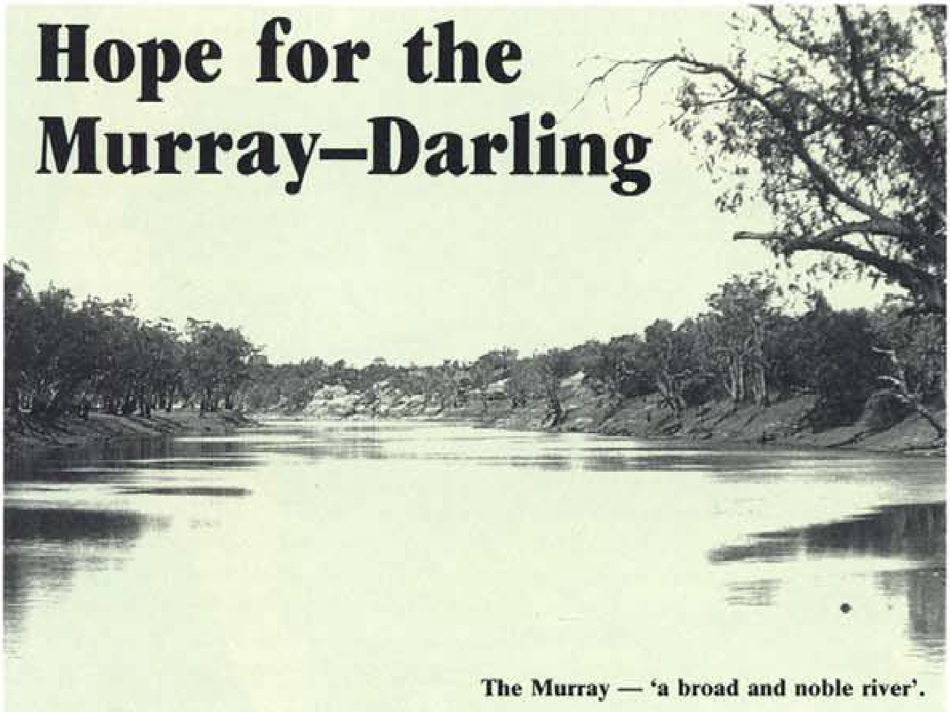
Hope for the Murray–Darling



The Murray — 'a broad and noble river'.

The historic agreement in March this year to form a Murray–Darling Basin Commission may mark a turn-around in the fortunes of this much-exploited and battered resource.

These rivers and the country they drain have been suffering enormous problems of salinity and land degradation for many years. Now, for the first time since Federation, the Commonwealth and the three States along the Murray — Victoria, New South Wales, and South Australia — have been able to agree on coordinated management approaches to the resource.

The new Commission, due to start functioning next year, is one of the first fruits of the Murray–Darling Basin Ministerial Council, an inter-governmental body that met formally for the first time in August 1986 'to promote and coordinate effective management and planning' for the Basin.

The Ministerial Council brings together 12 Ministers from the Commonwealth and the three States (Queensland, which contains one-quarter of the Basin, currently holds observer status).

Another significant outcome flowing from the activity of the young Ministerial Council is the recent publication of a review of the Murray–Darling Basin's environmental resources, compiled by more than 100 scientists and resource managers from State and federal government departments, CSIRO, and universities. This major report, as well as summarising existing scientific knowledge of the Basin, also includes proposals for remedying its ecological ills.

This article highlights some of the issues canvassed in the 'Murray–Darling Basin Environmental Resources Study'. The Ministerial Council is keen for people with environmental concerns for the Basin to make them known — a process that will assist the development of a 'natural resources management strategy'. The Council's Community Advisory Committee, which includes diverse local representatives, is providing inputs on particular concerns, and other interest groups and individuals are also invited to contribute.

