
**What values do wetlands have for us and how are these values affected by our land-use activities?** *Wetland-use Booklet 1*

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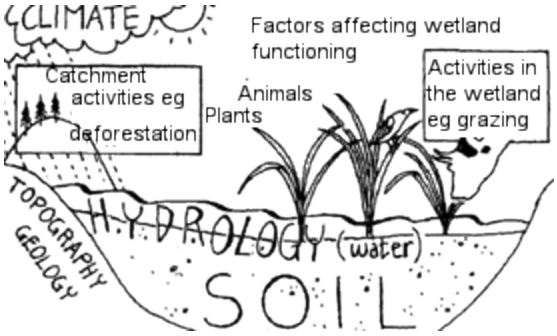
# Contents

**Introduction**

Without water there would be no life on earth. Plants, animals and people need water to survive and grow. South Africa does not have an abundance of water, and the water in many streams is polluted. Both droughts and floods are common. Wetlands are able to reduce the severity of droughts and floods by regulating streamflow. Wetlands also purify water and provide habitat for many different plants and animals. Besides these **indirect benefits** to society, wetlands provide many **direct benefits** in the form of resources such as fibre for making crafts. Until very recently the benefits of wetlands to society were often not recognized, and many wetlands have been destroyed or poorly managed.

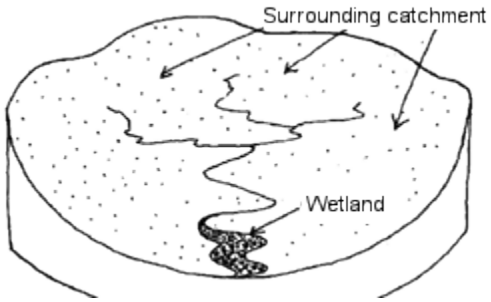
Section 1 of this booklet introduces you to the indirect and direct ways in which wetlands benefit society. Section 2 helps you to understand how these benefits are affected by the activities of people. Below is a brief overview of the factors affecting wetland functioning (for more detail **see Booklet 2)** It will be worthwhile keeping these factors in mind when using the rest of the booklet. A third booklet in the series, which is currently being drafted, indicates how this increased understanding can be used to improve the management of wetlands.



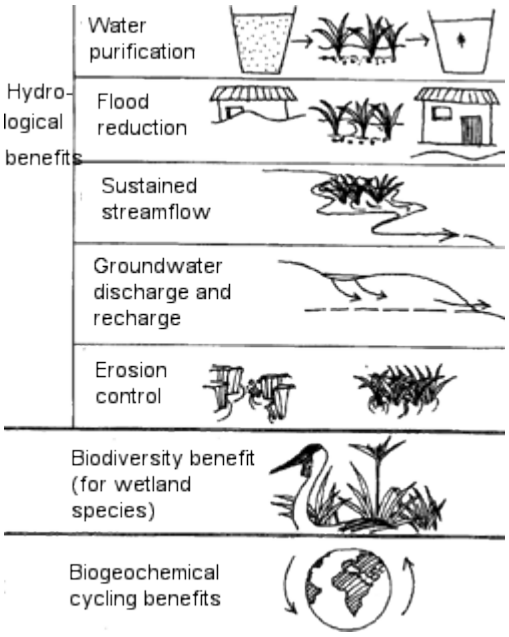

Water which falls as rain or snow in the **catchment**, and which is not lost to the atmosphere through **evaporation** or **transpiration**, moves through the catchment to the sea. Wetlands are found where the landform (topography) or geology slows down or obstructs the movement of water through the catchment (e.g. where the landform is very flat) causing the surface soil layers in the wetland area to be temporarily, seasonally or permanently wet.

This provides an environment where particular plants (e.g. reeds) that are adapted to wet conditions tend to grow in abundance. The plants, in turn, affect the soil and **hydrology** (e.g. by further slowing down the movement of water and by producing organic matter that may be accumulated in the soil). The plants provide shelter and food for particular animal species.

The functioning of a wetland is also affected by other factors, many of which result from the activities of people. These include "off-site" factors which take place in the surrounding catchment (e.g. a change in landcover from natural grassland to a gum tree plantation which would decrease the amount of water reaching the wetland) and "on-site" factors which take place at the wetland (e.g. fire).

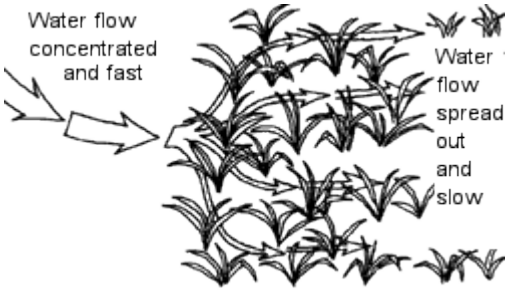



**Section 1: What benefits do functioning wetlands have?**
**Indirect Benefits**




**Flood reduction and streamflow regulation**

Wetlands spread out and slow down water moving through the catchment because of: (1) the characteristically gentle slopes of wetlands and (2) the resistance offered by the dense wetland vegetation. Also, many wetlands do not have well defined channels that would otherwise speed up the movement of water.

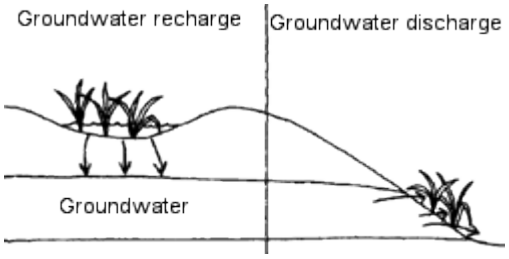



By slowing down the movement of water and detaining it for a while wetlands act like sponges which reduce floods and also prolong streamflow during low flow periods. Loss of water to the atmosphere through evaporation and transpiration does, however, reduce the amount of water available to prolong low flows. When wetland vegetation is growing, water is lost from the leaves through transpiration. However, the water lost into the atmosphere from a vegetated wetlands is usually less than would be lost from the surface of an open water area such as a dam. This is because the cover provided by wetland vegetation reduces evaporation from saturated or flooded soil by sheltering it against the sun and wind. When the vegetation dies back, there is no loss of water through transpiration and the dead leaves remain, continuing to shelter the soil. During such times, water loss is most effectively regulated.

