

# HOW TO STOP FUTURE CATASTROPHIC FLOODS ON THE CAMPASPE RIVER :

## RE-DESIGN THE LAKE EPPALOCK SPILLWAYS, AND KEEP 10% “AIR SPACE” IN ALL RESERVOIRS AS A FLOOD BUFFER DURING WET TIMES

A submission to the Victorian Flood Inquiry - June 2023

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### SUMMARY :

This submission focuses mainly on Lake Eppalock and the Campaspe River flood affecting Rochester.

#### Capital works are required at Lake Eppalock to upgrade both spillways.

5 metre radial gates on Spillway #1 would add 3 metres of storage, when combined with an extra 1m added to the wall of Spillway #2. These capital works would greatly reduce the risk of future catastrophic flood damage on the Campaspe River affecting Rochester, Elmore and Echuca during future climate extremes.

#### Water authorities (NCCMA and G-MW) absolutely failed to mitigate flood surges from Lake Eppalock.

The outlet pipe in the reservoir wall should have been opened in late Winter 2022, so as to act on the BOM's very wet weather prediction, so as to reduce reservoir volumes by as much 3.5% a week and to maintain “air space” for flood surges. By not doing this, the NCCMA was negligent and G-MW was complicit. **This went against Section 202 (e) of the 1989 Water Act regarding “minimising flooding and flood damage”.**

#### Reservoir flood levels were not communicated to residents or emergency services in real time.

Approximately 48 hours of flood preparation time was lost for Rochester residents, because data was not published on the G-MW website in real time. Most personal possessions could have been saved.

#### Water authorities across Victoria need to adopt new rules for managing reservoirs

Two sets of management rules are required – one for wet times, and one for dry times. A 10% buffer of “air space” needs to be adopted in wet times to allow for the possibility of “rain bombs” and flood surges.



**EPPALOCK NOW**

Currently no control on spillway, and no way to release bulk water before 100% capacity.



**PROPOSED – 5 metre radial gates**

Will allow flexible release of the top 5m of water, and create an additional 3m of safe flood storage.

## **EPPALOCK RELEASES MUST BE CAPPED AT 50,000 ML A DAY – USING FLOOD GATES**

To avoid catastrophic floods, it is essential that outflows from Eppalock be limited to 50,000 ML per day. At that level, downstream damage is manageable, and the effects on townships are minimal.

A peak flow of 55,000 ML per day was the operation norm for the first 48 year after Eppalock was built.

During the early hours of 14 Oct 2022, I calculate that a peak flow of 151,000 ML per day was leaving Eppalock, and that about 50,000 ML of flood surge went over the spillways in approximately 6 hours.

We were extremely lucky that the “rain bombs” predicted by the BOM did not hit the Eppalock catchments. For example, 200mm or more rain could easily have fallen in the Eppalock catchment on 11-12 October,

**More than 600.000ML would have flowed into Eppalock in 48 hours** ... not the 450,000 that was yielded,

It could have been a lot worse! (There could have been twice the volume to contend with.)

## **SUMMARY OF LAKE EPPALOCK FLOOD GATE DESIGN**

- **The Lake Eppalock primary spillway, is recommended to have the lip lowered by 2m and have radial flood gates installed that are 5m high.**
- **This design would allow rapid release of water in the days before any predicted “rain bomb” is due to hit the catchment, so that the 10% air space can be rapidly expanded to 20%.**
- **The primary spillway flood gates would provide an extra 3m in height, so as to safely store emergency flood water surges. (This installation must be combined with additional capital works to raise the height of the secondary / emergency spillway by 1m).**
- **The flood gates could be operated to allow 1m of controlled flow underneath the gates (at a safe release volume of 50,000 ML per day) while still safely holding an extra 3m of water with the upper portion of the gates.**
- **Using the gates, controlled flows can be released down the current spillway, starting three days before predicted peak inflows. Thus it will not be necessary to exceed releases of 50,000 ML per day. Even with much higher rainfall events, there should still be no need to have any of the releases flow in an uncontrolled manner over the emergency spillway (causing more damage to the valley below). The primary spillway would be able to release flows of 100,000ML+ per day if required.**

## **THE "TORUMBARRY WEIR" IS THE IDEAL DESIGN - COSTING APPROX \$50-70 MILLION?**

The Lake Eppalock flood gate design would need to be similar to the Torrumbarry Weir, on the Murray River (35km north-west of Echuca).

