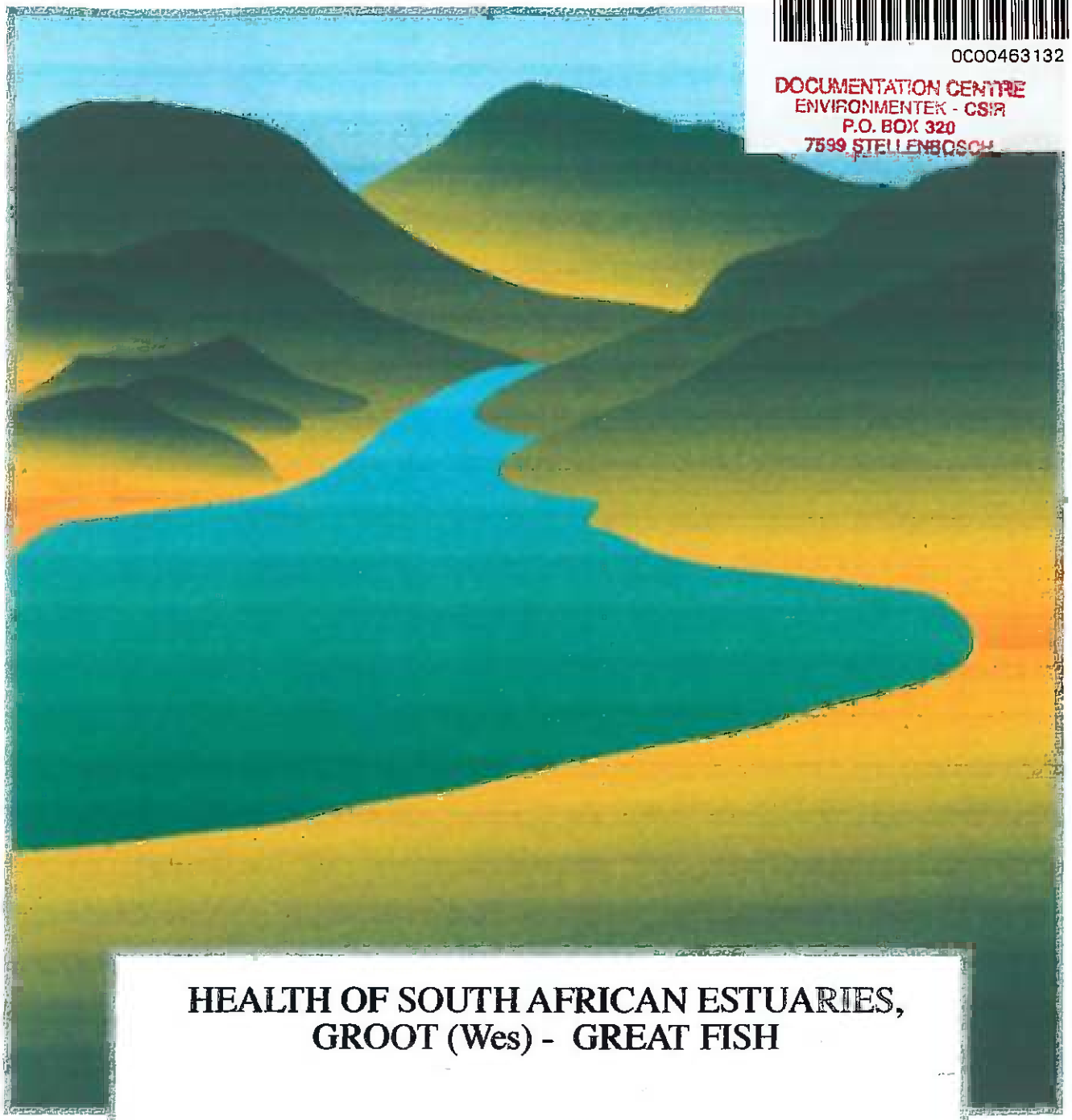

# HEALTH OF SOUTH AFRICAN ESTUARIES, GROOT (Wes) - GREAT FISH

## Executive Report

CCEP
CSIR

Catchment and Coastal Environmental Programme

HEALTH OF SOUTH AFRICAN ESTUARIES,
GROOT (WES) - GREAT FISH

# Executive Report

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# TABLE OF CONTENTS

# PART 1. GENERAL

*"Conservation of representative examples of the rich array of unique landscapes and biotic components in the Cape coastal region is fundamental to the protection and renewal of natural resources and the maintenance of the diversity of natural phenomena and processes.....the maintenance of ecosystem viability means the retention of all values whether they be recreational, commercial or aesthetic"*

Heydorn & Tinley (1980, p 60)

## 1.1. INTRODUCTION

South Africa's estuaries comprise one of the country's most abundant coastal environments. There is, however, wide variation both in the type of estuaries present around the coast, and in the degree to which they have been impacted by man's activities. This research project is concerned with (a) physically classifying estuaries into different types and (b) in assessing the degree to which they have been impacted by considering three aspects of their health: biological; water quality; and aesthetic condition.

Increasing populations are placing greater demands on estuarine areas as residential and recreational sites, waste disposal sites, water abstraction points, effluent discharge sites and so on. In order to manage this diversity of uses in combination with practising sustainable utilisation of these resources, an appraisal of the current state of the environment is necessary. This will enable planners to decide whether existing or planned uses are compatible with the actual state of the estuary and, if not, what steps have to be taken to either improve the state of the estuary or change the range of uses to which it is put. Such information is also necessary to plan for future uses (including conservation) of estuaries.

This report contains the results of investigations on the southeast Cape coast between the Groot (Wes) and Great Fish estuaries. Forty three systems were studied in this region and these were divided into four physical groups. Assessments of the biological health, water quality and aesthetic appearance of each of these systems were made, with the exception of twelve estuaries due primarily to their small size and/or access problems.

The results are presented in the form of an index which enables planners and managers to ascertain the state of the environment easily and effectively. Existing problems and good points are highlighted in each system and it is hoped that identification of these will lead to more effective estuarine management at local, regional and national scales. It should be noted that, while the information contained herein has been interpreted and reduced to index form, it is backed by a comprehensive array of baseline data, collected during our research. These additional data provide specific information on individual parameters in estuaries and may be of

value in (a) site-specific investigations or (b) regional investigations of a particular parameter of interest.

This report contains (a) a brief statement on the techniques used, (b) a two page summary of the state of each estuary and (c) a regional overview of the state of each system between the Groot (Wes) and Great Fish estuaries.

## 1.2. GEOMORPHOLOGICAL CLASSIFICATION

The range of estuaries in South Africa is such that a wide variety of environmental conditions exist in different systems. In order to place estuaries in groups with similar characteristics they were classified according to their physical properties. Because many estuaries have been physically altered by embankment construction, bank stabilisation and channel diversion, for example, an attempt was made to classify estuaries as they should be under natural conditions. For this reason the underlying factors that control estuarine morphology were identified and quantified as far as possible. Details of the quantification of these variables are given in the technical report.

These physical parameters were quantified and analysed using multivariate statistical methods as an aid to classification. The resulting classification identified several types of estuary on the southeast Cape coast. Estuaries of each type could be shown to contain basically similar range of physical conditions and habitats and so each should contain a similar potential range of fish biota.

## 1.3. BIOLOGICAL HEALTH INDEX

It is generally agreed that biological communities, which integrate the effect of changes across a wide array of environmental factors (chemical, physical and biological), are good indicators of ecosystem health since they reflect a combination of contemporary and past watershed conditions. Furthermore, the concept of biological community health is useful within the broader management context because in general, the idea of healthy ecosystems is readily comprehended and widely accepted by the public.

The Biological Health Index is based on a comparison of the fish species assemblage present within an aquatic system to the assemblage that would exist in the absence of or prior to degradation. The index assumes that the major differences between the potential species assemblage and the present assemblage are due to habitat degradation.

The fish community of the estuaries from the Groot (Wes) to the Great Fish was sampled during the period September 1995 to November 1995 using a seine net and a fleet of gill nets with a range of mesh sizes. After identification, the fish species collected in each estuary were classified according to their dependence on estuaries and their biogeographical ranges. The fish species collected in each estuary were then adjusted firstly by removing all species not usually associated with the biogeographical region under consideration and then by removing all stenohaline freshwater species, all inshore marine species and all exotic species. The resultant ichthyofaunal assemblage was considered as representative of the current faunal status of each estuary.

The development of the reference fish communities was based on the physical classification of the estuaries under the assumption that the hydrological, climatic, geological, and other relevant geographical variables influence the nature of the biota present, and that estuaries with the same range of conditions should contain similar fish species assemblages. A composite list of the fishes reported in the estuaries comprising each physical group was established using data from this survey as well as from available records. The fish species in each list were then classified according to their dependence on estuaries and their biogeographical ranges. The lists were then adjusted by removing all stenohaline freshwater species, all marine species and all exotic species. The resulting lists were then used as the reference communities representative of the physical group of estuaries under consideration.

The biological health of the estuaries on the southeast Cape coast was calculated using the Biological Health Index, which ranges from 0 (poor) to 10 (good). It must be stressed however that since the primary objective of the Biological Health Index is to produce a picture of the comparative health of a group of estuaries, the *absolute* index values of biological health are not as significant as the *relative* comparisons among systems. The results presented here represent the relative biological health of the estuaries on the southeast Cape coast from the Groot (Wes) to the Great Fish.

## 1.4. WATER QUALITY INDEX

The water quality of an estuary is usually expressed as a table of concentrations for selected chemical and bacteriological parameters. Interpretation of this information generally requires specialised knowledge and is therefore of little use to the lay person concerned with estuarine management. For this reason, the information is here condensed into an index number.

The basic form of our estuarine water quality index is based primarily on work in the UK, and is generally consistent with the recommendations for South African waters recently made by CSIR in conjunction with the Department of Water Affairs and Forestry. The index, in its

present form, incorporates seven widely accepted chemical indicators of water quality. These indicators reflect the water's suitability for aquatic life, suitability for human contact, and its eutrophication potential. These seven indicators are:

- dissolved oxygen (DO)
- oxygen absorbed (OA) - AQUATIC LIFE
- unionised ammonia

- *E. coli* - HUMAN CONTACT

- nitrate nitrogen
- phosphate phosphorus - EUTROPHICATION
- chlorophyll-*a*

The values for these seven parameters are combined to yield a single index value which can vary between 0 (worst possible water quality) and 10 (best possible water quality).

All of the estuaries were sampled during July/August 1995. Depending upon the size of the estuary samples were taken at between one and six sites. Where the water at a site was sufficiently deep (generally greater than 0.5 m) samples were taken just below the surface and just above the bottom. In addition to analyses for the above seven key indicators, a variety of additional data was also collected including depth, salinity, conductivity, turbidity and pH. This data was used in the interpretation of water quality conditions.

## 1.5. AESTHETIC HEALTH INDEX

The appearance of an estuary contributes to its perceived environmental health, particularly in terms of its utilisation by man. Certain uses (e.g. industrial/commercial development) change the appearance of an estuary and in so doing impair its suitability for other potential uses (e.g. recreation/tourism). The perception of the appearance of an area will vary from one person to another and from one socio-economic group to another and thus the measurement of aesthetic health is potentially very subjective. This problem centres on what the individual perceives the ideal state of an estuary to be. To eliminate this problem the ideal state of the estuarine area was taken to be the pristine state that existed before any human intervention whatsoever. Thus the basic premise of the Aesthetic Health Index is that an estuary which is totally unimpacted by man, reflecting a maximum degree of "naturalness", is in a perfect or pristine state - and deviation from this state is indicative of degradation.

A number of parameters contribute to the aesthetic health of an estuary and it is in the selection and assignment of a relative value to each parameter that subjectivity is involved. To aid in this task a survey of environmental managers and planners was undertaken during the development of the index.

The parameters which accommodate most of the aesthetic impact of an estuary included floodplain landuse, the degree to which the channel margins were natural, the appearance of the floodplain surrounds, the presence of various types of bridges, the presence of dams and weirs, the degree to which the mouth of a system is artificially stabilised, the amount of litter and rubble present, the degree to which the system is used by man, the presence of invasive and exotic vegetation, the presence of algal blooms and/or aquatic nuisance plants, water turbidity, odours, air pollution and noise.

The measurement of aesthetic health began with a perfect score of 10 (100%) from which points were deducted according to the type and degree of impairment. Thus a severely impacted estuary would have a value tending toward 0 and a near-pristine estuary would tend toward 10.

## 1.6. COMPOSITE ESTUARINE HEALTH INDEX

The composite estuarine health index (EHI) combines all three indices (biological, water quality and aesthetic) into a single value. At this stage the relative score of each index component was ranked on a scale from one to three, depending upon whether its relative status was poor (1) average/acceptable (2) or good (3). The composite index is portrayed as a stacked bar graph for each estuary and ranges from zero (poor) to nine (good). In some cases where one or more parameters were not assessed, the composite index is based (and scaled) on the remaining parameters only.

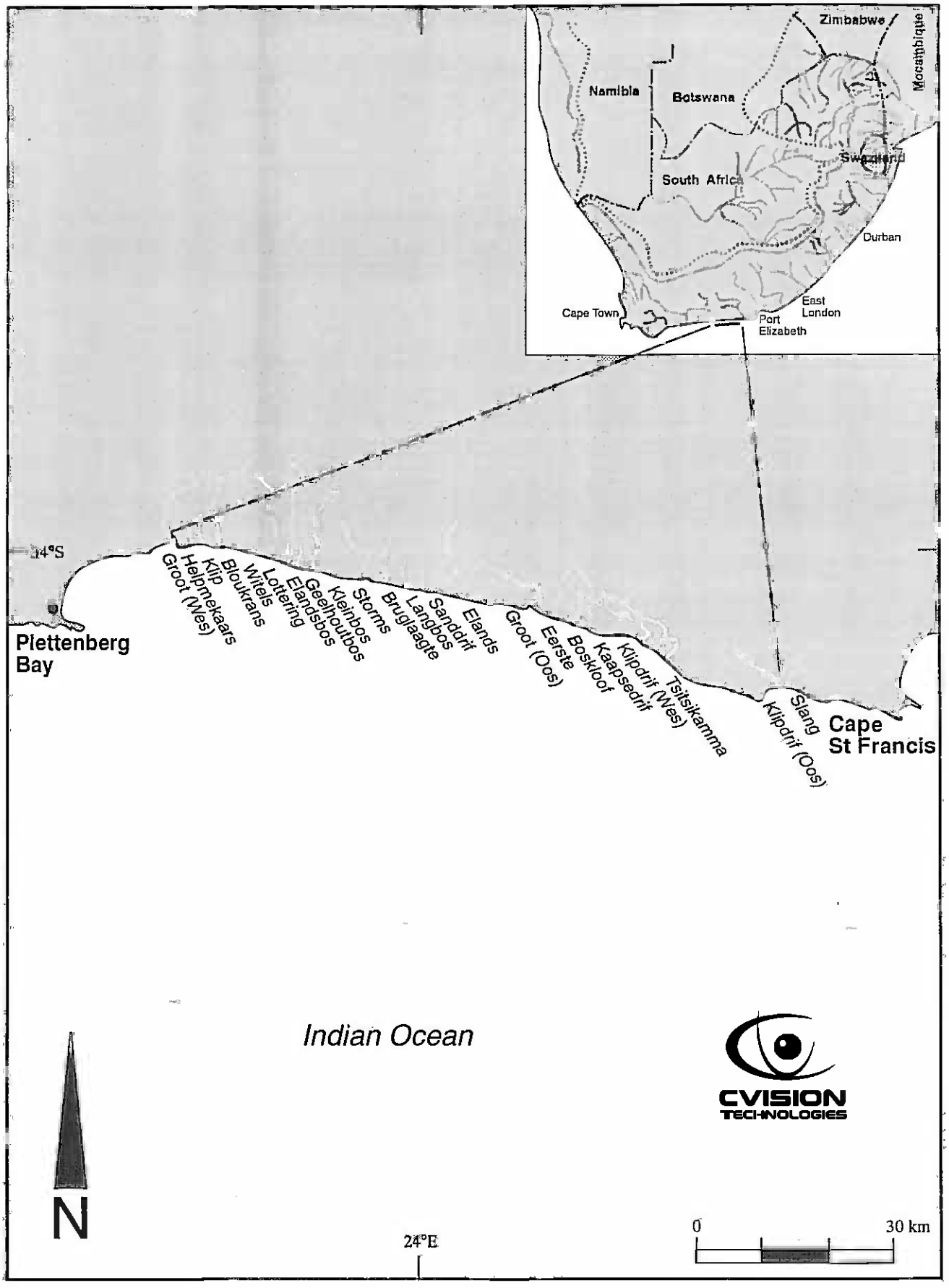
## 1.7. SUGGESTED READING

Branch, G.M., & Branch, M.L. 1992. *The Living Shores of Southern Africa.* 5th Edition. David Philip, Cape Town & Johannesburg.

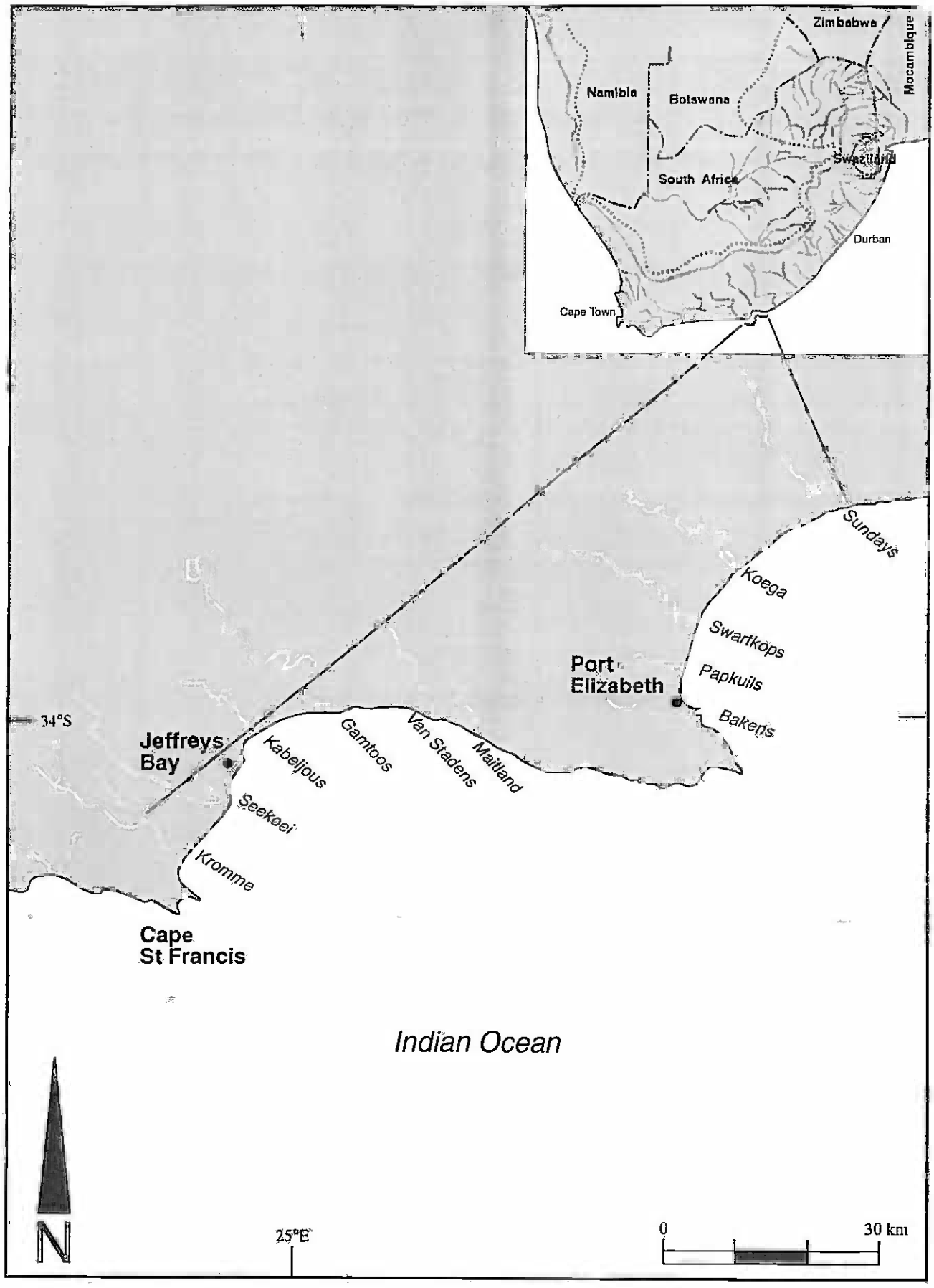
Day, J.H. 1981. *Estuarine ecology with particular reference to southern Africa.* AA Balkema, Cape Town.

Heydorn, A.E.F (Editor). 1986. *An assessment of the state of the estuaries sin the Cape and Natal in 1985/86.* South African National Scientific Programmes Report 30, CSIR, Pretoria.

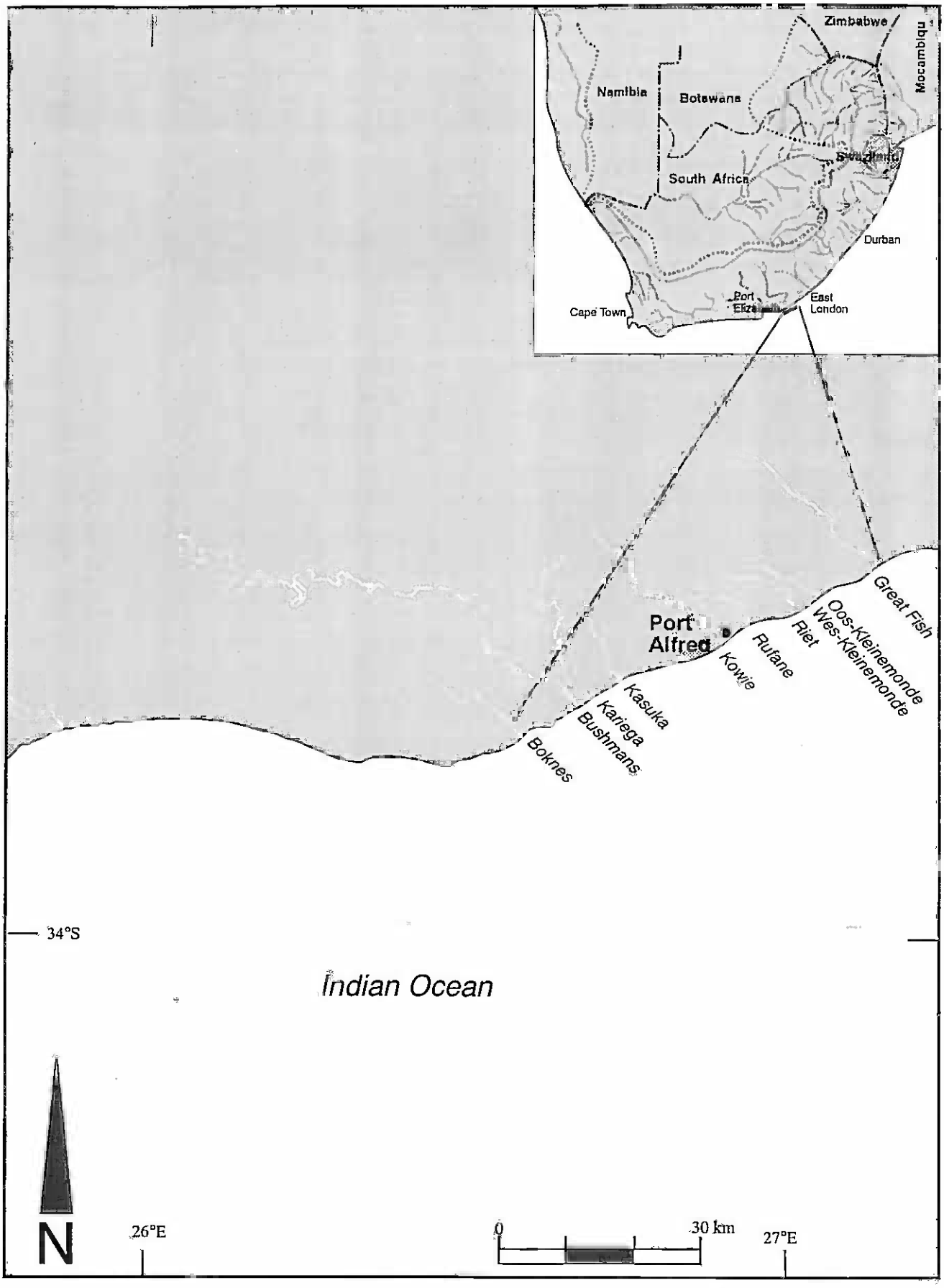
Heydorn, A.E.F. & Tinley, K.L. 1980. *Estuaries of the Cape. Part 1. Synopsis of the Cape coast - Natural features, dynamics and utilization.* CSIR Research Report 380, CSIR, Stellenbosch.




ESTUARIES OF SOUTH AFRICA : GROOT (WES) TO SLANG

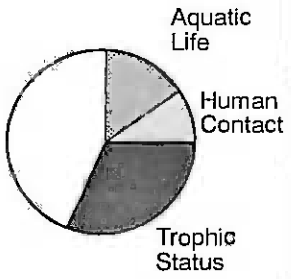



ESTUARIES OF SOUTH AFRICA : KROMME TO SUNDAYS




ESTUARIES OF SOUTH AFRICA : BOKNES TO GREAT FISH

The water quality of each system is interpreted by referring to the pie graph to the right. The relative contribution made by each of the three major components (suitability for aquatic life, suitability for human contact, and trophic status) can be readly assessed. In this example the overall water quality is approximately 60% with the major impact being in the category 'suitability for human contact'.



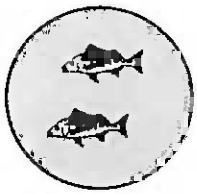

WATER QUALITY

The Aesthetic state or degree of "naturalness" of each system is interpreted by referring to the icon to the right. The icon can contain one, two or three trees which indicate relatively poor, moderate, or good aesthetic state, respectively. In this example the aesthetic state is represented as moderate.

AESTHETIC

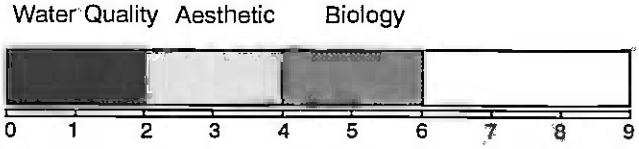
The biological health of each system is also intrepreted by referring to the icon to the right.This icon can contain one, two or three fishes which indicate relatively poor, moderate or good biological states, respectively. In this example the biological health is interpreted as moderate.

An open circle signifies that the system was either not sampled or was not classified as an estuary.



BIOLOGICAL

The overall or composite health of each system is represented by the bar-graph to the right. The relative state of each component (water quality, aesthetic state and biological health) is rated according to whether it is good (3) moderate (2) or poor(1) and the sum of these rankings provide an estimate of the overall state of a system. In this example all three components were in a moderate condition which yielded a composite score of 6 out of 9.




COMPOSITE HEALTH INDEX

# 1. GROOT (WES)

## PHYSICAL CLASSIFICATION

The Groot (Wes) at Nature's Valley was classified in a group of estuaries (Group 3) that are characterised by temporarily open mouths in sandy barriers, fresh to brackish water and shallow water areas separated from the sea by a broad dissipative beach across which overwash periodically introduces seawater into the back-barrier area. The Groot (Wes) contains black water from a cliff-bound stream which enters its upper reaches and is supplied with sea water by barrier overwashing. Available morophological evidence coupled with low salinity in the back-barrier suggests that when open the mouth serves mainly as an overflow channel rather than a tidal inlet. The water body averages 200m wide and is typically shallow. The upper reaches contain a fluvial delta which is indicative of a substantial sediment yield from the catchment. A small sand body near the mouth position of the Groot (Wes) may be a flood-tidal delta which suggests limited flood-tidal deposition

## BIOLOGICAL HEALTH

A total of seven fish species were collected in the Groot (Wes) estuary during this survey. *Gilchristella aestuaria* and *Psammogobius knysnaensis* are both dependent on estuaries during their entire life cycles. The remaining five species, *Heteromycteris capensis*, *Lithognathus lithognathus*, *Liza richardsonii*, *Pomatomus saltatrix* and *Rhabdosargus holubi*, are all marine species which show varying degrees of dependence upon estuaries during the juvenile phase of their life cycles. In terms of its fish species composition, the Groot (Oos) was rated as moderately poor and had an index score of **2.1**.

