Summary

For the past century, the Murray–Darling Basin (the Basin) has been developed with a focus on delivering water for productive use. Large dams have been built to capture and store as much water as possible to be used later for consumption and irrigation. There have also been many rules put in place across the Basin around how the rivers and dams are managed.

These structures and practices are of great benefit to our industries and have greatly supported the building of our nation, our Basin communities and our economy. However, the changes we have made have affected how, when and where the Basin's rivers flow and how healthy they are. Water that once flowed downstream is now often stored, and delivered in regular patterns at times that suits production, not necessarily in a more natural variable way that most benefits and supports the environment. Only when dams are full and spill over are there any significant overbank flows downstream.

For many floodplain areas of the Basin, the time between drinks is now too long for floodplain plants and animals. Small overbank flows that connect the river to its floodplain are vital to the environment. These overbank flows improve water and soil quality, recharge groundwater, and support native plant and animal species. Before rivers were regulated, these flows were far more common. The lack of these flows is affecting long-term river and floodplain health, and ultimately Basin communities and businesses that rely on healthy waterways.

Environmental watering has been successfully done for many years in some parts of the Basin, and is one way we can deliver water to benefit the environment. However, there would be many environmental benefits if we could deliver slightly higher flows in the future (mostly up to minor flood level) to reach the floodplains. So, the Basin governments requested that the Basin Plan include a Constraints Management Strategy (the Strategy) to explore how this might be done.

The Constraints Management Strategy

The Strategy is about ensuring that water can flow onto the floodplain, while mitigating any effects this water may have on property and people.

For the purpose of the Strategy, constraints are river rules, practices and structures that restrict or limit the volume and/or timing of regulated water delivery through the river system. Implementing the Strategy will support governments to operate our highly regulated rivers in smarter ways to increase the frequency and duration of small overbank flows to sustain and improve floodplain health.

Given consumption and irrigation needs, it is not possible, nor is it the goal, to return regulated rivers to their ‘natural’ or ‘without development’ flows. The Strategy is also not trying to create or change how often damaging moderate and major floods occur. The idea is to make modest regulated releases from storages, generally when higher flows downstream would have occurred if dams were not there. That is, the small overbank flows being proposed will ‘top-up’ natural rainfall or unregulated tributary flows, to increase either their peak or duration.

In 2014, we completed the first phase of work — the prefeasibility phase — which involved looking at seven areas of the Basin in more detail. The Murray–Darling Basin Authority (MDBA)
collected information about how small overbank flows, typically up to around minor flood level, affect the environment and people who live and work along this section of the River Murray. We also collected information about how such flows can be managed, and what sorts of protective measures are needed first.

This report about plans for the Hume Dam to Yarrawonga Weir reach was released for public comment in November 2014. Since then, we have continued discussing constraints with the communities that might be affected by any changes. This final version contains some updated information on the decisions made by Basin Governments in late 2014 and the next steps.

Hume Dam to Yarrawonga Weir reach

The Hume Dam to Yarrawonga Weir reach is one of seven areas of the Basin that MDBA is studying for the Strategy.

The Hume–Yarrawonga focus area covers the River Murray channel and associated anabranches between Hume Dam and Yarrawonga Weir. This region is close to the headwaters of the Murray with rainfall and some snowmelt contributing the main inflows in the winter period. This part of the River Murray is a meandering system with a multi-branched channel and a well-defined floodplain. The movement of anabranches across the floodplain has created a number of billabongs that are connected to the river at various flow heights.

Hume Dam and Yarrawonga Weir have dramatically changed the flow regime of the River Murray. Before regulation, the Hume–Yarrawonga stretch of the Murray would have experienced peak flows in winter and early spring, and low flows during the summer period. Hume Dam now captures winter and spring flows, with releases peaking in summer and autumn to support irrigation both locally, via the Mulwala and Yarrawonga irrigation channel system, and further downstream.

Regulated releases from Hume Dam to meet downstream demand have been restricted to 25,000 ML/day at Doctors Point since the 1990s, limiting the environmental benefits of the flows. Increasing the regulated release limit at Doctors Point will water vegetation within the Hume–Yarrawonga reach and contribute to significant benefits downstream.

We are investigating the potential to increase the regulated flow limit in the Hume–Yarrawonga reach of the river from 25,000 ML/day to 40,000 ML/day as measured at the Doctors Point gauge a few kilometres downstream of Hume Dam. Computer modelling shows that achieving flows in this range would allow for greater flows into the lower reaches of the River Murray. A flow of 40,000 ML/day at Doctors Point could be regulated to supplement flows from the Ovens River to contribute to a bigger peak flow downstream of Lake Mulwala.

The community

This reach report reflects MDBA’s current knowledge base after preliminary technical work and after talking with people along the Hume–Yarrawonga reach for a number of years.

Through the 1990s and 2000s, the Murray–Darling Basin Commission (now MDBA) worked with landholders to obtain the right to release 25,000 ML/day from Hume Dam. This involved purchasing landholder easements to enable these flows, upgrading some affected infrastructure and implementing a number of programs to promote river health.
Landholders are keen to be involved in the progression of the Strategy in the reach. MDBA has indicated to landholders that 40,000 ML/day as measured at Doctors Point will be the upper limit for flows to be investigated. Landholders highlight that the effects of such flows could be severe, particularly for landholders with smaller holdings dominated by low-lying land. Landholders also fear that an unexpected natural flow event following a regulated flow event could cause unacceptable levels of risk to livestock, as they could become stranded for prolonged periods. In this case livestock may need to be made to swim long distances to higher ground — a stressful and risky proposition.

Landholders also feel that there is not adequate information available for them to decide whether the regulated limit for environmental flows could be increased (with mitigation measures), and are seeking clarity on the following:

- proposed timing and duration of flows
- an understanding of how flood risk will be managed to ensure a regulated environmental flow event is not followed by a natural flood
- aerial photography and ground survey of an actual event to verify flood extents.

Landholders are open to further discussions of mitigation and compensation measures.

Councils in the region have also been consulted about increasing flows to 40,000 ML/day at Doctors Point. Flows of 25,000–40,000 ML/day at Doctors Point inundate some low-lying recreational areas in the Albury City and Corowa council areas.

**Next steps**

This is the start of a 10-year process. Basin governments are only at the early stages of finding out what the issues and opportunities are, to support future decision-making.

This reach report:

- provides a context and background to MDBA work on constraints, which seeks increased flexibility to connect rivers with their floodplains, as part of the implementation of the Basin Plan outlines the types of changes needed to achieve the river flows being investigated
- reports on community feedback and reaction to possible changes to managed river flows.

The MDBA released the reach reports for all seven regions on our website through October–December 2014. Discussions with community on these reports continued until March 2015 to add to our knowledge base and refine our understanding of what flows mean for communities.

Information from all seven priority areas of the Basin was included in the annual report, which made recommendations to Basin governments about options for further investigations. The annual report was made available on the MDBA website in late 2014.

In late 2014, Ministers decided to continue investigations in all of the seven priority areas. Further to this, Basin governments refined the flow limits that should be considered in future investigations.

The work in the Hume–Yarrawonga reach is more advanced than in many of the other reaches, with a long history of consulting with landholders on the likely effects of proposed flows. Based
on the extent of previous work, there may be the potential to accelerate the feasibility work in this reach. A decision to proceed with additional investigations is likely to be welcomed by the community, who have been living with uncertainty around these flows for many years.

Any further work will depend on the decisions of Basin governments. The first decision, in 2014, was about whether to proceed with collecting more information including technical and community studies to better understand the feasibility of overbank flows and the mitigation measures needed for delivering the proposed flows. The 2014 decision was not a green light to build, do or change anything about how the river is managed.

