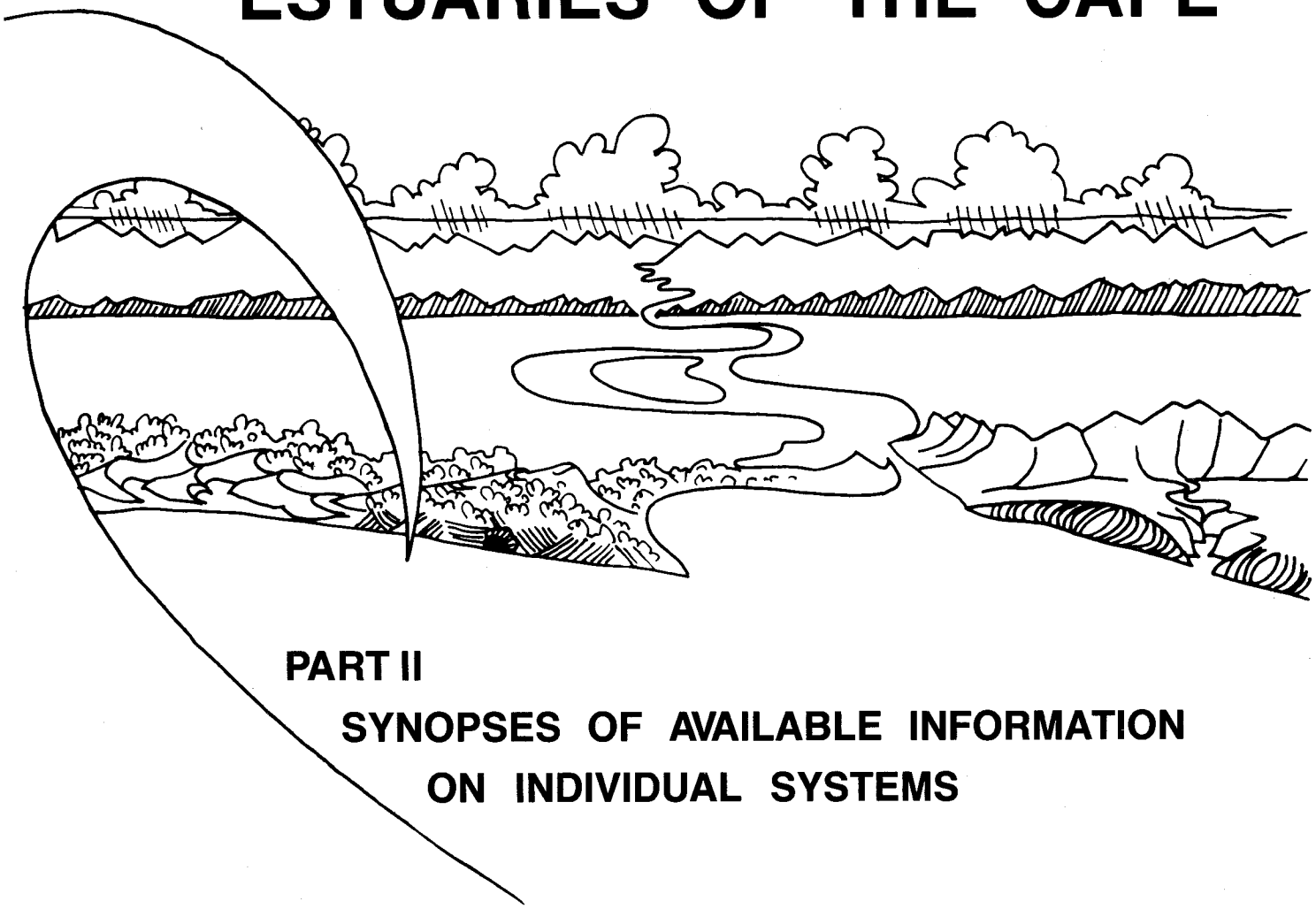
COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
NATIONAL RESEARCH INSTITUTE FOR OCEANOLOGY
ESTUARINE AND COASTAL RESEARCH UNIT – ECRU

ESTUARIES OF THE CAPE



PART II
SYNOPSES OF AVAILABLE INFORMATION ON INDIVIDUAL SYSTEMS

REPORT NO. 27

WILDEVOËLVLEI/NOORDHOEK (CW 28)

CSIR RESEARCH REPORT 426

Stellenbosch, South Africa
August 1985

ERRATUM

In the CSIR Research Report 426 Wildevoëlvlei/Noordhoek, kindly correct the following:-
On pg. 10 in the section ***Hydrology***
MAR 38 x 10^6 should read 3,8 x $10^6 m^3$;
area figure of 114 km^2 should read 11,4 km^2.
These figures were incorrectly given in the source publication, Noble and Hemens (1978).

ESTUARIES OF THE CAPE

PART II SYNOPSES OF AVAILABLE INFORMATION ON INDIVIDUAL SYSTEMS

EDITORS
A E F HEYDORN, National Research Institute of Oceanology, CSIR, Stellenbosch
J R GRINDLEY, Department of Environmental and Geographical Science, University of Cape Town

FRONTISPIECE: THE WILDEVOËL ESTUARY. ALT. ±500m, ECRU 79-10-23

REPORT NO. 27: WILDEVOËLVLEI/NOORDHOEK (CW 28)

(CW 28 – CSIR Estuary Index Number)

BY: T J E HEINECKEN

ESTUARINE AND COASTAL RESEARCH UNIT – ECRU
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PREFACE

The Estuarine and Coastal Research Unit (ECRU) was established by the National Research Institute for Oceanology (NRIO) of the CSIR in 1979 with the following aims:

to contribute information relevant to the development of a cohesive management policy for the South African coastline;

to compile syntheses of all available knowledge on the 167 estuaries of the Cape between the Kei and the Orange rivers;

to identify gaps in information, to conduct research to fill these and to stimulate universities, museums and other institutions to become involved in this kind of work;

to contribute to *ad hoc* investigations carried out by the NRIO on the impact of proposed developments in the coastal environment, especially in estuaries.

The Unit was established at the request of the Government, and the Department of Environment Affairs contributes substantially to the running costs.

In 1980 the Unit published its first report under the title "Estuaries of the Cape, Part I - Synopsis of the Cape Coast. Natural Features, Dynamics and Utilization" (by Heydorn and Tinley, CSIR Research Report 380). As the name of the report implies, it is an overview of the Cape Coast dealing with aspects such as climate, geology, soils, catchments, run-off, vegetation, oceanography, and of course, estuaries. At the specific request of the Government, the report includes preliminary management recommendations.

The present report is one of a series on Cape Estuaries being published under the general title "Estuaries of the Cape, Part II". In these reports all available information on individual estuaries is summarized and presented in a format similar to that used in a report on Natal estuaries which was published by the Natal Town and Regional Planning Commission in 1978. It was found, however, that much information is dated or inadequate and that the compilation of Part II reports is therefore not possible without brief prior surveys by the ECRU. These surveys are usually carried out in collaboration with the Botanical Research Institute and frequently with individual scientists who have special interest in the systems concerned. One of these is Prof J R Grindley of the University of Cape Town who is co-editor of the Part II series.

These surveys, however, are not adequate to provide complete understanding of the functioning of estuarine systems under the variable conditions prevalent along the South African coastline. The ECRU therefore maintains close contact with universities and other research institutes and encourages them to carry out longer-term research on selected estuarine systems. In this way a far greater range of expertise is involved in the programme and it is hoped that the needs of those responsible for coastal zone management at local, provincial and central government levels can be met within a reasonable period of time.

Although it has been attempted to write the Part II reports in language understandable to the layman, it has been impossible to avoid technical terms altogether, and a glossary explaining these is included in each report.

F P ANDERSON
CHIEF DIRECTOR

National Research Institute for Oceanology, CSIR

CONTENTS

WILDEVOËLVLEI - NOORDHOEK WETLANDS

1. INTRODUCTION

This report describes a system in which there is no major river feeding an estuary. Furthermore because of the inter-relationship between a high water table and the vleis and pans in the Noordhoek/Kommetjie basin, the two Wildevoëlvlei cannot be considered in isolation from the other water bodies in the basin.

The area being described consists of a low-lying flat-bottomed valley, flanked by mountains to the north and south, a low sandy ridge to the east and the Atlantic Ocean to the west. The central portion of the valley contains a number of shallow seasonal vleis or pans with three main water bodies, namely:

(a) The Noordhoek Saltpan which has become a permanent shallow lake dredged to a maximum depth of two metres as a result of an attempt to create a canal estate housing development.

(b) The two Wildevoëlvlei which used to be seasonal water bodies but now contain water permanently due to the discharge of treated sewage effluent into the upper vlei.

The substrate of the valley floor consists principally of deep quartzitic sand. The high water table is maintained by one perennial and numerous seasonal streams which drain the surrounding mountain slopes. During periods of prolonged rainfall the lower parts of the basin are inundated and the vleis and pans can become inter-connected. The water eventually drains, both by surface flow and sub-surface seepage, into two overwash lagoons situated along the beach. These lagoons, which lie in two extended back-beach slacks to the north and south of a central hummock dune area, also receive sea water from storm waves washing over the beach berm during high spring-tides.

2. HISTORICAL BACKGROUND

There does not appear to be much historical information available on the Wildevoëlvleis or the wetlands. The poor soils and marshy nature of the environment probably made the valley floor unsuitable for development or intensive farming, hence the lack of interest in the area during the early colonization of the Cape Peninsula.

The name Wildevoëlvleis - literally translated as "wild bird lakes" is obviously derived from the large numbers of waterfowl which frequent these water bodies.

The Wildevoëlvleis are situated on the farm Imhoffs Gift which was originally known as Slangkop when first granted to a certain Christina Diemer in 1743. The Van der Horst family who own the farm at present, acquired it just before the first World War (Midgley, 1975). Noordhoek (North Glen) which lies below Chapman's Peak, and Chapman's Bay were named by John Chapman, a master's-mate who on 29 July 1607 was sent ashore to look for water and an anchorage by the captain of the *Consort* which had anchored off the coast (Bulpin, 1980).

