(Paper presented by Broken System Reliability Reference Committee to Broken System Water Users Meeting - 30 June 2005)

SYSTEM RELIABILITY

Analysis of Technical Information

1. Background

The Government has announced its decision to decommission Lake Mokoan. This is a component of the Government's policy on Water Resources as presented in the White Paper.

Included in the White Paper is the Government's undertaking to "maintain security of Victoria's water entitlements". Additionally, Ministers have provided commitments that, even though Lake Mokoan will be decommissioned, there will be no reduction in the security of supply to water entitlements supplied from the Broken System.

Government has set up the Broken System Reliability Reference Committee to work with DSE and Goulburn Murray Water to provide advice on the system's reliability and offset measures necessary to maintain existing entitlements and reliability.

Since the decommissioning of Lake Mokoan was proposed the analysis of the reliability or irrigation supply has been analysed with increasing precision and the critical assumptions underpinning the Goulburn Simulation Model (GSM) (used to model the Broken System) have been identified.

In meetings prior to, and at the initial meeting of the BSRCC the following key issues have been identified:

- What is the current reliability of supply to Broken system irrigators with Lake Mokoan
- What offset measures are required to maintain reliability following decommissioning of Lake Mokoan.

The BSRRC agreed to consider the development of a list of potential offsets in parallel with continuing work on determining the existing reliability of the system.

It is now time for the committee to decide at least the minimum level of reliability of the system based on the information so far made available.

2. Critical Factors/Assumptions on Model Outcomes

The GSM model is well described in the Seker and Hannan paper presented to the committee on 31/3/05.

From this paper it is clear that the assumptions on the input data relating to the availability of water from Lake Mokoan as determined by Blue Green Algae blooms have a large impact on the reliability of supply of water for irrigation purposes.

Assumptions concerning transmission and operational losses in the system also have been found to impact significantly on reliability. The "rise and fall rules" on the operation of Lake Mokoan are also important but to a lesser extent.

There are also model operating rules such as storage targets, release rules, environmental flow requirements, and Murray/Goulburn supplement rules.

3. Data Presented

3.1 At the start of the analysis the position put to the irrigators regarding the existing reliability of supply was based on modelling undertaken in 2000 for the determination of Broken System Bulk entitlements. The estimate of current reliability from this modelling was 81.5%. However this modelling was done for a different purpose (establishing the Bulk Entitlement) and the estimate of reliability derived was later vigorously disputed by the VFF.

3.2 After additional work, an interim base run (b820) at 91.5% reliability was presented.

3.3 Further refinement of the input assumptions into the model has shown the following results:

Scenario (A) (G-M Water scenario A)

Interim Base Run	5 percentile	Reliability
Assumptions: 1. Mokoan off line 9.5 years in 10 2. Only available every second 1 in 10 dry event 3. Rise and fall is 1.85m		91.5%

Scenario (B) (G-M Water option B)

Open all dry years	10 percentile	Reliability
Assumptions: 1. Mokoan off line 9 years in 10 2. Available every dry year 3. Rise and fall 1.85m		93.1%

Scenario (C) (G-M Water option D)

Open all dry years	12.5 percentile	Reliability
Assumptions: 1. Mokoan off line 7 years in 8 2. Available every dry year 3. Rise and fall 1.85m		93.2%

Scenario (D) (G-M Water option C)

Open all dry years	46 percentile	Reliability
Assumptions: 1. Mokoan off line in 5.4 years in 10 2. Available every dry year 3. Rise and fall 1.85m		97%

Scenario (E) (G-M Water option E)

Nil impact of BGA	100 percentile	Reliability
Assumptions: 1. BGA has no impact on Mokoan availability 2. Rise and fall 1.85m		97%

4. Model Assumptions

4.1 Blue Green Algae impact

Except for one year blue green algae has never affected the security of supply to water users. In every other year when the lake has been closed supply had already been guaranteed. This was done with close consultation with the Broken Water Services Committee. Because it is an off-river storage it can be closed to alleviate problems of spreading BGA and its toxins further down the catchment. This is not the practice with other on stream storages. Broken water users should not be disadvantaged by what is essentially a management option. BGA is a management problem and can be solved by more enlightened management. Water users have been used to a security that assumes that BGA has no impact on availability (Scenario E) which gives 97% security.