Action needed

The terms of reference for the environmental resources study were to:

- ▷ locate sensitive environmental resources that require special consideration, particularly those affected by human activities
- ▷ propose actions that should be taken so as to safeguard these resources, including river red gums and other vegetation, fish, birds, other animals, wetlands, the landscape, heritage sites, and scientific resources
- ▷ identify what further investigations are needed to overcome deficiencies in our knowledge of the region
- ▷ consider how a Basin-wide monitoring program could be set up

The Ministerial Council directed that the study should not simply dwell on problems, but should also 'give adequate attention to the assessment of management issues and their solutions'. Emphasis has therefore been given to proposing actions that could solve the Basin's pressing environmental problems.

As the report dryly notes, 'all is not well in the Basin'. There is growing public concern about widespread land degradation, poor water quality, rising groundwater levels, loss of wildlife, loss of natural vegetation and land forms, overgrazing, and clearance and cropping of marginal land. Annual production losses due to salinity, wind and water erosion, soil acidity, and soil structure decline have been put at $220 million in cropping land alone.

While the study covered the Basin as a whole, its primary focus was on the river systems and their flood-plains, particularly on those issues — like salinity control — requiring an integrated approach by governments and public authorities.

A total of 33 State departments or authorities have responsibilities for aspects of Basin management, and there are 10 inter-governmental organisations with interests in it. In addition, 256 local governments have a stake in the region.

The heartland of the nation, the Murray–Darling Basin takes in about one-seventh of the continent. The waters of the Murray and its tributaries, including the Murrumbidgee and the Darling, are a lifeline for 1·6 million Australians and indirectly sustain many more.

More than 2·5 tonnes of salt flow over the South Australian border every minute.

The Basin supports one-quarter of the nation's cattle and dairy herds, half of its sheep and cropland, and nearly three-quarters of its irrigated land. Annual production is valued at some $10 000 million.

The Murray–Darling River system, comprising more than 20 major rivers, is the fourth-longest in the world — 3780 km. Almost three-quarters of all the water used for domestic, industrial, and agricultural purposes in the nation comes from it. About 90% of the water diverted is used for irrigation. Sixteen cities draw their water supply from it and, in South

Australia, more than 40% of municipal supplies rely on its long-travelled (and distinctively flavoured) waters.

Salty water

South Australians receive the accumulated impurities that up-stream activities have added. The main one is salt; more than 1·3 million tonnes of salt flow over the South Australian border every year — that's 2·5 tonnes every minute. In a dry year the concentration of salt can exceed the World Health Organisation's maximum desirable level for drinking water — 850 electro-conductivity (EC) units — although peak levels are not as high as they were under natural conditions before river flow was regulated. Within South Australia, major inflows of saline groundwater to the Murray cause a steep rise in salinity under both normal and dry conditions.

Land degradation is the most pressing problem.

Much of the river's salt comes from such inflows, caused by rising water tables. These have been brought about by two factors — clearing of native vegetation, and irrigation.

The native mallee trees, with roots extending to a depth of up to 17 m, are extremely efficient at extracting water. Under natural conditions only 0·1 mm of the average 250-mm rainfall escapes past the root zone to recharge the aquifer 30–40 m below the surface.

