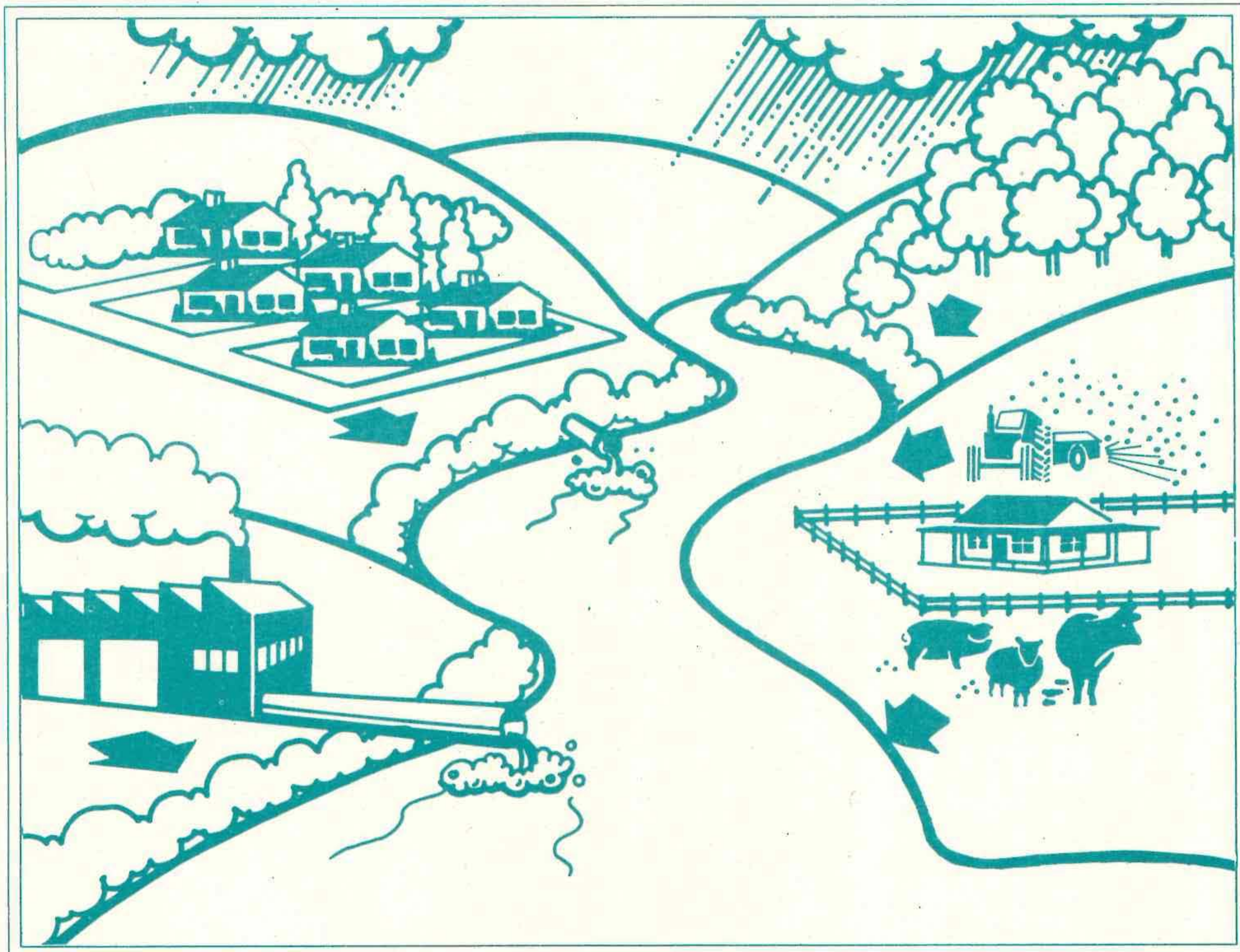


River and estuary pollution



Waterways Information No. 4

By Karen Majer and Beverley Thurlow



Waterways Commission, June 1991



River and estuary pollution

WATER POLLUTION

What is pollution?

Definition:

Pollution occurs when a waste product or other substance changes the physical, chemical, biological or thermal (heat) characteristics of the environment so that there is an adverse affect on people's health or safety, on plant or animal life, or on the uses people make of that environment.

