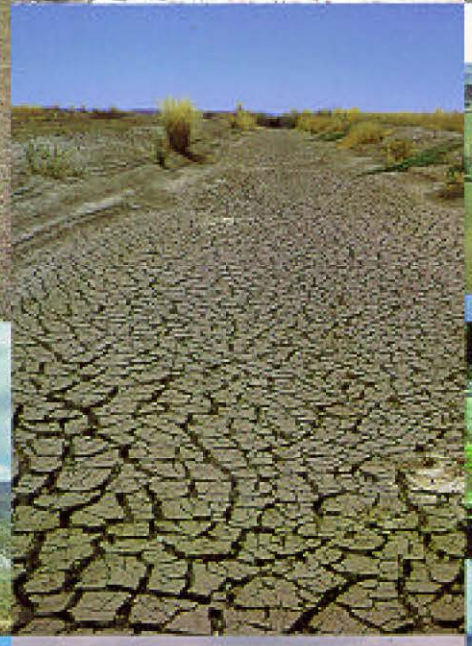
Soil Conservation



LAND & WATER CONSERVATION

Soil Conservation

Land degradation, including soil erosion, is one of the most urgent and difficult problems facing the world community today. According to figures published by the United Nations Organisation, the present rates of soil loss through erosion alone may be as high as 2 500 million tonnes per year — over half a tonne for every man, woman and child on planet Earth!

Yet the form and threat of soil erosion have been known for centuries. North Africa, for example, once the rich granary of the Roman Empire, is now a region of desert or semi desert and has to import much of its food supplies. Across the great plains of the United States of America some 2.5 million hectares of land, unsuited for cultivation with the farm technology then available, were ploughed between 1880 and 1920. During 1933 and 1934, in the wake of a severe drought, immense dust storms blew away between five and thirty centimetres of topsoil, creating the dust bowl of North America.

So far as Australia is concerned, our continent was relatively undisturbed before European settlement in 1788. Until then, Australian soils had supported between 300 000 and one million Aborigines. For thousands of years these original Australians, with their hunter-gatherer lifestyle, placed little strain on the environment. The only changes to the landscape came from the cumulative effects of natural erosion — the slow gradual processes which loosen and remove earth and rock from all parts of the Earth's surface. But with European settlement came European farming methods — methods which were ideal for the climate and soils of Europe but which proved unsuitable for most farming areas of Australia. Unfortunately, it has taken almost two hundred years to understand the severity of the consequences of the long term use of European farming methods and European designed farming tools. As a nation, we now have soil erosion and other land degradation problems which seriously affect our capacity to continue producing enough food and fibre for home use and for export.

Soil Conservation

A BIG COUNTRY

We are all aware of the terms "Wide Brown Land" and "The Big Country" as applied to the Australian continent and both descriptions are accurate. But while the land mass of Australia equates with that of the United States, the comparison suffers when we examine areas of land available for cultivation. Large tracts of Australia are either arid or semi-arid and only about 10 per cent of the continent has that combination of suitable soils, terrain and climate to sustain relatively high levels of agricultural production.

Unlike the soils of Europe and North America, Australian soils are both ancient and shallow. Much of the fertile soil in the United States is metres deep, while a spade pushed into an Australian paddock is likely to strike subsoil fifteen centimetres below the surface. In the pioneering days there seemed to be unlimited land available although there was little in-depth knowledge of the new country other than that provided by earlier explorers. There was a total lack of information on the capability of Australian soils either for grazing or cropping. Unwittingly, perhaps, the pioneers were to write the first chapter in the history of land abuse in Australia.

BEGINNINGS

Not until the 1930's, when the first Erosion Committee in Australia's history was formed in New South Wales, were the consequences of 150 years of mismanagement of our soil resources revealed. The Committee found that soil erosion was widespread on farming and grazing lands and reported that ". . . this

◀ *Serious gully erosion prevents the land from being used to its full potential.*

▶ *Landholders who require erosion control earthworks to be built on their property can hire heavy earth-moving equipment — complete with driver — from the Soil Conservation Service. To enable the vital work to proceed without delay, a Government-backed loan may also be made available. The Plant Hire Scheme plays a vital role in the fight against erosion in rural New South Wales.*

State, still in the early stages of its agricultural and pastoral occupation, is liable to very serious losses."