An interesting historical account of the Noordhoek Estate is given by the Physical Planning Branch of the office of the Prime Minister in a letter to Mr B A Farrell who carried out an environmental impact assessment of the area in 1983. The estate was owned by the late Sir Drummond Chaplin, who was a Governor of Rhodesia (now Zimbabwe), in the early 1900s.

The magnificent manor house was designed by Sir Herbert Baker and built by Sir Drummond Chaplin in 1923. It was bequeathed by the Chaplins, who had no children, to their nieces - the Misses Godman. Being concerned about the future of the estate the last surviving Miss Godman, prior to her death a few years ago, decided to sell the estate subject to 60 percent, including the manor and its surroundings being retained as a nature reserve and that the "stately home" be opened to public viewing on occasions (Director-General, Office of the Prime Minister, Physical Planning Branch, *in litt.)*. The present owner of the estate is the Minister of Environment Affairs and Tourism, Mr John Wiley. One third of this estate has recently been subdivided into a number of two hectare plots *(The Constantiaberg Bulletin,* 29 August 1985).

Use of the Wildevoëlvlei/Noordhoek wetlands seems to have been limited to sporadic cultivation of cash crops and some dairy farming in the more fertile areas around the perimeter of the valley floor. This practice used to and still does take place mainly on the northern and eastern sides of the basin in the vicinity of Noordhoek and Sun Valley.

Hill Kaplan Scott and Partners (1972), Midgley (1975) and Giliomee (1984) all mention the use made of the Noordhoek Saltpan for the production of salt. This pan was dredged in 1974 as part of a scheme for a waterside housing development which was never completed. During the dry summer months prior to its dredging, the hard flat surface of the pan was used as an unofficial motor racing track (Giliomee, 1984).

An interesting historical landmark of the area is the wreck of the *Kakapo,* a steamship which ran aground at the southern end of Noordhoek beach on 25 May 1900 (see Figure 1). The remains of this wreck now serve as a useful reference point for changes in the beach profile and shoreline.

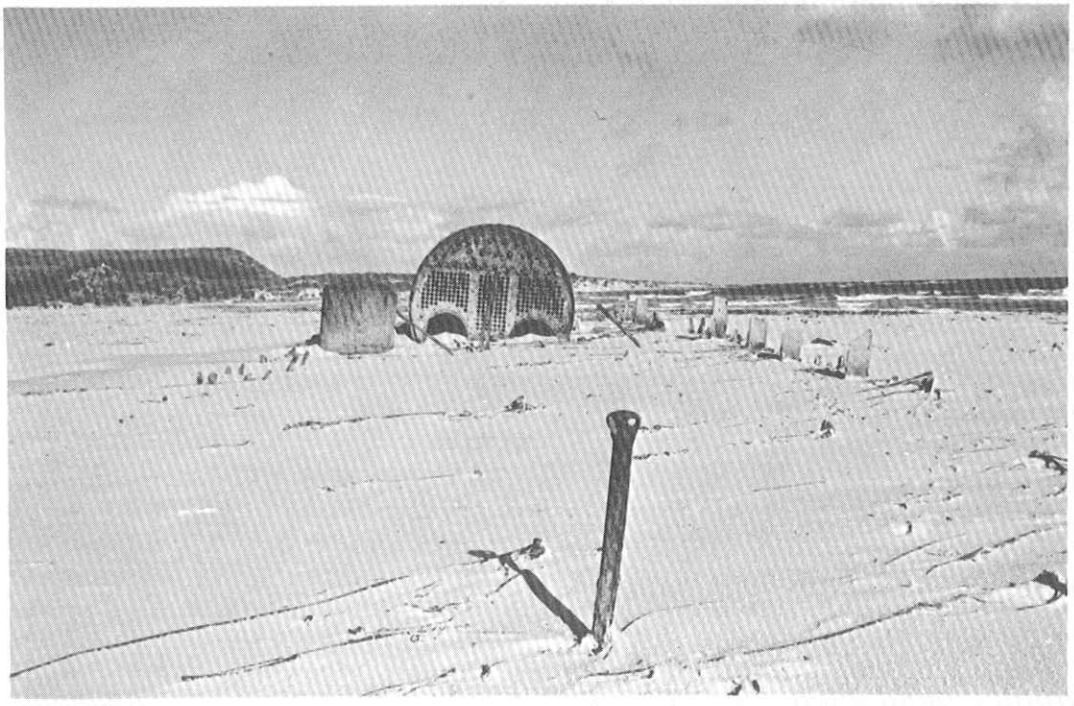
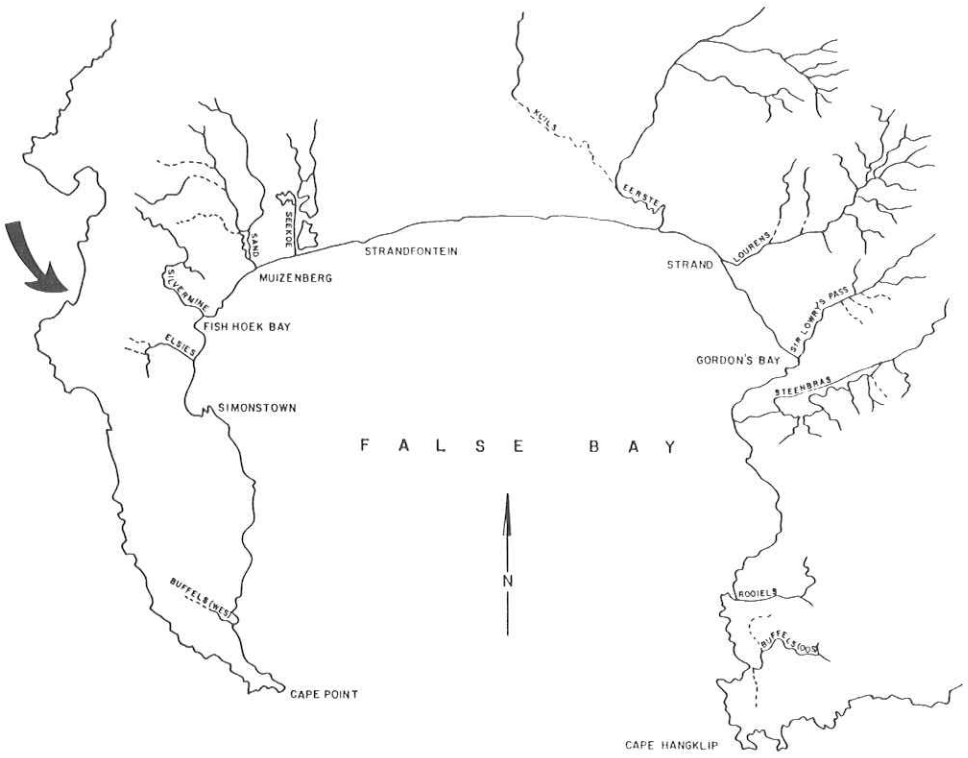


FIG. 1: Remains of the wreck of the *Kakapo,* beached on 25 May 1900.

3. LOCATION

The grid reference of the central point of the area under review is 34° 07′S, 18° 22′E (1:50 000 Sheet 3418 AB and AD)



3.1 Accessibility

Access to the Noordhoek/Kommetjie area is via three tarred main roads leading from Cape Town. These are, the Ou Kaapse Weg which traverses the Steenberg Mountains from Constantia, the Chapman's Peak Drive a scenic route around the precipitous coastline from Hout Bay and the main road between Fish Hoek and Kommetjie (see Centrespread).

The Wildevoëlvleis as such are not accessible to the public as they are situated on private property and public access is prohibited because treated sewage effluent is released into the vleis.

The mouth area of the vleis at the southern end of Noordhoek beach as well as the beach and the two backshore lagoons are accessible via the road leading to the Imhoff Caravan Park and from the Noordhoek Corner (see centrespread).

Numerous tracks and bridle paths criss-cross the low-lying central part of the basin, but as most of this area is in private ownership, it is not freely accessible to the general public.

3.2 Local Authorities

A large portion of the low-lying part of the wetlands adjacent to the coast, although still in private ownership, has been incorporated within the proclaimed Cape Peninsula Nature Area (see centrespread) (J Avis, Department of Environment Affairs, pers. comm.).

The entire area falls under the jurisdiction of the Cape Divisional Council. It has been zoned for various uses which may be revised as the Council is at present preparing a Structure Plan for the Noordhoek/Kommetjie/Sunnydale area (C Blandy, Cape Divisional Council Planner, pers. comm.). The Sun Valley township which used to be within the Divisional Council area has recently been incorporated within the Fish Hoek Municipality (J Avis, pers. comm.).

4. ABIOTIC CHARACTERISTICS

4.1 Catchment

4.1.1 Catchment Characteristics

The catchment area of the Wildevoëlvleis is given by Noble and Hemens (1978) as 114 km^2. The entire catchment area of the Noordhoek/Wildevoëlvlei basin as measured from the 1:50 000 Topocadastral Sheet 3418 AB and AD is 310 km^2.

Geology (see Centrespread and Figure 2)

Geomorphologically the Noordhoek/Kommetjie basin consists of a low-lying flat area surrounded by a steep-sided mountain formation. This starts in the north with Chapman's peak of 590 m and Noordhoek peak of 550 m; it then sweeps around to Spitskop (441 m) and Dassenberg (135 m) in the east. The ridge between the latter two peaks separates the Noordhoek valley from the Silvermine/Clovelly catchment. The perimeter of the basin then dips down into the Fish Hoek/Noordhoek Gap at Sun Valley before rising up to the Brakkloof ridge (300 m) in the south-east.

Another dip in the topography at this point marks the separation between the Glencairn valley and the Noordhoek/Kommetjie basin. The catchment boundary then rises up to the Rooikrans Peak (364 m) in the south before it swings westwards and drops down to sea level along the Klein Slangkop ridge which separates the Wildevoëlvlei catchment from that of the Bokramspruit (1:50 000 Topographic Sheet 3418 AB and AD).

According to Haughton (1933) the Fish Hoek/Noordhoek Gap is cut along an east/west line of faulting which forms a narrow valley, 2 km to 5 km wide. In the west this valley broadens out into a low-lying expanse of Recent sediments overlying weathered kaolinised Cape Granite (see Figure 2).

