# Measurement and comparison of evaporation in water storages

*This fact sheet explains the method used to calculate evaporation from storages across the southern-connected Murray–Darling Basin and demonstrates why the Menindee Lakes offer the greatest potential to reduce evaporative losses.*

## How evaporation is calculated

NSW Department of Industry has calculated the evaporation for each of the storage areas across the southern-connected Murray–Darling Basin using an internationally accepted standard. This method includes the following calculations and steps:

- To effectively estimate the evaporation loss from a water body, the depth of evaporation from a relevant standard Bureau of Meteorology pan evaporation gauge[1] is multiplied by the surface area of the water body to give a volume of water evaporated.
- Surface area varies over time. After undertaking a detailed ground survey, figures for height, depth, surface area and volume can be calculated. Reading water depth from a staff gauge then provides the corresponding surface area of the water body.
- A mass balance calculation is used to determine a pan factor that can convert the daily evaporation reading from the measurement pan to the volume of evaporation from a water body. A mass balance calculation is a method of calculating unknown losses from a system. It is a simple calculation of the change in volume of water stored and the difference between inflow and outflow.
- The mass balance calculation uses recorded storage volumes, and recorded water outflows and inflows. Cross-referencing actual results with calculated results using the pan factor allows for the pan factor to be improved over time.

Our use of 'pan factors' and mass balance calculations to model evaporation is considered the industry standard. It is used broadly across the industry, including by the Australian Bureau of Meteorology.

## Why the Menindee Lakes are so vulnerable to evaporation

The surface area to volume ratio (SA:V) of a water body is a good indication of the potential for evaporation. A larger SA:V indicates that more of the water is exposed to the climatic factors that promote evaporation. Evaporation increases with exposure to sun, wind and elevated temperatures. Evaporation also increases when humidity is low.

The Menindee Lakes have a large surface area in comparison to the volume of water they hold, and so have a larger SA:V when compared to other southern Murray–Darling Basin storages. This means that a typical two metres of evaporation loss in a year from the Menindee Lakes is a much bigger portion of the total volume compared to other storages.

Additionally, the Menindee Lakes are located in a hot, semi-arid area with little rainfall. The lakes are shallow, set within a flat terrain and exposed to wind, which increases the potential for evaporation.

[1] a standardised metal tray used to measure evaporation

Up to 700 gigalitres can be lost to evaporation annually when the lakes are full. As well, each lake contains a percentage of 'dead storage' that cannot be accessed. This will also be lost to evaporation. This dead storage is estimated at 125 gigalitres for the four main lakes.

The Menindee Lakes have the largest surface area of any of the southern Basin storages and have the largest SA:V. Table 1 shows the significant impact this has on the average annual net evaporation loss from storage:

**Table 1. Surface area to volume ratios and evaporation from various storages**

| Storage name | Storage surface area (Ha) | Storage volume (GL) | SA:V | Net evaporation loss (GL/yr) |
|---|---|---|---|---|
| Blowering Dam | 4,300 | 1,631 | 0.003 | 6.3 |
| Burrinjuck Dam | 5,500 | 1,026 | 0.005 | -2.0 |
| Dartmouth | 6,380 | 3,856 | 0.002 | 0.5 |
| Eildon | 13,832 | 3,334 | 0.004 | 3.8 |
| Hume Dam Storage | 20,091 | 3,005 | 0.007 | 76.4 |
| Lake Victoria | 12,200 | 677 | 0.018 | 130 |
| Menindee Lakes | 45,700 | 1,731 | 0.026 | 399 |

The table shows that on average 399 gigalitres is lost each year from the Menindee Lakes as net evaporation loss. This compares with only 6.3 gigalitres lost from Blowering Dam, which has a comparable storage volume. If evaporative loss from the Menindee Lakes is reduced there would be more water available in the system.

The figures quoted in Table 1 are net of rainfall and evaporation, so the effect of evaporation is offset by rainfall directly onto the storage. This means that the net evaporation loss can be negative if rainfall over the storage surface exceeds evaporation loss from the surface. A good example of this is Burrunjuck Dam, which has an annual average net evaporation loss of -2.0 gigalitres because the average rainfall over the storage area exceeds evaporation.

The 399 gigalitres of net evaporation loss per year from Menindee Lakes as quoted in Table 1 is less than the 426 gigalitres recently quoted by the Murray–Darling Basin Authority (MDBA) on its website at mdba.gov.au/river-murray-system/running-river-murray/menindee-lakes-facts.

The department's calculation of net evaporation loss for all storages in Table 1 is based on Basin Plan baseline diversion limit conditions (2009) for consistency between valleys. The MDBA's calculation of net evaporation loss for the Menindee Lakes uses a more recent 'current conditions' (2018) scenario that includes some updated calibrations and a longer time period. When the same reference conditions are used, the two sets of evaporation calculations are closely aligned.

## More information

For more information on water management in NSW, visit the department's website at industry.nsw.gov.au/water