The gravity of the report spurred the State Government into action, and in 1938 a Soil Conservation Bill passed through Parliament, paving the way for the subsequent establishment of the Soil Conservation Service. This was the first piece of conservation legislation to be enacted in Australia.

The Soil Conservation Service of New South Wales drew on the information gathered by the Erosion Committee to devise effective means of preventing the further deterioration of the State's soil resources. This demonstrated that while different types of soil erosion could be quickly identified, much more detailed knowledge was needed on how the many variations in climate, soils and landforms influenced the erosion process. Accordingly, six Research Centres were set up at strategic locations throughout the State with the aim of developing erosion control measures and land use practices which could be conveyed to landholders by means of practical demonstrations.

EROSION SURVEY

A full-scale attack on the erosion problem was delayed by the outbreak of World War II. However, 1943 saw the completion of the first detailed erosion survey of the State. It revealed that 48.3 per cent of the Eastern and Central Divisions of New South Wales — which includes almost all the arable areas and carries 90 per cent of the livestock — had suffered appreciable erosion damage. Since some of this area comprised what had been highly productive land, its loss was a severe blow to the State's agricultural potential. In all, nearly 22.7 million hectares of agricultural and pastoral land in the better rainfall areas were considered to be potential wastelands unless drastic changes in land use were introduced. The post-war strategy of the Soil Conservation Service was based largely on the results of this survey.

To step up Service activity, the concept of community involvement and community benefit in erosion control was introduced in the form of soil conservation projects. A project provides a coordinated approach to the problems of erosion within a defined area, usually a water catchment area or an entire valley. Properties within the project are provided with erosion control plans, necessary structures are installed and improved land management practices are introduced to meet standards specified by the Soil Conservation Service. Projects are essentially joint ventures between landholders and the State Government and can be initiated by either.

Soil Conservation

The first soil conservation project commenced at Goorianawa, north-west of Coonabarabran, in 1956. Since then more than thirty soil conservation projects have been undertaken in various parts of the State.

THE WIDER SCENE

Our Catchments

The 1938 Soil Conservation Act made the Soil Conservation Service responsible for protection of the State's vital water catchment areas. As with the grazing and cropping lands, the early years of settlement saw the over-clearing of our steeper hillslopes which removed the protective tree canopy and exposed the soil to the erosive effects of rainfall. This accelerated the rate of water runoff, eroding the lower slopes and washing huge quantities of sediment — our precious topsoil — into streams and water bodies.

Since Australia's continued development called for the building of large water storage dams and reservoirs, it was obvious that those facilities would be rendered useless if the heavy sediment flow could not be arrested. Fortunately, controls were introduced in 1946 to regulate clearing along riverbanks, and the administration of this function was taken over by the Catchment Areas Protection Board in 1972 (the Board's Deputy Chairman being the Commissioner of the Soil Conservation Service).

Since that year the Board has been mapping steep land throughout the State, and since 1987 it has been mapping environmentally sensitive land as well.

◀ *Unsound land practices may lead to severe land degradation.*

▶ *Overclearing of steep timbered land can be a major cause of soil erosion.*

These three categories — riverbanks, steep and environmentally sensitive lands — are known as "protected land" under the Act and, subject to minor exceptions, anybody wishing to lop, fell or remove any tree, sapling, shrub or scrub on protected land must first obtain an authority from the Board. Where permission is granted to injure or destroy any trees, etc., on protected land, the Board always imposes stringent conditions.

Mining

Australia's post-war development saw mineral exports replace wool as this country's biggest single export earner. The mining boom also brought increased concern for the environment as both government and industry realised the necessity of repairing the landscape and rehabilitating areas disturbed by mineral extraction.

In 1973 the NSW Department of Mineral Resources introduced new legislation governing the rehabilitation of mined lands which specified the Soil Conservation Service of NSW as the authority responsible for approving the conditions for post-mining treatment of land. The Service was no stranger to this problem, having been involved in stabilisation works associated with the vast Snowy Mountains Hydro-Electric Project during the 1950's and 1960's.

The close cooperation which developed between the Soil Conservation Service and the mining industry saw the emergence of intensive research programs, along with the publication of several case histories, and the holding of a succession of rehabilitation seminars. The Service also collaborated in the writing of a handbook on mine rehabilitation published by the New South Wales Combined Colliery Proprietors Association.