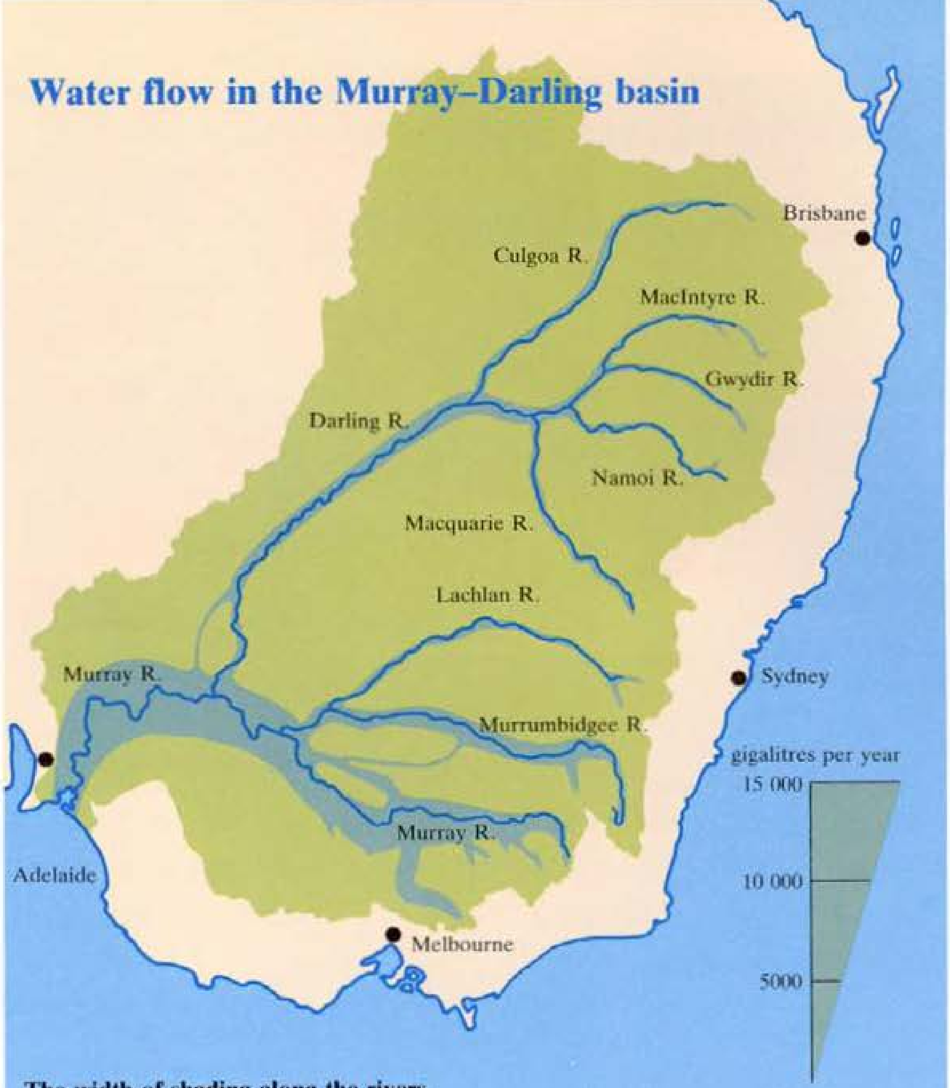
However, in much of the Murray Basin little of the original vegetation now remains. As a result, recharge rates have increased by 3–20 mm a year. In some irrigation areas, groundwater levels have been observed to be rising at rates of more than 200 mm a year. The water table has already reached the surface in some areas, and within the next 20 years a much larger area will become affected.

As the water rises, it brings dissolved salts — principally sodium chloride — to the surface. The amount of salt stored may be 3000 tonnes per ha, or even more.

Initially it was believed that the salt remained from when the sea covered the area millions of years ago. Now scientists consider the salt was borne in on the wind from the ocean and deposited by rain.

As the regional aquifers fill up, increasing areas of irrigation districts will become groundwater-discharge zones and groundwater flow to the Murray will increase.

Water flow in the Murray–Darling basin



The width of shading along the rivers represents annual average flow.

Salinised land — its productive potential destroyed.

Salinised land in South Australia where grapevines once grew.

