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Underground water supplies in the wheatbelt

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UNDERGROUND W•A•T•E•R

SUPPLIES IN THE WHEATBELT

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Underground water originates from rainfall. The size of the underground resource in any region is broadly related to the amount of rainfall. However, rainfall intensity and seasonal distribution are just as important as the quantity. A relatively small annual fall which consists of a series of heavy showers or storms close together, may be a more effective source of recharge to underground water than a larger total fall that is more evenly distributed over a longer period.

A large annual rainfall, however, is no guarantee that underground water supplies will be readily available. This is because soils and the underlying rocks allow water to infiltrate and move through them with differing degrees of difficulty. Similarly, soils and rocks can store vastly varying amounts of water.

Underground water is not evenly distributed. Australia, particularly south-western Australia, is rather poorly endowed in comparison with areas elsewhere which have a similar rainfall.

Occurrence

Groundwater is contained in the pores between mineral grains and cracks in hard rocks which together can be likened to a sponge through which water is moving slowly.

The rate of infiltration is balanced by losses through outflow, evaporation and vegetative use. The water held in pores and cracks constitutes a storage, which should be regarded as a reserve which may be used in times of drought. It is the amount of seasonal input from rainfall—the recharge—that should govern the rate at which the resource can be pumped without over-exploitation.

Western Australia may be divided into two types of geological areas: the sedimentary basins and the fractured rock provinces (see map). The sedimentary basins contain the larger groundwater resources because their generally sandy soil readily allows the infiltration of rain, and its storage, within the pores of many hundreds of metres of sediment.

Unfortunately, most of the State's wheatbelt lies in a fractured rock province. The soil cover commonly has poorer infiltration characteristics than found in the sedimentary basins, and the subsoil forms part of a laterite profile which only allows water to move through it slowly. The soil cover and lateritic profile is generally 10 to 25 metres thick above fractured bed-rock. Only part of this thickness is saturated and the total water storage is relatively small.

The extremely efficient use of much of the infiltrating rain by native vegetation has led to the accumulation of large amounts of salt in the soil profile over thousands of years. This salt has been brought in by rain.

The clearing of land for agricultural development, however, has drastically reduced the water use by vegetation. This is largely a result of the annual pasture and crop plants having a much shallower root system than the perennial native plants which they replaced. Much more water now drains below the plant root zone, causing the watertable to rise, bringing the stored salt with it. This rising saline watertable is the principal cause of the poor chemical quality of underground water in most of the wheatbelt.

Location of bore sites

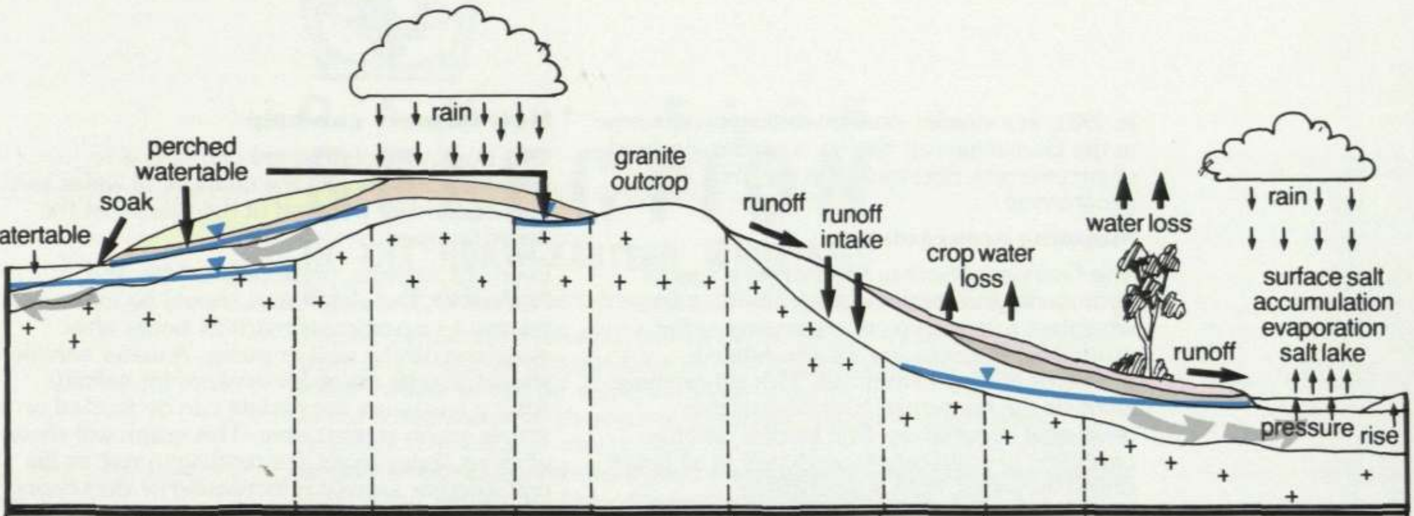
The figure shows a typical section of wheatbelt landscape, including most of the underground conditions under which groundwater occurs.