## WATER QUALITY

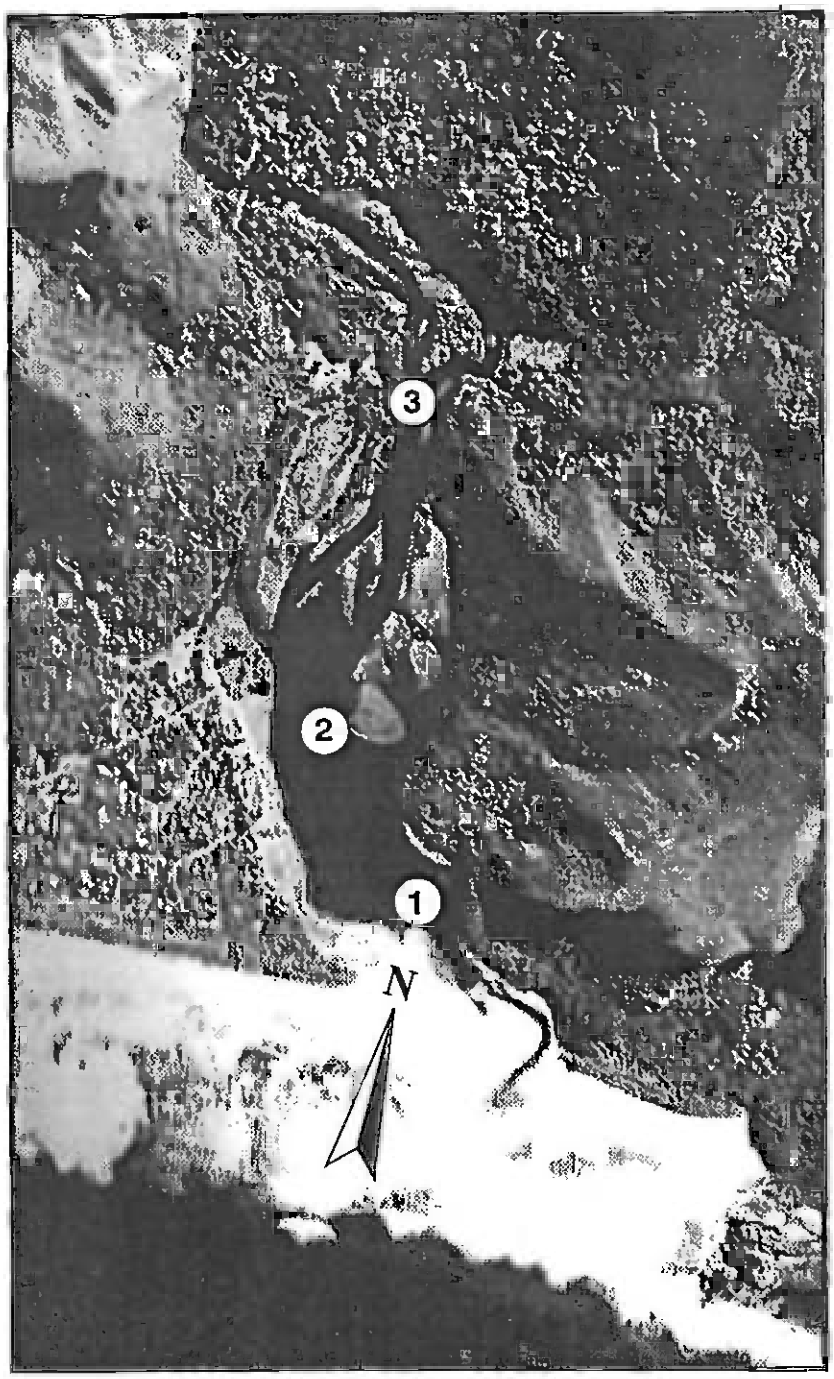
Water quality in the Groot (Wes) estuary was sampled at the positions shown opposite. The overall water quality was good with an index value of **7.4**. The most significant impairment was in the suitability for human contact resulting from elevated *E. coli* counts on the day of sampling, and in suitability for aquatic life due to supersaturated DO concentrations.

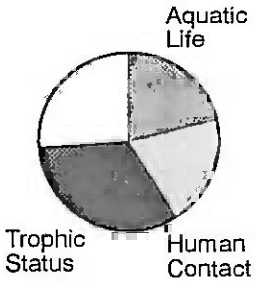
## AESTHETIC STATE

In terms of its appearance the Groot (Wes) estuary scored **9.2**. The system forms part of the De Vasselot section of the Tsitsikamma National Park which is administered by the National Parks Board. The township of Nature's Valley is situated on the western shore of the system and as a result, part of the floodplain is used for residential development. Overall, the Groot (Wes) estuary was rated as being in a good condition aesthetically.

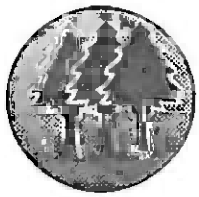
## OVERALL ESTUARINE HEALTH

The biological status of the Groot (Wes) was moderately poor while the overall water quality was good. The system also scored highly aesthetically. Overall, the Groot (Oos) is in a moderately good condition with a composite score of **7 out of 9**.

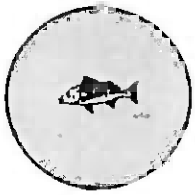



**WATER QUALITY**

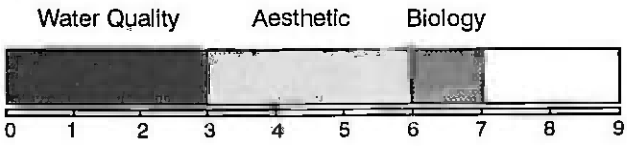


**AESTHETIC**



**BIOLOGICAL**

0 200 m




**COMPOSITE HEALTH INDEX**

## GROOT (Wes)

## 2. HELPMEKAARS

### PHYSICAL CLASSIFICATION
The Helpmekaars was not considered an estuary due to its small size.

### BIOLOGICAL HEALTH
Due to its relative inaccessibility and small size, a ichthyofaunal survey of the Helpmekaars was not undertaken.

### WATER QUALITY
Due to its relative inaccessibility and small size, a water quality survey of the Helpmekaars was not undertaken.

### AESTHETIC STATE
Due to its relative inaccessibility and small size, an aesthetic appraisal of the Helpmekaars was not undertaken.

### OVERALL ESTUARINE HEALTH
Due to its relative inaccessibility and small size, the overall health of the Helpmekaars was not assessed.

0 200 m

WATER QUALITY

AESTHETIC

BIOLOGICAL

## HELPMEKAARS

## 3. KLIP

### PHYSICAL CLASSIFICATION
The Klip was not considered an estuary due to its small size.

### BIOLOGICAL HEALTH
Due to its relative inaccessibility and small size, the fish community of the Klip was not sampled.

### WATER QUALITY
Due to its relative inaccessibility and small size, a water quality survey of the Klip was not undertaken.

### AESTHETIC STATE
Due to its relative inaccessibility and small size, an aesthetic appraisal of the Klip was not undertaken.

### OVERALL ESTUARINE HEALTH
Due to its relative inaccessibility and small size, the overall health of the Klip was not assessed.


0 300 m

WATER QUALITY

AESTHETIC

BIOLOGICAL

KLIP

# 4. BLOUKRANS

## PHYSICAL CLASSIFICATION

The Bloukrans occupies a narrow bedrock valley. Its mouth area comprises a medium grained sand barrier which is entirely covered at high tide forming a 100m wide, 2m deep inlet channel. At low tide a 20-30m wide outflow channel discharges freshwater into the sea. This barrier is in effect the flood-tidal delta of the estuary. Limited vertical stratification is evident in the water column. The river channel is characterised by bedrock and pebbles/boulders which, together with the limited extent of the barrier indicate low sediment supply from marine and terrestrial sources.

The Bloukrans is one of six estuaries on the Tsitsikamma coast which are characterised by steep-sided, narrow bedrock valleys, intertidally exposed barriers which permit full tidal exchange at high tide and black water of low pH supplied by inflowing streams. In all cases, wave energy is dissipated at the mouth area such that calm conditions characterise the estuarine areas. Salinity is highly variable depending on the state of the tide and may vary from fully marine to fresh at the mouth

## BIOLOGICAL HEALTH

Six fish species were captured in the Bloukrans during this survey. *Psammogobius knysnaensis* is dependent on estuaries during its entire life cycle while the remaining five species, *Diplodus sargus capensis*, *Lithognathus lithognathus*, *Liza richardsonii*, *Myxus capensis and Pomadasys commersonnii*, are all inshore marine species which depend upon estuaries during the juvenile phase of their life cycle. In terms of its fish species composition, the Bloukrans was rated as moderately poor with an index score of **2.2**.



## WATER QUALITY

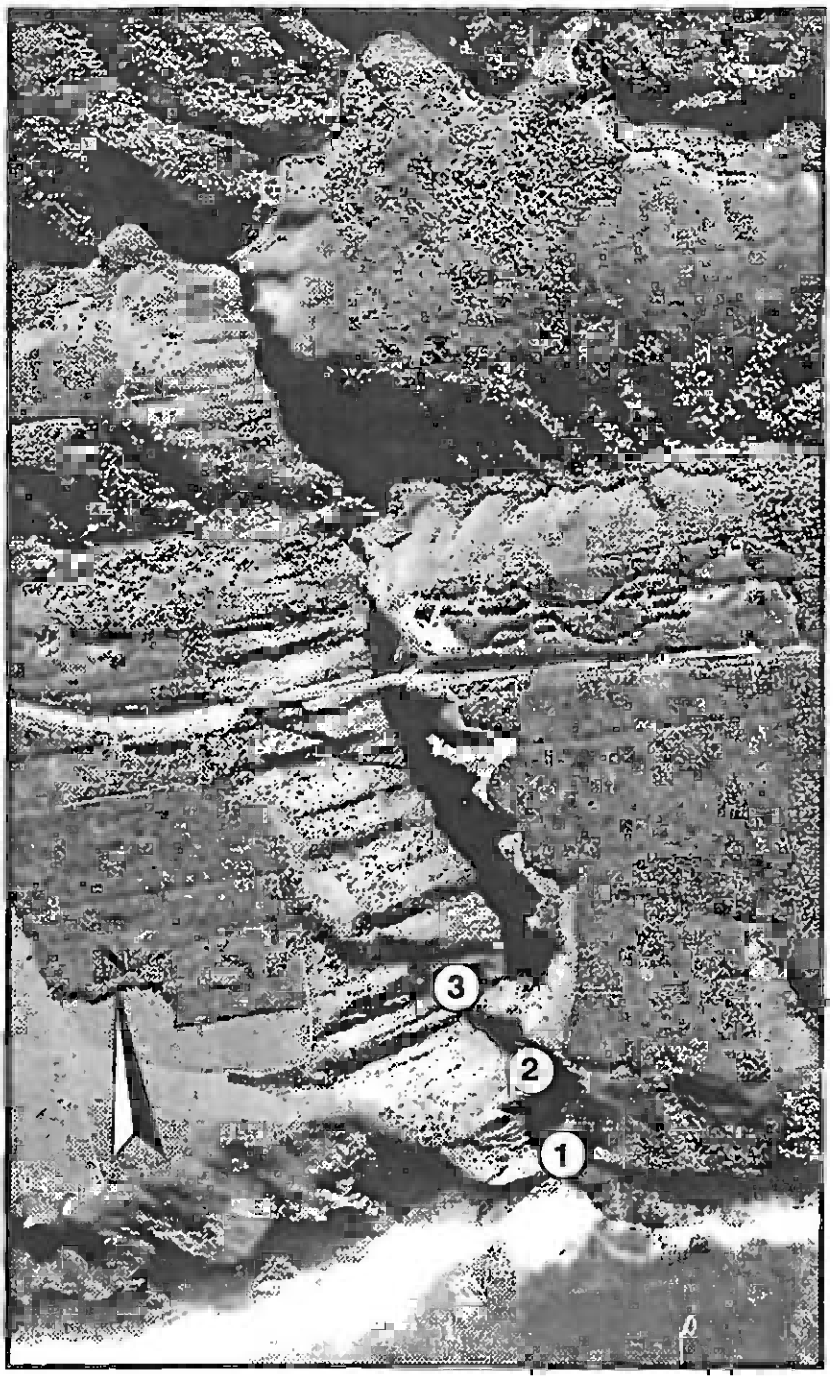
Water quality in the Bloukrans estuary was sampled at the positions shown opposite. The overall water quality was very good with an index value of **8.8**. The only observed impairment was in the suitability for aquatic life resulting from moderately low bottom DO concentrations.

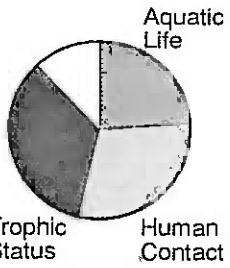
## AESTHETIC STATE

The Bloukrans had an Aesthetic Health Index score of **9.8**. This system falls within the Tsitsikamma National Park which is administered by the National Parks Board. Apart from commercial forestry in the surrounding area, the system is totally undeveloped and is near-pristine.

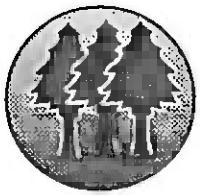
## OVERALL ESTUARINE HEALTH

The Bloukrans was classed as moderately poor biologically with a good water quality and aesthetic appearance. Overall, the system is regarded as being in a moderately good condition with a composite score of **7 out of 9**.

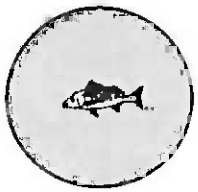



**WATER QUALITY**

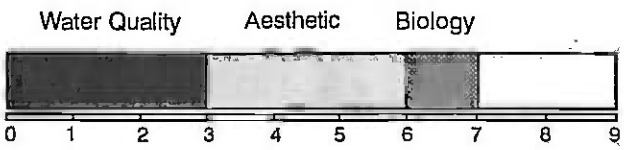


**AESTHETIC**



**BIOLOGICAL**

0 300 m




**COMPOSITE HEALTH INDEX**

# BLOUKRANS

## 5. WITELS

### PHYSICAL CLASSIFICATION
The Witels was not considered an estuary due to its small size.

### BIOLOGICAL HEALTH
Due to its relative inaccessibility and small size, the fish community of the Witels was not sampled.

### WATER QUALITY
Due to its relative inaccessibility and small size, a water quality survey of the Witels was not undertaken.

### AESTHETIC STATE
Due to its relative inaccessibility and small size, an aesthetic appraisal of the Witels was not undertaken.

### OVERALL ESTUARINE HEALTH
Due to its relative inaccessibility and small size, the overall health of the Witels was not assessed.

0 300 m

WATER QUALITY

AESTHETIC

BIOLOGICAL

**WITELS**

# 6. LOTTERING

## PHYSICAL CLASSIFICATION

The Lottering is confined within a narrow bedrock valley at the mouth of which, an intertidally exposed flood-tidal delta forms a barrier to incoming wave energy. At high tide most of the barrier is flooded producing an inlet 50-60m wide and 2 m deep. At low tide an outlet of about 10m in width is maintained. Strong river flow may maintain freshwater conditions at the mouth. Bedrock outcrop along the margins of the river mouth, coupled with the coarse grained sediment in the river valley indicate limited fluvial and marine sediment supply. Fine-grained (sandy) sediment is largely confined to the flood-tidal delta. Wind-driven deflation of the barrier has produced climbing dunes at the margins of the valley.

The Lottering is one of six estuaries on the Tsitsikamma coast which are characterised by steep-sided, narrow bedrock valleys, intertidally exposed barriers which permit full tidal exchange at high tide and black water of low pH supplied by inflowing streams. In all cases, wave energy is dissipated at the mouth area such that calm conditions characterise the estuarine areas. Salinity is highly variable depending on the state of the tide and may vary from fully marine to fresh at the mouth.

## BIOLOGICAL HEALTH

Two fish species were recorded in the Lottering during this survey. *Liza richardsonii*, and *Myxus capensis* are both inshore marine species which depend upon estuaries during the juvenile phase of their life cycles. In terms of its fish species assemblage, the Lottering was rated as poor with an index score of **0.7**.

## WATER QUALITY

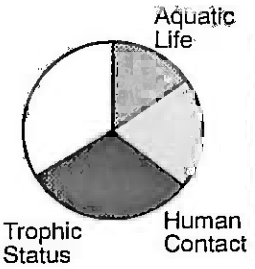
Water quality in the Lottering estuary was sampled at the positions shown opposite. The overall water quality was good with an index value of **6.6**. The most significant impairment was in the suitability for aquatic life resulting from low bottom DO concentrations. Elevated *E. coli* counts on the day of sampling also suggested faecal contamination.

## AESTHETIC STATE

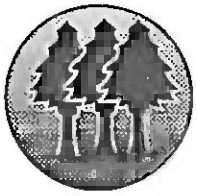
The Lottering had an Aesthetic Health Index score of **9.8**. This system falls within the Tsitsikamma National Park which is administered by the National Parks Board. Apart from commercial forestry in the surrounding area, the Lottering is totally undeveloped and is near-pristine.

## OVERALL ESTUARINE HEALTH

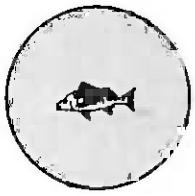
The Lottering was classed as poor biologically with a good water quality and aesthetic appearance. Overall, the system is regarded as being in a moderate condition with a composite score of **7 out of 9**.


WATER QUALITY

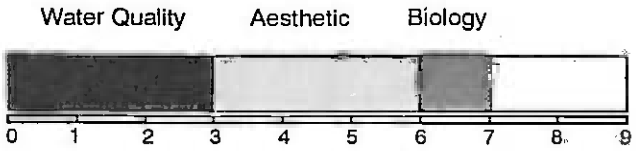


AESTHETIC



BIOLOGICAL

0 300 m




COMPOSITE HEALTH INDEX

## LOTTERING

# 7. ELANDSBOS

## PHYSICAL CLASSIFICATION

The Elandsbos is confined within a narrow bedrock valley and maintains a flood-tidal delta at its mouth which is completely covered at high tide producing an inlet that is 50 m wide and 2m deep. At low tide an outlet 20 m wide and 30 cm deep enables freshwater discharge through the centre of the emergent flood-tidal delta that forms a barrier. Black water may fill the valley right to the barrier and may displace sea water even at high tide if river flow is sufficiently strong. Fine sediment in the system is limited to the flood-tidal delta, which has been partly deflated to produce climbing dunes on the valley margins. Wave energy is dissipated on the flood-tidal delta.

The Elandsbos is one of six estuaries on the Tsitsikamma coast which are characterised by steep-sided, narrow bedrock valleys, intertidally exposed barriers which permit full tidal exchange at high tide and black water of low pH supplied by inflowing streams. In all cases, wave energy is dissipated at the mouth area such that calm conditions characterise the estuarine areas. Salinity is highly variable depending on the state of the tide and may vary from fully marine to fresh at the mouth.

## BIOLOGICAL HEALTH

Four fish species were identified in the Elandsbos system during this survey. *Psammogobius knysnaensis* is dependent on estuaries during its entire life cycle. The remaining three species, *Lithognathus lithognathus*, *Liza richardsonii* and *Myxus capensis*, are inshore marine species which depend upon estuaries during the juvenile phase of their life cycle. In terms of its fish species composition, the Elandsbos was classed as moderately poor with an index score of **1.4**.

## WATER QUALITY

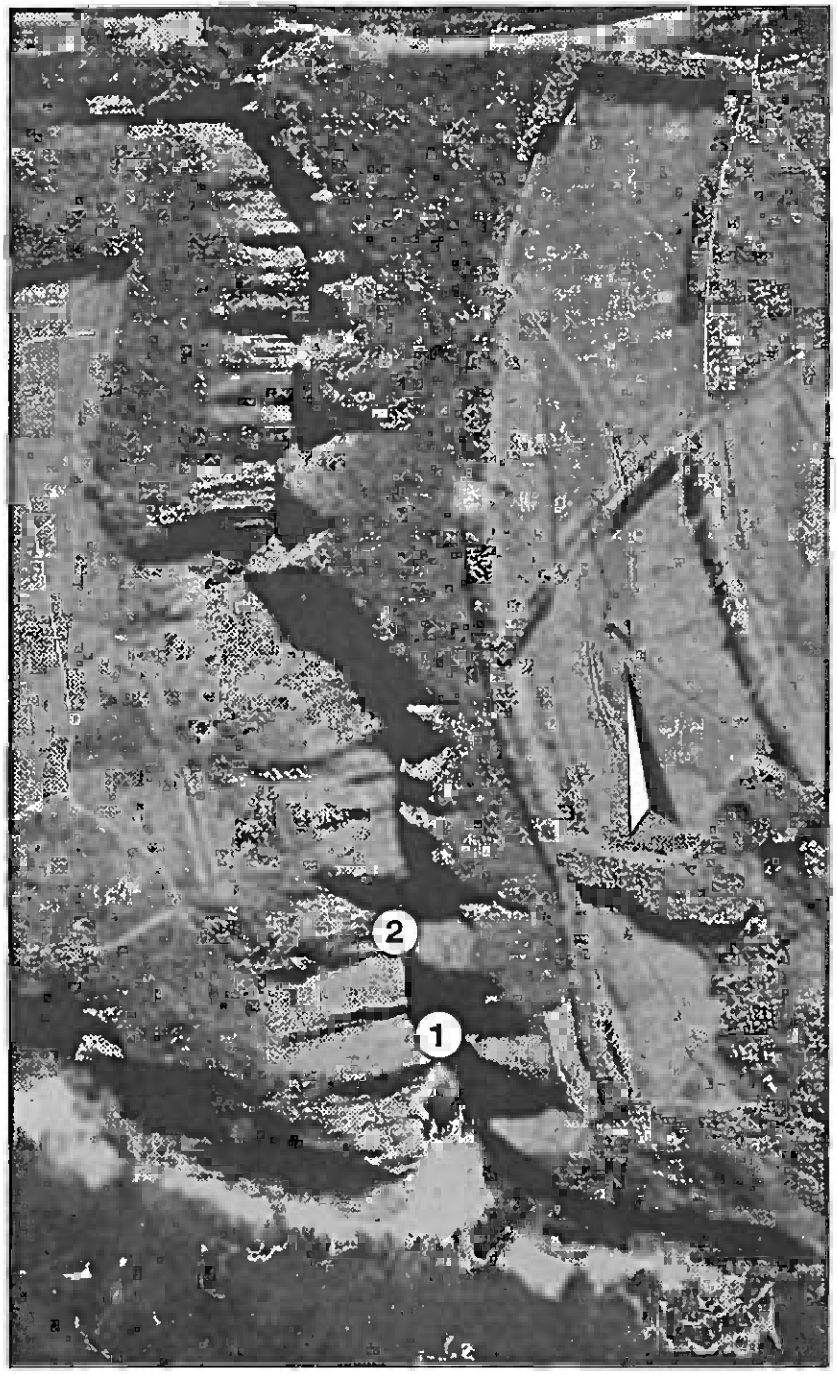
Water quality in the Elandsbos estuary was sampled at the positions shown opposite. The overall water quality was very good with an index value of **8.8**. The most significant impairment was in the suitability for aquatic health resulting from elevated OA concentrations on the day of sampling.

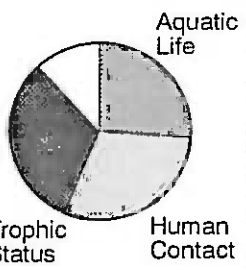
## AESTHETIC STATE

The Elandsbos had an Aesthetic Health Index score of **9.8**. This system falls within the Tsitsikamma National Park which is administered by the National Parks Board. Apart from commercial forestry in the surrounding area, the system is totally undeveloped and is near-pristine.

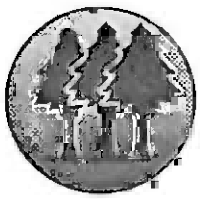
## OVERALL ESTUARINE HEALTH

The Elandsbos was classed as moderately poor biologically with a good water quality and aesthetic appearance. Overall, the system is regarded as being in a moderately good condition with a composite score of **7 out of 9**.

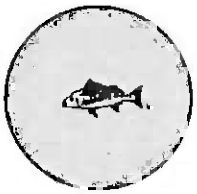



**WATER QUALITY**

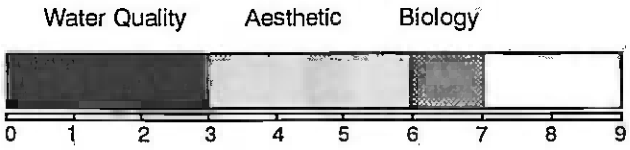


**AESTHETIC**



**BIOLOGICAL**

0 300 m




**COMPOSITE HEALTH INDEX**

## ELANDSBOS

# 8. GEELHOUTBOS

## PHYSICAL CLASSIFICATION

The Geelhoutbos was not considered an estuary due to its small size

## BIOLOGICAL HEALTH

Due to its relative inaccessibility and small size, the fish community of the Geelhoutbos was not sampled.

## WATER QUALITY

Due to its relative inaccessibility and small size, a water quality survey of the Geelhoutbos was not undertaken.

## AESTHETIC STATE

Due to its relative inaccessibility and small size, an aesthetic appraisal of the Geelhoutbos was not undertaken.

## OVERALL ESTUARINE HEALTH

Due to its relative inaccessibility and small size, the overall health of the Geelhoutbos was not assessed.

0 300 m

WATER QUALITY

AESTHETIC

BIOLOGICAL

## GEELHOUTBOS

## 9. KLEINBOS

### PHYSICAL CLASSIFICATION
The Kleinbos was not considered an estuary due to its small size.

### BIOLOGICAL HEALTH
Due to its relative inaccessibility and small size, the fish community of the Kleinbos was not sampled.

### WATER QUALITY
Due to its relative inaccessibility and small size, a water quality survey of the Kleinbos was not undertaken.

### AESTHETIC STATE
Due to its relative inaccessibility and small size, an aesthetic appraisal of the Kleinbos was not undertaken.

### OVERALL ESTUARINE HEALTH
Due to its relative inaccessibility and small size, the overall health of the Kleinbos was not assessed.

0 300 m

WATER QUALITY

AESTHETIC

BIOLOGICAL

## KLEINBOS

# 10. STORMS

## PHYSICAL CLASSIFICATION

The Storms river is confined within a steep sided valley into which the inflowing stream supplies black water of low pH. Although no barrier is present at the mouth, wave energy is dissipated before entering the estuary through interaction with the sea bed. The estuary is up to 14 m deep and is characterised by a lack of fine-grained sediment of marine or fluvial origin. The steep sided walls and lack of flood-tidal delta mean that intertidal areas are extremely limited. The depth of water in the Storms river and lack of surface turbulence means that some stratification may develop. During sampling in June 1995 the surface waters were 16 ppt compared to 28.4 ppt at 4.5 m depth.

The Storms is one of six estuaries on the Tsitsikamma coast which are characterised by steep-sided, narrow bedrock valleys, intertidally exposed barriers which permit full tidal exchange at high tide and black water of low pH supplied by inflowing streams. In all cases, wave energy is dissipated at the mouth area such that calm conditions characterise the estuarine areas. Salinity is highly variable depending on the state of the tide and may vary from fully marine to fresh at the mouth.

## BIOLOGICAL HEALTH

Five fish species were captured in the Storms system during this survey. All five species, *Lithognathus lithognathus*, *Liza richardsonii*, *L. tricuspidens*, *Monodactylus falciformis* and *Pomatomus saltatrix*, are inshore marine species which depend upon estuaries during the juvenile phase of their life cycle. In terms of its fish species assemblage, the Storms was rated as moderately poor with an index score of **1.8**.

## WATER QUALITY

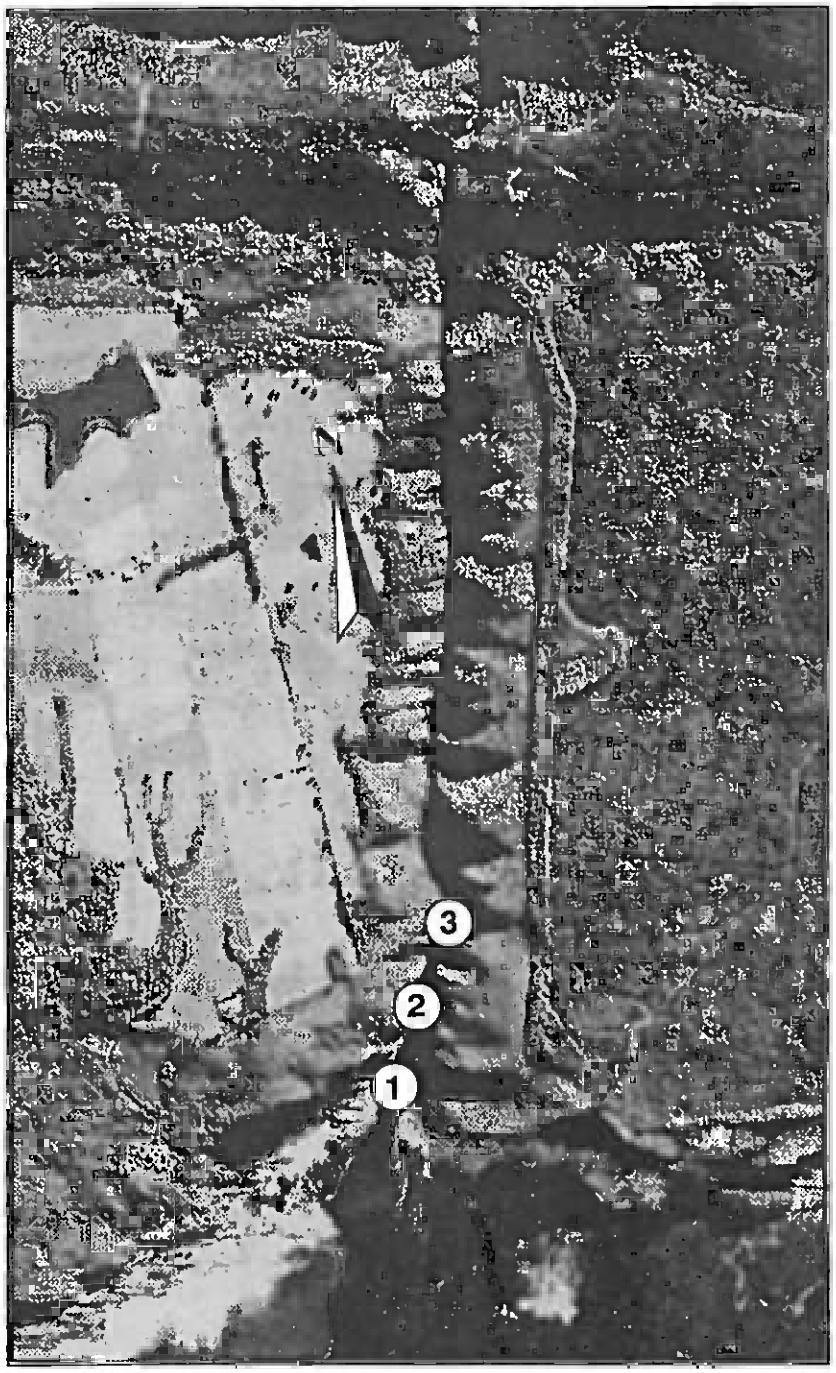
Water quality in the Storms estuary was sampled at the positions shown opposite. The overall water quality was very good with an index value of **8.4**. The most significant impairment was in the suitability for human contact resulting from elevated *E. coli* counts on the day of sampling.