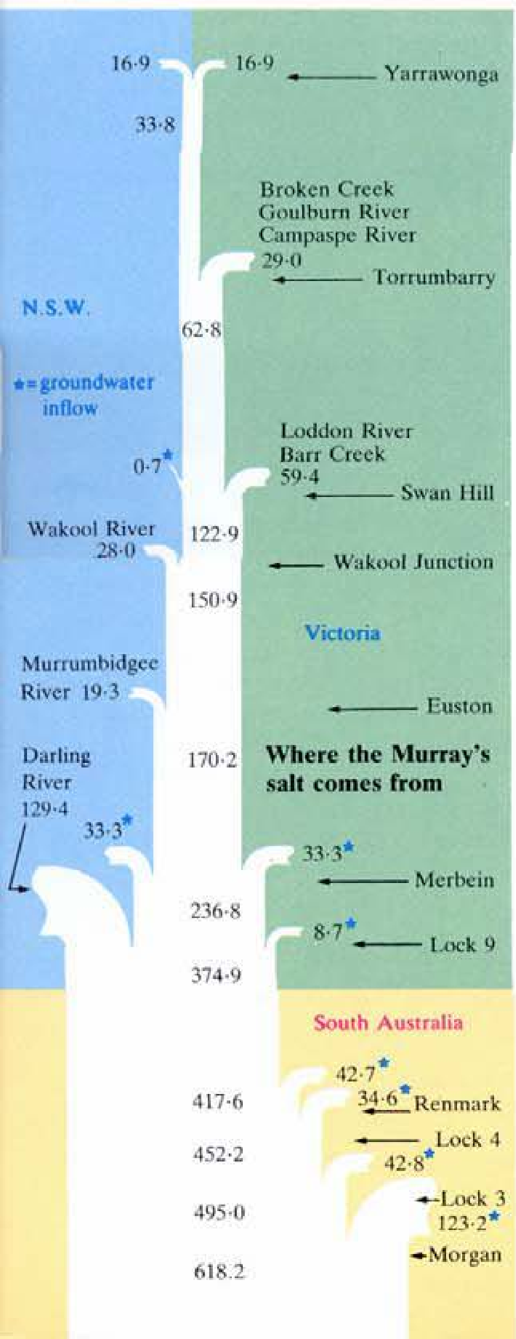
More creeks will become like Barr Creek, which drains the Kerang region and intersects groundwater with a salinity level as high as 60 000 EC. Except when there is rain, Barr Creek is now a salt-encrusted lifeless drain.

Of more immediate concern is the way in which rising saline groundwater creates intolerable growing conditions for crops and remaining vegetation. The Study estimates that 1219 sq. km of irrigation land now suffer from saline soil, and 5240 sq. km overlie an ocean of salt water less than 2 m below the surface.

Fixes — temporary or permanent

In tackling the salt problem, we can treat symptoms or eliminate causes. Engineering schemes stopped an estimated 167 000 tonnes of salt from reaching the Murray in 1984/85. They involve constructing channels or sub-surface drains to intercept groundwater before it reaches the surface and pumping it away to evaporation basins. On average, existing schemes reduce the salinity of Murray River water at the South Australian border by about 30 EC, one-tenth of the salinity at that point.

The figures show, in electroconductivity units, the average contribution of tributaries and groundwater inflows to the salinity at Morgan, S.A.



Tonnes of salt — better harvested commercially (as here at Kerang) than dissolved in the Murray.

But such an operation is not sustainable indefinitely — it only buys time, perhaps 30 years, before the evaporation basin fills up or the advancing tide of groundwater overwhelms pumping capacity.

While acknowledging that some engineering fixes are required to gain immediate relief from the worst excesses, the Study also advocates the permanent, although more difficult, solution: eliminating causes. Methods proposed include reforesting aquifer-recharge areas and phasing out flood irrigation of groundwater-recharge areas and of land prone to waterlogging.