Rainfall contributes to soil moisture and will run off impermeable surfaces such as granite outcrops and the heavier soils.

Where light soils or gravels occur, infiltration may be enough to sustain a watertable. When these soils are high in the landscape and are over clay, the watertable may be perched, but may still sustain small soaks, even if the saturated material is not thick enough to be exploited by a borehole.

The amount of water that infiltrates and drains below the root zone, and sustains the watertable, depends partly on the type of vegetation and cropping practices over the intake areas.

Small changes in infiltration and drainage below the root zone may result in relatively large changes in the depth to the watertable.



BORE YIELD	LOW MODERATE	LOW SEASON-AL	NIL	LOW	NIL	VERY LOW OR SEASONAL	LOW-MOD	MOD	MODERATE
WATER SALINITY mg/L T.D.S.	2000-20000	500-2000		500-2000		500-2000	2000-10,000	10000-20000	20000-100000
SUPPLY	SOME USEFUL STOCK SUPPLIES	NOT USABLE		MAY BE USABLE		RARELY EXPLOITABLE	USEFUL STOCK SUPPLY	TOO SALINE FOR STOCK	

SAND
LATERITE CAPROCK (COFFEE ROCK OR IRONSTONE)
FINE TEXTURED SOILS
Direction of groundwater movement
CONFINING CLAY
WEATHERED ZONE
BASEMENT ROCK
watertable.

■ Typical section of wheatbelt showing occurrence of groundwater.

Research has shown that the difference between saturated and non-saturated clays (their specific yield) represents a relatively small quantity of water. Thus, changes in cropping practices designed to reduce watertable levels in areas subject to scalt scald may reduce the availability of water to bores.

Almost all bores and wells are sunk below the main watertable. They only have useful yields where the soils will transmit water reasonably well and where the saturated thickness is adequate to provide enough drawdown for pumping.

Although the groundwater associated with a perched watertable may move relatively rapidly, most groundwater moves extremely slowly, generally less than a metre a day. As it moves some water may be taken up by the roots of trees or other deep-rooted plants. Much of the salt brought in by rain, and that mobilised from the soil, remains behind dissolved in the groundwater so that during the course of its movement, groundwater salinity invariably increases.

The distance over which the groundwater has to move before salinity levels become too high for farm use depends on local conditions, but it can be as little as a hundred metres.

Together these factors seriously limit the locations and areas for drilling boreholes which can supply useful quantities of groundwater.

Nevertheless, many wheatbelt farmers have located groundwater with a low enough salt content to be suitable for stock. About 14 000 boreholes in the wheatbelt supply water with a salinity varying between 1 000 and 10 000 milligrams per litre total dissolved solids (T.D.S.). However, few yield more than 5 to 10 kilolitres per day. These characteristics limit the use of underground water to stock supply and, occasionally, for domestic purposes.

Drought drilling programme

The limited extent of favourable underground conditions makes it difficult to confidently select sites for bores in the wheatbelt.

In 1969-70, the Western Australian Government mounted an extensive drilling programme for drought relief at Holt Rock, Ongerup, Mt Walker, Lake Grace, South Burracoppin, North and South Stirlings and South Yilgarn. A total of 67 300 m of drilling was carried out at 2 639 sites, of which 263 were successful in locating useful quantities of water suitable for stock. The overall success rate was 10 per cent, although in different districts the success rate was very variable and ranged from more than 20 per cent at North and South Stirlings, Ravensthorpe and Holt Rock to less than 5 per cent at Lake Grace and South Yilgarn.

A bore was considered successful if it indicated a daily yield of 4.55 kilolitres of water having a salinity of less than 11 000 mg/L T.D.S. All bores were located and drilled under geological supervision.