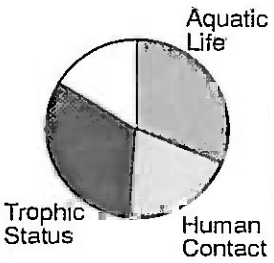
## AESTHETIC STATE

In terms of its appearance the Storms scored **9.7**. The system falls within the Tsitsikamma National Park which is administered by the National Parks Board and is in a near natural state. The Storms River Mouth Rest Camp is located nearby and the public have access to the system. A low suspension footbridge also crosses the mouth of the system.

## OVERALL ESTUARINE HEALTH

The Storms was rated as moderately poor biologically. Both the water quality and the aesthetic appearance of the system was considered good. Overall the Storms is regarded as being in a moderately good condition with a composite score of **7 out of 9**.



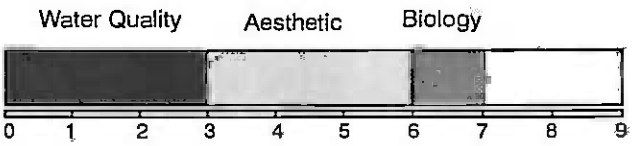




**WATER QUALITY**

**AESTHETIC**

**BIOLOGICAL**

0 300 m




**COMPOSITE HEALTH INDEX**

## STORMS

# 11. BRUGLAAGTE

## PHYSICAL CLASSIFICATION

The Bruglaagte was not considered an estuary due to its small size.

## BIOLOGICAL HEALTH

Due to its relative inaccessibility and small size, the fish community of the Bruglaagte was not sampled.

## WATER QUALITY

Due to its relative inaccessibility and small size, a water quality survey of the Bruglaagte was not undertaken.

## AESTHETIC STATE

Due to its relative inaccessibility and small size, an aesthetic appraisal of the Bruglaagte was not undertaken.

## OVERALL ESTUARINE HEALTH

Due to its relative inaccessibility and small size, the overall health of the Bruglaagte was not assessed.

0 300 m

WATER QUALITY

AESTHETIC

BIOLOGICAL

## BRUGLAAGTE

# 12. LANGBOS

## PHYSICAL CLASSIFICATION
The Langbos was not considered an estuary due to its small size.

## BIOLOGICAL HEALTH
Due to its relative inaccessibility and small size, the fish community of the Langbos was not sampled.

## WATER QUALITY
Due to its relative inaccessibility and small size, a water quality survey of the Langbos was not undertaken.

## AESTHETIC STATE
Due to its relative inaccessibility and small size, an aesthetic appraisal of the Langbos was not undertaken.

## OVERALL ESTUARINE HEALTH
Due to its relative inaccessibility and small size, the overall health of the Langbos was not assessed.


WATER QUALITY

AESTHETIC

BIOLOGICAL

**LANGBOS**

## 13. SANDDRIF

### PHYSICAL CLASSIFICATION
The Sanddrif was not considered an estuary due to its small size.

### BIOLOGICAL HEALTH
Due to its relative inaccessibility and small size, the fish community of the Sanddrif was not sampled.

### WATER QUALITY
Due to its relative inaccessibility and small size, a water quality survey of the Sanddrif was not undertaken.

### AESTHETIC STATE
Due to its relative inaccessibility and small size, an aesthetic appraisal of the Sanddrif was not undertaken.

### OVERALL ESTUARINE HEALTH
Due to its relative inaccessibility and small size, the overall health of the Sanddrif was not assessed.


WATER QUALITY

AESTHETIC

BIOLOGICAL

## SANDDRIF

# 14. ELANDS

## PHYSICAL CLASSIFICATION

The Elands is confined within a bedrock valley and is separated from the sea by an intertidally exposed flood-tidal delta which forms a barrier to wave energy but permits flood-tidal inflow across a 150m wide, 2m deep, inlet. At low tide the mouth is 20m wide and 50 cm deep and dominated by river outflow. Blackwater of low pH flows in from upstream.

The Elands is one of six estuaries on the Tsitsikamma coast which are characterised by steep-sided, narrow bedrock valleys, intertidally exposed barriers which permit full tidal exchange at high tide and black water of low pH supplied by inflowing streams. In all cases, wave energy is dissipated at the mouth area such that calm conditions characterise the estuarine areas. Salinity is highly variable depending on the state of the tide and may vary from fully marine to fresh at the mouth.

## BIOLOGICAL HEALTH

A total of five fish species were identified in the Elands during this survey. *Psammogobius knysnaensis* is dependent on estuaries during its entire life cycle while remaining four species, *Heteromycterus capensis*, *Lithognathus lithognathus*, *Liza richardsonii* and *Rhabdosargus holubi*, are all inshore marine species which depend upon estuaries to varying degrees during the juvenile phase of their life cycles. In terms of its fish species assemblage, the Elands was rated as moderately poor and had an index score of **1.8**.

## WATER QUALITY

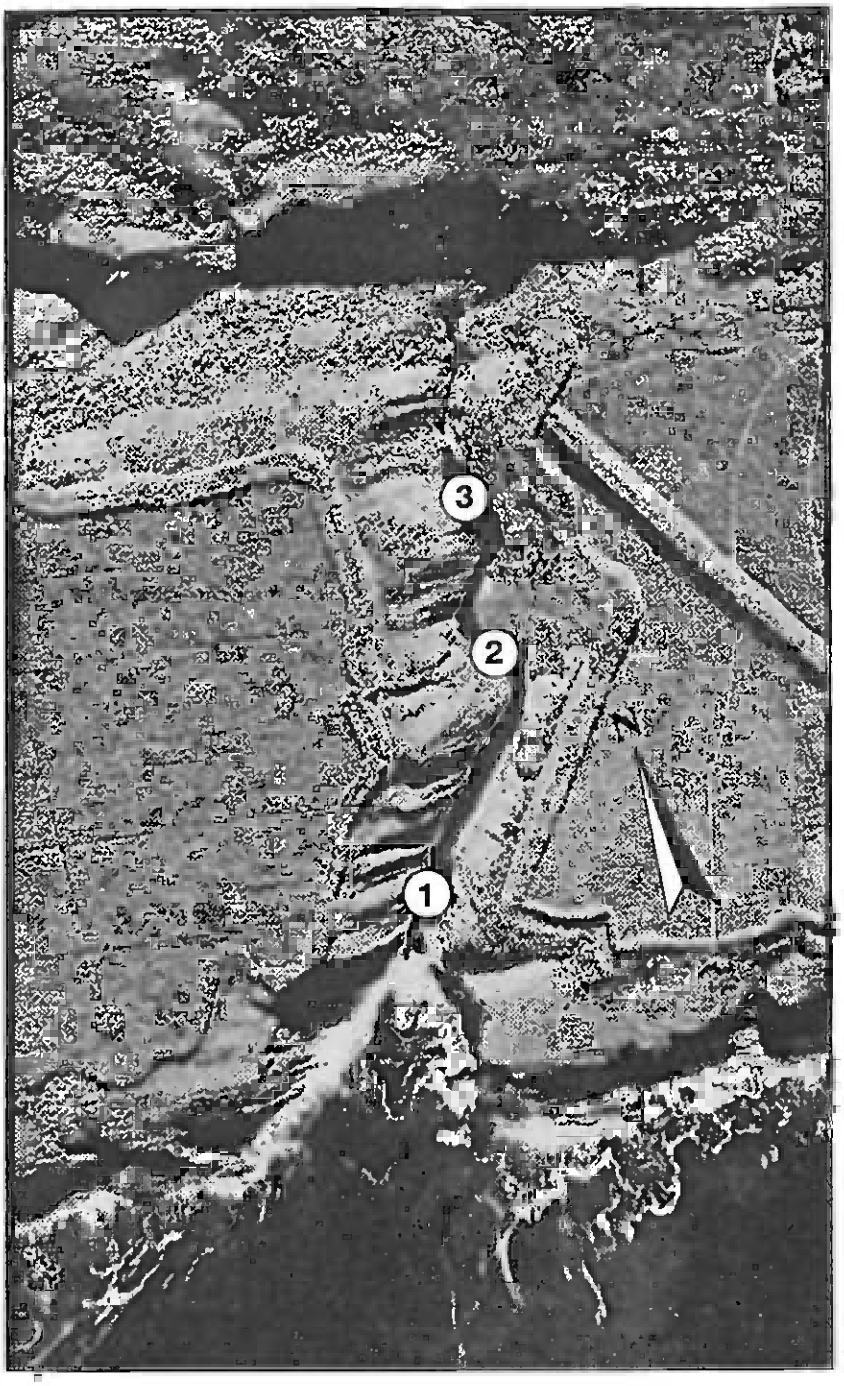
Water quality in the Elands estuary was sampled at the positions shown opposite. The overall water quality was good with an index value of **7.6** Some impairment in suitability for human contact resulted from elevated *E. coli* concentrations.

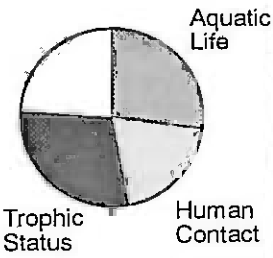
## AESTHETIC STATE

The Elands had an Aesthetic Health Index score of **9.9**. This system falls within the Tsitsikamma National Park which is administered by the National Parks Board. Apart from commercial forestry in the surrounding area, the system is totally undeveloped and is near-pristine.

## OVERALL ESTUARINE HEALTH

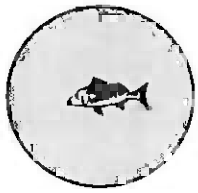
The Elands was classed as moderately poor biologically with a good water quality and aesthetic appearance. Overall, the system is regarded as being in a moderately good condition with a composite score of **7 out of 9**.



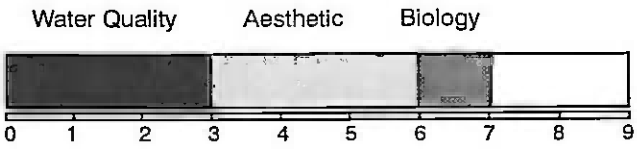

**WATER QUALITY**

**AESTHETIC**



**BIOLOGICAL**

0 300 m




**COMPOSITE HEALTH INDEX**

# ELANDS

## 15. GROOT (OOS)

### PHYSICAL CLASSIFICATION

The Groot (Oos) is located within a bedrock valley sheltered from marine wave energy by an intertidally exposed flood-tidal delta which is overtopped at high tide enabling tidal inflow on a 150 m wide front. At low tide, emergence of the delta reduces the channel to 20m and it is dominated by river outflow. Some waves reform after breaking on the seaward margin of the flood-tidal delta and penetrate the mouth of the estuary as bores.

The Groot (Oos) is one of six estuaries on the Tsitsikamma coast which are characterised by steep-sided, narrow bedrock valleys, intertidally exposed barriers which permit full tidal exchange at high tide and black water of low pH supplied by inflowing streams. In all cases, wave energy is dissipated at the mouth area such that calm conditions characterise the estuarine areas. Salinity is highly variable depending on the state of the tide and may vary from fully marine to fresh at the mouth.

### BIOLOGICAL HEALTH

Nine fish species were recorded in the Groot (Oos) during this survey. *Atherina breviceps*, *Gilchristella aestuaria* and *Psammogobius knysnaensis* are all species which breed in estuaries while *Argyrosomus hololepidotus*, *Heteromycteris capensis*, *Lithognathus lithognathus*, *Liza richardsonii*, *Rhabdosargus globiceps* and *R. holubi*, are all marine species which show various degrees of dependence upon estuaries during the juvenile phase of their life cycles. In terms of its fish species assemblage, the Groot (Oos) was rated as moderate with an index score of **3.3**.

### WATER QUALITY

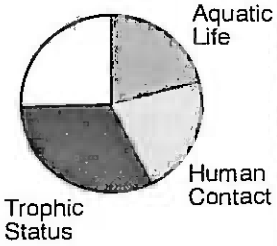
Water quality in the Groot (Oos) estuary was sampled at the positions shown opposite. The overall water quality was good with an index value of **7.4**. Some impairment was observed in the suitability for human contact resulting from elevated *E. coli* counts on the day of sampling and suitability for aquatic life resulting from elevated OA concentrations and somewhat depressed dissolved oxygen levels.

### AESTHETIC STATE

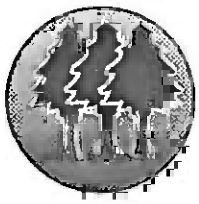
The Groot (Oos) had an Aesthetic Health Index score of **9.9**. This system forms part of the Tsitsikamma National Park which is administered by the National Parks Board. The coastal resort of Oubosstrand lies to the east of the estuary however apart from commercial forestry in the surrounding area, the system is totally undeveloped and is near-pristine.

### OVERALL ESTUARINE HEALTH

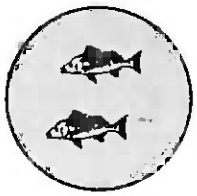
The biological status of the Groot (Oos) was considered acceptable while the water quality and general aesthetic appearance of the system were both considered good. Overall, the Groot (Oos) is regarded as being in a relatively good condition with a composite score of **8 out of 9**.


**WATER QUALITY**

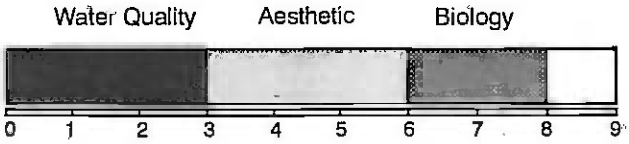


**AESTHETIC**



**BIOLOGICAL**

0 300 m




**COMPOSITE HEALTH INDEX**

## GROOT (Oos)

## 16. EERSTE

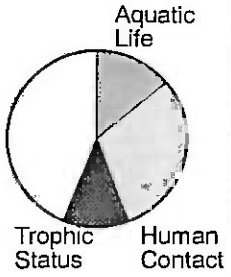
### PHYSICAL CLASSIFICATION
The Eerste was not considered an estuary due to its small size.

### BIOLOGICAL HEALTH
Due to its small size and rocky nature, the fish fauna of the Eerste was not sampled during this survey.

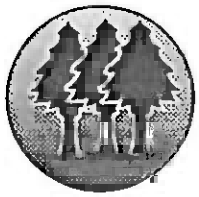
### WATER QUALITY
Water quality in the Eerste estuary was sampled at the positions shown opposite. The overall water quality was moderate with an index value of **5.6**. The most significant impairments were in the suitability for aquatic life resulting from the absence of DO in bottom waters on the day of sampling, and in trophic status due to high surface phosphate and nitrate concentrations. These characteristics are suggestive of significant eutrophication.

### AESTHETIC STATE
In terms of its appearance the Eerste scored **9.7** and apart from some residential development in the surrounding area, the system is in a near natural state overall.

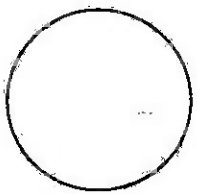
### OVERALL ESTUARINE HEALTH
The water quality of the Eerste was moderate and the aesthetic appearance of the system good. Based on these two parameters, the system is regarded as being in a moderately good condition with a composite score of **5 out of 6**.


WATER QUALITY



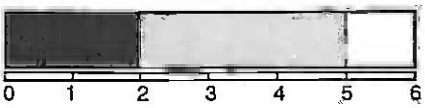
AESTHETIC



BIOLOGICAL

0 300 m

Water Quality Aesthetic




COMPOSITE HEALTH INDEX

**EERSTE**

## 17. KLIPDRIF (WES)

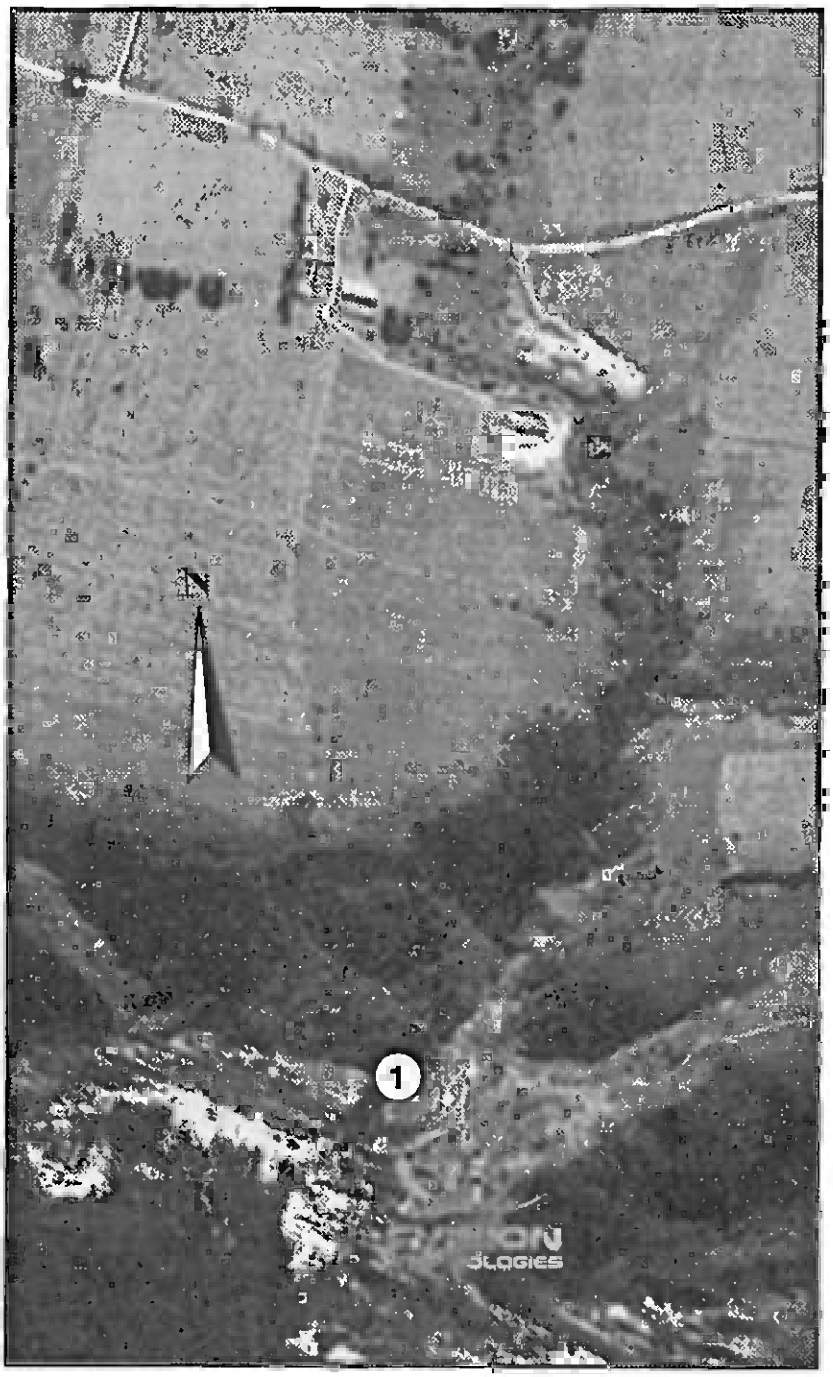
### PHYSICAL CLASSIFICATION
The Klipdrif (Wes) was not considered an estuary due to its small size.

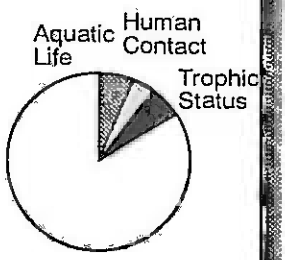
### BIOLOGICAL HEALTH
Due to its small size and rocky nature, the fish fauna of the Klipdrif (Wes) was not sampled during this survey.

### WATER QUALITY
Water quality in the Klipdrif (Wes) estuary was sampled at the positions shown opposite. The overall water quality was very poor with an index value of only **1.6**. Impairments in all water quality areas were severe. Lack of DO in bottom water, high OA concentrations, high surface ammonia, nitrate and phosphate levels, and relatively high *E. coli* counts on the day of sampling all point toward severe catchment derived pollution.

### AESTHETIC STATE
In terms of its appearance the Klipdrif (Wes) scored **9.3**. This small system falls within farmlands and apart from the construction of a slipway near the mouth and some holiday cottages in the surrounding area, the system is little developed.

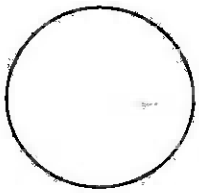
### OVERALL ESTUARINE HEALTH
The water quality of the Klipdrif (Wes) was rated very poor while the aesthetic appearance of the system was classed as good. Based of the water quality and aesthetic state of the system, the Klipdrif (Wes) is regarded as being in a satisfactory condition with a composite score of **4 out of 6**.




WATER QUALITY

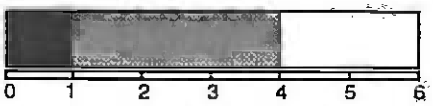
AESTHETIC



BIOLOGICAL

0 200 m

Water Quality Aesthetic




COMPOSITE HEALTH INDEX

## KLIPDRIF (Wes)

## 18. BOSKLOOF

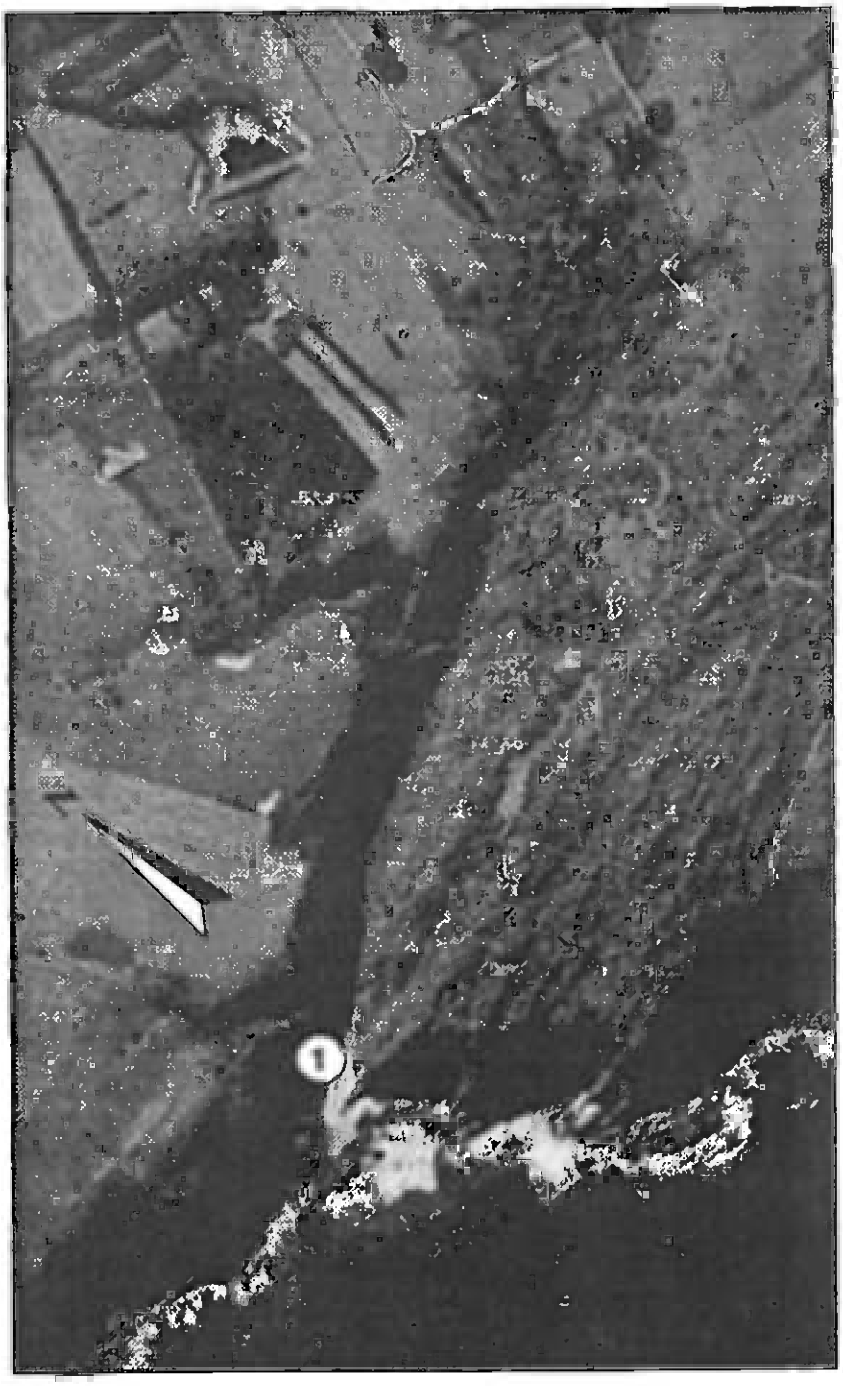
### PHYSICAL CLASSIFICATION
The Boskloof was not considered an estuary due to its small size.

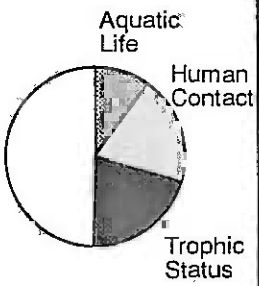
### BIOLOGICAL HEALTH
Due to its small size, the Boskloof was not considered an estuary. The Biological Health Index was therefore not applied to this system. Sampling in the system did however yield a number of juvenile mullets (Mugilidae) which are dependent on estuaries during the juvenile phase of their life cycle.

### WATER QUALITY
Water quality in the Boskloof estuary was sampled at the positions shown opposite. The overall water quality was moderate with an index value of **5.1**. The most significant impairment was in the suitability for aquatic life due to the absence of DO in bottom water and high OA concentrations. *E coli* counts were also elevated and nutrient concentrations were relatively high.

### AESTHETIC STATE
In terms of its appearance the Boskloof scored **9.6**. The system falls within farmlands and the floodplain, shoreline and the surrounding area are in a near-natural condition. The only major impact on the aesthetic state of the Boskloof was the presence of flotsam washed into the system from the sea.

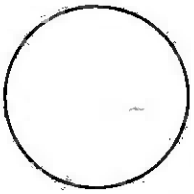
### OVERALL ESTUARINE HEALTH
The water quality of the Boskloof was moderate and its aesthetic appearance was considered good. Based on these two parameters, the system is regarded as being in a moderately good condition with a composite score of **5 out of 6**.



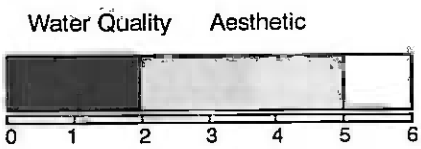




**WATER QUALITY**

**AESTHETIC**



**BIOLOGICAL**


**COMPOSITE HEALTH INDEX**

# BOSKLOOF

# 19. KAAPSEDRIF

## PHYSICAL CLASSIFICATION

The Kaapsedrif was not considered an estuary due to its small size.

## BIOLOGICAL HEALTH

Due to its small size, the Kaapsedrif was not considered an estuary. The Biological Health Index was therefore not applied to this system. Sampling in the Kaapsedrif did however yield a number of juvenile mullets (Mugilidae) which are dependent on estuaries during the juvenile phase of their life cycle.