**Ground water recharge and discharge**

Wetlands may have an important influence on the recharge or discharge of groundwater.

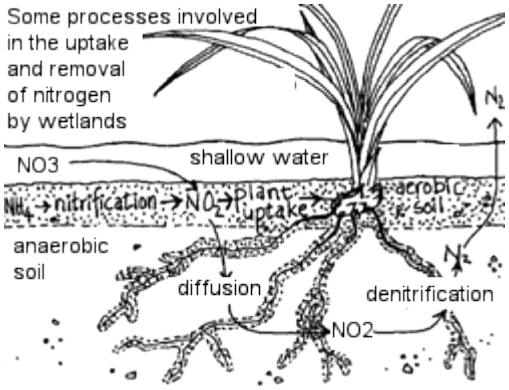
Groundwater recharge refers to the movement of surface water down through the soil into the zone in which permeable rocks and overlying soil are saturated. Groundwater discharge, in contrast, refers to the movement of groundwater out into the soil surface. Although poorly understood, it appears that most wetlands are groundwater discharge or throughflow areas. Wetland areas where groundwater is discharging are often referred to as seepage wetlands because they are places where the water seeps slowly out into the soil surface (**see Booklet 2** ).




**Water purification**

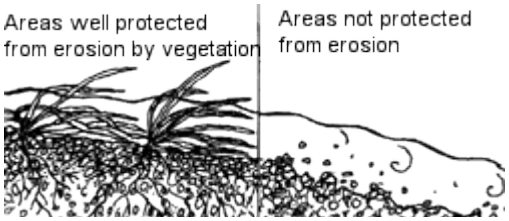
Wetlands are natural filters, helping to purify water by trapping pollutants (i.e. sediment, excess nutrients [most importantly nitrogen and phosporus] heavy metals, disease-causing bacteria and viruses and synthesised organic pollutants such as pesticides). Thus, the water leaving a wetland is often purer than the water which enters the wetland. Wetlands are able to purify water effectively because :

- they slow down the flow of water (see flood reduction and streamflow regulation) causing sediment carried in the water to be deposited in the wetland. This also results in the trapping of other pollutants (e.g. phosphorus) which are attached to soil particles;
- surface water is spread out over a wide area, making it easier for exchanges between soil and water;
- there are many different chemical processes taking place in wetlands that remove pollutants from the water. For example, wetlands provide a suitable place for denitrification because anaerobic and aerobic soil zones are found close together. Denitrification is important because it converts nitrates, which could potentially pollute the water, to atmospheric nitrogen which is not a pollution hazard;
- some pollutants such as nitrates (NO3) are taken up by the rapidly growing wetland plants;
- the abundant organic matter in wetland soils provides suitable surfaces for trapping certain pollutants such as heavy metals; and
- wetland micro-organisms help decompose man-made organic pollutants such as pesticides.



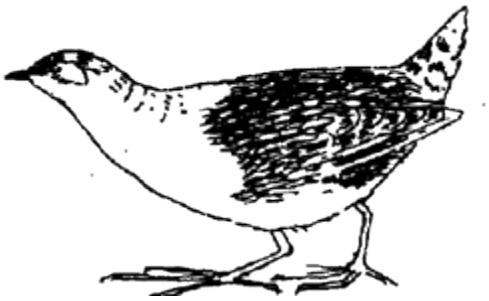
**Erosion control by wetland vegetation**

Wetland vegetation is generally good at controlling erosion by : (1) reducing wave and current energy; (2) binding and stabilizing the soil; and (3) recovering rapidly from flood damage.




**Biodiversity**

Wetlands are usually places where there is much plant growth because of the abundance of water and nutrients in the soil. The plants, in turn, provide food and shelter for animals. There are many different plants and animals that depend on wetlands, and without the habitat that wetlands provide, they would not be able to survive. Several of these species, such as the white-wing flufftail and wattled crane are threatened.



**Chemical cycling**

In wetlands, the **decomposition** of organic matter is slowed down by the anaerobic conditions present in wetlands. This results in wetlands trapping carbon as soil organic matter instead of releasing it into the atmosphere as carbon dioxide. Presently too much carbon dioxide is being released into the atmosphere when fossil fuels (i.e. coal and oil) are used to produce energy, resulting in the global climate being disrupted. Coal is, in fact, formed from plant material accumulated under wetland conditions in **swamps** that existed millions of years ago. Thus, instead of destroying wetlands and releasing carbon dioxide into the atmosphere, we should be conserving wetlands which will help reduce carbon dioxide levels in the atmosphere.

**Direct Benfits**

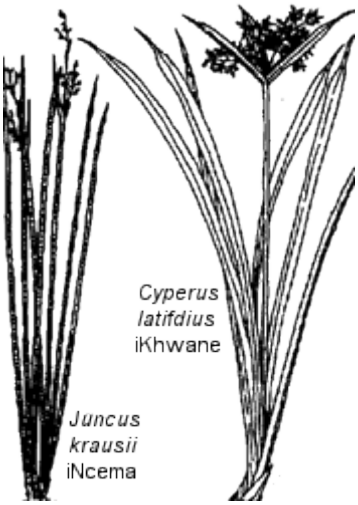
**Livestock grazing**

Wetlands, especially temporarily and seasonally **waterlogged** areas, may provide very valuable grazing-lands for domestic and wild grazers. This is particularly so in the early growing season and during droughts when grazing reserves are low in the surrounding veld (rangeland) but the wetlands

continue to produce a lot of grazing. Permanently wet **marsh** areas tend to have a lower grazing value because most mature marsh plants are unpalatable, and the excessive wetness may stop animals getting into the wetland. Utilization needs to be **sustainable** if the wetland is to maintain its value for grazing. As with dryland pastures, wetlands are only able to sustain a certain amount of grazing. Particular care is required in wetlands where the erosion hazard is high (see Section 2).

