Following the floods: the effects of the 2010 floods

That Australia is a land of droughts and flooding rains has truly been demonstrated in the Murray–Darling Basin system over the past year. Over the past 12 months, Basin communities have lurched from severe drought to record-breaking floods, with devastating impacts on people's lives. This article looks at these recent rain and flood events to reveal some of the hydrological and environmental characteristics of the Basin's unique landscape.

When heavy rains flooded vast areas of northern Australia during the summer of 2009–10, it was generally expected that the water would make its way south and bring relief to drought-stricken environments and communities in the southern Murray–Darling Basin.

In reality these initial floods had little impact on major dams in the northern Basin and only a modest, but welcome, impact on the Murray system.

The summer of 2010–11 has seen further heavy rains falling over eastern Australia, creating major floods in many areas with devastating effects on towns and communities. While these communities are currently counting the terrible human and economic costs of these floods, it is not yet known what environmental and hydrological impacts will be seen in the Murray–Darling Basin.

So where did all this water go?

The Murray–Darling is Australia's largest — and one of the world's major — river systems. Despite its size, it is, however, small in terms of water discharge (or runoff). On a global scale, Australia (together with southern Africa) experiences higher runoff variability than any other continent. On average, just 5% of the rain that falls in the Basin ends up in its rivers.

The headwaters of both the Murray and Darling rivers start in the mountains of the Great Dividing Range. These mountains are not high by world standards, and the Darling and Murray rivers flow over plains for much of their length. This is particularly true in the Darling (the northern) catchment of the Basin.

Many Australian rivers also have extremely low gradients, so under normal conditions water moves down them slowly. During floods, water can travel even more slowly because it meanders through the floodplains — kickstarting plant and animal life in floodplain forests, wetlands and billabongs, and recharging aquifers.

Rain in the Basin's northern catchments can only connect to rivers in the southern Basin through extreme and sustained periods of water flow — which is what we experienced in late 2010 and early 2011. While they are a natural occurrence of the Basin's hydrological and environmental character, these extreme water flows can have devastating consequences for Basin communities and the national economy.

The Darling River is unusual in that its channel narrows rather than broadens as it travels downstream. When a large amount of water flows through the Darling system, it spills over riverbanks and onto floodplains; most of this water spreads out, filling shallow lakes, seeping into the ground, evaporating or being used by vegetation.

Only a small amount of this water actually finds its way downstream — while the Darling captures runoff from tributaries in southern Queensland and northern New South Wales, on average it contributes just 12% of the River Murray's flow downstream of Wentworth, New South Wales.

It can take up to three months for floodwater to travel from the headwaters of the Darling River to the Menindee Lakes, a system of nine natural lakes modified for water storage on the Darling River in south-west New South Wales, because the Darling falls at less than 10 centimetres per kilometre. The final volume of water reaching the Menindee Lakes greatly depends on how much is lost through evaporation and floodplain absorption as the floodwaters move slowly downstream. How much water reaches the Menindee Lakes and how long it takes to get there is difficult to predict. No two floods are the same and each tributary responds differently.

The floods of December 2009 to January 2010 and March to May 2010

Late in December 2009 and early in January 2010, heavy rain in the north of the Murray–Darling Basin caused flooding in northern New South Wales, particularly in the Castlereagh, Namoi and Culgoa rivers.

About 1,000 gigalitres (GL)[*] reached the Menindee Lakes; about 600 GL of this passed downstream, with about 500 GL reaching the River Murray and being captured for future water supply at Lake Victoria, about 60 km downstream of the Murray–Darling junction near the South Australian and New South Wales border.

By the end of this flood, storage in the Menindee Lakes had increased from 9% capacity to 32%, or about 550 GL.

Menindee Weir — water is held back here to fill lakes Pamamaroo and Wetherell. The flood peak reached the Menindee Lakes in early May 2010, increasing their storage level to 88% capacity (photo by Arthur Mostead © MDBA)

[*] A gigalitre is a billion litres.

In late February and early March 2010, further heavy rainfall in the northern Basin, particularly in southern Queensland, caused widespread major flooding in the lower Condamine, Balonne, Maranoa, Warrego and Paroo rivers. The peak flow at St George, on the Balonne in southern Queensland, of 255 GL a day was at that time the highest on record. By May, a small volume of water from the Paroo started to flow into the Darling, joining the two rivers — a rare event that has occurred on only a handful of occasions since European settlement began.

