# "A Better Way" for the Murray Darling Basin!

Supplementary to the documentary *Muddied Waters - A Clear Solution.*

And:

- It won't cost the earth – certainly not A$13 billion dollars.
- It won't damage floodplain farms and force farmers from their land.
- No need for water entitlement diversion reductions to service a government wish.
- Will use a portion only of the freshwater volumes currently used for the Lower Lakes etc. with provisions for handing back the balance for productive upstream use.
- No need for costly over-bank flooding and subsequent property damage.
- No disruption for growers - improved growth in Australian foodstuff production and export.
- Growers and communities throughout the basin and the nation will benefit.
- Massive sulphuric acid mobilisation below Lock One will be checked.
- Murray River environments, aquatic life and biota will benefit.
- A working estuary will reward immeasurably with huge benefits and because:
- The MDB and the Lower Lakes are within a highly variable system; the Lakes will always be a reversible system – fresh generally during natural flooding and estuarine at other times.

**However: Climate Change with sea level rise is already upon us. It will make all of this inevitable by (circa) 2050. This will affect the 7.6km barrages and all of the island embankments between.**

Please make: Today's urgent priority for tomorrows Future!

Anything else will be a very poor and costly alternative

Contents by Ken Jury
Last updates - 06/05/16

**Very much in brief:**
To keep the Murray Mouth open nine out of ten years, a former Federal Water Minister ordered large volumes of fresh water flushed down the 2,500km Murray River system. Much will be lost along the way! Upwards of 60% evaporation loss alone is possible across the basin(fmr.*MDBCdata*), and that's without the additional river floodplain constraints issues where additional evaporation and seepage from forcing shallow water over dry, fertile floodplain land will occur, with an extreme likelihood of extensive top soil loss.

Historically, minimal water flows have been maintained throughout the length of the Murray River since the 1936 completion of the Hume Dam. The Murray system since then is regulated through this storage to assist with avoiding over-bank flooding in narrow sections of the Murray system at all times, save for rare natural flood occasions. Similarly, large volumes of water released from the Murrumbidgee River storages in recent years, although these have already caused damage and heightened concerns for growers.

Given the government proceeds with its "constraints" issues, there is no doubt whatsoever it will cause extensive damage to flood plain property and soils located in these extensive areas where narrower river sections occur, particularly in NSW and Victoria, where fencing, crops, stock, farm infrastructure and bridges etc. will suffer various levels of damage, some will be permanent. Councils throughout river regions including the 18 Ramroc group of councils are very concerned, while compensation and insurances alone will be difficult for all parties.

There are potential threats to upstream holiday homes in South Australia, notwithstanding a possibility of damage on reaching the lower Murray flats in South Australia. There're increasing concerns from among ordinary Australians with little basin connection who are learning about the ways of the authority with its constraints issues, and they're venting their dis-belief that a government and its agency would pursue such a course of destruction and waste.

A waste that would have been further exacerbated by the extra 450 gigalitres proposed (not confirmed) in Goolwa, SA by the then Prime Minister Julia Gillard as additional to the 2750GL/yr designated up to 2019, to be increased to 3200GL and forced down the Murray and Murrumbidgee systems by about 2024. Reduced volumes have since been discussed in August, 2015.

The *Murray Darling Basin Authority* (*MDBA*) had proposed to increase the flows from the current maximum of between 25,000ML/day and 40,000 ML/day through several severely restricted river flood plain reaches, farms and other properties, including extensive public and private holdings found along these systems.

As an example, flows three years ago (2012) through the Millewa and Barmah Chokes were controlled at 10,500ML/day and about 8500ML/day respectively.

The original *MDBA* proposal was to fulfill a flow-rate of 2000GL/yr over the Lower Lakes barrages for 95 per cent of the time with a minimum 650GL at all times, in line with what the agency announced in its first *Guide for the Basin Plan*. Simply though, the MDB system and subsequent rain runoff into the catchments doesn't provide enough for additional flows of river water over riverbanks and floodplain expanses, to service a whim of overbank flooding as a means to cater for the Lower Lakes and the Murray

Mouth at the end of system! It's quite apparent today this nonsense will be thwarted by a lack of freshwater.