Urban Development

Australia is one of the world's most urbanised countries, with 85 per cent of its citizens living in large cities or towns. To meet the continuing demand for housing, factories, supermarkets, highways, etc. huge tracts of land must be converted for urban or industrial use and, without adequate safeguards, severe problems can arise. In the past, erosion, sedimentation and structural damage have cost developers, individual home owners and ratepayers dearly. Today, local authorities and developers are acutely aware of the difficulties that can follow massive disturbance of the urban landscape.

◀ *More than 100 years of mining operations left a 15 hectare waste dump at Captains Flat, near Canberra. The eroding dump sent toxic matter into the Molonglo River and threatened the viability of Lake Burley Griffin. Following a Federal/State agreement the ravaged area was re-shaped and covered with rock and clay. The Soil Conservation Service then moved in to revegetate the entire area with grass and clover. The resulting 'new' landscape is shown in this photograph.*

◀ *Land subjected to coal mining has been re-shaped and rehabilitated (foreground) while in the background, mining continues.*

Soil Conservation

To avoid unnecessary and costly damage the Soil Conservation Service, on request, will assess an area's capability for urban development. This is done by collating and mapping the land resource data of a region and then analysing that data to gauge the impact of any proposed development. Aerial photography and field surveys are used to identify land slopes, the type of terrain, drainage patterns and other significant features. Data from soil surveys and laboratory analyses provide descriptions of the types of soils found in the area, in particular those factors which will affect planned developments. Flowing from an interpretation of all resource data, the Soil Conservation Service can provide guidelines to maintain the stability of the land surface in relation to three broad categories of development:

commercial/industrial;
residential;
recreational.

► *Eroded sand dunes are fenced off while new vegetation is established. Specially designed walkways provide pedestrian access.*

When a decision is made to proceed with a new suburb, industrial area, park or shopping complex, the Service can recommend measures which are designed to minimise erosion and sedimentation.

Beach Protection

Well managed sand dunes are very effective coastal protection features. They absorb the erosive energy of waves generated by storms and act as reservoirs of sand to nourish the beach during periods of normal wave activity. Vegetation on the dunes traps wind-blown sand, adding to dune build-up and preventing sand from being blown inland.

Even with their protective covering of vegetation, beach dunes are so fragile that too much trampling can damage or kill the plants, placing the dune at risk. Vehicles driven across dunes are even more damaging, greatly increasing the chance of destroying dune vegetation.

The Soil Conservation Service is actively engaged in beach dune rehabilitation programs along the New South Wales coastline. With the collaboration of local councils, State Government departments and other interested bodies, the Service has stabilised many eroding sections of beach dunes. This vital work continues. Large tracts of beach dunes and hind-dune areas which have been mined have also been restored and stabilised by re-shaping and planting with grasses and shrubs. The Service is assisted in these latter operations by the cooperation of mining companies and the Department of Mineral Resources.

Soil Conservation

Roadside Erosion

Road networks provide essential access, transport and communications but can dominate the landforms they traverse and exert a major impact on natural drainage patterns within catchments.

To avoid creating erosion hazards the planning and construction of associated road drainage should be coordinated with all new roadworks. For best results this should be complemented with permanent and temporary soil conservation control techniques to improve the control of water flowing within the particular catchment.

In pursuing the concept of coordinated road drainage systems, the Soil Conservation Service cooperates with road authorities, landholders, urban and commercial developers, mining groups and others to ensure that the entire community will benefit. The advantages which stem from this approach include:

- halting of gullies forming along drainage lines
- protection of drainage structures from undermining
- control of erosion in rural and urban property
- reduced sedimentation of streams, farm dams, reservoirs, etc.
- prevention of sedimentation of roadways
- reduced road maintenance costs
- prevention of roadside erosion.

Research

A fuller understanding of the cause and effects of the erosion process is essential for the further development of effective control methods. To expand its

◀ *Operating from 66 offices throughout New South Wales soil conservationists provide practical and effective advice to landholders.*

Field staff using a Total Surveying Station which stores survey observations electronically in a data recorder.

Computer work station used by survey staff to interpret field data.

capability to deal with problems of land degradation, the Soil Conservation Service operates Research Centres at Gunnedah and Cowra, together with Research Service Centres at Inverell, Scone, Wellington and Wagga Wagga.

