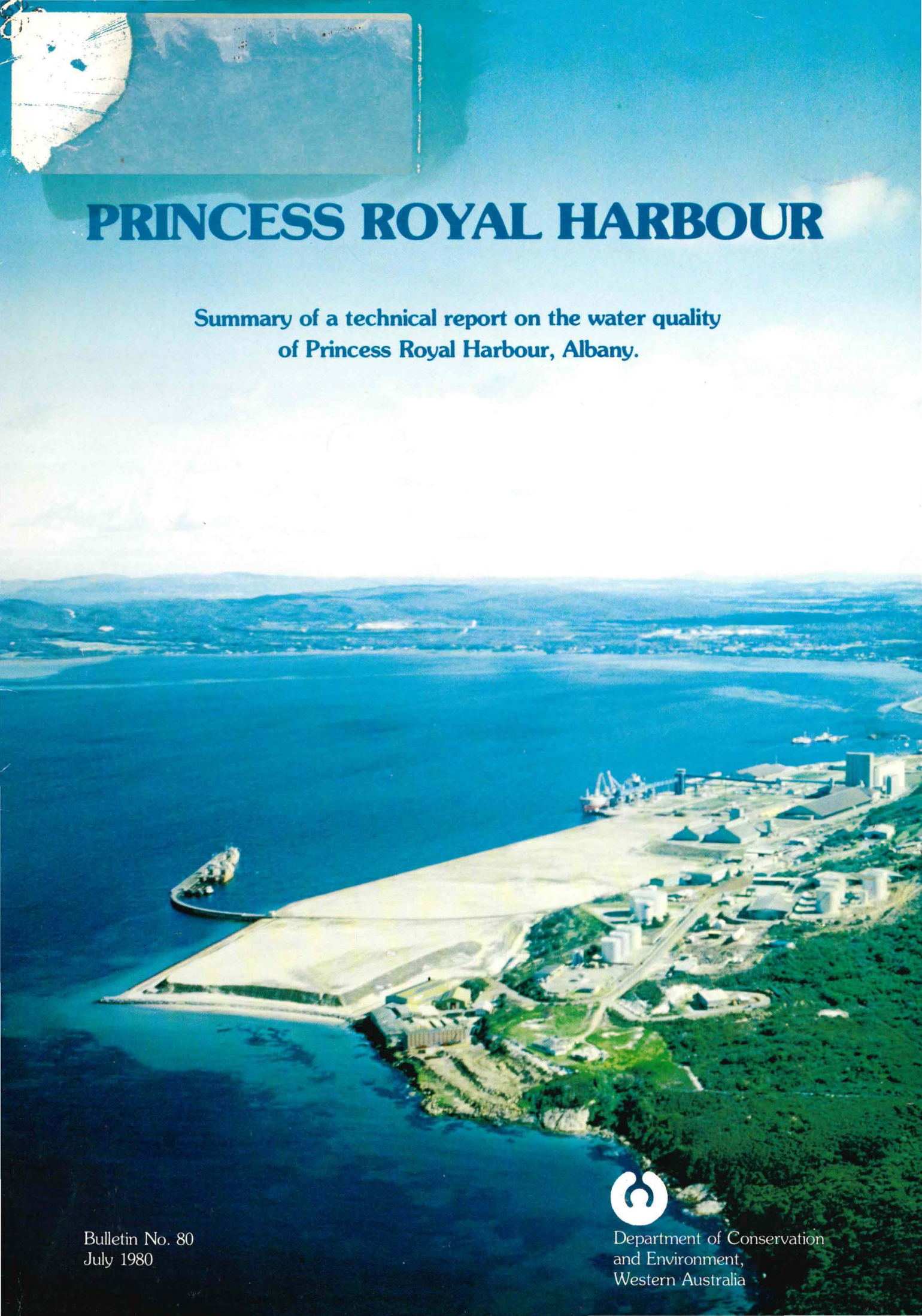
PRINCESS ROYAL HARBOUR

Summary of a technical report on the water quality of Princess Royal Harbour, Albany.



