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The Comprehensive Water Supply Scheme

by K. J. Kelsall, Deputy Director of Engineering,
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Western Australia comprises roughly one third of the whole of the Australian continent. However the main population has been restricted to the south-west sector—an area bounded by Geraldton, Kalgoorlie and Esperance.

Although this sector is only 15 per cent of the area of the State, it contains extensive resources, which provided the principal earnings for the State until the spectacular iron ore development occurred in the Pilbara during the sixties.

A valuable part of this south west sector is the area to the east of the Darling Ranges, which is commonly identified as the wheatbelt or the agricultural area. It is an area which is capable of great production of wool and cereals once certain severe natural difficulties have been overcome. One of the most important of these difficulties has been the shortage of potable water.

Most of the agricultural area lies within the 250 mm to 400 mm average rainfall zone. In much of the area the rainfall is adequate and generally reliable, but it becomes lower and less reliable to the east and north east.

During the period of 1920 to 1930, the agricultural area was extensively developed and vast areas were cleared. The clearing of the perennial vegetation caused the natural subsurface moisture balance to be upset, and released vast quantities of salt into the drainage system. As a result, all streams
and rivers became saline, and were thereby unsatisfactory for either domestic or stock purposes.

Also in most of the agricultural area underground water is scarce, and is invariably of high salinity. The common method of providing for farm water supplies has been to construct excavated tanks (dams) to store water which runs off from the natural earth during periods of rain.

In the twenties and thirties farmers' dams were generally small, because the mechanical equipment had not then been developed that would economically construct the large capacity, deep excavations which enable water collected in a good season to be stored and carried through to the following years. Periods of water shortage on farms were fairly common, with resultant high stock losses.

In 1902 Western Australia completed the then world famous Goldfields Water Supply Scheme, which was later expanded to supply towns along the pipe route. So far as the capacity of the Scheme would allow, water was reticulated to agricultural areas adjacent to the pipe line.

District water supplies from local storages had been constructed at Barbalin, Narembeen and Kondinin. These proved to be unreliable, and frequently either failed completely or were very near to failure. In 1937 a 68 km pipe line was constructed from the Goldfields Water Supply Main to Barbalin.

By 1940, the Goldfields Water Supply Scheme was being utilised to its designed capacity, both in respect to the storage available at Mundaring Weir as well as in the size of the pipe line and pumping stations.

Except for those along the Goldfields Main, towns in the agricultural areas had no water supply or unreliable schemes supplied from earth or rock catchments.

Earth catchments responded satisfactorily only in periods of intense rainfall, while rock catchments seldom gave the high run off efficiency that might be expected.

At that time, bitumen catchments were in an early stage of development, while no work had been undertaken to improve run off by the use of roaded catchments.

Of the larger towns, those in the Great Southern had the poorest water supplies. Brookton, Pingelly, Narrogin and Katanning had very inadequate supplies.

Pingelly (population 500) obtained its water from the Hotham River and was so saline that it was not potable at any time of the year.

Brookton and Narrogin were both supplied from local dams, and had been on very severe restrictions for long periods.

On occasions the schemes failed completely, and water was actually delivered by road tankers and pumped into rain water tanks at the rate of 25 litres per head per day.

Katanning (2 500 population) was frequently restricted to receiving fresh water on two days of the week, and brackish water from a local well on the other five days.

Proposal for a water reticulation scheme

Over a number of years, schemes had been investigated by which parts of the area east of the Darling Range might be provided with a reliable reticulated water supply.

However in every case it was found that the revenue which could be generated would barely cover operating expenses, and could not service the heavy annual interest and repayment charges.

Consequently, in January 1946, the State Government forwarded its proposal for a Comprehensive Water Supply, to the Commonwealth Government with a request for financial assistance in the form of a grant.

The justification for this scheme was based on bringing stability to an important area, increasing production, and, most importantly to bring an essential social amenity to the people.

The basic scheme included a provision for the raising of the existing walls at Mundaring Weir (by 9.8 m) and Wellington Dam (by 15.2 m) to increase their storage capacities. However the State Government had agreed to undertake this work from its own financial resources.

The work for which Commonwealth assistance was sought was:

- to increase by stages the capacity of the pumping stations, service reservoirs, and mains on the Goldfields Water Supply Scheme, and to reticulate water to about 2.5 million ha of farmland plus northern sector;
- to construct a steel main with pumping stations and service reservoirs from Wellington Dam to Narrogin, and to reticulate water to about 2.5 million ha of farmland plus towns in the southern area.

The proposal provided that a metered water service would be made available at the boundary of every farm, and that the farm would be rated on an area basis.

The proposal was limited to an area which could be reticulated with reasonable economy from the Mundaring and Wellington Schemes. It omitted the northern agricultural area, but covered about 60 per cent of the cereal and sheep areas which had been developed up to that time.