A river or estuary is polluted when a substance which harms the water quality, plants or animals, enters the waterway and alters its natural functions. This, in turn, can reduce people's enjoyment and use by spoiling the scenery, restricting recreation (for example if the water is no longer safe or pleasant for boating or swimming) and damaging economic uses including fisheries.

Why are waterways prone to pollution?

Rivers and estuaries have always been a focus for human settlement and recreation. The waters are used for transport, recreation and development of port and boating facilities. The banks are a focus for residential, tourist and industrial development and roads. In the past, they were often used as convenient dumping grounds for sewage, rubbish and industrial wastes. Fertile river floodplains are used for intensive

agriculture, including market gardens and vineyards. The wider catchment often supports a range of land uses including agriculture, mining and forestry.

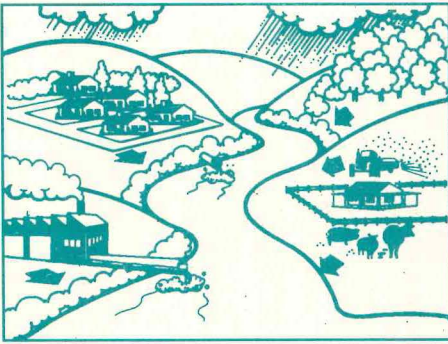
All these activities can pollute waterways. Waste discharges, accidental spills, urban and agricultural runoff, and groundwater flow carry a wide range of pollutants. Some of the pollutants flow to the sea, where they are dispersed in a very large volume of water. However estuaries are semi-enclosed water bodies and some of the pollution stays in the water or bottom sediments.

How badly a waterway is affected depends on the type and amount of pollution and also on characteristics of the waterway itself, especially how well the estuary is flushed by the tides (see 'The impact of pollution').

How do pollutants enter waterways?

Pollutants may enter directly, for example in industrial waste discharges or wastes from boats, or in water flowing into the estuary in surface (creek, river or drain) or groundwater flow from the surrounding catchment.

A catchment is the area from which a wetland, river or estuary collects its water, and can be a very large area. For example, the Avon River, which feeds Perth's Swan River, has a catchment over 100,000 square kilometres. The Peel-Harvey Estuary catchment is about 12,000 square kilometres and Leschenault Estuary's is nearly 5,000 square kilometres.



Water from right across the catchment eventually finds its way into the estuary. This means that pollutants from all land uses in the catchment can also end up in the estuary.

Sources of pollution

Pollutants enter a river system from a range of land uses across its catchment. Often, poor water quality is the result of the combined effects of a variety of activities across the catchment. Some pollution comes from sources which can be pin-pointed, for example a factory or a piggery discharging its wastes into a drain. These are called 'point sources.' However, many of the pollutants which enter estuaries come from a wide area, for example fertilisers used throughout a farming area, or on a town's parks and gardens. These 'non-point' sources are harder to control.



Point source



Non-point source

TABLE 1 shows the variety of pollutants carried in wastes and runoff from the major land uses.

What pollutants can harm waterways?

Pollutants can be divided into four types: nutrients, toxins, pathogens and physical pollutants.

TABLE 2 summarises the major sources of these types of pollutants, their effects on the waterway, methods of monitoring the level of pollution and control measures.

Nutrients are required by plants and animals for growth. People get their nutrients from the food they eat. Algae in the estuary take their nutrients from the water. When excessive amounts of nutrients, especially nitrogen and phosphorus, enter the estuary it is called 'eutrophication'. The nutrients fertilise the growth of algae in the water just like fertiliser on a lawn. Some algae will grow in vast amounts (called a 'bloom') and upset the delicate natural balance of plants and animals in the estuary. Large stores of nutrients can build up in the sediment of the estuary floor, forming a nutrient 'bank'. Under certain conditions these can be released for use by algae.

Toxins are substances which are poisonous to living organisms. Chemicals such as pesticides and petroleum products (petrol, oil, diesel) can cause illness or death of plants and animals.

