# Wivenhoe and Somerset Dams Optimisation Study

## Discussion Paper

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# Background of WSDOS

Following the 2010-2011 Queensland floods, a Commission of Inquiry investigated the circumstances in which the flooding occurred. In March 2012, a Final Report was released by the Queensland Floods Commission of Inquiry and 177 recommendations were put forward and endorsed by the Queensland Government. As a result of recommendation 17.3 of that report, the Department of Energy and Water Supply (DEWS) commenced the Wivenhoe and Somerset Dams Optimisation Study (WSDOS) with other study partners.

The purpose of WSDOS is to assess and present various options for operating the Wivenhoe and Somerset Dams, enabling the government to make informed decisions on their future operation.

This stage of WSDOS is about making the best use of the existing dam infrastructure. This requires finding the best balance of flood mitigation, water supply security, protecting the dam structure, submergence of low level bridges and river crossings, bank slumping and erosion, and impacts on riparian fauna and flora. For example, improving urban flood mitigation requires reducing the importance that is given to one or more of those other objectives.

Following the community consultation and the completion of the study, the Queensland Government will make a decision on the best balance for the future operation of Wivenhoe and Somerset dams.

# Aim of this Discussion Paper

The Queensland Government has publicly released a report of the Wivenhoe and Somerset Dams Optimisation Study (WSDOS Report). This discussion paper has been developed as a guide to understanding the more technical WSDOS Report. The WSDOS Report is the primary document about the study.

The Queensland Government is seeking your feedback on all of the operational options for the dams that are presented in the WSDOS Report. The Government is particularly interested in feedback on the most promising new option, labelled in the report as “Alternative Urban 3”.

The findings of the WSDOS Report suggest this option achieves the best balance of the three key objectives for the dams:

(1) securing our water supply,
(2) flood mitigation and
(3) safeguarding the dams for very rare, but extremely large, potential floods.

The WSDOS Report evaluates 32 ways of balancing these three objectives and also discusses at length eight different ways of operating the dam during a flood. This discussion paper focuses on the most promising options and also how the dams operate now, detailing what each means, the difference between them, and the impacts if a new option is implemented.

This discussion paper and the WSDOS Report deal mainly with Wivenhoe Dam as not only is it three times larger than Somerset Dam, but the water released from Somerset Dam flows directly into Wivenhoe Dam.

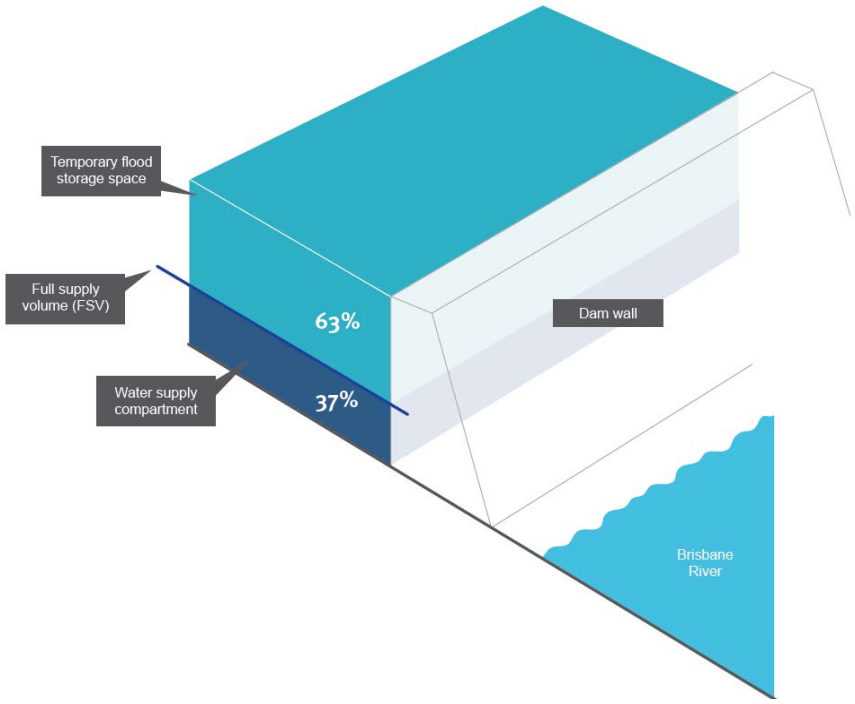
# Key Concepts

## Full Supply Volume/Level and Flood Mitigation

Wivenhoe and Somerset dams were both built for the dual purposes of water supply storage and flood mitigation. Both dams have gates that allow the dam operators to have some control over how much water is released during a flood. How much control the dam operators have is also determined by the size and type of flood.