By 1976, only 118 of these test bores had been developed as successful water supplies, another seven proved to be unsuccessful, and the remainder had not been developed—mainly because significant rainfall replenished surface supplies and new supplies were not necessary.

In 1981, in a smaller drought-drilling programme in the Gnowangerup district, a similar low level of success was obtained as in the 1969-70 programme.

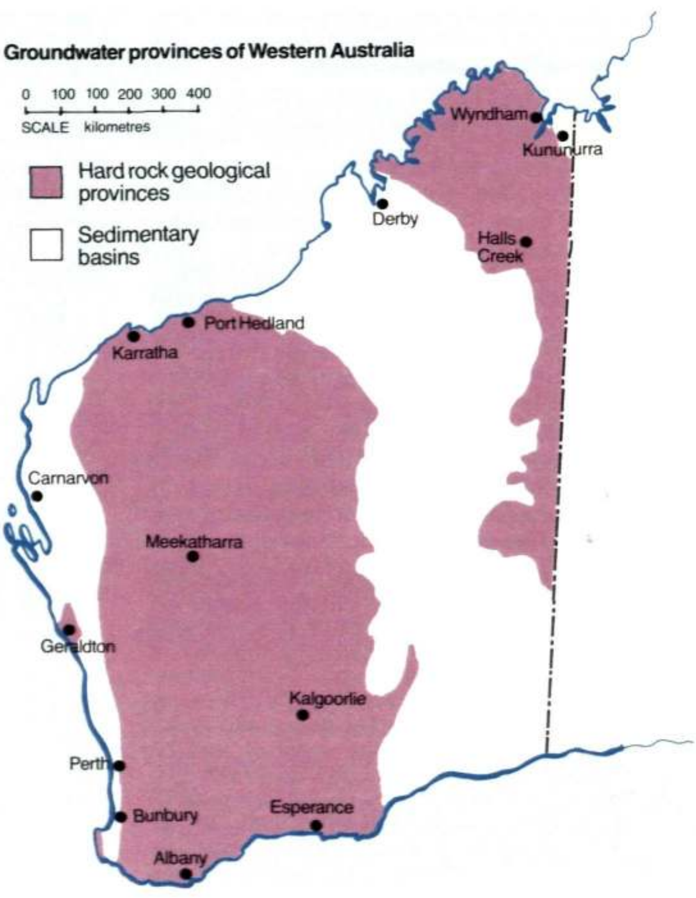
Mapping programme

The Geological Survey has started a special hydrogeological mapping programme in the wheatbelt to improve understanding of the groundwater resources and the related problems of land salinisation. This programme involves the reinterpretation of available geological information, field studies and the collection of comprehensive details of all bores drilled for water, both successful or unsuccessful.

The maps will show the types of rocks which occur, the likely extent of water bearing formations and variations in the chemical quality of the underground water. Where possible, potential yields from bores and wells will be indicated. This new series of hydrogeological maps will be available to the public.

The mapping programme is a long term project. Landowners can help by ensuring that they retain records of the form of construction of bores, types of soil material penetrated and details of the quality and quantity of water struck during drilling or produced by pumping. The Geological Survey will give farmers forms for recording this information.

Groundwater provinces of Western Australia



How farmers can help

One way in which farmers can help is to systematically record the changes of water level in each bore or well and of the salinity of the water pumped.

Every six months, preferably in May and November, the water level should be measured relative to a particular mark 24 hours after switching off the well or pump. A water sample should also be taken for analysis for salinity. After a few years the results can be plotted on a simple graph against time. This graph will show whether water levels are tending to rise or fall and whether salinity is increasing or decreasing.

These trends will indicate whether the source of water is being over-exploited, or turning saline, and thus may give a farmer warning of forthcoming trouble. Any changes are likely to be gradual. For the results to be useful, reasonably accurate water level measurements (within 5 mm) and reliable water analyses are needed. An electrical conductivity test is all that is required and this is available from Department of Agriculture District Offices.

In relatively few instances more comprehensive analyses are needed. These can be done at the Government Chemical Laboratories. A scale of charges applies depending on the analyses done.

Useful contacts

These organisations can help with groundwater problems in the wheatbelt:

- Department of Agriculture. For general advice and some analyses.
- Geological Survey of Western Australia, Hydrogeology Branch. For advice on location, depth and quality of groundwater.
- Government Chemical Laboratories, Water Division. For advice on water quality.