Some toxins, including heavy metals (such as lead) and some chemicals (such as pesticides) build up in the sediments. They can be taken up by plants or animals over a period of time without causing

TABLE 1









LAND USE	WHAT GETS INTO THE WATERWAYS?	POTENTIAL POLLUTANTS
<p>URBAN</p>    	<p>Stormwater drainage Runoff from roads, parks, gardens</p> <p>Groundwater from areas with septic tanks Sewage effluent</p> <p>Groundwater (leachates) and surface runoff from sanitary landfill and liquid waste disposal sites</p> <p>Runoff from foreshore recreation areas and marinas, bilge and ballast water from watercraft</p>	<ul style="list-style-type: none"> • Nutrients (fertilisers) • Pathogens (bacteria and viruses) • Fuel and oil from vehicles • Tyre rubber • Heavy metals (e.g. lead from petrol, chromium, cadmium) • Pesticides • Litter • Sediments • Nutrients • Chemicals (e.g. fats, soaps, detergents, cleansers, disinfectants, grease) • Pathogens (bacteria and viruses) • Acids and alkalis • Bacteria, especially <i>Salmonella</i> (spread by scavenging birds, rodents and insects) • Toxic substances depending on nature of wastes • Litter • Oil & petrol (e.g. from boat engines) • Nutrients (fertiliser and watercraft discharges) • Pathogens (bacteria and viruses) • Oil and hazardous chemicals in bilge water • Heavy metals (anti-fouling paint)
<p>INDUSTRY</p> 	<p>Industrial waste discharges Accidental spills Runoff and groundwater from industrial areas</p>	<ul style="list-style-type: none"> • Nutrients • Chemicals depending on industrial process(e.g. acids, alkalis, heavy metals, oil, solvents, organic chemicals) • Heated water
<p>AGRICULTURE AND HORTICULTURE</p> 	<p>Runoff, water from agricultural drains, groundwater</p>	<ul style="list-style-type: none"> • Nutrients (fertilisers & animal wastes) • Sediments • Bacteria • Heavy metals • Pesticides, herbicides, weedicides • Salt
<p>FORESTRY</p> 	<p>Runoff and groundwater</p>	<ul style="list-style-type: none"> • Herbicides
<p>MINING</p> 	<p>Runoff from mined area, refuse heaps and tailings ponds Mine process or cooling water</p>	<ul style="list-style-type: none"> • Sediments • Acid and alkaline wastes • Toxic substances depending on process(e.g. heavy metals, cyanide, oil, solvents)

TABLE 2

TYPE OF POLLUTANT	MAJOR SOURCES	EFFECT	MEASUREMENT	CONTROL OR PREVENTION
<p>NUTRIENTS especially nitrogen (N) and phosphorus (P)</p>	<p>Stormwater drainage. Fertilisers from parks and gardens. Sewage. Agricultural runoff containing fertilisers and animal wastes. Phosphate detergents. Leachates from rubbish tips and septic tanks. Organic industrial wastes. Sediment banks in estuary.</p>	<p>High nutrient levels cause excessive growth of algae, disturbing ecological balance in estuary and reducing recreation values.</p>	<p>Monitor N,P inputs to estuary.</p>	<p>Catchment management to reduce nutrient inputs. Clean up algae to keep beaches clean. Increase flushing of estuary to sea. Public education.</p>
<p>TOXINS (poisons including pesticides, petroleum, heavy metals)</p>	<p>Pesticides and herbicides in runoff from urban areas, agriculture, horticulture, forestry. Spills or industrial waste discharges of petroleum products or toxic chemicals. Anti-fouling paint from boats. Leachates from tip sites. Some species of microscopic algae introduced in ballast water from ships from other parts of the world.</p>	<p>Poisoning of plants and animals causing defects, illness or death. Sometimes toxins accumulate in the food chain.</p>	<p>Monitor industrial effluent discharges. Measure heavy metals in sediments or 'indicator' species. Monitor water quality, e.g. pesticides and metals. Measure pesticide levels in fish.</p>	<p>License and control waste discharges. Store and transport petroleum and chemical products carefully. Clean up accidental spills before they reach waterways. Manage waste disposal sites carefully. Restrict use of pesticides and herbicides.</p>
<p>PATHOGENS (bacteria and viruses)</p>	<p>Sewage and septic tank effluent. Animal wastes. Organic wastes from industry (e.g. food processing). Runoff from stock holding areas.</p>	<p>Disease in plants or animals, including people.</p>	<p>Public health monitoring of faecal bacteria.</p>	<p>Sewer urban development. Discharge sewage away from watercourses. Control waste discharges.</p>
<p>PHYSICAL POLLUTANTS (Litter, sediment, silt, debris, oil, plastic)</p>	<p>Rubbish and litter dumped or blown into waterways. Sediments from erosion of foreshores, catchment soil loss, dredging, mining, building, road construction. Suspended solids in industrial wastes. Oil spills.</p>	<p>Plastic entangles or suffocates wildlife. Sediments reduce water quality, smother bottom - dwelling plants and animals and reduce light penetration. Litter causes visual pollution. Oil pollution.</p>	<p>Visual inspection of waters and foreshores. Measure water clarity (secchi disc).</p>	<p>Control rubbish and litter. Restrict dredging. Stabilise banks. Soil conservation measures in catchments. Control waste discharges. Public education.</p>