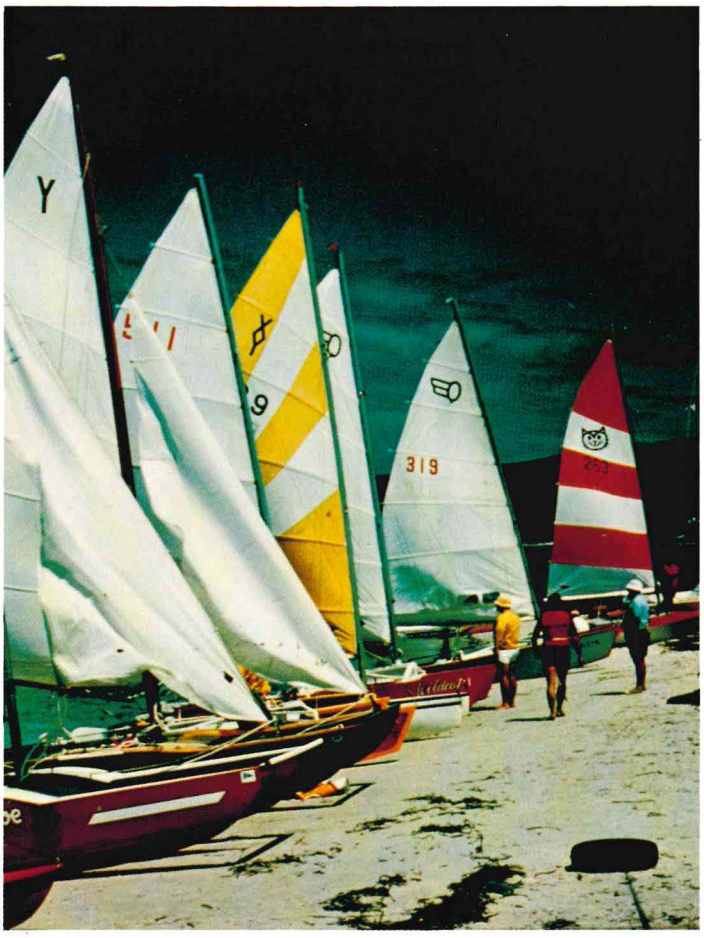
Bulletin No. 80
July 1980

Department of Conservation
and Environment,
Western Australia

INTRODUCTION

This pamphlet summarises Department of Conservation and Environment Bulletin No. 74, "A Technical Report on the Water Quality of Princess Royal Harbour, Albany", dated July 1980. The report covers the work of a study requested by the Albany Waterways Management Advisory Committee and carried out by the Department of Conservation and Environment in co-operation with the Botany Department, University of Western Australia, the Public Health Department and the Department of Fisheries and Wildlife.

Why was a study of the harbour's waters necessary? For some years there had been concern over what was regarded as a deterioration of water quality. Complaints had been made of excessive weed accumulation at the western end of the harbour and alleged health hazards from effluents of the abattoir and other industrial enterprises. Apart from receiving effluents the harbour acts as a shipping terminal, and as a base for professional fishermen; it is also used for recreation by amateur fishermen and sailing enthusiasts. To ensure that all these users of the harbour can continue their activities this study, although by no means comprehensive, was commissioned to define the main problem areas and recommend appropriate action.



Princess Royal Harbour is an embayment on the south coast of Western Australia. It has a deep basin surrounded by a sandy marginal shelf covered in some areas by seagrass meadows. An area on the northern shore has been dredged to allow for easy shipping access to Albany's wharf and deep water jetty. No rivers discharge into the harbour and so the only source of fresh water is stormwater runoff and drainage channels. The study area map shows the locations of the industries discharging effluents into the harbour.

THE STUDY PROGRAMME

To assess the general water quality of the harbour water, samples were collected at monthly intervals from December 1978 to December 1979 using the Albany Port Authority boat the "Avon". Each sample was then analysed for certain characteristics.

An earlier monitoring survey carried out by the Government Chemical Laboratories had drawn attention not only to the contaminants in discharges of industries but also to those discharged by a main drain which passes close to the fertiliser plant, then through farmland and finally runs onto the shallow western shelf of the harbour. The Public Works Department's sewage outfall at King Point did not come under scrutiny in the earlier study despite its proximity to Middleton Beach.

With this information as background knowledge the study team selected twenty-four stations for water sampling and identified the characteristics to be analysed. Mussels were also collected at certain points within the harbour and analysed for their bacterial content. Furthermore the nutrient content of industrial discharges was analysed to complement the earlier work of the Government Chemical Laboratories.