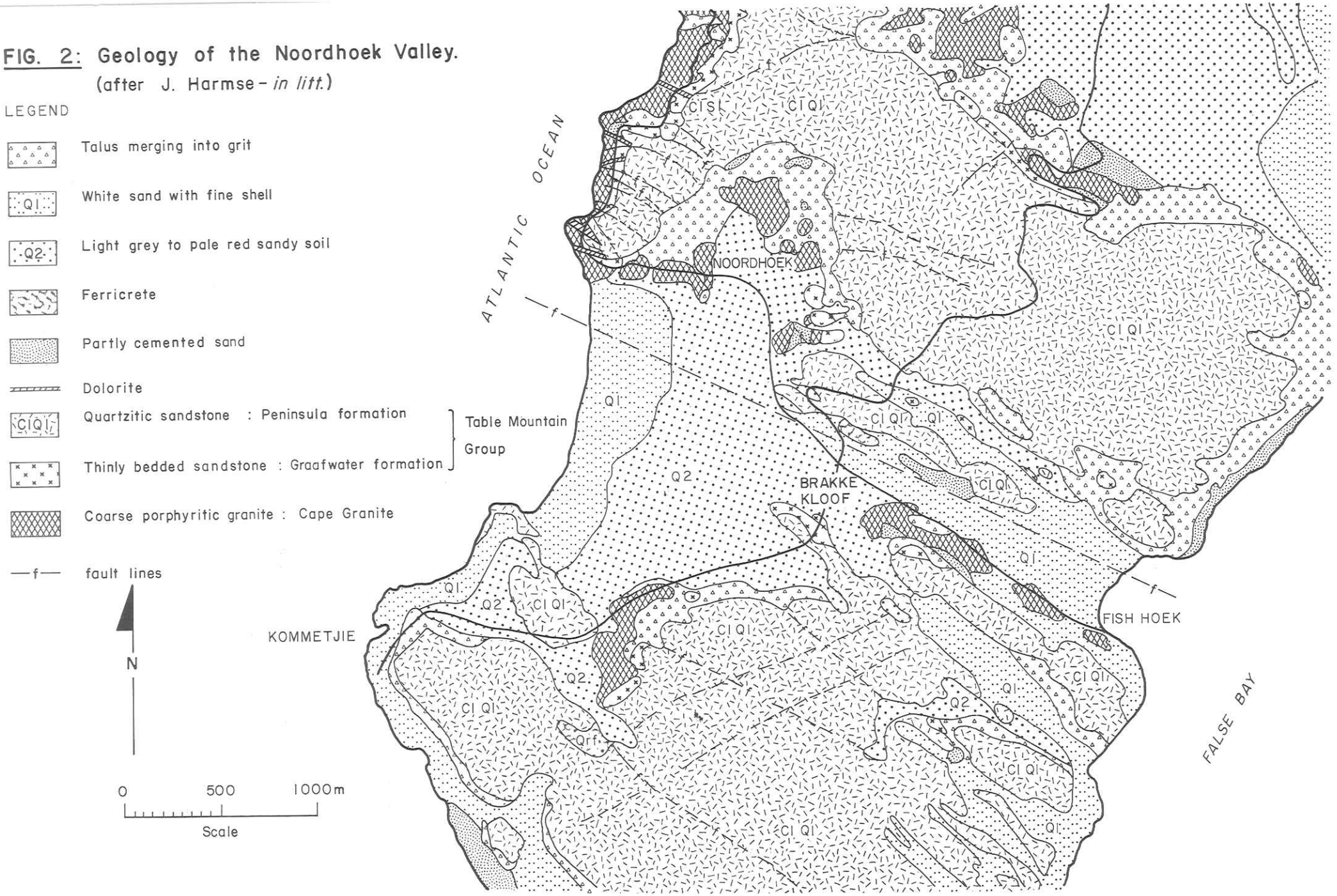
In places these sediments can be up to 95 m deep (Rogers, 1980). A series of boreholes was drilled by Geological Survey in the Noordhoek basin as part of a project to establish the lithostratigraphy of Cenozoic sediments on the coastal plain. The presence of scientifically important peat sequences containing palm pollen and pockets of high quality artesian water were found during the drilling operation (J Rogers, Department of Geology, University of Cape Town, pers. comm.).

The mountains surrounding the Noordhoek basin consist of quartzitic sandstone of the Table Mountain Group, this rests on a base of shale which in turn overlies granite (Treasure, 1977). Where this coarse porphyritic granite has been decomposed by weathering there are exploitable deposits of high-grade kaolin (see centrespread). Some of these deposits are being mined at present and proposed future expansion of these operations in the area resulted in a controversy which focussed attention on the conservation and future management options for the entire Noordhoek/Kommetjie basin.

The lower slopes of the mountains surrounding the basin are made up of thick talus formations of sand and TMS boulder scree. These slopes are generally stable except for the driftsand slopes north-west of Fish Hoek (Prof. J Harmse, University of Potchefstroom *in litt.*).

The Tertiary to Recent sediments which make up the basin floor have been divided into four types by Hill Kaplan Scott and Partners (1972), these are: *Raised beach deposits* occuring at elevations of 9 m to 12 m, south of the Klein Slangkop ridge; *Older sands* which cover most of the central part of the basin; *Drift*

FIG. 2: Geology of the Noordhoek Valley.
(after J. Harmse – *in litt.*)



sands which make up the beach along the edges of the overwash/tidal lagoon area as well as the central part of the beach and **Tufa* which occurs mainly on the south-eastern edges of the Wildevoëlvlei.

Slightly elevated scattered platforms of calcrete occur in the central portion of the basin between the beach and the Noordhoek Saltpan (ECRU Survey, October 1981).

Due to the locality and nature of the quartzitic sands of the Noordhoek/Kommetjie basin and the associated offshore deposits of sand, it has been suggested by Birch (1979) that these may have originated from False Bay. He speculates that this sand could have been blown through the Fish Hoek Gap and over from Glencairn by the strong prevailing summer south-easterly winds. Historical aerial photographs seem to support this theory - although this mechanism no longer exists today as most of the area has either been developed or stablized with vegetation (mainly alien *Acacia* spp.).

Harmse *(in litt.)* and Heydorn and Tinley (1980) maintain that the coastline of Chapman's Bay is indicative of a prograded coast. Harmse bases his argument on the fact that the sand and shell deposits of the Noordhoek Saltpan are of typical marine origin and he maintains that the Saltpan represents the remains of an earlier tidal lagoon. Furthermore he states that the dune formations between the Saltpan and the present coastline consist of a succession of un-orientated coastal foredunes rather than the normal pattern of beach-foredune-parallel dunes.

A study of aerial photographs from 1944 to 1984 shows that the former area of bare mobile dunes (4-5 m high), which were situated in the central part of the beach, have now almost completely disappeared. All that remain are a few low dunes fixed with Marram grass *(Ammophila arenaria)* and Sea Wheat *(Agropyron distichum)* and even these show signs of active erosion (see Figure 3).

FIG. 3: Hummock dunes in the central beach area being actively eroded by wind.

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* Tufa: A general name for deposits of $CaCO_3$ formed by deposition from solutions of calcium bicarbonate, $Ca(HCO_3)^2$. (Whitten and Brooks, 1978).

Soils

The soils of the Noordhoek/Kommetjie basin have been described by Smith-Baillie *et al.* (1976), while Hill Kaplan Scott and Partners (HKS) (1972) refer specifically to the soils in the vicinity of the Wildevoëlvleis.

According to Smith-Baillie *et al.* the area is an almost level floodplain with vleis and depressions adjoining moderately sloping valley sides. The gradient of the slopes is low and the water moves relatively slowly down them. Poor drainage occurs in the low-lying level part of the basin. Aeolian sediments form the basis of most of the soils while along the southern and northern edges of the basin the weathered products of granite and TMS have influenced the type of soil.

HKS divided the soils around the Wildevoëlvleis into granite soils, Table Mountain sands, raised beach sands, vlei deposits and beach and dune sands.

A theory for the origin of the Noordhoek Saltpan advanced by Giliomee (1984) is that it is a hollow deflation pan formed behind the early vegetated sand dunes of the basin floor. This would have been widened and deepened by wind action on the bare pan surface during the dry summer months. A dune, only as wide as the pan itself, existed along the north-western shores of the Saltpan prior to its dredging for township development.

Rainfall and Climate

No recorded climatic data are available specifically for the Noordhoek/Kommetjie basin. Generally, however, the climate can be considered as Mediterranean with hot, dry summers and cool, wet winters. A mean annual rainfall of 785 mm is given by Midgley and Pitman (1969).

The climatic processes, patterns and peculiarities of the Noordhoek/Kommetjie area have been described in some detail by B Gasson of the Department of Urban and Regional Planning of the University of Cape Town (1984). This description can be summarized as follows; he refers to the area as an ESE-WNW trending corridor where temperatures are normally between 20°C and 24°C with a low value of 6°C during the colder winter months and a high value of 26°C to 30°C in the hot summer months. The mean annual temperature is around 17°C.

The winds in the area are dominated by the southerlies in summer and northerlies in winter. Intense funnelling and acceleration of the southerly winds occur through the Fish Hoek Gap and the valleys leading down into the Noordhoek/Kommetjie basin, particularly along the southern flank of the basin. The strong northerly winds in winter which come straight off the sea or through the gap between Chapman's Peak and Noordhoek Peak with great velocity, cause unpleasant vortex conditions within the Noordhoek amphitheatre.

The erosive capacity of the winds is high, particularly during the dry summer months when any bare, exposed sand is easily set in motion by the wind. According to J Harmse *(in litt.)* the sands of the Fish Hoek dunes to the east of the basin are moved by winds with a speed as low as 12 km per hour.

The rainfall over the basin is both cyclonic and orographic with a pronounced winter peak (see Table 1). The topography plays an important role in the distribution of rainfall which is highest up against the south-facing mountain-slopes (see Figure 4).