Torrumbarry Weir uses six large hydraulic radial gates (approximately 5 metres high) to control a 73.5m wide section of the Murray River.

This system was installed in 1994 at a cost of \$36 million.



The width of the Eppalock primary spillway lip is 100m. The scope of new works would have to be the subject of a feasibility study by water authorities.

However, with consideration of inflation, a ballpark figure of \$50-70 million might be a reasonable starting point for the capital works budget.

For comparison, Vicroads spent \$86m in 2015 to rebuild an intersection of the Calder Highway near Bendigo (Ravenswood Exchange) after there had been only two road deaths since 2009.

## WATER SHOULD HAVE BEEN RELEASED FROM LAKE EPPALOCK DURING SPRING

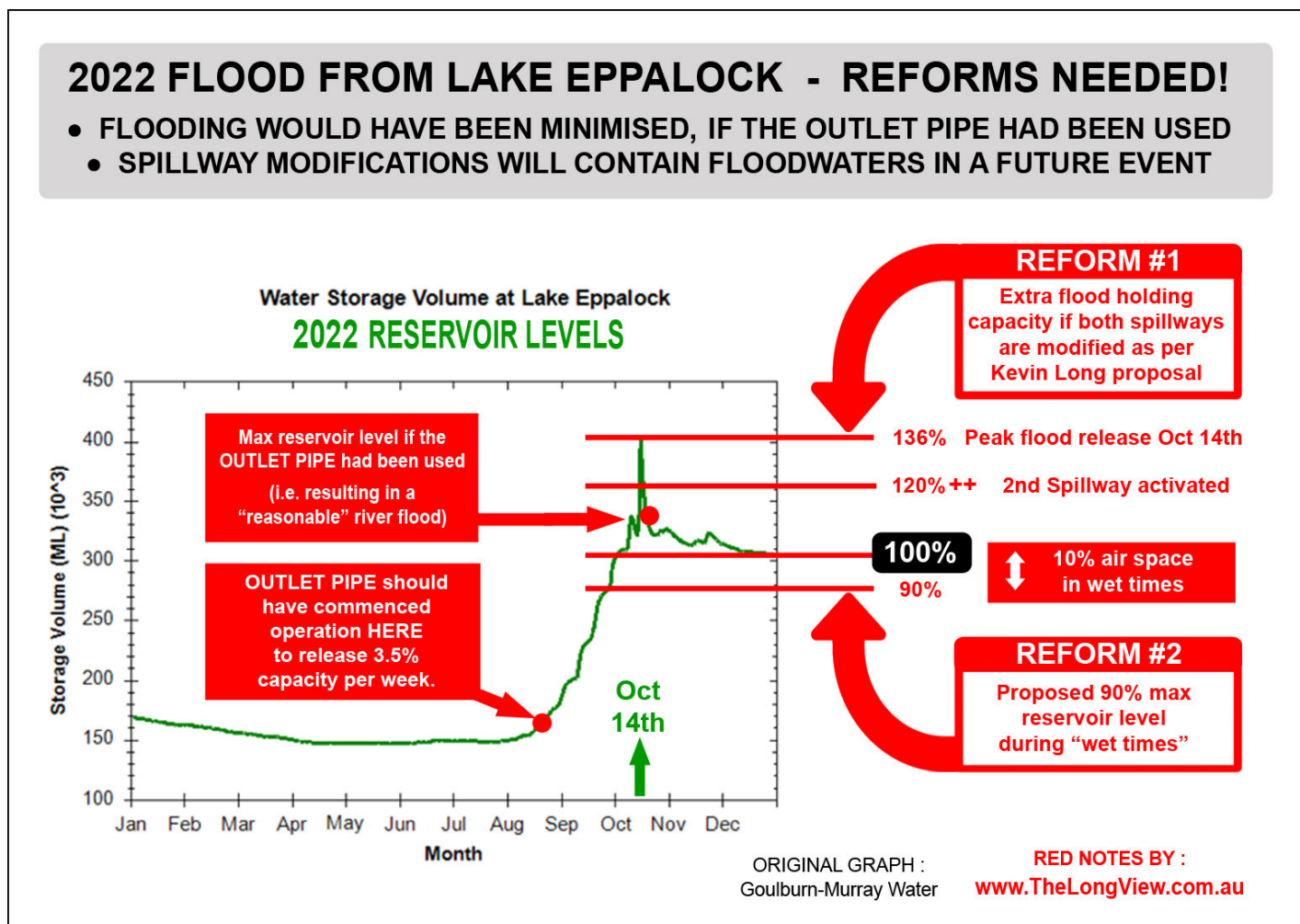
Water authorities (NCCMA and G-MW) were very aware that wet conditions had been predicted by the BOM.