**An important Quote:**
From a fact sheet (undated), the former *Murray Darling Basin Commission* **(*MBDC*)** advised its concerns with the *Barmah Choke* on the Upper Murray River system when it wrote, "there're other environmental challenges in river management with the *Barmah Choke.* Operating the river for long periods at top-of-bank levels leads to notch erosion and bank instability."

"The *Barmah Choke* also limits the ability to target the delivery of environmental flows from upstream storages to downstream icon sites," the former *MDBC* said.

**Seriously:**
None of the proposed, man-forced over-bank flooding impulses down the Murray, the Goulburn and Murrumbidgee systems need occur, notwithstanding the likelihood of extensive property damage. Certainly not when attempting to keep the Murray River mouth clear. Distance and evaporation alone will defeat such a destructive notion!

**There is a Solution:**
All it will take is one more river Lock; we'll call it *Lock Zero* given the current first lock, *Lock One* is located some 275km upstream of the Murray Mouth, at Blanchetown in South Australia, together with minor barrage adjustments and the removal (or part removal) of an unwanted island that grew from being a sandbar.

**Importantly:**
History reveals much about the interaction of the Murray River with the Lower Lakes, the Coorong and the Southern Ocean.

In pre-barrage times, it was a variable Lower Lakes when low flows meant the remaining fresh water flows had to compete with regular Southern Ocean intrusions, as the latter pushed fresh water back into the upper end of the Lower Lakes and on occasions, into the river resulting in a mix of ocean and fresh water, becoming estuarine as naturally found upstream in most global estuaries. Importantly, the lakes in pre-barrage times contained extensive water bodies that were extremely useful, with high value outcomes.

Records from pre-barrage times reveal how estuarine fish populations flourished high up in Lake Alexandrina to where it supported major commercial fishing operations for 44 or so commercial fishers who were based at Milang , some of whom regularly fished towards the top of Lake Alexandrina area, where they harvested freshwater Murray Cod, Callop (Yellowbelly or Golden Perch) and estuarine Mulloway, often in the same hour and on the same day.

Prior to the barrages, each of the fresh and estuarine species were almost plying the same water column save for the natural stratification of fresh water accompanied nearby by estuarine water, at times the fresh still stratified but expected to gradually mix into estuarine water, at which stage the cod would follow freshwater trails for survival while mulloway remained in estuarine water. Often within close proximity; sometimes found in areas less than a few hundred meters apart. History reveals how Pioneer; Captain Charles Sturt discovered stratified lakes water following his arrival out of the River Murray into Lake Alexandrina.

Fishers primarily established their grounds by taste-testing for fresh water and saline water in the often stratified water columns. These details are provided from an interview by the author of this paper with one of the few remaining **Lower Lakes Commercial Fishers, Mr Victor Woodrow** (in his upper eighties today) who fished with his late father near the top of Lake Alexandrina in the area described above until the completion of the Goolwa Barrage. Mr Woodrow resides in retirement today in the suburb of Marion, Southwest of Adelaide).

**Records reveal how flourishing estuarine fish populations in the Lower Lakes came to an abrupt end when the barrages were completed.** Following the introduction of the barrages, estuarine fish, invertebrates and general biota once found in the Lower Lakes and sometimes as far upstream at Swan Reach during low flows in pre-barrage times, were shut out from what was previously a magnificent estuarine system. A system that supported a major South Australian fishery supplying SA state fish needs with surplus being railed into Victoria, for almost five decades.

Today, fish species including Mulloway and Black Bream continue to be guided into the Coorong part of the estuary due to their DNA, but the barrages thwart them even though these fish come right up to these concrete structures with a view to reaching the lakes and channels to breed. It is known through recent fish tagging that mulloway entering the Glenelg River in Victoria, where this river is slightly located in South Australia, do not breed in this river. Science tells how they rest and feed in the Glenelg River and then make their way to the Coorong with the notion of entering and breeding in the Lower Lakes.

Some suggest that the basin ends at the real mouth of the river just below Wellington at the head of Lake Alexandrina and not 45km downstream at 'the bottom of the lakes, east-south-east of the Coorong, at the Murray Mouth where the river spills into the sea.'

