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INQUIRY INTO FLOODPLAIN HARVESTING

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Submission to the NSW Legislative Council Inquiry into Floodplain Harvesting

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Summary

Context of floodplain harvesting

- Floodplain harvesting captures water on floodplains, generally during high river flows.
- NSW estimates there is 1450 gigalitres (GL) of on-farm storage ("turkey nests" or "ring tanks"). For comparison, the largest dam in the Northern Basin, Copeton Dam, stores 1364 GL.
- Some on-farm storage would be for licensed Supplementary Flows; the remainder would largely be for unlicensed floodplain harvesting.

Impacts

- Unlicensed floodplain harvesting, as it has grown in NSW, favours upstream irrigators.
- Floodplain harvesting traps floodwater so that downstream irrigators, communities and the environment receive less; causing impacts on:
    - Flows,
    - Environments,
    - Aboriginal cultural values,
    - the irrigation industry, and
    - social equity and well-being.
- These are impacts in addition to licensed diversions.

The Cap, floodplain harvesting and the Baseline Diversion Limit

- Diversions of surface water in the MDB were capped at 1993/94 levels (The Cap) by the Howard government and the Murray-Darling Basin Ministerial Council, with representation from NSW.
- After The Cap (1 July 1994) there should have been no additional diversions of water.
- Estimates of diversions at that time are called the Baseline Diversion Limit (BDL).
- Floodplain harvesting was, and is, acknowledged as being underestimated; hence the BDL is likely underestimated.
- The BDL is not, however, an estimate of available water for diversions. The logic that an underestimate of the BDL means there is more water and more licenses potentially available is false. There is no legislation or policy by the Federal Government to suggest this.

  The total water available in a catchment is calculated first, then the Environmentally Sustainable Level of Take (ESLT) followed by the Sustainable Diversion Limit (SDL). After that process the BDL is applied to calculate the volume of water recovery required to reach the SDL. Any underestimate in the BDL does not change the SDL.

Path Forward

Floodplain harvesting

- License any floodplain harvesting that occurred before 1 July 1994
- Identify floodplain harvesting infrastructure built after 1 July 1994.
- Allow irrigators using floodplain harvesting after 1 July 1994 to purchase an existing license and water share within the present market.
- Do not allocate additional licenses with additional shares of the water – this would not be consistent with the SDL.

- Levees that are used in floodplain harvesting to hold water need to be removed to allow floodwaters to flow back to the river. These levees trap and kill native fish in contravention of the NSW Fisheries Management Act (Section 219).
- Floodplain harvesting that becomes licensed and uses pumps, should start to adopt screening technologies to protect native fish, aligning with industry trends and responsibilities.

Opportunities

The issues of water management in the Northern Basin including floodplain harvesting and the use of water, also highlight an attainable **vision for sustainable irrigation, communities and the environment.** It includes:

- Baseflows
- Flow pulses
- All on-farm storage covered (Note that up 40% of water is lost in evaporation)
- All diversions/pumps screened – negligible loss of native fish
- Communities engaged in habitat restoration of rivers
- Aboriginal cultural values improved
- Improved ecosystem resilience
- Irrigation thriving in upstream and downstream communities
- Recreational fishing thriving
- Tourism increasing

The above vision is dependent on significant restoration of baseflows and flow pulses. Licensing floodplain harvesting with new licenses and new shares of a fixed water resource would entrench the loss of additional flows since 1994 (The Cap) and make this vision very, very difficult to achieve.

1. Introduction

In this submission I will address the issues of floodplain harvesting in NSW, discussing the policy context and impacts, and proposing a path forward.

My background is that I am an aquatic scientist that has worked in the Murray-Darling Basin for 35 years. I completed my PhD on fish ecology on the Murray River in 1996. I was a government scientist (NSW Fisheries) for 10 years and have been an independent consulting scientist advising on fish ecology, fish migration, river and floodplain rehabilitation for over 25 years. I have worked on over 100 projects across the Basin in that time, including projects at every weir and most floodplains along the Murray River; and many weirs along the Barwon-Darling River and tributaries.