The Centres at Gunnedah and Cowra concentrate on research applicable to the northern and southern parts of the State respectively, both undertaking studies aimed at meeting the following objectives:

- developing methods of delineating the type, severity and extent of land degradation in New South Wales
- identifying and quantifying land degradation processes and consequences
- developing land degradation prevention and control technology
- evaluating the economic/social benefits of soil conservation and the economic cost of land degradation.

Research Service Centres provide back-up technical services as well as conducting specific investigative programs.

Mapping Program

To provide an inventory of those areas of the State capable of supporting rural activities, the Service has prepared rural land capability maps of the Eastern and Central Divisions. At a scale of 1:100 000, the maps are used as part of the natural

Soil Conservation

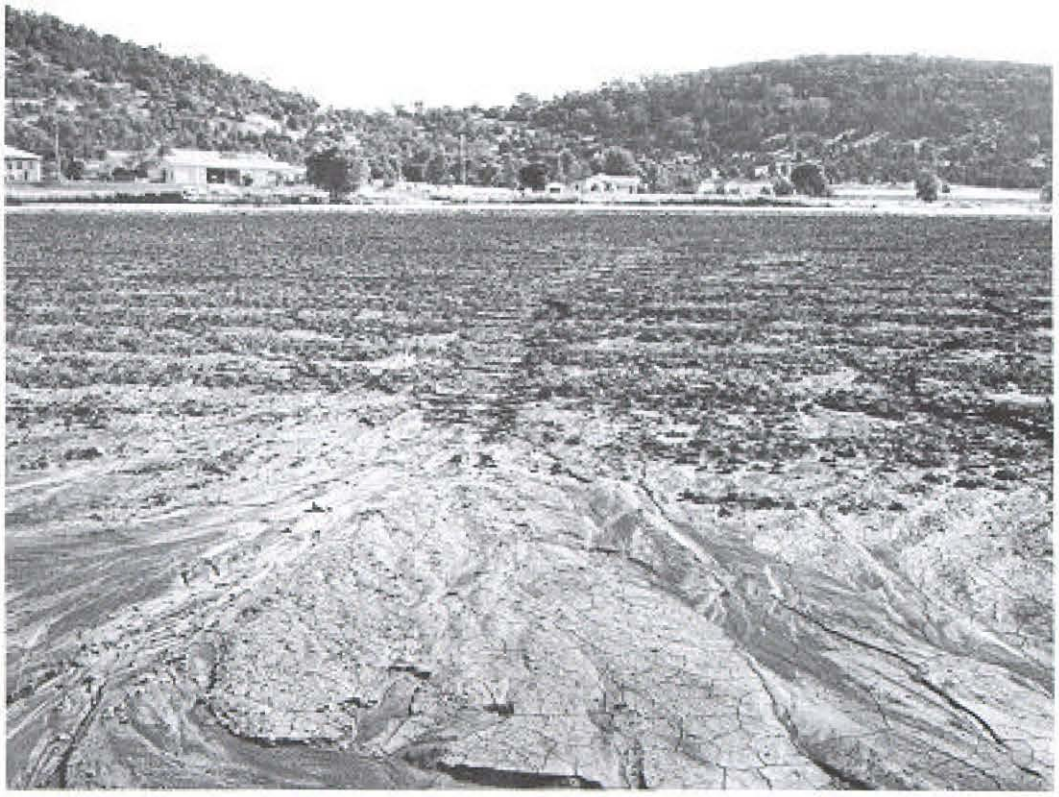
resources information needed for wise land use planning and management.

A series of soil erosion surveys of four major river valleys in the State was commenced during 1985. Prepared at a scale of 1:100 000 and intended to overlay the 1:100 000 land capability maps, these surveys will reveal the location and extent of erosion in the catchments of Warragamba Dam and the Shoalhaven, Hunter and MacIntyre Rivers. This information will be used to:

- highlight to the State Government, local councils and land users, the extent and severity of soil erosion problems within each catchment
- identify types of treatment needed to control erosion
- identify areas for priority treatment
- prepare estimates of costs of soil erosion control.

Soil landscape maps at a scale of 1:250 000 for the eastern half of New South Wales are underway. In addition more detailed maps of 1:100 000 covering the Sydney region are being prepared. Both are to be accompanied by a booklet. The maps provide detailed soils and related land resource information for local and regional planning authorities.