### Full Supply Volume for our water supply

Wivenhoe and Somerset dams both have dedicated compartments for storing our drinking water supply. The maximum amount allowed to be stored for drinking water is called the “full supply volume” or “full supply level”. If the volume of water in the dam goes over the full supply volume then the dam operators must release the extra water.




It is important to remember that Wivenhoe and Somerset dams, as flood mitigation dams, are not near their total capacities when their water supply storage compartments are full. Both dams have much more space specially reserved for dealing with floodwaters. For Wivenhoe Dam, the water supply storage compartment can hold up to 1.165 million megalitres of our drinking water, which is less than 40 per cent of the total 3 million megalitres capacity of the dam.

Wivenhoe and Somerset dams are often described only by their drinking water supply capacities. The dams are said to be “full”, or even “at 100%”, when only the drinking water compartments are full and the flood storage space is completely empty.

The flood storage space is not used to store our water supply.

### Flood mitigation

The dams start flood operations when incoming floodwaters cause the water in the dams to rise above the full supply volume. The flood mitigation operations of the dams are about how the dedicated space for flood storage is used to absorb and store the floodwaters during the flood.

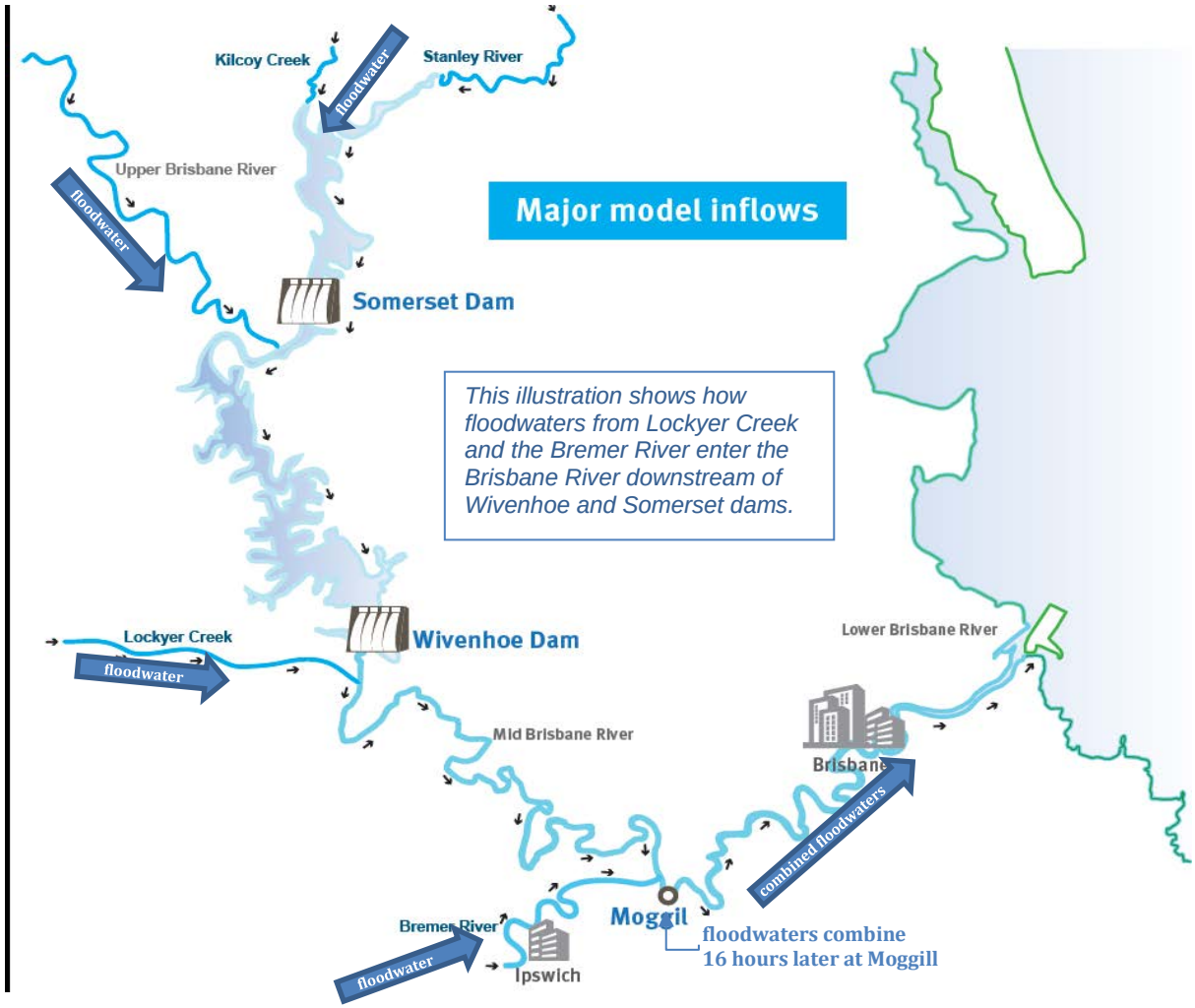
The basic aim of flood mitigation is that floodwater comes out of the dam at a slower rate than the floodwater comes into the dam.