Much of my present work is advising the governments of the Mekong River, especially Laos PDR and Cambodia, and the Mekong River Commission on fish ecology, fish migration and balancing the development of hydropower with food security, livelihoods and biodiversity. Recently I have started working with the Dharriwaa Elders Group in Walgett examining the overlap of western science and Aboriginal cultural science. I can supply a detailed CV if requested.

2. Types of floodplain harvesting

Floodplain harvesting captures: i) high flows that spill over the banks of a stream (i.e. overbank flow) and inundate floodplains, or ii) overland flow directly from rainfall. Farm dams that capture overland flow for stock and domestic are not included in the present submission. Figure 1 shows three main types of floodplain harvesting:

a) Capture by levee banks (overbank flow or overland flow).
b) Pumping unlicensed flows directly from the floodplain to an unlicensed on-farm storage.
c) Pumping unlicensed flows directly from the floodplain to a licensed on-farm storage that is also used for licensed flow from the river channel.

3. Magnitude of floodplain harvesting

Large on-farm storages ("turkey nests" or "ring tanks") provide an indication of the extent of floodplain harvesting. The NSW Government estimates there is 1450 gigalitres (GL) of on-farm storage in the Northern Basin of NSW, which aligns with the independent assessment of Slattery and Johnson (2021)[1] of 1395 GL. For comparison, the largest dam in the Northern Basin is Copeton Dam which stores 1364 GL.

Some of these on-farm storages are for licensed Supplementary Flows and some for floodplain harvesting that was in place before 1 July 1994 and The Cap (see Section 5). Storages built after 1 July 1994 are likely to be built for additional floodplain harvesting that is above The Cap and not part of the Sustainable Diversion Limits (SDLs). This is discussed in further detail in Section 5.

[1] Slattery & Johnson 2021. Floodplain water harvesting in the Northern New South Wales Murray-Darling Basin. 36 p.