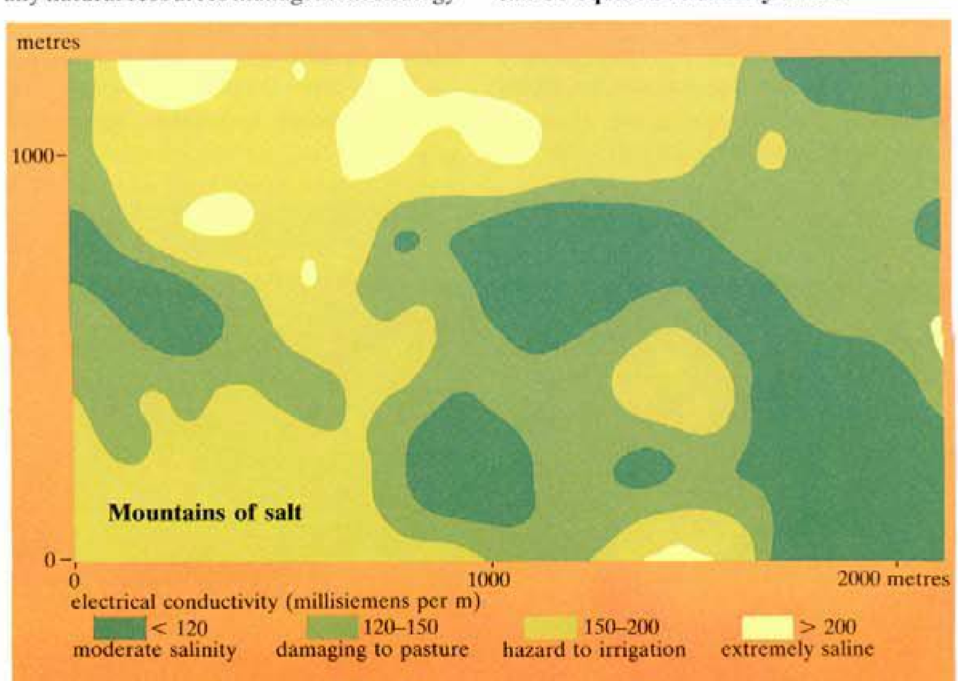
Reforestation would mean ending existing pastoral and agricultural activities. Land retired from irrigation would revert to dryland agriculture or forestry. The difficulties here are likely to be more economic and political than technical. Introduction of such fundamental changes would probably be a slow process. Clearly, any natural resources management strategy would need to include both short- and longer-term measures.

Other possible actions suggested by the Study include:

- ▷ substituting, where practicable, low-salinity deep groundwater for river water used for irrigation and other purposes. This approach could work in the Coleambally Irrigation Area, N.S.W.
- ▷ sponsoring research into desalinisation and re-use of high-salinity groundwater.

Apart from salt, water quality can be compromised in other ways. The Darling River, and the Murray below Wentworth, are often highly turbid. Nutrients, bacterial pollution, and pesticides cause concern at times. A few riverside sewage-treatment plants still release treated effluent to the river instead of onto land.

The results of an electromagnetic survey near Griffith, in the Murrumbidgee Irrigation Area, show contours of underground electrical conductivity, which can be equated to salinity levels.



A spectrum of CSIRO research

The problems besetting the Murray–Darling Basin are diverse and complex, and there are no simple answers. Nonetheless, the efforts of the large numbers of scientists undertaking research in the Basin should help us to understand better what's going on and show what avenues are most likely to lead to effective solutions.

The Environmental Resources Study has drawn on the expertise of more than 100 scientists from State and federal departments, CSIRO, and universities. A brief outline of the most directly relevant research involving CSIRO gives some idea of the scope of the scientific enterprise in the Basin.

The Murray–Darling Freshwater Research Centre

Established in 1986, this is a cooperative venture between CSIRO and three other bodies: the Australian Water Research Advisory Council, the River Murray Commission, and the Albury–Wodonga Development Corporation. Its aim is to study the physical, chemical, and biological conditions of the river and its surrounds.

Combining the resources of the Albury–Wodonga Development Corporation's Peter Till Laboratory and CSIRO's Centre for Irrigation and Freshwater Research at Griffith, the new Centre is mounting a very comprehensive research program. Projects already established include studies of:

- the limnology of turbid waters in the River Murray
- the impact of irrigation on water quality
- the ecology of wetlands, their role in the catchment, and their potential use for treating waste water
- aquatic flood-plain and riverine animals and their responses to different flood regimes
- the impact on river water quality exerted by townships and other settlements along the river, and the consequent need for well-designed monitoring systems
- river-side vegetation and its importance in stabilising river banks
- the causes of tastes, odours, and toxins in domestic water taken from the river

Division of Water Resources Research

This newly formed CSIRO Division takes in most of the water-related research of the former Division of Water and Land Resources (based in Canberra), and of the former Division of Groundwater Research (based in Perth). Some research from the Division of Soils in Adelaide has also been incorporated.

Scientists have been using electromagnetic instruments to survey underground salt stores. The map on page 5 shows results of a survey of 250 ha near Griffith, in the Murrumbidgee Irrigation Area (M.I.A.). Other surveys have covered northern Victoria, the Lachlan Valley, N.S.W., and Lake Victoria, N.S.W.