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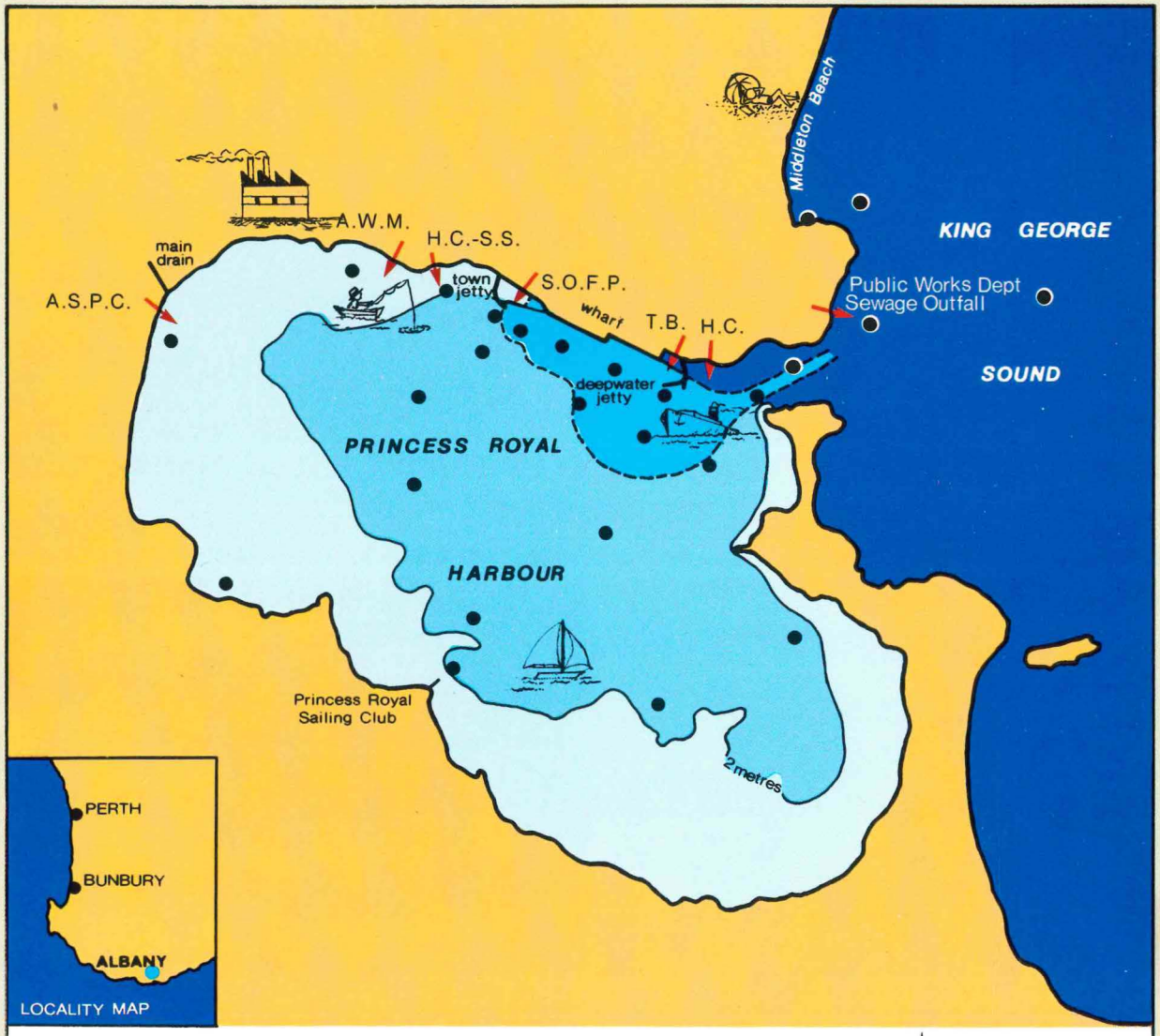


THE STUDY AREA

Industries discharging effluent directly into the harbour

Albany Superphosphate Co., (A.S.P.C.)	— manufacture of superphosphate
Albany Woollen Mills (A.W.M.)	— wool spinning, weaving and dyeing
Hunts Canning Co., Short St. (H.C.S.S.)	— fish thawing, cleaning and processing
Southern Ocean Fish Processors (S.O.F.P.)	— thawing, cleaning and processing fish. (This company ceased operations in April 1979).
Thomas Borthwick and Sons Abattoir (T.B.)	— slaughtering cattle and sheep
Hunts Canning Co. (H.C.)	— fish freezing, thawing and cleaning, vegetable processing

THE FINDINGS

To understand where and how effluents were being dispersed once they reached the harbour's waters a knowledge of the extent of water movement was important. Accordingly at each sampling station salinity, temperature and water transparency readings were taken at different depths and these were considered in relation to weather and tidal information.