To achieve this flood mitigation benefit, some of the incoming floodwater must be held back by being temporarily stored in a dedicated flood mitigation compartment. The larger the flood, the more the flood storage space will fill, and the releases out of the dam may increase so that the dam does not overtop.

## Importance of the Moggill reach of the Brisbane River

Managing flooding downstream of Wivenhoe Dam is complex because the water released from the dam combines with other rivers downstream. Floodwaters from Lockyer Creek and the Bremer River do not pass through Wivenhoe Dam and therefore cannot be stopped or mitigated by the dam. These downstream rivers alone can flood Brisbane and Ipswich.

It takes about 26 hours for water released from Wivenhoe Dam to travel along the Brisbane River and reach Brisbane City. During this journey in the Brisbane River, water released from the dam first meets and combines with floodwaters coming from Lockyer Creek. About 16 hours later near Moggill, this water combines with floodwaters coming from the Bremer River.




The dam operators measure the floodwaters in the Brisbane River at Moggill as it is the first place where major floodwaters all combine. The dam operators try to avoid the highest releases from Wivenhoe Dam arriving at Moggill at the same time as the highest floodwaters from Lockyer Creek and the Bremer River.

Previous floods have shown that there is a distinct increase in flood damage to houses and buildings when the combined floodwaters at Moggill go beyond 4,000 cubic metres per second (about 4,000 tonnes of water per second). A more dramatic increase in flood damage to houses and buildings occurs when the floodwaters at Moggill go beyond 6,000 cubic metres per second. Some damage can occur from as low as 2,000 cubic metres per second.

This is why the dam operators strive for the combined floodwaters at Moggill not to be any higher than this threshold of 4,000 cubic metres per second unless it is unavoidable. As an

example, if the floodwaters from the Lockyer Creek and Bremer River are already 3,000 cubic metres per second, the Wivenhoe Dam operators strive to release no more than 1,000 cubic metres per second for a combined flow at Moggill of no more than 4,000.

Once floodwater has been released from Wivenhoe Dam, it cannot be retrieved. So, if major rainfall then occurs in the Bremer/Lockyer catchments during the many hours its takes for the floodwater to travel from Wivenhoe Dam, the combined flow at Moggill could be higher than predicted.

### The three flood strategies

All floods start small but some continue to develop into much larger floods. If the floodwater levels in the flood storage compartment of Wivenhoe Dam continue to rise, the dam operators move through three different strategies. These strategies represent different ways of managing the floodwater and lake level according to the risks involved.

The three strategies are:

1) **rural flood mitigation strategy** to reduce rural inconvenience by aiming to keep open the low level river crossings. This is the first strategy used in any flood.
2) **urban flood mitigation strategy** aims to protect houses and buildings from floodwaters. This second strategy is only used if a larger flood develops.
3) **dam safety** prioritises protecting people by protecting the dam structure from very rare and extreme floods. This last strategy is used only if a very large flood develops because houses and buildings will be damaged by the floodwaters.