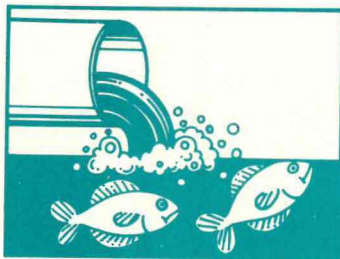
obvious ill-effects. Symptoms such as lesions (skin damage) on fish, thinning of birds' egg shells, or birth defects, appear as the level of the toxin builds up. Some animals, like mussels, store toxins in their tissues and can become poisonous to other animals or people that eat them.

Some toxins are of living, rather than chemical, origin. These 'biotoxins' can be produced by microscopic plants (blue-green algae, diatoms or dinoflagellates) which may occur naturally or be introduced into a waterway from somewhere else. Filter-feeding animals can take up the tiny plants and become poisonous, so care should be taken about eating shellfish or mussels from an estuary when there is a 'bloom'.

Oil is a particularly unpleasant pollutant which, as well as being toxic, irritates animals' eyes and skin, clogs the gills of fish and smothers plants and small animals.

Pathogens are microscopic organisms (bacteria and viruses) which cause disease in plants or animals. The presence of some bacteria, such as *Escherichia coli*, in an estuary usually indicates pollution by sewage. It is rare for pathogens to be present in Western Australian estuaries in levels high enough to cause illness in people.

Physical pollutants include rubbish, litter and sediment (soil particles) from dredging activities or erosion. Rubbish, especially plastic and fishing line, can kill birds, dolphins and fish which accidentally eat it or become entangled. Sediments in the water can block fish gills, smother bottom-living plants and animals, reduce the clarity of the water so that birds such as cormorants cannot see their underwater prey, and restrict the light available for growth of seagrass beds.



THE IMPACT OF POLLUTION

Effects on the waterways

The effects of pollution can vary from place to place from localised damage to disturbance to the ecology of an entire estuary. The impact of pollution depends on the type and amount of pollution and on the characteristics of the waterway itself, especially how well an estuary is flushed with sea water when the tides go in and out. Water exchange between an estuary and the sea is limited by the size and depth of the estuary's inlet channel and often by a seasonal sand bar at the mouth. An estuary with a deep, open channel to the sea will be flushed by the tide and will be able to withstand more pollution before showing symptoms than an estuary with more restricted tidal exchange. This ability to tolerate pollutants is called the waterway's 'assimilative capacity'.

For example, the Peel-Harvey Estuary is a large, shallow water body with a narrow, five kilometre inlet channel to the sea. Although the entrance has been dredged and is kept permanently open, tidal movement of sea water in and out is limited and the estuary is showing the excessive growth of algae which is a symptom of eutrophication. The Swan River Estuary receives nutrient inputs similar to those of the Peel-Harvey Estuary, but so far has shown less impact because it has good tidal exchange through the channel at Fremantle.

Are Western Australia's south-west estuaries polluted?

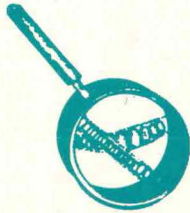
Most of our south-west estuaries have good water quality. The waterways are generally safe to swim in, have abundant plant and animal life and usually offer good catches of fish, crabs and prawns.

At this stage the greatest concern is rising nutrient levels in many waterways. Some are already showing signs of environmental damage and others are on the brink.

The Peel-Harvey Estuary at Mandurah has had blooms of large green algae ('weed') since the early 1970s. The weed accumulates in the shallows and along the shoreline, where it rots with an unpleasant odour. Spring growths of the toxic blue-green alga *Nodularia* have turned the water green almost every spring since 1978. Fish catches decline during the *Nodularia* bloom, and oxygen levels in the water drop, often causing mass death of bottom-living animals which form the basis of the food supply for the fishery.