In the arid Western Division of New South Wales, the Service is continuing a land assessment and resource inventory program for each of some 1 500 holdings in the Division. The information obtained is used to assess safe stocking rates for individual holdings, to identify areas suitable for particular land uses and as a basic tool on which to base land management decisions. Additionally, the Service has almost completed a land system mapping program for the western part of the State at a 1:250 000 scale.



◀ *Heavy soil losses threaten the future of cropping.*

A NATIONAL PROGRAM

While it is recognised by all governments — State and Commonwealth — that soil erosion and land degradation are by far the most serious long-term environmental threats to Australian land resources, a national approach to erosion control has been slow to emerge.

Any doubts as to the magnitude of the problem were eliminated when the results of a comprehensive Commonwealth/States study were published in 1978. Titled 'A Basis for Soil Conservation Policy in Australia' the study revealed that 55 per cent of arid Australia and 44 per cent of the more intensively used areas were in need of treatment in order to maintain productivity. So far as New South Wales is concerned, approximately 90 per cent of

Erosion has rendered this land — and any improvements to it — virtually useless.

the agricultural and pastoral area needed some type of soil conservation treatment.

In 1984, a National Soil Conservation Program was launched by the Commonwealth Government with the following objectives:

- development of sound long-term land management practices
- education on the problems of land degradation and the need for soil conservation
- coordination of policy and action by all organisations and individuals involved
- implementation of appropriate land use practices
- restoration of degraded lands and the protection of existing productive potential.

The National Program has two basic components:

- erosion control projects funded directly by the Commonwealth
- projects undertaken by State soil conservation authorities.

Priority is given to projects requiring national coordination or to problems which exist in more than one State. Funds are provided to organisations with expertise in the area of soil conservation for projects involving public education, practical demonstrations, training and research.

Under the State component of the National Program assistance is provided for projects undertaken by the responsible State authorities. However, individual States are expected to maintain their existing levels of expenditure on soil conservation works.

Soil Conservation

NEW DIRECTIONS

State Soils Policy

A policy has been prepared by the Soil Conservation Service following discussion and review with interested people and organisations. This policy has been formally adopted by the Government and recognises the following principles:

- use of the State's soils for any purpose should not lead to their loss or degradation and must therefore be within the bounds of their inherent capability to ensure continued utility, stability and, as appropriate, productivity and improvement
- the New South Wales community as well as the individual land user has a responsibility for preventing and mitigating soil erosion and land degradation and for maintaining the utility, stability and productivity of the State's soils. Statutory provisions will be utilised to achieve these latter ends as necessary
- a State soil conservation program with vigorous national support, implemented via a properly conceived statutory framework by a soil conservation organisation adequately equipped and funded is essential for the conservation of the State's soil resources
- conflicts of interest in relation to the use of the State's soils should be resolved within the existing planning framework and due account taken of the finite nature of those soils, their capability and their suitability

◀ *Specially designed earth banks and farm dams control erosion on mixed farming land.*

- Total Catchment Management which takes a cooperative and integrated whole catchment approach to soil, water and vegetation resource management is the most effective framework within which to implement soil conservation and rehabilitation measures
- land capability and land suitability assessments which take full account of soil characteristics and limitations are essential prerequisites to determination of the best use of the State's lands and associated soils
- in the case of agricultural soils, there is a need to maintain and, where possible, improve soil fertility, structure and productivity through proper land management practices
- recognition that some of the State's soil resources will be rendered agriculturally unproductive through

infrastructure development and use but that this impact on the productivity and stability of the State as a whole should be minimised

- education and community participation programs are essential to achieve a wider awareness of the costs of soil degradation and of the need for soil conservation and rehabilitation as well as community commitment to stewardship of the State's soils.

THE NEW AGRICULTURE

For many years land has been cultivated to prepare a seedbed, to control the growth of weeds and to conserve the moisture held in the soil. However, it is now known that many traditional methods of cultivation cause a breakdown in the structure of the soil itself. This can lead to a number of problems including:

- sealing of the soil surface
- compaction of topsoil
- reduced water and root penetration
- retarded crop growth
- increased erosion.

The realisation that cultivation could be harming the soil coincided with the development of improved ways of controlling weeds by using chemicals. This led soil scientists to look for alternative ways of managing the soil, with the aim of reducing soil erosion by improving soil structure and shielding the soil surface from the ravages of wind and water. The result was **Conservation Tillage**. This is a system of cultivation which uses far fewer or no tillage operations, where both weeds and insect pests can be controlled by using herbicides and insecticides, and where crop residues are retained.