While the tributaries of the Darling often experience periods of very low or no flow, about 6,700 GL passed the downstream gauges in Queensland during the March-to-May flood. However, only 18% of this flow reached Wilcannia, partly because many of these northern tributaries are not well connected to the Darling River and contain lakes and wetlands that capture water as it travels downstream. The floodwaters also had to travel long distances over parched floodplains in southern Queensland and northern New South Wales; because these floodplains absorbed a lot of water, the severity of the floods downstream were significantly reduced.

The flood peak reached Menindee Lakes in early May, adding 1,200 GL to them and increasing their storage level to 88% capacity. The two larger storages — Lake Menindee and Lake Cawndilla — received water for the first time since 2001. In the previous nine years only the upper lakes in the Menindee system were used to store water (see sidebar).

As water flowed down the rivers, about 1,500 GL was legally diverted into private storages. Volumes in the major state storages of the northern Basin increased by only a small amount — about 240 GL — because most rain fell downstream of these.

By the end of June 2010, public storages across the Basin, including the Menindee Lakes, were at about 38% capacity, or 3,285 GL, much higher than the 14%, or 1,200 GL, capacity recorded the previous June, but still well below the long-term average of 5,530 GL.

The Menindee Lakes water storage system

The Menindee Lakes water storage system is located on the Darling River, about 250 km upstream of the junction of the Darling and Murray rivers.

The Menindee Lakes consist of nine lakes, but water is generally stored in the four largest lakes — Pamamaroo, Wetherell, Menindee and Cawndilla.

Before the Menindee Lakes storage scheme was built, the lakes filled naturally during high river flows and then gradually dried to form a series of pools.

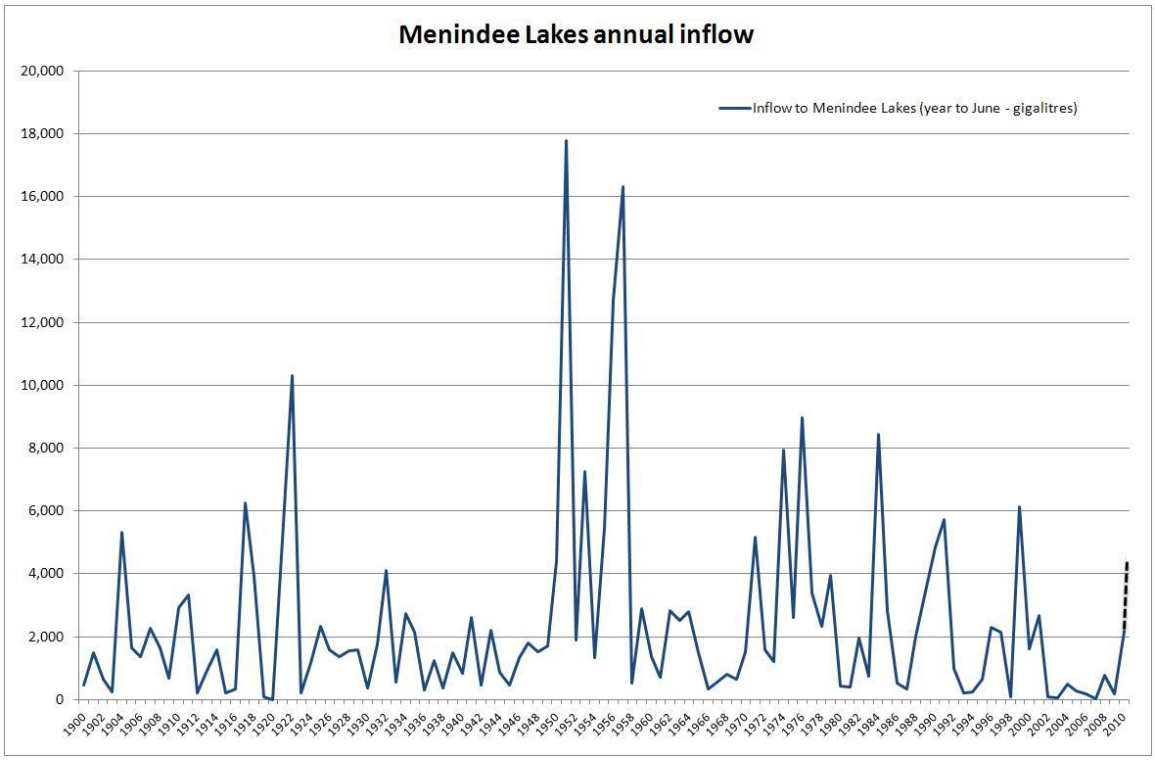
The Menindee Lakes were modified in the 1950s and 1960s to provide Broken Hill with a reliable water supply and to supply water for irrigation to New South Wales, Victoria and South Australia.