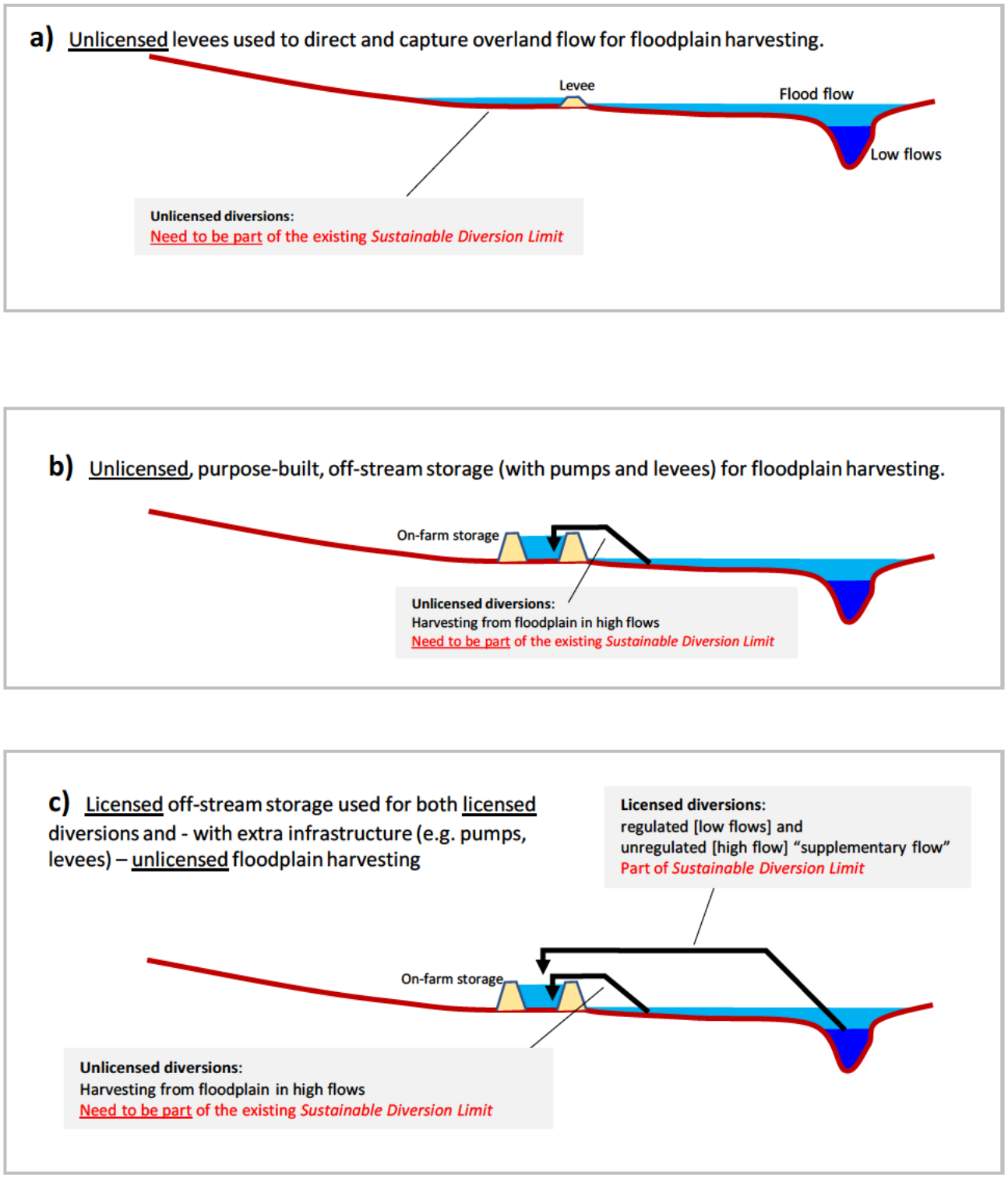

Figure 1. Different types of floodplain harvesting using: a) levees, b) on-farm storage ("ring tanks" or "turkey nests") with pumps and sometimes levees, c) on-farm storage use for licensed diversion and unlicensed floodplain harvesting.

4. Impacts of floodplain harvesting

4.1. Overview

Figure 2 shows a conceptual diagram of the impacts of floodplain harvesting on flow. These impacts are in addition to the impacts of licensed irrigators. The diagram shows the flow pattern of a flood pulse, with and without floodplain harvesting.