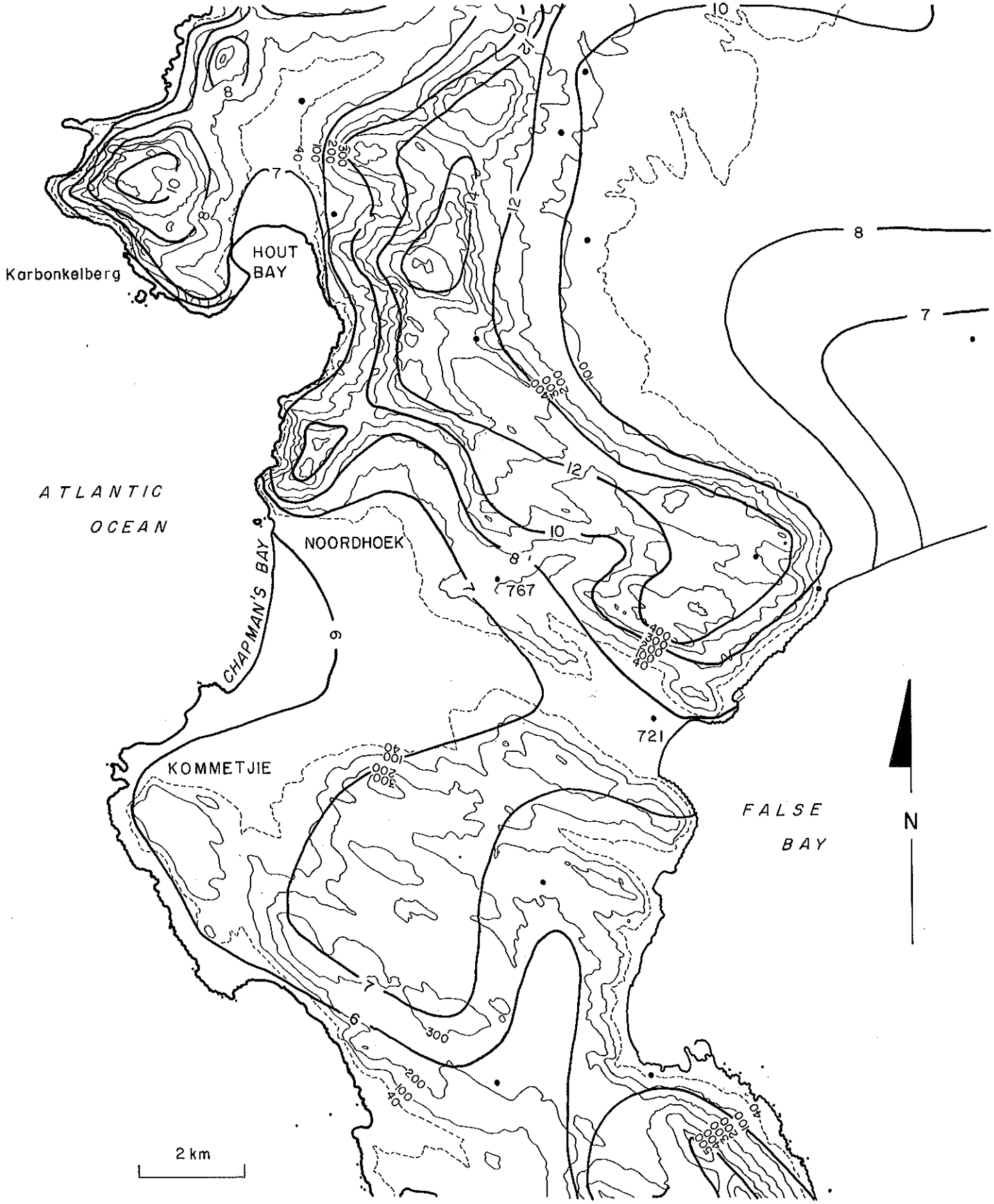

FIG. 4: Noordhoek - Kommetjie area: rainfall.
(Isohyets in hundreds of millimeters) (after B. Gasson – *in litt.*)

TABLE 1: Fish Hoek - Average rainfall in millimetres

J	F	M	A	M	J	J	A	S	O	N	D
35,8	18,3	21,1	46,7	106,7	137,4	83,8	85,3	85,6	70,1	32,5	11,9

Source: *Climate of South Africa, Pt.9: Average Monthly Rainfall* (South African Weather Bureau, 1965).

According to Blandy (in prep.) the local modifications caused by topography give rise to six fairly well-defined climatic regions. These are the following:

(1) The *high cool wet slopes* (160 m and upwards) of the Noordhoek amphitheatre. The rainfall here is estimated to be between 1 000 mm and 1 200 mm per annum, much of which can be attributed to the orographic effect. During winter this area is subjected to the full force of the strong north-westerly winds.

(2) The *south facing bowl* of the amphitheatre has a more temperate climate with an annual rainfall of approximately 850 mm which also falls mainly in winter. The area is protected from the south-easterly winds but as with the area previously mentioned, it is affected by the strong winter winds.

(3) The *warmer eastern slopes* situated at an altitude of between 30 m and 160 m receive the afternoon sun and can become very hot. The annual rainfall is between 700 mm and 800 mm and the effects of both the south-easterly and north-westerly winds are felt in this area. This is particularly so in the neck between the Noordhoek and Clovelly valleys.

(4) *North-facing, southern slopes* on the Kommetjie side of the basin receive the most sunlight. They are hot and dry and would be the hottest part of the basin were it not for the moderating effects of altitude and the prevailing winds. The average rainfall in this region is 700 mm per annum.

(5) The *low-lying central area,* with an altitude of less than 20 m is the warmest, dryest (in terms of rainfall) part of the basin. It is exposed to the south-easterly summer winds and the prevailing winter winds. The average annual rainfall is in the vicinity of 600 mm and it receives no orographic precipitation as is the case with the areas situated close to the mountain slopes. The southern part of the area is generally hotter, dryer and more windy that the remainder of the area (T Heinecken, pers. obs.).

(6) The *coastal strip,* which is a narrow belt approximately 1 km wide adjacent to the beach. In this region the moderating effect of the sea results in lower summer temperatures. Diurnal land and sea breezes also tend to moderate the climate. The average annual rainfall is less than 600 mm but sea fog is fairly common over this area, mainly in autumn (B Gasson, *in litt.)*. As with the central area described above, the coastal strip is subjected to the full force of both the summer and winter prevailing winds.

Based on a study of temperature, wind and rainfall, B Gasson *(in litt.)* recognized only four micro-climatic zones which are relatively different from one another (see Figure 5). Because of the lack of actual records Gasson feels that the variations may not necessarily be significant.

The microclimatic zones given by Blandy and Gasson differ slightly as there are some overlaps between Gasson's Zone 1 and those described by Blandy.

Hydrology

No detailed overall figures are available for the run-off of the whole catchment of the Noordhoek/Kommetjie basin. Noble and Hemens (1978) have given a mean annual run-off (MAR) of 38 x 10^6 m^3 for the Wildevoëlvlei catchment, presumably for their catchment area figure of 114 km^2 for which they do not define the boundaries.

The MAR of the upper portion of the Goeiehoop River, the only well-defined stream feeding the basin, is given as 0,8 x 10^6 m^3 by L de Kock (DEA, Division of Hydrology, *in litt.)*. This applies only to the catchment of the stream situated above the tarred main road from Chapman's Peak Drive, an area of 3,5 km^2.

The hydrology of the basin is complicated by the fact that there are no well-defined water courses besides the Goeiehoop River which drains the Noordhoek amphitheatre. The run-off from the remainder of the catchment seeps down into the flat basin floor which, with its porous sandy substrate, acts like a sponge. The valley bottom forms an extensive wetland which includes the three separate main water bodies of the Noordhoek Saltpan, the two Wildevoëlvleis and a permanent marshy area towards the centre of the basin floor known as Papkuilsvlei (see Plate I). Although the Noordhoek Saltpan and Wildevoëlvleis, through artificial manipulation, now contain water permanently, they are all interconnected via the high water table which exists throughout the entire basin floor.

During the wet winter seasons the whole area becomes inundated and, although no obvious surface drainage patterns are evident, the Saltpan receives water from pans at the western end of the Fish Hoek valley mainly by sub-surface seepage, as well as by an artificial surface water course carrying stormwater from Sun Valley. Contour lines and marsh vegetation also indicate that a relict connection existed between the Saltpan and the upper Wildevoëlvlei as well as between Papkuilsvlei and the Wildevoëlvlei.

During the winter of 1984 when Papkuilsvlei and the wetlands were fully charged, the water flowed out over the central portion of the beach in a channel some 15 m wide and 1,3 m deep (see Plate II). This phenomenon has apparently not occurred since the time of an early map of the area which shows the "Noordhoek River" flowing out over the beach in this vicinity (Maps - Cape Peninsula, 1890, Gov. Arch. No. M3-1806).

4.1.2 Land Ownership/Uses

Land ownership within the catchment of the Wildevoëlvlei/Noordhoek basin is shared between the State, the Cape Divisional Council, the Cape Town City Council, the Fish Hoek Municipality and private landowners (see centrespread).

The land owned by the Divisional Council consists of a large portion (Ptn 933) situated to the north-west of the Saltpan, the land on which the sewage treatment plant is situated east of the Wildevoëlvleis and a number of smaller portions in the Noordhoek/Sunnydale area. The administration of the portion of State land adjacent to the beach in the northern corner of the basin is also vested in the Divisional Council.