The Swan River Estuary has been noted for its good water quality for a river flowing through a capital city. In recent years, however, micro-algal blooms in the upper reaches have led to public concern that the river may be on the verge of serious damage from the increasing population pressures.

Nodularia



The Leschenault Estuary at Bunbury is another estuary which still has good water quality, but like the Swan River it has reached the point where any further

increase in nutrient inputs could upset the estuary's balance. The abundance of weed is of the same order as in Peel Inlet, but it does not usually cause a problem because the algae do not often blow up onto beaches near residential areas.

The Avon River, which becomes the Swan River at Woorooloo Brook, collects water from a huge agricultural catchment. The Avon has been showing signs of pollution, including increased salinity levels, silting and high nutrient levels, for many years. One of the most serious problems is rising salinity levels, and the associated impact on the native flora and fauna. Scouring and siltation of the river as a result of the River Training Scheme carried out between 1956 and 1972 have also had serious consequences. The sediment filled many of the deep river pools which once formed a chain of tree-lined permanent waterholes along the river bed during the dry summer months. These pools were important summer wildlife refuges, and the few that remain are vitally important for conservation.

Princess Royal Harbour at Albany is under pressure from both nutrient enrichment and industrial pollution. Identification of lead and mercury in fish from the Harbour has caused the western side of the harbour to be closed to fishing. Industries have ceased to discharge these pollutants. However excessive growth of algae has continued to smother the seagrass meadows and about 90% of the seagrass beds in Princess Royal Harbour and 80% in Oyster Harbour have been lost since the 1960s.

Seagrass



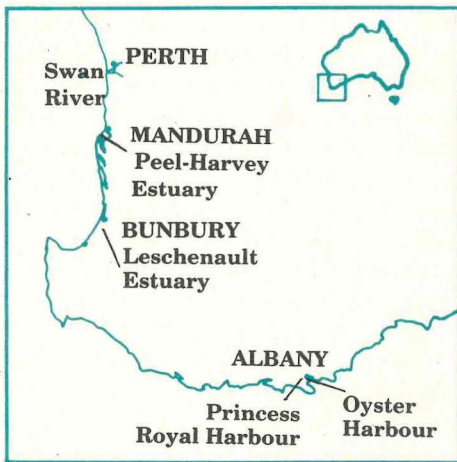
PREVENTING POLLUTION



The role of the Waterways Commission and the Swan River Trust

The Waterways Commission has the task of protecting and managing the State's waterways. Community-based Management Authorities are the on-the-ground management arms of the Commission in Mandurah (Peel-Harvey Estuary), Bunbury (Leschenault Estuary) and Albany (Princess Royal Harbour and Oyster Harbour). The Swan River Trust is responsible for protecting the Swan-Canning River System.

The Waterways Commission and Swan River Trust have power to control pollution of the waterways under their management. The pollution control powers are delegated from the Environmental Protection Act, which gives the Western Australian Government power to prevent pollution throughout the State and to prosecute offenders.



Waterways currently managed by the Waterways Commission and the Swan River Trust

What does the Waterways Commission do about pollution?

The Commission and the Trust control pollution in the waterways in several ways:

DETECTING POLLUTION...

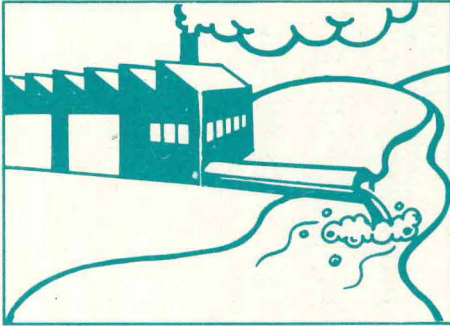
- inspecting the waterways and drains regularly for signs of pollution;
- monitoring water quality to detect changes in the health of the estuaries;
- monitoring water quality in streams, drains and rivers running into estuaries to locate sources of pollutants, especially nutrients;
- responding to public complaints.



...CONTROLLING SOURCES OF POLLUTION...

- licensing and monitoring industrial discharges into the waterways;
- responding to and dealing with specific pollution problems;
- providing information and advice on preventing pollution and catchment management (e.g. to industries, local government and landowners);

- providing advice on the suitability of proposed developments around waterways and conditions on development approvals to minimise the risk of pollution.



PREVENTION IS BETTER THAN CURE - many of these activities, including monitoring, pollution control, and providing information and advice, aim to prevent rather than clean up pollution.