Flows enter the system through Lake Wetherell, and then flow through to lakes Pamamaroo, Menindee and Cawndilla. Releases to the Darling are made from lakes Menindee, Pamamaroo and Wetherell, while releases to the Great Darling Anabranch are made from Lake Cawndilla.

The lakes are controlled by New South Wales until they reach 640 GL (or 37% of capacity) when the Murray–Darling Basin Authority takes over their management, with water shared between New South Wales, Victoria and South Australia. When the capacity of the lakes falls back below 480 GL, control reverts to New South Wales.

A proportion of water from the first flood in the Darling River was delivered to the Lower Lakes at the terminus of the Murray–Darling system, which increased their level from 0.9 metres below sea level in late January 2010 to 0.2 m below sea level in July. As the lakes were still below sea level, no water flowed out the Murray Mouth to sea.

So, despite the welcome summer and autumn rains in the Basin's north, many irrigators, as well as the environment, in the southern part of the Basin still faced drought conditions at the end of June 2010.



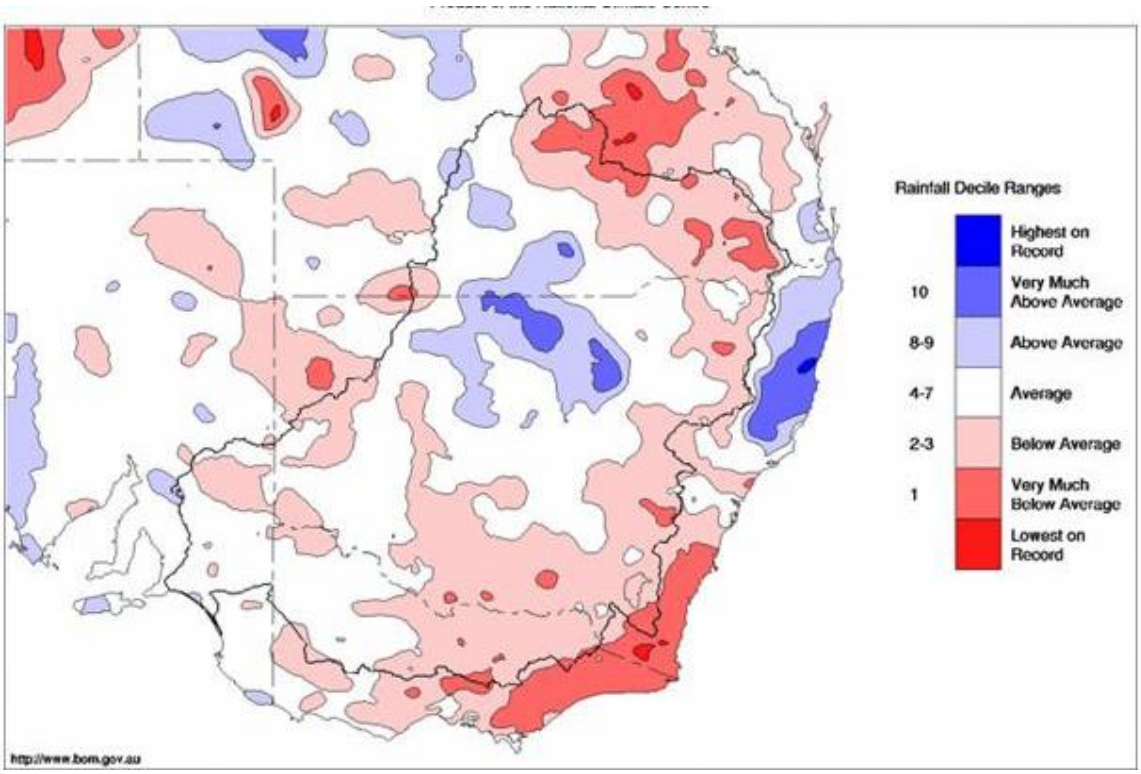
The final value for 2010–11 Menindee inflow is not yet known, but indications are it will trend higher than the value in 2009–10, but this will still be significantly lower than many historic inflow volumes recorded during the past century