## WATER QUALITY

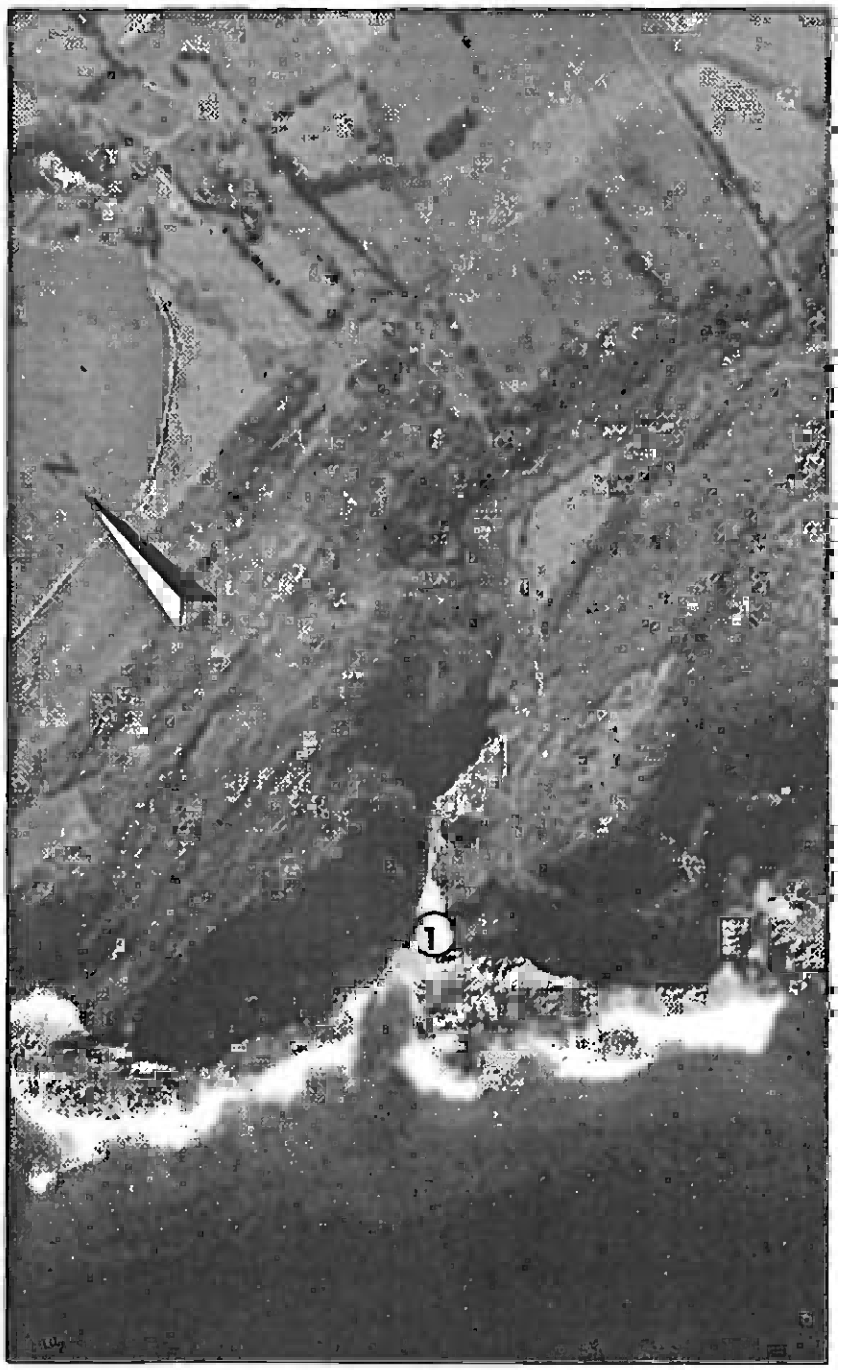
Water quality in the Kaapsedrif estuary was sampled at the positions shown opposite. The overall water quality was moderate with an index value of **4.5**. Significant impairment was observed in all three of the water quality areas. Impairment in the suitability for human contact resulting from relatively high *E. coli* counts was significant on the day of sampling.

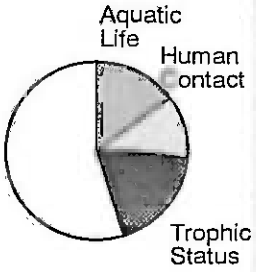
## AESTHETIC STATE

In terms of its appearance the Kaapsedrif scored **9.7**. The system falls within farmlands and access is relatively difficult. Apart from the presence of flotsam washed in from the sea, the system is in a near natural state.

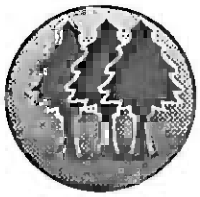
## OVERALL ESTUARINE HEALTH

The water quality of the Kaapsedrif was moderate and its aesthetic appearance was good. Based on these two parameters, the system is regarded as being in a moderately good condition with a composite score of **5 out of 6**.

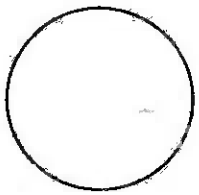



WATER QUALITY

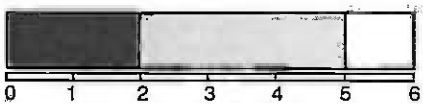


AESTHETIC



BIOLOGICAL

0 200 m




COMPOSITE HEALTH INDEX

# KAAPSEDRIF

## 20. TSITSIKAMMA

### PHYSICAL CLASSIFICATION

The Tsitsikamma estuary is confined behind a permanently supratidally exposed barrier which renders it different to most other systems in the Tsitsikamma area. Tidal exchange may occur through its periodically open mouth although evidence of recent breaching during a field visit in August 1995 included clear evidence of higher water levels when the mouth is closed. This suggests a certain amount of draining during open phases.

The Tsitsikamma was classified in a group of moderately sized estuaries (Group 3) that are characterised by temporarily open mouths, fresh to brackish water and shallow water areas separated from the sea by a broad dissipative beach across which overwash periodically introduces seawater into the back-barrier area.

### BIOLOGICAL HEALTH

Eight fish species were recorded in the Tsitsikamma during this survey. Two species, *Gilchristella aestuaria* and *Psammogobius knysnaensis* are species which depend on estuaries during their entire life cycle. The remaining six species, *Lithognathus lithognathus*, *Liza richardsonii*, *Monodactylus falciformis*, *Mugil cephalus*, *Myxus capensis* and *Rhabdosargus holubi*, are all inshore marine species which depend upon estuaries during the juvenile phase of their life cycle. In terms of its fish species assemblage, the Tsitsikamma was rated as moderately poor with an index score of **2.5**.

### WATER QUALITY

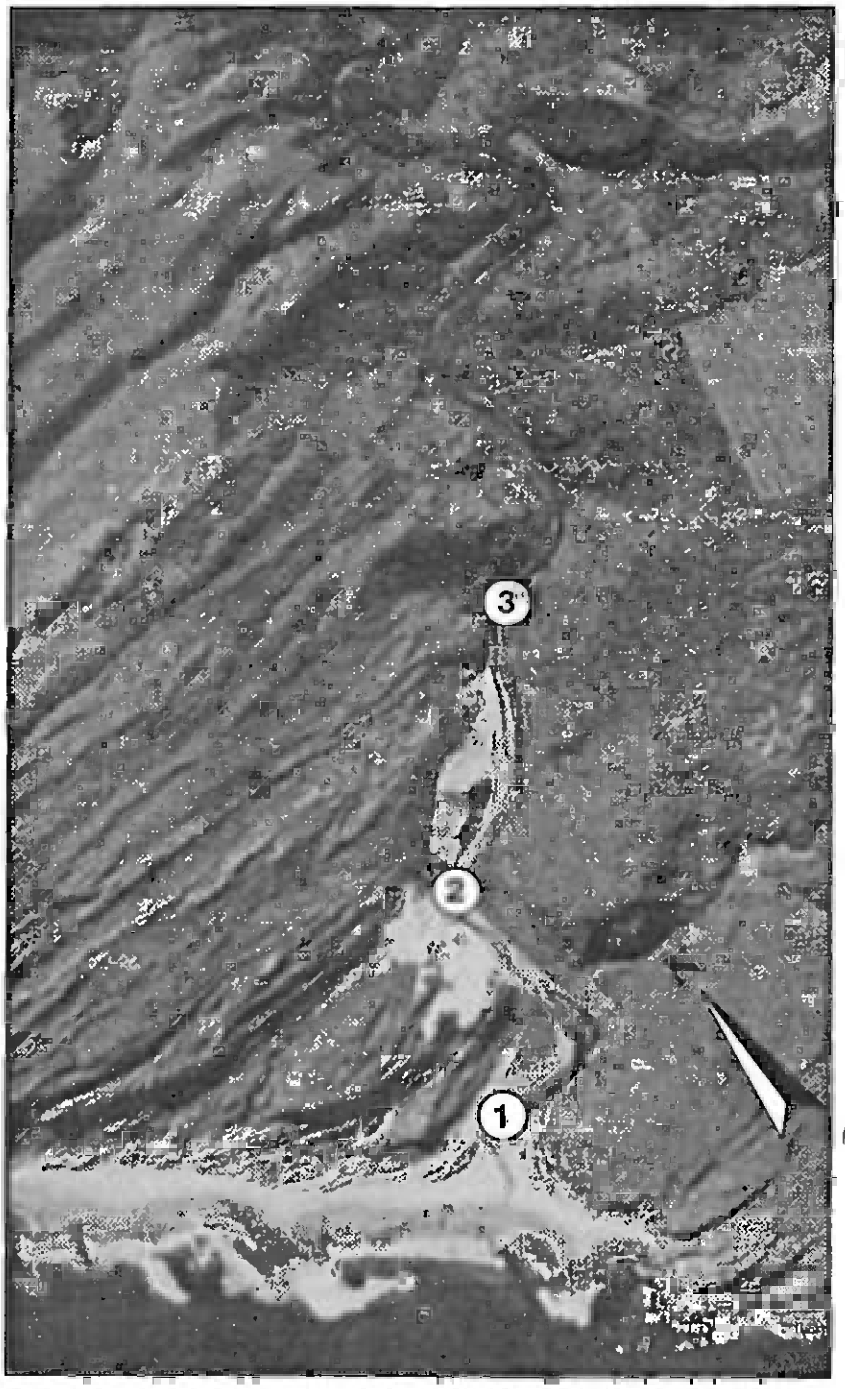
Water quality in the Tsitsikamma estuary was sampled at the positions shown opposite. The overall water quality was good with an index value of **6.7**. Moderate impairment was observed due to the presence of *E. coli* and high OA concentrations.

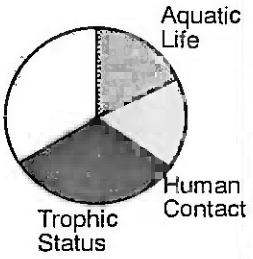
### AESTHETIC STATE

In terms of its appearance the Tsitsikamma system scored **9.6**. The system forms part of the Huisklip reserve, administered by Algoa Regional Serviced Council. The floodplain, shoreline and immediate estuary surrounds are undeveloped and the system appears near natural. Some holiday cottages however have been built to the east of the system.

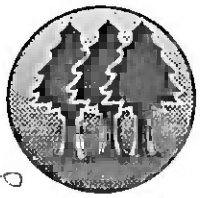
### OVERALL ESTUARINE HEALTH

The biological status of the Tsitsikamma was moderately poor while both the water quality and general aesthetic appearance were considered good. The system is regarded as being in a moderately good condition overall with a composite score of **7 out of 9**.

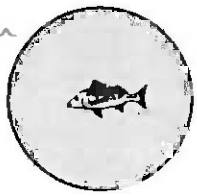



WATER QUALITY



AESTHETIC



BIOLOGICAL

0 200 m

Water Quality Aesthetic Biology


COMPOSITE HEALTH INDEX

## TSITSIKAMMA

## 21. KLIPDRIF (OOS)

### PHYSICAL CLASSIFICATION

The Klipdrif Oos runs parallel to the coast before discharging into the sea via a shallow outlet channel. Its water area is small and water depths average less than 0.5m in the lower reaches. The sandy channel is characterised by reeds and fresh water.

This is one of five small shallow sandy systems (Group 2) which are typically closed to the sea for extended periods and which, when they open, form shallow drainage channels for river water with minimal tidal inflow. The principal source of marine water input is via barrier overwash, which coupled with periodic surface flow provides connection with the sea. All these estuaries are fronted by broad, low, dissipative barriers.

### BIOLOGICAL HEALTH

Two fish species were identified in the Klipdrif (Oos) during this survey. *Psammogobius knysnaensis* lives and breeds in estuaries while *Mugil cephalus* is an inshore marine species which depends upon estuaries during the juvenile phase of its life cycle. In terms of its fish species assemblage, the Klipdrif (Oos) was rated as poor with an index score of **0.9**.

### WATER QUALITY

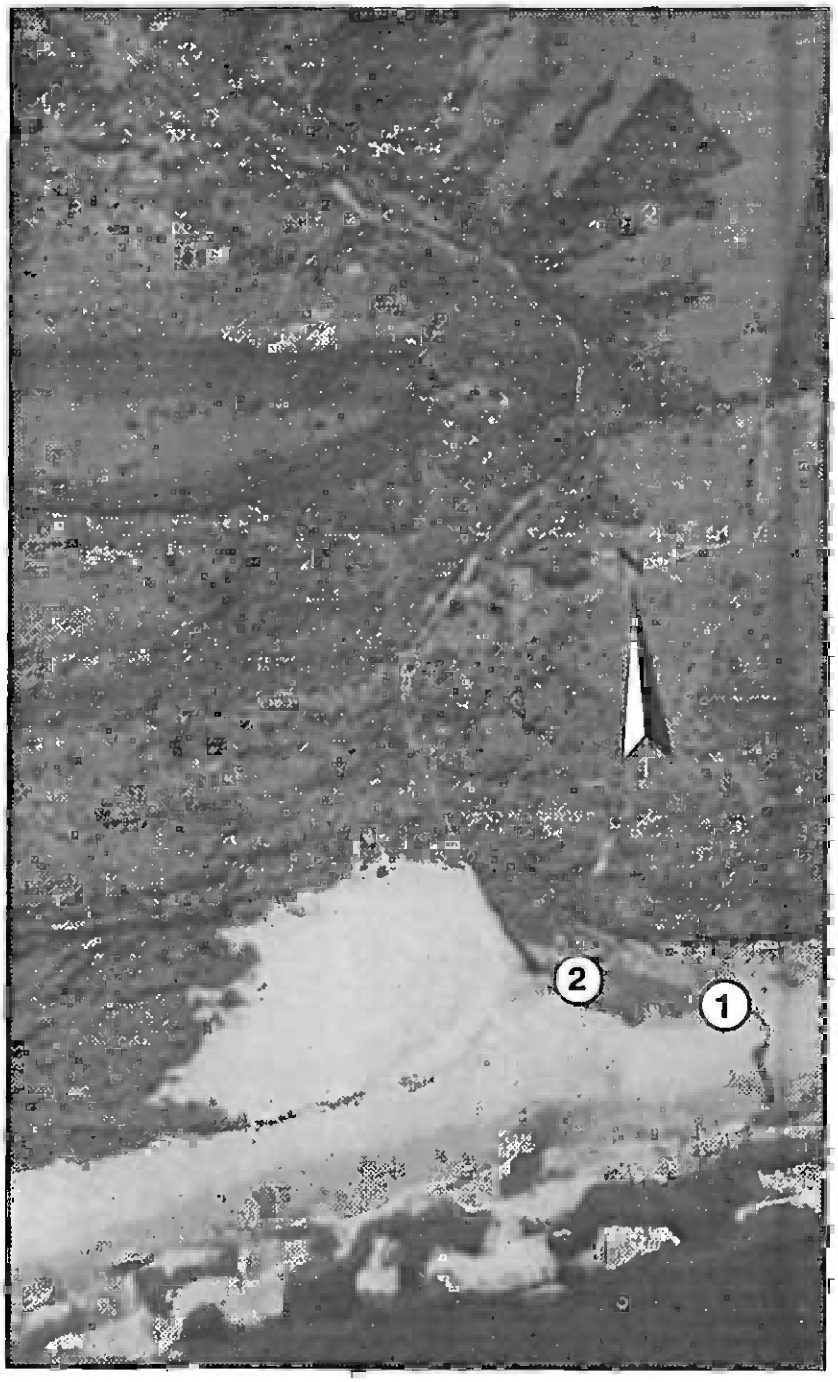
Water quality in the Klipdrif (Oos) estuary was sampled at the positions shown opposite. The overall water quality was moderate with an index value of **5.9**. Moderate impairment was observed in the suitability for aquatic life due primarily to supersaturated DO concentrations and elevated OA levels. The presence of elevated *E. coli* counts suggested faecal contamination.

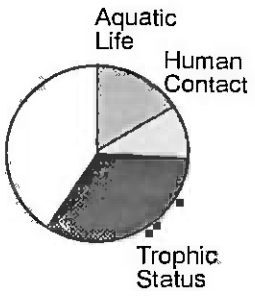
### AESTHETIC STATE

In terms of its appearance the Klipdrif (Oos) scored **9.3.** The system lies within farmlands and the floodplain, shoreline and the immediate surroundings all appear natural. The system however was experiencing a severe algal bloom at the time of the survey. Overall, the Klipdrif (Oos) was rated as being in a good condition aesthetically.

### OVERALL ESTUARINE HEALTH

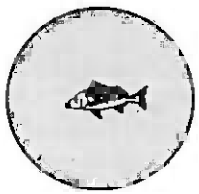
The biological status of the Klipdrif (Oos) was rated as poor. The overall water quality was moderate and the aesthetic appearance of the system was good. Overall, the Klipdrif (Oos) is regarded as being in a moderate condition with a composite score of **6 out of 9**.



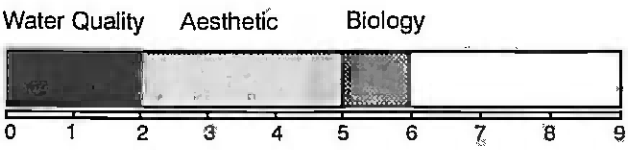

**WATER QUALITY**

**AESTHETIC**



**BIOLOGICAL**

0 300 m




**COMPOSITE HEALTH INDEX**

# KLIPDRIF (Oos)

# 22. SLANG

## PHYSICAL CLASSIFICATION

The Slang flows coast-parallel along the beach, behind a low berm for about 200m before discharging into the sea via a 2m wide and cm deep channel. The low barrier contains morphological evidence for barrier overwashing, which is reflected in the stratified water column in the back barrier area. The back-barrier area is shallow, sandy and, in spite of stratification, is characterised by reeds and aquatic vegetation along its margins. Dunes are encroaching on the water body from the west.

This is one of five small, shallow, sandy systems (Group 2) which are typically closed to the sea for extended periods and which, when they open, form shallow drainage channels for river water with minimal tidal inflow. The principal source of marine water input is via barrier overwash, which coupled with periodic surface flow provides connection with the sea. All these estuaries are fronted by broad, low, dissipative barriers.

## BIOLOGICAL HEALTH

Only one fish species, *Mugil cephalus*, was recorded in the Slang during this survey. *M. cephalus* is an inshore marine species which depends upon estuaries during the juvenile phase of its life cycle. In terms of its fish species assemblage, the Slang was rated as poor with an index score of **0.5**.

## WATER QUALITY

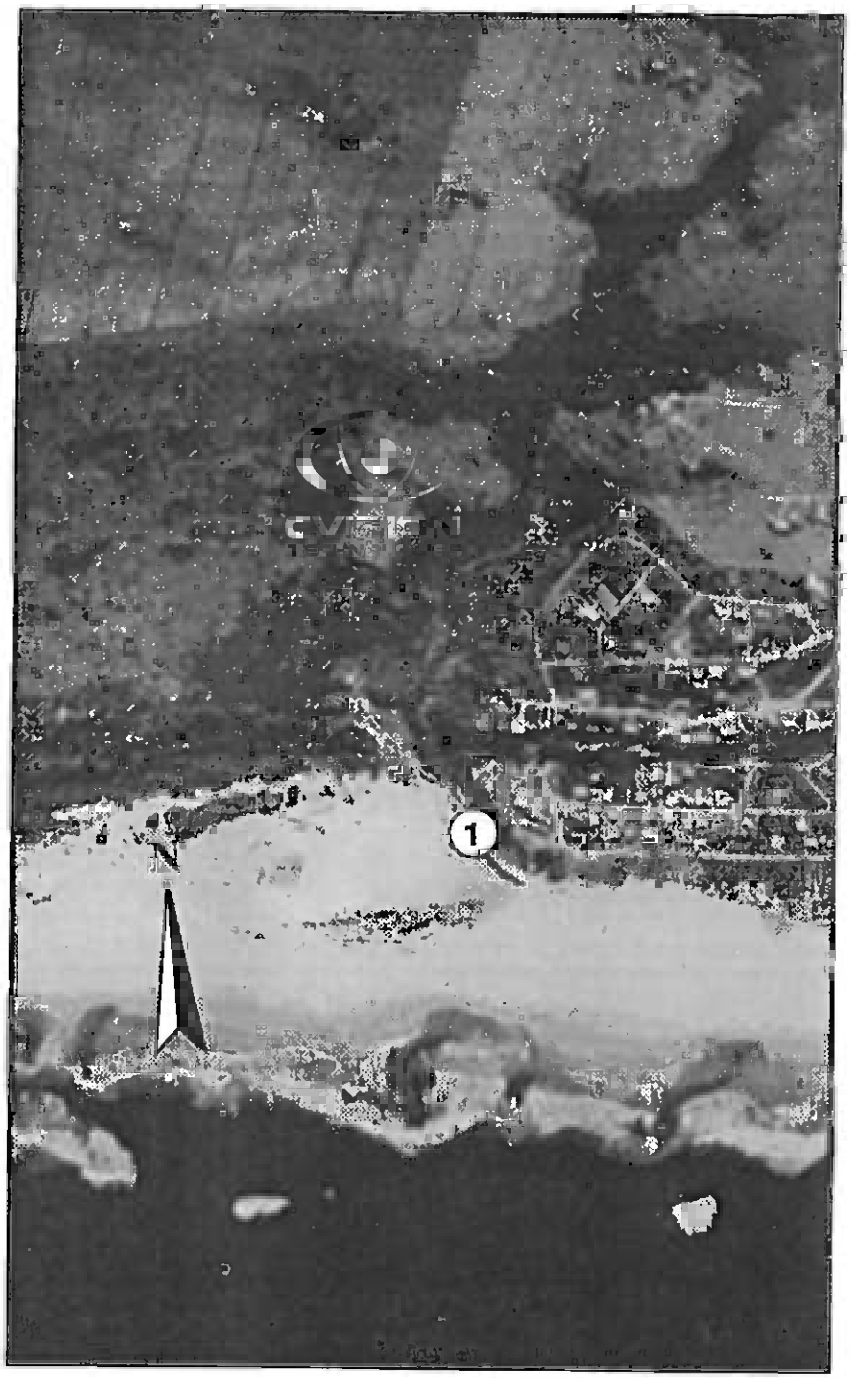
Water quality in the Slang was sampled at the positions shown opposite. The overall water quality was good with an index value of **6.7**. The most significant impairment was in the suitability for human contact resulting from relatively high *E. coli* counts on the day of sampling. The water's suitability for aquatic life was also somewhat impaired due to highly supersaturated bottom dissolved oxygen levels which suggest the presence of benthic algae or dense algal mats.

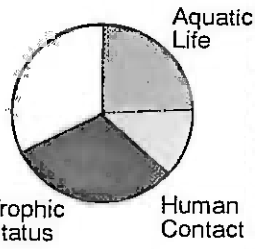
## AESTHETIC STATE

In terms of its appearance the Slang scored **9.4**. The floodplain and shoreline appear almost entirely natural while the coastal resort of Oyster Bay has resulted in some development in the surrounding area. The system was also experiencing a moderate algal bloom at the time of the survey. Overall the Slang was considered to be in a good condition aesthetically.

## OVERALL ESTUARINE HEALTH

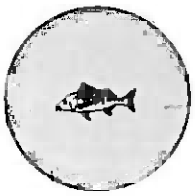
The biological status of the Slang was rated as poor. The overall water quality and aesthetic appearance of the system were both good. Overall, the Slang is regarded as being in a moderate condition with a composite score of **7 out of 9**.



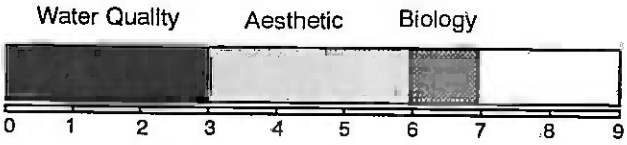

**WATER QUALITY**

**AESTHETIC**



**BIOLOGICAL**

0 200 m




**COMPOSITE HEALTH INDEX**

## SLANG

## 23. KROMME

### PHYSICAL CLASSIFICATION

The Kromme was classified as one of several estuaries (Group 4) that are characterised by near-permanent tidal inlets maintained by reversing tidal currents and regular tidal variation in water level.

The flood-tidal delta of the Kromme is well-developed and extends 4-5 km upstream of the mouth where its produces large intertidal sand flats which are densely colonised by the burrowing infauna (chiefly *Callianassa*). The flood-tidal delta is dissected by deep ebb channels which remain permanently inundated. Although hypersalinity has been noted in the Kromme system , it is areally restricted and is therefore of reduced ecological importance. A marina on the southwestern shore has resulted in artificial dredging of an access channel through the flood-tidal delta.

Construction of dams in the Kromme catchment is likely to limit the scouring of flood-tidally deposited sediment during river floods.

### BIOLOGICAL HEALTH

A total of 30 fish species were recorded in the Kromme during this study. Nine species, *Atherina breviceps, Caffrogobius multifasciatus, C. natalensis, C, nudiceps, Clinus superciliosus, Gilchristella aestuaria, Glossogobius callidus, Psammogobius knysnaensis* and *Syngnathus acus* are species which breed in southern African estuaries. Twenty species, *Argyrosomus hololepidotus, Diplodus sargus capensis, Galeichthys feliceps, Heteromycteris capensis, Lichia amia, Lithognathus lithognathus, Liza dumerilii, Liza macrolepis, L. richardsonii, L. tricuspidens, Monodactylus falciformis, Mugil cephalus, Myxus capensis, Platycephalus indicus, Pomadasys commersonnii, Pomatomus saltatrix, Rhabdosargus globiceps, R. holubi, Sarpa salpa* and *Solea bleekeri* are all inshore marine species which depend upon estuaries during the juvenile phase of their life cycle to varying degrees. *Diplodus cervinus hottentotus* occurs in estuaries in small numbers but is not dependent on these systems. In terms of its fish species assemblage, the Kromme was rated as good with an index score of **5.7**.

### WATER QUALITY

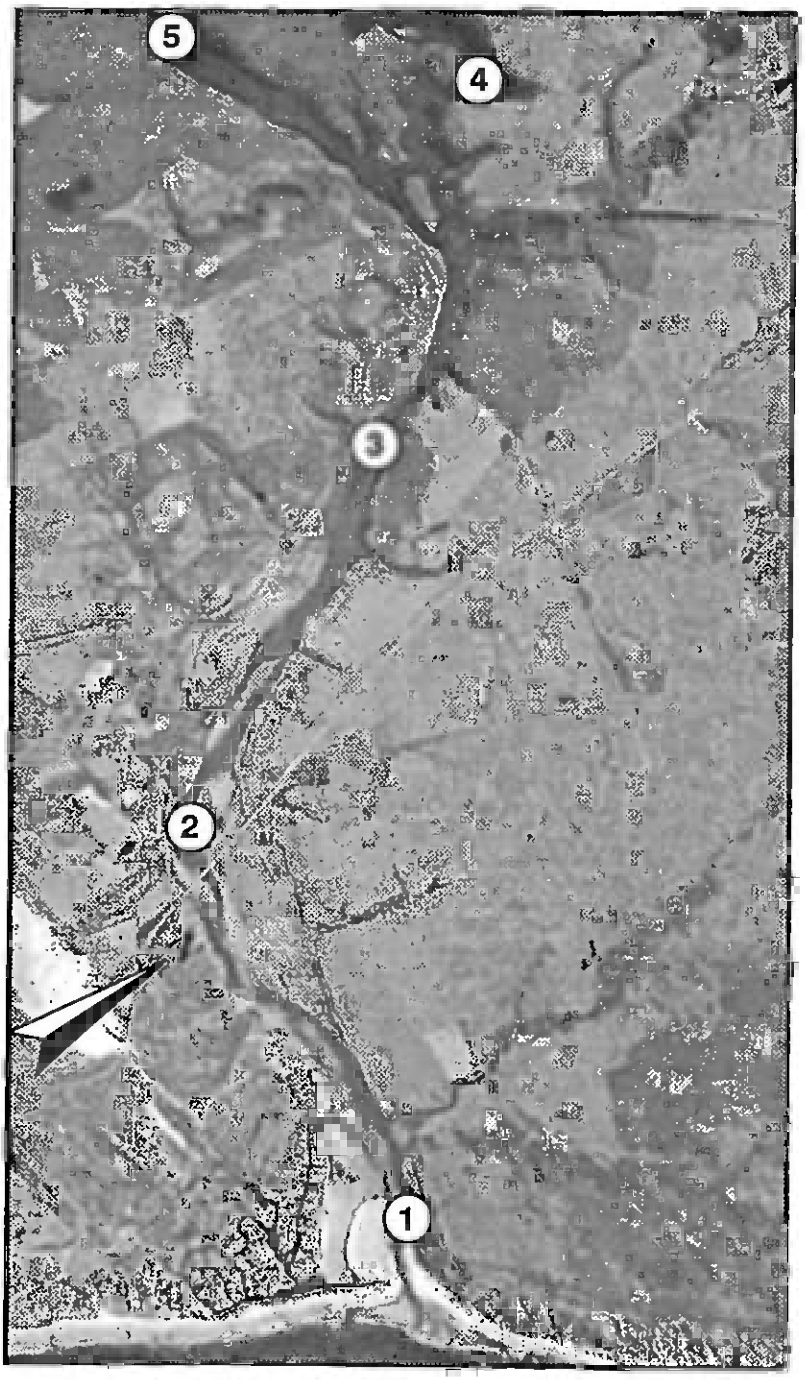
Water quality in the Kromme estuary was sampled at the positions shown opposite. The overall water quality was very good with an index value of **8.6**. Impairment was largely due to elevated OA values.