The second decision, in 2016, is about whether to start putting mitigation measures in place, based on recommendations from the feasibility studies. Actions would happen between 2016 and 2024 to ensure mitigation measures are in place — such as formal arrangements with landholders, rule or management practice changes, asset protection and infrastructure upgrades — before any managed overbank flows are delivered.
What is the Constraints Management Strategy?

The Constraints Management Strategy looks at ways to allow rivers to connect to their floodplains more often to improve and maintain the environment, while avoiding, managing or mitigating effects on local communities and industries.

In a river, ‘constraints’ are the things that stop water from reaching some areas.

The constraints can be:

- physical structures, such as bridges, roads or outlet works
- river management practices.

The Constraints Management Strategy (the Strategy) is about ensuring that we can use environmental water to best benefit our rivers — and the environments and communities they support — to make sure they stay healthy and sustainable.

By carefully managing constraints, we can ensure that water continues to sustain our vital river environments and communities, both now and in the future.

What areas are being looked at

The Strategy is looking at seven areas of the Murray–Darling Basin (the Basin) (Figure 1). These areas were chosen because we are likely to get the best environmental benefits by changing constraints to increase regulated flows in these areas. The areas are:

- Hume to Yarrawonga
- Yarrawonga to Wakool Junction
- Goulburn
- Murrumbidgee
- Lower Darling
- River Murray in South Australia
- Gwydir region.
Figure 1: Areas in the Murray–Darling Basin affected by the Constraints Management Strategy
What could change

**Current situation:**

- The current regulated operation of the river system provides flows within a range that is largely governed by irrigation requirements and minimum flow provisions.
- Irrigation requirements generally follow crop demand patterns and do not vary significantly during the summer irrigation season.
- Rivers are operated to maximise water availability for consumptive use and to limit evaporation losses on floodplains.
- Releases from storages resulting in overbank flows are a consequence of managing storages when they are close to full or spilling over, rather than to meet environmental objectives.

Over time, such operations have led to a substantial decline in floodplain health across the Basin. The Strategy is about identifying and enabling smarter ways to manage rivers so that water availability is still maximised and damage from large floods is limited, but also so that some of the smaller overbank flows that are essential for floodplain health are reinstated.

The environment is a relatively new ‘customer’ for regulated water delivery and has different water requirements — including timing and amounts — compared to crops. This is why the Murray–Darling Basin Authority (MDBA) is trying to determine if there are ways to increase flexibility in the range of regulated flows that can be delivered to meet the needs of this new customer.

**Possible future situation:**

- Flows from unregulated tributaries may be topped up with regulated releases from storages. Together, these sources of water would combine to become a flow of sufficient size to result in small overbank flows downstream.
- Small overbank flows are designed to reach particular parts of the floodplain to achieve specific ecological outcomes.

The ability to do this relies on river managers having hydrological information that is accurate enough to enable them to plan, with confidence, when and when not to make regulated releases. It also relies on governments being able to understand and mitigate any impacts on private land and community assets along the entire flow path.

Mitigation measures must be in place before regulated overbank flows can be delivered. These include formal arrangements with landholders, rule or management practice changes, asset protection, and infrastructure upgrades. The Strategy is focusing on these types of activities during the next decade.

It is important to note that the Strategy should not increase how often damaging moderate and major floods occur. The Strategy is about delivering increased flows, which are still less than the minor flood level at Albury (see ‘Small overbank flows’), but that may cause negative effects for riparian landholders.
Small overbank flows

In unregulated river systems, small overbank flows occur frequently, wetting the floodplain areas around the river.

The changes being investigated in the Constraints Management Strategy aim to increase the frequency and duration of some of the small overbank flows, allowing water to reach particular parts of the landscape that haven’t been getting water as often as they need, such as creeks, billabongs and floodplain vegetation.

The flows being investigated are generally below or at the level defined as a ‘minor flood’ by the Bureau of Meteorology. Bureau of Meteorology flood warnings fall into three categories — minor, moderate and major. The official definition of a minor flood is a flow that causes inconvenience. Low-lying areas next to rivers and creeks start to get wet, requiring the removal of stock and equipment. Flows of a longer duration may also begin to kill or affect the health of pasture species. Minor roads may be closed and low-level bridges and crossings submerged.

The Strategy is about delivering small overbank flows, which are below flood levels that are damaging (Figure 2).

Note: The descriptions of minor, moderate and major floods are the official definitions from the Bureau of Meteorology.¹

Figure 2: The effects of minor floods compared with moderate and major floods

The small overbank flows would be created by ‘topping up’ unregulated tributary flows with releases from storage to increase the peak or duration of a flow event, and so reinstate some of the flows that have been intercepted and stored by dams.

Although classified at around minor flood level, the Murray–Darling Basin Authority understands that some of the flows under investigation by the Constraints Management Strategy will affect businesses and the community, and that these effects need to be mitigated before flows are allowed to pass.

Background to the Strategy

The Strategy was developed in 2013 through technical assessments and many conversations with local communities and industries. It incorporated community views and suggestions from a public comment period in October 2013 (see ‘What does the community think?’ and the Constraints Management Strategy public feedback report\(^2\)).

The Strategy is part of the implementation of the Murray–Darling Basin Plan.

The Australian Government has committed $200 million to carry out approved mitigation works that are identified as priorities by the Basin states in the next 10 years from 2016.

Why is the Strategy important?

Connecting rivers to their floodplains sustains the local environment and provides benefits to communities, such as improved soil and water quality. River development and regulation have reduced the overbank flows that provide this connection. The Constraints Management Strategy (the Strategy) aims to enable governments to put back some water to the environment where it is most needed to boost riverine productivity, and increase health and resilience.

The flow regime in the Hume–Yarrawonga reach of the Murray has been altered significantly since the development of the Hume Dam. Delivering higher, more seasonal flows in this reach of the river will have significant benefits for the in-reach and downstream environment of the River Murray.

In unregulated river systems, there are no constraints to overbank flows caused by high rainfall and catchment run-off, which periodically spread out across the floodplain and reach floodplain creeks, wetlands and billabongs.

In regulated river systems, dams and weirs harvest and control high rainfall events, significantly reducing the flow down river (Figure 3).

Figure 3: Rivers with pre-regulation and post-regulation flow
This affects the behaviour of the river downstream. It reduces the height and duration of small overbank flows, and increases the time between overbank flows (Figure 4).

![Figure 4: Changes to a river’s hydrology after river regulation (hypothetical flow curve used to demonstrate concept)](image)

Regulated releases from storage are mostly restricted to in-channel flows (Figure 5). This reduces the water that reaches particular parts of the landscape — most notably the floodplain and its creek network, wetlands and billabongs. River water stimulates the ecology of many plant and animal species, and without flows to trigger a range of ecological processes (feeding, breeding, moving), both the diversity of species and their individual numbers have declined.

![Figure 5: Regulated releases from storage are mostly restricted to in-channel flows](image)
In the Murray–Darling Basin

The Murray–Darling Basin (the Basin) has become highly regulated. In 1891, the construction of Goulburn Weir near Nagambie, Victoria, marked the beginning of almost a century of construction of major assets to support irrigation in the Basin.

By the time Dartmouth Dam was completed in 1979, enough dams had been built across the Basin to store more than one year’s average inflow. The large dams in the southern Basin — Burrinjuck, Blowering, Hume, Dartmouth and Eildon — were all sited at locations where they could capture and store as much inflow as possible.

These dams typically fill through winter and spring, and are subsequently drawn down through summer and autumn to support large-scale irrigation.

In the southern Basin, where 80% of the Basin irrigation occurs, the combination of dam construction and irrigation changed the rivers from winter–spring flowing to summer–autumn flowing and, in the process, eliminated most small flood events.