Since their introduction, conservation tillage practices have been widely adopted in New South Wales as a means of reducing soil degradation caused by repeated disturbance of the soil.

Conservation tillage practices include reduced tillage, no-tillage or direct drilling and strip cropping.

Reduced Tillage

The general term for a tillage system in which crops are grown with fewer tillage operations than is traditional. Herbicides and/or grazing animals may be used for weed control.

No-tillage or Direct Drilling

A system of minimum tillage, with the crop sown directly into a soil which has remained untilled since the previous crop was harvested. Weed control is by grazing, burning or by the use of herbicides. The retention of stubble is encouraged to protect the soil from erosion but in certain farming systems, it may be removed by grazing stock.

Strip Cropping

Strip cropping is a management technique designed to combat water erosion on very gently sloping country. Strips of growing crop, stubble or pasture, laid out at right angles to the water flow, slow the water and reduce its erosive power before it flows across fallowed land.

For many years, strip cropping has been used successfully to prevent erosion

Conservation tillage — retaining stubble helps protect the soil from erosion.

Soil Conservation

on low-slope farming country, particularly in northern New South Wales. Strip cropping methods have been further developed and integrated with the latest crop rotation practices embodied in conservation farming.

After almost 200 years of agricultural development in New South Wales, conservation tillage systems are fast becoming a major factor in the reduction of soil degradation. However, it is only part of the answer to our degraded soils. In the long term, all land must be used in a manner which causes neither soil erosion nor loss of utility. This calls for correct land assessment, planning and management.