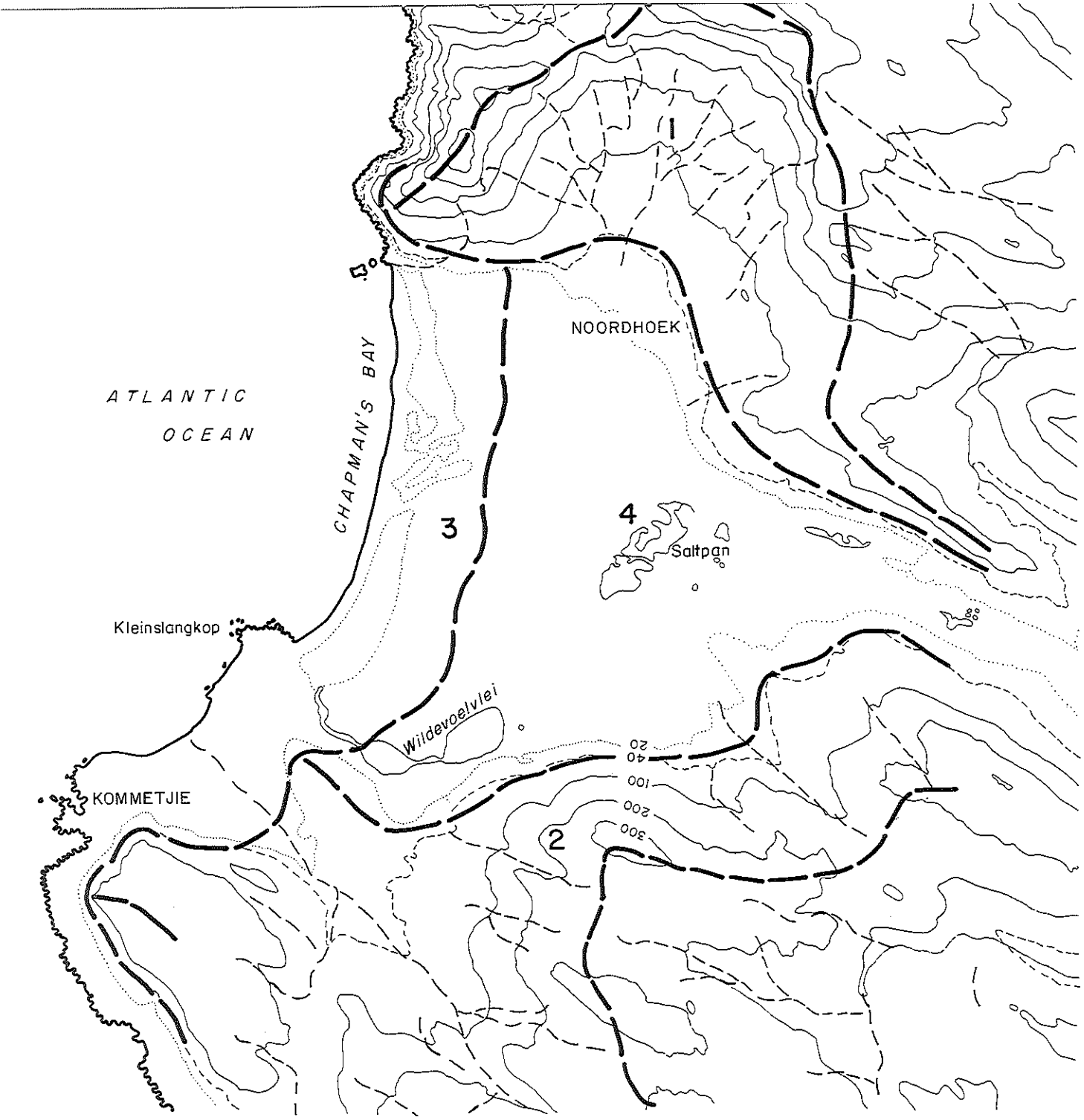

FIG. 5: Noordhoek - Kommetjie area: micro - climates.
(after B. Gasson - *in litt*)

1 Northern Region
- Cool Wet Zone

2 Southern Region
- Hot Dry/ Moist Zone

3 Littoral
- Mild Zone

4 Central Region
- Warm Dry Zone

N

1km

The Cape Town City Council owns those portions of the Silvermine Nature Reserve which fall within the catchment of the Noordhoek basin. The largest privately owned portions of ground are those belonging to Kommetjie Estates which includes the farm of Imhoffs Gift and the Wildevoëlvlei. Other large private portions of ground are the Sir Drummond Chaplin Estate, Dassenberg and De Goede Hoop - Portion 930, which have been sub-divided into a few fairly large properties.

The remaining privately-owned properties consist of smallholdings at Noordhoek and Sunnydale, the single residential areas of Chapman's Peak Estate, San Michele and Sunnydale. There is also the township of Sun Valley which falls under the jurisdiction of the Fish Hoek Municipality.

According to Blandy (in prep.) existing zoning within the Noordhoek Valley which encompasses almost the entire catchment of the basin, is as follows:

Existing zoning	Land areas (hect)	Percentage of local area
Single residential	505,2	16,89
Agricultural zoning	383,1	10,35
Commercial/Light industry	10,4	0,35
Rural zoning	1 290,4	43,13
Amenity area	802,5	26,83
	2 991,6	97,55

As can be seen from the above, agricultural and rural zoning accounts for some 53 percent of the area. Originally most of the area was used for market gardening, dairy farming and low-intensity rough grazing in the wetland areas during the drier summer months. With the growth of the Cape Town metropolitan area and its suburbs, a demand for rural residential smallholding areas on the perimeter of the built-up suburbs has increased. The Noordhoek/Wildevoëlvlei basin lends itself to this type of development and this has occurred in the area.

The largest single farming unit which remains is the farm Imhoffs Gift and even here the farming operations are of a low intensity. Some market gardening takes place on the black soils in the Noordhoek area while a few poultry units exist in the warm dry areas on the southern side of the basin.

The Department of Agriculture has indicated that some high potential agricultural land exists in the low-lying central part of the Noordhoek/Wildevoëlvlei basin in the vicinity of the Saltpan and within the Noordhoek amphitheatre. Such areas must be protected against urban encroachment (Cape Metropolitan Area Draft Guide Plan, 1984).

With the appointment of the Hey Commission in 1977 to report on the future control and management of Table Mountain and the Southern Peninsula Mountain Chain the question of reserve status for parts of the Noordhoek/Wildevoëlvlei area was considered (Hey, 1978). Following the publication of this report a substantial area of the Noordhoek/Wildevoëlvlei wetlands adjacent to the coast was included in the Cape Peninsula Nature Area which was proclaimed in 1983 under the Physical Planning and Utilization of Resources Act No. 88 of 1967. The boundaries of the Nature Area in the Noordhoek/Kommetjie area are shown in the centrespread. Although most of this land remains in private ownership, its development and management is subject to the conditions of a management policy which has been drawn up for the Nature Area (Mr J Avis, DEA, pers. comm.). Some

40,1 percent of the Noordhoek area falls within the proclaimed Nature Area. Important aspects of the management policy for the Nature Area will consist of alien vegetation eradication and the control of the recreational usage of the wetlands and coastline.

Existing township developments within the Noordhoek/Wildevoëlvlei area are: The Chapman's Peak Estate (201 erven), San Michele (82 erven), Sun Valley (405 erven), Sunnydale (171 erven). Approved developments include two townships in the Sunnydale area, namely Fish Hoek Ext. 14 ("Capri" 247 erven), and Noordhoek Ext. 8 (99 erven). A marina development on the Saltpan is proposed (495 units). A number of subdivisions into Agricultural smallholdings have also been approved including that of part of the Drummond Chaplin estate into 46 two ha units.

The Divisional Council owns 180,2 hectares in the area of which 128,4 ha (Farm 933) are zoned for amenities and within which the garden refuse dump is situated in the south-eastern corner adjacent to the Saltpan, and 27,6 ha (Farm 948/28) containing the sewage treatment works situated adjacent to the Wildevoëlvleis. At present this treatment plant handles sewage from Fish Hoek, Sun Valley, Sunnydale and Ocean View.

Low-intensity kaolin mining has taken place at a few sites around the perimeter of the basin for many years. Due to an increased demand for kaolin, application was made to expand and extend the operations within the Noordhoek valley. This application resulted in considerable public resistance due to the environmentally sensitive nature of the area and the conflicting interests for land use. Although the applicant for the mining permit submitted an environmental impact statement (EIS) for their development, an independent firm of Environmental Consultants was appointed by the Department of Constitutional Development and Planning (Physical Planning Branch) to evaluate the original EIS and to provide recommendations for the best practical land uses for the area. This report known as the "Farrel and Van Riet Report: Noordhoek" has not been made public, but portions of the original report were made available by courtesy of the Department of Constitutional Development and Planning.

A report dealing with an opinion poll concerning kaolin extraction in the Noordhoek/Kommetjie area concluded that if the majority opinion were to be taken as an indicator, then kaolin extraction operations should not be expanded in this environmentally sensitive area but that other development options should be considered (I J van der Merwe, H L Zietsman and J H van der Merwe, 1981).

The Cape Metropolitan Draft Guide Plan (1984) states that when permits are issued for the exploitation of kaolin, strict conditions protecting the important natural assets must be imposed.

4.1.3 Obstructions

The only obstructions to water flowing into the wetlands are the bridges on the roads which cross the various water courses draining the surrounding mountain slopes. None of these bridges, which are all minor structures, appear to impede waterflow to any great extent.

Some of the tributaries of the Goedehoop River and other streams which drain the Noordhoek amphitheatre have been dammed to provide irrigation water for the Drummond Chaplin Estate and smallholdings in the Noordhoek basin.

4.1.4 Siltation

At present it does not appear as if siltation of the streams or wetlands takes place. Fears have, however, been expressed that should expansion of the kaolin extraction operations occur within the area, surface or sub-surface water carrying kaolin in suspension could enter the streams and the wetland system (M A C Vandoolaeghe, Department of Water Affairs, Division of Geohydrology, and L de Kock, Department of Water Affairs, Division of Hydrology, *in litt.)*.

Well-developed vegetation cover along the banks of the water courses and around the vleis and marshes acts as a filter to any sediment or silt carried by the water flowing into the wetlands. This vegetation should be protected wherever possible.

4.1.5 Abnormal Flow Patterns and Level Fluctuations

There is little evidence of severe flooding in the higher lying areas. As mentioned previously, the wide flat basin floor with its sandy substrate, acts as a sponge, absorbing all the run-off during wet seasons. Once the wetlands become fully charged, flood waters escape to the sea by sub-surface seepage and surface flow through the Wildevoëlvlei outlet and through the backshore tidal lagoons.

Township development within the area will lead to increased storm-water run-off and an increased flood risk in the low-lying areas. As the 1 in 50 year floodline at the proposed Saltpan canal estate development and the adjacent property are both at 5,1 m above msl Blandy *(in litt.)*, feels that the demarcation of the 1 in 50 year floodline to limit development would serve little purpose. He therefore proposes that the wetland zone as such should be defined and that no township development should take place within it. As most of the wetlands and the highest water level of the permanent water bodies lie below the 5 m contour it would seem both practical and realistic to use this as the boundary below which no development should take place.

The proposed township development around the Saltpan falls within the wetland area, but a large proportion of the land around the pan has been artificially raised using dredge spoil. Water level control within the pan is effected by a channel leading to Papkuilsvlei and this would supposedly drain flood-waters from the pan (see centrespread and Figure 6).