With Australia’s highly variable rainfall and heavy irrigation use, it became quite common from winter–spring rain events to be almost fully captured in storages. Significant overbank flows only happen now when the major storages have filled and, subsequently, spill. Thus, only the wettest 15% of years now result in significant overbank flows in the middle to lower Murray. Before development, such flows would have occurred in almost 50% of years.

The impact on floodplain species has been dramatic, with large areas of floodplain forests and woodlands dead or highly stressed.

Connecting rivers to their floodplains

Small overbank flows, which are being considered by the Strategy, are vital to the environment.

Overbank flows:

- **improve water quality and groundwater supplies**, by
  - flushing out the salt along river banks and floodplains
  - helping recharge groundwater supplies
- **improve soil quality**, by
  - moving carbon and nutrients between rivers and floodplains
  - stabilising the river banks through increased vegetation cover
- **support native species**, by
  - triggering plants to seed or germinate — for example, river red gums need flooding for their seeds to germinate
  - supporting habitat and breeding of aquatic bugs and insects (the primary source of the river food chain)
  - stimulating animals like native fish to feed and breed — for example, golden perch need pulses at the right time to spawn and floodplains make great nursery habitats for young fish
  - allowing plants and animals to move throughout river systems and colonise new areas.
Before river areas were developed, small to medium flows were common events. River species have therefore evolved to depend on this pattern, and different species respond to different water levels (Figure 6).

The proposed overbank flows will usually ‘top-up’ existing flows, increasing either their peak (river height) or duration (Figure 7).

Flows are important for many environmental processes, such as breeding and migration, and many species use weather conditions as triggers in anticipation of a large flow. Coordinating regulated water releases with rainfall events and catchment run-off makes use of natural ecological cues to improve environmental outcomes.
Why the Strategy is important in the Hume–Yarrawonga reach

Over time, there have been significant changes to flows in the Hume–Yarrawonga reach of the river. With the construction of Hume Dam for irrigation, the seasonality of flows in the river has changed dramatically from winter–spring dominant flow to summer–autumn. Implementation of the Strategy will allow the delivery of slightly larger flows that can be delivered when the river needs it — both within the Hume–Yarrawonga reach and downstream locations.
What is happening in the Hume–Yarrawonga reach?

Regulated flows to meet downstream demands in the Hume–Yarrawonga reach are currently restricted to 25,000 ML/day at Doctors Point. This restriction limits the amount of water that can be delivered from Hume Dam to contribute to downstream environmental outcomes. Given the large size of Hume Dam, altering this rule to allow a larger flow will be critical in using environmental water to the greatest benefit downstream. Releasing higher flows at seasonally appropriate times will also benefit the many billabongs and wetlands in the Hume–Yarrawonga reach of the Murray.

Flow footprints have been developed for flows up to 40,000 ML/day at Doctors Point.

Reach characteristics

The Hume to Yarrawonga reach refers to the River Murray channel and associated anabranches between Hume Dam and Yarrawonga Weir (Figure 8). This region is close to the headwaters of the Murray, with snowmelt a relatively small contributor to Hume Dam inflows. It is a multi-branched channel with a well-defined floodplain. The anabranches historically moved across the floodplain as a result of natural erosive processes, creating a number of billabongs that are connected to the river at various flow heights (Thoms et al. 2000).

The major tributaries that contribute to flows in this reach are the Kiewa River and Ovens River (Figure 8). Other minor contributions are made from Indigo Creek and Black Dog Creek in this reach of the Murray. None of these tributaries are regulated, so regulated releases from the Hume Dam need to take into account additional flows that originate from within the reach.
People and economy

Albury, with its twin Victorian city Wodonga, is the largest regional centre in the Hume–Yarrawonga reach with a population of just over 100,000 people. Additional townships located on the River Murray in this reach include Corowa (5,600), Mulwala (1,900) and Howlong (2,600) on the New South Wales side of the river, and Wahgunya (800) and Yarrawonga (6000) on the Victorian side. The Wiradjuri, Dhudhuuroa, Yorta Yorta, Bangerang and Waywurru people are the Traditional Owners of the land in this stretch of the river.

Albury serves as the regional centre for all surrounding agricultural districts. It also has a burgeoning tourism industry, with nearby small towns such as Rutherglen attracting wine enthusiasts. In summer, people flock to the region for water sports such as boating and waterskiing. Albury also has a small manufacturing industry, including a newsprint paper mill, an automotive parts manufacturer and a processing centre for the Australian Taxation Office.

Riparian landholders in this reach of the River Murray are predominantly cattle graziers that practice opportunistic cropping. They often have a mixture of native and improved pastures, with the latter usually located on higher ground.

Environment

The reach of the River Murray between Hume Dam and Yarrawonga Weir is characterised by a complex network of anabranches along a 50-metre-wide main stem. There is an almost-
continuous line of riparian vegetation along the main channel that is predominantly made-up of river red gums along both banks. The reach also contains more than 700 wetlands.

Overbank flows that inundate private and public land occur when flows approach 25,000 ML/day at Doctors Point, which is just downstream of the Kiewa River confluence, upstream of Albury/Wodonga. Modelling has demonstrated the benefits to both local and downstream flood-dependent ecosystems that arise from increasing the regulated flow limit at Doctors Point to 40,000 ML/day (MDBA 2012a).

There are also two nationally listed wetlands in this reach: Ryans Lagoon, downstream of Lake Hume; and another wetland at the junction of the Ovens and Murray in the upper reaches of Lake Mulwala. Although the latter relies largely on flows from the Ovens, and thus not likely to benefit from increased flows, the flows should have benefits for Ryans Lagoon.

Ryans Lagoon has been identified as ecologically important due to its diversity of species, from macroinvertebrates to birds that use it for breeding, including species such as the Australian white ibis, eastern great egret, rufus night heron, black swan, grey teal and black-fronted dotterel (DNRE 1995). Although Ryans Lagoon has been affected by flow changes, land clearing and grazing, it is still a good representation of riverine billabongs in the Hume–Yarrawonga reach (DNRE 1995).

Much of the native understorey vegetation, which would have been a shrub layer with an understorey of native grasses and sedges, has disappeared from the river red gum woodland. This vegetation community in the Hume–Yarrawonga stretch is in fairly poor condition, with much of the riverbank vegetation cleared or grazed. River regulation has concentrated flows to high, in-channel flows, rather than more variable low flows or high flows that would spill onto the floodplain (Erskine et al. 1993). This practice has increased the power of the water to erode by up to three times more than what it would have been before river regulation. This has had a significant impact on bank stability and on bank vegetation persistence (Erskine et al. 1993).

The Snowy Mountains Hydro-electric Scheme has also exacerbated the effects of regulation. The scheme was completed in 1972 for the purposes of generating electricity and providing additional irrigation water to the west. Construction of the scheme means that, on average, an extra 620 GL per year of water is diverted from the Snowy River and directed into Hume Dam, increasing the amount of water that passes between Hume Dam and Yarrawonga Weir as regulated flows.

Historic clearing and grazing of the riparian zone has also contributed to erosion in the reach. In the 1970s, extensive works were undertaken to remove dead woody debris from this stretch of the river with the aim of improving flow efficiency. During the past decade, extensive re-snagging works have been undertaken to restore fish habitat.

How the Hume–Yarrawonga reach is managed

Hume Dam on the River Murray near Albury has a capacity of around 3,000 GL. Construction of the Hume Dam commenced in 1919, with the first stage of construction completed in 1936. The size of the storage was increased from 1,522 GL to 1,800 GL in 1949, to 2,460 GL in 1958 and to around 3,000 GL in 1961. Water is released from the dam for consumptive and environmental needs, and is gauged at Heywood Bridge immediately downstream of the dam. It is also gauged
at Doctors Point, which picks up the flow in both the Murray and Kiewa about 6 km downstream of the dam.