**Fibre for construction and handcraft production**

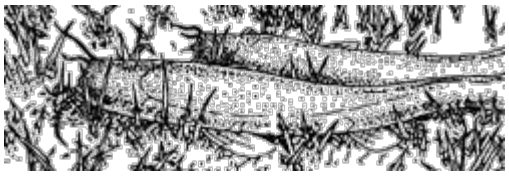
Wetland plants have been used for thousands of years, providing valued material for products such as mats, baskets and paper (produced from papyrus, which is a sedge). There are several plant species which are suitable and are used extensively for making handcrafts in South Africa, such as the rush *Juncus krausii* (iNcema), and the **sedges***Cyperus latifolius* (Ikhwane) and *C.textilis* (iMisis). The common reed (*Phragmites australis*) is used for construction purposes. Some wetland plants are also collected for medicines.




Handcraft production from harvested wetland plants has many benefits as a development option in poor communities : it makes use of local traditional skills; it has the potential for immediate cash returns and, by increasing the financial benefits to the local people, it increases the incentive not to destroy the wetland, thereby contributing to the conservation of natural habitats. However, harvesting needs to be sensitive to the functioning of the wetland (see Section 2).


**Valuable fisheries**

Although the value of wetlands for fisheries varies greatly, floodplain wetlands (e.g. Pongola River Flats) and estuaries (e.g. Kosi Bay) are typically valuable in the production of fish for human consumption. Many sea fishes in South Africa spend some of the early phases of their life cycle in estuaries, and freshwater fishes such as barbel also use wetlands.

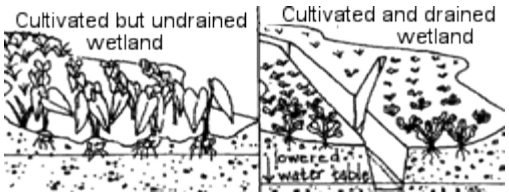


**Hunting waterfowl and other wildlife**

Some wetlands are important places where waterfowl (including ducks and snipe) and other wildlife such as reedbuck can be hunted. In the USA a great many people take part in the recreational hunting of waterfowl which depend on wetlands for breeding and food. In fact, duck hunters have helped to conserve many wetlands. The hunters recognize the importance of wetlands for ducks and are willing to pay to make sure that the wetlands remain in their natural functioning condition.

**Valuable land for cultivation**

Wetland soils are potentially productive. However, the anaerobic conditions associated with wetlands exclude most commonly grown crops except for those specially adapted, such as madumbes (Colocasia esculenta) and rice. Thus, wetlands are often drained so that plants not adapted to the waterlogged conditions can be grown. This has important environmental impacts, requiring that the cultivation of wetlands be well controlled (see Section 2).




Some wetlands are used for timber production but because of the impact that trees have on wetland benefits, strict controls are required (see Section 2).

**A valuable source of water**

Because water is stored in wetlands, they provide sites for the supply of water for domestic and livestock use, as well as for irrigation. The storage capacities of wetlands are sometimes increased through damming. However, this often has important negative effects on other benefits (see Section 2).

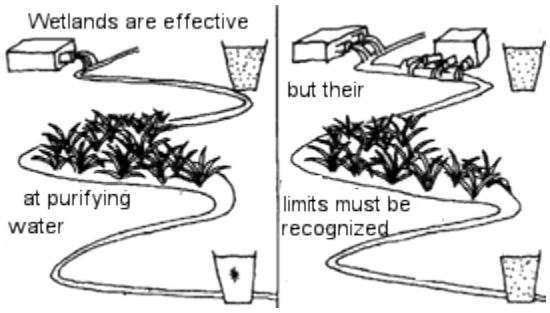
**Economically efficient wastewater treatment**

You will have learned in the water purification section that wetlands purify water. Natural wetlands provide this service to society "free of charge". Thus, natural wetlands are sometimes purposefully used to treat polluted water and many artificial wetlands area being created for wastewater treatment. When using a wetland to treat wastewater, several factors need to be considered to assess how effectively a wetland will purify water :

- the pollutant, the wetland soil, flow patterns in the wetland, the size of the wetland, and the climate affecting the wetland, which all determine the capacity of the wetland for purifying

the wastewater. For example, more pollutants are likely to be trapped in a wetland where the flow is spread out across all of the wetland than in a wetland where a channel concentrates flow in only part of the wetland. If the pollutants are heavy metals then a wetland with soils rich in organic matter is likely to be more efficient at trapping heavy metals than a wetland with soils poor in organic matter; and

- the amount of pollutant relative to the capacity of the wetland. The capacity of the wetland is obviously limited, and if the amount of pollutant greatly exceeds the capacity, the wetland will not effectively purify the water. The impacts of pollutants on the wetland also need to be considered (see Section 2).




**Aesthetics (beauty) and nature appreciation**

Although wetlands which fringe estuaries, rivers and streams are next to open water, most natural inland wetland have fairly limited open water associated with them. Thus, they are generally not good sites for water sports. However, wetlands are good places to see birds. Large numbers of birds are often attracted to wetlands, with many of these birds found only in wetlands. Wetlands also add to the diversity and beauty of the landscape. Wetlands have a diverse range of colours and textures and some very attractive flowers such as those of **vlei** lilies (Crinum spp.) and ground orchids.

**Section 2: How do our land-use activities affect wetlands?**

The manner in which we use wetlands and the scale on which we do so determines the extent of our impact. Uses which provide good economic returns are not necessarily sustainable. Land-use activities (e.g. growing crops or damming water) often affect how a wetland functions and what benefits it provides to society. In many cases, the effects are negative, such as when a wetland is disturbed in order to plant crops, the wetland's function of trapping sediment and holding the soil is reduced. This reduces the benefits that society receives from the wetland in purifying water and controlling erosion.

Impacts on wetlands result from both 'on-site' activities at the wetland site (e.g. drainage, disturbance through cultivation, infilling, and flooding by dams) and from 'off-site' activities in the wetland's surrounding catchment (e.g. afforestation, mining and crop production) (see Introduction,

page1)

**On site land-use impacts**

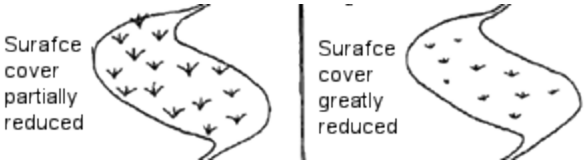
**How do on-site land-uses affect the functioning and benefits of wetlands?**

Below are four points to consider when assessing the general "on-site" impacts of land-uses on wetlands (for more information see references).

