Water erosion control - 4

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RUN-OFF water must be expected at some time or other from most agricultural land in Western Australia, where high intensity rains are likely to occur both in winter and summer. This run-off water will tend to concentrate in the natural drainage depressions of the slopes, and flow down to the main creeks. Running water is a principal agent of soil erosion, and it is essential that all channels where water flows must be protected if our lands are to be saved from the ravages of severe gully erosion.

When rain falls faster than it can be absorbed by the soil, the unabsorbed water collects in small pools in hollows in the soil surface. On sloping land, increasing accumulation causes the water to overflow from these hollows and commence to move downhill under the force of gravity.

Under natural vegetation the surface soil on the slopes is usually protected against running water by leaf mould on the surface and root systems in the soil. In the natural drainage depressions the vegetation (trees, scrub and grasses) is generally much thicker and so provides protection for the soil when a concentrated flow of water occurs. Actually these drainage depressions and in fact the whole topography of the land have been formed by geological erosion occurring over thousands of years. However, when we refer to soil erosion, we mean
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This series of articles outlines the principles of soil conservation and their main applications in W.A. It is hoped they will impress on farmers the need to conserve the soil and prevent erosion, and assist them in doing this. The Soil Conservation Service exists to cooperate with farmers for this purpose. If you would like a visit to discuss soil erosion, write to the Commissioner of Soil Conservation, Department of Agriculture, Perth.

accelerated erosion caused when the balance of nature is upset.

As man develops an area for agriculture the natural balance between water absorbed and used by vegetation, run-off water, and the drainage pattern of the run-off water is upset. The protective vegetation is removed, root systems are destroyed, the soil is cultivated and left bare for varying periods and the crops grown often use less water than the natural vegetation. The amount of water which can be absorbed and the maximum rate of absorption are altered and more water is likely to run off the ground. Cultivation lines, fences, roads, railways, etc., may cause run-off water to concentrate and flow on unprotected soil, thus causing gully erosion. In view of this it is obvious that a system of land use must be achieved in which run-off water is kept to a minimum and can safely flow down to the permanent water courses without causing serious gully erosion.

Improved systems of soil management will increase the amount of water absorbed at or near where it falls. However, we must expect run-off water from most of our sloping agricultural lands. Contour banks can be used to intercept water flowing down a slope, and make it flow slowly across the slope. It is essential that the water diverted by such banks be discharged into a planned and stabilised water channel known as a waterway. A grassed waterway (a channel protected by a dense cover of grass) is the most economical and satisfactory waterway.

THE IDEAL WATERWAY

The essentials of a safe waterway are:

1. It needs to extend up the slope far enough to take the discharge from the top bank.
2. It must be large enough to carry the water.
3. It should have as small a gradient as possible.
4. It should be readily protected against erosion by good plant cover and if necessary by simple earth structures.
5. If possible it should be fenced off so that grazing can be carefully controlled. If the waterway needs to be sown to pasture and it cannot be fenced, then it should be sown in the same year as the rest of the paddock is cropped, so that there would be no grazing during that year.
6. It must be designed so that the water will flow down it at a safe speed.

This can be accomplished by increasing the width of the channel so that the flowing water can spread over a wide area at a moderate depth. (It is a combination of depth and speed which gives running water its cutting power.) If the depth of flowing water is shallow the speed will be limited by the resistance provided by the grass cover. If the situation is such that the water would tend to concentrate, then mechanical structures may be necessary at intervals to slow the water and spread it over a wider area.

In practice various types of waterway have been tried and used in Western Australia, and these are now described.
Fig. 1 (top picture).—This gullied depression, stabilised with gully stops, is the waterway carrying the run-off from an area of 150 acres treated with contour banks. The gully was originally steep-sided and fast-flowing. The gully stops shown have been in position for four winters. In that time the gully edges have rounded off considerably and are becoming grassed, and much silt has been trapped above the gully stops. In the foreground, the cutting starting to work back from the gully has been caused by the contour bank on the left being discharged too close to the gully. The lower picture shows a close-up of a gully stop designed to intercept water flowing down the gully, and spread it over the grassed area adjacent. When the water rises higher in the gully, it will flow out around the bank. The white pegs mark the top of the bank and the white tape shows the line of flow of the water.