Dartmouth Dam on the Mitta Mitta River also has an influence on the management of the Hume Dam. Dartmouth Dam is the tallest dam in Australia (180 m) and the largest storage in the Murray–Darling Basin (around 3,850 GL). The dam was commissioned in 1979 and serves mainly as a drought storage. Nearly 10% of the inflows to the River Murray system are generated above Dartmouth Dam, which regulates around 87% of the inflows. Given Dartmouth’s storage capacity, of about five times its average annual inflow, it does not experience uncontrolled spills very often. The Mitta Mitta River joins the River Murray upstream of Hume Dam, so the dams are operated ‘in harmony’ with rules in place to maximise both the water stored and to minimise flood risk downstream.

Yarrawonga Weir is located about 237 km downstream of Hume Dam. Completed in 1939, the primary purpose of the weir is to create enough hydraulic head to allow water to be diverted by gravity for irrigation via Mulwala Canal in New South Wales, and Yarrawonga Main Channel to Victoria.

Releases from Hume Dam, under normal operations, are limited to up to 25,000 ML/day at Doctors Point, with releases largely driven by irrigation demand. During summer, releases have historically been close to channel capacity for long periods before declining in autumn when irrigation demand drops. Hume Dam captures most inflows in winter and spring; however, a minimum flow requirement of 1,200 ML/day at Doctors Point provides sufficient flow to meet some in stream and riparian environmental needs through winter. This flow would have often been well below the natural, unregulated amount that would have passed through, so is unlikely to meet all environmental requirements for the reach.

The main constraint to increasing the regulated flow limit is the threat to local landholders, who have private property inundated at flows of more than 25,000 ML/day. Accessibility is also an issue, as rising water inundates low-lying land and cuts off areas of higher ground on some properties.

How the Hume–Yarrawonga reach has changed

Major diversions for irrigation from Yarrawonga have significantly reduced the annual flow volume and altered the seasonality of flows downstream (Thoms et al. 2000). Conversely, annual average flow at Albury has increased due to Snowy Scheme transfers (Thoms et al. 2000).

Other effects of the changed flow regime include (Thoms et al. 2000):

- lower surface water temperatures due to releases from deep offtakes in the dam
- impacts of prolonged inundation on low-lying wetlands that would naturally dry out in autumn
- an overall decrease in flow variability caused by the capture of flows
- rain rejection events (times when ordered irrigation water is not used because of rainfall) that have caused unseasonal flooding of important environmental assets, such as the Barmah–Millewa Forest.

Further, the current flow rate is not enough to effectively water wetlands and water-dependent ecosystems both within the reach and to the river downstream. Having the flexibility to deliver
higher regulated flows from Hume Dam will contribute to higher flows along the whole length of the Murray.

### Establishing the right to release 25,000 ML/day

Understanding how the right to release 25,000 ML/day was established provides important background for the Hume–Yarrawonga reach, as well as useful insight for progressing constraint work in the other key focus areas.

The Hume and Dartmouth Dam Operation Review of 1999 followed the emergency release required during the floods of 1996. This review found that adverse effects for landholders had occurred as a result of regulated flows, and that these should be addressed. This recommendation was supported by the Murray–Darling Basin Commission, which wished to confirm its right to make regulated releases of up to 25,000 ML/day.

A process was established to confirm the right of the Commission to release 25,000 ML/day as measured at Doctors Point. The process involved:

- surveying landholders to
  - identify the impacts of full regulated flow
  - map extent onto aerial photographs
  - estimate areas impacted via mapping
- confirming the area affected with landholders.

The process was agreed to and supported by a reference group that included representatives of the Commission, landholders, irrigators and experts (water policy, agriculture, land valuation).

The guidelines for establishing an agreement were set by the Commission and included the need to establish lasting, voluntary agreements; recognise erosion issues; be forward looking; and make landholder agreements voluntary.

The reference group considered a range of mechanisms for establishing the right to release, with acquisition of easements as the preferred method compared to covenants or property purchase.

The process was delivered according to a set of agreed principles that were transparent and robust, and a consistent approach was used for development of all landholder easements based on disaggregated land worth, and the type and degree of impact compared with pre-managed flow conditions.

Of the 103 landholders affected, 93 offers were made and 85 landholders accepted. A complementary riparian management program was also implemented to reduce erosion effects in the reach.
The tools we used to understand constraints

The Murray–Darling Basin Authority (MDBA) is examining and developing an understanding of river processes and their effects using the best available quantitative data and modelling tools.

We used computer modelling to show the difference in flows that would have occurred in the Hume–Yarrawonga reach of the River Murray if water was not stored in dams. This gives an idea on the type of changes that have occurred by comparing modelled natural conditions with current practice. For the Hume–Yarrawonga reach, we have modelled different scenarios to show the difference in the flow rates at Doctors Point. The two scenarios shown here are:

- if no dams or infrastructure existed (modelled natural conditions)
- with the current dam infrastructure in place, but without the Basin Plan (current conditions).

The modelling was based on 114 years of flow data and shows the number of events under the different scenarios. Regulated environmental flows will usually be delivered during winter–spring (June–November) to reflect what would have occurred naturally.

The hydrograph in Figure 9 shows the modelled flow patterns for what would have happened during the past 114 years under natural conditions and current conditions for flows of 20,000–25,000 ML/day at Doctors Point.

![Figure 9: Timing of flows of 20,000–25,000 ML/day for ‘modelled natural conditions’ and ‘current’ conditions](image)

Figure 9 shows that, under baseline conditions, flows of 20,000–25,000 ML/day at Doctors Point happen far more often and at a different time of the year to how a natural flow would occur under ‘without development’ conditions.
In comparison, Figure 10 shows the flow patterns for what would have happened during the past 114 years under modelled natural conditions and current conditions for flows between 26,000–40,000 ML/day at Doctors Point (i.e. above the current regulated release limit).

Figure 10 shows that flows of 26,000–40,000 ML/day only now occur when associated with a dam spill, which may not always be when you would want these flows to get the maximum benefit for the environment.

Figure 11 shows flows in the range of 40,000–80,000 ML/day. Like the flows in Figure 10, these flows only occur when the dam spills. In the past they would have occurred in about 50% of years, but now happen about half as often, but still at similar times to when they would have naturally occurred. Although MDBA will not ever attempt to create flows of this size, it is important to note that such high flows were reasonably common in the past, and the floodplain environment has evolved with such flows.
‘Flow footprint’ maps let you look at what areas of land are likely to get wet for different-sized flow rates. They are based on hydraulic models that approximate how water moves down the river and across the landscape. The advantage of using a hydraulic model compared with aerial or satellite images is that it produces depth information and a good approximation of how a ‘typical’ flow might spread across the landscape. As no two flow events are alike, the model cannot account for all conditions that might occur before or during a flow event that could affect the inundation extent. It can only account for the modelled parameters for various factors, such as whether the catchment is dry or wet before the flows. Flow and inundation relationships are also inconsistent, as flows and floods can shape and change the river and its floodplain over time.

The hydraulic modelling approach to creating flow footprints is designed to answer two questions:

- How high does the river get for any given flow at that point along the river?
- What gets wet at that height?