Changes to the flow pattern within the wetland through drainage channels which cause flow to become more channelled and less diffuse, thereby reducing the wetness of the area.


Disturbances of the soil, making it more susceptible to erosion.


Changes in the surface roughness and vegetation cover (when these are reduced the ability of the wetland to slow down water flow, reduce erosion and purify water is reduced).



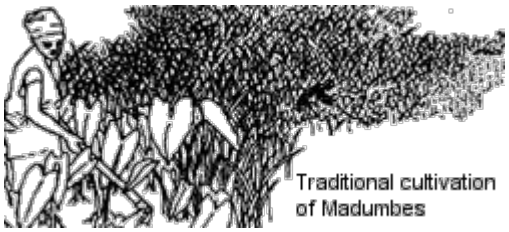

Replacement of the natural vegetation by introduced plants, which generally reduces the value of the wetland for wetland dependent species.


**Drainage and the production of crops and planted pastures**

When wetlands are converted to cropland most of the indirect benefits of the wetland are lost, especially if the wetland is drained. Drained wetlands are less effective at regulating streamflow and purifying water because the drainage channels speed up the movement of water through the wetland. Drainage increases the danger of erosion by concentrating water flow and thus increasing the erosive power of the water. Also, the hydrological changes resulting from drainage have negative effects on the soil (e.g. reduced soil organic matter and moisture levels and, sometimes, increased risk of

underground fires and increased acidity due to the oxidation of sulphides to produce sulphuric acid).

The soil is disturbed when crops are planted, and crops do not bind or cover the soils as well as the natural wetland vegetation (see Section 1). Thus, erosion is controlled less effectively, which may be a very serious problem in areas with high erosion hazards. Adding fertilizer and pesticides (which may leach into the river system) further reduces the effectiveness of the wetland in purifying water. The impact of cultivation can be reduced if practices characteristic of low input/traditional cultivation are followed.



Traditional cultivation of Madumbes

Traditional cultivation practices, which are more sensitive to the functioning of the wetland, include:

- planting crops (e.g. madumbes) which are tolerant of waterlogging, minimizing the need to drain;
- tillage and harvesting by hand, resulting in less soil compaction and potential disturbance than with mechanical tillage and harvesting;
- not using pesticides and artificial fertilizers, which reduces the impact on water quality; and
- not planting extensive areas but leaving indigenous vegetation between cultivated patches.

In South Africa wetlands are protected by the Conservation of Agricultural Resources Act 43 of 1983 (administered by the Directorate:Resource Conservation) that prevents land users from cultivating or draining wetlands.

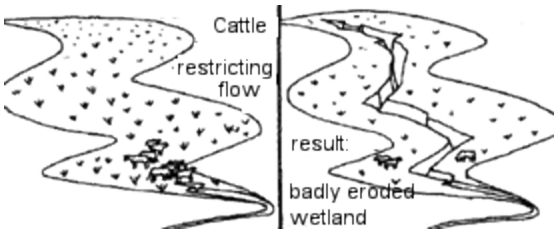
**Timber production**

Timber plantations have a high impact on the water storage function of wetlands because a lot of water is lost by the trees through transpiration. Some trees (e.g. gum trees) use more water than other trees (e.g. poplars, which lose their leaves in winter). Trees also have a strong negative effect on the habitat value of wetlands. Under increased shading beneath the trees, the vigour of indigenous plants which are not adapted to these conditions is reduced and they are often out-competed by alien invasive plants. In South Africa there is a law (Section 75 of the Forestry Act No 122 of 1986) which prevents the planting up of wetlands to timber.

**Grazing of undeveloped wetlands by domestic stock**

Grazing may have both positive and negative effects on the indirect benefits of wetlands. In wetlands which have some areas grazed short and other areas left tall, the diversity of habitats is increased. In wetlands which are grazed short completely, the diversity of habitats is decreased.

Heavy grazing may cause valuable grazing species to be replaced by less productive and/or palatable species. Some wetlands erode easily when disturbed by trampling and grazing. The most easily eroded are those wetlands with unstable soil and where water flowing diffusely across the wetland concentrates into a channel. In these situations erosion can cause the channel to cut up into the wetland and dry it out, destroying most of its value. Thus, grazing pressure should not be too high and cattle need to be kept away from these flow concentration areas.




**Causes and effects of wetland erosion**

As we described at the beginning of this section, wetlands are characteristically areas where the movement of surface water is slowed down and sediment is deposited. Sometimes, however, wetlands with high erosion hazards erode and more sediment is removed from the wetland than is deposited. The erosion hazard of the wetland depends on several factors, including the erodibility (stability) of the soil, slope and landform setting. Other factors which are influenced by management, such as vegetation cover and disturbance of the soil (e.g. by cattle or farm machinery), also contribute to erosion. As a very general rule, soils from dry areas (i.e. <750mm of rainfall per year) tend to be less erodible than soils from wetter areas (>750mm rainfall). The particular type of rock from which the soil is formed also affects its erodibility. Landforms that are steep and landforms that have open drainage tend to erode more easily than those which are gently sloped and those which have inward drainage.

Erosion of wetlands may result in deep gullies which drain the water rapidly from the wetland and make the water regime much less wet. This often greatly reduces the values of the wetland (see Booklet 1).

**Mowing and harvesting of plants**

Mowing and harvesting of plants by hand tends to have much less of a negative impact on the indirect benefits of wetlands than cultivation. Cutting plants has similar effects to grazing and generally increases habitat diversity, provided that extensive areas are not mown or cut at one time. Mowing and harvesting may also be harmful if done while animals are still breeding. In the case of mowing, the machinery used for cutting may also disturb the wetland soil and increase the danger of erosion. This would not occur when plants are harvested by hand. Harvesting must be done on a sustainable basis if we are to continue to benefit from the wetland plants. If harvesting is beyond the resource's capacity for renewal, resource degradation will occur and the benefits derived by the users will be lost. Plants should not be harvested more than once a year ,and the areas which are harvested should be rested for a whole year a least every third or fourth year.