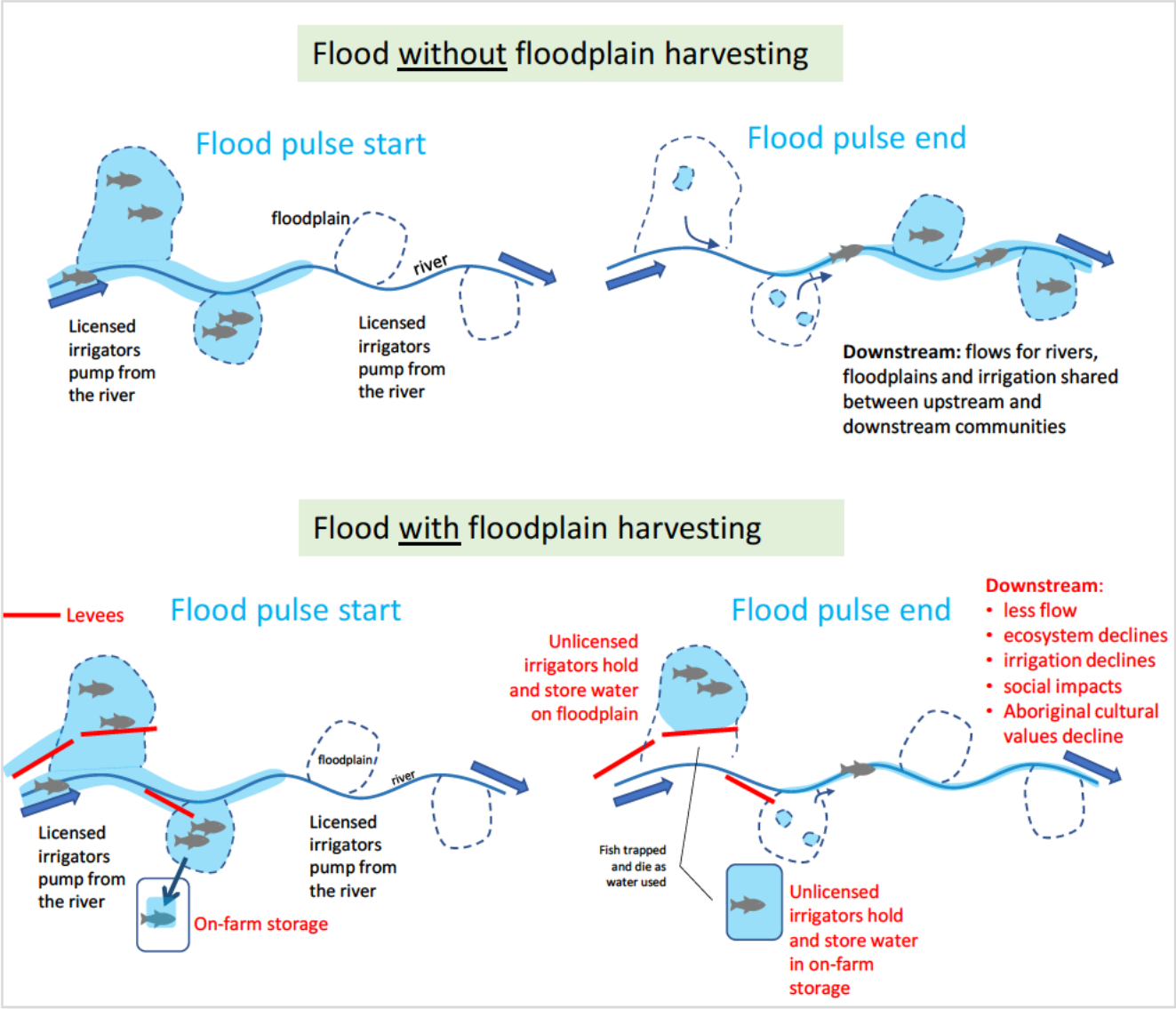

Figure 2. Conceptual diagram of the impacts of floodplain harvesting. The scale of impacts is 100s-1000s km.

Without floodplain harvesting, a flood pulse arrives, floodplains are filled and licensed irrigators can take *Supplementary Flows* (high flows that cannot be captured in dams or weirs). As the flood pulse ends upstream, floodplains naturally retain some water, which sustains the floodplain ecology for birds, trees and fish; while licensed irrigators have diverted water. The flood pulse travels downstream (potentially over 100s or 1000s km) to downstream irrigators and floodplains, so that water is shared between communities and environments.

With floodplain harvesting (Figure 2), there are levees, pumps and on-farm storage capturing water, in addition to licensed diversions for *Supplementary Flows*. At the end of the flood pulse upstream, there is captured water on floodplains (using levee banks) and in on-farm storages, resulting in much less water downstream for the river, irrigators and floodplains.

This has multiple negative impacts on:

- Flows,
- Environments,
- Aboriginal cultural values,
- the irrigation industry, and
- social equity and well-being.

4.2. Impacts on Flow

In NSW the impacts of floodplain harvesting have been greatest in the Northern Murray-Darling Basin and these impacts accumulate in the Barwon-Darling River, which drains the entire Northern Basin.

To examine these impacts, it is firstly important to understand the nature of the Barwon-Darling: i) prior to any diversions, and ii) how it would be now without diversions.

Baseflows

Examining the historical flow data from 1886-1950 in the Barwon-Darling River, and contemporary modelled flow data[2], shows that under natural conditions:

- the Darling River flows for 92% of the time on average, and 85% of the time in the worst possible droughts; and
- there are high baseflows, even in droughts. For example, historical droughts have 250 ML/d[3] for >70% of the time at Wilcannia, compared with 5 ML/d in the Millennium and recent (2013-19) droughts;

Although historical periods of zero flow in the Barwon-Darling are often emphasized, it is not a desert river like the Cooper Creek system in the Lake Eyre catchment.

Baseflows in the Barwon-Darling are mainly impacted by: capture of flow in the large tableland dams (Keepit, Copeton etc.); and licensed irrigation diversions from the river channel. At very low flows there are significant impacts from domestic and town water supplies[2]. Floodplain harvesting would also potentially impact baseflows a long distance downstream by capturing part of the total volume of a flood pulse, with subsequent downstream users getting less and less. Despite this inherent logic, the extent that floodplain harvesting impacts baseflows in addition to other flow diversions has not been quantified.