Bearing in mind that the data obtained were merely indicators of water movement patterns, the results showed good vertical mixing of the waters and a rapid exchange of water between the harbour basin and King George Sound. On the other hand the movement of the water over the shallows was low and therefore these areas are prone to a build-up of effluent components. Wind appeared to be a major influence on water circulation.

TABLE OF INPUTS

INDUSTRY	BACTERIA		NUTRIENTS			
			Load in kg/day			
	Per cent occasions effluent heavily polluted, i.e. 110,000+ faecal coliforms	Number of isolations of *Salmonella* serotypes	Sampled in June 1979		Sampled on four occasions between April 1977 and January 1978	
			Nitrogen	Phosphorus	Nitrogen	Phosphorus
Borthwick Abattoir	100	17	26	7	161	ND
Main Drain	ND	ND	33	97	5	29
Hunts Canning Short Street	70	6	7	1	82	ND
Hunts Canning East	48	5	4	0.5	5	ND
Woollen Mills	ND	ND	1	1	1	ND
Superphosphate Co.	ND	ND	ND	ND	<0.5	1
Southern Ocean Fish Processors	75	0	ND	ND	ND	ND
Sewerage	100	15	ND	ND	83*	16*

ND = No Data

* Based on PWD average annual flow rates at Albany and nutrient content of primary treated sewage, Cockburn Sound Environmental Study 1976-79.

EFFLUENT COMPONENTS OF POTENTIAL CONCERN

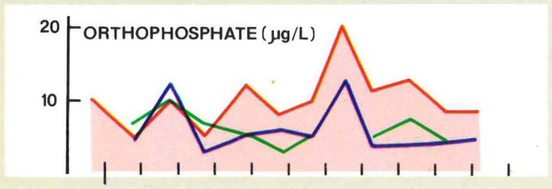
NUTRIENTS

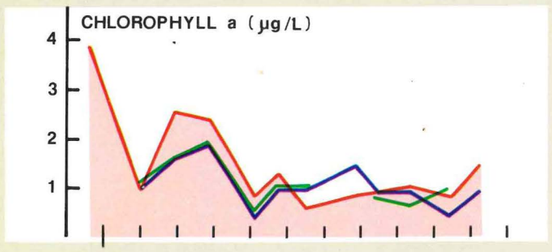
As most of the industries discharging into the harbour are concerned with the processing of animal and vegetable materials their effluents would tend to over enrich the waters with the nutrients, nitrogen and phosphorus. These can promote the growth of algae, both the larger species (weed) and the minute plant cells, known as phytoplankton, which in sufficent densities are known as 'blooms'.

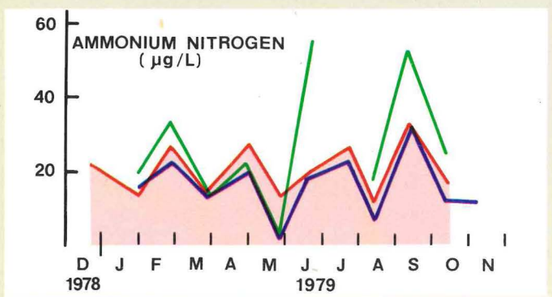
'Blooms' are high concentrations of phytoplankton; they can lower water quality and clarity and ultimately interfere with recreational activities, because the water becomes greasy to feel and unpleasantly smelly. Occasionally fish die from lack of oxygen as a consequence of a decaying 'bloom'.

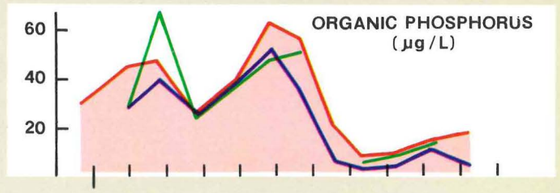
With these potential problems in mind the study set out to measure various forms of nitrogen and phosphorus in the water samples. Their relationship with chlorophyll **a** concentrations, as a measure of phytoplankton density, was assessed statistically by computer.