Hume–Yarrawonga reach modelling

In 2006, the Murray–Darling Basin Commission (now MDBA) engaged the contractors DHI Water & Environment, and Hassall & Associates to develop flow footprint maps for flows between 25,000 and 50,000 ML/day, and examine their effects on properties in the Hume Dam and Yarrawonga reach. As a result of this work, flow footprint maps were produced at 5,000 ML/day increments from 30,000 to 50,000 ML/day. Maps were then validated against previous flood events captured in aerial photography. In those cases where a mismatch occurred, the model was modified to reflect the actual event. Flow footprint maps were subsequently overlaid with property boundaries to determine the extent of inundation for each property within the reach. An inundation map, showing the effects of a 40,000 ML/day flow on their property, was provided to affected landholders.
Figure 12 shows the 40,000 ML/day flow inundation footprint for the reach that was used to generate the maps for the affected properties. Given the extensive validation process, a high degree of confidence in the data was achieved. Many landholders, however, still feel that the inundation extent is an underestimate and, consequently, not fit for purpose at a property scale. Landholders have requested that aerial photography and on-ground survey to be obtained when a suitable event occurs to confirm the inundation extent.
Figure 12: Inundation mapping for flows of 40,000 ML/day at Doctors Point on the River Murray from below Hume Dam to Yarrawonga Weir
In 2013, Corowa and Albury City councils requested that additional flow footprint mapping be developed to provide confidence that infrastructure in the riverside towns of Corowa, Howlong, Mulwala and Albury would not be affected by flows of 40,000 ML/day. This mapping was completed and presented to the two councils in July 2014.

Consultation on the mapping undertaken by MDBA in 2014 to better understand the impact on local towns suggests that some low-lying areas used for recreational purposes in Albury and Corowa may become inundated more frequently at flows between 25,000 and 40,000 ML/day. Several businesses may also become inaccessible more often should the frequency of flows in this range increase. Although these areas are typically affected by flows most years under current conditions, future development in these areas will need to consider the potential for increased frequency and duration of inundation. Additional consultation with the councils and other potentially affected stakeholders will be necessary to further develop our understanding of potential impacts.

How MDBA has used the flow footprint maps

MDBA has used the flow footprint maps to determine how flows would affect native vegetation and wetlands on the floodplain, as well as agricultural land use, and roads, bridges and other structures.

By identifying what might be affected at different flow levels, we are also able to identify potential mitigation measures and their associated cost. Mitigation measures in this reach that we have developed cost estimates for are:

- easements, or other arrangements, to allow flows on private land
- infrastructure works — for example, upgrades to roads and bridges, including bridges and crossings on private properties.

These cost estimates will be presented in the Constraints Management Strategy annual report, which will be available in late 2014.

It is important to note that mapping to date has not produced an inundation extent that reflects potential contributions of the unregulated Ovens River, near Lake Mulwala. The implications of backwater effects for a regulated release that coincides with substantial flows in the Ovens River also need to be assessed.
What flows are being considered for the Hume–Yarrawonga reach?

Flows of 40,000 ML/day at Doctors Point are being considered for the Hume–Yarrawonga reach. Figure 13 shows the flow events in the Hume–Yarrawonga reach from 1970 to 2014.

As Figure 13 shows, flows of 40,000 ML/day already happen without regulated contributions every few years. However, attaining the right to deliver flows of 40,000 ML/day will mean that water can be released when it is seasonally appropriate (June–November) and when it can be coordinated with other flows to get the greatest benefit from the water available, both within this reach and for the river downstream. Being able to deliver the water when we need to also means that the duration of flow events in the 25,000–40,000ML/day window will be longer, providing greater environmental benefit downstream.
How these flows have been chosen

The local story
The question around increasing flows in the Hume–Yarrawonga reach of the Murray has a long history. By the mid-2000s, delivery of environmental water from Hume Dam was gaining momentum through The Living Murray program, and Basin governments anticipated that environmental flow outcomes could be improved if the regulated release limit from Hume Dam was increased. The upper flow limit of 40,000 ML/day was established early in discussions between landholders represented by the Murray River Action Group (MRAG) and the former Murray–Darling Basin Commission (now the Murray–Darling Basin Authority [MDBA]).

This upper value for regulated flows has been explored in some detail with potentially affected landholders. The work included detailed flow modelling and development of inundation footprints. The results of studies commissioned by MDBA have been shared with potentially affected landholders in an effort to understand possible impacts. In 2011, a detailed landholder impact survey was conducted by MRAG to better understand the potential impacts of flows of 40,000 ML/day at Doctors Point using mapping made available by MDBA.

Although flows of 40,000 ML/day are still considered too high by many landholders, landholders consider it is the most pragmatic level that you might be able to ‘get away with’. Consultation has shown that flows larger than 41,000 ML/day cause increasing impacts for a considerable number of landholders. Thus, there is general acceptance among landholders that 40,000 ML/day at Doctors Point is the agreed upper limit for flows to be investigated.

A limit of 40,000 ML/day is also below the minor flood level at Albury, which is around 44,000 ML/day as measured at Doctors Point or 4.3 m at the Albury gauge. It is, however, above the Bureau of Meteorology minor flood level at Corowa, which has recently been raised to 26,900ML/day or 4.6 m on the Corowa gauge. Table 1 provides an overview of flow heights at different gauges throughout the Hume–Yarrawonga reach, considering the average two-day travel time between Doctors Point and Corowa (e.g. a flow of 25,000 ML/day at Doctors Point will be a similar flow — 24,900 ML/day — in Corowa two days later, depending on diversions, losses and inflows from other tributaries).

Table 1: Gauge height of 25,000 ML/day and 40,000 ML/day flows

<table>
<thead>
<tr>
<th>Flow at Doctors Point</th>
<th>Gauge height at Doctors Point</th>
<th>Approximate gauge height at Albury</th>
<th>Approximate gauge height at Corowa</th>
<th>Approximate flow at Corowa gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>25,000 ML/day</td>
<td>3.8 m (12 ft 6 in)</td>
<td>3.0 m (9 ft 10 in)</td>
<td>4.4 m (14 ft 5 in)</td>
<td>24,900 ML/day</td>
</tr>
<tr>
<td>40,000 ML/day</td>
<td>5.0 m (16 ft 5 in)</td>
<td>4.1 m (13 ft 6 in)</td>
<td>5.6 m (18 ft 4 in)</td>
<td>39,500 ML/day</td>
</tr>
</tbody>
</table>

The Basin story
In 2011, Basin governments requested a review of river operations for the southern connected system. The broad directive of the Basin Officials Committee was to develop a program of work to investigate opportunities to change river management activities to meet the needs of both consumptive users and the environment in more efficient and effective ways.

To support this directive, MDBA hosted a workshop in April 2012 for river operators and modellers from across the southern connected Basin. Workshop participants investigated how to
increase the frequency of overbank flows in the Lower Murray (downstream of Euston) in the range of 50,000 ML/d to 80,000 ML/d (the ‘target range’), for between 7 and 30 days (a ‘target event’), every four or five years. In this part of the river, flows within the target range achieve the greatest increase in area of floodplain inundated for every extra gigalitre of flow.

The modelling that underpins the report from this workshop (see MDBA 2012b) shows that increasing the regulated flow limit to 40,000 ML/day at Doctors Point will have important implications for increasing the likelihood of meeting the flow targets in the Lower Murray downstream of Euston (50,000–80,000 ML/day) under certain circumstances.

It is important to note that increasing the regulated flow limit in the Hume–Yarrawonga reach will affect how and to what extent water can be delivered further downstream to meet these flow targets. For example, if all current impacts could be addressed within the Hume–Yarrawonga reach and the limit for a regulated environmental flow was increased to 40,000 ML/day at Doctors Point, downstream constraints would still need to be addressed to enable the water to be delivered to its intended location. This reinforces the relationship between river reaches and emphasises the need to address constraints in different reaches across the Basin.

When and how often these flows would happen

In June 2014, MDBA modelled different scenarios to provide an indication of the types of changes that are likely to influence the frequency, timing and duration of the proposed flows. This modelling was used to show two things — what flow events would look like with the current dam infrastructure in place, but without the Basin Plan; and what flow events would look like if the Basin Plan was implemented with constraints addressed. The modelling was based on 114 years of flow data and showed:

- the number of events of a prescribed duration under current conditions and with constraints relaxed under the Basin Plan
- the difference in the number of events for different flow durations.