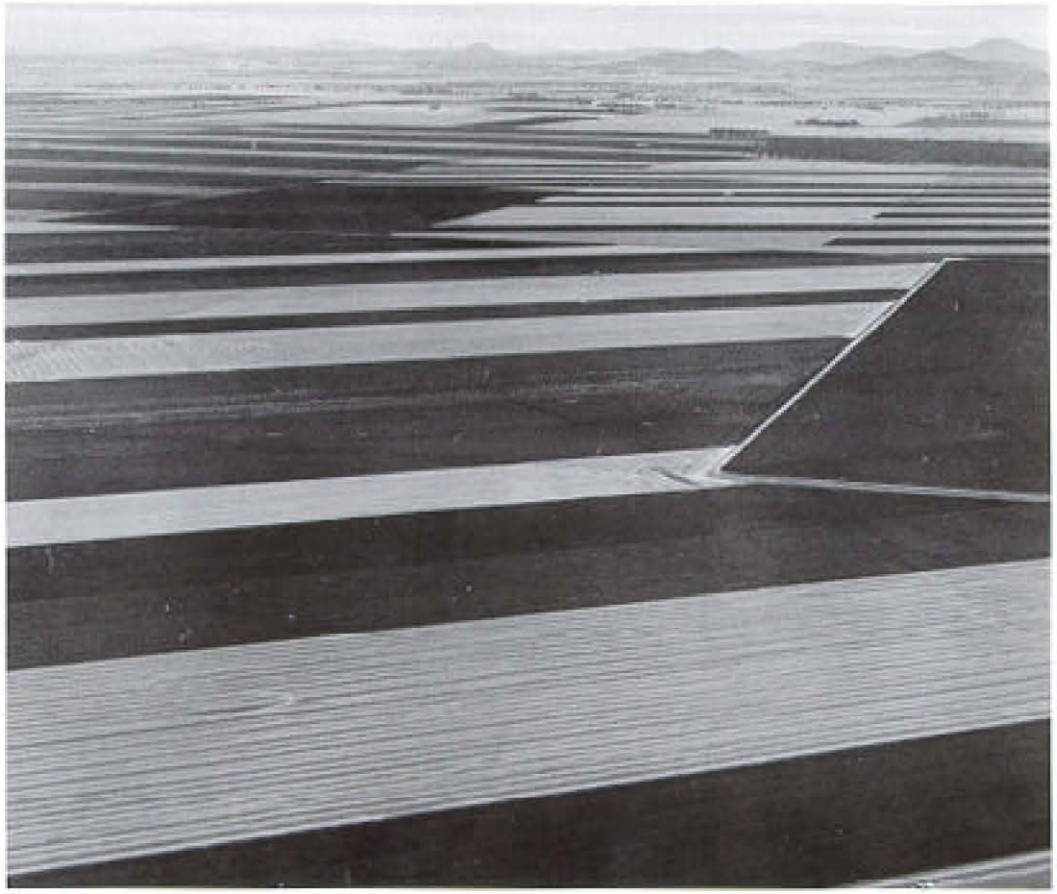
LIVING CATCHMENTS

Whether it be for food, housing, transport, power generation and supply or simply recreation, Australians depend on the basic resources of soil, water and forests. These three resources are the basis of our water catchment areas and whether they be large or small, the correct management of these areas is basic to our survival.

A catchment area can be described as an area of land within which water drains down to a specific point. Catchments vary in size and there may be many smaller catchments within a large one. A look at a map of New South Wales will show that most of us live in a catchment and within these areas are found forests, crops, grasslands, orchards, birds and wildlife. Catchments may also contain large cities or small towns, farms and forests, rivers, roads and railways. In short, every catchment area is a microcosm of Australian life and as such, the vital assets of soil, water and forests must be preserved and protected.

With this in mind, the Soil Conservation Service of New South Wales has adopted the concept of Total Catchment Management (TCM) and is taking steps to achieve a more coordinated approach to the management of the State's water catchment areas.

The principal aim of TCM is to ensure the continuing stability and productivity of our soils, a satisfactory yield of clean water for industrial and domestic use, and the maintenance of an adequate protective cover of grass and trees across all catchments.



◀ *Strip cropping in northern NSW.*

▶ *Total Catchment Management provides an opportunity for ALL landholders to get together to ensure that their activities have a minimal impact on the environment.*

Soil Conservation

◀ *This mass of debris in Newcastle harbour shows how heavy rainfall in a catchment area can seriously affect our ports and estuaries.*

As a first step towards the management and conservation of all resources contained within major river valleys, the Soil Conservation Service is preparing a series of resource maps of the Gwydir, Namoi, Hunter and Macintyre River valleys. In addition, an interdepartmental committee was established under the authority of the Premier of New South Wales and chaired by the Commissioner of the Soil Conservation Service, to foster adoption of the TCM concept throughout the community.

As the knowledge of soil conservation is continually growing and at the same time major changes in land use are occurring, the initiative has been taken to establish soil conservation catchment committees, consisting primarily of local landholders, to make recommendations on soil and water conservation; assist in identifying problems relating to erosion, water resources and land use; organise field days; and arrange agreements between landholders about land use and management.

A control dam has been installed near the headwall of this gully. Any overflow from the dam is diverted from the gully, thus preventing further erosion.

SOIL AND WATER

Following a Government decision to overhaul the State's water policies, the functions of the Soil Conservation Service were broadened to make provision for the conservation of farm water resources. In addition to officers experienced in all aspects of soil conservation, the Service now has a staff with a background in farm water management. Rural landholders are now provided with advisory services in the following areas:

- complete design, survey, supervision and construction of farm dams including provision of advice on strategies for water harvesting, property drought proofing and multi-purpose use
- design and planning of farm water reticulation schemes for stock and domestic water supply
- management and control of surface water flow on farms including the design of soil conservation works ranging from waterway and flood routing to gully head stabilisation
- integrated catchment modelling to support and coordinate soil conservation project works.

It should be noted, however, that provision of advice regarding water storage, reticulation or use for irrigation is the province of the NSW Department of Agriculture & Fisheries.

Total Catchment Management marks a cornerstone in the management of the natural resources contained within our river valleys and its success is essential to ensure their preservation and protection.

Soil Conservation

Much depends on the willing cooperation and support of local authorities, land users and other individuals throughout the State.