The **rural flood mitigation strategy** is about keeping low level river crossings open to avoid inconvenience and disruption to rural communities; it is not about protecting houses in rural areas. The protection of houses and buildings, in both rural and suburban areas, is the aim of the **urban flood mitigation strategy**.

Each strategy is engaged when the water in the dam reaches a certain level. For instance, at the start of a flood the rural strategy would be in place. Operating the dam using this strategy means the focus is primarily on rural convenience by keeping river crossings open. If the water in the dam continues to rise, operations move into the urban strategy causing a shift in focus to protecting houses and buildings and possibly closing river crossings. If a rare and very large flood develops, the focus shifts to protecting people by protecting the dam.

## Findings of the WSDOS report

WSDOS assessed eight different ways of using the above three flood strategies. WSDOS also assessed four different “full supply volumes” (FSV) for a total of 32 different options for operating Wivenhoe Dam. As discussed earlier, the full supply volume is the maximum amount of water permitted to be stored in the dam for our water supply.

The eight variations of flood operations for Wivenhoe Dam include:

- the “base case” (how the dam operates now)
- six variations of the rural strategy, urban flood mitigation strategy and the dam safety strategy including changing how much floodwater may be released under a strategy,
- one case of mandating specific releases from Wivenhoe Dam that increase as the water levels in the dam also increase (“prescribed operations”). This variation does not take into account floodwater from the Lockyer Creek and Bremer River at Moggill.

The study assessed the overall advantages and disadvantages of the alternatives to produce a score. This score is called the “net present costs” and effectively reduces benefits of every option down to a dollar figure to help make comparisons. The net present costs is only a

guide but it takes into account not just the impacts of floods, but also other impacts including on our water supply.

A key finding in the WSDOS Report is that lowering the water supply below its current 37 percent share is too great a risk to our long term water supply security. Risking our water supply security would put upwards pressure on the price of water by requiring expensive alternatives to be built sooner, and increase the likelihood of severe water restrictions.

The WSDOS Report indicates that out of the 32 options assessed, only two new options may produce an overall benefit compared to how Wivenhoe Dam is currently operated. Only one of those options, called "Alternative Urban 3", may be implemented in less than a year.

Those two new options, together with the existing way of operating Wivenhoe Dam, are summarised below. Detailed descriptions of all the options assessed by the study can be found in the WSDOS Report.

### **Base Case** (existing operations and "Option 1" in the WSDOS Report)

The Base Case shows how the dams are currently operated to help make comparisons with new options. In summary, the base case has the following strategies:

- ***Water Supply***: the lowermost **37 percent** of Wivenhoe Dam is dedicated to storing and securing our water supply.
- ***Flood Mitigation****:* the middle **29 percent** of Wivenhoe Dam is dedicated to mitigating floods and is divided into two strategies:
  - *rural flood mitigation*: the first strategy uses 5 percent of Wivenhoe Dam to mitigate small floods and aims to keep low level river crossings open.
  - *urban flood mitigation:* if a large flood develops, the second strategy uses the next 24 per cent of Wivenhoe Dam to protect houses and buildings but rural crossings may get inundated.
- ***Dam Safety****:* the uppermost **34 per cent** of Wivenhoe Dam is dedicated to protecting people by protecting the dam from extreme flood events.

### **Alternative Urban 3** ("Option 21" in the WSDOS Report)

In summary, under Alternative Urban 3, the three strategies are:

- ***Water Supply***: remains unchanged at **37 percent**
- ***Urban Flood Mitigation***: is increased from 24 percent to **35 percent** (the rural flood mitigation strategy is removed)
- ***Dam Safety***: is marginally decreased to **28 percent**.

The advantage of Alternative Urban 3 is that more space is available to protect houses and buildings from damage during large floods. This is achieved by increasing the urban flood mitigation space by removing the rural flood mitigation strategy and also taking a small share of the space currently set aside to protect the dam.

Alternative Urban 3 would also introduce, for that small share of the current dam safety space, a new upper limit at Moggill of 6,000 cubic metres of floodwater per second. This new upper limit may delay or avoid much higher and more damaging releases for dam safety. The dam safety strategy would still be used if a larger flood continues to develop.