Investigations of saline disposal schemes (where saline groundwater is pumped to evaporation basins) have also been carried out in the M.I.A. and in the Noora Basin.

Other work involves study of the chemistry of shallow groundwater (less than 10 m deep), with a view to getting basic chemical information for water re-use schemes and for predicting the economics of recovering sodium chloride from groundwater (where it sometimes resides in very concentrated solution).

Remote sensing techniques are being used by Divisional scientists to monitor moisture levels in irrigation areas (the M.I.A., Colleambally Irrigation Area, Wakool, and Shepparton).

Studies near Woolpunda, S.A., seek to assess the change in groundwater recharge following clearing of the native mallee vegetation. Recent results demonstrate that the effect on recharge rates can be unexpectedly variable: whereas scientists can measure a recharge value of 3 mm a year at one site, 100 m away they can find a figure of 50 mm a year — even though the landscape appears uniform.

Basic studies of catchment erosion and sedimentation in reservoirs are under way at a number of sites, and the fundamentals of hydrology are being investigated in several typical catchments.

Division of Wildlife and Rangelands Research

Studies of wildlife along the river and of land degradation are centred at Deniliquin, N.S.W. The semi-arid rangelands in the surrounding area are intensively used, and scientists are looking at the ways in which grazing, fire, and social and economic factors affect the land's productivity.

To overcome the problem that no authority has sole responsibility for preserving, let alone improving, the quality of the water, the Study proposes that the States uniformly adopt water-quality management policies developed by the River Murray Commission. It says water use in the Basin should be integrated into a management scheme that takes into account the whole catchment.

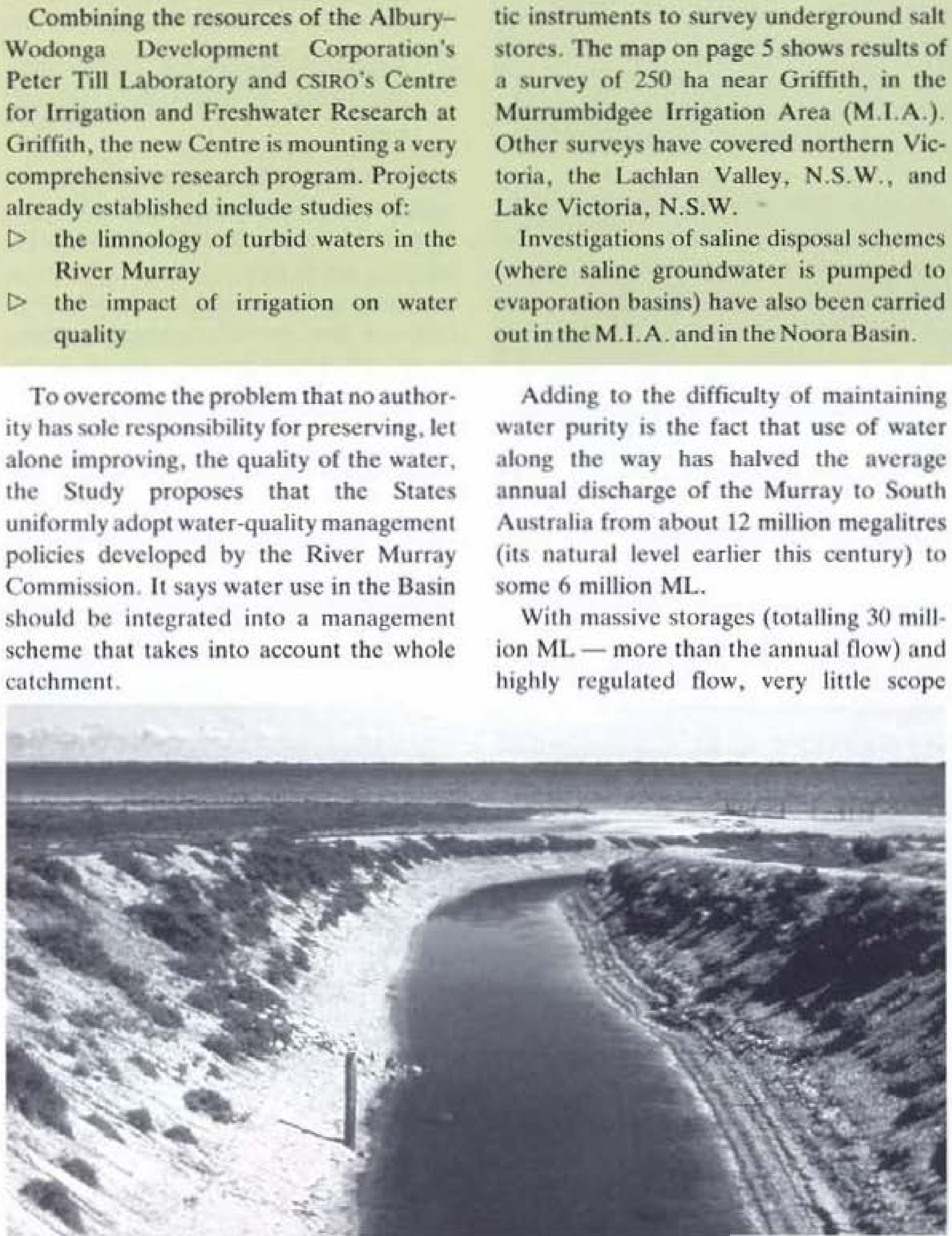
Adding to the difficulty of maintaining water purity is the fact that use of water along the way has halved the average annual discharge of the Murray to South Australia from about 12 million megalitres (its natural level earlier this century) to some 6 million ML.