Near-annual flow pulses

Examining the same historical flow data (1886-1950) and contemporary modelled flow data, shows that under natural conditions:

[2] Mallen-Cooper, M., and Zampatti, B.P. (2020) Restoring the ecological integrity of a dryland river: why low flows in the Barwon-Darling River must *flow*. *Ecological Management & Restoration*, 11.
[3] At 250 ML/d the river is 1.5 m deep over rock bars and has obvious flowing-water.

- there are near-annual flow pulses of 8,500 to 12,500 ML/d in the Darling River, even in the most severe droughts on record (Mallen-Cooper and Zampatti 2020). Importantly, the river modelling of inflows over the last 20 years shows that these pulses would still have occurred in the recent droughts if there was no capture and diversion of flow.

  These flow pulses are now reduced to less than 700 ML/d in the Millennium and recent (2013-19) droughts due to diversion of flow.

  In practical terms, a near-annual pulse of 8,500 to 12,500 ML/d is 4-6 m deep and 55-75 m wide (e.g. at Wilcannia), and connects key floodplains such as Lake Menindee (i.e. prior to the Menindee Lakes Scheme). A reduced pulse of 700 ML/d is 1.2 m deep and 25 m wide in the Darling River and does not connect any significant floodplains or wetlands.

The near-annual flow pulses are mainly impacted by: capture of flow in the large tableland dams (Keepit, Copeton, etc.); licensed irrigation diversions taking *Supplementary Flows* (high flows) from the river channel; and unlicensed floodplain harvesting. The additional impact of floodplain harvesting can be assessed from the estimates of growth of on-farm storages.

I mentioned earlier that the NSW Government estimates there is 1450 gigalitres (GL) of on-farm storage. Slattery and Johnson (2021)[4] also estimate that the growth of on-farm storage since the 1 July 1994 (The Cap) is from 574 GL to 1395 GL. The difference of 821 GL is equivalent to a flow pulse of 15,000 ML/d for more than 50 days. The 821 GL is also a very significant volume when compared with the Basin Plan water recovery target of 2750 GL.

4.3. Impacts on the Environment

The Barwon-Darling River is often described as having highly variable flows. The features just described – persistent baseflows and near-annual flow pulses - are, however, highly consistent. The fish, birds, plants, mussels, and snails are adapted to these consistent features, as well as the infrequent floods.

Large floods are spectacular events, but the near-annual flow pulses inundated low-lying floodplains on a regular basis providing regular pulses of river productivity. Floodplain harvesting has a major impact on these regular pulses of flow, because the diversions of flow are occurring in these flow events.

Some fish species, like golden perch, only spawn during these large flow pulses, while many birds will only breed when floodplains are inundated. Golden perch and many other native fish species, like Murray cod, have larvae that drift with the current. Floodwaters that are trapped by levees for floodplain harvesting also trap these larvae and larger fish; as the water is used, these fish die, and populations decline.

Using levees to trap and hold water that contain native fish is also in contravention of Section 219 of the Fisheries Management Act which states that "Passage of fish [is] not to be blocked" which includes

[4] Slattery & Johnson (2021). Floodplain water harvesting in the Northern New South Wales Murray-Darling Basin. 36 p.

"an obstruction . . . across or around a flat". Pumps can potentially be screened to prevent loss of fish and the irrigation industry is starting to apply these technologies[5].

In 2018-19 there were fish, mussel and snail kills in the Darling River, showing a major decline in river conditions[2]. These aquatic biota can, however, recover if suitable flows are provided.

Floodplain harvesting did not directly contribute to these kills, but they contribute to the decline in abundance and lack of resilience of these populations. These animals need baseflows and flow pulses to bounce back; without them, populations keep ratcheting down. A major one-off fish kill is a disaster, but a greater disaster is entrenching flow diversions that keep an ecosystem in a suppressed fragile state that cannot bounce back. Communities living along the river deeply understand this.

Climate change is also often put forward as a major impact on flow in the Northern Basin in NSW. All data and models of flow published by the government and other scientists show that the major impact on present and future flows is diversions for irrigation; climate change is an additional impact and stressor but not the major impact on flow.

4.4. Impacts on Aboriginal cultural values

Aboriginal people have lived and prospered on rivers and floodplains of the Murray-Darling Basin for over 40,000 years. Flow and the river/floodplain ecosystem are deeply ingrained in their cultural and spiritual values. Baseflows, near-annual flow pulses and the productive healthy ecosystem those flows generate are part of that culture.