From drought to flooding rains

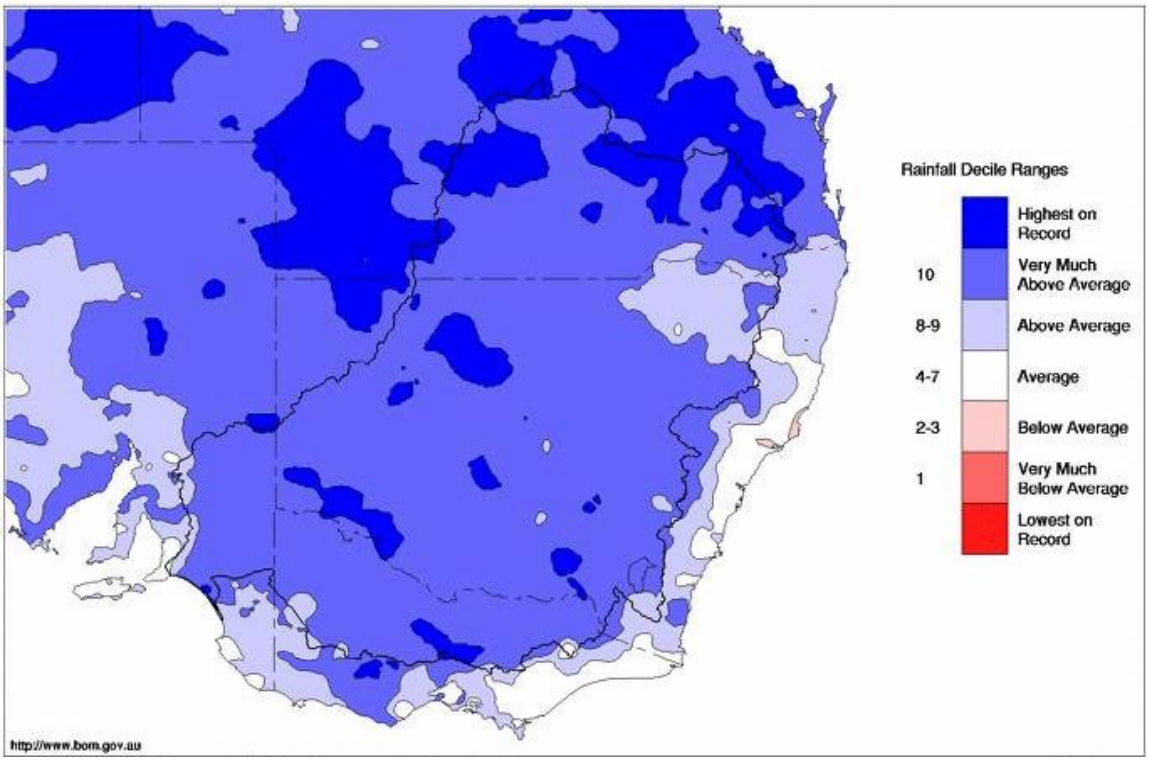
Demonstrating the variability of Australia's climate, the turnaround from drought to flood began in July 2010, when good rain across much of the Basin throughout winter, spring and into summer shifted conditions from dry to very wet — with flooding in many Basin rivers, including the upper Murray, Murrumbidgee, Macquarie, Queanbeyan, Castlereagh and Namoi rivers in New South Wales, and the Ovens, Kiewa, Campaspe, Loddon and Goulburn catchments in Victoria. High flows were also experienced along the Weir, Moonie and Warrego rivers and, at the end of the year, very large floods returned to southern Queensland, with the Condamine and Balonne rivers and some of their tributaries affected.

According to the Bureau of Meteorology, 2010 was the Murray–Darling Basin's wettest year on record (see maps 1 and 2). Rainfall was very much above average over most of the Basin during the year, with some areas recording their highest annual totals on record. For example, Surat in south-western Queensland recorded 1,127 millimetres of rainfall compared with its long-term average of 571 mm; Orange in central New South Wales recorded 1,592 mm, compared to its long-term average of 936 mm; and the annual total at Mildura in north-western Victoria was 597 mm, about twice its long-term average of 286 mm.