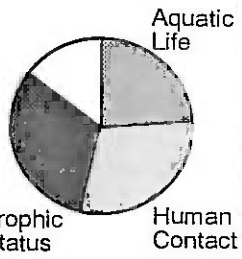
### AESTHETIC STATE

In terms of its appearance the Kromme scored **8.5**. On the southern bank of the estuary, near the mouth, lies the resort of Marina Glades. A number of private jetties and boat houses occur along the shoreline and on the floodplain of the system. Much of the surrounding area appears natural although some residential development is present. A road bridge with an embankment crosses the lower reaches of the system and traffic noise is persistent. The Kromme appears to be important recreationally and was regarded as satisfactory aesthetically.

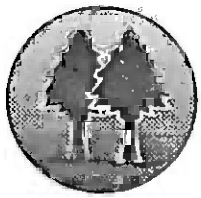
### OVERALL ESTUARINE HEALTH

The biological health and water quality of the Kromme were both rated good while its aesthetic appearance was moderate. Overall, the Kromme is regarded as being in a good condition with a composite score of **8 out of 9**.

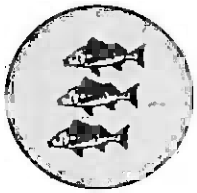



**WATER QUALITY**

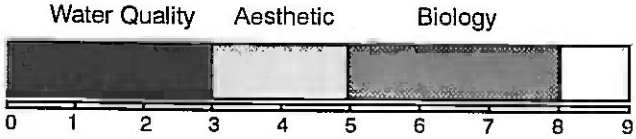


**AESTHETIC**



**BIOLOGICAL**

0 200 m




**COMPOSITE HEALTH INDEX**

## KROMME

## 24. SEEKOEI

### PHYSICAL CLASSIFICATION

The Seekoei was identified as unique in the classification principally on the basis of its hypersalinity. Its' present hydrology, however, is almost entirely controlled by humans since the former floodplain now serves as a series of salt pans. Sea water is pumped into a canal on the eastern shore and then backs up beyond the road bridge. Excess water overflows into the former estuarine channel which is now virtually unrecognisable.

Although historical records of the former state of the system were not obtained, the long barrier which is partially dune-covered, and wide floodplain suggest that the system may originally have been similar to those systems of Group 3 in which ephemeral mouths permit drainage of the system during high water levels, after which closure rapidly occurs. Widespread overwashing of the present barrier is indicative of introduction of sea water into the system by this means while the presence of aeolian dunes is likely to have contributed to maintenance of the outlet in a closed condition. In view of the lack of available evidence to the contrary, this system is therefore provisionally likened to those systems of Group 3.

### BIOLOGICAL HEALTH

Thirteen fish species were captured in the Seekoei during this survey. Four species, *Atherina breviceps*, *Gilchristella aestuaria*, *Glossogobius callidus* and *Psammogobius knysnaensis* are species which depend on estuaries during their entire life cycle. Eight species, *Heteromycterus capensis*, *Lichia amia*, *Lithognathus lithognathus*, *Liza dumerilii*, *L. richardsonii*, *Monodactylus falciformis*, *Mugil cephalus* and *Rhabdosargus holubi* are all inshore marine species which depend upon estuaries during the juvenile phase of their life cycle. *Oreochromis mossambicus* is a freshwater species which may breed in both freshwater and estuarine systems. In terms of its fish species assemblage, the Seekoei was rated as moderately good with an index score of **4.0**.

### WATER QUALITY

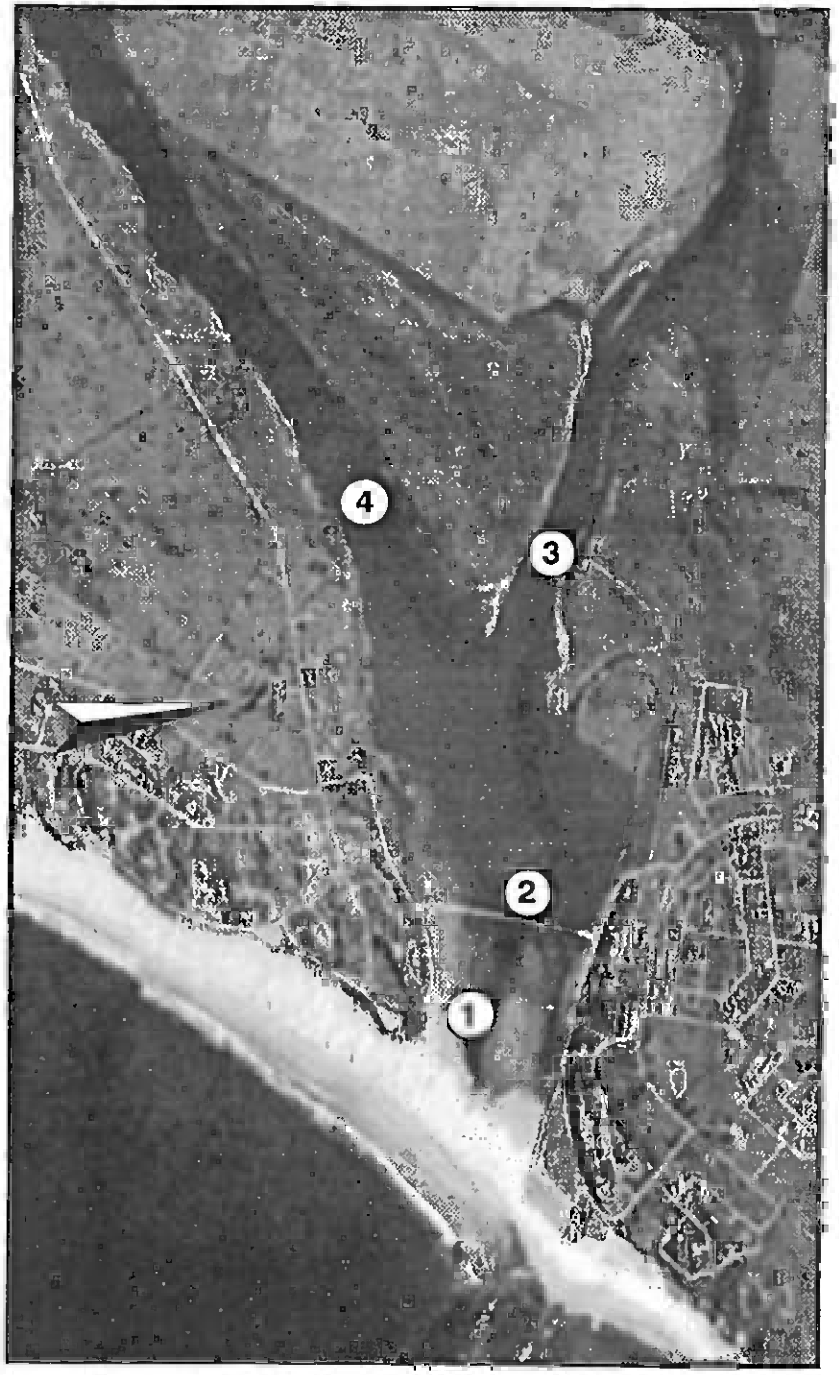
Water quality in the Seekoei estuary was sampled at the positions shown opposite. The overall water quality was good with an index value of **7.0**. The most significant impairment was in the water's suitability for aquatic life due to low bottom dissolved oxygen levels and elevated OA concentrations.

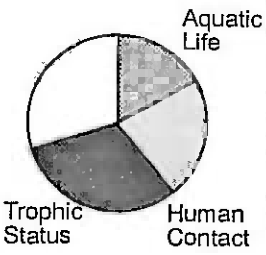
### AESTHETIC STATE

In terms of its appearance the Seekoei scored **8.2**. A causeway which crosses the lower reaches of the system and links the resorts of Aston Bay on the northern bank and Paradise Beach on the southern bank. Above the causeway the system forms part of a nature reserve, administered by East Cape Nature Conservation and development in the surrounds is limited largely to the lower reaches. Traffic noise in the area is persistent. The system was experiencing an algal bloom at the time of the survey. Overall, the Seekoei was classed as being in a satisfactory condition aesthetically.

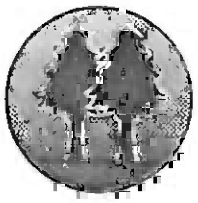
### OVERALL ESTUARINE HEALTH

The Seekoei was moderately good biologically with a good overall water quality. Aesthetically, the system was satisfactory. Overall, the Seekoei is regarded as being in a moderately good condition with a composite score of **8 out of 9**.

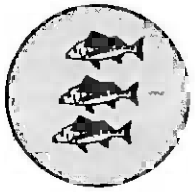



**WATER QUALITY**

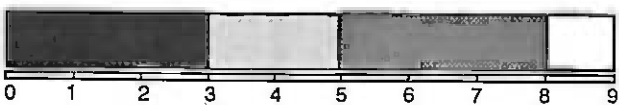


**AESTHETIC**



**BIOLOGICAL**

0 200 m




**COMPOSITE HEALTH INDEX**

**SEEKOEI**

## 25. KABELJOUS

### PHYSICAL CLASSIFICATION

The Kabeljous was closed during a field visit in June 1995 by a sandy beach about 50m wide. The former channel was evidenced by sharp scarps on the beach which indicated it to have been about 40m wide. Evidence of higher water levels around the estuary suggested some draining had occurred when the system opened and the presence of low salinity water suggest that limited tidal inflow occurs when the mouth is open. Overwash is likely at the former mouth position but is likely to be limited elsewhere on the barrier by a high berm.

The Kabeljous was classified in a group of moderately sized estuaries (Group 3) that are characterised by temporarily open mouths, fresh to brackish water and shallow water areas separated from the sea by a broad dissipative beach across which overwash periodically introduces seawater into the back-barrier area.

### BIOLOGICAL HEALTH

Eleven fish species were captured in the Kabeljous during this survey. Three species, *Atherina breviceps*, *Gilchristella aestuaria* and *Psammogobius knysnaensis* are all species which depend on estuaries during their entire life cycle. Eight species, *Lichia amia*, *Lithognathus lithognathus*, *Liza richardsonii*, *Liza tricuspidens*, *Monodactylus falciformis*, *Mugil cephalus*, *Myxus capensis*, and *Rhabdosargus holubi* are inshore marine species which depend upon estuaries to varying degrees during the juvenile phase of their life cycle. In terms of its fish species assemblage, the Kabeljous system was rated as acceptable with an index score of **3.4**.

### WATER QUALITY

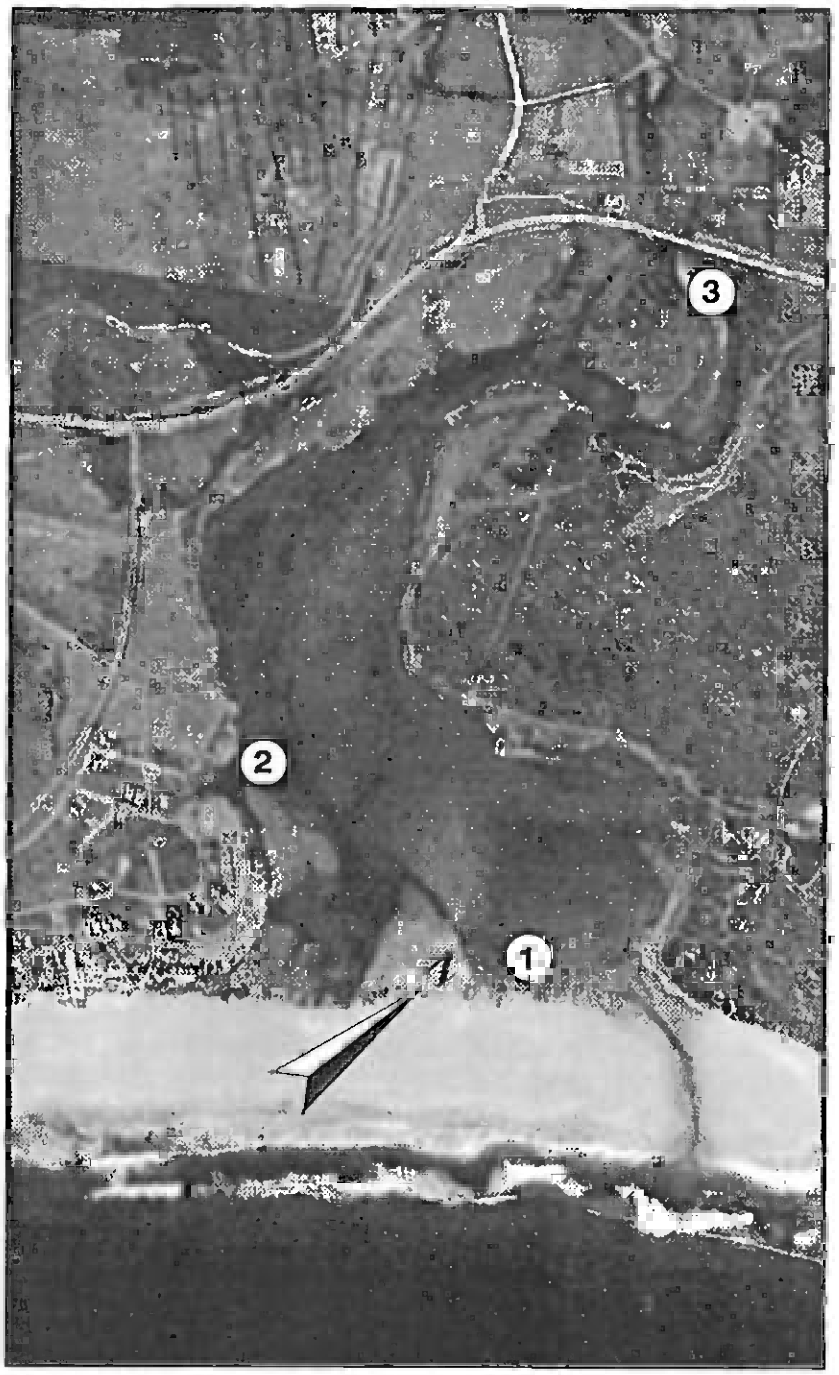
Water quality in the Kabeljous estuary was sampled at the positions shown opposite. The overall water quality was moderate with an index value of **5.5**. Impairment was observed in all three categories. Relatively low surface DO coupled with the absence of DO in bottom water, and elevated *E. coli* all contributed to the impairment of the system's water quality.

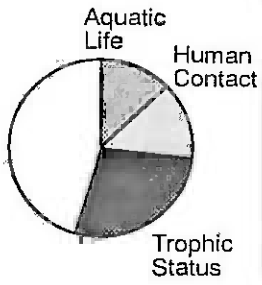
### AESTHETIC STATE

In terms of its appearance the Kabeljous scored **8.9**. A large proportion of the estuary appears to be privately owned and much of the floodplain and shoreline appears to be in a natural state with some residential development occurring in the surrounding area. Two bridges, one rail and one road, cross the upper reaches of the system and traffic noise is persistent. Overall, the Kabeljous was classed as being in a good condition aesthetically.

### OVERALL ESTUARINE HEALTH

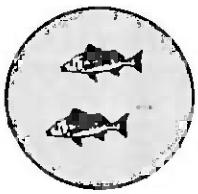
The biological status and water quality of the Kabeljous were both satisfactory while the aesthetic state of the system was rated as good. Overall, the system is regarded as being in an acceptable condition with a composite score of **7 out of 9**.




**WATER QUALITY**

**AESTHETIC**



**BIOLOGICAL**

0 200 m

Water Quality Aesthetic Biology

0 1 2 3 4 5 6 7 8 9

**COMPOSITE HEALTH INDEX**

# KABELJOUS

# 26. GAMTOOS

## PHYSICAL CLASSIFICATION

The Gamtoos was classified as one of several estuaries (Group 4) that are characterised by near-permanent tidal inlets maintained by reversing tidal currents and regular tidal variation in water level. It is among the largest of these systems and occupies a 3 km-wide floodplain across which an extensive, dune-topped barrier has formed. Although the estuarine channel of the Gamtoos is narrow and sinuous (due to the high mud content of incoming fluvial sediment) and intertidal areas consequently restricted, an elongate extension of the channel behind the dune barrier, provides extensive intertidal areas in the sandy sediments which occur there. These sediments are densely covered by *Callianassa* burrow openings. The water of the Gamtoos was markedly turbid which is consistent with the high mud content of sediments in its catchment. The flood-tidal delta of the Gamtoos is restricted to the mouth region in response to fluvial flow and channel morphology.

## BIOLOGICAL HEALTH

A total of 24 fish species were captured in the Gamtoos estuary during this survey. Five species, *Atherina breviceps*, *Caffrogobius multifasciatus*, *Gilchristella aestuaria*, *Glossogobius callidus* and *Psammogobius knysnaensis*, are all species which live and breed in estuaries. The remaining nineteen species, *Argyrosomus hololepidotus*, *Diplodus sargus capensis*, *Elops machnata*, *Galeichthys feliceps*, *Heteromycteris capensis*, *Lichia amia*, *Lithognathus lithognathus*, *Liza dumerilii*, *L. richardsonii*, *L. tricuspidens*, *Monodactylus falciformis*, *Mugil cephalus*, *Myxus capensis*, *Platycephalus indicus*, *Pomadasys commersonnii*, *Pomatomus saltatrix*, *Rhabdosargus globiceps*, *R. holubi* and *Solea bleekeri*, are inshore marine species which depend upon estuaries to varying degrees during the juvenile phase of their life cycle. In terms of its fish species assemblage, the Gamtoos was moderately good and had an index score of **4.9**.

## WATER QUALITY

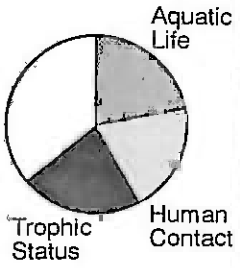
Water quality in the Gamtoos estuary was sampled at the positions shown opposite. The overall water quality was good with an index value of **6.4**. Moderate impairment was observed in all three categories of impact.

## AESTHETIC STATE

In terms of its appearance the Gamtoos estuary scored **8.7**. Much of the floodplain appears to comprise farmlands. The shoreline of the system appears to be natural as does most of the immediate surrounding area of the system. Two bridges, both with embankments cross the system. The Gamtoos is a popular estuary and is used extensively for boating and angling. Overall, the Gamtoos estuary was classed as being in a satisfactory condition aesthetically.

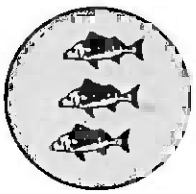
## OVERALL ESTUARINE HEALTH

The biological status and water quality of the Gamtoos were rated as good while the aesthetic appearance of the system was satisfactory. The system is regarded as being in a moderately good condition overall with a composite score of **8 out of 9**.


**WATER QUALITY**

**AESTHETIC**



**BIOLOGICAL**

0 400 m

Water Quality Aesthetic Biology


**COMPOSITE HEALTH INDEX**

# GAMTOOS

# 27. VAN STADENS

## PHYSICAL CLASSIFICATION

The Van Stadens river mouth is a large body of water separated from the sea by a 50m-wide beach with a low berm. Although it was closed during a field visit in June 1995, its moderate salinity suggested periodic marine inputs via barrier overwash. The water body is relatively deep (>2m) and is fringed by extensive shallow marginal areas. It appears to be perched on the beach above sea level which precludes extensive tidal inflow when the barrier is breached.

The Van Stadens was classified in a group of moderately sized estuaries (Group 3) that are characterised by temporarily open mouths, fresh to brackish water and shallow water areas separated from the sea by a broad dissipative beach across which overwash periodically introduces seawater into the back-barrier area.

## BIOLOGICAL HEALTH

A total of 15 fish species were captured in the Van Stadens during this survey. Four species, *Atherina breviceps*, *Gilchristella aestuaria*, *Glossogobius callidus* and *Psammogobius knysnaensis* are all species which depend on estuaries during their entire life cycle. The remaining eleven species, *Diplodus sargus capensis*, *Lichia amia*, *Lithognathus lithognathus*, *Liza dumerilii*, *L. richardsonii*, *L. tricuspidens*, *Monodactylus falciformis*, *Mugil cephalus*, *Myxus capensis*, *Rhabdosargus holubi* and *Sarpa salpa*, are inshore marine species which depend upon estuaries to varying degrees during the juvenile phase of their life cycle. In terms of its fish species assemblage, the Van Stadens was moderately good and had an index score of **4.6**.

## WATER QUALITY

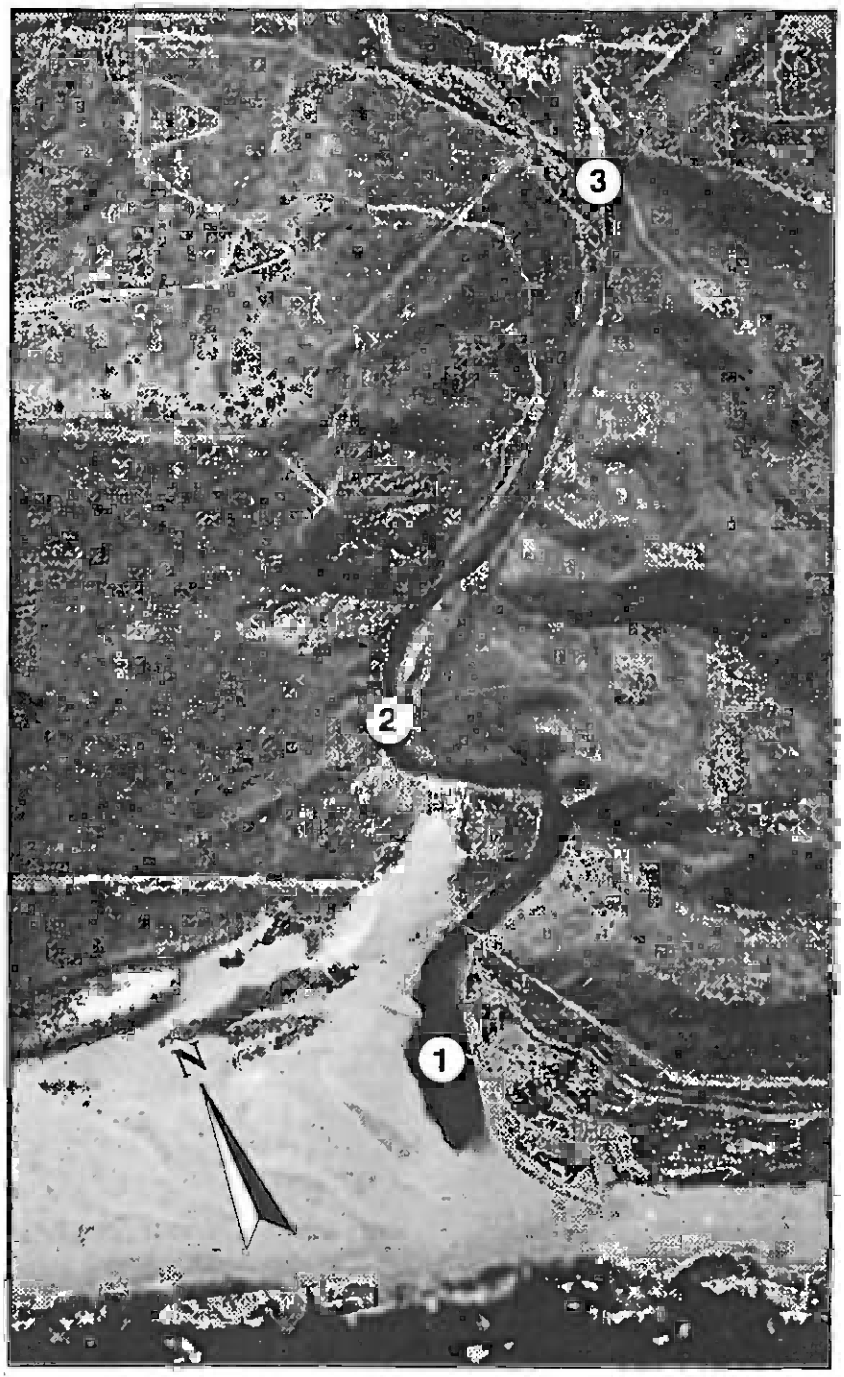
Water quality in the Van Stadens estuary was sampled at the positions shown opposite. The overall water quality was good with an index value of **6.9**. The water's suitability for aquatic life was impaired due to low dissolved oxygen levels and elevated OA concentrations.

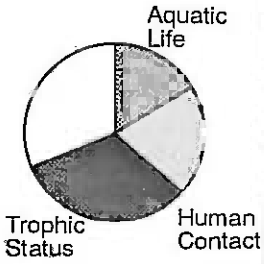
## AESTHETIC STATE

In terms of its appearance the Van Stadens scored **8.4**. Much of the floodplain of the lower reaches of the system is used for the resort of Van Stadensriviermond. A large proportion of the shoreline at the resort in lower reaches, comprises solid walls. A water pipeline also crosses the lower reaches of the estuary. Most of the surrounding area of the Van Stadens system however, appears to be in a fairly natural condition. The estuary is a popular recreational venue for visitors to the resort. Overall, the Van Stadens system was rated as being in an acceptable condition aesthetically.

## OVERALL ESTUARINE HEALTH

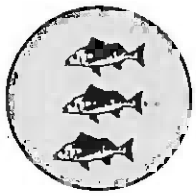
Both the biological health and the water quality of the Van Stadens were rated good while aesthetically the system was acceptable. Overall, the Van Stadens is regarded as being in a moderately good condition with a composite score of **8 out of 9**.




**WATER QUALITY**

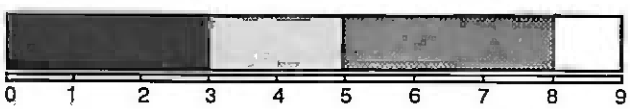
**AESTHETIC**



**BIOLOGICAL**

0 200 m

Water Quality Aesthetic Biology




**COMPOSITE HEALTH INDEX**

## VAN STADENS

## 28. MAITLAND

### PHYSICAL CLASSIFICATION

The Maitland system is very shallow (10-20 cm) and may be maintained by the groundwater table on the broad dissipative beach on which it is located. It forms an open water body perched on the sandy beach and flows out to sea via a cm-deep outflow channel which during a field visit in June 1995 was absorbed by the porous beach before it reached the sea. Low salinities in the system suggest limited overwash inputs and 200m from the mouth the vegetation which includes *Phragmites* resembles that of an interdune vlei.

This is one of five small, shallow, sandy systems (Group 2) which are typically closed to the sea for extended periods and which, when they open, form shallow drainage channels for river water with minimal tidal inflow. The principal source of marine water input is via barrier overwash, which coupled with periodic surface flow provides connection with the sea. All these estuaries are fronted by broad, low, dissipative barriers.

### BIOLOGICAL HEALTH

A total of five fish species were captured in the Maitland system during this survey. *Psammogobius knysnaensis* lives and breeds in estuaries while *Lithognathus lithognathus*, *Mugil cephalus*, *Myxus capensis* and *Rhabdosargus holubi* are inshore marine species which depend upon estuaries to varying degrees during the juvenile phase of their life cycle. In terms of its fish species assemblage, the Maitland system was moderately poor and had an index score of **2.3**.

### WATER QUALITY

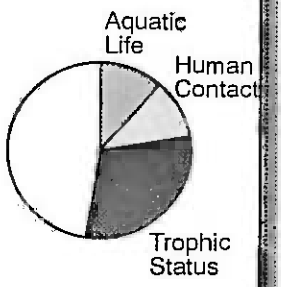
Water quality in the Maitland estuary was sampled at the positions shown opposite. The overall water quality was moderate with an index value of **5.2**. Significant impairment was in the suitability for aquatic life (low DO levels and elevated OA's) and suitability for human contact (elevated *E. coli* counts.

### AESTHETIC STATE

In terms of its appearance the Maitland system scored **8.8**. The Maitland is a popular riverside resort and a fair proportion of the floodplain of the system appears to be given over to recreational development. Most of the shoreline and surrounding area however appear to be in a fairly natural condition. A water pipeline crosses the lower reaches of the system. At the time of our survey, the system was experiencing an algal bloom. Overall, the Maitland was rated as being in a moderately good condition aesthetically.

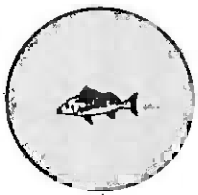
### OVERALL ESTUARINE HEALTH

The biological status of the Maitland system was moderately poor with a satisfactory water quality. Aesthetically, the system was moderately good. Overall, the Maitland is regarded as being in a moderate condition with a composite score of **6 out of 9**.