The modified scheme

The above proposal was not acceptable to the Commonwealth Government, and in October 1947 the State submitted a modified proposal which provided for:

- increasing by stages the capacity of the pumping stations, service reservoirs and mains on the Goldfields Water Supply Scheme, and reticulating water to about 1.6 million ha of farmland in the north-eastern sector;
- construction of a steel main with pumping stations and service reservoirs from Wellington Dam to Narrogin and extending to supply the Great Southern towns from Brookton to Katanning.

This area was obviously the sector within the boundary of the 1946 proposal which was most disadvantaged by the lack of a satisfactory water supply. Also the
modified proposal made provision for a reliable supply of water to 15 substantial wheatbelt towns—excluding those already served from the goldfields main. Of these towns five had no supply at all, while the other 10 were served by unsatisfactory local schemes.

This proposal, which in 1947 had been estimated to cost $8 600 000 was approved by the Commonwealth Government in December 1948.

Work on the scheme commenced in 1949, but due to shortages of material and labour, it was not completed until 1962. The final cost was $20 430 000, of which the Commonwealth Government contributed $10 000 000 as a grant on a dollar for dollar basis.

Extending the scheme

In 1960, a request to the Commonwealth Government for financial assistance to complete the remaining portion of the 1946 proposal at a total cost of $34 968 000 was rejected. The State Government (from its own financial resources) then decided to extend the Comprehensive Water Supply mains to provide reliable water supplies to the towns of Corrigin, Dalwallinu, Pithara, Ballidu and Kojonup.

In April 1963 a further submission was made to reticulate an area of 1.5 million ha plus towns (including Gnowangerup and Broomehill) at an estimated cost of $21 000 000. This proposal is shown on the map as Stage 2. The selected area was located within the boundaries of the 1946 proposal, except for some small additional areas at Kalannie, North Koorda, North Bencubbin and Willoyne, which were assessed as having a high priority, and which could be supplied without any upgrading of the basic hydraulic design of the scheme.

The submission requested a grant on a dollar for dollar basis, and provided justification for the capital expenditure by describing the benefits of increased productivity, stability for the area and improved standard of living. This submission was examined by the Commonwealth Bureau of Economics, which reported favourably on the potential increased productivity in the area, if a reliable water supply was available.

In 1965, the Commonwealth Government agreed to support Stage 2 of the Scheme on a dollar for dollar basis by making available a special interest bearing loan, with a maximum contribution of $10 500 000. In 1970 the Commonwealth Government agreed to increase its contribution to the special loan by $1 500 000 (i.e. to a maximum of $12 000 000), to assist in meeting the escalating cost of the work.

Stage 2 of the Scheme was finally completed in 1974 at a final total cost of $29 747 000.

Proposal for stage 3

In 1967, the Commonwealth Government formulated its National Water Resources Development Programme, and requested submissions from the states. As part of its submission, the Western Australian Government in January 1968, put forward a request for a $6 250 000 grant to reticulate an area of 260 000 ha in the York-Greenhills and Corrigin-Bullaring areas. The areas covered by this proposal are shown on the map as Stage 3. They contain no towns of any size which were not already served with a water supply from the comprehensive system.

These areas were selected on the basis that they could be reticulated at the least capital cost per unit of area serviced, and when this factor was combined with the needs of the areas and with other economic considerations, they qualified for a priority higher than other sectors which still remained to be reticulated within the original boundaries fixed in 1946.

The submission for the 1968 proposal had relied fairly extensively on the predictions for increased productivity which had been developed by the Commonwealth Bureau of Agricultural Economics in 1965, when it examined adjacent areas under the Stage 2 proposals.

The Stage 3 proposal was finally rejected by the Commonwealth Government in September 1972.

At the time that the 1968 submission was receiving its detailed economic assessment by the Commonwealth Government, there was a significant recession in rural industries. However there had been quite a dramatic recovery about the time the rejection was announced, and it was on the basis of the greatly improved outlook affecting wool, wheat and meat that the State attempted to encourage the Commonwealth Government to reconsider its decision. However, these moves were unsuccessful.

Review of the scheme

Thus by early 1973 the Government faced a difficult situation when attempting to determine how to allocate priorities for possible future extensions to the Comprehensive Water Supply Scheme.

Capital costs had been continually rising since the scheme was planned, and there was every indication that in future they would increase at an unprecedented rate.

With the completion of Stage 2 of the Scheme, there remained 1.7 million ha of farmland within the original 1946 boundary which were not supplied with reticulated water, and the cost to complete the remaining work was estimated at $50 000 000. It was further realised that the water charges which it could reasonably fix, were insufficient to service the necessary Loan Funds, even if funds of this magnitude could have been allocated for the purpose. The State was already involved by the 1975-76 financial year in commencing to repay with new Loan Funds the loan obtained for constructing the Stage 2 proposal.

Although no reasons were officially given by the Commonwealth Government for rejecting the Stage 3 proposal, there are reliable indications that it was not satisfied about

- the extent to which water supplies were hampering development;
- the potential for, and economics of, farm dams as an alternative source of supply;
- the justification for the priority treatment given to the York and Corrigin districts.
In reviewing the overall position, it will be noted that the Commonwealth Government initially rejected the 1946 proposal as an integral scheme, and that it repeated this decision when the request to complete the original proposal was re-submitted in 1960.