With massive storages (totalling 30 million ML — more than the annual flow) and highly regulated flow, very little scope remains for further dams (to capture floodwaters and increase the regulated flow). Yet demand for water continues to increase. The Study concludes that water will need to be used more efficiently, and reallocated to higher-value uses.

Each State is introducing 'transferable water entitlements' that allow irrigation farmers to trade their water entitlements. The Study supports this move and advocates application of the 'user pays' principle to all water users, believing that, in the long term, this should result in water being used where it is most profitable.

Land under threat

Salinisation of land is a massive and rapidly growing problem. For example, about



A channel of salty water enters an evaporation basin, Lake Ranfurly. Diverting salt from the Murray in this way buys time, but it can't go on for ever.

The cost of land degradation

form of degradation	$ million per annum
largely non-reversible and cumulative:	
wind erosion of crop land	0·1
water erosion of crop land	5·0
reversible but requires expensive infrastructure:	
shallow water tables (including saline) in irrigation areas	39·1
dryland salinisation of crop land	0·4
reversible through appropriate farm management:	
soil acidification of crop land	27·8
soil structure decline of crop land	144·8
total	217·2

Preliminary estimates of the annual value of agricultural production foregone through land degradation in the Murray–Darling Basin. By far the biggest loss comes from soil structure decline.

140 000 ha of Victorian irrigation areas are now described as affected by salinity, and a further 395 000 ha are judged salt-prone, and likely to be at risk following wet years. The Victorian government sees salinity as the single greatest threat facing the State's environment, and has committed itself to 'Salt Action', a $90 million program to address the problem.

Groundwater levels in Victorian irrigation areas are estimated to have risen by 250 mm a year for the past 80 years. If this rate continues, by 2020 the water table will be close to the surface over an area of more than 520 000 ha.

In New South Wales, as much as 19% of the irrigation land is suffering salinisation. The area affected by high water tables is expected to increase from 201 000 ha to 295 000 ha over the next 8 years.

Dryland salinity — due solely to raised water tables from vegetation clearance, and not to irrigation — is also a problem over about 45 000 ha in Victoria. The area is much less in other States, although it may be underestimated. Generally, the amount of land affected is, depending on locality, increasing by 2–5% a year.

The Study concludes that land degradation is the most pressing problem in the Murray–Darling Basin. It takes many forms besides salinisation.