Regulated environmental flows will usually be delivered during winter–spring (June–November) to reflect what would have occurred naturally.

The modelling showed that:

- there would be a slight increase in the number of times a flow of between 25,000 and 40,000 ML/day at Doctors Point would occur — around once more every 10 years
- the duration of flow events of 26,000–40,000 ML/day would generally be longer (i.e. events longer than seven days would be more frequent, and events of less than seven days would be less frequent).

Flows of between 25,000 and 40,000 ML/day would inundate both native and improved pastures, meaning they are not able to be grazed for some time afterwards. Further work is required to understand how these potential inundation patterns affect plant health and survival, and what this might mean for agricultural enterprises.

Although the purpose for release of environmental water will vary across years — an upper limit of 40,000 ML/day will provide river operators with greater ability to meet flow demands when needed. The Basin Plan provides some insight into the watering patterns that may develop. For
example, the *Guidelines for determining priorities for applying water* (MDBA 2012c) suggest that decision makers should take into account resource (or water) availability as well as the antecedent conditions. A decision matrix suggests that in very dry years the focus for managers might be to avoid critical species loss, likely resulting in small flows to specifically targeted areas. In contrast, during very wet periods, environmental water could be used to supplement natural flow events to enable different areas of the floodplain to connect via rivers and creeks. In many scenarios, the trigger to use environmental water would be a natural flow in an unregulated tributary to maximise the water available and to coincide with a natural ‘cue’.

**What is not being considered**

We are not trying to create or change how often major floods occur. These are recognised as damaging and disruptive, and are outside the bounds of active river management.

**Options for creating a higher flows in the Hume–Yarrawonga reach**

Creating a flow of 40,000 ML/day in the River Murray between Hume Dam and Yarrawonga Weir would typically be achieved by coinciding releases from Hume Dam with inflows from the Kiewa River. For example, if there was 15,000 ML/day coming in from the Kiewa, then the release from Hume Dam may only be 25,000 ML/day. Topping up unregulated inflows with environmental releases to generate a higher peak flow and/or longer event duration has proved successful and is a common tool for water managers (see ‘What will change’).

The April 2012 river operators and modellers workshop concluded that reaching the target range of flows (50,000–80,000 ML/day) in the Lower Murray would require the coordinated release of water from multiple valleys to achieve a single event outcome. For example, high flows of 50,000–80,000 ML/day in the Lower Murray could be delivered through coordinating releases from storages such as the Hume Dam, Lake Eildon and the Menindee Lakes, combined with unregulated flows entering the Murray from tributaries such as the Kiewa, Murrumbidgee or Ovens rivers during winter or early spring.

Any regulated environmental release will have to be managed in a way to minimise flood risk. Although river operators are experienced in managing this risk, MDBA recognises that more work needs to be done to understand and demonstrate how the risk will be managed.
What might be the effect of the proposed flows in the Hume–Yarrawonga reach?

Environment effects

In 2014, the Murray–Darling Basin Authority (MDBA) undertook a modelling exercise to determine what sorts of environmental benefits might be achieved from increasing flows in each of the seven key focus reaches. This exercise involved overlaying the various flood inundation footprints with vegetation maps for this reach to identify what types of vegetation would benefit from the flows under investigation.

Table 2 shows the extent of vegetation inundated for four different vegetation types and Australian National Aquatic Ecosystem wetlands in increments of 5,000 ML/day to 40,000 ML/day.

<table>
<thead>
<tr>
<th>Flow rate (Doctor's Point ML/d)</th>
<th>Total inundated vegetation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Red gum woodlands (ha)</td>
</tr>
<tr>
<td>30,000</td>
<td>874</td>
</tr>
<tr>
<td>35,000</td>
<td>986</td>
</tr>
<tr>
<td>40,000</td>
<td>1,090</td>
</tr>
</tbody>
</table>

ANAE = Australian National Aquatic Ecosystem

The table shows that, by extending the area and duration of inundation, there are likely to be benefits to floodplain vegetation and wetlands, and the many flora and fauna species they support, within the Hume–Yarrawonga reach.

Key environmental assets downstream that would benefit from increased flows include the Barmah–Millewa Forest, Werai Forest, Gunbower–Koondrook–Perricoota forests, Hattah Lakes and the Riverland–Chowilla Floodplain. Other lesser known but significant areas include various wetlands along the River Murray channel and the Wakool River system (Green & Alexander 2006).

Community report on the effects of inundation

MDBA’s understanding of potential impacts and landholder concerns is well understood in the Hume to Yarrawonga reach. Landholders within this reach have a long-standing connection with the former Murray–Darling Basin Commission (MDBC) and MDBA that has evolved during decades of regulated flow management. Importantly, the Murray River Action Group (MRAG), a representative riparian landholder group, provides an important and coordinated voice for most riparian landholders within the reach, and has played a valuable role in helping MDBA to understand the impacts of higher flows in this reach.
Extensive community consultation around the prospect of increasing flows in the Hume–Yarrawonga reach has been undertaken during a number of years.

Building on the events and consultations of the 1990s (see ‘How the Hume–Yarrawonga reach is managed’), in the mid-2000s, the MDBC explored the possibility of increasing flow rates in this reach up to 50,000 ML/day. A series of studies examined a range of flows through river modelling, development of flow footprints and land impact assessments. Consultation with the community settled on a potential maximum flow rate of 40,000 ML/day. MRAG members are quick to point out that although they accept that this level is the maximum level that will be explored, they are not supportive of flows of 40,000 ML/day at Doctors Point.

40,000 ML a day is still unacceptable to most of us — anything above that is completely unacceptable to all of us.
MRAG representative

Farming on a floodplain is risky by nature; however the very existence of Hume Dam has reduced this risk for landholders in the reach. Although the purpose of Hume Dam operations as set out in the Murray–Darling Basin Agreement is not to mitigate floods but to conserve water, a by-product of the dam collecting high winter and spring inflows has been that many floods may be captured, so the impact of these flows have been mitigated for landholders in the reach. This situation has guided the business decisions of floodplain enterprises. Landholders with smaller holdings situated on flood-prone country are most at risk, as they may not have land to move stock onto during managed environmental flow events.

Landholders are also particularly concerned about the risk to livestock if a regulated flow event is followed by a natural flow event. Although landholders might choose to leave stock on an island of higher ground for a regulated event of a certain duration, they are concerned that doing so might expose livestock to additional risk if a natural rainfall event follows.

What if I am told an out-of-bank environmental flow will only last for say 14 days, and I decide to leave livestock on isolated land with impeded access? Towards the end of that period a big general rain occurs and the river floods much higher than anticipated — the environmental flow means the retreat to higher ground has been compromised and the potential for a disaster becomes very real.
MRAG representative

To understand the feasibility of 40,000 ML/day flows, it is important to have a clear picture of the effects on landholders. The flow footprint maps show that an additional 1,332 ha of freehold land will be inundated as a result of increasing the flow limit from 25,000 ML/day to 40,000 ML/day. It also shows that an additional 8,433 ha would be affected by access issues. In 2011, a survey of 112 landholders in the reach was conducted by GHD on behalf of MRAG into the potential effects and mitigation options for flows of 40,000 ML/day (GHD 2010). The survey received a response rate of 56% representing 62% of potentially affected land. The findings from the survey listed the types of effects that can be expected from inundation caused by increasing the regulated flows to 40,000 ML/day. This includes effects on production, infrastructure and access routes, and changes to farm management practices. The average stocking rate for the land in the Hume-
Yarrawonga reach as expressed as dry sheep per hectare (an expression of stocking rate that reflects all grazing animals in terms of a 50kg castrated male sheep) is 14.62.

Table 3 shows the estimated effects on agricultural land from 40,000 ML/day flows.