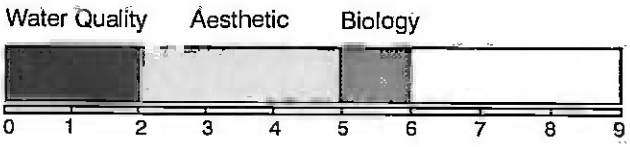

**WATER QUALITY**

**AESTHETIC**



**BIOLOGICAL**

0 200 m




**COMPOSITE HEALTH INDEX**

# MAITLAND

# 29. BAKENS

## PHYSICAL CLASSIFICATION

The Bakens river is presently canalised along most of its length and its bed too is composed of fill and concrete. It discharges directly into the harbour at Port Elizabeth and little trace of its former state is evident. Investigation of archival sources would be required to provide at least qualitative information on its former state.

Although severely impacted, its dimensions, catchment discharge data, and setting enable the tentative suggestion that this system was formerly similar to the small, shallow, sandy systems of Group 2 which are typically closed to the sea for extended periods and which, when they open, form shallow drainage channels for river water with minimal tidal inflow. The principal source of marine water input is via barrier overwash, which coupled with periodic surface flow provides connection with the sea. All these estuaries are fronted by broad, low, dissipative barriers.

## BIOLOGICAL HEALTH

Nine fish species were captured in the Bakens during this survey. Two species, *Atherina breviceps* and *Psammogobius knysnaensis* are species which breed in estuaries. The remaining seven species, Diplodus sargus capensis, Heteromycteris capensis, *Lithognathus lithognathus*, *Liza dumerilii*, *L. richardsonii*, *Mugil cephalus* and *Rhabdosargus holubi*, are all inshore marine species which depend upon estuaries during the juvenile phase of their life cycle. In terms of its fish species composition, the Bakens was rated as moderately good with an index score of **4.2**.

## WATER QUALITY

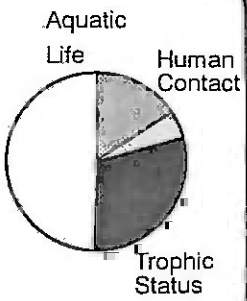
Water quality in the Bakens estuary was sampled at the positions shown opposite. The overall water quality was moderate with an index value of **5.1**. Significant impairment was in the suitability for human contact (high *E. coli* counts) and suitability for aquatic life (low bottom DO levels and elevated OA's).

## AESTHETIC STATE

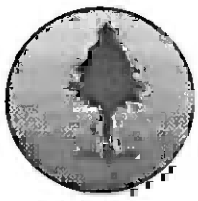
In terms of its appearance the Bakens scored **1.4**, the lowest recorded during this study. The system has essentially been canalised and flows through the city of Port Elizabeth before entering the harbour. Nine bridges cross the system and noise in the area is persistent. Litter and rubble in the area was extensive and persistent. The Bakens was considered to be in a very poor condition aesthetically.

## OVERALL ESTUARINE HEALTH

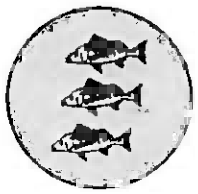
The biological status of the Bakens was moderately good with a moderate water quality. Its overall aesthetic appearance however was very poor. Overall, the system is considered to be in a moderately poor condition with a composite score of **6 out of 9**.


**WATER QUALITY**



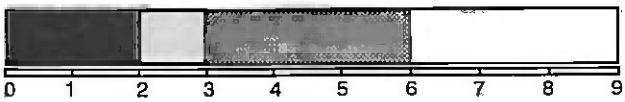
**AESTHETIC**



**BIOLOGICAL**

0 400 m

Water Quality Aesthetic Biology




**COMPOSITE HEALTH INDEX**

# BAKENS

## 30. PAPKUILS

### PHYSICAL CLASSIFICATION

The Papkuils is canalised along its lower reaches and its bed is concreted. The coast is rock-armoured where it enters the sea and little remains to provide evidence of its former state. At present flood-tidal currents enter the canal and flow upstream for at least 200m.

On the basis of its dimensions, setting and catchment characteristics the Papkuils was tentatively classified in a group of moderately sized estuaries (Group 3) that are characterised by temporarily open mouths, fresh to brackish water and shallow water areas separated from the sea by a broad dissipative beach across which overwash periodically introduces seawater into the back-barrier area. Clearly additional historical evidence is needed to verify such an assessment.

### BIOLOGICAL HEALTH

No fish species were collected in the Papkuils during this study. The system is severely degraded and had an index score of **0.0**.

### WATER QUALITY

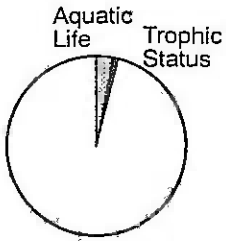
Water quality in the Papkuils estuary was sampled at the positions shown opposite. The overall water quality was the poorest in the study area with an index value of only **0.4**. Supersaturated DO's, high OA's, high nitrate and ammonia concentrations and very high *E. coli* counts contributed to this system's severely degraded state. The bacterial counts were the highest recorded during this study (38000 per 100 ml), providing evidence of severe human sewage contamination.

### AESTHETIC STATE

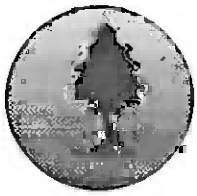
In terms of its appearance the Papkuils scored **2.5**. The system serves as an industrial canal and runs through the industrial areas of Deal Party and North End in Port Elizabeth. Much of the floodplain is used for industry and its associated infrastructure. Factory emissions in the area are persistent and a lot of rubble is also present in the area. Four bridges cross the system and traffic noise is persistent. Although seawater may enter the system, the water at the time of the survey looked dirty and polluted. The Papkuils was considered to be in a very poor condition aesthetically.

### OVERALL ESTUARINE HEALTH

The Papkuils is severely degraded in terms of its biology, water quality and aesthetic appearance. Overall, the system is in a poor condition with a composite score of **3 out of 9**.


WATER QUALITY

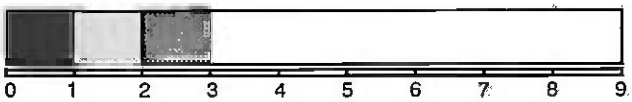


AESTHETIC

BIOLOGICAL

0 200 m

Water Quality Aesthetic Biology




COMPOSITE HEALTH INDEX

# PAPKUILS

## 31. SWARTKOPS

### PHYSICAL CLASSIFICATION

The Swartkops estuary has a particularly wide floodplain (2000m) and extensive open water area within which several islands and extensive intertidal areas are present. Some of these may have originated as flood-tidal deltas. Contemporary dredging serves to maintain deep channel areas in the system. A large salt marsh is present in the Swartkops system on the low islands and on surrounding muddy areas just above modal high tide level. These salt marsh areas are dissected by numerous narrow tidal channels. The tidal inlet of the Swartkops is typically 100m wide and is presently confined on one margin by bridge-associated structures. A flood-tidal delta is present in the lower 1500m of the estuary and upstream the channel bifurcates around semi-isolated sections of the floodplain. The system may represent a less advanced evolutionary stage for this type of estuary whereby the floodplain has not been raised to fully supratidal levels by overbank deposition during floods.

The Swartkops was classified as one of several estuaries (Group 4) that are characterised by near-permanent tidal inlets maintained by reversing tidal currents and regular tidal variation in water level.

### BIOLOGICAL HEALTH

A total of 30 fish species were captured in the Swartkops estuary during this survey. Nine species, *Ambassis gymnocephalus*, *Atherina breviceps*, *Caffrogobius multifasciatus*, *C. natalensis*, *C. nudiceps*, *Clinus superciliosus*, *Gilchristella aestuaria*, *Glossogobius callidus* and *Psammogobius knysnaensis* are all species which breed in southern African estuaries. The remaining 21 species, *Argyrosomus hololepidotus*, *Diplodus sargus capensis*, *Elops machnata*, *Galeichthys feliceps*, *Hemiramphus far*, *Heteromycteris capensis*, *Lichia amia*, *Lithognathus lithognathus*, *Liza dumerilii*, *L. richardsonii*, *L. tricuspidens*, *Monodactylus falciformis*, *Mugil cephalus*, *Platycephalus indicus*, *Pomadasys commersonnii*, *Pomatomus saltatrix*, *Rhabdosargus globiceps*, *R. holubi*, *Sarpa salpa*, *Sillago sihama* and *Solea bleekeri* are inshore marine species which depend upon estuaries to varying degrees during the juvenile phase of their life cycle. In terms of its fish species assemblage, the Swartkops was rated as good and had an index score of **5.7**.

### WATER QUALITY

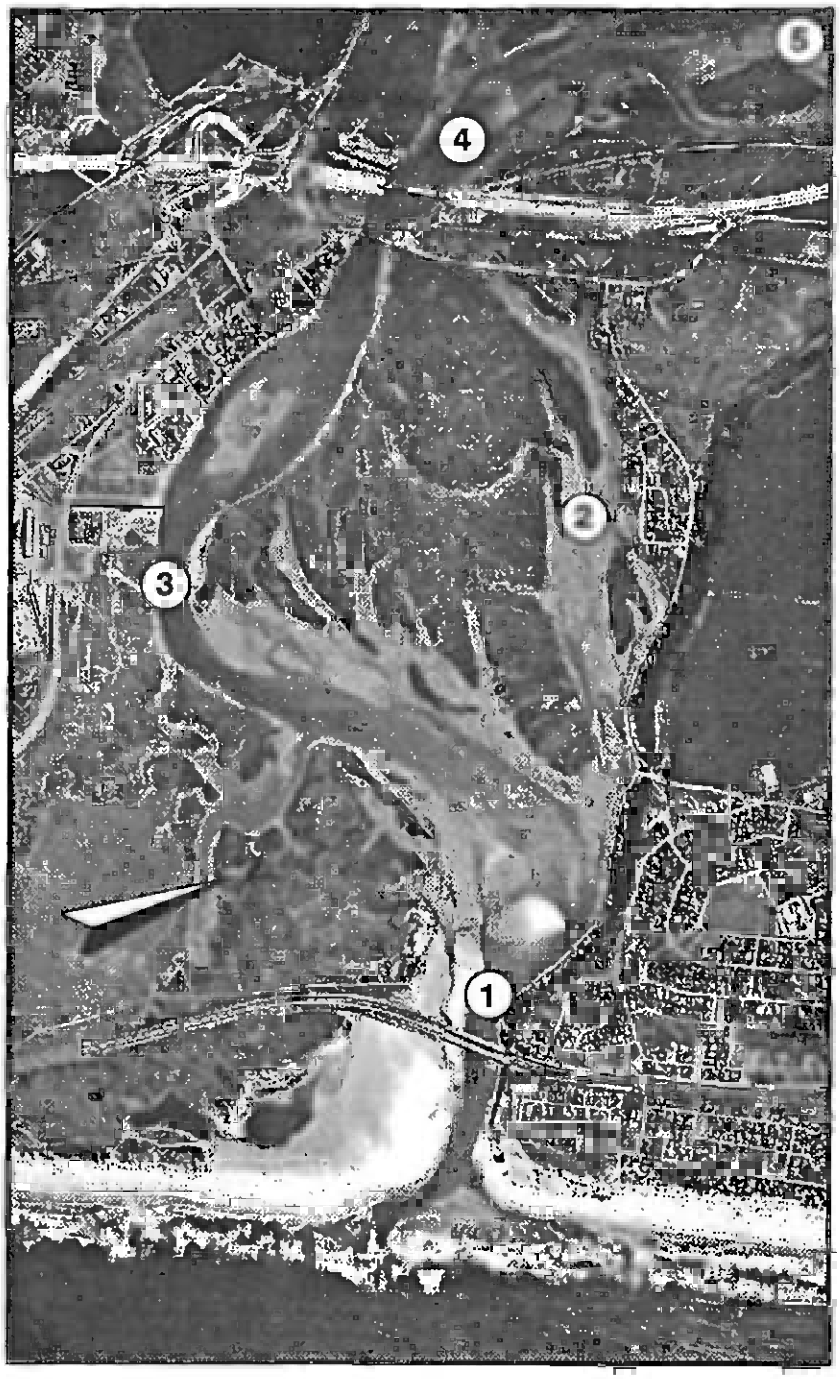
Water quality in the Swartkops estuary was sampled at the positions shown opposite. The overall water quality was good with an index value of **7.6**. The two areas of impairment were suitability for human contact (elevated *E. coli* counts and moderate impairment of trophic status, due to elevated surface phosphate concentrations.

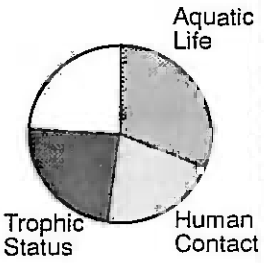
### AESTHETIC STATE

In terms of its appearance the Swartkops scored **6.1**. Much of the floodplain of the lower reaches appears to be in a natural state with some industrial and residential developments and their associated infrastructure also occurring. A fair proportion of the shoreline of the lower reaches is stabilised and comprises solid structures. The residential developments of Swartkops and Bluewater Bay / Amsterdamhoek account for much of the development in the immediate surrounds of the lower reaches. Factory emissions are evident from the industrial area of Swartkops. Five bridges, all with embankments cross the system and traffic noise is persistent. The Swartkops appears to be a popular recreational venue for water sports such as angling, boating, water-skiing, swimming and yachting. Overall, the Swartkops estuary was considered to be moderately poor aesthetically.

### OVERALL ESTUARINE HEALTH

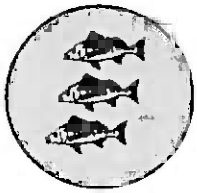
The biology and overall water quality of the Swartkops were both rated as good while its aesthetic appearance was considered moderately poor. Overall, the system is regarded as being in a moderately good condition with a composite score of **7 out of 9**.




**WATER QUALITY**

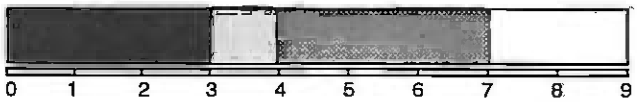
**AESTHETIC**



**BIOLOGICAL**

0 400 m

Water Quality Aesthetic Biology




**COMPOSITE HEALTH INDEX**

## SWARTKOPS

# 32. KOEGA

## PHYSICAL CLASSIFICATION

The Koega system is highly altered from its natural state through utilisation of its former floodplain for salt evaporation ponds. In its present state sea water is pumped into a canal and thence into artificial ponds. It may overflow into the former estuarine channel which is consequently hypersaline. The high probability of overwashing (numerous overwash channels were present on the barrier, with distinct overwash lagoons formed on the beach in interdune hollows) would have introduced seawater into the unaltered system and while this may have potentially rendered the system periodically hypersaline during low river flow periods in its natural state, the relatively large catchment area >600 $km^2$ and associated freshwater runoff probably mitigated against prolonged hypersalinity. Except for its unusual salinity characteristics and human structures this system resembles those estuaries in Group 3 and may have had similar characteristics in its unaltered state. Although further research is required to verify such a possibility it has been compared to these systems for the purposes of this report.

## BIOLOGICAL HEALTH

Fish sampling in the Koega was limited to the mouth area below the salt evaporation pans. Despite the hypersaline conditions recorded at the time of the survey (>40‰), a total of eight fish species were captured. Four species, *Atherina breviceps*, *Gilchristella aestuaria*, *Glossogobius callidus* and *Psammogobius knysnaensis* are species which breed in estuaries while the remaining four species, *Heteromycteris capensis*, *Liza richardsonii*, *Mugil cephalus* and *Rhabdosargus holubi*, are inshore marine species which depend upon estuaries to varying degrees during the juvenile phase of their life cycle. In terms of its fish species assemblage, the Koega was rated as moderately poor and had an index score of **2.5**.

## WATER QUALITY

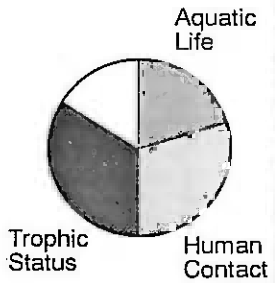
Water quality in the Koega estuary was sampled at the positions shown opposite. The overall water quality was very good with an index value of **8.4** The one worrying impairment was due to the absence of dissolved oxygen in bottom water on the day of sampling. However, all other water quality indicators were excellent.

## AESTHETIC STATE

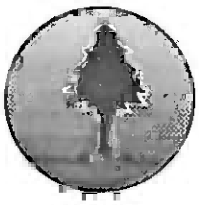
In terms of its appearance the Koega scored **5.0**. The entire floodplain and shoreline has been modified for the establishment of a saltworks. Much of the surrounds however, appear to be in a relatively natural condition. One road bridge, with an embankment crosses the system. Overall the Koega was considered to be in a poor condition aesthetically.

## OVERALL ESTUARINE HEALTH

The biological health and aesthetic appearance of the Koega were both rated poor while the overall water quality of the system was good. Overall, the Koega is regarded as being in a moderate to moderately poor condition with a composite score of **5 out of 9**.


**WATER QUALITY**



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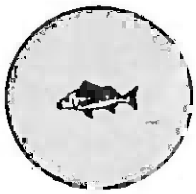
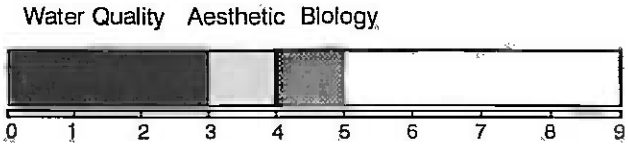


**BIOLOGICAL**

0 200 m




**COMPOSITE HEALTH INDEX**

## KOEGA

# 33. SUNDAYS

## PHYSICAL CLASSIFICATION

The Sundays was classified as one of several estuaries (Group 4) that are characterised by near-permanent tidal inlets maintained by reversing tidal currents and regular tidal variation in water level. It has a large, near permanent tidal inlet that is up to 200m wide at high tide and 30 m at low tide. It is maintained by reversing tidal currents against both aeolian deposition and wave-induced coastal sedimentation Although it has a broad floodplain the channel is confined by steep muddy banks to an average width of 150 m. The water in the estuary is also quite turbid. The inlet is characterised by an extensive flood-tidal delta and sandy margins on the barrier and adjacent coastal dunefield. These sandy intertidal areas are inhabited by dense communities of *Callianassa*. Limited salt marsh and *Zostera* beds are present in the lower reaches.

## BIOLOGICAL HEALTH

A total of 27 fish species were captured in the Sundays estuary during this survey. Seven species, *Atherina breviceps*, *Caffrogobius multifasciatus*, *C. natalensis*, *Gilchristella aestuaria*, *Glossogobius callidus*, *Psammogobius knysnaensis* and *Syngnathus acus* are all species which breed in southern African estuaries. Seventeen species, *Argyrosomus hololepidotus*, *Diplodus sargus capensis*, *Elops machnata*, *Galeichthys feliceps*, *Heteromycteris capensis*, *Lithognathus lithognathus*, *Liza dumerilii*, *L. richardsonii*, *L. tricuspidens*, *Monodactylus falciformis*, *Mugil cephalus*, *Myxus capensis*, *Platycephalus indicus*, *Pomadasys commersonnii*, *Rhabdosargus globiceps*, *R. holubi* and *Solea bleekeri*, are inshore marine species which depend upon estuaries to varying degrees during the juvenile phase of their life cycle. Three species, *Amblyrhynchotes honckenii*, *Diplodus cervinus hottentotus* and *Eugomphodus taurus* are marine species which are not dependent on estuaries. In terms of its fish species assemblage, the Sundays was classed as moderately good and had an index score of **4.9**.

## WATER QUALITY

Water quality in the Sundays estuary was sampled at the positions shown opposite. The overall water quality was good with an index value of **6.6**. Moderate impairment was observed in all three categories. The impairment was caused by slightly depressed DO, slightly elevated OA, elevated bottom phosphate and some evidence of *E. coli.*

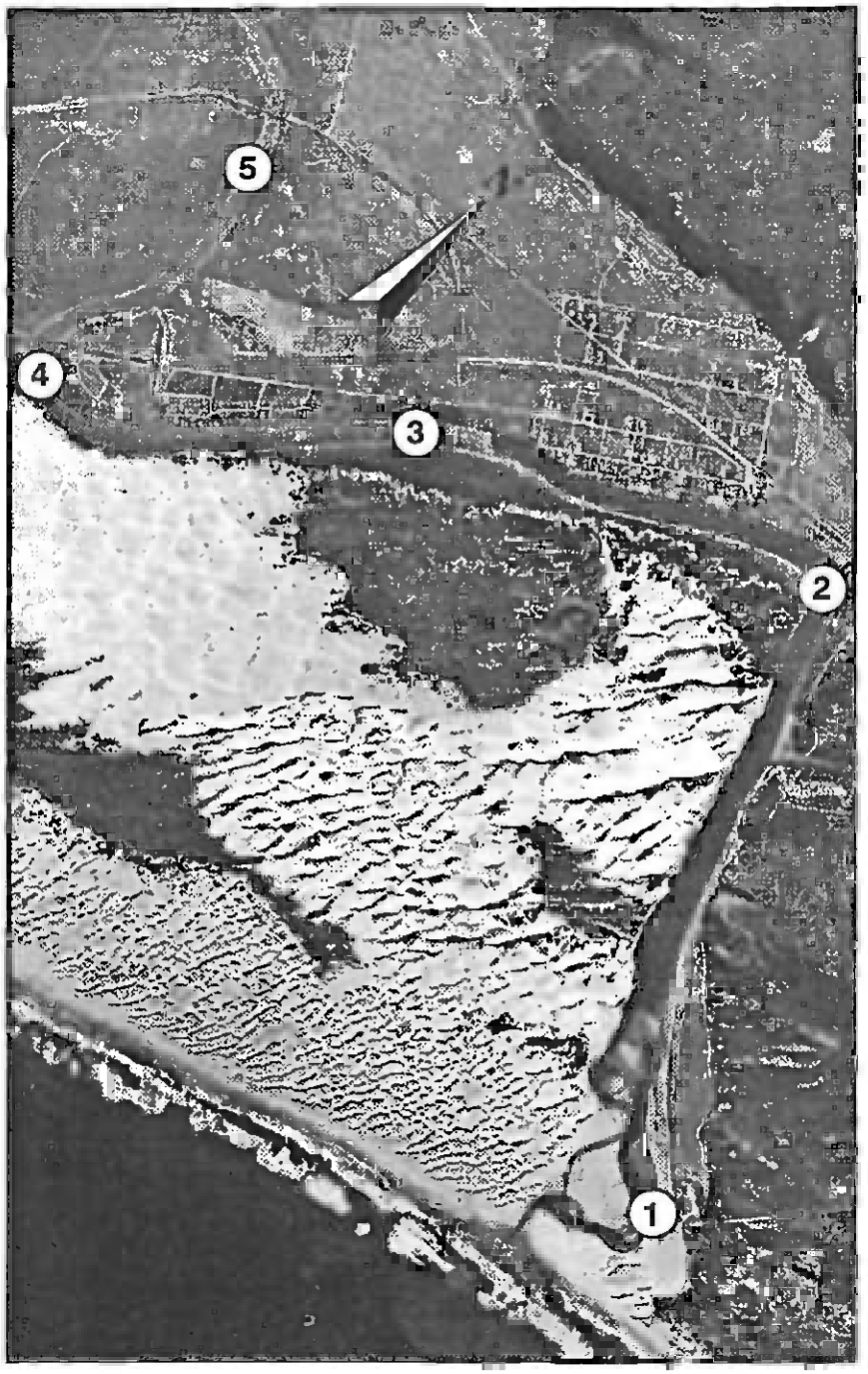


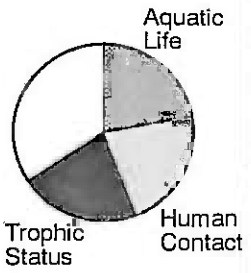
## AESTHETIC STATE

In terms of its appearance the Sundays scored **7.8**. Residential development and its associated infrastructure as well as recreational facilities occur on part of the floodplain and in the surrounding area. Most of the shoreline is natural with some solid structures. The Sundays is a popular recreational venue for angling, boating and swimming. Overall, the Sundays estuary was rated as moderate aesthetically.

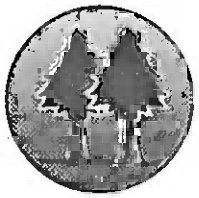
## OVERALL ESTUARINE HEALTH

The biological status and water quality of the Sundays were rated good with a satisfactory aesthetic appearance. Overall, the Sundays is regarded as being in a moderately good condition with a composite score of **8 out of 9**.

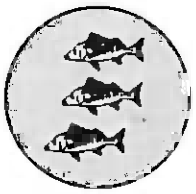



**WATER QUALITY**



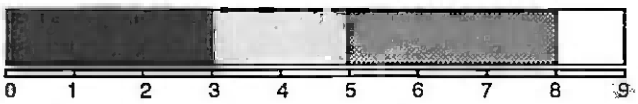
**AESTHETIC**



**BIOLOGICAL**

0 200 m

Water Quality Aesthetic Biology




**COMPOSITE HEALTH INDEX**

## SUNDAYS

# 34. BOKNES

## PHYSICAL CLASSIFICATION

The Boknes is separated from the sea by a 20m wide barrier which is covered by dunes on either side of the ephemeral river outlet position. The crest of the barrier is less than 1 m above high tide level and thus overwashing is a common occurrence. During a visit in June 1995, the barrier contained landward-directed current ripples indicative of shallow surface flow across the barrier. The system is sandy and contains dense concentrations of *Callianassa* burrows. A coast-parallel narrow section of the system extends behind a dune-topped barrier section. In its upper reaches the Boknes contains a shallow water area in which sand body morphology is strongly suggestive of a fluvial delta advancing into the estuary.

The Boknes was classified in a group of moderately sized estuaries (Group 3) that are characterised by temporarily open mouths, fresh to brackish water and shallow water areas separated from the sea by a broad dissipative beach across which overwash periodically introduces seawater into the back-barrier area.

## BIOLOGICAL HEALTH

A total of eleven fish species were captured in the Boknes during this survey. Four species, *Atherina breviceps*, *Gilchristella aestuaria*, *Glossogobius callidus* and *Psammogobius knysnaensis* are all species which live and breed in southern African estuaries. Six species, *Heteromycteris capensis*, *Lithognathus lithognathus*, *Liza dumerilii*, *L. richardsonii*, *Monodactylus falciformis* and *Rhabdosargus holubi*, are inshore marine species which depend upon estuaries to varying degrees during the juvenile phase of their life cycle. *Oreochromis mossambicus* is a freshwater species which may breed in both estuarine and freshwater systems. In terms of its fish species assemblage, the Boknes was rated as moderate and had an index score of **3.4**.

## WATER QUALITY

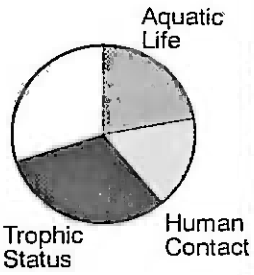
Water quality in the Boknes estuary was sampled at the positions shown opposite. The overall water quality was good with an index value of **7.0**. The most significant impairment was in the suitability for human contact resulting from relatively high *E. coli* counts on the day of sampling.

## AESTHETIC STATE

In terms of its appearance the Boknes scored **9.3**. Almost all of the floodplain and the shoreline of the system is natural. Some formal residential and recreational facilities do however occur in the immediate surrounds at Boknesstrand on the western bank. Farmlands occur to the east of the system. The Boknes is a popular recreational venue. Overall, the system was classed as being in a good condition aesthetically.

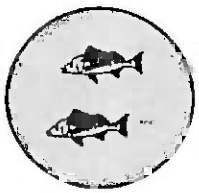
## OVERALL ESTUARINE HEALTH

The biological status of the Boknes was satisfactory while the water quality and aesthetic appearance of the system was good. Overall, the Boknes is regarded as being in a moderately good condition with a composite score of **8 out of 9**.

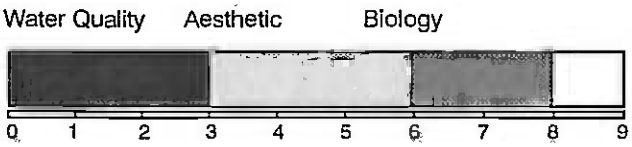

**WATER QUALITY**

**AESTHETIC**



**BIOLOGICAL**

0 200 m




**COMPOSITE HEALTH INDEX**

# BOKNES

## 35. BUSHMANS

### PHYSICAL CLASSIFICATION

The Bushmans was classified as one of several estuaries (Group 4) that are characterised by near-permanent tidal inlets maintained by reversing tidal currents and regular tidal variation in water level. Its inlet is 50-60 m wide and 2-3 m deep and is constrained on one bank by bedrock outcrop. The lower reaches contain an extensive flood-tidal delta that extends over 2 km upstream. The stability of this feature was indicated by the presence, in certain locations, of stabilising vegetation during field visits in 1995. Deep, permanently submerged ebb channels dissect the inter- and supra-tidally exposed flood-tidal delta. Flood-tidal delta sediment must be largely supplied by a mobile dune field updrift of the estuary mouth. Upstream of the flood-tidal delta the channel deepens Reports in the literature suggest the Bushmans is estuarine for 40 km during low river flow periods and that even during normal river flow, flood-tidal currents predominate over fluvial currents.