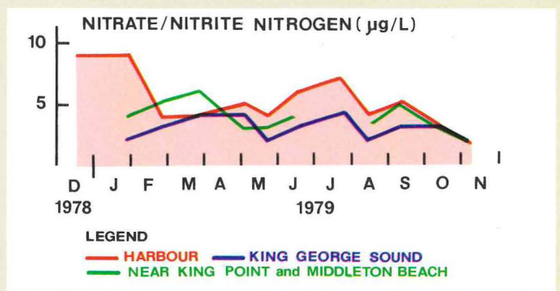
MONTHLY NUTRIENT LEVELS





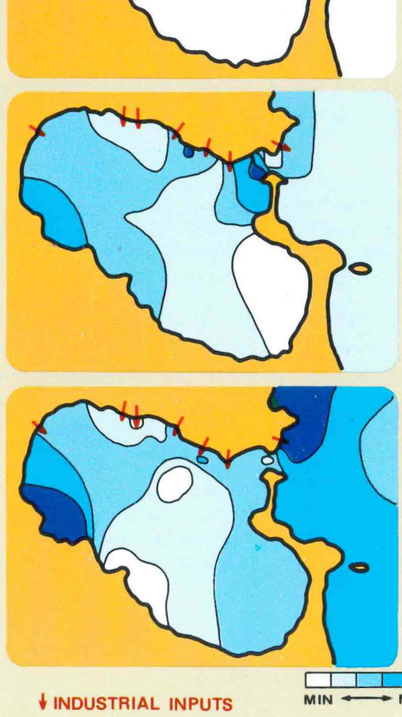






In general nutrient levels were found to be low, with little seasonal variation, and similar to those found in unpolluted waters. Under present conditions nutrients do not appear to be accumulating in harbour basin waters. With phytoplankton densities also low for most of the year the threat of widespread 'blooms' would seem to be minimal under present levels of nutrient input.

Mapping by computer enabled the study to relate nutrient distribution in June 1979 to points at which effluents were discharged.



Ammonium nitrogen concentration, a major component of sewage, is shown in this map to be high in an area close to Middleton Beach and the sewage outfall at King Point.

This map shows the surface concentration of organic nitrogen to be high over the shallow western shelf and the northern sector of the harbour. The main drain and the Borthwick Abattoir, the two most important nutrient contributors to the harbour, discharge into these areas.

Phytoplankton concentrations are high on the shallow western shelf and extending from the area into which effluents are discharged off the northern shores and King Point.

BACTERIA

With an abattoir and a fish processing plant discharging their wastes into the harbour as well as a primary treated sewage outfall close to its entrance,bacterial contamination might be expected. The aim of the sampling programme was to identify areas, if any, which might be regarded as public health risks for swimming and other water sports or the taking of seafood such as mussels. To achieve this seawater and mussel samples were collected periodically during 1979 from stations around the harbour; mussels were taken mainly from the town jetty and deep water jetty. These samples were analysed for numbers of faecal coliforms (bacteria commonly found in the faeces of warm-blooded animals) as a measure of the degree of contamination and for the presence of *Salmonella* bacteria. The results could then be compared with widely accepted standards for receiving waters and foodstuffs and hence problem areas could be defined. Effluents were also sampled so that the origins of the bacteria could be traced.