Goulburn-Murray Water (G-MW) issued a press release on 25 August 2023 providing many flood warnings for reservoirs, but entirely failed to mention Lake Eppalock or the Campaspe River region.

Water releases from Eppalock should have commenced via the 1.8m **OUTLET PIPE** at that time.

However, water authorities currently have no operational awareness to minimise flood risks from Eppalock!

The graphic below shows how Eppalock reservoir volumes could have been greatly reduced by using the Outlet Pipe in a timely manner, and shows how the proposed installation of floodgates would have safely regulated the 136% dam capacity peak which occurred during the 2022 floods.



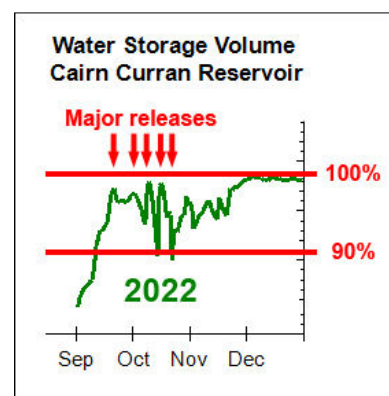
## FLOODING FROM CAIRN CURRAN RESERVOIR WAS MUCH BETTER MANAGED - WHY?

Why did Central Victoria's other major reservoir, Cairn Curran (on the Loddon River) seem to have been managed under completely different principles to Lake Eppalock?

Cairn Curran had five major water releases from mid-September to early November, using its radial flood gates to rapidly drop reservoir levels so as to remain in what was clearly a "target range" of 90-100% capacity range.

Air space was maintained. 100% capacity was not breached.

**Why was no flood mitigation implemented at Lake Eppalock?**





# OVERVIEW OF LAKE EPPALOCK SPILLWAYS



◀ 220 m ▶  
Emergency  
Spillway  
**No. 2**

▲  
Outlet Pipe  
(1.8 metre diameter  
at base of main wall  
which is 1km long)

◀100m▶  
Spillway  
**No.1**



▲ Spillway #2 – wall is approx 220m long and approx 1m high.



▲ Spillway #2 – Uncontrolled flow into the valley below did irreparable damage during the 2022 event.



▲ Spillway #2 – As viewed from the Lake side, looking into the destroyed valley below.



The **OUTLET PIPE** at the bottom middle of the main wall is the only controlled method of releasing water from Lake Eppalock into the Campaspe River.

The outlet can release approx. 3.5% capacity per week (10,000 ML)

**If this pipe had been opened in late Winter 2022, the reservoir could have maintained some air space before the Oct 13th catastrophe.**

**Instead, the lake was left at 110% full, which was a catastrophe waiting to happen.**

**Then 120mm of rain fell in three days.**



▲ Spillway #1 – NO GATES ! Width is approx 100 metres. Lip height is approx 2m.



▲ Spillway #1 is a straight, walled concrete structure, referred to as an “uncontrolled chute”.



▲ Spillway #1 emptying into the uncontrolled flow from Spillway #2 during the 2022 flood event.



## **MODIFICATIONS TO THE EPPALOCK SPILLWAYS ARE URGENTLY REQUIRED**

To minimise future catastrophic flood flows on the Campaspe, the Eppalock spillways must be modified to make life sustainable for all the downstream residents.