The interim BGA model assumes that Lake Mokoan is closed 95 years in 100. (The model assumes the lake is closed from February to May every year except half of the driest 10%. Dry years are when inflows to Lake Nillahcootie drop below the 90% probability of exceedence or 14800 ML)

Actual data from 1991/2 to 2004/05 shows that Mokoan was closed 10 years in 14 and apart from one year these closures did not affect actual security. For the 10 year period 1996-2005 Mokoan was available 4 years in 10. In 01/02 it was closed for a short period only from 4/03/02 to 16/04/02. It is also significant that Lake Mokoan has been open for the last 3 consecutive years.

Predicting the impact of Blue Green Algae impact on Lake Mokoan availability is complex as BGA occurrences are dependent on a number of factors such as climatic conditions, including rainfall and wind, nutrient levels of run off, health of the lake bed etc. Consequently a prediction of the BGA impact must be based on current knowledge over a relatively short period of time to predict the impact in perpetuity. (Compare this situation with predicting inflows that are based on well over 100 years of reliable climate data).

The assumption that Lake Mokoan is closed due to BGA in 95 years in 100 is clearly overly pessimistic and invalid. There are no records to support this assumption. Furthermore no account is taken of the ever improving knowledge of the management of BGA or the substantial community and government investment to address the problem through the Lake Mokoan restoration project.

It is useful to list some of the actions that have been put in place under this program:

- Development of a community working group
- Fencing of grazing leases
- Removal of grazing below FSL
- Construction of 2 artificial wetlands on the seven mile and eleven mile creeks
- Reclamation of the Duck Pond
- Moira grass seeding
- CMA reclamation works in the upper catchment
- Installation of silt traps on tributaries.

Not surprisingly implementation of these programs appears to have had an impact reducing the incidence of BGA in the last 4 years.

There is other evidence to support the contention that water quality is improving and the risk of BGA declining. Turbidity has declined since the mid 1990s. A 2002 review of water quality in all Goulburn Murray storages reports most indicators of water quality in Lake Mokoan are improving.

The number of months when Blue Green Algae reached alert level 3 in the 3 year periods since 1991/92 are as follows

91/92 to 93/94	17 months BGA alert level 3
94/95 to 96/97	8 months BGA alert level 3
97/98 to 99/00	6 months BGA alert level 3
00/01 to 02/03	3 months BGA alert level 3
02/03 to 04/05	0 months BGA alert level 3

On this evidence it is not unreasonable to argue that over a one hundred year period that the BGA issues of the late 1980s to late 2000s is an aberration, such that the long term impact of BGA on reliability is of little impact.

There is also the argument that the BGA issues with Lake Mokoan were caused by poor management in the late 1980s and this is in the process of being rectified. The experience in the 1990s should not be used to reduce reliability in perpetuity.

The assumption that Lake Mokoan will only be available in every second dry year is also invalid as it is not supported by the actual data from recent years where the lake has been open on every dry year

4.2 Rise and Fall Rule

The results of the modelling on 1.85 rise and 1.85 fall does not significantly limit the potential reliability of the Lake Mokoan supply.

It must be acknowledged that in the past the rise and fall rule has been adjusted depending on the circumstances of the day increase reliability for irrigators. The GSM model does not take into account this human management factor when it computes a long term reliability figure.

4.3 Operational and Transmission Losses

From data so far presented to the committee it is clear that operational losses are currently minimized due to a high level of operational management (the MEEK factor) and so improvement in reliability through technology such as total channel control is unlikely to be of high impact on the Broken System.

Further work is required to quantify how transmission and operational losses will be effected when water is sourced only from Lake Nillahcootie. Confidence limits relating to losses as inputs to the model are required.