Another important aspect to consider is the balance between the water table level and the vegetation covering the valley floor. This vegetation has stabilized much of the formerly bare mobile sand dune area in the central part of the basin; any disturbance of this balance could adversely affect the vegetation cover.

4.2 Estuary

(Sections 4.2.1 and 4.2.2 are based on a detailed report by the Sediment Dynamics Division of the NRIO (G A W Fromme, in prep.).

4.2.1 Estuary Characteristics

The Noordhoek beach is 4 km long, 500 m wide and is very flat. The north and south beaches are divided by a central dune area which separates two large shallow, seasonal backshore lagoons. The southern lagoon is fed by an overflow channel from the Wildevoëlvlei and the northern lagoon by seasonal storm water drainage from the Papkuilsvlei and washover from the sea during winter storms

and high spring-tides. The southern lagoon is also at times filled by washover but it drains perennially to the sea at its southern extremity. The foreshore is wider at the northern beach and the backshore lagoon formed at this end of the beach is connected to the sea only when it is full and breaks open at its northern end. The beach sediment consists of fairly uniform medium to fine sand. The longshore transport direction cannot be determined conclusively without more detailed analysis but it appears as if the drift is mainly northwards.

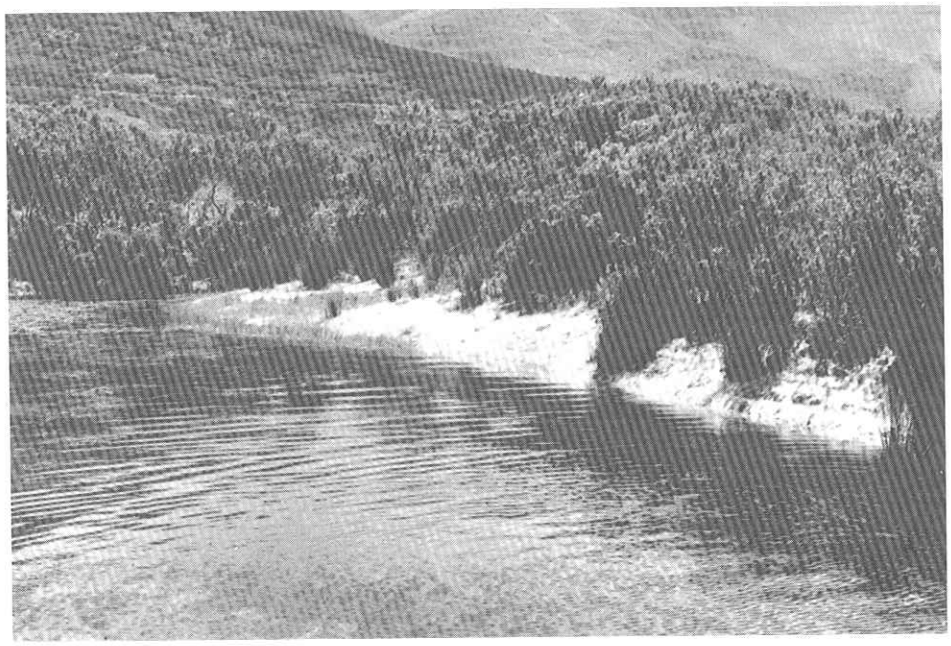

FIG. 6: The overflow channel from the proposed Saltpan canal estate development scheme.

4.2.2 Dynamics of Noordhoek wetland basin

Cartographic evidence

Maps and charts are available for 1786, 1790, 1822, 1890, 1901, 1964 and 1978. From these maps it appears as if human influence over the years has significantly altered the drainage patterns. In the past it seems that there were more feeder streams and better established interconnections between the vleis and pans. The earlier maps contain no evidence of backshore lagoons at either the south or north beaches, however, in 1933 the SA Navy Chart of the area shows a backshore lagoon at the south beach. The area where the backshore lagoons are presently situated was previously covered with dunes (I van Heerden, NRIO, in prep.). Aerial photographs were studied covering the years 1944, 1958, 1968, 1977, 1979 and 1980. The 1944 photographs show a barren dune field behind the North beach between two ridges of Holocene dunes and the recent barrier dunes. At present the alien vegetation planted to stabilize this dune field covers all but the central dune area (see Figure 7).

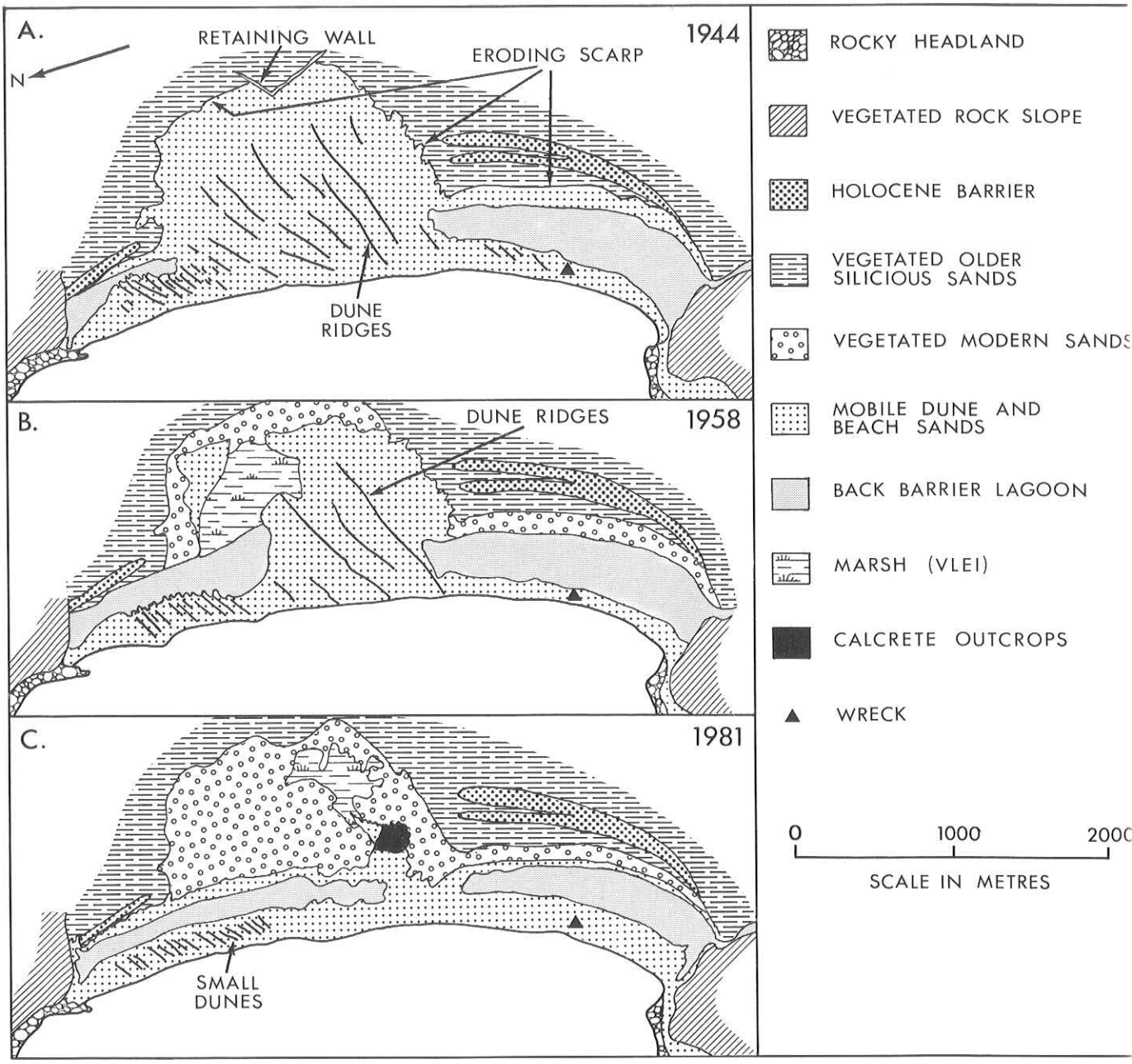

FIG. 7: Changes in the morphology of the Noordhoek beach as drawn from a series of aerial photographs (Van Heerden, in prep.).

Wind and aeolian processes (see also Section 4.1.1 *Rainfall and Climate)*

The wind and associated aeolian processes have been and are of great significance in the formation of the present Noordhoek basin and beach. There are no actual wind recordings specifically for the Noordhoek/Kommetjie area, but according to records kept by the Fisheries Development Corporation at Hout Bay, the predominant wind direction is south-east and to a lesser extent north-west. These records also show that at Hout Bay the summer south-easterly winds can reach speeds of up to 72 km/h (the highest recorded speed) while in winter the recorded maxima were 36-54 km/h (VISKOR, 1981).

Insofar as aeolian sand transport is concerned, the dry spring and summer months, when the offshore south-easterlies predominate, are windier than the wetter winter months of autumn and winter. However, strong onshore north-westerly winds also occur during the dry seasons when they can cause appreciable sand displacement.

It is concluded that Noordhoek beach loses sand towards the inland dunes during north-westerly winds while the south-easterly winds transport sand from these dunes back towards the beach and into the surf zone. From the surf zone it is returned to the shore by onshore sediment transport during accretionary sea conditions.

Waves and longshore currents

Chapman's Bay is open to the Atlantic ocean and can be influenced by waves approaching anywhere from the south-west around to the north-north-west. Locally the south beach is sheltered by the rocks of Klein Slangkop Point, whereas the whole of the Noordhoek beach is indirectly sheltered by the Karbonkelberg off Hout Bay (see Figure 4).

According to Voluntary Observing Ship data (VOS) (Swart and Serdyn, unpublished) the dominant wave direction during all seasons is south-west. Undiffracted waves arrive at Noordhoek beach about 54 percent of the time, whereas diffracted waves occur for the remaining 46 percent.

The VOS data indicate maximum deep-sea wave heights of about 9 m to 10 m and median wave heights of about 2,8 m to 3 m. The latter corresponds well with the median wave height of 2,8 m recorded 14 km offshore at Slangkop by a Waverider buoy anchored in 170 m water depth.