Loss of these flows and loss of fish and other animals that have high totemic value has damaged Aboriginal cultural values. That damage flows onto well-being, mental health, and physical health. The NSW Government is presently not meeting a key objectives (Objects) of the NSW Water Act 2000 "to foster . . . benefits to the Aboriginal people in relation to their spiritual, social, customary and economic use of land and water." The government of NSW and non-Aboriginal people of NSW have benefited enormously from the extraction and use of water that was never ceded, underpinning irrigated agriculture for over 100 years with a present annual value for the state of $4.4 billion[6]. Fostering Aboriginal cultural values is not only consistent with the Water Act, it is our joint responsibility.

Floodplain harvesting impacts the flow pulses that are part of Aboriginal culture. These are the pulses that refreshed and restored the river, creating abundant fish and wildlife; this mechanism is not folklore, it is a direct overlap of western science and the cultural science of Aboriginal people. Entrenching any reduction in these flow pulses, through licensing additional (post 1994) floodplain harvesting, would entrench those losses of cultural values.

[5] Boys, C. A., Rayner, T. S., Baumgartner, L. J., & Doyle, K. E. (2021). Native fish losses due to water extraction in Australian rivers: Evidence, impacts and a solution in modern fish-and farm-friendly screens. *Ecological Management & Restoration*.

[6] ABS (2021), Gross Value of Irrigated Agricultural Production (GVIAP) in NSW for 2017-18.

4.5. Impacts on the irrigation industry

Floodplain harvesting has been free water, which produces a fundamentally unequal industry where other irrigators are paying for water in a deregulated market. This inequality includes irrigators within the same catchment, between catchments and within the entire Murray-Darling Basin.

Without a clear policy (or metering) of floodplain harvesting, developments since 1 July 1994 have favoured upstream irrigators over downstream irrigators – there was no strategic policy that shared water amongst all users in NSW, or incorporated all the objectives (Objects) of the NSW Water Management Act. It was "first in – first served," so upstream irrigators benefited.

Licensing post-1994 floodplain harvesting is not a strategic policy for agriculture or water resource management in NSW – it institutionalises and embeds the inequality of post-1994 practices and mistakes, rewarding irrigators that took that risk knowing the embargo on further diversions.

It is also worth noting that a fairer distribution of water for industry has allied benefits for the environment. Although flows for irrigation and the environment are often considered separately, irrigation flows can benefit the environment if managed well. For example, there are far greater benefits for the environment if industry flows are delivered equally along the river system, rather than captured and used upstream, which results in less water in downstream reaches.

4.6. Social equity and well-being

The imbalance between upstream and downstream irrigators flows onto other aspects of communities. Upstream towns prosper at the expense of downstream towns, leading to other economic impacts, less services and further social inequity.

Having a healthy river underpins the well-being of river communities. The last drought and blue-green algae outbreaks showed how much these communities not only depend on the river for water, but also the high value they place on a healthy river. An unhealthy river impacts well-being, flowing onto poorer outcomes for mental and physical health.

Part of a healthy river is abundant fish populations. Recreational fishing is a major value of river communities that contributes to well-being and mental health. It is also very significant economically; in the Murray-Darling Basin fishers spend on average $1.3 billion per year[7]. The loss of water in downstream communities means less fish and less income from recreational fishers.

[7] Deloitte Access Economics (2012). Benefits of the Basin Plan for the fishing industries in the Murray-Darling Basin. 72 p.

5. The Cap, Floodplain Harvesting and the Baseline Diversion Limit (BDL)

In 1995 the Howard government and the Murray-Darling Basin Ministerial Council (with representation from all Basin states) imposed "The Cap" on water diversions in the MDB, which capped growth in surface water diversions at levels for 1993-94. It was not a cap on development or further water infrastructure, but a cap on total diversions.

Estimates of diversions up to 1993-94 levels form the Baseline Diversion Limit (BDL). Floodplain harvesting was included at the time, but it is widely acknowledged that it was underestimated; hence, the BDL is underestimated.

Some people have argued that if Floodplain Harvesting and the BDL are underestimated then the BDL estimate should be higher; therefore, more water can be diverted for consumptive use (mainly irrigation). The logic, however, is incorrect and has no basis in legislation or policy.