We need a combination of improved infrastructure and compassionate management of water levels, so that only about 50,000 ML per day is ever released. This is not achievable with the current spillway design.

To achieve the 50,000 ML cap on floodwater release from Eppalock during saturated catchment conditions, there needs to be about 200,000 ML of “air space” available on the day a major rain is forecast to occur.

This air space could be achieved if radial flood gates were fitted to a slightly lowered primary spillway. The gates must be able to release 50,000 ML per day, for two days prior to a forecast major rain event.

**I propose that 5m high gates be installed, with the base 2m below the height of the current primary spillway lip. This would enable quick release of water down to 80% of lake capacity.**

**The gate height would also create an extra 3m of emergency flood surge capacity, when combined with the emergency (secondary) spillway wall also being raised by 1 meter.**

**These modifications would allow Lake Eppalock to store 100,000ML of flood surge above the current 100% level, before the emergency spillway begins releasing any water.**

**These radial gates would need to be similar to those at the 75 metre Torrumbarry Weir (below).**



▲ Radial gates at Torrumbarry Weir on the Murray allowing a small and controlled downstream flow.



▲ Radial gates raised to full height allow open flow on the Murray River.

## **THE SECONDARY SPILLWAY IS CURRENTLY A RISK TO CRITICAL INFRASTRUCTURE**

The uncontrolled flow from emergency Spillway #2 into the valley (seen at right in Oct 2022) has twice destroyed water infrastructure that supplies water to Heathcote, Bendigo and Ballarat (i.e. damage to the pump station and pipes to Heathcote).

The cost of re-designing and increasing the height of the wall (currently at about 1m high) surely pales into insignificance against the current risks it poses.



**An extra 1m of height added to Spillway #2 (220m long) will increase flood storage capacity by 100,000 ML above the 100% full level.**

**This flood surge can then be released at a safe flow rate through the new radial gates on Spillway #1 over the following week.**



## **CATASTROPHIC FAILURE TO WARN ROCHESTER RESIDENTS OF IMMINENT FLOOD LEVELS**

When a catastrophic flood event is building, real-time reporting of flow rates (both in and out of Lake Eppalock) is required on an hourly basis. This information was not made available during either of the last two “Rochester-destroying” flood events.

Reporting of spillway levels is done primarily by G-MW. They record the lake level at 9am each morning, but do not post these measurements on their web site until after mid-night (i.e. at least 15 hours later).

The next morning, the State Emergency Service then reports this data to the ABC Radio emergency flood reporting service. Hence, the figures delivered to the public are **at least 24 hours out of date.**

Early estimates of flood flows being yielded from the catchment rains were never reported to the public.

Hence the residents of Rochester spent two days sand-bagging for a catastrophic and **unstoppable** flood event.

Rochester residents should have been told 48 hours in advance that a “record-breaking flood” was coming, with 80% greater flows than the 2011 floods.

The correct information would have allowed 95% of Rochester’s households to focus on **removing all their valuables, instead of wasting their time sand-bagging.**



- **The G-MW website needs to be updated in real time during critical wet periods. More investment in instrumentation, IT links and staffing levels are essential.**
- **Rainfall needs to be measured at many locations across the catchment in real time, and used to compute imminent dam inflows and maximum dam release volumes.**
- **This reporting is crucial for responsible reservoir management and early disaster warnings.**

## **FLOOD FLOWS IN HISTORICAL PERSPECTIVE**

For the first 48 years since the building of Eppalock, there had never been a single megalitre of water over the emergency spillway. Even in the two wettest decades, flood releases never exceeded 55,000 ML a day.

The 55,000 ML a day flow is reached when 6ft or 1.85m of water is flowing over the primary spillway. At that point, the second spillway begins flowing. (For reference, 1m going over the first spillway is 30,000 ML a day, and 1m going over the secondary spillway is 66,000 ML a day).

In January 2011, a new flood flow record was recorded, with 2.2 meters flowing over the primary spillway and 400mm flowing over the emergency spillway. This was a 95,000 ML per day “peak flow”.