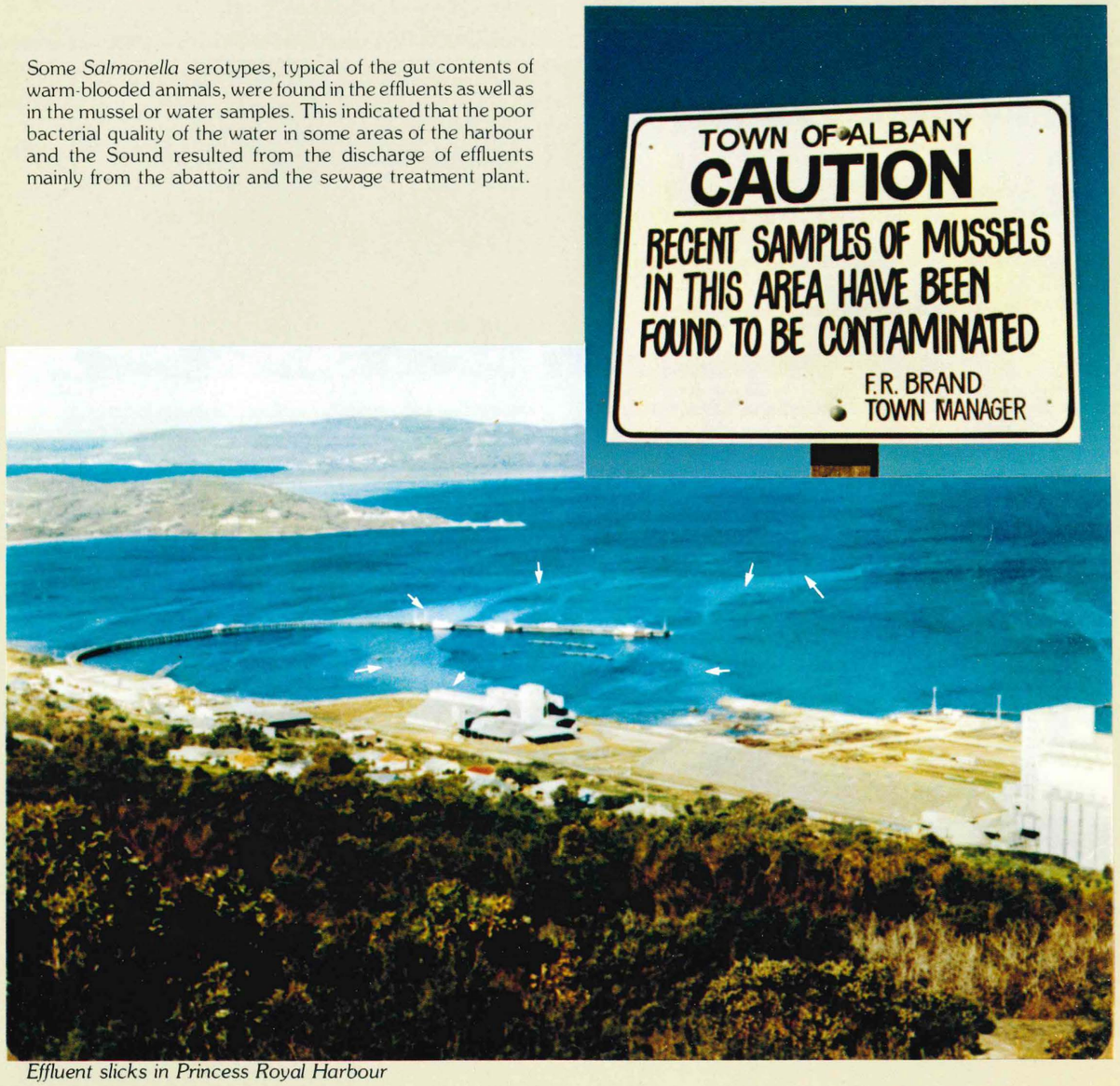
Some *Salmonella* serotypes, typical of the gut contents of warm-blooded animals, were found in the effluents as well as in the mussel or water samples. This indicated that the poor bacterial quality of the water in some areas of the harbour and the Sound resulted from the discharge of effluents mainly from the abattoir and the sewage treatment plant.

... in mussels

The level of bacterial contamination in mussels was high by most standards. This was inevitable as mussels are filter feeders and tend to accumulate bacteria, which were present in the surrounding water at unacceptable levels. Of even more concern was the finding that sixty-five per cent of the samples were contaminated with one or more of nine serotypes of *Salmonella*.

... in industrial effluents

With the exception of the fertiliser works' and Albany Woollen Mills'effluents, all contained high concentrations of faecal coliforms and a total of fifteen *Salmonella* serotypes were identified. The magnitude of the bacteria counts is clearly illustrated in the table of inputs which summarises the degree of bacterial contamination of the harbour.