Typically and for most large floods (over 4,000 cubic metres per second), urban flooding under Alternative Urban 3 would be up to 5 to 10 percent less than the existing way of operating the dam. There will always be potential in some floods for a worse performance with this option (see Part 7.6.4 of the WSDOS Report). There is a marginal increase in risk to the dam itself.

On balance over the full range of potential floods, Alternative Urban 3 would typically produce small, but still better, reductions in urban flooding compared to existing operations.

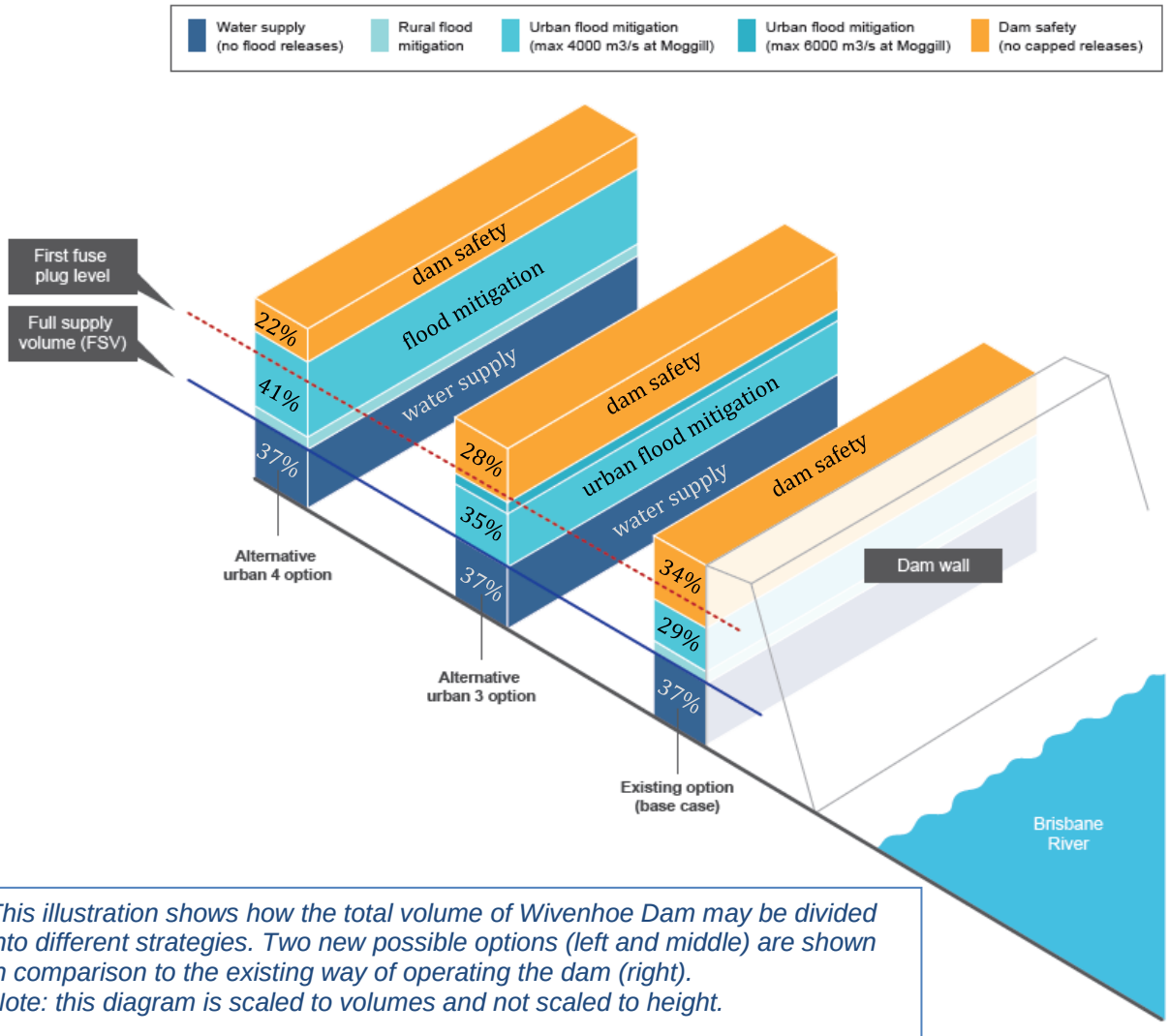
The disadvantage is an increased chance of low level river crossings being inundated in small but more common floods. The low level river crossings include Savages Crossing, Colleges Crossing, Burtons Bridge and Kholo Bridge. This would potentially increase rural inconvenience. The dam operators would still aim to keep open the Geoff Fisher Bridge on the Brisbane Valley Highway at Fernvale and the Mt Crosby Weir Bridge* as part of the improved urban flood mitigation strategy.

