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Farm dams in the wheatbelt

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Many wheatbelt dams are unreliable water supplies

Of the estimated 76,000 farm dams in the wheatbelt, about 8 per cent either leak or are salt affected. The remaining 70,000 dams are capable of holding water for livestock use and can be regarded as serviceable dams.

A great many of the serviceable dams are unreliable water supplies due to the combined effects of lack of runoff from catchments, shallow depth of stored water and small size of storage in relation to expected demand from livestock and evaporation loss.

Dams that leak

In most districts less than 5 per cent of all dams leak. Some particular districts have soils which, although having a considerable clay content, do not constitute good dam building materials.

In the West Midlands, 40 per cent of all dams leak, and in the Jarrah Belt, probably more than 10 per cent of all dams leak. In these districts it is the dams constructed in the mottled sub-soils under the lateritic gravel surfaces that frequently leak.

In the north-eastern and eastern wheatbelt, where 15 per cent of all dams leak, good dam-building soil is common at shallow depth but below 3 metres, the red-brown plastic clay gives way to a white or near-white kaolinized granite or gneiss. This white material usually textures as a sandy clay loam, is characteristically of low plasticity and often has a ‘talcly’ or slippery feel. Dams constructed in this material frequently leak.

Salt-affected dams

A few dams in most districts are affected by salt water intrusion into the excavation, thus rendering the stored water unusable. For example, in 1973 in the Beacon, Narembeen, Lake Varley, Corrigin and York districts, between 2 and 4 per cent of all dams were too salty for use by stock.

By contrast, in the Bindi Bindi district 18 per cent of dams were too salty for stock use in 1967 on a selection of farms which were not necessarily representative of the whole district. Siting of many of the early dams in relatively fresh creek lines which have since turned salty has been partly responsible for this.

Other causes of dam failure

Relatively few farm dams in the cereal and sheep districts hold a significant proportion of stored water above previous ground level (and against an embankment). For this reason, failure by over-topping or by ‘piping’ or tunnelling through the wall, is rare.

Failure due to lack of runoff from the catchment is also important, and is considered in the next section.

Reliability of dams as water sources

Dams which are ‘too salty’ and dams which leak will be failures even in years of above average rainfall.

The effectiveness or reliability of all non-salt, non-leaking dams (serviceable dams) in any given year is governed by the following—

- depth of dam
- capacity of dam
- evaporation rate
- rate of water use
- rainfall character—amount, seasonal incidence and intensity
- catchment character.
During surveys in the central and north-eastern wheatbelt in 1973 an attempt was made to estimate the reliability of all farm dams. Questions were asked about the frequency of dam-filling and of dams going dry.

The analysis showed that in those districts the approximate percentage of dams likely to fail in different years were as follows:

- in an above average rainfall season—25 per cent
- in an average rainfall season—45 per cent
- in a below average rainfall season—60 per cent
- in the worst season likely—85 per cent

Failures in above average rainfall years were those dams which were too salty, leaked or filled only rarely. Dam failures in average and below average rainfall years were largely due to lack of runoff.

From this analysis it can be seen that in central and north-eastern wheatbelt districts only about 15 per cent of all dams could be regarded as drought-proof. It also appears that by far the greatest cause of failure, overall, is lack of runoff from the catchment.

Although the situation is similar in other parts of the wheatbelt with lack of runoff being the greatest cause of dam failure, the proportion of all dams that are drought-proof may be different. In some districts such as in the Esperance sandplain and Jerramungup-Gairdner River district, where up to 50 per cent of all dams have improved catchments, the proportion of dams that are drought-proof would be higher than 15 per cent.

**Catchments**

A large proportion of farm dams rely on runoff from natural catchments for filling.

Natural catchments are generally 20 to 100 ha areas of sloping pasture land, and every third year this land is normally cultivated and a cereal crop sown. A small proportion of most natural catchments is occupied by high runoff areas such as farm tracks, formed roads, homestead areas and out-cropping rock.

Surface soil textures vary through the full range from sand to clay, but most W.A. farming soils have a sandy surface of variable depth. The amount and frequency of runoff from natural catchments is extremely variable in most districts and therefore catchment improvement techniques, such as contour drains, roaded catchments and flat-batter dams are increasingly being used.

Contour drains have been used for many years, especially in the more undulating country of the Great Southern to extend the area contributing runoff to a dam. For example, at Broomehill in 1976, 20 per cent of all dams were served by contour drains.