Wind erosion is a major problem in pastoral lands, and sometimes extends into crop land during drought. Water erosion is a significant hazard in all areas. Soil acidity, due to pasture improvement and use of fertilisers, occurs extensively in the south-eastern cropping and pasture lands. Soil structure decline, from the effects of ploughing, is widespread in cropping areas. Finally, shrub invasion of semi-arid grazing lands, and decline of palatable rangeland species, afflict wide areas; and pest plants and animals cause degradation and heavy economic losses throughout the Basin.

Whereas soil erosion caused by surface run-off is the most widespread form of land degradation, preliminary calculations in the Study indicate that soil structure decline brings about the largest loss — $145 million — in annual agricultural production foregone. This compares with a $39 million loss from raised water tables, $28 million from soil acidification, and more than $20 million for the pest plants blackberry and serrated tussock.

The Environmental Resources Study proposes that the primary goal in managing land resources should be to achieve efficient and sustainable production while avoiding or minimising off-site effects. Land use planning and community participation in the integrated management of all resources within catchments should be utilised more fully to achieve this. Appropriate legislative measures may be needed.

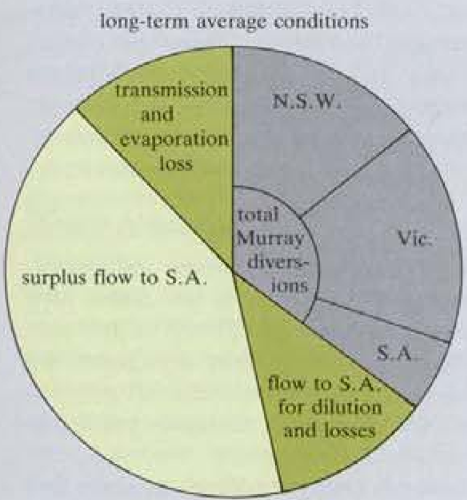
Farm size in dryland areas should be examined, and drought policies should ensure protection of the land as a first priority. To improve decision-making, better land resources information should be made available, perhaps on computer data bases.

And, of course, more research into salinisation, soil erosion, acidification, soil structure decline, and pest-plant control is vital.

In a dry year, there's no surplus water. And, with little scope for extra storages, no additional water-consuming uses can be entertained — unless we can improve the efficiency of existing uses.

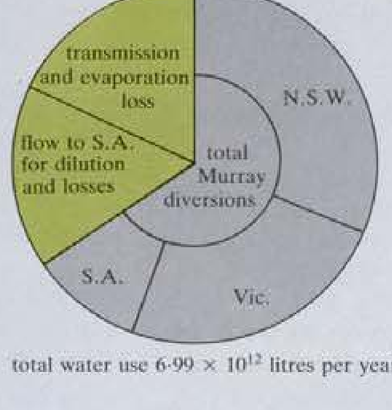
Where the Murray's water ends up

long-term average conditions



total water use $11{\cdot}25 \times 10^{12}$ litres per year

typical dry conditions



total water use $6{\cdot}99 \times 10^{12}$ litres per year

Overcome neglect

The report goes on to examine other deteriorating aspects of the Murray–Darling's environment. Separate chapters deal with aquatic and riverine resources; flora and fauna; vegetation management; parks and reserves; and cultural heritage.

The Study points to the lack of conservation of the riverine ecosystems that existed before European settlement as a major area of neglect in management of the Basin. We have not given nearly enough attention to the needs of wetlands, floodplains, inland fisheries, river red gum forests, and water-bird habitats, it concludes.

Proposals for remedying the situation include establishing vegetated buffer zones along the rivers to reduce pollution, particularly from soil erosion, and establishing wildlife corridors to allow fauna to move between various national parks and nature reserves.

Andrew Bell

More about the topic

'Murray–Darling Basin Environmental Resources Study.' (Murray–Darling Basin Ministerial Council: Canberra 1987.) The report is available from the Murray–Darling Basin Ministerial Council Secretariat, C/- Department of Resources and Energy, G.P.O. Box 858, Canberra, A.C.T. 2601. It is now being used as a basis for developing a natural resources management strategy for the Basin. Comments on the report and its implications for strategy development are invited and should be forwarded to the Secretariat at the above address.