**Significantly:**
So long as the barrages are open to exhaust flooding freshwater, with regular high tides and even during neap tides, together with regular, strong prevailing westerly winds, it's inevitable that Southern Ocean intrusions will reverse out-flowing fresh water back through the river mouth, and through the open barrages, pushing fresh and by now, ocean and fresh (estuarine) flows back upstream into Lake Alexandrina, towards the entry point of the Murray River into the larger Lake Alexandrina.

The threat of sea level rise is real and proven so that we can with certainty expect increases in Ocean intrusion into the Lower Lakes! There're already noticeable signs along Australia's southern coast.

**NASA said in its extensive August 26th, 2015 *"Global Climate Change"* data, "*Warming seas and melting ice sheets,"***
"For thousands of years, sea level has remained relatively stable and human communities have settled along the planet's coastlines. But now Earth's seas are rising. Globally, sea level has risen about eight inches (20 centimeters) since the beginning of the 20th century and more than two inches (5 centimeters) in the last 20 years alone."
"Scientists estimate that about one-third of sea level rise is caused by expansion of warmer ocean water, one-third is due to ice loss from the massive Greenland and Antarctic ice sheets and the remaining third results from melting mountain glaciers. But the fate of the polar ice sheets could change that ratio and produce more rapid increases

in the coming decade," NASA said 10/09/2015. Footnote: NASA, BOM and the CSIRO share their data on climate change.

In the Lower Lakes Murray Mouth region, evidence has been collected from officially located automatic beacons streaming out 'real time' probe data. This data, by now in computer storage, is ready for our hard copy printouts, containing ECu (electrical conductivity unit levels), otherwise known as salinity level plots accurately describing in 'real time,' ocean water ingress being recorded across the Lower Lakes system, into the government's electronic monitoring system.

These computer findings are regularly monitored and recorded on hard copy in an exercise to reveal that water in the lakes is often estuarine. A series of plot data collected by the author and a colleague scientist also reveals ocean ingress occurrences when southern ocean water actually circumnavigates Hindmarsh Island.

There is a huge waste of expensive freshwater entering the lakes with much of this becoming highly saline and wasted. The Lower Lakes aren't lakes but leaky, shallow depressions of sand, silt and river debris culminating in the formation of extensive acidic soils with high levels of seepage and evaporation. They were formed by receding ocean water about 7000 yrs ago, leaving remaining sand, silt and calcareous ridges that border the lakes and the SE natural drains today. The lakes combined today hold 2018GL.

NE Lake Albert, the smaller of the two lakes at the peak of the Millennium Drought. The black dots are cattle seeking water from an ever receding lake. Pix by Ken Jury

The 4,500GL annual average of freshwater used in the Lower Lakes, the Goolwa Channel and Murray Mouth region during the peak of the Millennium drought was valued then at around A$10 billion dollars.

The figure of $2.4 million dollars per gigalitre was likely the absolute top tender buyback figure during the Millennium drought, when water was scarce! Water prices have since fallen with an average tender price for High Security water (SA) during 2012-13 standing at about $1.675 million per gigalitre. This figure puts a value on Lower Lakes stored and used water for an average year at around $7.53 Billion dollars, and they (the previous Govt.) say they'll continue to send water towards the river mouth for 9 out of every 10 years

Basically, precious freshwater is being sent down to evaporate, to be drained and to be wasted in the ocean! This is ludicrous! One wonder's what the return would realise when using the same volume of water for additional food grown in the basin over the same period?

**There's a much better way:**
To make better use of limited fresh water and with the help of free, highly oxygenated Southern Ocean water, another lock (Lock Zero), should be built upstream of Wellington towards Tailem Bend.

**A more practical foundation opportunity for another Lock is available today!**
As *Rowan* BSc Hon. points out, in today's world it's no longer a problem when not locating sound bedrock for river footings, when the use of friction piling has very much become the accepted alternative.

One recent example of friction engineering is the Hindmarsh Island Bridge where friction piling was successfully used to hold this massive structure in place.

As old as it is, the Goolwa barrage also sits on this type of friction footing!