**Fishing and hunting**

In order that hunting and fishing be sustainable, the number of animals caught or hunted should obviously not exceed the capacity of the population to renew itself. If too many animals are caught or hunted there will not be enough left to reproduce and to replace the ones that are removed. Consequently, the value of the wetland to continue providing these resources will be reduced.

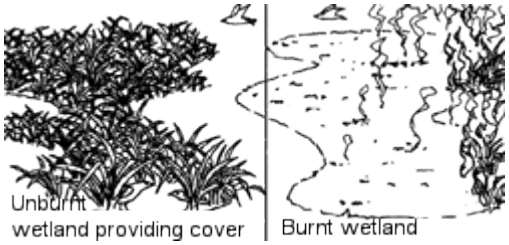
**Burning**

Wetlands are burnt for many reasons: to improve the grazing value for livestock by removing old dead material and increase productivity; to improve the habitat value for wetland dependent species; to assist in alien plant control; and, to reduce the risk of run-away fires.

Wetland fires usually burn above-ground plant parts and most plants recover rapidly from this. Some fires also burn soil and plant parts below the ground, which usually destroys the plants. This generally detracts from the values of the wetland (e.g. by increasing the risk of erosion). However, by burning away the upper soil layers, open water areas may be created which may enhance the diversity of the wetland.

While burning has short term impacts such as killing some animals which are not able to escape, it also has many positive effects (e.g. controlling alien plants and increasing the productivity of the indigenous plants which may increase the breeding success of certain wetland dependent animals). Whether or not the overall effect will be positive or negative depends on many factors including : timing, frequency and extent of the fire, and the type of fire (determined by conditions at the time of the fire, such as humidity and air temperature). Late winter burning is least likely to impact on breeding animals, as very few species are likely to be breeding at this time. Early winter or summer burns are more likely to affect breeding animals.

It appears that in the high rainfall areas of South Africa, a fire every second year is unlikely to have a negative effect on known wetland dependent species. However, when a wetland area is burnt it is important that unburnt areas are present nearby where animals can seek cover while the burnt area is re-growing.




Back fires (burning against the wind) tend to have a greater impact on the growing points of plants than head fires (burning with the wind). Burning when humidity is high and air temperature low, generally has a lower impact than burning when humidity is low and air temperature high.

**Damming**

Many wetlands in South Africa have been flooded by dams, as wetlands are often found in places which are ideal dam sites. Whilst dams perform certain wetland functions (e.g. sediment trapping and water storage) they do not perform other functions well. The habitat required by specialised wetland dependent species if frequently lost when a wetland is dammed. The vegetation which develops around the shoreline is limited in many dams by sudden fluctuations in the water level and by the steep sides of the dam. When a series of dams occurs along a stream, the cumulative effect that the dams have in reducing the streamflow may be considerable, particularly where water is pumped out of the dams. The effects of dams are usually most noticeable in the early wet season, when dams are at their lowest levels after the dry season and retain the early flows.

**Purification of wastewater**

From Section 1 we saw that wetlands are generally very effective at purifying polluted water. However, using a wetland to purify wastewater will affect the functioning of the wetland and may cause a loss of some of the other benefits of the wetland, particularly if the pollutant loadings are close to or greater than the capacity of the wetland for purification. For example, under increased nutrient inputs the bulrush (Typha capensis), a very common wetland species that competes well under nutrient-rich conditions, may out-compete and eliminate less common wetland species. This would reduce the diversity of the wetland. Standards have been set by the Department of Water Affairs and Forestry for the discharge of wastewater into streams (see references) and these should not be exceeded.

**Off site Impacts**

Most of the water in a wetland derives from the catchment surrounding the wetland. Therefore wetlands are strongly influenced by activities in the surrounding catchment even when they are

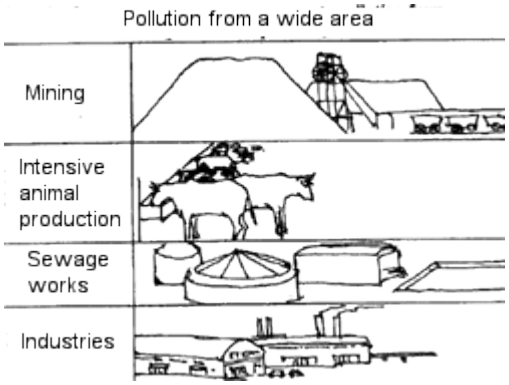
distant from the wetland. When assessing the impacts of off-site land-uses on wetlands one needs to look at how the land-uses change the quality and quantity of water entering the wetland from the surrounding catchment and how this, in turn, affects the functioning and benefits of the wetland.

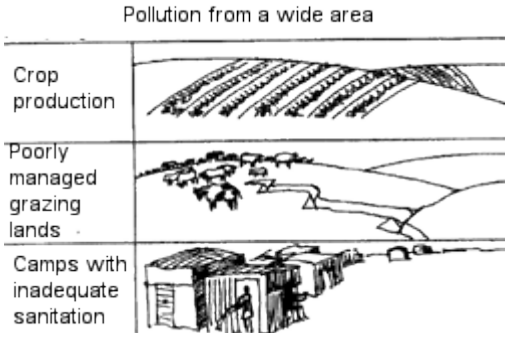
**How do off-site land-uses affect the quality and quantity of runoff?**

Probably the two most important land-uses affecting runoff quantity and timing from the wetland's surrounding catchment are damming/pumping of water (usually for irrigation) and afforestation. As a general rule, trees use more water than natural grassland. Gum trees use the most water (sometimes increasing water loss by more than twice that of natural grassland) followed by wattle and pine trees. Sugarcane also increases water loss. The extra water used by trees, sugarcane or any other crop that has a high transpiration rate would no longer reach the wetland. Dams reduce runoff through evaporation from the dam surface. Dams also allow for large quantities of water to be abstracted and used for irrigation, which may greatly reduce runoff to the wetland.