## **Alternative Urban 4** ("Option 25" in the WSDOS Report)

Alternative Urban 4 potentially produces better urban flood mitigation when compared to all of the other options (see Part 7.6.5 of the WSDOS Report).

The advantages of Alternative Urban 4 are achieved by increasing the space available for flood mitigation from 30 percent to 41 percent of Wivenhoe Dam.

However, this significant increase in flood mitigation space is only achieved at the expense of the dam safety space. At this time, Alternative Urban 4 would increase the chance of using the extra emergency spillways built into Wivenhoe Dam, called "fuse plugs". More study work is required to assess if the risks of this option can be dealt with by future upgrades works to Wivenhoe Dam. Alternative Urban 4 is not feasible now but may be considered as part of longer term infrastructure planning for Wivenhoe Dam.




*This illustration shows how the total volume of Wivenhoe Dam may be divided into different strategies. Two new possible options (left and middle) are shown in comparison to the existing way of operating the dam (right).*
*Note: this diagram is scaled to volumes and not scaled to height.*

*An earlier version of this discussion paper mistakenly referenced Mt Crosby Weir Bridge as one of the low level crossings

## Key points

This stage of WSDOS is about making the best use of our existing dams.

Modelling simulations show that under existing operations the dams significantly reduce the impact of flooding in Brisbane and Ipswich, typically between 30 and 50 per cent in major floods.

Meaningful improvements to flood mitigation can only be achieved by either decreasing the space set aside for our water supply or decreasing the space set aside to safeguard the dam.

Optimising the operations of Wivenhoe and Somerset dams required recognition that every flood will be different and that operational strategies must provide balanced outcomes across a very wide range of flood possibilities and not just for one particular historical flood.

The options were assessed against:

- large historical flood events from the last 125 years comprising 1887, 1890, 1893, 1898, 1908, 1931, 1959, 1971, 1973, 1974, 1983, 1989, 1996, 1999, 2011 and 2013;
- almost 4,000 simulated potential floods.

In addition to mitigating the severity of a flood, dams also delay the on-set of flooding increasing the warning time for the community to take action.

A lowering of the water supply storage compartment will increase the risks of reaching water restriction triggers earlier and increase the operational costs of our water supply.

The Minister will retain the power to declare that the dam temporarily operate at a lower level if supported by seasonal forecasts for an above average wet season and wet catchment conditions.

The findings of the WSDOS Report suggest the “Alternative Urban 3” option achieves the best balance by producing small but meaningful reductions in urban flooding without creating unacceptable risks to our water supply security or the safety of the dam.

It is possible to implement option “Alternative Urban 3” in less than one year. This option:

- allows higher releases earlier in a flood by removing consideration of some low level downstream crossings and the inconvenience,
- increases the urban flood mitigation compartment by marginally reducing the dam safety compartment but does not pose an unacceptable increase in risk to the dam,
- uses that increased urban flood mitigation space in large floods to allow a transition into higher flood mitigation releases which may delay or avoid much higher and more damaging releases for dam safety,
- maintains the current level of the water supply compartment for water security to avoid an upwards pressure on water prices.

Alternative Urban 3 also increases the likelihood of low level rural bridges being inundated in the smaller but more common floods leading to in inconvenience and disruption to rural communities.

Risking our water supply security would put upwards pressure on the price of water by requiring expensive alternatives to be built sooner and increase the likelihood of severe water restrictions.

# Moving Forward

The public consultation period provides the opportunity to submit feedback on the Wivenhoe and Somerset Optimisation Study.

We ask that you provide your thoughts on the report and the preferred options by submitting them online www.dews.qld.gov.au or emailing optimisationstudies@dews.qld.gov.au.

The consultation period closes on 30 June 2014.

Comments and feedback will be collated for consideration and assessment by the project team, and included in the final WSDOS Report to be published in late 2014.