**Benefits to be gained from preventing uncontrolled use and loss of River Murray water in Lake Alexandrina:**

An additional lock, Lock Zero should be built and used to regulate minimal freshwater flow into Lake Alexandrina to mix with ocean water, forming and maintaining an estuarine environment, and for the first time, to provide for the control of the pool height between Lock One at Blanchetown and Lock Zero, while providing the means to greatly assist in clearing the Murray Mouth.

This in itself would rid this section of the river of acid mobilization, so bad at times that even the authorities openly admit defeat with treatment of mobilised acid-laden water, notwithstanding a possible threat to the intake pipes that feed water back to Adelaide hills storages.

Liming highly acidic water in Currency Creek that flows into the Goolwa Channel.

Currency Creek succumbs to drought; oxygen reaches cracked acidic soils leading to the mobilization and formation of sulphuric acid to a dangerous ph.1.5 which is similar to that found in a car battery. Nearby Lake Alexandrina contains at least 500 million tonnes of acidic soils.

**Returning to an estuarine system during low or nil fresh water flows:**

In what would have been a natural occurrence in pre-barrage times, the use of clean, highly oxygenised water from the Southern Ocean, mixed with a percentage of stored fresh water gradually released from upstream through Lock Zero; the Lower Lakes system would again become estuarine to inundate the lakes and deal with any drying lake or channel mud while limiting acid sulfide development and mobilisation throughout the estuarine environment. All without using massive volumes of expensive irrigation water, year after year, that should otherwise should be better used to produce Australia's food.

By retaining the barrages, freshly mixed estuarine water could be held within the lakes system for extended periods, and released out of the lakes/channels, from selected barrages to provide strong scouring flows to begin and then regulate the removal of silt and sand from the areas between the barrages and the Murray Mouth outlet to the sea.

Using lake stored estuarine water, the system can be flushed at will because replenishment of the lakes with free ocean water will greatly supplement much smaller qualities of freshwater from behind Lock Zero!

By allowing lake levels to recede by 10 to 20cm only by selective use of barrage gates, estuarine water from the 840 sq km surface of the lakes will provide ample flushing and scouring water for the river mouth.

**Scouring the channels and mouth:**

Upgrading the barrages will enable restriction of the outgoing flows to elected channel(s), to bias the movement of sand and silt during outflows, and regulated to suit falling tides. Further important details on river mouth flushing available on page eleven.

To enable selective flushing, there should be an upgrading at the Goolwa Barrage where the lifting of multiple barrage compartment concrete logs stacked on top of each other is both cumbersome and time consuming as they're handled individually- one by one as commonly seen at this barrage today.

This is an extremely costly and time wasting exercise to continue with when it's necessary to reach the desired scouring out-flow swoosh effects from this barrage.

Yes, lifting single concrete logs this way is far from practical and it's outdated.

The alternative is for a single, thick walled poly tank to fit the slot in each bay, to operate in one single lift and fall motion to enable necessary strength in water outflows to clear the mouth and keep it clear while equally affording opportunity to direct outflows of estuarine water towards the mouth with a view to a portion of this water entering the southern section of the northern lagoon in the Coorong.

The lakes themselves would gradually become estuarine again and develop channels and flats, quickly becoming colonized with estuarine biota associated with the cycles of inundation and exposure to inter-tidal zones.

**The savings would be massive:**
During average river flow years, the use of ocean water mixed with a 40% portion of fresh would free up a minimum 2700 gigalitres/yr of freshwater being part of what was previously used in the lakes and the channels, now to be re-directed back upstream as


surplus freshwater for food production with some towards environmental flows for up-river environments. **There's more, but first:**

**Remove this sandy, highly vegetated knoll, shown above:**
Bird Island as its known, faces the river mouth, is located downstream of the Mundoo Barrage and it must be removed as it directly blocks about 70% of the flow from this barrage to the mouth. This obstruction and a minor connected peninsula gradually formed and vegetated as a result of building the Mundoo barrage. It also impedes movement both ways of Coorong water and water released from the Mundoo Barrage and 3 other barrages within the area that would otherwise clear the mouth of sand and silt.