There are several land-uses that may affect the quality of runoff, including :

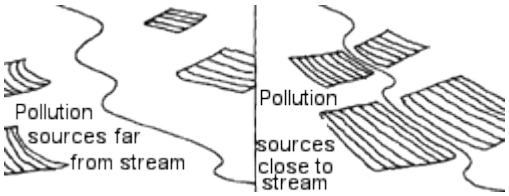
- mining
- intensive animal production
- sewage works
- industries
- crop production
- poorly managed grazing lands
- human settlements with inadequate sanitation

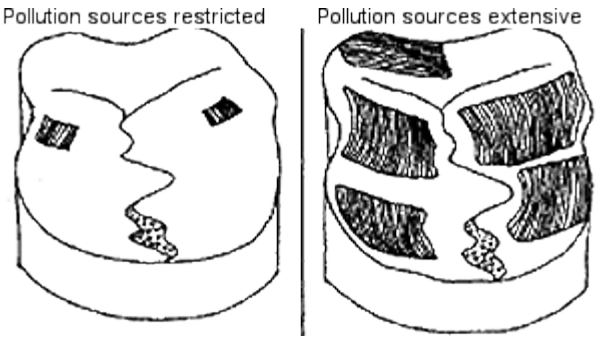



In order to determine the potential problems that may be generated by a pollution source (point source and non-point source) you will need to find out :

- Are the water quality standards of the Department of Water Affairs being met (see references)?
- What is the type of pollutant being released and what are its concentrations (this may vary greatly through the year)?
- How close is the pollution source to a stream (pollution which enters directly into a stream is likely to have a greater impact than pollution which has to pass overland first, particularly if it moves through wetland areas)?
- In the case of non-point source pollution, what is the extent in the catchment of the area generating the pollutant (the greater the area occupied by the land-sue, the greater the potential impact)?




Runoff from mines typically has high pollutant levels. For example, iron sulphate-bearing rocks dug up to mine coal are exposed to oxygen and water, which produces sulphuric acid, and, under the acidic conditions metals such as manganese and zinc become more soluble and may reach toxic concentrations. Wastewaters from many industries also have high levels of pollutants, including a wide range of pollutant types. Wastewaters from intensive animal production operations and sewage works typically have high levels of nutrients and disease-causing bacteria and viruses.

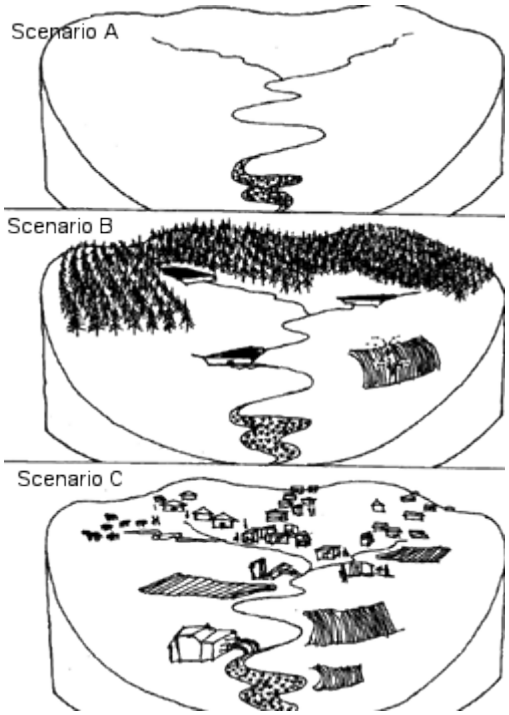
By law, water from point sources has to meet certain water quality standards set by the Department of Water Affairs and Forestry (see references). However, in many cases even though wastewaters receive some treatment before being allowed to continue down the catchment, the water quality standards are not met.

Well-managed veld used for grazing generally has a low level of impact on runoff. However, heavy grazing pressure may have a high impact particularly if it leads to high levels of soil erosion. Also, heavy grazing pressure, causing decreased vegetation cover and increased soil compaction, decreases infiltration and groundwater recharge. This, in turn, increases floods and reduces dry season flows from the catchment.

The disturbance involved in crop production and the reduced vegetation cover increases soil losses, leading to increased sediment loads. It has been shown that even if lands are protected, and acceptable levels of soil loss are occurring, soil loss is still likely to be greater than that which would

occur from well-managed natural veld. Thus, where lands are inadequately protected the potential impact may be considerable.

Human settlements without adequate sanitation usually produce pollutants consisting of nutrients and disease-causing bacteria and viruses.




Let us look at the surrounding catchment of a wetland under different land-use scenarios and see to what extent the quality and quantity of runoff is likely to differ (refer to the diagrams). Scenario A has very little human activity and is likely to yield unaltered volumes of good quality water, which would benefit downstream users. In Scenario B, a large proportion of the catchment is afforested and there are several dams and some irrigation. Scenario B is likely to yield less water for downstream users, which may be of a slightly lower quality than in Scenario A. Scenario C has no afforestation and damming but has cultivation and human settlements with poor sanitation situated close to the streams. It is therefore likely to have poorer water quality than Scenarios A and B but yield more water than Scenario B. Imagine a combination of catchment Band C where the quality and quantity of water would be lowered.

**How do off-site impacts on runoff affect wetlands?**

The effect of a change in the water quality of the runoff on the functioning and benefits of a wetland depends very much on the type and concentrations of the pollutant and the type of wetland (see wastewater treatment, page). The deposition within the wetland of excess sediment from the wetland's catchment will alter the wetland landform, which may then affect the hydrological regime of the wetland. For example, if a wetland depression is filled with deposited sediment, it will retain less water than previously.

A reduction in the quantity of runoff obviously changes the hydrology of the wetland. If the runoff is greatly reduced, the wetland may become much less wet. This would happen if the wetland was artificially drained, causing many of its benefits to society to be lost. A change in the timing of runoff would also alter the hydrology of the wetland, and is likely to cause some of the wetland benefits to be lost. The species found naturally in a wetland may be adapted to wetness at a particular time and they may not be able to survive if this is changed.

Besides reducing the amount of water reaching the wetland, trees planted close to the wetland may increase shading of the natural vegetation and allow the establishment of alien plants. Wetland dependent species, such as wattled crane, which use non-wetland grassland areas nearby for feeding would also be negatively affected by trees planted close to the wetland.