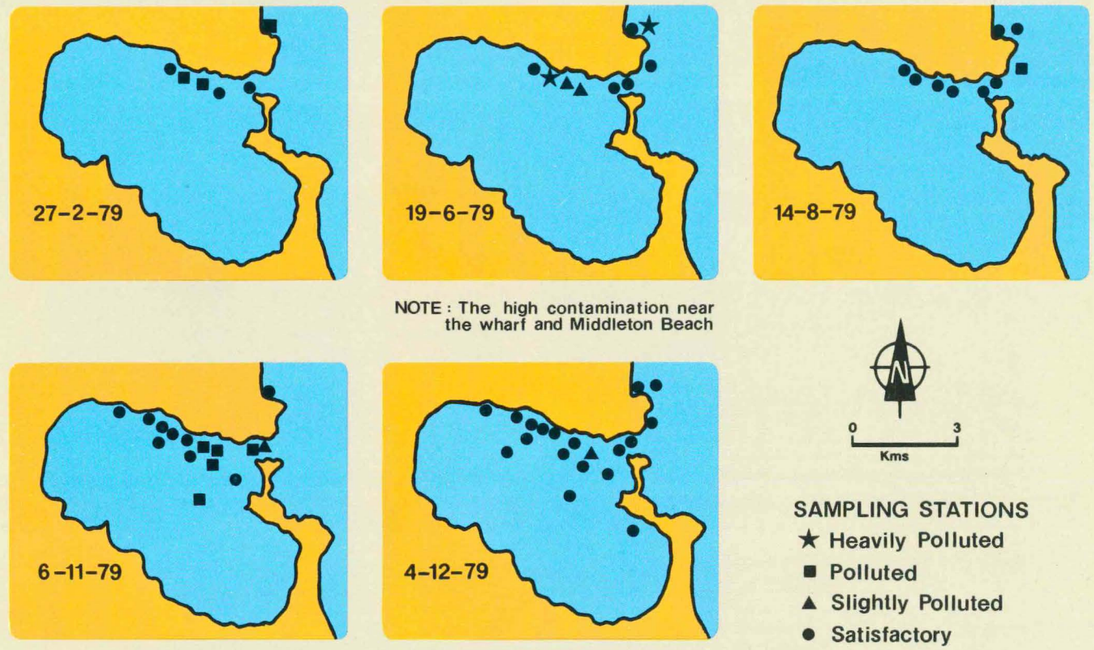
Effluent slicks in Princess Royal Harbour

... in waters of the harbour.

The maps below show the extent of contamination by faecal coliforms on five of the sampling days. Taking all the data into account the waters in general could be classified as satisfactory although at times they are slightly polluted.

However, bacterial quality of the water in the wharf area and occasionally in the vicinity of the sewage discharge was poor. *Salmonella* were isolated from eleven of the sampling stations during the study.

BACTERIAL QUALITY OF WATERS



NOTE : The high contamination near the wharf and Middleton Beach

NOTE: The influence of industrial discharge well into the harbour

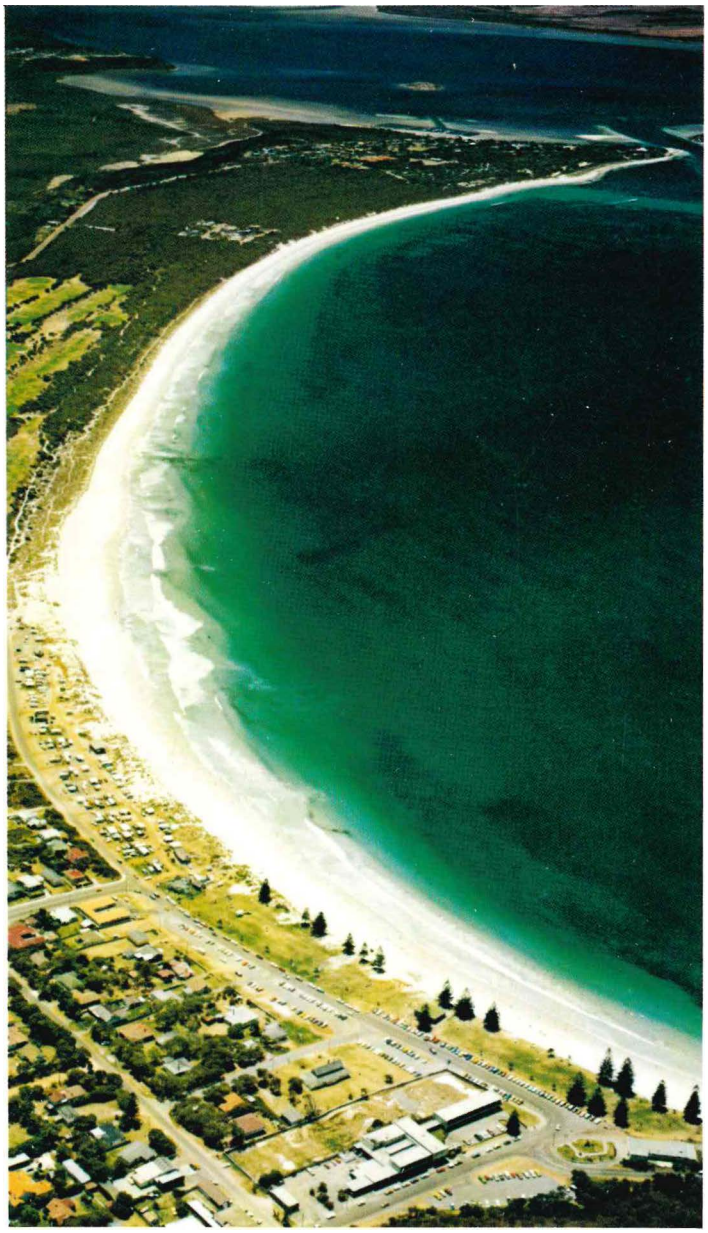
A HEALTH HAZARD?