**A formula for success:**
Combined, the lower lakes hold approx. 2018GL of freshwater at capacity and often its highly saline water. That's approximately 750GL below the original 2,750GL amount of fresh water being sought by the *MDBA* and a former Water Minister from upstream food growers, **as its environmental saviour.**

In consideration of a future for the Lower Lakes system, we should keep in mind how these lakes and nearby channel environs regularly require at least 4500gigalitres/yr of freshwater. This amount includes top-ups to replace and maintain evaporation and seepage from the shallow lakes, to maintain the channels leading to the river mouth by providing for scouring these extensive systems before & beyond the barrages, and to supply regular scouring flushes to keep the mouth open.

Current scouring success rates today are minimal, extremely wasteful and expensive.

On occasions in recent months, larger vessels have not always been able to comfortably navigate across the Coorong adjacent to the inside of the Murray Mouth. Dredging the mouth continues at great expense! That expense in one single decade reached $50 million dollars in a single year.

**With change – we can do with much less:**
Simplistic perhaps, but logically there's a view to reduce the fresh water maintenance volume for the lower lakes to just 40%, (about 1800GL/yr) as a freshwater allowance required to mix with barrage entrapped, highly oxygenated Southern Ocean water for the return of a healthy estuarine system within the Lower Lakes.

In order to do so, and as mentioned previously, there will be the need for retaining the barrages (with some minor and in-expensive modification) so that fast manipulation of incoming ocean water and outgoing estuarine water can occur un-impeded.

Albeit, after retaining 40% (1800GL of fresh) for an estuarine mix behind a new lock we'll name "Zero", there remains a freshwater balance of 2,700GL as a left-over from an annual average of 4,500|GL/yr previously used within the lakes and for clearance purposes etc.

This represents a meagre 50GL below the 2750GL MDBA water claw-back figure, at the time dumped upon famers and irrigators etc, for the environment, and to keep the mouth clear.

We should also bear in mind a likely additional freshwater saving, over and above from not allowing freshwater into the lakes on its own, to be lost to salinity increase, massive evaporation and seepage and for clearing the mouth. There're more positives here!

**Yes, a reversal of the system has many possibilities:**
There're often seasonal periods when the elected 40% or 1800GL/yr of freshwater required for mixing in the lakes may be further reduced due to seasonal Lofty Ranges rain run-off reaching the lakes. There's a handful of streams that reach the Lower Lakes including Currency Creek and the Finniss and Angus River's that yield significant winter freshwater flows that often reach Lake Alexandrina. This Lofty Ranges run-off water will again help compensate growers or it could be held as future fresh water meant for the lakes (to mix with ocean water), being held upstream of Lock Zero for this purpose.

Moreover in an adaptive way of thinking, to suit the situation at the time when ensuring the continuity of the estuary or, if additional fresh flows persist through flood or minor flood, then ocean water and flood water would be adjusted by way of the now rejuvenated barrages and through Lock Zero to suit the situation. In all circumstances the biota throughout will adjust both ways (fresh or estuarine), as it most certainly always does in an estuarine environment!

**Estuarine water**:
Importantly, estuarine water can be made up of varying volumes of fresh and ocean water as is naturally the case in most estuarine deltas worldwide. Contrary to claims (and alleged state Govt. tests), estuarine water occurs at varying levels in all estuaries worldwide. These are generally healthy eco-systems that provide immeasurable benefits

including commercial and recreational. Ramsar is generally keen to promote the values of a workable estuary.

Returning the Lower Lakes to estuarine would once again create a very useful and beneficial environment. Estuaries 'the world over' are known for their productiveness! Such the case with viable fisheries! It's a known fact that Mulloway (one of many examples of quality commercial fish known to the region) would gradually return to the Lower Lakes again to become part of a major fisheries nursery and breeding ground, for the return of a larger fishery. In turn, tourism would surge ahead and so would development.

**How little did the River hold during the Millennium drought?**
In our worst drought in history, during the year when about 1100 GL were lost to evaporation from the lakes, a qualified individual had set-about measuring as best he could, water volumes held in the river/anabranches and backwaters between Wellington at the head of Lake Alexandrina and the border with NSW during the same year. The results concluded that evaporation and seepage claimed a greater loss of water from the Lower Lakes than what the river contained at the same time within the South Australian section of the river. Annually, these water losses alone cost multiple billions of dollars while losses during the worst millennium drought years from the Lower Lakes would have likely reached higher levels in the region.