Discussion of dynamics

On the basis of the preceding discussion and with Figure 7 as reference, it is possible to summarize the dynamics of the area as follows:

> A barrier dune ridge about 500 m landwards of the present shoreline was created during a sea level high within the Flandrian transgression about 12 000 to 4 000 years ago, when the sea level was about 3 m above present MSL (Van Heerden, 1985). The area landwards of this Holocene dune ridge is governed by its low relief, a high rainfall and an impermeable granite layer which is overlain by sand. These features are responsible for a high groundwater table and hence an extensive marshy area with numerous vleis and pans which were all interlinked in the past, with many mountain streams feeding them. It appears that many of the early links between the vleis and pans have now become overgrown, silted up and non-functional except during very wet seasons when the system still drains towards the Wildevoëlvleis and its perennial outflow channel to sea.

The Noordhoek beach is an extremely dynamic system. These large variations are apparently aided by the low-lying nature of the backshore area. There are at least five mechanisms which in some way or another drive the system. These are

- short-term onshore-offshore shift of sand due to fluctuations in incident wave height and period
- seasonal onshore-offshore and longshore shift of sand, primarily due to fluctuations in the incident wave direction
- long-term fluctuations in the shoreline position due to variations in the sea level
- of lesser importance but something that cannot be overlooked is the varying offshore supply of sediment

the aeolian supply of sand primarily in the south-east/north-west corridor and mainly of importance after 1900 could have aided the growth of the North Beach. The landward limit of the dunefield displays a spur and groove outline indicative of retreat and erosion which implies that the dominant aeolian sand movement is from south-east to north-west.

The relative magnitude of these processes is not known exactly although, on the basis of available information (Skene, 1983), the seasonal fluctuations in the waterline position could amount to about 80 to 120 m. Long-term variations of up to 500 m have, according to cartographic evidence, occurred over the last two centuries. The relative interaction of these processes is still being investigated.

4.2.3 Land Ownership/Uses

The estuarine portion of the system, that is, those parts of the system which, by definition, have a measurable variation of salinity due to the mixture of sea water and fresh water from land drainage, are confined to the two Wildevoëlvleis, with their outlet to the sea and the two backshore overwash lagoons.

The Wildevoëlvleis and outlet channel lie within the privately-owned farm Imhoff's Gift and the land belonging to Kommetjie Estates. This land is also part of the Cape Peninsula Nature Area (see centrespread).

The two backshore lagoons are State land. Although these lagoons are indicated as being "tidal" on the 1:50 000 topocadastral sheet 3418 AB + AD they only receive sea water via high spring-tide overwash and it has been suggested that any tidal fluctuation in their levels is due to sub-surface influence from the sea and percolation through the sand of waves washing up the beach berm (Boland, 1974, unpublished Honours project). The lagoons often dry out completely during the dry summer months.

Populations of sand prawn *(Callianassa kraussi)* occur within the lagoon areas, particularly at the northern end of the northern lagoon. These prawns, as well as sand mussels *(Donax serra)* which are found off the central portion of the beach, are exploited by anglers for bait.

The lagoons and beach are utilized for swimming, surfing and other general beach recreational activities. The wide flat beach which is not frequented by large numbers of people, is used extensively for riding by many horse-owners who live in the Noordhoek area. According to Mr V Taylor (University of Western Cape, *in litt.)* the Noordhoek beach has a low usage and a low potential as a recreational area, mainly because of poor access and various unpleasant environmental features such as excessive wind, exposure, dangerous bathing and cold water.

The Wildevoëlvlei receive treated sewage effluent from the Cape Divisional Council's treatment plant situated adjacent to the upper vlei (see Figure 8). In terms of the permit issued to the Council by the Water Pollution Control Branch of the Department of Water Affairs, the Council had to obtain occupational rights by way of a servitude or land purchase in order to discharge effluent into the vleis. The permit also states that the vleis must be adequately fenced and may not be utlized for any recreational activities.

FIG. 8: The Wildevoëlvlei sewage treatment works.

4.2.4 Obstructions

Shortly after the Divisional Council commenced discharging sewage effluent into the Wildevoëlvleis, the owner of the farm Imhoff's Gift, closed the connection between the two vleis. He had hoped that by a series of water releases he would be able to desalinate the water in the upper vlei, so that this water could be used to irrigate pastures. Heavy rains in the catchment and high seas following the closure of the channel between the vleis, resulted in the earth embankment being washed away and the owner, Mr Van der Horst, abandoned his plans. The remains of another earth embankment are also evident between the lower vlei and the 0,75 km long channel connecting the vleis to the sea.

During storms and high spring-tides large amounts of marine debris e.g. kelp, pieces of wood, plastic bottles etc. are driven up the connecting channel into the lower vlei and on occasions even through to the upper vlei. This occurred during the exceptional storm and high seas which were experienced from 15 to 17 May 1984.

4.2.5 Physico-chemical Characteristics

Since the construction of the Wildevoëlvlei sewage treatment plant and the release of purified effluent into the vleis in 1977, the water in the vleis is monitored regularly four times per year by the Water Pollution Control Branch of the Cape Divisional Council.

Prior to the release of any effluent a number of samples were taken from various points in the vleis during 1975, 1976 and 1977 (see Tables 2 and 3). The results of the analysis of these samples serve as baseline data for the sampling which will be undertaken now that effluent is being released into the system (Mr P King, Cape Divisional Council, Water Pollution Control Branch, pers. comm.). Chemical analyses by the Council's Water Pollution Control Branch of the final effluent and of samples taken at three stations in the upper vlei for the period January 1982 to June 1983 are given in Table 4.

TABLE 2: SUMMARY OF WILDEVOëLVLEI WATER ANALYSES (before discharge of effluent into vleis)

Date sample taken	Total dissolved solids at 180 C mg/l	Total dissolved solids at 600 C mg/l	Suspended solids at 180 C mg/l	Chloride (Cl) mg/l	Free and Saline Ammonia (N) mg/l	Nitrate (N) mg/l	Nitrite (N) mg/l	Phos-phorus (P) mg/l	Chemical Oxidation Demand (COD) mg/l	Oxygen absorbed from N/80 $KMnO_4$ 4hrs at 80°F mg/l	Bio-chemical oxidation demand (BOD) mg/l	Alka-linity ($CaCO_3$) mg/l	pH value	Remarks
28.04.75	59 668	45 700	50	26 240	10	0	8	2			7	170	8,3	
02.07.75	35 126	28 496	166	19 680	9	0,54	0,06	3,60	636	11	6	120	8,6	Lake full
27.08.75	23 660	17 370	98	10 990	1	0,01	0	0,35	197	5,1	1,5	250	8,2	Lake full
22.10.75	26 384	22 400	100	13 230	2,1	1,70	0	0,13	207	16	5,5	390	8,3	25% full
04.02.76	338 900	193 700	885	178 710	10,0	1,75	0,25	0,30			145	1 250	7,1	1-2% full
12.05.76	71 160	63 250	14	39 090		0,70	0,02	0		17	42	150	7,7	80% full
06.08.76	35 120	29 170	28	17 659		0,60	0,01	0	321	12	5,5	180	9,0	95% full

TABLE 3: WILDEVOËLVLEI BOTTOM DEPOSITS - 3.8.1977 (before discharge of effluent into vleis)

Stratum	Sample Point No. 1*		Sample Point No. 2*		Sample Point No. 3*		Sample Point No. 4*	
	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
% volatile solids	15,11	1,39	25,28	8,59	13,25	0,72	23,35	2,34
% total nitrogen	0,68	0,02	0,65	0,43	0,77	0,01	0,90	0,04
% total carbon	7,17	0,66	12,01	4,08	6,29	0,34	11,09	1,11
Total phosphorus mg/kg	420	80	630	310	1 220	30	550	180
Chemical oxygen demand mg/g	211	4,4	236	118	140	1,0	231	9,0
Carbon/Nitrogen ratio	10,5	33	18,5	9,5	8,2	34	12,3	27,8
Stratum thickness mm	100	50	100	50	100	100	125	50

* See centrespread.

TABLE 4: WATER ANALYSIS - WILDEVOËLVLEI (from Cape Divisional Council Water Pollution Control Branch Annual Report 83/84)

Sample		Treatment works final effluent	Wildevoëlvlei (see Figure)		
			Station 1	Station 2	Station 3
Biol. O_2 demand (BOD)	mg/l	5			
Chem. O_2 demand (COD)	mg/l	55			
Ammonia	mg/l	0,2	0,15	0,1	0,1
Nitrite NO_2 nitrogen	mg/l	0,2	0,15	0,1	0,1
Nitrate NO_2 nitrogen	mg/l	6,6	1,2	1,1	1,0
Dissolved solids	mg/l	429	1 995	2 897	2 776
Chloride as Cl	mg/l	119	750	860	895
Sulphate as SO_4	mg/l	58	290	224	244
Phosphorus as P	mg/l	5,0	2,8	1,1	2,6
Sodium as Na	mg/l	90	516	748	763
Potassium as K	mg/l	26	68	79	77
pH		8,7	8,9	9,2	9,2
Alkalinity as $CaCo_3$	mg/l	76			
Conductivity	mS/m	70	322	442	405

TABLE 5: PHYSICO-CHEMICAL DATA - WILDEVLOËLVLEI AND NOORDHOEK WETLANDS (ECRU Survey (1983), Giliomee (1984) and Boland (1974))

Locality (see centrespread) and date	Depth (m)	Temp. degree C		Salinity parts per 1 000		pH	Secchi
		Surface	Bottom	Surface	Bottom		
Wildevoëlvlei (upper) ECRU Stn 1, 21.11.83	0,60	22,6	21,3	4	5	7-8	> 0,60 m
Wildevoëlvlei (lower) ECRU Stn 2, 21.11.83	0,60	25,0	25,0	13	-	6-7	0,45 m
Wildevoëlvlei (channel) ECRU Stn 3, 21.11.83	0,60	26,6	25,6	15	15	7	> 0,60 m
Wildevoëlvlei (mouth) ECRU Stn 4, 21.11.83	0,40	-	-	22	-	-	> 0,40 m
Noordhoek Saltpan (south part) ECRU, 24.11.83	-	-	-	12	-	-	-
Noordhoek Saltpan (north part) ECRU, 24.11.83	-	-	-	9	-	-	-
Noordhoek Saltpan (south part) Giliomee, 03.02.84	-	-	-	20	-	8,8	-
Noordhoek Saltpan (north part) Giliomee, 03.02.84	-	-	-	15	-	9,0	-
Tidal lagoon (north) ECRU, 24.11.83	< 0,50	-	-	9 to 25		-	-
Tidal lagoon (north) Boland, July 1974 (range over 8 stations)	0,20-0,70	18,6 to 8,5		7 to 23		7,7-8,2	-
Pool in wetlands near beach, ECRU, 24.11.83	-	-	-	< 2	-	-	-

Some basic data were collected during the ECRU survey of November 1983 in the Wildevoëlvlei, the Noordhoek Saltpan and the northernmost backshore Lagoon. These data together with physico-chemical data extracted from Boland (1974) and Giliomee (1984) are presented in Table 5.

pH

From the tables it can be seen that the pH throughout the system is and has remained from neutral (7) to alkaline (9,2); this is despite the normally acid run-off one would expect from a TMS environment. The sandy soils with their high shell (calcium carbonate) content and the buffering effect of saline waters is probably the reason for the high pH levels.