During the October 2022 flooding, farmers and all residents of the Campaspe Valley including Rochester and Echuca were impacted by a catastrophic 151,000ML per day peak flow rate.

A level of 2.85 metres passed over the primary spillway, with 1 metre flowing over the emergency spillway, giving a peak reservoir height of 136% of capacity, which was only maintained for a couple of hours.

## **A BURST OF RAIN CAN HAVE A CRITICAL EFFECT ON RESERVOIR LEVELS**

When any catchment has been fully wetted down, damaging floods can be yielded whenever the next heavy rain event occurs. When the Eppalock catchment is wetted down, just 100mm of rain will produce inflows of approximately 300,000 ML. (This is essentially 100% of Eppalock’s total capacity.)

In conditions like October 2022, well over 100mm of rain a week can be expected. (e.g. Loddon Valley had over 200mm in two days in January 2011). Such events are to be expected across all our catchments in future years, due to cyclical climate extremes.

In early Spring 2022, Eppalock was at 110% capacity, having received 95 mm of rain (26 Sep to 6 Oct). Then another 122mm fell in the catchment (12 -14 Oct) yielding a peak daily inflow of 240,000 ML.

Most of that flood surge passed straight through the already 110 % over-flowing Lake Eppalock over the next three days, because there was no air space maintained to absorb any of that catastrophic flood surge.

## **THERE IS AN URGENT NEED TO UPDATE RESERVOIR STORAGE RULES**

The catastrophic floods of 2011 and 2022 were the product of the current inappropriate reservoir management policies.

Given our present climate conditions (and the public alarm about “climate extremes”), these long-established management policies are now antiquated and need a complete re-write.

The reservoir managers NCCMA & G-MW seem to be obliged under current policies (e.g. water allocation volumes, based on early climate records) to store the maximum amount of water possible, without taking any responsibility or consideration for the loss of life and property damage that they cause downstream.

This is despite the Water Act (1989) Section 202 (e) stating that the aims of water corporations include :

**“... to take any action necessary to minimise flooding and flood damage”.**

Take note that, during very wet years, **the top 10% of the reservoir has almost no commercial value.**

Hence, this storage volume would be better used as “air space” to shield communities from catastrophic flood damage. The top 10% water volume can be released and categorised as early environmental flows.

The massive legislative changes around water during the last thirty years (e.g. the MDB Plan, water trading, water buybacks for the environment, etc) have led to a profound change in water use and reservoir levels.

“The Environment” is now the largest water holder in Lake Eppalock. Due to the shutdown of the Rochester irrigation districts, the water stored for farmers is now only about 10% of Eppalock’s capacity. (This is less than the lake’s natural losses from evaporation and seepage).

A full review of water allocations (i.e. “bulk entitlements”) is now decades overdue.

We still face the absurdity that Victoria’s reservoirs are basically emptied within three years, any time an extended El Nino drought impacts our climate. This is because water authorities are obliged to meet 100% of bulk entitlements (especially for the environment) ... without reserving any water for the fourth or subsequent years.

### **2 SETS OF WATER RULES ARE NEEDED, FOR THE EXTREMES OF OUR CLIMATE:**

In **DRY** conditions : “Use Half, and Save Half” of stored water each year.

In **WET** conditions : **Maintain 10% air space in all reservoirs whenever possible, and plan to store the damaging peak flows of any flood events.**

## **DAMAGING FLOODS ARE CYCLICAL ... AND WERE VERY PREDICTABLE IN 2022**

Flood mitigation polices need to be implemented without delay when there are abundantly clear indicators for a “high flood risk” season. The prerequisites for “high flood risk” were all in play during 2022.

- A well-developed La Nina anomaly combined with a dominance of above-average sea surface temperatures close to Australia is indicative of high atmospheric moisture levels.
- If the late Summer period brings extreme flash flooding across the northern regions of Australia, this is a warning sign of pending disastrous floods further south later that year.
- If concentrated “rain bombs” occur in northern NSW and work their way south during Winter, this is another sign of an imminent wet Spring for the southern MDB regions.
- If a catchment has been wetted down after a month of above-average rain, and local reservoirs have risen to above 90% of capacity, then damaging floods are very likely within the next month.
- Finally, if the Bureau of Meteorology forecasts a wet Spring, they most likely will be correct.