**Table 3: Effect of higher flows on freehold agricultural land**

<table>
<thead>
<tr>
<th>Item</th>
<th>Total effect from 40,000 ML/day flows</th>
<th>Incremental effect from 25,000 ML/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Properties affected</td>
<td>112</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total freehold inundated area</strong></td>
<td>3,008 hectares</td>
<td>1,332 hectares</td>
</tr>
<tr>
<td>Cropped area</td>
<td>150 hectares</td>
<td>67 hectares</td>
</tr>
<tr>
<td>Improved pastures</td>
<td>1,444 hectares</td>
<td>639 hectares</td>
</tr>
<tr>
<td>Native pastures</td>
<td>1,414 hectares</td>
<td>626 hectares</td>
</tr>
<tr>
<td>Impeded access area</td>
<td>8,433(^{a}) hectares</td>
<td>8,151(^{b}) hectares</td>
</tr>
</tbody>
</table>

\(^{a}\) Based on responses from 60% of landholders surveyed and extrapolated for the remaining land, including freehold, crown and leased land. Expert advice suggests this is a high estimate. The extent of the inundation footprint for 40,000ML/day requires further investigation and validation to build community confidence.

\(^{b}\) This figure represents an estimate of the increase in the area experiencing impeded access after taking into account the bridging program that had provided access for flows to 25,000 ML/day.

Table 4 shows the estimated effects on farm infrastructure on agricultural land from 40,000 ML/day flows.

**Table 4: Effect of higher flows on infrastructure on agricultural properties**

<table>
<thead>
<tr>
<th>Infrastructure</th>
<th>Total effect from 40,000 ML/day flows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fencing</td>
<td>30 kilometres</td>
</tr>
<tr>
<td>Bridges</td>
<td>85</td>
</tr>
<tr>
<td>Crossings</td>
<td>222</td>
</tr>
<tr>
<td>Tanks/troughs</td>
<td>79</td>
</tr>
<tr>
<td>Hay sheds</td>
<td>10</td>
</tr>
</tbody>
</table>
Table 5 shows the types of land management issues identified by landholders that may arise from these effects.

**Table 5: Potential land management issues reported as arising from increasing the flow limit at Doctors Point to 40,000 ML/day**

<table>
<thead>
<tr>
<th>Management area</th>
<th>Potential issues</th>
</tr>
</thead>
</table>
| Animal health                    | • hard to predict safe calving times due to uncertainty of timing and duration of overbank flows  
  |                                   | • animals drowning                                                                 |
|                                  | • interrupted access to treat animals                                            |
|                                  | • increased risk of footrot in sheep                                             |
| Weeds                            | • increase of weeds, reducing pasture growth                                    |
|                                  | • extra cost and time associated with managing weeds                             |
|                                  | • impeded access could prevent timely weed control                               |
|                                  | • weeds include Bathurst burr, rushes and blackberry                             |
| Clean-up after inundation        | • time consuming and costly                                                      |
|                                  | • includes repair and replacement of fences                                      |
|                                  | • repairs to access tracks                                                      |
|                                  | • repairs to river crossings                                                    |
|                                  | • bridge maintenance                                                            |
| Farm planning                    | • uncertainty of timing impacts overall farm enterprise                           |
|                                  | • impeded access, especially when paddocks isolated                             |
|                                  | • loss of opportunity to opportunistically crop the floodplain                   |
|                                  | • loss of fodder production                                                     |
|                                  | • cost of additional feed or agistment to deal with lost pasture                 |

The majority of affected floodplain land in the reach is used to graze stock. This means that changes in farm production resulting from 40,000 ML/day flows might typically result in changes to stock management. Figure 14 shows the typical pasture profile for floodplain enterprises.

**Figure 14: A typical pasture profile for floodplain enterprises in Hume–Yarrawonga**
The two scenarios set out below illustrate the potential impact of higher flows in the reach, and their direct and indirect effects.

**Scenario 1 — indirect impacts**

Some of Farmer A’s paddocks are on the floodplain and some are on higher ground. Farmer A usually crops the higher ground and grazes the floodplain. Under the current river operations regime, Farmer A moves his stock to higher ground in high flow events until the floodplain paddocks are again suitable for grazing. His cropping regime is managed to allow stock to be directed to higher ground in wet conditions, and the amount of his property he sets aside to cut for hay is informed by the likelihood of stock having floodplain pasture to eat.

If Farmer A’s floodplain paddocks are inundated for longer periods, Farmer A will need to alter his cropping regime to ensure that a greater area of his higher paddocks is available to be grazed during times of higher flows.

**Scenario 2 — direct impact**

Farmer B’s whole property is situated on the floodplain. Under the current river operations regime, some parts of her farm cannot be used when flows exceed 32,000 ML/day because paddocks are inundated. Other parts of her farm become isolated under these conditions. If Farmer B chooses to leave stock in isolated paddocks, she risks overgrazing and the need for supplementary feeding before the water subsides. Further risks arise if, for example, cows are calving and need assistance when they are isolated. Farmer B is used to managing this risk. It affects the amount of stock she can carry, and it is in her business model to find agistment for her cattle in wet periods.

Increasing flows to 40,000 ML/day would increase the likelihood and frequency of Farmer B’s paddocks becoming inundated or isolated, therefore making her business model riskier.

Landholders in the reach generally don’t improve pastures exposed to flows of up to about 30,000 ML/day. The part of the floodplain exposed to these flows supports flood-tolerant native grasses. Higher in the floodplain profile, there is a trend towards improved pastures and more active pasture management. Higher flows may discourage floodplain graziers from investing in improving floodplain pasture that is inundated by flows of 40,000 ML/day. This could decrease the productivity of floodplain grazing enterprises.

Several requests were made by the community in 2013 regarding funding for independent legal and technical advice to support increased landholder input into costing mitigation options. Landholders would like to be able to get their own professional advice and be provided with funding to pay for this advice directly to ensure independence from MDBA. These measures will only need to be considered if the project progresses to the feasibility phase.

It is important to mention that the maps used in the survey presented modelled flow footprints developed during the 2006 Hassall & Associates study. Many landholders believe that the maps underestimate the extent of a 40,000 ML/day flow, and feel that the way they were generated is not appropriate to establish the inundation footprint at a property scale. A possible next step is to verify the accuracy of the maps by way of aerial photography and on-ground survey if a flow of this type was to occur. MDBA has a project developed for aerial photography to be taken should
such an event occur, but the combination of such flows and good weather conditions for taking imagery is rare and may not occur for years.

In general, many community members are concerned about the possibility and effect of flows of 40,000 ML/day becoming more common. However, there is recognition that flows bring additional nutrients to the floodplain and landholders are keen to receive further information on potential future flow patterns and their timing. Such information will assist in developing a fair and equitable compensation procedure for any adverse impacts.

Landholders in the reach are keen to stay involved and help shape the journey towards 40,000 ML/day flows. Although most landholders would not like to see flows of up to 40,000 ML/day become more common, they see the value in continuing to discuss the issue with government so that they can influence the way in which they are compensated for impacts if such regulated flows are implemented.

Other stakeholders

As mentioned in ‘Flow footprint maps’, discussions with Albury City and Corowa councils have suggested some recreational areas may be inundated more frequently under the proposed flows. Several businesses may also become inaccessible more often at flows in the flow range of 25,000–40,000ML/day at Doctors Point. Although these areas are typically affected by flows most years under current conditions, future development in these areas will need to consider the potential for increased frequency and duration of inundation. Additional consultation with the councils and potentially affected businesses will be necessary to further develop our understanding of potential impacts if the project progresses to feasibility.

What people said about timing, duration, impacts and processes

The magnitude of the change for landholders would depend on the combination of the frequency, timing and duration of 40,000 ML/day flows. Landholders are very keen to see more detail on the timing, frequency and duration of proposed flows.

