	6.9	6.9
<b>Net Present Value</b>	<b>11.2</b>	<b>-31.3</b>	<b>-2.3</b>	<b>-43.8</b>	<b>-49.4</b>	<b>-79.5</b>

It is clear from Table 4-3 that Option A is still the preferred option with these adjustments, and is the only economic option under a four percent discount rate. Option D becomes uneconomic under a four percent discount rate when purchase entitlement adjustments are included in the analysis. The Modified Lake Mokoan proposal remains extremely uneconomic under both discount rates.

**4.3 Conclusions**

It is clear from this analysis that decommissioning Lake Mokoan is economically preferred to implementing the Modified Lake Mokoan proposal. Both decommissioning options results in net gains under a four percent discount rate – that is, the present value of benefits outweigh costs. If current high prices are to prevail, however, Option D will only be economic if the capitalised value of water savings is \$1,735 per megalitre or greater under a four percent discount rate (about \$80 per megalitre per year). Under all scenarios analysed, Option A is preferred over Option D. The benefits provided by both options are identical, however Option D is a more expensive option.

Although the Modified Lake Mokoan proposal would retain greater recreational values than decommissioning, these gains are outweighed by the value of the additional water savings resulting from the decommissioning option. The Modified Lake Mokoan proposal is also considerably more expensive to implement than decommissioning, and is uneconomic under all scenarios analysed.

Environmental and heritage assessment have not undertaken for the Modified Lake Mokoan proposal. As a result, environmental and heritage issues have not been included in the analysis of any of the options, other than values of improved environment flows from water savings. Environmental and heritage impacts of decommissioning have been assessed under both Victorian (EES) and Commonwealth (EPBC) legislation, which found no significant impact, and no requirement for further environmental assessment under the legislation.

## Section 5

## References

DCA Economics et al. (2007), *River Red Gum Forest Investigations – Socio-Economic Assessment*, Report produced for the Victorian Environmental Assessment Council

SKM (2007), *Decommissioning Lake Mokoan Program – Review of Modified Lake Mokoan Proposal*, Report produced for the Department of Sustainability and Environment

URS (2003), *Lake Mokoan Study, Volume 1 – Current Situation*, Report produced for the Goulburn Broken Catchment Management Authority

URS (2003), *Lake Mokoan Study, Volume 2 – Option Assessment*, Report produced for the Goulburn Broken Catchment Management Authority

URS (2003), *Lake Mokoan Study, Volume 5 – Benefit Cost Analysis: Addendum*, Report produced for the Goulburn Broken Catchment Management Authority

## Section 6

## Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of the Department of Sustainability and Environment and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 29/6/2007.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

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