Salmonella are the organisms which cause a variety of complaints in humans, particularly those associated with the gut, such as food poisoning or *Salmonellosis*. Some of the serotypes constantly discharged into the harbour are the same as the major strains responsible for sporadic cases and outbreaks of *Salmonellosis* in Albany. Although no cases of *Salmonellosis* in Albany have ever been proved to be caused by the eating of local shellfish or other local waterbased activities, it is a fact that sporadic cases are rarely traced to their source of infection. Obviously this should not detract from the need to maintain adequate standards. The study clearly indicates that public recreation areas need to be sited a safe distance from the abattoir and sewage outfalls.

THE FUTURE

AREAS OF CONCERN

- To Albany residents **Middleton Beach** is important in the summer months for swimming and other beach side activities. If nutrient levels in the water increase, phytoplankton 'blooms' could occur under calm weather conditions. Occasionally high bacterial levels occur and indicate the need for continuing to monitor the waters.



- Although public access is limited to the **wharf front**, the area is polluted by bacteria originating mainly from the abattoir effluent.

- The **shallow western shelf** is an area characterised by reduced water movement, higher nutrient levels (the main drain being the major source) leading to a higher growth rate of algae, commonly referred to as weed, and of phytoplankton. High nutrient levels in waters over seagrass may lead to its decline and eventual loss resulting in a chain of events which in the long run could be detrimental to the harbour as a resource for both industrial and recreational purposes.

WHAT SHOULD BE DONE?

- A detailed study should be made of water movement in the harbour and King George Sound so that nutrient dispersal and accumulation may be fully understood and appropriate management assured.

- Effluent should not be released into shallow nearshore areas where dispersal is poor and nutrient accumulation could result in excessive weed growth.

- Additional release of effluent at or near King Point should be given careful consideration.

- The possibility of extending the sewage outfall further into the Sound, where dispersal may be more efficient, should be investigated.

- Suspended solids in the Borthwick Abattoir and sewage effluent should be reduced.

- The origin of the nutrients entering by the main drain should be determined.

- The public are entitled to adequate warning of the potential dangers of eating mussels harvested from the deep water jetty, town jetty and wharf front.

- The nutrient and heavy metal content of sediments in areas where nutrients are known to accumulate in the waters should be investigated.

- A regular monitoring programme of water quality, particularly for bacteria at Middleton Beach, should be established.

- A survey of the harbour's animals and plants (particularly seagrass) their health and distribution should be carried out as an indication of present water quality and as a baseline for any future changes.

Any comments or queries relating to this study should be directed to the Albany Waterways Management Advisory Committee, c/- Great Southern Regional Administrator, 63 Serpentine Road, Albany, W.A., 6330, telephone (098) 414088.

Further information and the technical report are available from the Department of Conservation and Environment, 1 Mount Street, Perth, 6000, telephone (09) 322 2477.

Photographs: Albany Residency Museum, Albany Town Hall Pharmacy, John Bell, Brian Hudson, Department of Conservation and Environment, Peter R. Whyte.