**Conclusion**

We have seen that functioning wetlands may have many benefits to society. Some of these benefits, particularly the indirect benefits, are not obvious and can be easily overlooked. This is partly why many of the wetlands in South Africa have been destroyed through development and degradation. Unless action is taken to positively influence the activities of people affecting wetlands, the results could be very serious. In a water-poor country such as South Africa, continued destruction of wetlands will result in :

- lower agricultural productivity;
- less pure water;
- less reliable water supplies;
- increased downstream flooding; and
- increasingly threatened plant and animal resources.

From the discussion on wetland benefits and land-use impacts we have seen that the hydrology of a wetland is the most important factor determining its functioning. Thus, as a general rule, the more you alter the hydrology of a wetland the greater will be the effect on its functioning. When people use wetlands or their catchments to obtain resources, the functioning and indirect benefits of the wetland are often affected negatively. However, some uses (e.g. sustainable harvesting of wetland plants) are much less destructive than others (e.g. draining and cultivating crops). These uses which do not alter the hydrology and which do not affect the functioning of the wetland negatively need to be promoted. By doing this, local people can benefit directly from the wetland while, at the same time, the benefits received by society are not lost (i.e. more people benefit and the total value of the wetland is increased).

If you use a wetland directly or are giving advice, it is important to know how different land-use choices affect the functioning of the wetland and the benefits it provides to society. This booklet and the references given below will help you. Advice may also be obtained from the several organizations concerned with wetlands which are also listed.

**Useful References**

Begg G W, 1986. The wetlands of Natal (Part 1): An overview of their extent, role and present status. Natal Town and Regional Planning Report 7

Begg G W, 1989. The wetlands of Natal (Part 3): The location, status and function of the priority wetlands of Natal. Natal town and Regional Planning Report 73.

Begg G W, 1990. The wetlands of Natal (Part 4): Policy proposals for the wetlands of Natal and KwaZulu. Natal Town and Regional Planning Commission Report 75.

Cowan G I (ed.) 1995. Wetlands of South Africa. Department of Environmental Affairs and Tourism.

Cowardin L M, Carter V, Golet F C, and LaRoe E T, 1979. Classification of wetlands and deepwater habitats of the United States. U S Fish and Wildlife Service Pub. FWS/OBS-79/31, Washington D C.

Department of Water Affairs and Forestry, 1995. Procedures to assess effluent discharge impacts. WRC Report No. TT64/94, Water Research Commission, Pretoria.

Kotze D C, 1996. Wetlands and people: what benefits do wetlands have and how are these benefits affected by our land-use activities? WETLAND-USE Booklet 1. SHARE-NET, Howick.

Kotze D C, 1996. How wet is a wetland?: an introduction to wetland hydrology, soil and landforms. WETLAND-USE Booklet 2. SHARE-NET, Howick.

Kotze D C and Breen C M, 1994. Agricultural land-use impacts on wetland functional values. WRC Report No 501/3/94. Water Research Commission, Pretoria.

Mitsch W J and Gosselink J G, 1986. Wetlands. Van Nostrand Reinhold, New York.

Soil Classification Working Group, 1991. Soil classification: a taxonomic system for South Africa. Memoirs on the Agricultural Natural Resources of South Africa No, 15. SIRI, D.A.T.S., Pretoria.

Wyatt J, 1995. Wetland Fix: Assessment, management, and restoration of South African wetlands. Part 1: Introduction and wetland assessment. Rennies Wetlands Project.

Wyatt J, 1995. Wetland Fix: Assessment, management, and restoration of South African wetlands. Part 2: Wetland burning and grazing guide. Rennies Wetlands Project.

Wyatt J, 1995. Wetland Fix: Assessment, management, and restoration of South African wetlands. Part 3: Streambank stabilization and channel plug development. Rennies Wetlands Project.

Wyatt J, 1995. Wetland Fix: Assessment, management and restoration of South African wetlands. Part 4: Indigenous plants suitable for streambank stabilization and channel plug development. Rennies Wetlands Project.

Wyatt J, 1995. Wetland Fix: Assessment, management and restoration of South African wetlands. Part 5: Stream source wetlands spring protection guide. Rennies Wetlands Project.

Wyatt J, 1995. Wetland Fix: Assessment, management and restoration of South African wetlands. Part 6: Alien plant control. Rennies Wetlands Project.

**Glossary of Terms**

**Aerobic** : having molecular oxygen (02) present.

**Anaerobic** : not having molecular oxygen (02) present.

**Biodiversity** : the variety of life in an area, including the number of different species, the genetic wealth within each species, and the natural areas where they are found.

**Biological integrity** : refers to the fauna and flora that are characteristic of an area (i.e. the species that would naturally be in an area).

**Bog** : a mire (i.e. a **peat** accumulating wetland) that is hydrologically isolated, meaning that it is

only fed by water falling directly on it as rain or snow and does not receive any water from a surrounding catchment. Bogs have acidic waters and area often dominated by mosses (Mitsch and Gosselink, 1986). The term bog is frequently used much more broadly in South Africa to refer to high altitude wetlands that have organic-rich soils. Many of these wetlands would not be bogs in the correct sense.

**Bottomland** : the lowlands along streams and rivers, often on alluvial (river deposited) soil.

**Catchment** : all the land are from mountaintop to seashore which is drained by a single river and its tributaries.

**Chroma** : the relative purity of the spectral colour, which decreases with increasing greyness.

**Decomposition** : the breakdown of dead organic matter into simpler substances.

**Direct (wetland) benefits** : have worth, quality or importance to humans and are realized by individuals actively using a wetland (e.g. for recreation, or pasture production).

**Estuary** : where the river and sea meet and the fresh water from the river mixes with the sea water.

**Evaporation** : the change from a liquid or solid state to a vapour.

**Fen** : a mire (i.e. a peat accumulating wetland) that receives some drainage from mineral soil in the surrounding catchment.

**Gley** : soil material that has developed under anaerobic conditions as a result of prolonged saturation with water. Grey and sometimes blue or green colours predominate but mottles (yellow, red, brown and black) may be present and indicate localized areas of better aeration.