## **FINAL THOUGHTS**

During many years of climate research and weather forecasting, I have identified that the main drivers of climate extremes are the lunar declination cycles, combining with planetary cycle gravity extremes and El Nino / La Nina events.

Hence many climatic extremes are produced on time-scales up to 297 years long.

My research indicates that the wettest climate extreme for 297 years, most likely occurred during 2010/11.

This produced the wettest 13 months on record in the Bendigo region. This wet extreme was then followed nine years later by the record-breaking driest season in eastern Australia.

This timing between extremes correlates to the “half-period” phase of the 18.6-year lunar driven flood cycle.

The current decades are affected by the most extreme fluctuations of the 297-year cycle.

Hence we are experiencing the most extreme “flips” from floods into droughts every 2 to 3 years (i.e. the combining forces of solar, lunar, planetary, sea ice and La Nina / El Nino cycles).

Some may call it a perfect storm.

These extreme cycles are impacting the entire MDB, and I forecast we will see at least 3 more decades of these extremes, which is in line with the present lunar, planetary and solar sunspot cycles.

These cycles can (and do on repeated occasions) create what climatologists refer to as “mega-droughts” which can run for many decades.

I have researched and written about mega-droughts and how they have previously affected Northern Victoria, for periods as long as about one hundred years.

We also experience very wet periods where 200% to 300% of yearly rain can last for 3 or more years.

So, buckle in!

We can take the first steps in this new era by implementing spillway changes at Lake Eppalock for the prevention of future catastrophic flooding, and better water storage capacity for future dry climate periods.

Immediate proactive control of all water resources will greatly reduce the impact of future catastrophic flood events and droughts, which will occur again maybe sooner than later.

It will be very costly for all concerned, if we have not changed our ways of managing imminent floods.

A repeat flood scenario could be with us as soon as this Winter / Spring period in 2023 ... or at best when the next strong La Nina system develops - very likely by 2026 or 2030.

Government action is needed immediately to maintain air space in all reservoirs during this Winter / Spring,

The first rain event of Winter 2023 already has the catchments fully wet and the reservoirs ready to deliver another round of catastrophic flooding - with almost no air space left available as of June 12th.

The urgent need for upgrading water storages has been apparent for two decades now, and it is costing our economy unnecessary billions every time a climate extreme impacts Victoria.

Sincerely, Kevin Long

**For more information: [www.TheLongView.com.au](http://www.TheLongView.com.au)**



## **IMAGE CREDITS**

Aerial stills of Lake Eppalock are from : <https://write.corbpie.com/category/creative/>  
and from various parts of the following YouTube videos :

<b>SUBJECT</b>	<b>YOUTUBE WEB LINK</b>
Spillway # 1 in flood	<a href="https://www.youtube.com/watch?v=IKUSoqDvO4c">https://www.youtube.com/watch?v=IKUSoqDvO4c</a> Lake Eppalock Spillway in Flood Part 2   Victoria Floods - Oct 2022
Spillway #2 in Flood	<a href="https://www.youtube.com/watch?v=O-oXuRZqHTA">https://www.youtube.com/watch?v=O-oXuRZqHTA</a> Lake Eppalock spilling over Knowsley-Eppalock Rd. 14 October 2022
Spillway #2 damage after flood	<a href="https://www.youtube.com/watch?v=7jTZBjwSCEk">https://www.youtube.com/watch?v=7jTZBjwSCEk</a> Lake Eppalock in Flood Part 3 Oct 2022   Victoria Floods
Spillway #2 damage after flood	<a href="https://www.youtube.com/watch?v=7KleZg1IDjk">https://www.youtube.com/watch?v=7KleZg1IDjk</a> Flood Damage at Spillway 2 Lake Eppalock

Torrumbarry weir images are from the following YouTube videos :

Torrumbarry Weir

<https://www.youtube.com/watch?v=DWN0pikiS1s>

Visiting the Spectacular Torrumbarry Weir on the Murray River

<https://youtu.be/GYMi8qOp00Q>