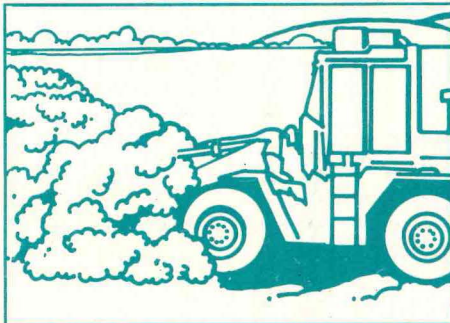
Catchment management

The key to preventing pollution is good catchment management. The Commission is working closely with other agencies concerned with planning and land management, as well as local government, catchment groups and land owners, to make sure that our waterways are protected for the future.

Co-operation right across the community is the key to caring for our waterways. Everyone lives in a catchment - and everyone has a role to play in making sure our uses of the land do not destroy our waters.

..AND CLEANING UP THE MESS

- cleaning up accidental spills of oil, chemicals and petroleum products which might pollute the waterways;
- assisting other emergency services to clean up hazardous chemical spills which threaten the waterways;
- beach cleaning and harvesting algae to keep foreshore beaches clean.



WATER QUALITY MONITORING

The first step in preventing waterway damage from pollution is to identify the problems: Where is pollution occurring now and where is it likely to happen in the future?

An important way to detect pollution in its early stages is to keep a close eye out for any changes in water quality. Water quality monitoring programmes are carried out to gather information on the current condition of the waterways and to pick up changes over time. The monitoring programmes provide a 'watch-dog' for pollution problems and an understanding of what is happening to our waterways - information which is vital to future management. Water quality monitoring is the subject of Waterways Information leaflet No. 5.

FURTHER READING

Atkins RP & Klemm VV (1987)

The effects of discharges, effluent and urbanisation on the Swan River. In: Swan River Estuary, Ecology and Management. Curtin University Environmental Studies Group Report No 1.

Fisheries Department of Western Australia. Pollution and the Recreational Fisher.

Peel District Education Office and Peel Inlet Management Authority (1991) Caring for our waterways. Peel-Harvey Estuary education programme.

Swan River Trust (1991). Preventing river pollution - information for industry. Waterways Advice No 3.

Thurlow BH, Chambers C&Klemm VV (1986) Swan Canning estuarine system, environment, use and the future. Waterways Commission Report No. 9

Waterways Commission (1991) Water quality monitoring -understanding Western Australia's estuaries. Waterways Commission. Waterways Information No.5.

The Waterways Commission publishes technical reports on water quality monitoring programmes. A complete list of publications is available from the Commission. (09) 321 8677.

For more information on pollution, visit the Environmental Protection Authority library at Environment House, 1 Mount Street, Perth between 8am and 5pm on weekdays.

ACKNOWLEDGEMENTS

Written by Karen Majer and Beverley Thurlow with assistance from the staff of the Waterways Commission. Typing by Lynne Bailey and Joanna Noakes. Design by LaserDesigns.

This booklet is one in a series on aspects of Western Australian waterways.

For more information contact:



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YOU CAN HELP

- **Reduce the use of pesticides and manufactured fertilisers on your garden. If you must use pesticides, follow manufacturers directions carefully.**
- **Make your own compost, and reduce your rubbish at the same time.**
- **Switch to household detergents without phosphates, or use soap.**
- **Avoid using abrasive or chemical cleaners, ammonia or bleach in sinks or toilets. Try 'green' products which reduce pollution.**
- **On picnics or fishing trips to the river, dispose of your litter, bait, fish and prawn scraps and plastic wrappings carefully in a bin or take them home with you.**
- **Boat owners, make sure that no bilge discharge or other pollutants enter the waterway.**
- **Notify your local Waterways Management Authority or the Swan River Trust immediately if you notice any accidental spill to a drain, creek or river, or if you see signs of obvious pollution.**

How to report pollution

For more information, or to report pollution of a waterway, contact:

Swan River	Swan River Trust
Canning River	(09) 481 0121
	A/Hours 016 98 2027
Peel Inlet	Peel Inlet
Harvey Estuary	Management Authority
	(09) 535 3411
Leschenault	Leschenault Inlet
Estuary	Management Authority
	(097) 211 875
Princess Royal	Albany Waterways
Harbour	Management Authority
Oyster Harbour	
Other waterways	Waterways Commission
& general information	(09) 321 8677

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