The BDL is not an estimate of available water for diversions, but an estimate of diversions that is used to calculate water recovery for the Basin Plan, **after** calculations of the Sustainable Diversion Limit (SDL) (Figure 3).

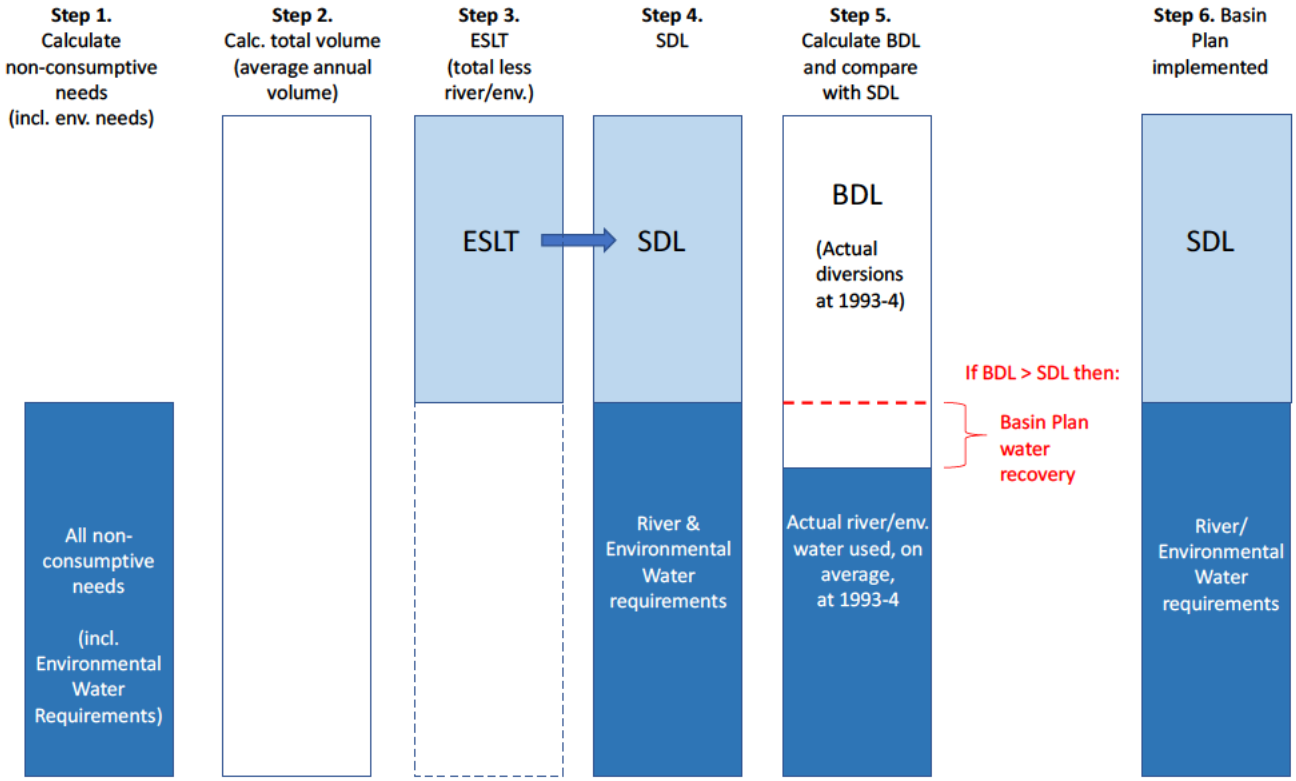

Figure 3. Steps used to calculate water recovery and the SDL for the Basin Plan, showing the application of the BDL.

Figure 3 shows the steps that are used to calculate water recovery and the SDL for the Basin Plan. Step 1 is to calculate all non-consumptive needs – these include seepage, groundwater recharge, evaporation, environmental needs, etc. Step 2 is to calculate the average total volume available and

Step 3 the Environmentally Sustainable Level of Take (ESLT, i.e. diversions of water). After these steps the SDL can be calculated and only then is the BDL applied to estimate water recovery (Figure 3).