By the end of December 2010, water storages across the Murray–Darling Basin were at 82% capacity, with most at full capacity. Storage in Hume Reservoir on the River Murray near Albury, New South Wales was at 100% (3,005 GL), with the dam spilling to pass the high inflows. The Menindee Lakes on the Darling River in New South Wales were also at 100% capacity, with water being released to manage further expected high inflows in early 2011. Dartmouth Dam on the Mitta Mitta River in Victoria, with a capacity of 3,856 GL (the largest storage in the Basin), had increased its storage from 31% to 56% since January 2010; the comparatively smaller increase, despite the wet conditions, due to its substantial volume relative to its catchment area. When full, Dartmouth Dam can hold five years of average inflows.



Map 1 Rainfall in the Murray–Darling Basin, 1 January to 31 December 2009 (image courtesy of the Australian Bureau of Meteorology)



Map 2 Rainfall in the Murray–Darling Basin, 1 January to 31 December 2010 (image courtesy of the Australian Bureau of Meteorology)

Lower Lakes — flush with improved health

The impact of flooding in the northern and southern parts of the Basin was felt at the Murray Mouth by early August 2010, with Lake Alexandrina above sea level for the first time in three years. Continued high inflows enabled some water to be released from the Lower Lakes to the Coorong by early September. By the middle of October, both lakes Alexandrina and Albert had reached their full supply level, allowing water to be released through the Goolwa barrages into the estuarine Coorong and out the Murray Mouth every day — flushing out saline water and improving water quality in the Lower Lakes.

By December, dredging at the Murray Mouth to keep water flowing to the sea had stopped for the first time in eight years.

Flooding provides life to the plains

When dry floodplains are inundated, a series of events are triggered. Wetting dry soil releases a surge of nutrients. Within hours of wetting, the floodplains are swarming with tiny aquatic animals, many of them microscopic, which have lain dormant in the soil since the previous flood.

Within days, larger creatures, such as midge larvae, appear to feed on the small creatures and decaying organic matter. In turn, these larger creatures provide food for bigger animals such as waterbirds that flock, often in their thousands, to the wetlands to breed. Isolated patches of water are reconnected with each other and with their parent rivers, joining habitats and creating breeding opportunities for fish and other aquatic species.

In the northern Basin, the floods of 2010 have brought significant environmental benefits for floodplain plants and animals. In May 2010 ,bird surveys of the Narran Lakes area recorded 39,000 grey teal (*Anas gracilis*), 4,500 whistling ducks (*Dendocygna arcuata*), 6,200 Australian wood ducks (*Chenonetta jubata*), 600 Pacific black ducks (*Anas superciliosa*) and 500 hardhead (*Aythya australis*), along with many nesting black swans (*Cygnus atratus*). At Lake Wyara in the upper Paroo catchment 21,000 pelicans (*Pelecanus conspicillatus*) were observed, most of which were nesting.

Thousands of whistling ducks, grey teal and other species were recorded throughout the Darling wetlands upstream of the Louth–Tilpa road. About 500 straw-necked ibis (*Threskiornis spinicollis*) were nesting on a lignum swamp at Toorale on the lower reaches of the Warrego River.

Blackwater fish deaths, a side effect

While flooding has brought enormous environmental benefits to thirsty wetlands and floodplains across the Murray–Darling Basin, it has also had its downside. Blackwater events in the Murray–Darling system have resulted in depleted dissolved oxygen in river waters causing Murray crayfish (*Euastacus armatus*) to leave their homes and resulting in small and large-scale fish deaths in many river reaches.

Blackwater events occur when widespread flooding washes large amounts of organic material, such as leaf litter accumulated from years of drought, into rivers. The breakdown of leaf litter plays an important ecological role because it transfers nutrients back into the river system, promoting the growth of many aquatic organisms. However, the process can result in very low dissolved oxygen levels, which causes fish deaths as well as water discolouration.

In the southern Basin, internationally-recognised sites such as the Barmah–Millewa Forest have received a welcome dousing — the first sustained flooding for a decade — the effects of which are being seen in the vigorous growth of river red gums (*Eucalyptus camaldulensis*) and the appearance of thousands of waterbirds, including endangered species such as the great egret (*Ardea alba*) and intermediate egret (*Egretta intermedia*), which are now nesting in the flooded forest wetlands.

A flooding Darling River, January 2010 (photo by Denise Fowler © MDBA)

The cycles of wet and dry continue to influence the environment and people of the Murray–Darling Basin. The past 12 months have seen a dramatic change in the Murray–Darling Basin environment, from record drought to widespread flooding. The impact of these floods on communities throughout the country has been devastating, reminding us how unpredictable the environment can be and that, with only 119 years of written records, how much we still have to learn about the Basin and its complex systems and requirements.

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