### BIOLOGICAL HEALTH

A total of 31 fish species were captured in the Bushmans estuary during this survey. Nine species, *Atherina breviceps*, *Caffrogobius multifasciatus*, *C. natalensis*, *C. nudiceps*, *Clinus superciliosus*, *Gilchristella aestuaria*, *Glossogobius callidus*, *Hippichthys heptagonus* and *Psammogobius knysnaensis* are all species which breed in southern African estuaries. Nineteen species, *Argyrosomus hololepidotus*, *Diplodus sargus capensis*, *Elops machnata*, *Galeichthys feliceps*, *Heteromycteris capensis*, *Lichia amia*, *Lithognathus lithognathus*, *Liza dumerilii*, *L. richardsonii*, *L. tricuspidens*, *Monodactylus falciformis*, *Mugil cephalus*, *Pomadasys commersonnii*, *Pomatomus saltatrix*, *Rhabdosargus globiceps*, *R. holubi*, *Sarpa salpa*, *Solea bleekeri* and *Torpedo sinuspersici*, are inshore marine species which depend upon estuaries to varying degrees during the juvenile phase of their life cycle. Three species, *Diplodus cervinus hottentotus*, *Gymnocrotaphus curvidens* and *Pomadasys olivaceum* are marine species which are not dependent on estuaries. In terms of its fish species assemblage, the Bushmans was rated as good and had an index score of **5.5**.

### WATER QUALITY

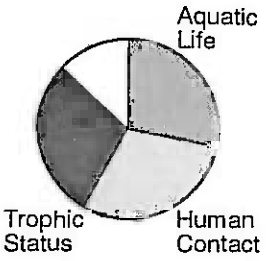
Water quality in the Bushmans estuary was sampled at the positions shown opposite. The overall water quality was very good with an index value of **8.7**. No significant impairment in any water quality indicator was observed on the day of sampling.

### AESTHETIC STATE

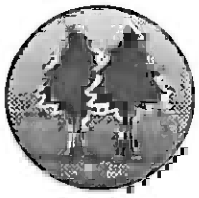
In terms of its appearance the Bushmans scored **8.6**. Most of the floodplain and shoreline of the system is undeveloped. The immediate surrounds however of the lower reaches comprises the residential developments of Boesmansriviermond in the west and Kenton-on-Sea in the east. One bridge with an embankment crosses the system and traffic noise is persistent. The Bushmans estuary is a popular recreational venue. Overall, the Bushmans system was rated as being in an acceptable condition aesthetically.

### OVERALL ESTUARINE HEALTH

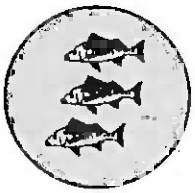
The biological status of the Bushmans was good with a very good overall water quality. The aesthetic state of the system was considered acceptable. Overall, the Bushmans is regarded as being in a good condition with a composite score of **8 out of 9**.


**WATER QUALITY**



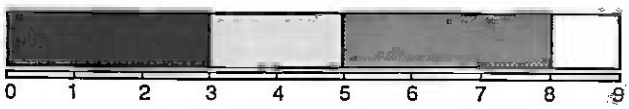
**AESTHETIC**



**BIOLOGICAL**

0 400 m

Water Quality Aesthetic Biology




**COMPOSITE HEALTH INDEX**

# BUSHMANS

## 36. KARIEGA

### PHYSICAL CLASSIFICATION

The Kariega system is located in a bedrock-confined valley within which a wide channel is maintained. The channel contains a large flood-tidal delta which extends for 2 km upstream of the mouth whereafter the channel deepens. Ebb channels dissect the flood-tidal delta sands. The surface of the flood-tidal delta is intertidally exposed and contains large numbers of Callianassa burrow openings. Salt marsh vegetation has colonised the surface of the flood-tidal delta in places and suggests relative stability of this non-cohesive sediment. Elsewhere, upstream-directed bedforms indicate active sediment transport.

The Kariega was classified as one of several estuaries (Group 4) that are characterised by near-permanent tidal inlets maintained by reversing tidal currents and regular tidal variation in water level. Its large flood-tidal delta is a conspicuous feature.

### BIOLOGICAL HEALTH

A total of 35 fish species were captured in the Kariega estuary during this survey. Ten species, *Atherina breviceps*, *Caffrogobius multifasciatus*, *C. natalensis*, *C. nudiceps*, *Clinus superciliosus*, *Gilchristella aestuaria*, *Glossogobius callidus*, *Omobranchus woodi*, *Psammogobius knysnaensis* and *Syngnathus acus* are all species which breed in southern African estuaries. Twenty two species, *Acanthopagrus berda*, *Argyrosomus hololepidotus*, *Diplodus sargus capensis*, *Elops machnata*, *Heteromycteris capensis*, *Lichia amia*, *Lithognathus lithognathus*, *Liza dumerilii*, *L. macrolepis*, *L. richardsonii*, *L. tricuspidens*, *Monodactylus falciformis*, *Mugil cephalus*, *Myxus capensis*, *Pomadasys commersonnii*, *Pomatomus saltatrix*, *Rhabdosargus globiceps*, *R. holubi*, *Sarpa salpa*, *Solea bleekeri*, *Torpedo sinuspersici* and *Valamugil buchanani*, are inshore marine species which depend upon estuaries to varying degrees during the juvenile phase of their life cycle. Three species, *Diplodus cervinus hottentotus*, *Pomadasys olivaceum* and *Siganus sutor*, are marine species which are not dependent on estuaries. In terms of its fish species assemblage, the Kariega was rated as good and had an index score of **6.3**.

### WATER QUALITY

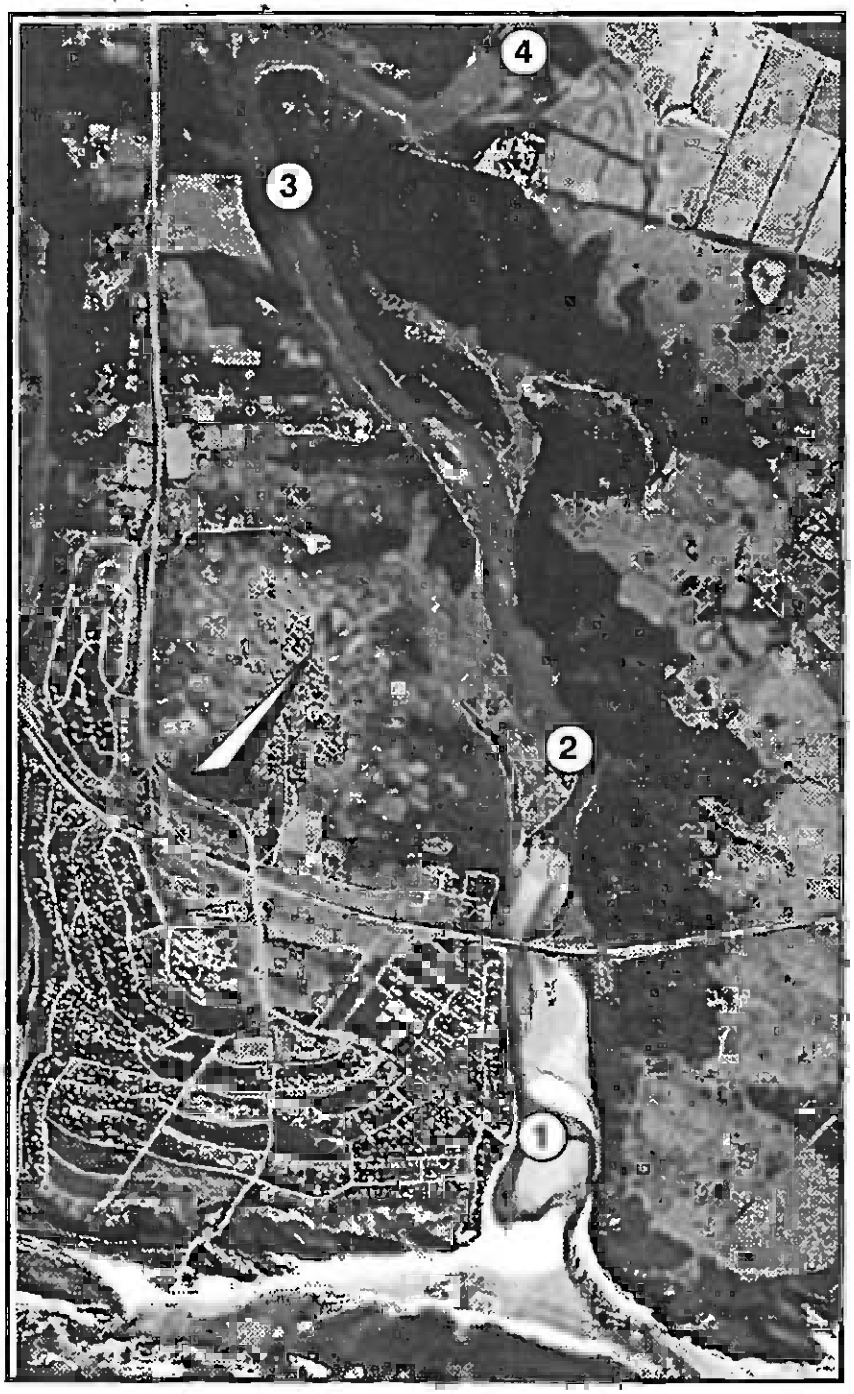
Water quality in the Kariega estuary was sampled at the positions shown opposite. The overall water quality was good with an index value of **7.2**. A moderate level of impairment was observed for all three categories of water quality.

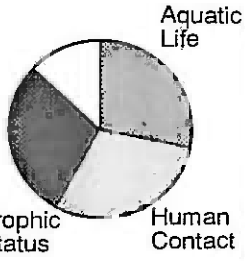
### AESTHETIC STATE

In terms of its appearance the Kariega scored **8.9**. Most of the floodplain and shoreline of the system is undeveloped. The only development in the immediate surrounds of the lower reaches of the system is that of Kenton-on-Sea in the west. One bridge with an embankment crosses the system and traffic noise is persistent. The Kariega estuary is a popular recreational venue. Overall, the Kariega system was rated as being in a good condition aesthetically.

### OVERALL ESTUARINE HEALTH

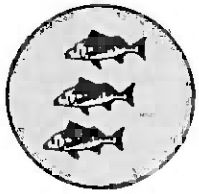
The biological status, overall water quality and aesthetic state of the Kariega were all rated good and the system had a composite score of **9 out of 9**.




**WATER QUALITY**

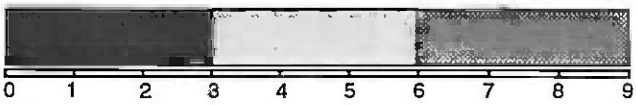
**AESTHETIC**



**BIOLOGICAL**

0 400 m

Water Quality Aesthetic Biology




**COMPOSITE HEALTH INDEX**

## KARIEGA

# 37. KASUKA

## PHYSICAL CLASSIFICATION

The Kasuka system is an elongate water body that averages 80 m wide and which has steep cohesive banks. It occupies a narrow floodplain and is typically separated from the sea by a sandy barrier which is topped by migrating sand dunes. Comparatively high salinity in the system coupled with morphological evidence (landward-directed ripples) suggests that overwash introduces sea water into the system through interdune depressions on the barrier. The lack of a flood-tidal delta in the system suggests that when open the dominant flows are seaward and that tidal inflow is limited.

The Kasuka was classified in a group of moderately sized estuaries (Group 3) that are characterised by temporarily open mouths, fresh to brackish water and shallow water areas separated from the sea by a broad dissipative beach across which overwash periodically introduces seawater into the back-barrier area.

## BIOLOGICAL HEALTH

A total of 21 fish species were captured in the Kasuka estuary during this survey. Four species, *Atherina breviceps*, *Gilchristella aestuaria*, *Glossogobius callidus* and *Psammogobius knysnaensis* are all species which breed in southern African estuaries. Sixteen species, *Argyrosomus hololepidotus*, *Caranx sexfasciatus*, *Diplodus sargus capensis*, *Galeichthys feliceps*, *Heteromycteris capensis*, *Lichia amia*, *Lithognathus lithognathus*, *Liza dumerilii*, *L. richardsonii*, *L. tricuspidens*, *Monodactylus falciformis*, *Mugil cephalus*, *Myxus capensis*, *Pomadasys commersonnii*, *Rhabdosargus holubi* and *Sarpa salpa* are inshore marine species which depend upon estuaries to varying degrees during the juvenile phase of their life cycle. *Oreochromis mossambicus* is a freshwater species which may breed in both freshwater and estuarine systems. In terms of its fish species assemblage, the Kasuka was rated as good and had an index score of **6.4**.

## WATER QUALITY

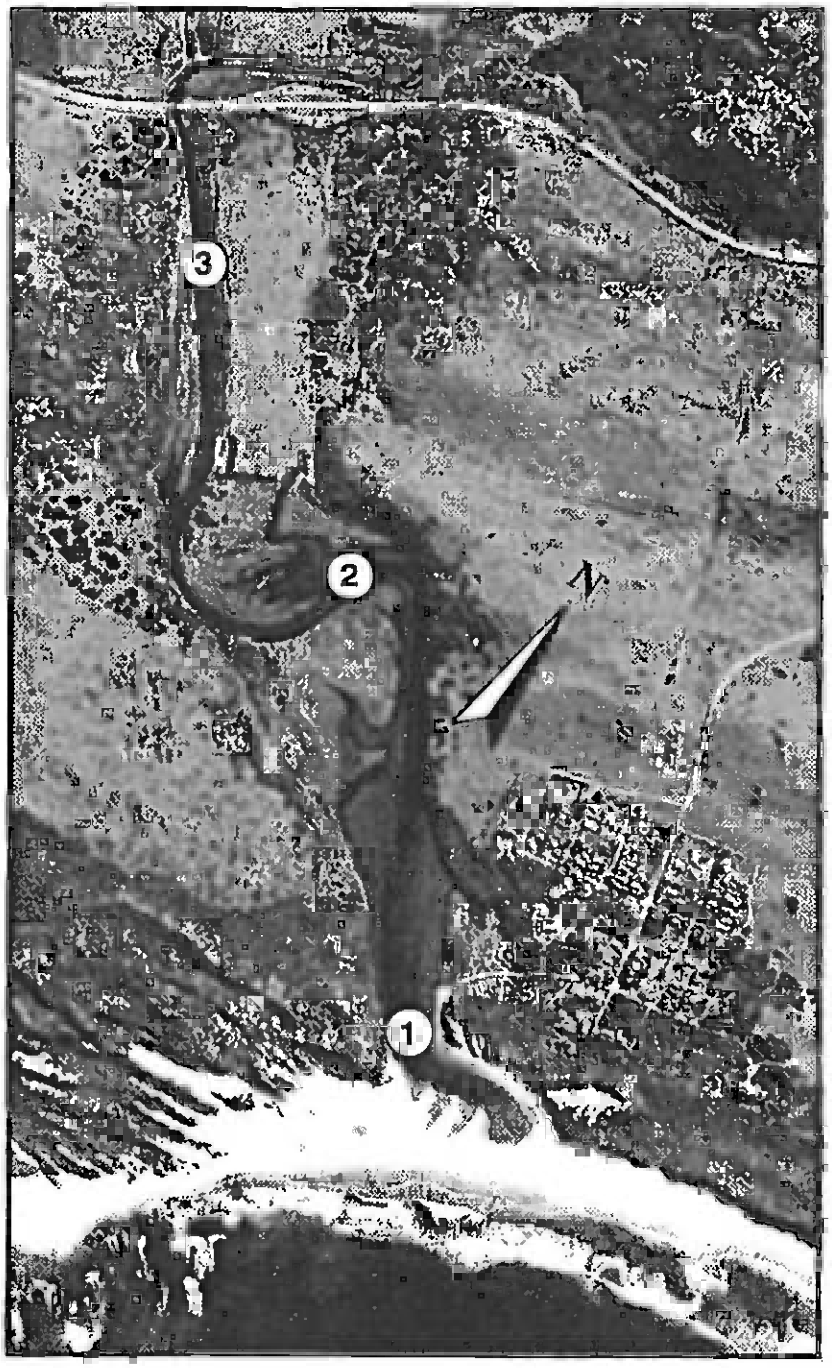
Water quality in the Kasuka estuary was sampled at the positions shown opposite. The overall water quality was good with an index value of **7.8**. Moderate impairment was observed in the suitability for human contact resulting from the presence of *E. coli* counts on the day of sampling. The water's suitability for aquatic life was also slightly impaired due to moderate dissolved oxygen levels and elevated OA levels.

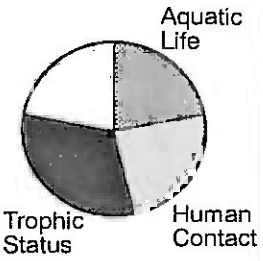
## AESTHETIC STATE

In terms of its appearance the Kasuka scored **9.6**. The floodplain, shoreline and immediate surrounds are near natural. Generally the area is little developed apart from the small holiday township of Kasouga in the east. One low bridge crosses the system in the upper reaches. Overall the Kasuka was rated good aesthetically.

## OVERALL ESTUARINE HEALTH

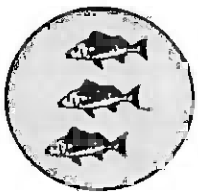
The biological status, the overall water quality and the aesthetic appearance of the Kasuka were all good. Overall, the system is considered to be in a good condition with a composite score of **9 out of 9**.




**WATER QUALITY**

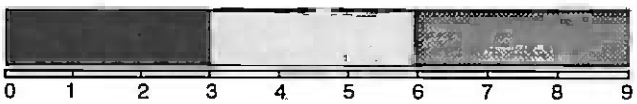
**AESTHETIC**



**BIOLOGICAL**

0 200 m

Water Quality Aesthetic Biology




**COMPOSITE HEALTH INDEX**

# KASUKA

# 38. KOWIE

## PHYSICAL CLASSIFICATION

The Kowie estuary presently has its inlet confined by artificial structures in order to assure navigation. While this was effected in the last century, more recently, much of the floodplain has been converted into a marina which has altered the bank substrate and changed the natural circulation patterns. Consequently the former salt marsh area has been much reduced. The steep banks in the Kowie render intertidal areas limited in extent and while it is tempting to relate this to the artificial manipulation of the banks, high turbidity in the river suggests that natural banks were probably muddy and consequently cohesive and steep.

The Kowie was classified as one of several estuaries (Group 4) that are characterised by near-permanent tidal inlets maintained by reversing tidal currents and regular tidal variation in water level.

## BIOLOGICAL HEALTH

A total of 32 fish species were captured in the Kowie estuary during this survey. Seven species, *Atherina breviceps*, *Caffrogobius multifasciatus*, *C. nudiceps*, *Clinus superciliosus*, *Gilchristella aestuaria*, *Glossogobius callidus* and *Psammogobius knysnaensis* are all species which breed in southern African estuaries. Twenty two species, *Acanthopagrus berda*, *Argyrosomus hololepidotus*, *Diplodus sargus capensis*, *Elops machnata*, *Galeichthys feliceps*, *Hemiramphus far*, *Heteromycteris capensis*, *Lichia amia*, *Lithognathus lithognathus*, *Liza dumerilii*, *L. richardsonii*, *L. tricuspidens*, *Monodactylus falciformis*, *Mugil cephalus*, *Myxus capensis*, *Pomadasys commersonnii*, *Pomatomus saltatrix*, *Rhabdosargus globiceps*, *R. holubi*, *Sarpa salpa*, *Solea bleekeri* and *Valamugil buchanani*, are inshore marine species which depend upon estuaries to varying degrees during the juvenile phase of their life cycle. Three species, *Amblyrhynchotes honckenii*, *Pomadasys olivaceum* and *Trachurus trachurus*, are marine species which are not dependent on estuaries. In terms of its fish species assemblage, the Kowie was rated as good and had an index score of **5.9**.

## WATER QUALITY

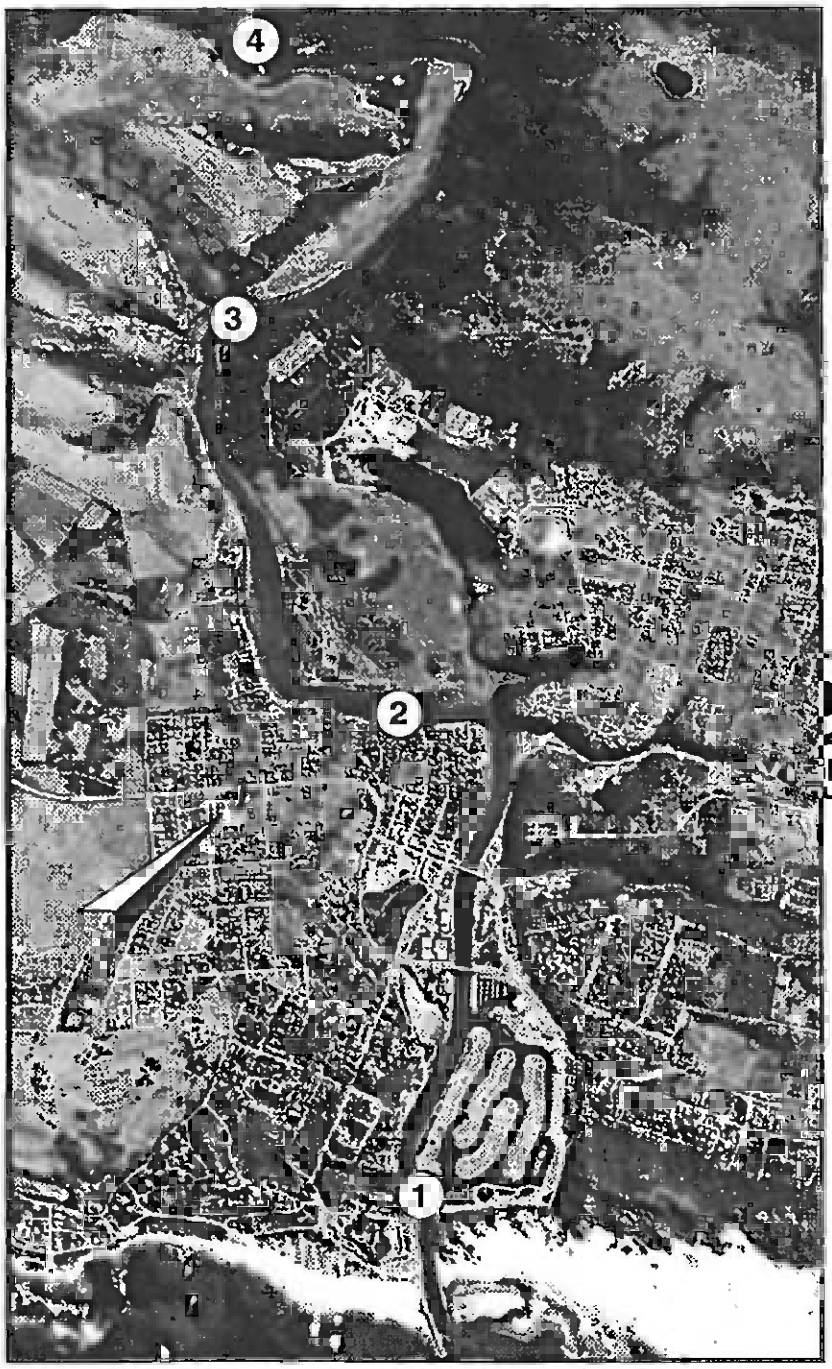
Water quality in the Kowie estuary was sampled at the positions shown opposite. The overall water quality was good with an index value of **7.5**. A moderate level of impairment was observed for all three categories of water quality.

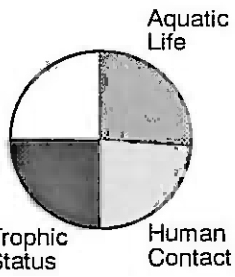
## AESTHETIC STATE

In terms of its appearance the Kowie scored **4.2**. The system flows through the town of Port Alfred and almost the entire floodplain of the lower reaches has been utilised either for commercial or residential purposes and their associated infrastructure. The lower reaches of the system has been canalised and the mouth is stabilised by two breakwaters. Most of the immediate surrounds in the lower reaches comprises residential development. Two bridges, both with embankments cross the system and traffic noise is persistent. The Kowie estuary is a very popular venue for angling, boating, windsurfing and water-skiing. The upper reaches of the Kowie fall within nature reserves, however, the aesthetic state of the lower reaches of the system was rated poor.

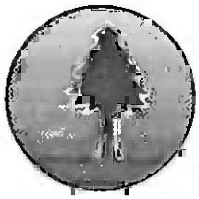
## OVERALL ESTUARINE HEALTH

The biological status and overall water quality of the Kowie were both rated good while its aesthetic appearance was poor. Overall, the system is regarded as being in an acceptable condition with a composite score of **7 out of 9**.

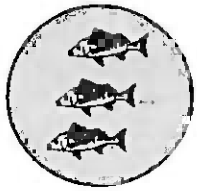



**WATER QUALITY**

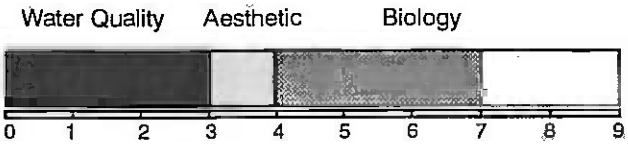


**AESTHETIC**



**BIOLOGICAL**

0 400 m




**COMPOSITE HEALTH INDEX**

## KOWIE

## 39. RUFANE

### PHYSICAL CLASSIFICATION

Rufane river flows into the sea through a broad mobile dunefield and wide dissipative beach. It flows over the beach and ponds there, suggesting it is maintained by groundwater levels. Ephemeral outlet channels are typically a few cm deep and few m wide. Tidal inflow is unlikely due to the elevated nature of the water body, but overwash during high seas undoubtedly occurs. A vlei occurs upstream of the mouth among the mobile sand dunes.

This is one of five small, shallow, sandy systems (Group 2) which are typically closed to the sea for extended periods and which, when they open, form shallow drainage channels for river water with minimal tidal inflow. The principal source of marine water input is via barrier overwash, which coupled with periodic surface flow, provides connection with the sea. All these estuaries are fronted by broad, low, dissipative barriers.

### BIOLOGICAL HEALTH

Twelve fish species were captured in the Rufane during this survey. Three species, *Atherina breviceps*, *Gilchristella aestuaria* and *Glossogobius callidus* are all species which breed in southern African estuaries. Eight species, *Heteromycteris capensis*, *Lithognathus lithognathus*, *Liza richardsonii*, *Monodactylus falciformis*, *Mugil cephalus*, *Myxus capensis*, *Rhabdosargus holubi* and *Sarpa salpa* are inshore marine species which depend upon estuaries to varying degrees during the juvenile phase of their life cycle. *Oreochromis mossambicus* is a freshwater species which may breed in both freshwater and estuarine systems. In terms of its fish species assemblage, the Rufane was rated as good and had an index score of **5.6**.

### WATER QUALITY

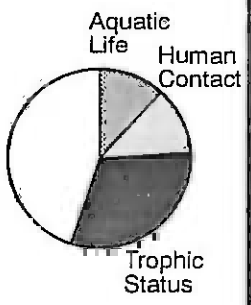
Water quality in the Rufane estuary was sampled at the positions shown opposite. The overall water quality was moderate with an index value of **5.5**. Significant impairment was observed in the waters suitability for aquatic life due to supersaturated surface DO combined with zero bottom DO. OA levels were also elevated. The suitability for human contact was impaired by the presence of *E. coli*.

### AESTHETIC STATE

In terms of its appearance the Rufane scored **9.8**. This small system is almost totally undeveloped and the floodplain, its surrounds and its shoreline are almost entirely natural. The presence of a parking area and ablution facilities nearby however suggests that the area is popular recreationally. Overall, the Rufane was considered to be in a good condition aesthetically.

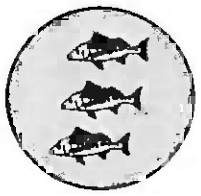
### OVERALL ESTUARINE HEALTH

The biological status of the Rufane was rated good. Its overall water quality was moderate and its aesthetic appearance was good. Overall, the system is considered to be in a relatively good condition with a composite score of **8 out of 9**.

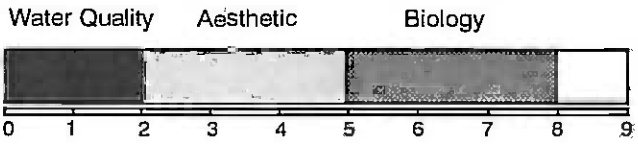

**WATER QUALITY**

**AESTHETIC**



**BIOLOGICAL**

0 200 m




**COMPOSITE HEALTH INDEX**

# RUFANE

## 40. RIET

### PHYSICAL CLASSIFICATION

The Riet system reaches the coast in the midst of a mobile dune field. Upstream it comprises a 50m-wide channel with steep reed-lined banks and a floodplain of similar width. Where it emerges onto the coastal sand body it forms a shallow brackish back-barrier water body among the dunes and maintains a temporary surface outflow channel to the sea, 2m wide and a few centimetres deep. The low barrier enables periodic overwash to introduce sea water into the system and this is concentrated around the outflow channel. Five metre-high barchan dunes migrate across the barrier and these probably exert a strong control on outlet position and persistence.