When, how often, how big, and how long — these are the questions we need the answers to. If we knew it would only be maybe 4–5 days [duration] perhaps we could work it out. Not knowing how long it might be for and that it could come at any time on a political whim — that is the problem. You can’t plan your farm business for that.

MRAG representative

Timing

The MRAG advised that 40,000 ML/day flows would have the least impact in winter and spring. This is partly because the catchment is usually saturated at this time, meaning that the effects of erosion are minimised, and partly because landholders are used to planning for higher natural flows in winter and spring. Given the desirability of delivering environmental flows both on top of natural flows, and when they are likely to have occurred in an unregulated system, this preference correlates with the environmentally desirable times for delivering flows.

Landholders are also seeking more information on how environmental water holders/river operators plan for a managed environmental event, particularly how they assess the risk of a managed event being followed by a natural rainfall event.
Duration

Some landholders indicated that there could be benefits associated with 40,000 ML/day flows that last four to five days during winter and spring. Such flows would bring water and nutrients to the floodplain, thereby potentially improving floodplain grazing. Whether these flows would be beneficial depends on a number of factors, including existing conditions, the capacity to manage erosion and the capacity to deal with inundated access routes. Deposition of silt during an event also has the potential to increase the duration of exclusion, as livestock will not graze plants covered in silt and it may be necessary to exclude livestock until the silt is washed off by rainfall.

Improved pastures such as legumes cannot tolerate prolonged inundation, with the time period varying depending on factors such as the depth of inundation and the turbidity of the water. Some native grasses may also be affected by prolonged inundation, although they are typically more tolerant of inundation than introduced species. Landholders felt that five days would be around the maximum duration that any pastures could tolerate without impacts on plant health.

Feedback from the councils also emphasised the importance of defining a maximum duration to determine the likely impacts of higher flows and whether they could be mitigated.

Frequency

Landholders are concerned that if the 25,000 ML/day limit were changed, the chance of overbank flows would always be ‘hanging over their head’.

If easements are used as a mitigation tool to facilitate environmental flows, landholders will be faced with the management dilemma of possible out-of-bank flows on a daily basis.
MRAG representative

At present, the volume of water in Hume and Dartmouth dams at any given time provides landholders with a sound estimate of the likelihood of spills or flows up to and exceeding 40,000 ML/day. Altering the regime of higher flows would necessitate a change in business decisions by landholders to accommodate the increased chance of higher flows.

Consultation in the development of the Constraints Management Strategy highlighted that potentially affected landholders would like additional information on proposed flow patterns and greater certainty (or predictability) about the timing of specific events.

Riparian landholders are open to more detailed investigations of potential impacts and are keen to develop a fair and equitable compensation procedure to account for potential land management changes and land worth.
What happens next?

The publication of the reach reports and the development of recommendations are just the start of a much longer process (Figure 15). There will be no change to the current regulated flow limit in the Hume-Yarrawonga reach for some years to come, if at all.

Figure 15: Phases of the Constraints Management Strategy

2014 Phase 1 — Prefeasibility

Phase 1 of the Strategy has been about collecting information about the management and effects of higher flows. MDBA:

- investigated options to modify constraints, looking at different potential flows
- assessed the effects of these changes, including talking to landholders and communities about how different flows might affect them
- identified options to avoid or mitigate inundation effects (e.g. building bridges, upgrading roads or buying easements).

Information for the Hume-Yarrawonga reach was then drawn together with information from the six other areas into the Constraints Management Strategy annual report, which was published in late 2014. This report informed decisions by Basin ministers as to which areas will be the subject of more detailed investigation.

At the end of Phase 1, MDBA recommended to Basin governments that they continue to explore the potential to relax constraints in each of the seven key focus areas through the feasibility phase (2015 to June 2016).³

Basin ministers (state and federal) have agreed that detailed investigations should proceed for higher managed flows in all seven key focus areas as part of feasibility investigations. This is a commitment to undertake further studies, not a commitment to go ahead with planning and implementation of mitigation measures to allow higher managed flows.

2015–16  Phase 2 — Feasibility

The Australian Government Department of the Environment has made funding available for the key focus areas to provide states with the resources needed to conduct detailed studies and prepare business cases.

In Phase 2 of the Strategy, MDBA and Basin states will need to:

- do more detailed hydrologic analysis to determine the best flow rates to relax constraints to in each key focus area
- assess inundation impacts and options to mitigate those impacts
- improve cost estimates
- undertake further community consultations.

MDBA will lead the feasibility assessment for the River Murray on behalf of Basin states. An integrated package of constraints business cases for the three River Murray key focus areas — Hume to Yarrawonga, Yarrawonga to Wakool junction, and South Australian River Murray — will be finalised during November 2015

Ministers have requested that further studies be done on constraint measures in the Gwydir, Lower Darling, Murrumbidgee and the Goulburn. In these reaches the work is being led by the state governments with support from the MDBA.

2016–24  Phase 3 — Planning and implementation

State and federal governments will decide by mid-2016 about whether to go ahead with easing constraints (planning and implementing mitigation measures that then allow higher managed flows). This decision will be based on the environmental gains, whether any effects on communities can be overcome, and the costs involved.

If constraint measures move ahead to planning and implementation (mid-2016 to 2024), it is likely the states will undertake this work.

To address constraints, proponent states would need to negotiate and pay for agreements with landholders, such as easements, to allow water to flow onto private land (for flows to reach an environmental asset or allow sufficient water to flow down a channel). The effects of inundation on infrastructure such as roads and bridges would also have to be managed before higher flows could proceed.

Post 2024  Higher managed flows will only be possible when packages of mitigation options are fully implemented

It is essential that measures are in place to mitigate the adverse effects on private landholders and community assets before overbank flows can be considered.
Potential mitigation options were discussed with the Murray River Action Group (MRAG) through the development of the Strategy for this reach. A range of options are available to mitigate the effects of regulated releases of 40,000 ML/day, with the following mentioned as important.

**Erosion controls**
Landholders are concerned that increasing the limit of regulated flows will accelerate erosion of the banks of the main stem of the river and its anabranches. Landholders are keen to see work done to rehabilitate riverbanks and prevent erosion as part of the implementation of the Strategy. This could include bank stabilisation and revegetation initiatives similar to those undertaken in the reach as part of the river health program during the past two decades.

**Access management**
Another key concern among landholders is that higher flows could cut-off access to paddocks that are not actually inundated. The 2011 landholder survey estimated that the area of land affected by 40,000 ML/day flows jumps from 3,008 ha to 8,433 ha if paddocks that essentially become islands are included. Finding a way to work around this will be critical in gaining support for increasing the flow rate in this reach. The Murray–Darling Basin Commission and MDBA have been contributing funding for river crossings in this reach for many years. This program could potentially be expanded to accommodate the higher flow rate.

**Understanding flood risk**
Improved understanding of the potential for increased flood risk and a demonstration that these risks can be effectively managed are key components of any future work. This work will be critical in helping build community confidence in identifying an acceptable future flow rate.

**Collaborative process**
MRAG members stressed that there were some key elements relating to process that should be adhered to, regardless of the method devised to obtain the right to deliver 40,000 ML/day flows. These elements include:

- establishing a technically robust process
- supplementing MRAG through the addition of independent technical experts and legal representation as necessary. MRAG would request the right to hire their own representatives and to have access to pay representatives directly
- allowing riparian landholders to be involved in negotiations
- ensuring that a set of principles emphasising the need for fairness, equity and transparency is devised and adhered to throughout.

Finding appropriate mitigation strategies will reduce the impacts on landholders from environmental flows. A combination of mitigation options may be appropriate in some cases. For the purposes of the prefeasibility phase, the main mechanism identified for mitigating the effects of inundation was flow easements and infrastructure upgrades. However, further work will be required during the implementation phase to ensure these measures address all landholder concerns.
References


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