**Groundwater** : subsurface water in the zone in which permeable rocks, and often the overlying soil, are saturated.

**Groundwater table** : the upper limit of the groundwater.

**Hydric soil** : soil that in its undrained condition is saturated or flooded long enough during the growing season to develop anaerobic conditions favouring growth and regeneration of hydrophytic vegetation (i.e. wetland soil).

**Hydrology** : the study of water, particularly the factors affecting its movement on land.

**Hydrophyte** : any plant that grows in water or in soil that is at least periodically anaerobic as a result of saturation; plants typically found in wet habitats.

**Indirect (wetland) benefits** : have worth, quality or importance to humans but do not require active use of wetlands by individuals in order for the benefits to be realized. Instead, the wider public benefits indirectly from the services that wetlands provide (e.g. purification of water).

**Marsh** : a wetland which is seasonally or permanently flooded/ponded, with soils which remain semi-permanently or permanently saturated, and which is usually dominated by tall (usually >1.5m) emergent herbaceous vegetation, such as the common reed (Phragmites australis).

**Mottles** : soils with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.

**Open water** : temporarily to permanently flooded areas characterized by the absence (or low abundance) or emergent plants.

**Peat** : soil material with a high organic matter content. According to the Soil Survey Staff (1975) definition, in order for a soil to be classed as organic it must have >12% organic carbon by weight if it is sandy and >18% if it is clay-rich.

**Perched water table** : the upper limit of a zone of saturation in soil, separated by a relatively impermeable unsaturated zone from the main body of groundwater below.

**Permanently wet soil** : soil which is flooded or waterlogged to the soil surface throughout the year, in most years.

**Red data species** : all those species included in the categories of endangered, vulnerable or rare, as defined by the International Union for Conservation of Nature and Natural Resources.

**Riparian** : the area of land adjacent to a stream or river that is influenced by stream-induced or related processes. Riparian areas which are saturated or flooded for prolonged periods would be considered wetlands and could be described as riparian wetlands. However, some riparian areas are not wetlands (e.g. an area where alluvium is periodically deposited by a stream during floods but which is well drained).

**Roughness coefficient** : an index of the roughness of a surface and is a reflection of the frictional resistance offered by the surface to water flow.

**Runoff** : total water yield from a catchment including surface and subsurface flow.

**Seasonally wet soil** : soil which is flooded or waterlogged to the soil surface for extended periods (>1 month) during the wet season, but is predominantly dry during the dry season.

**Sedges** : grass-like plants belonging to the family Cyperaceae, sometimes referred to as nutgrasses. Papyrus is a member of this family.

**Soil drainage classes** : describe the soil moisture conditions as determined by the capacity of the soil and the site for removing excess water. The classes range from very well drained, where excess water is removed very quickly, to very poorly drained, where excess water is removed very slowly. Wetlands include all soils in the very poorly drained and poorly drained classes, and some soils in the somewhat poorly drained class.

**Soil saturation** : when all spaces between the soil particles are filled with water.

**Sustainable use** : the use of a resource in a way which allows that resource to renew itself so that it will continue to be available for the benefit of future generations.

**Swamp** : a wetland dominated by trees or shrubs (USA definition). Swamp is also sometimes used to refer to reed or papyrus dominated areas.

**Temporarily wet soil** : the sol close to the soil surface (i.e. within 40 cm) is occasionally wet for period >2 weeks during the wet season in most years. However, it is seldom flooded or saturated at the surface for longer than a month.

**Transpiration** : the transfer of water from plants into the atmosphere as water vapour.

**Vlei** : a colloquial South African term for wetland.

**Water quality** : the purity of the water.

**Waterlogged** : soil or land saturated with water long enough for anaerobic conditions to develop.

**Wet grassland** : an area which is usually temporarily wet and supports a mixture of : (1) plants which are common to non-wetland areas and (2) short (<1m) hydrophytic plants (predominantly grasses).

**Wet meadow** : an area which is usually seasonally wet and dominated by hydrophytic sedges and grasses which are common only to wetland areas.

**Wetland** : a collective term used to describe land where an excess of water (i.e. waterlogging) is the dominant factor determining the nature of the soil development and the types of plants and animals living at the soil surface (Cowardian et al., 1976); lands that are sometimes or always covered by shallow water or have saturated soils, and where plants adapted for life in wet conditions usually grow.

**Wetland soil** : synonymous with hydric soil.

**Wetland catchment** : all of the land area upslope of the wetland (from which water drains into the wetland) and including the wetland itself. The "surrounding catchment" refers to that part of the wetland catchment excluding the wetland.

**Organizations Concerned with Wetlands**

Your provincial Nature Conservation Department

Directorate : Resource Conservation
Department of Agriculture
P/Bag X120
Pretoria
0001

Department of Environmental Affairs and Tourism
Private Bag X447
Pretoria
0001

Your provincial Department of Agriculture

The Wildlife & Environment Society of South Africa
P O Box 394
Howick
3290

Southern African Crane Foundation
P O Box 905
Mooi River
3300

Rennies Wetlands Project
P O Box 44189
Linden
2104

If you have general concern for wetlands, increase your understanding and support the wetland activities of organizations such as the Wildlife Society. These activities include: campaigning for wetlands that are threatened; collecting information that will be used to assist managing wetlands; rehabilitating (restoring) wetlands by controlling alien plants and blocking drainage channels (see

references); and making other people aware of the benefits of wetlands to society. For more information on rehabilitating wetlands see references, Wyatt (1995)

**Quiz**

In order to test yourself and see whether you have a reasonable understanding of this booklet, you should be able to answer the following questions :

1. Suggest some differences between direct and indirect wetland benefits received by people from wetlands, and give some examples of each.

2. What is groundwater discharge?

3. Name some features that make wetlands good at purifying water?

4. What are some of the negative effects of artificial drainage on the indirect values of wetlands?

5. Are the following statements true or false (explain your answers) :

a) all wetlands erode very easily

b) wetlands should never be burnt

c) dams are able to perform all the functions of wetlands

6. How is a wetland likely to be affected if its entire surrounding catchment is afforested with gum trees?