Roaded catchments were in use on 5 per cent of dams at Broomehill in 1976 and on 11 per cent and 8 per cent of dams in the Beacon and Westonia districts respectively in 1973. By contrast, less than 1 per cent of dams in the North Wickepin, East Beverley and East York districts were served by roaded catchments in 1973.

In parts of the south coastal farming districts, where the soils are generally sand overlying a clay subsoil, almost every farm has at least two roaded catchments and on many farms every dam has a roaded catchment.

It is thus estimated that in the Jerramungup, Gairdner River, Cape Riche, South Stirlings and Esperance sandplain districts more than 40 per cent of dams would be served by roaded catchments or flat-batter dams.

The reliability of more than 50 per cent of farm dams in the cereal and sheep districts could be improved by the addition of roaded catchment and satisfactory sites for roaded catchments probably exist on three out of five of these. This would require construction of approximately 0.5 to 1.5 ha of catchment per 1 000 cubic metres of dam capacity, costing on average, $350 per ha of roaded catchment.

In some districts there are distinct site limitations to catchment improvement. Some soils are crumbly, self-mulching or very well-structured clay soils; and loose sand, gravelly sand or gravel soils with less than 3 per cent clay content. They will not compact to form a firm foundation or a watershedding crust.

It should be possible to use many wheatbelt sandplain soils for roaded catchment construction. On any site where a loamy sand or heavier-textured soil occurs and compaction can be applied to the moist soil during construction, a successful catchment can be built. This assessment assumes that design, survey and supervision can be provided, and that suitable construction equipment and drivers are available.

There may be a problem in some districts due to lack of suitable construction plant and operators. In other districts the shire council or private contractors will make graders and rollers available for roaded catchment construction on farms.

Bitumen catchments yield better quality water than compacted earth catchments, and because they give about twice the runoff percentage, they require half the area of an earth catchment. Despite these advantages bitumen surfacing of farm catchments will seldom be warranted, due to the costs involved. The cheapest bitumen catchment will be 10 times the cost of a good roaded catchment on nearly all farms, and maintenance of bitumen will usually cost more than for earth catchments.

**Flat batter dams** are excavated tanks especially suited to sites with deep sandy overburden (on which roaded catchment construction would be expensive—greater than $500 per ha), and fairly flat sites with restricted natural catchment. They are being increasingly used in the south coastal sandplain districts.

Flat batter dams consist of an excavation surrounded on three or four sides by clay-covered catchment with a gradient from the perimeter into the excavation edge. When made to a square plan, erosion at the corners of the excavation may be severe. This problem can be largely overcome by making a dam and catchment of circular plan and arranging for all
runoff to enter the excavation through a pipe laid through a circular embankment around the upper edge of the excavation.

**Capacity and depth of individual dams**

The average capacity of dams in the wheatbelt in 1970 was 1454 cubic metres. The more recently developed districts and the hotter and drier districts generally have on average, larger dams than the older and the cooler, wetter districts.

For example, average dam sizes at York and Beverley were approximately 1500 cubic metres in 1973; compared with 2400 cubic metres at Beacon and 3270 cubic metres at Westonia.

The range in individual dam sizes in all districts was large. In the Beacon district, dams range from about 500 cubic metres to 16,000 cubic metres.

In the Broomehill district only 5 per cent of all dams were more than 3050 cubic metres capacity and 50 per cent of all dams were in the range 760 to 1530 cubic metres.

These figures have been selected from the many surveys and are considered representative of most districts in which dams are commonly found.

The average depth of dams ranges from 3.3 m at Beacon to 3.9 m at Westonia.

At Broomehill the mean depth of dams was 3.6 m but only 6.6 per cent of dams were deeper than 4.9 m. Fifty per cent of all dams had depths in the range 3.05 m to 4.25 m.

From the above statistics it is evident that a large proportion of dams in the wheatbelt are relatively small and shallow. In general, farmers are making dams bigger and deeper now than in the past but this trend cannot continue as there are frequently site limitations which restrict the depth of new dams. One obvious limitation is the poor holding soil at depth which is commonly found throughout the north-eastern wheatbelt, and another limitation is the presence of salty water tables in many otherwise satisfactory dam sites. Solid rock or semi-weathered rock is also sometimes present and can limit depth and size of dams.

**Ring tanks** are excavated tanks with above ground storage, and are useful on sites where dam depth is limited by a shallow salt-water table, poor holding soil at depth, or rock. They are sometimes incorrectly called 'turkey nest' dams, and are also known as four-way push dams. They are useful on relatively flat sites, and can be either square or circular in plan.