However it did support with a dollar for dollar grant the Modified Scheme (i.e. the Stage 1 Proposal), which covered the area of farmland within the 1946 boundary that was most disadvantaged by the lack of a satisfactory water supply, and which also provided a reliable water supply to many of the towns whose need was obvious.

The Commonwealth Government was less enthusiastic about the Stage 2 Proposal, which it finally supported with a special interest bearing short term loan.

All indications pointed to the fact that future priorities would need to be carefully allocated, and this cast doubts on the feasibility of persevering with the initial intention of reticulating all farm­lands within the 1946 boundary of the Scheme, before considering any other areas—even though the agricultural area had expanded considerably since 1946.

Another important factor was the manner in which the construction of farmers’ dams and catchments had been revolutionised by the development of new equipment since 1946.

Future priorities
Following the rejection of the Stage 3 proposal, and the refusal of the Commonwealth Government to reconsider its decision, the Department of Agriculture was asked to examine the whole of the agricultural areas to cover the factors which influence the water deficiency of an area. These include:

(a) Evaporation Rate.
(b) Rainfall—average annual; seasonal incidence; intensity; variability.
(c) Availability of underground water.
(d) Catchment soil type.
(e) Depth of water which can be stored in dams.
(f) Salinity.

The Department of Agriculture prepared a report in December 1973 which listed in order of priority, 16 areas with water problems greater than the remainder of the agricultural areas. These areas are identified on the map.
All 16 areas were outside the boundaries of the 1946 proposal. The Department of Agriculture also recognised that there were a number of districts with pockets of land which experience severe water problems.

As a result of the 1973 study, the Public Works Department prepared basic designs for a farmland reticulation programme to serve 964,000 hectares of farmland at West Midland, Eradu and the area to the east of Merredin, at a total estimated cost of $36.6 million.

In 1975 the then Commonwealth Government requested the states to submit long term programmes of projects under its National Water Policy. One of the projects submitted by this State was the proposal for farmland reticulation. Because of the current economic situation the Commonwealth Government is now unwilling to support special purpose finance for water resources development works.

The only recent extensions to the Scheme were the construction of a main to Moulyinning in 1974 and to Lake Grace in 1975. This work was financed entirely from State Funds.

**SUMMARY**

The Comprehensive Water Supply Scheme has been a great boon to the agricultural area, and it has received strong support from all political parties. The Scheme has been responsible for increased prosperity of country towns, the decentralisation of industry, and general improvements in the standard of living. It has given increased security to the areas of farmland that it serves, although the increase in production which was forecast in the submission has not evinced.

Unfortunately the capital cost is very high, and it is difficult to forecast when the next major work of this type will be undertaken, or which area will be first served. However, it does appear that with the readjusted priorities, it is unlikely that any further work will be undertaken within the boundary of the original 1946 proposal.

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**Test sites for farm dams**

The site for a new farm should be thoroughly researched—especially it should be test bored. Preliminary work can make the cost of a dam a much safer investment. Proper site selection and test boring can eliminate failure from poor catchment or excessive seepage.

The dam must be sited to collect water. Test boring should then be done to determine the presence of good holding clay for the entire depth of the dam, freedom from rock which may limit the depth, and freedom from sandy seams and a salty watertable.

A power rotary drill which most contractors have, can be used for exploratory drilling to determine whether rock or a salt water table is present. Inspection of the holes next day will reveal if a salty watertable is present.

Because a power rotary drill mixes the soil, sandy seams may be mixed with good clay and remain undetected. Therefore a hand auger must be used to test for good holding clay and freedom from sandy seams. A hand auger such as a 5 cm Jarret auger with galvanized water pipe used for handles will cost about $20.

Using such an auger, two men can easily hand auger to a depth of 8 metres in two hours. The whole site can be test bored in about one day. For an investment of about $100 for the two man days and the hand auger to test bore, the expenditure of an average size dam is made much safer.

**Number of test holes**

At least five test holes should be bored for every proposed dam site. Holes should be drilled at the corners, and in the middle of the proposed dam floor.

The test holes should be 60 cm deeper than the proposed dam.

**Testing the soil**

The ability of the soil to hold water should be tested. This ability depends on soil texture and plasticity.

Good holding clay obtained from the hand-augered holes should be at least as good as a "sandy clay". A "sandy clay" when moist can be squeezed between the thumb and forefinger into a ribbon 2 to 3 mm thick and 50 mm long. If the soil at the dam site can form this ribbon then it contains enough clay.

The actual quality of the clay should also be assessed. This can be done with experience by determining its plasticity. The more plastic the clay the harder it is to mould into different shapes when moist. Therefore the more resistance a soil has to compression, the better its plasticity and the better it holds water.

*From a Department of Agriculture Farmnote.*