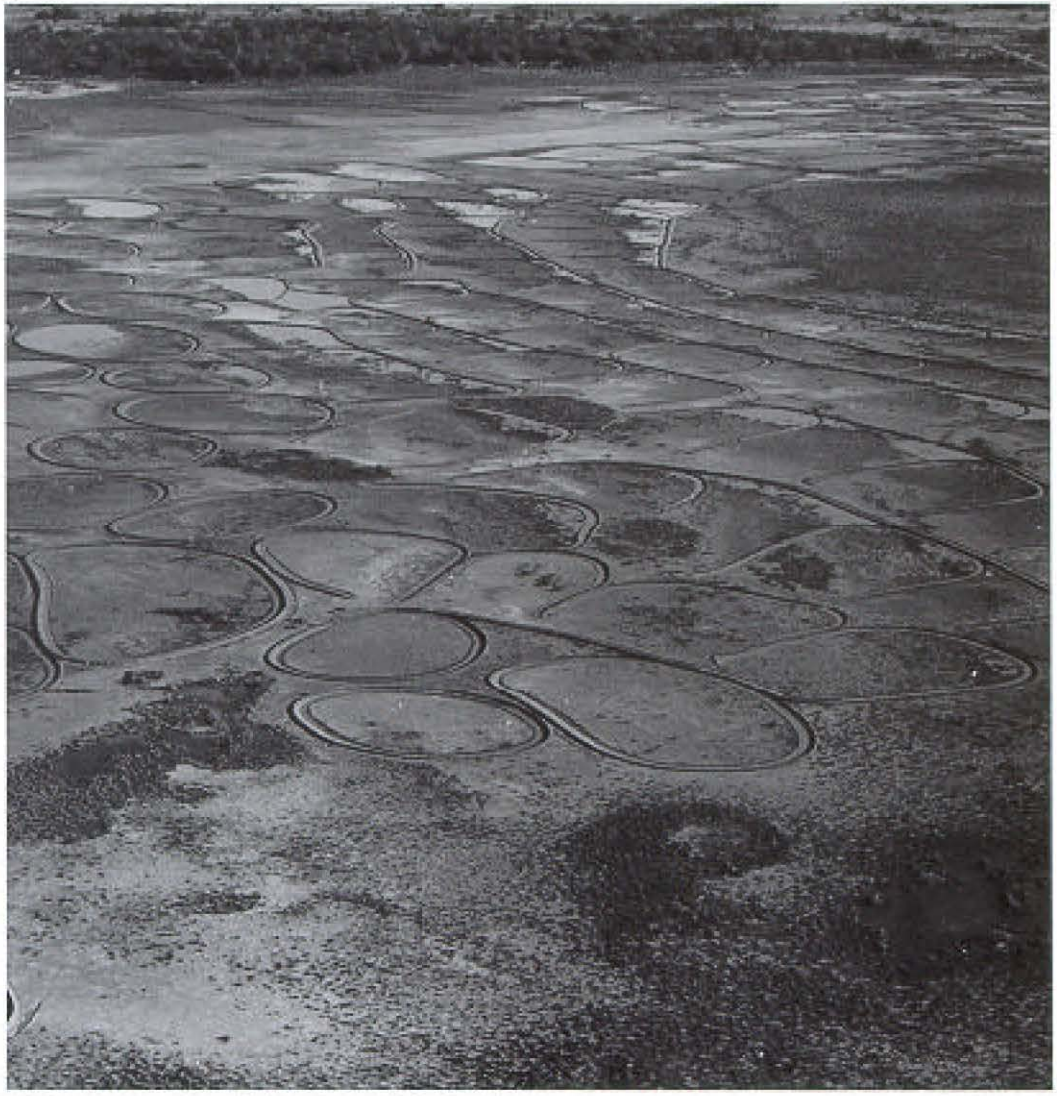
The Murray–Darling Basin Scheme was implemented in 1985 using the principles of integrated catchment management to promote and coordinate effective planning and management for the equitable, efficient use of the land, water and environmental resources of the Murray–Darling Basin.

As 79 per cent of the area of New South Wales falls within the Murray–Darling Basin, the State Government has an important role to play in planning the Basin's management. The Service has been involved from the outset of the Scheme in planning, through representation on interstate committees and through the production of maps of land capability, land use and soil erosion hazard in the New South Wales sector.

LEGISLATION

Recently the New South Wales Government strengthened the legislative provisions governing our soil assets in order to provide further protection from the actions of irresponsible people.

The amended Act gives the Commissioner of the Soil Conservation Service specific powers to ensure that activities causing, or likely to cause, soil erosion can be stopped. Where damage has occurred the Act provides for restoration to be undertaken.



◀ *Waterponding — a technique used to control erosion on rangelands in western NSW.*

LAND & WATER CONSERVATION

The Department of Land and Water Conservation
(formerly Conservation and Land Management and Water Resources)

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