The above-ground embankment of ring tanks is continuous around the excavation with a pipe laid through the wall at ground level. This allows water to gravitate into the excavation, up to the original ground level. Closing the pipe and pumping over the wall then allows additional storage.

**Capacity per farm and per sheep equivalent**

In 1970 the mean total dam capacity for farms with dams, in 63 shires was 11,150 cubic metres. The figure for the Beacon district was 11,930 cubic metres, ranging from 1500 cubic metres on one farm to 31,150 cubic metres on another; 10 per cent of all farms had total dam capacities less than 3400 cubic metres and 10 per cent had total capacities greater than 22,300 cubic metres.

The mean total dam capacity per sheep equivalent varies widely between districts and partly depends upon the availability of other water sources on the farm. In some districts which depend largely on dams for stock water this ratio can be as low as 4.9 cubic metres per sheep equivalent (for example, Broomehill 1976) but at Westonia in 1973 it was 8.9 cubic metres per sheep equivalent.

Individual farms vary widely in the available dam capacity per sheep equivalent.

**Evaporation from dams**

Evaporation loss occurs from all dams in W.A. every year at a variable rate which increases from approximately 1 m depth per year at the south coast, to more than 2 m depth per year in the northern wheatbelt.

Reduction of evaporation from farm dams by roofing with conventional roofing is very costly and not economically justifiable. In some particular seasons, when water carting over long distances may be an alternative, a cheap covering material to shade and shelter a dam could be of value. As yet no suitable covering material is available.

**Water quality in farm dams**

The following data on water quality are from the Great Southern region where a water quality survey...
was done by the Department of Agriculture and the Government Chemical Laboratories in 1972/73.

In general, dam water contains a low level of soluble salts—less than 1000 milligrams per litre total soluble salts. It has some turbidity which is largely due to suspended clay particles. It is frequently possible to settle suspended clay from water by treatment of the water in tanks, thus making the treated water suitable for general washing purposes.

Dam water is seldom colourless, usually due to small amounts of soluble organic materials, and it contains small but variable amounts of the plant nutrients, phosphorus and nitrogen.

An annual trend in acidity occurs. pH values tend to rise gradually from approximately 6.7 (faintly acid reaction) in winter months to 8.4 (mildly alkaline) by late summer, and with inflow in autumn and winter the pH suddenly falls to 6.7.

Bacterial counts of dam waters are extremely variable. Under certain conditions bacterial counts are greater than normal. These conditions occur when:

(i) large amounts of organic matter are washed into a dam.
(ii) the water level in a dam is low and direct faecal contamination can occur, or
(iii) a carcass of a dead animal is allowed to foul the water.

Dissolved oxygen concentrations in surface water samples from dams are commonly high, due to the presence of algae. Algae are fairly universally present in dams and occasionally, when conditions are favourable, some toxic forms of algae proliferate and may result in deaths of animals drinking from the dam.

These water quality limits allow the water stored in dams to be normally satisfactory for use by all farm stock and for homestead uses such as garden watering and toilet flushing.

Organic pollution of dams

Following heavy summer and autumn storms on dry pasture a considerable quantity of plant debris and animal manure may be washed into farm dams. When this occurs, the resulting mixture of water and rotting organic matter is apparently unpalatable to sheep for several days. If no other source of water is available, sheep will drink this water with no obvious ill-effect. Water colour can be adversely affected for more than twelve months after such events, due to the gradual breakdown of organic matter and release of soluble organic fractions into the water.

Some farmers have devised means of diverting high flows in summer, using earth embankments. Others have used various filtering structures such as walls of loose rocks and angled fences of rabbit netting.

If such protection is not used, the severity of the problem can be reduced by the mechanical removal of as much of the organic matter as possible from the water surface before it absorbs water and sinks.

In brief

- Farm dams are used to supply water to 50 per cent of the normal stock numbers in the cereal and sheep districts.
- Catchment improvement techniques can be used to improve reliability of existing dams and to enhance the prospects of creating drought-proof supplies from new dams.
- In general, most farms have plenty of available dam capacity. Only a small fraction of this total capacity fills with water in the years of below average runoff.
- Sites for deeper dams than are commonly used at present are generally not available.
- Although evaporation loss from farm dams is recognised as a major and recurrent loss, methods of reducing this loss are unlikely to be economically justifiable.

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