—Photo., J. E. Watson
NATURAL DEPRESSIONS

It follows from the above discussion that an ideal waterway would be a shallow drainage depression, with no gullies, which had been left out of cultivation for many years. Such an area would get more moisture than the rest of the paddock and would develop a dense cover of grass—usually containing species which in the dry stage are unpalatable to stock. The result is that good all the year round grass cover is likely to be maintained.

IDEAL WATERWAYS ARE HARD TO FIND

However, it is rare to find such a depression in our crop lands, and usually an area must be specially treated to become a safe waterway. Often the most obvious erosion problem in a paddock is a large gully in the main drainage depression. In such a case there may be great difficulty in finding a suitable site for safe water disposal, and we are forced to consider using the gullied depression as a waterway. Experience has shown that in Western Australia this can be done safely if we can follow the general principles of waterway requirements as discussed earlier, especially points (4) and (6), which stress the need for grass cover and the reduction of velocity by spreading the flow over a wide area.

The gullies in the depressions were probably originally formed when a heavy rain caused a concentrated flow of water down the depression while it was in a cultivated condition. Once a gully is in existence, any further flows of water will concentrate in the narrow channel of the gully and a rapid flow will result. To stabilise the gully so that it will handle such a flow without further erosion, it is almost certain that well designed concrete structures will be required. This method of stabilising a gully is expensive and unlikely to be used in a normal erosion control programme in this State. It has been used on a gully carrying run-off from a catchment area to a large dam, where it was essential to get a maximum flow of water free of silt.

USE OF EROSION GULLIES AS WATERWAYS

However, if after a gully has formed in a depression, the farmer has kept well back from the edge of the gully when ploughing, there is likely to be a good grass cover on the uncultivated area. If this is so, it can be made safe for use as a waterway by building a series of gully stops which are designed to prevent any flow directly down the gully. The water is spread over the grassed area adjacent, thus increasing the area of flow and reducing the velocity.

GULLY STOPS

To build a gully stop the gully is first filled in with earth for a length sufficient to make a crossing for a tractor. On top of the filled-in area an earth bank is built of sufficient height to ensure that no water can flow over the top. This bank is continued outwards from the gully along a line surveyed with a fall (up to one per cent.) away from the gully. The water will fill up the gully above the stop and then be diverted out on to the grassed area. The stops are built from one and a half to three chains apart, depending on the situation. Small spreader furrows with a fall of one per cent. away from the gully may be required between gully stops to spread the water over the grassed area. Any water flowing back into the gully between the stops will be intercepted and dammed back by the next stop. Any soil coming off the paddock, or from the breaking down of the sides of the gully will be caught by the next stop and will be helping to silt up the gully.

The gully stops can be readily built by bull-dozer, front end loader, or tractor and scoop. If no implement for pushing dirt is available some shovel work may be required to make the gully crossable for the tractor and scoop.

If a gullied depression is used as a waterway, contour banks should be discharged well back (a half chain or more) from the edge of the gully, and a spreader furrow built just below the discharge point. If banks are carried right to the gully, the waterfall effect of the
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water spilling over the edge may cause headward erosion to work back along the contour bank channel.

Where a gullied depression is used as a waterway and all water from the area to be contour banked normally goes down that depression, it is best to build the banks at the same time as the waterway is prepared. The reason for this is that total run-off from an area is likely to be greatly reduced after the banks are put in.

Where there is a considerable side slope right to the edge of the gully, or where the area alongside the gully is not well grassed, there will be a definite risk in using this type of waterway. If there seems no alternative, and this risk is taken, the farmer must be prepared to make every effort to prevent damage occurring. Straw mulches should be spread on the area, and if necessary pinned down with old wire netting in danger spots, such as the ends of spreader banks. If water spilling back into the gully starts to cut a definite channel, the edge of the gully at this spot should be rounded off and protected with straw and wire netting.