The Riet was classified in a group of moderately sized estuaries (Group 3) that are characterised by temporarily open mouths, fresh to brackish water and shallow water areas separated from the sea by a broad dissipative beach across which overwash periodically introduces seawater into the back-barrier area.

### BIOLOGICAL HEALTH

A total of 17 fish species were captured in the Riet during this survey. Four species, *Atherina breviceps*, *Gilchristella aestuaria*, *Glossogobius callidus* and *Psammogobius knysnaensis* are all species which breed in southern African estuaries. Twelve species, *Argyrosomus hololepidotus*, *Caranx sexfasciatus*, *Heteromycteris capensis*, *Lithognathus lithognathus*, *Liza dumerilii*, *L. richardsonii*, *L. tricuspidens*, *Monodactylus falciformis*, *Mugil cephalus*, *Myxus capensis*, *Pomadasys commersonnii* and *Rhabdosargus holubi* are inshore marine species which depend upon estuaries to varying degrees during the juvenile phase of their life cycle. *Oreochromis mossambicus* is a freshwater species which may breed in both freshwater and estuarine systems. In terms of its fish species assemblage, the Riet was rated as moderately good and had an index score of **5.2**.

### WATER QUALITY

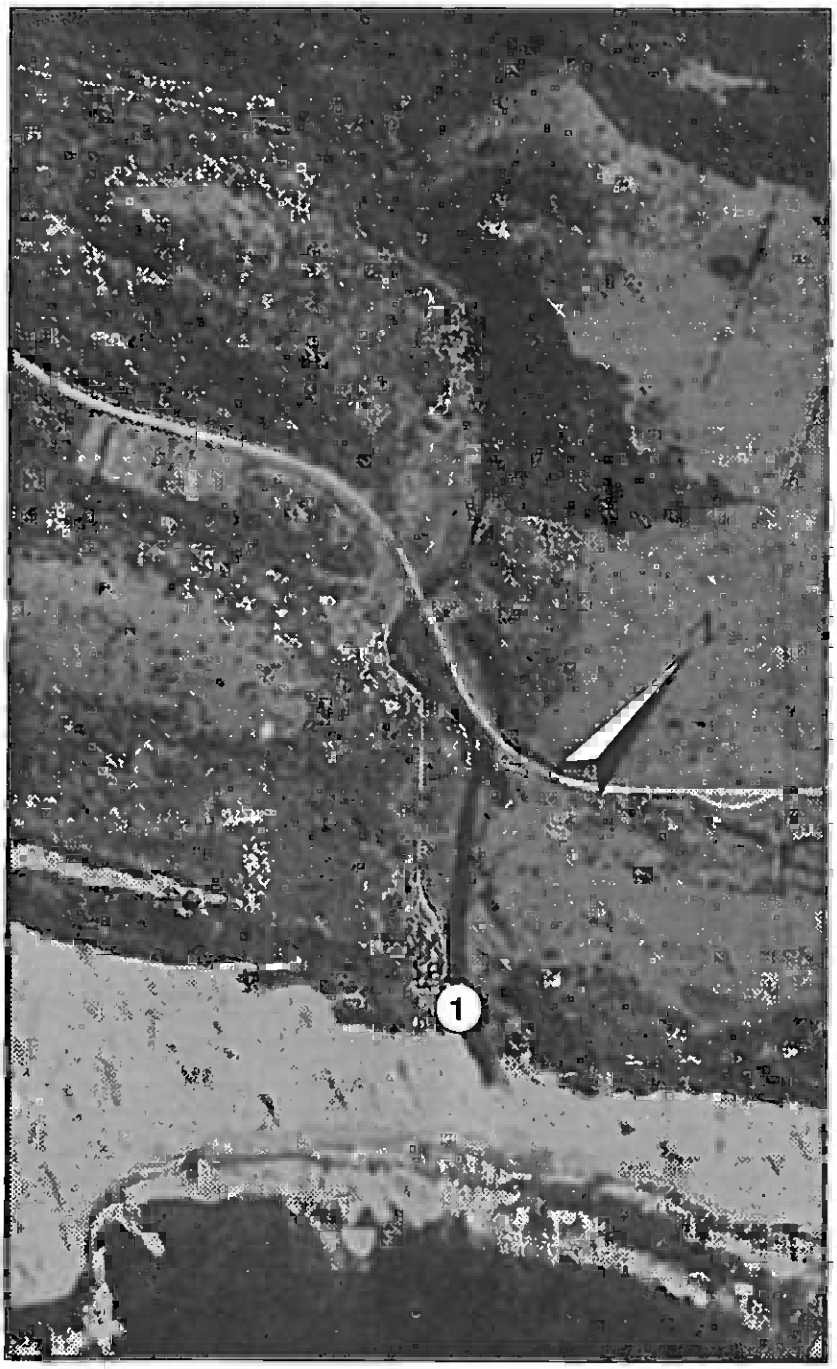
Water quality in the Riet estuary was sampled at the positions shown opposite. The overall water quality was good with an index value of **6.1**. Impairment was in the suitability for human contact resulting from moderately high *E. coli* counts on the day of sampling. The water's suitability for aquatic life was impaired primarily due to elevated OA levels and low bottom dissolved oxygen concentrations.

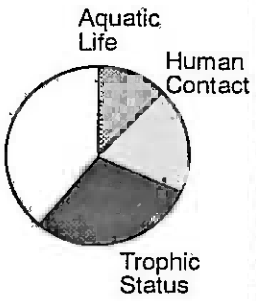
### AESTHETIC STATE

In terms of its appearance the Riet scored **9.1**. The floodplain and shoreline of the system are largely natural however, an access road to holiday cottages on the western side has led to part of the floodplain becoming isolated and part of the shoreline being stabilised. Some cottages also appear to be built on the floodplain. The surrounding area is largely natural in appearance with a few holiday cottages present. One low bridge crosses the system in the upper reaches and traffic noise is persistent. Overall the Riet is rated as being in a good condition aesthetically.

### OVERALL ESTUARINE HEALTH

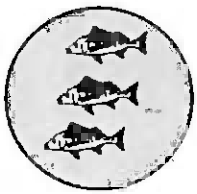
The biological status of the Riet was good. Its overall water quality was good and its aesthetic appearance was largely natural. Overall, the system is considered to be in a good condition with a composite score of **9 out of 9**.



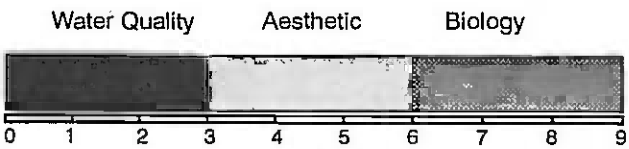

WATER QUALITY

AESTHETIC



BIOLOGICAL

0 200 m




COMPOSITE HEALTH INDEX

# RIET

## 41. WES-KLEINEMOND

### PHYSICAL CLASSIFICATION

The Wes-Kleinemond was classified in a group of moderately sized estuaries (Group 3) that are characterised by temporarily open mouths, fresh to brackish water and shallow water areas separated from the sea by a broad dissipative beach across which overwash periodically introduces seawater into the back-barrier area.

The estuary is brackish and is linked to the Oos-Kleinemond by a shallow channel behind the coastal barrier. The system is typically closed to the sea but the presence of former channel margin scarps on the beach testify to recent opening during a field visit in June 1995. The barrier is partly covered by aeolian dunes which reduce the ease with which the barrier breaches during river floods. When open the system partially drains. The system was artificially shortened in 1960 by barrage construction in its upper reaches. Salt marsh vegetation is present in its upper reaches.

### BIOLOGICAL HEALTH

A total of 17 fish species were captured in the Wes-Kleinemond during this survey. Four species, *Atherina breviceps*, *Gilchristella aestuaria*, *Glossogobius callidus* and *Psammogobius knysnaensis* are all species which breed in southern African estuaries. Twelve species, *Argyrosomus hololepidotus*, *Heteromycteris capensis*, *Lichia amia*, *Lithognathus lithognathus*, *Liza dumerilii*, *L. richardsonii*, *L. tricuspidens*, *Monodactylus falciformis*, *Mugil cephalus*, *Myxus capensis*, *Pomadasys commersonnii* and *Rhabdosargus holubi* are inshore marine species which depend upon estuaries to varying degrees during the juvenile phase of their life cycle. *Oreochromis mossambicus* is a freshwater species which may breed in both freshwater and estuarine systems. In terms of its fish species assemblage, the Wes-Kleinemond was rated as moderately good and had an index score of **5.2**.

### WATER QUALITY

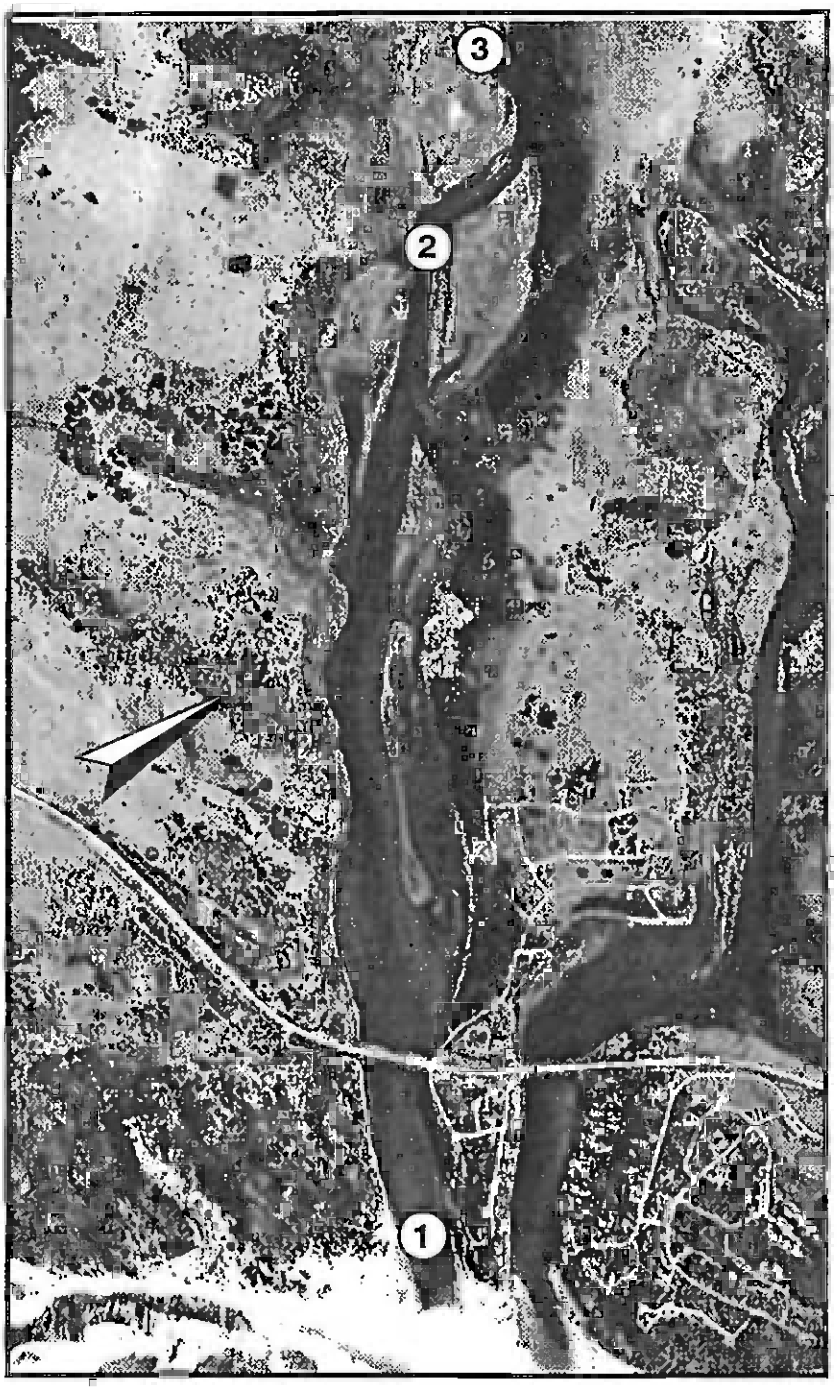
Water quality in the Wes-Kleinemond estuary was sampled at the positions shown opposite. The overall water quality was good with an index value of **6.8**. The most significant impairment was in the suitability for human contact resulting from somewhat elevated *E. coli* counts on the day of sampling. Suitability for aquatic life was also slightly impaired due to moderate DO concentrations and elevated OA.

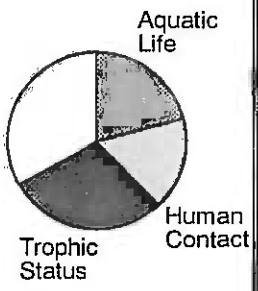
### AESTHETIC STATE

In terms of its appearance the Wes-Kleinemond scored **8.8**. Most of the floodplain and the shoreline appear natural apart from the presence of an access road to holiday cottages on the western shore near the mouth. The surrounding area is largely natural with some residential development and its associated infrastructure in the lower reaches. One bridge with an embankment crosses the system and traffic noise is persistent. The Wes-Kleinemond appears to be a popular recreational venue. Overall the system was considered to be in a moderately good condition aesthetically.

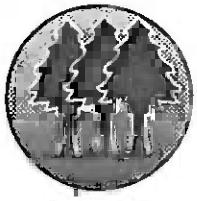
### OVERALL ESTUARINE HEALTH

The biological status, overall water quality and aesthetic status of the Wes-Kleinemond were all rated good. Overall, the system is regarded as being in a good condition with a composite score of **9 out of 9**.

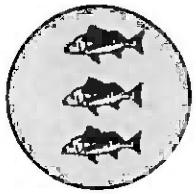



**WATER QUALITY**

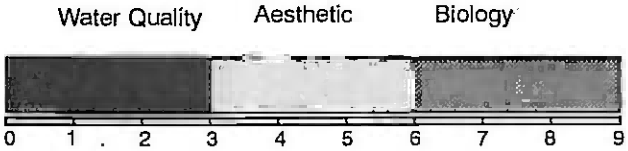


**AESTHETIC**



**BIOLOGICAL**

0 200 m




**COMPOSITE HEALTH INDEX**

## WES-KLEINEMOND

## 42. OOS-KLEINEMOND

### PHYSICAL CLASSIFICATION

The Oos-Kleinemond is separated from the sea by a broad, dissipative barrier on which aeolian dunes are developed. A shallow channel at the rear of the coastal barrier forms a free surface connection to the Wes-Kleinemond and the two systems share a common outlet when breached. Salt marsh vegetation is present in the upper reaches of the estuary

The Oos-Kleinemond was classified in a group of moderately sized estuaries (Group 3) that are characterised by temporarily open mouths, fresh to brackish water and shallow water areas separated from the sea by a broad dissipative beach across which overwash periodically introduces seawater into the back-barrier area.

### BIOLOGICAL HEALTH

A total of 17 fish species were captured in the Oos-Kleinemond during this survey. Four species, *Atherina breviceps*, *Gilchristella aestuaria*, *Glossogobius callidus* and *Psammogobius knysnaensis* are all species which breed in southern African estuaries. Twelve species, *Heteromycteris capensis*, *Lichia amia*, *Lithognathus lithognathus*, *Liza dumerilii*, *L. richardsonii*, *Monodactylus falciformis*, *Mugil cephalus*, *Myxus capensis*, *Pomadasys commersonnii*, *Rhabdosargus holubi*, *Sarpa salpa* and *Solea bleekeri* are inshore marine species which depend upon estuaries to varying degrees during the juvenile phase of their life cycle. *Oreochromis mossambicus* is a freshwater species which may breed in both freshwater and estuarine systems. In terms of its fish species assemblage, the Oos-Kleinemond was rated as moderately good and had an index score of **5.2**.

### WATER QUALITY

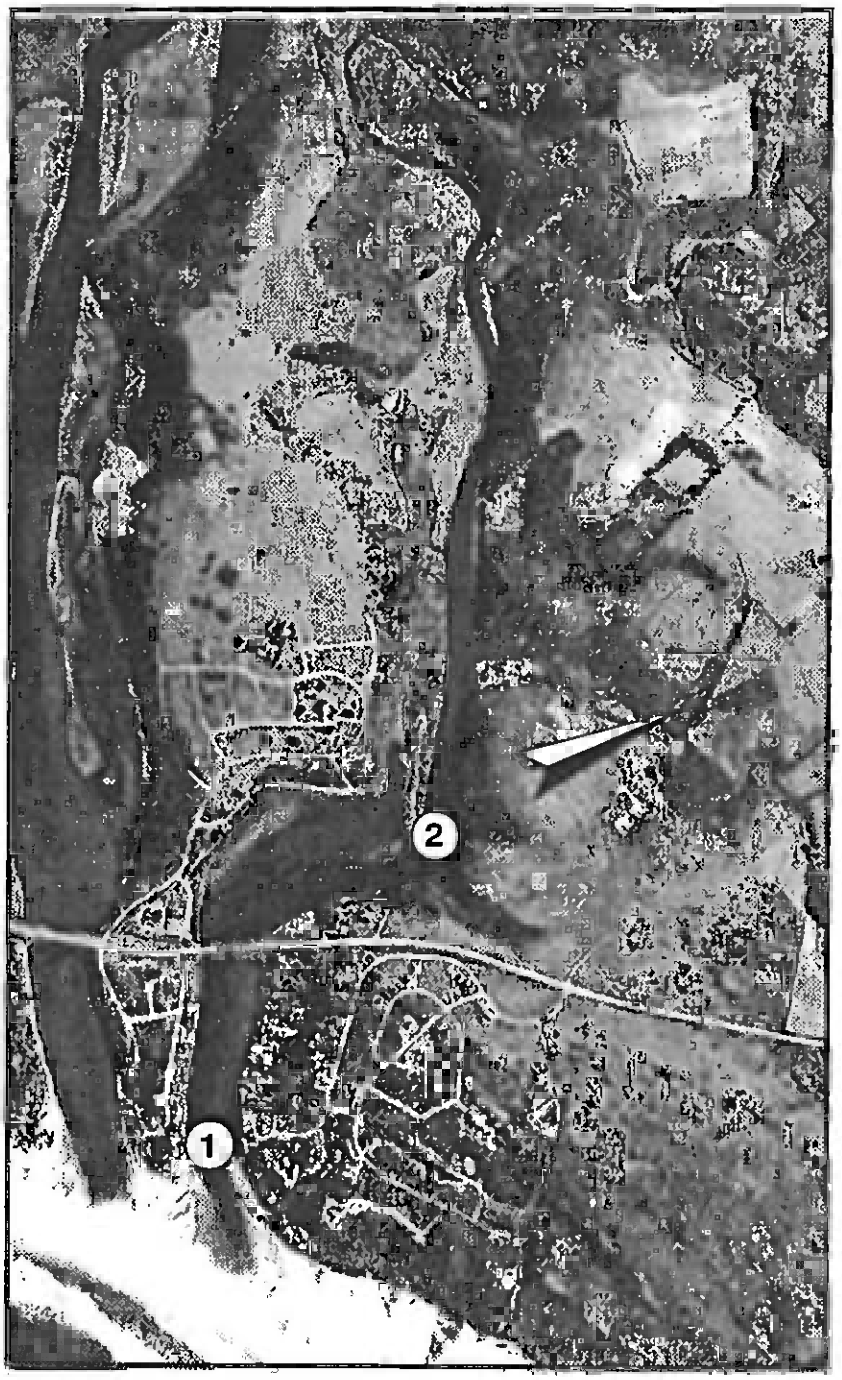
Water quality in the Oos-Kleinemond estuary was sampled at the positions shown opposite. The overall water quality was good with an index value of **7.3**. The impairment in suitability for aquatic life and human contact was very similar to that of the Wes-Kleinemond estuary.

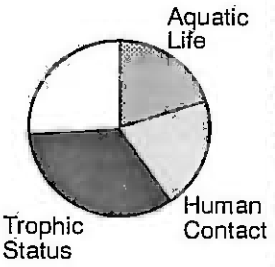
### AESTHETIC STATE

In terms of its appearance the Oos-Kleinemond scored **8.6**. Most of the floodplain appears undeveloped however a fair proportion of the shoreline is stabilised and vegetated. The surrounding area comprises mostly formal residential development and its associated infrastructure. One bridge with an embankment crosses the system and traffic noise is persistent. The Oos-Kleinemond appears to be a popular recreational venue. Overall the system was rated satisfactory aesthetically.

### OVERALL ESTUARINE HEALTH

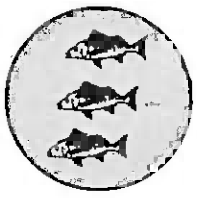
The biological status and overall water quality of the Oos-Kleinemond were both rated as good while its aesthetic appearance was considered acceptable. Overall, the system is regarded as being in a moderately good condition with a composite score of **8 out of 9**.




**WATER QUALITY**

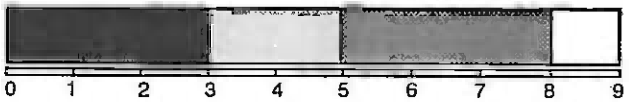
**AESTHETIC**



**BIOLOGICAL**

0 200 m

Water Quality Aesthetic Biology




**COMPOSITE HEALTH INDEX**

## OOS-KLEINEMOND

## 43. GREAT FISH

### PHYSICAL CLASSIFICATION

The Great Fish was classified as one of several estuaries (Group 4) that are characterised by near-permanent tidal inlets maintained by reversing tidal currents and regular tidal variation in water level. The Great Fish estuary has a tidal inlet through which regular tidal exchange occurs. Strong fluvial inflow from a mud-rich catchment , however, renders the estuary turbid and limits the extent of flood-tidal deposition to about 1500m upstream of the mouth. The tidal currents are also considered relatively weak and this further limits the upstream transport of marine sediment. The cohesive muddy banks confine the river channel to the northern quarter of its floodplain which is less than 800 m wide. During a field visit in June 1995 the inlet was only 20 m wide.

### BIOLOGICAL HEALTH

A total of 21 fish species were captured in the Great Fish estuary during this survey. Three species, *Caffrogobius nudiceps*, *Gilchristella aestuaria* and *Psammogobius knysnaensis* are all species which breed in southern African estuaries. Fourteen species, *Argyrosomus hololepidotus*, *Diplodus sargus capensis*, *Galeichthys feliceps*, *Johnius dussumieri*, *Lithognathus lithognathus*, *Liza dumerilii*, *L. richardsonii*, *L. tricuspidens*, *Mugil cephalus*, *Myxus capensis*, *Pomadasys commersonnii*, *Rhabdosargus globiceps*, *R. holubi* and *Solea bleekeri*, are inshore marine species which depend upon estuaries to varying degrees during the juvenile phase of their life cycle. *Trachinotus* sp. is a marine species which is not dependent on estuaries. *Clarias gariepinus* is a freshwater species which has been introduced to the Great Fish system through the Orange-Fish water tunnel while *Cyprinus carpio* is an exotic freshwater species. *Anguilla mossambica* is an obligate catadromous species which use estuaries as transit routes between the marine and freshwater environments. In terms of its fish species assemblage, the Great Fish was rated as moderate and had an index score of **3.7**.

### WATER QUALITY

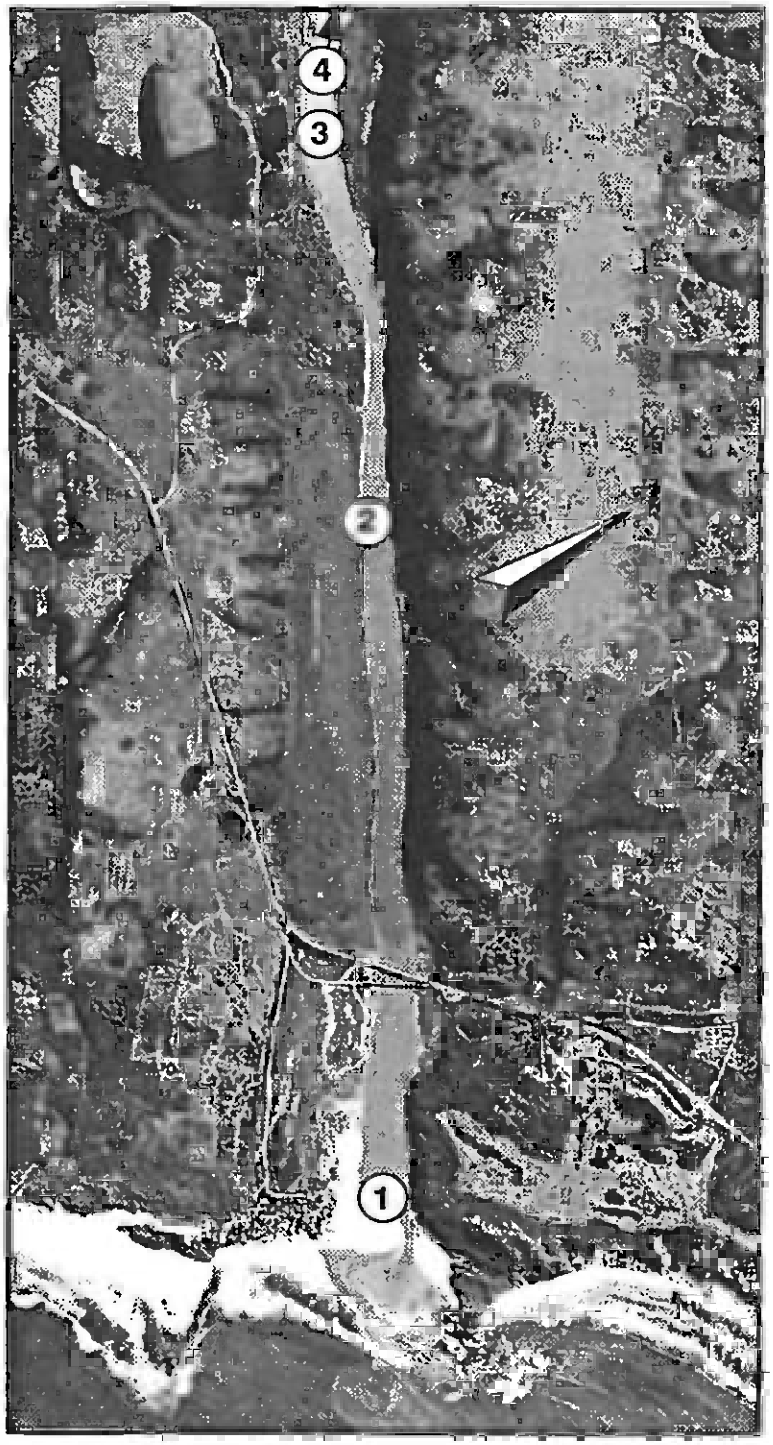
Water quality in the Great Fish estuary was sampled at the positions shown opposite. The overall water quality was good with an index value of **6.3**. Impairment was greatest in the suitability for aquatic life due to relatively low DO concentrations and elevated surface OA concentrations. Suitability for human contact was also moderately impaired (elevated bacterial counts).

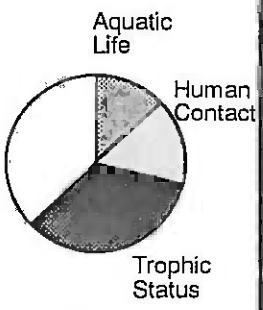
### AESTHETIC STATE

In terms of its appearance the Great Fish scored **8.7**. The system is largely undeveloped and the floodplain, its surrounds and its shoreline appear mostly natural. The western shore of the system forms part of the Great Fish River Wetland Reserve which is administered by the Algoa Regional Services Council. A campsite and holiday cottages have been developed in this area. A shop and car park are situated on the eastern side and a picnic area has been established on the shore. Two bridges, both with embankments cross the system and traffic noise is persistent. The Great Fish is a turbid system which is a popular angling venue. Overall this system ranked satisfactory aesthetically.

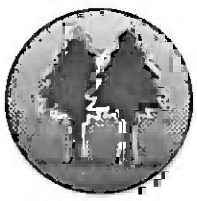
### OVERALL ESTUARINE HEALTH

The biological status of the Great Fish was rated acceptable. Its overall water quality was good and its aesthetic appearance was satisfactory. Overall, the system is considered to be in a moderately good condition with a composite score of **7 out of 9**.



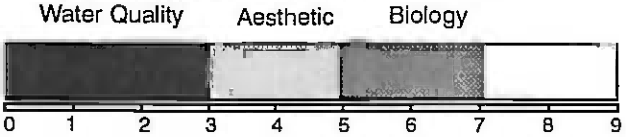

**WATER QUALITY**



**AESTHETIC**

**BIOLOGICAL**

0 400 m




**COMPOSITE HEALTH INDEX**

## GREAT FISH

## PART 3. REGIONAL OVERVIEW

The Estuarine Health Index presented in the accompanying figures summarises the relative biological health, water quality condition and aesthetic state of the estuaries on the southeastern Cape coast. For several estuaries, not all the parameters were measured and in these cases, only the available information is presented. The utility of the Estuarine Health Index can clearly be seen where the relative health of each system can be ascertained at a glance. It must be stressed however that, as with all index methods, some information is sacrificed for perspective and that for any detailed evaluation, professional advice is imperative.