**Flushing the river mouth:**

On returning the lakes to estuarine; during periods when flushing is desirable across the Lower Lakes system, carefully selected barrage gates would be opened to coincide with outgoing tidal periods with particular emphasis on directional flow towards the Murray Mouth. In particular the operation of Mundoo Barrage with released flows moving through Mundoo channel delta that faces the Murray Mouth. Should the level in the lakes fall only 10cm on a single outgoing tide as an example, then this would represent an overall 75 GL of water that would flow out through all selected barrage gates towards the mouth during the same outgoing tidal period. A 20 cm lake surface drop would realise somewhere in the order of 150GL that would be used in one out going, single tidal session to successfully scour and clear the mouth. Volumes of this dimension have only been available in previous flood times. Basically, the use of Southern Ocean water becomes the greater component for this estuary, while its also provides the means for clearing the mouth region. Replenishment of ocean water into the lakes can be done often and at will, during incoming tidal periods as required. Due to barrage control of water in and out, marinas should not be affected to where it would be detrimental, providing suitable but simple management strategies are agreed and exercised.

**Engineering improvements to the Goolwa Barrage would allow for the quicker movement of larger volumes of water.** Photo Ken Jury

**In the photograph above, removed logs are shown on the top of the barrage to the right, just beyond one of two rail lines that support a crane (out of shot) used as the mobile lifting or lowering device across the barrage. The other rail line is found slightly right of the pedestrian walk. Log slots are located centrally in the structure, as seen across the top, in every bay across the barrage where individual logs are lowered down between the protective steel lined slots found at either end of each bay, to accept individually inserted or removed logs.**

The concrete logs in the Goolwa Barrage represent gates (or logs) that either harness or release water. Goolwa barrage is one of five barrages spread over 7.6km. Earthen embankments separate the remaining four barrages.

An engineering solution is considered regarding the current issue of lifting and manipulating the cumbersome concrete blocks in the Goolwa barrage. There is a view, these should be replaced with much lighter single polyethylene tank-like/hollow blocks (single lift units or tanks), call them what you like, to fit the same slot dimensions in the Goolwa Barrage, in each single bay compartment instead of a stack of cumbersome concrete blocks so that each can be raised and lowered with a simple water hydraulic ram/bag pressurised by a common pump. We believe that the use of purposely built high quality, UV stabilised and reinforced polyethylene single tanks would be equally robust to that of concrete, while providing a lighter, faster and more economic method of water management through the barrages.

These could easily and quickly be manufactured locally. The ram would press against a boom (tappet- like) over each gate (tank) with the hydraulic pressure delivered to each ram by piping from a single pump. Leakage under this circumstance would not be an issue as the fluid for the hydraulics is the water already located at the source of the need, and tank lowering need only drop the ram and expel the water through a simple valve.

We believe that selective lifting of multiple blocks across the barrages in a single action will provide the necessary estuarine water outflows to clear the mouth and keep it clear

while affording opportunity to direct outflows or inflows of clean ocean water or to expel outflows of ocean/freshwater towards the mouth and, to offer minimal assistance to the southern end of the northern lagoon of the Coorong.

Importantly, my colleagues and I share the belief that neither the former 2750GL/yr nor 3,200Gl/yr would have made any useful difference to keeping the mouth of the river clear. There are many reasons including the fact that most of this water, when available would be sent downriver to be lost.

Furthermore, and as an example in 2011; during the months of March to May in that year, a remnant minor flood came down the river whereby flows of up to 80GL/day were seen passing Goolwa and through the opened barrage gates. Flows at this rate made no discernable difference to the sand bars and the depth of the channel through the Murray Mouth. In fact at the time, prevailing wind and tides pushed much of this water back through the open barrages, as is the case on many occasions during autumn and winter.

**Note: A single gigalitre is equal to one km x one km by one metre deep.**

The weight and power behind the volumes of freshwater sent in recent times are hard pressed to match the weight and push of the mighty southern ocean and with water availability waning, one would seriously expect that the Lower Lakes should not be kept in a freshwater condition only.

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Exec. Producer, *MuddiedWaters-A Clear Solution* documentary.

Please note: My documents are always ‘Work in Progress’ documents. (6/05/2016)