If a gullied depression is becoming bare because of salt seepage it should be fenced off and planted with roots of Paspalum vaginatum, a salt-tolerant creeping grass.

ARTIFICIAL WATERWAYS

Where no natural depression is available as a suitable waterway, another possibility is an area of level or nearly level cross section, with gentle downward slope, which can be readily grassed and stabilised to carry a large volume of flowing water. A small bank may be necessary at one or both sides of the waterway to confine the water to the desired channel. Some small spreader furrows may be required to keep the water from concentrating against one side bank. Such a furrow is constructed along a line surveyed with a fall of not more than one per cent. away from the bank.

Attempts with small machinery (e.g., grader ditchers) for grading a level cross-section waterway have not been very successful in this State. Our topsoils are usually very shallow and if much grading is necessary the subsoil
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is exposed and there is little chance of getting a good grass cover quickly.

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**TIME TO PREPARE WATERWAYS**

The waterway should be prepared and adequately grassed before banks are discharged into it. This usually means that the waterway should be prepared two or three years before the banks are built. If the need for banks is urgent, they are often constructed at the same time as or soon after the waterway is prepared. In such a case it is better to discharge the banks short of the waterway and keep the water from entering it. If gullying occurs where the banks are discharged, these gullies can be filled in later when the banks are extended to the waterway.

**GRASSING OF WATERWAYS**

If the existing grass cover is not adequate it will be necessary to make every effort to establish one as quickly as possible. The area should be seeded soon after the opening winter rains so as to get a quick growth. There is scope for much experimental work with waterway seedings in this State. So far, sub-clover and Wimmera rye grass have been the only sown pastures. They are not always suitable as very few waterways have been fenced, and these grasses are likely to be grazed almost bare in summer. The ideal waterway grass would be quick-growing in winter, and in the dry stage unpalatable to stock.

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Fig. 3.—This graded waterway was prepared at the same time as the banks were constructed to discharge into it. Before the waterway was stabilised and sufficiently protected by grass cover, heavy rain caused a flow of water which resulted in the damage shown in this photo.

—Photo., G. H. Burvill
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Fig. 4.—This grassed area of nearly level cross section serves as the waterway carrying run-off from an area of about 45 acres. The lines of white pegs show the small banks at either side of the waterway. Note the area outside the waterway (between the left hand bank and the fence) which provides space for a road and a firebreak.

The best recommendation is for the area to be sown with anything which will give a good immediate cover. This will usually be Wimmera rye grass, sub-clover (in suitable rainfall areas) and a cereal cover crop. The cover crop should be cereal rye, or a strong-strawed variety of wheat, so that the stubble will give some protection in summer.

Other natural grasses such as barley grass, silver grass, etc., may be introduced by the use of a grass straw mulch. The grass straw could be cut and stored during late summer. A loose layer of up to two inches thick should be spread over the waterway immediately after seeding. The mulch would keep the surface soil moist after rain thus helping germination of the sown pastures. A good germination of the natural grasses could also be expected.

Where there is likely to be sufficient moisture, sod forming grasses such as couch and kikuyu should be planted in the waterway. In moist salty areas Paspalum vaginatum is the best grass.

If this is so, a series of short lengths of large capacity absorption banks should be built. These banks should be close together and designed so that the water will fill the top bank and then flow around one end and down to the next bank and so on until it spills on to the head of the main waterway.

Banks may be discharged into timbered areas, but usually some spreader furrows or absorption banks will be required to prevent gullying.

In areas where water supplies depend on storage in dams (earth tanks), it is essential that these be considered in any scheme of water diversion. However, where discharge from a bank (or banks) flows into a dam it is necessary that a safe waterway be provided for overflow.

LARGE NATURAL CREEKS

Contour banks may sometimes discharge directly into a natural creek. If the creek has a steep bank some special attention may be needed to prevent gullying occurring where the water flows down into the creek.

Where a waterway joins a natural creek, it is even more important to ensure that there is no chance of a gully commencing and extending up the waterway.

OTHER WATER DISPOSAL AREAS

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