These steps have been agreed upon by all states and parties to the Basin Plan over many years. There has been complete transparency of the methodology. There has been no change to the Federal Water Act or MDBA policy to suggest that an underestimate of diversions in 1993-94 - and an underestimate of the BDL - should have any influence on the SDL and water recovery.

In summary, any licensing of floodplain harvesting needs to be within SDLs (and the Environmentally Sustainable Level of Take) that are already agreed upon.

6. Identifying post-1994 floodplain harvesting

If post-1994 floodplain harvesting is not valid, how can it be identified? Slattery and Johnson (2021) provide a method which applies satellite imagery and LiDAR to identify on-farm storages. I understand that DPIE also uses this method. I have reviewed the method and consider it is sound, robust and unbiased.

The nest step from identifying on-farm storage is to confirm the results of Slattery and Johnson (2021) who quantify storages built post-1994. It is possible that a few on-farm storages built after 1994 may relate to a license for Supplementary Flow held prior to 1994 or purchased legitimately after 1994. These should be simple to check against NSW government records. The remainder should be post-1994 unlicensed floodplain harvesting.

7. Path forward

Floodplain harvesting

The Cap was a high profile, transparent decision, with high press coverage; and it was well known within the irrigation industry. It is difficult to consider that any additional floodplain developments and additional diversions done after 1994 were done in ignorance of this landmark decision.

Irrigators that chose to develop infrastructure for floodplain harvesting post-1994, and utilise it, have since received a significant financial bonus from the state as the water was free, at the expense of licensed irrigators, and downstream communities and environments.

Nevertheless, floodplain harvesting is an acknowledged and legitimate form of water diversion and should be treated as such – that is, it needs to be within the Basin Plan and SDL framework.

The concept of licensing and quantifying the volume of floodplain harvesting through metering and surveys is commendable. However, allocating *more licenses* and *water shares* from a fixed resource (i.e. surface water within a catchment) is not consistent with the SDL or the Basin Plan. It is also not prudent management or consistent with the Objects of the Water Management Act. The simple solution is to allow those irrigators using floodplain harvesting (post 1994) the opportunity to purchase *existing water licenses*, as irrigators have been doing for many years.

The Select Committee should also consider the long-term cost risks for the government if additional licenses and water shares were allocated. If these additional licenses were in breach of the SDL or Basin Plan, or impacts were not consistent with the Water Management Act, the government may

need to purchase the water back. This would be very costly and unpopular, as we have seen with the Basin Plan buybacks.

In summary, I suggest the path forward is:

- License any floodplain harvesting that occurred before 1 July 1994
- Identify floodplain harvesting infrastructure built after 1 July 1994.
- Allow irrigators using floodplain harvesting after 1 July 1994 to purchase an existing license and water share within the present market.
- Do not allocate additional licenses with additional shares of the water – this would not be consistent with the SDL.
- Levees that are used in floodplain harvesting to hold water need to be removed to allow floodwaters to flow back to the river. (As described earlier, these levees trap and kill native fish).
- Floodplain harvesting that becomes licensed and uses pumps, should start to adopt screening technologies to protect native fish, aligning with industry trends and responsibilities.

Opportunities

The issues of water management in the Northern Basin including floodplain harvesting and the use of water, also highlight an attainable **vision for sustainable irrigation, communities and the environment.** It includes:

- Baseflows
- Flow pulses
- All on-farm storage covered (Note that up 40% of water is lost in evaporation[8])
- All diversions/pumps screened – negligible loss of native fish
- Communities engaged in habitat restoration of rivers
- Aboriginal cultural values improved
- Improved ecosystem resilience
- Irrigation thriving in upstream and downstream communities
- Recreational fishing thriving
- Tourism increasing ("Experience the Outback and catch a mighty Murray cod[9] - one of the largest freshwater fish in the world")

The above vision is completely achievable - the science around flows and river ecology is rock-solid. The vision is then a choice for communities and the government of NSW. The vision is also achievable with irrigated agriculture but is not achievable without significant restoration of baseflows and flow pulses. Licensing floodplain harvesting with new licenses and new shares of a fixed water resource would entrench the loss of additional flows since 1994 (The Cap) and make this vision very, very difficult to achieve.

[8] Jacobs, 2017, Mole River Dam Feasibility Study. 187p.
[9] A Murray cod can be 1m long and 20kg!