5. Deliverability Issues

When Lake Mokoan is decommissioned, this removes a mid-way storage for the delivery of water from Lake Nillahcootie. As the majority of water usage is towards the end of the Broken River the delivery time for water from Lake Nillahcootie is seven days.

Consequently planning for irrigators becomes much more difficult as weather forecasts are unreliable beyond 4 days.

With a longer delivery time should a rain event occur just after a release from Lake Nillahcootie and irrigators cancel orders, then significant water could be lost to the system.

A problem could also arise when irrigators all wish to water at the same time. The river could easily be sucked dry upstream leaving no water available to irrigators at the end of the river. In 2002, even with Lake Mokoan this occurred a number of times.

It is currently uncertain what the level of transmission losses might be given a much reduced flow downstream of Lake Mokoan, once the only supply is from Lake Nillahcootie.

Supplying irrigators that currently pump from Lake Mokoan through pumps and pipes from Casey's Weir seems expensive, of a high energy cost, and develops high recurrent costs.

It is clear that the reliability of the availability of water for irrigators depends upon both the volume of water stored as well as the timely delivery of that water. Offset measures must be designed with due regard to both factors.

6. Comment on DSE draft paper *Decommissioning Lake Mokoan* presented to BSRRC meeting 6

This DSE paper puts forward a number of arguments to support the BSRRC adopting a target of 91% for the existing reliability of supply including supporting the assumption the Lake will be closed in 95% of years due to BGA.

In summary the paper argues:

- Lake Mokoan was constructed primarily to meet demand within the Goulburn system. This has not eventuated because of the occurrence of BGA. If the BGA assumption in the model is relaxed (from 95% of years) the resulting water could reasonably be allocated to the Goulburn system not Broken system diverters.

- The increase in reliability resulting from "recalibration" of the original BE base run, which increased the estimate of reliability from 80% to 91%, was the result of improved operational efficiency observed since 1997. This in turn was due to the dedication of the Broken system senior diversions inspector. The paper contends the improved efficiency cannot be assured into the future and consequently the 91% estimate of current reliability is generous.

These arguments cannot be accepted. The historical records show that local valley needs were to be supplied first. While it was originally intended that water would be transferred from the Broken to the East Goulburn main it is also the case that seasonal allocations to Broken diverters were tied to those received by Goulburn diverters. It is difficult to envisage a situation where allocations would be made from the Broken to the Goulburn if it had the effect of reducing the water available to Broken valley irrigators. Furthermore when it became clear the pumps to take water from the Broken to the East Goulburn main would not be installed, 6500 ML of additional water right was sold by auction to Broken diverters.

The improvements in efficiency since 1997 are attributable to a number of factors in addition to the efforts of the senior diversions inspector. The involvement of irrigators through the water service committee in managing the water system also played a significant part. While the existing management will not remain indefinitely the improved procedures implemented over the last 8 years have been documented and will be largely on going.

7. Conclusions for the Committees' Consideration

1. The committee notes:

- that Lake Mokoan has not been closed through BGA in the last 3 years
- Water quality in the Lake appears to be improving.
- The substantial investment of the community and government in restoration works appears to be having an impact on water quality and general environmental health of the lake

In the light of this the BSRRC insist the improving performance of Lake Mokoan in respect of BGA over the last 5 years and particularly the last 3 years be acknowledged and taken into account in the modelling.

2. While it is unlikely the BGA problem will be totally solved it must be assumed the lake will be open in more years than it is closed as a result of BGA this issue will have only minimal practical impact on actual security. The modelling of current irrigator's security must reflect this position.

3. Based on advice received so far it appears if it is assumed the lake is closed by BGA in 5 years in 10 but open in all of the driest years modelled security will be close to 97%

4. Further work is required to identify the key factors effecting:

    - deliverability
    - operational losses
    - transmission losses

5. The analysis of technical information is ongoing as part of the work of the committee and as additional technical information is considered by the committee, then this document will be updated.