FACTSHEET

REDUCING FARM DAM EVAPORATION

Evaporation reduction by suspended and floating covers and chemical films may substantially reduce stored water losses if the right product is selected for a specific water storage. In the Granite Belt Region of Queensland – where horticulture production is dominant – evaporation from storage is typically between 1.6m and 1.8m/year.

The value and cost of water in Australia has increased significantly and evaporation is usually the largest component of loss from rural and urban water storages. The depth of most Queensland farm storages is less than 7 metres, and most have a surface area of less than 2ha, with evaporative loss accounting for 30-40% of the total volume held in the storage.

Evaporation of water from a water surface, and seepage through the walls and base depend on the construction and type of storage, water depth, water and air temperature, humidity, and wind speed above the water surface.

Measuring evaporation and seepage losses

Evaporation rates from a storage can be estimated from regional climate information (eg temperature, solar radiation, humidity and wind), from local weather stations or from standardised evaporation pans. More accurate measurements can be obtained by accurately measuring changes in storage water level during periods of no pumping or rainfall. These measurements need to differentiate between seepage and evaporation losses. Pressure sensitive transducers (PSTs) can be used to precisely measure water depth and accurately determine the seepage and evaporation components when used in conjunction with a local automatic weather station.

▲ *Equipment used to measure seepage and evaporation losses (pressure sensitive transducer top and automatic weather station above).*

Structural and storage management options

Methods to reduce evaporation loss can include structural modification to the dam such as raising storage wall height and/or splitting a single large storage into two or more cells. Evaporation mitigation is achieved by reducing the surface to volume ratio of each cell.

Configuring a storage into multiple cells also reduces evaporative loss if the water level in at least one cell is managed to increase the depth and residence time, leaving other cells empty. Concentrating water into one storage across the property provides similar benefits.

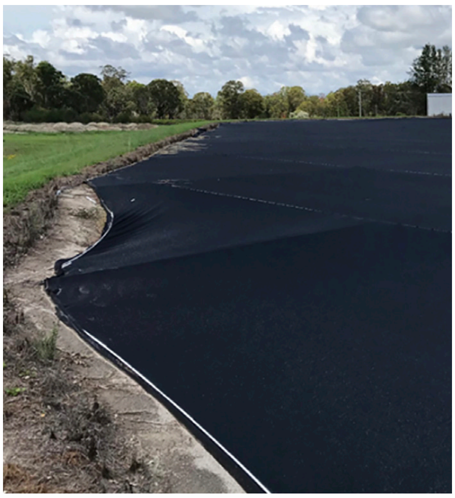
The earth works required for structural modification incurs a high, one-off, up-front cost, off-set in part by the opportunity to ameliorate seepage loss. A shelter belt of trees perpendicular to the prevailing wind of smaller (< 1ha), regularly shaped storages may achieve a reduction in evaporation of up to 30%.

Commercial product options

SUSPENDED COVERS

Many growers are familiar with suspended physical covers used for hail or bird protection in orchards. Covers suspended over a water storage are supported by high tension cables and poles, anchored to the banks. The fabric is permeable to rain, but reduces wind and sunlight, reducing evaporation. Suspended covers may reduce evaporative loss by up to 90%, and improve water quality by inhibiting algal growth.

The design life of suspended covers is 30 years (15 years for cloth), provided regular maintenance of the tensioning cables and supports is undertaken. The seams and fabric may be prone to tearing and perforation during storm events. Suspended covers allow access to the storage basin for water sampling and maintenance, are self-cleaning, and are not affected by changes in water level.



▲ *Suspended shade cloth cover over 0.5ha storage holding 10ML of water.*

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FLOATING COVERS

Floating covers physically reduce the impact of wind, wave and sun energy at the water surface, reducing evaporation. With full surface coverage, floating covers may reduce evaporation up to 100 per cent. At less than full coverage, evaporative reduction is proportional to the total surface area covered. Floating covers may need to be removed or cleaned regularly to remove attached algae and debris accumulating on the upper and submerged surfaces.

▲ *View from underneath a suspended shade cloth cover over a 3.8ha storage holding 133ML of water. Internal supports are used in this instance owing to the long span of suspension cables.*

MODULAR COVERS

Modular covers consist of a series of small (typically up to 1m diameter) individual floating units typically constructed from food-grade, high density polyethylene plastic which can be tethered or contained within a specific area. Modules may be installed incrementally to spread up-front costs, and may reduce evaporation by up to 85% once the total surface of the water is covered. At less than full coverage the reduction in evaporation is proportional to the surface area covered. In windy locations modules may need to be tethered or contained within floating booms, to avoid beaching. Modules may be most appropriate for storages which always hold water, as units may not readily re-float from dried, muddy basins. The impact of algae attaching to the underside of modules on water quality has not been investigated.

▲ *Floating covers can be installed in sections covering a portion of the dam.*

CHEMICAL FILMS

A chemical film is designed for intermittent application by hand from a simple dispenser, or from an automated applicator. Chemical films offer the greatest flexibility and may be applied only when required, to reduce evaporative loss. Two categories of chemical film are available. A mono-molecular chemical film or monolayer and a multi-molecular chemical film which forms a much thicker slick at the water surface.

Chemical films are biodegradable spread across the water surface and are not as reliable as other methods in reducing evaporation because they biodegrade, with wind, waves, UV radiation, water quality, algae and bacteria affecting film integrity and longevity. The main advantage of monolayers is the low initial setup cost and the ease of repeat application only when required. The main impediment for adoption of monolayer systems is the highly variable field performance and the uncertainty of water savings.

▲ *Hexagonally shaped modular covers tightly packed to achieve close to 100% cover.*

Economics

Several commercial farming operations have successfully installed evaporation reduction systems. It is recommended that an economic assessment is first undertaken to determine product viability. This compares the annualised cost of an evaporation mitigation technology, based on cost per unit of water saved, with the additional crop produced and revenue generated using the saved water, or with the cost to purchase water.

The annual cost of an evaporative mitigation technology per unit of water saved is a function of the capital cost of the product, installation and annual maintenance costs, offset against the annual and seasonal water lost from the storage, storage operating conditions and requirements, and the efficiency of the technology in reducing water loss.

For example, in the Granite Belt area of Queensland, the annualised cost of a suspended shade cloth cover, saving 85% of evaporation, with a fabric life of 15 years and capital cost of $13/sqm would be around $700-$1,000 per megalitre of water saved. This increases to around $1,700-$2,000 per megalitre for a cover costing $30/sqm. Given the high value of horticulture products, and the high cost of purchasing replacement water, this could be considered a viable option for horticultural farmers who would also benefit from water quality improvements.

An Economic Ready Reckoner tool *https://evapadvisor.com/* has been developed for undertaking site-specific analysis to inform potential users of the cost-benefit of each technology.

A detailed report providing an assessment of evaporation mitigation technologies in Queensland was prepared in 2020 through funding from the Queensland Government.

https://evapadvisor.com/assets/reports/Assessment_of_Evaporation_Mitigation_Technologies_in_Queensland.pdf

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