Salinity

The salinities of the various water bodies fluctuate considerably according to the seasons. This can be attributed to a high evaporative loss from the shallow pans during the hot windy summers and the fresh water input from the catchment in the winter.

The variation in salinity of the Wildevoëlvlei has been drastically reduced since the continuous input of treated sewage effluent commenced.

According to Waher (1971) it appears that the salt content of the Noordhoek Saltpan is being reduced; this is evidenced by an increase in the growth of the bulrush (*Typha* sp.) and other essentially fresh water species.

Nutrients

Although the levels of nutrients in the Wildevoëlvleis are relatively high, the input from the sewage treatment works does not appear to be causing any undue eutrophication problems at present. The reduction in the ammonia, nitrite, nitrate and phosphorus levels between the final effluent from the treatment works and the samples taken in the vlei itself (see Table 4) is no doubt due to uptake of these nutrients by the prolific growth of aquatic plants in the vleis (see Figure 9). The large numbers of mullet found in the vleis benefit from the vast amount of particulate organic matter, epiphytic algae and detritus which is present in the system.

4.2.6 Pollution and Public Health Aspects

Prior to the release of treated sewage effluent into the Wildevoëlvlei in 1977, these vleis normally dried up during the hot summer months. At present they contain water perennially and practically all the summer inflow can be attributed to the treated sewage effluent input. The treatment works handled an average daily flow of incoming waste water of 2 715 m^3 per day with flows of up to 4 000 m^3 per day in winter. It is not known exactly what percentage of this reaches the vlei in the form of treated effluent but it can be assumed that it is about 80 percent.

At present the treatment plant only handles sewage from Fish Hoek, Sun Valley and Ocean View, but with the expected increase in townships and residential areas within the Noordhoek/Kommetjie basin, the amount of effluent entering the vleis is likely to increase proportionately.

The permit issued to the Divisional Council allows an average dry weather flow of sewage to the first stage of the purification works not exceeding 7 000 m^3 per day. The final effluent must comply with the General Standards as laid down

FIG. 9: Prolific aquatic vegetation in the upper Wildevoëlvlei.

in Government Notice R553 of 5 April 1962. In the case of Wildevoëlvlei the conditions with respect to the maximum *E. coli* counts were relaxed to allow up to 1 000 *E. coli* per 100 ml of effluent. The normal standard is a maximum of 200 *E. coli* per 100 ml. From the Divisional Council records for the period January 1982 to June 1983 the *E. coli* counts varied between nil and 79 MPN* per 100 ml. This is well within the limits imposed by their permit.

Permit conditions state that the lagoons must be fenced off to prevent recreational activity and notices warning the public to this effect are supposed to be erected. As both Wildevoëlvlei are situated on private land the public normally does not have access to them.

During the ECRU survey in November 1983, eutrophic conditions existed in the channel from the vleis and in the mouth region where dense mats of both actively growing and rotting filamentous algae were present (see Plate III).

Although the mouth of the vleis is situated some distance from the sewage effluent outfall, no notices exist at the mouth warning the public of the possible dangers of bathing in the estuary.

In the Saltpan and the remainder of the water bodies, seasonal reduction in water level concentrates the nutrients present, which leads to prolific aquatic plant growth and eventually to eutrophic conditions as plant material dies and starts rotting. Both Hill Kaplan Scott and Partners (1972) and Giliomee (1984) express concern about the effects of this type of problem on proposed township development schemes at the Wildevoëlvlei and Noordhoek Saltpan respectively. With any form of waterside residential development, the maintenance of high water quality is of prime importance.

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* MPN = Most Probable Number.

The refuse dump situated north-west of the Saltpan is a source of unsightly litter which is blown around and distributed by the strong winds which funnel through the Noordhoek/Fish Hoek Gap. Furthermore, pollution of the ground water by substances dumped at the refuse site is likely to occur.

In the event of increased kaolin mining taking place, air pollution from the fine kaolin dust can be expected, particularly along the roads used by the trucks carrying kaolin to the railhead at Fish Hoek. If the kaolin is mined down to the parent granite bed rock, possible pollution of ground water supplies by water carrying kaolin in suspension could be expected (M A C Vandoolaeghe, *in litt.)*.

5. BIOTIC CHARACTERISTICS

5.1 Flora

(This section has been contributed by M O'Callaghan of the Botanical Research Institute, Stellenbosch)

5.1.1 Phytoplankton/Diatoms

Boland (1974) mentions the presence of *Navicula* sp. and abundant brown benthic diatoms throughout the northern backshore tidal lagoon.

5.1.2 Algae

Filamentous green algae (mainly *Enteromorpha* sp) were found in both vleis as well as in the southern backshore lagoon at the mouth of the vleis (see Figure 9). When water levels are low, the decay of these algae may cause unpleasant anoxic conditions. The presence and distribution of various species of algae have been noted by both Waher (1971) in the Noordhoek Saltpan and Boland (1974) in the northern backshore tidal lagoon.

5.1.3 Aquatic Vegetation

Potamogeton pectinatus was found in both vleis, but is most prolific in the upper vlei where a dense growth of brown epiphytic algae was present on most of the plants. This indicates a higher nutrient concentration in the water of the upper vlei, due to inflow from the sewage works.

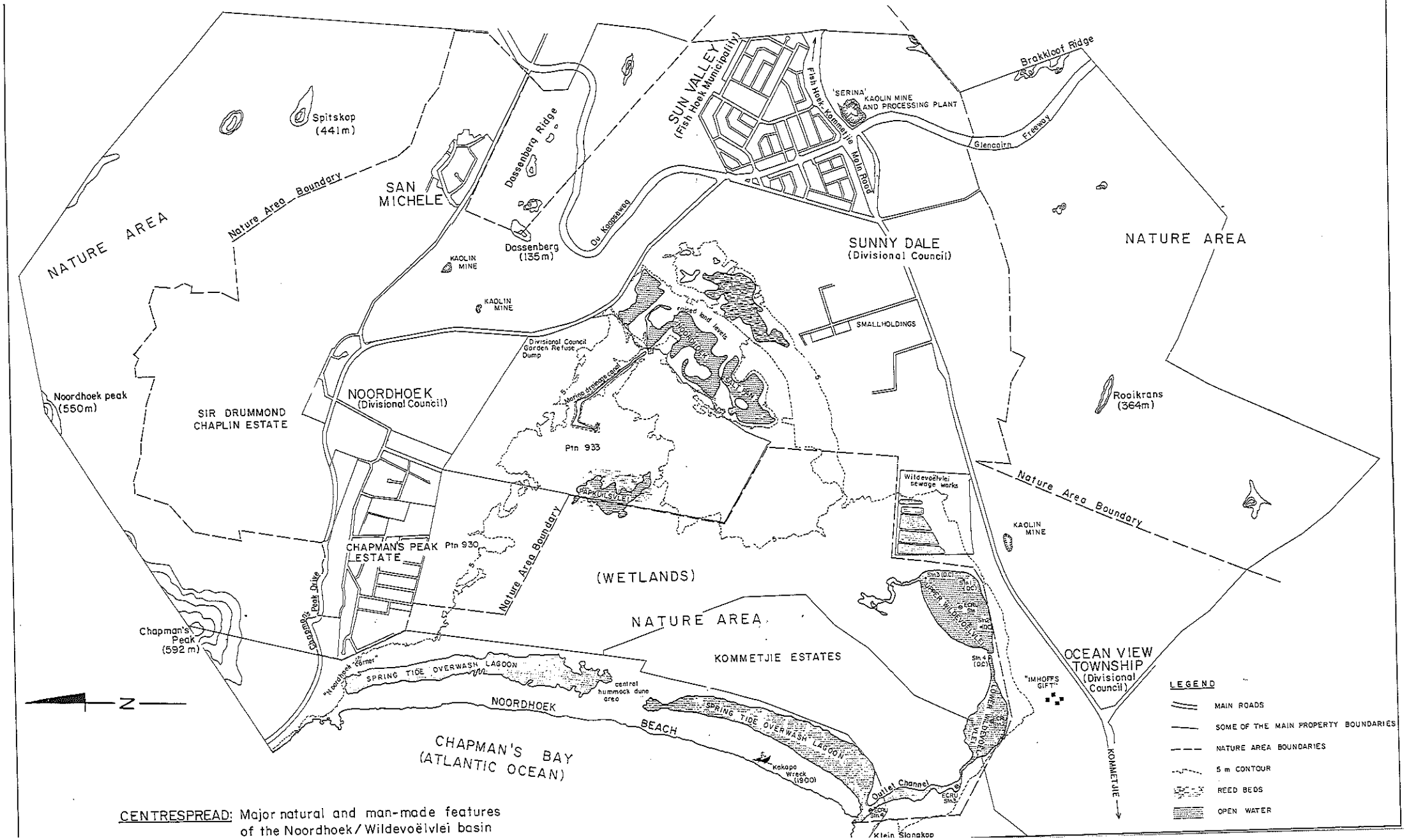
5.1.4 Semi-aquatic Vegetation

The entire Noordhoek basin is a relatively wet area and numerous semi-aquatic vegetation types are to be found (see Figure 10 and Appendix I).

(a) *Sporobolus virginicus/Scirpus maritimus* Fringe Vegetation

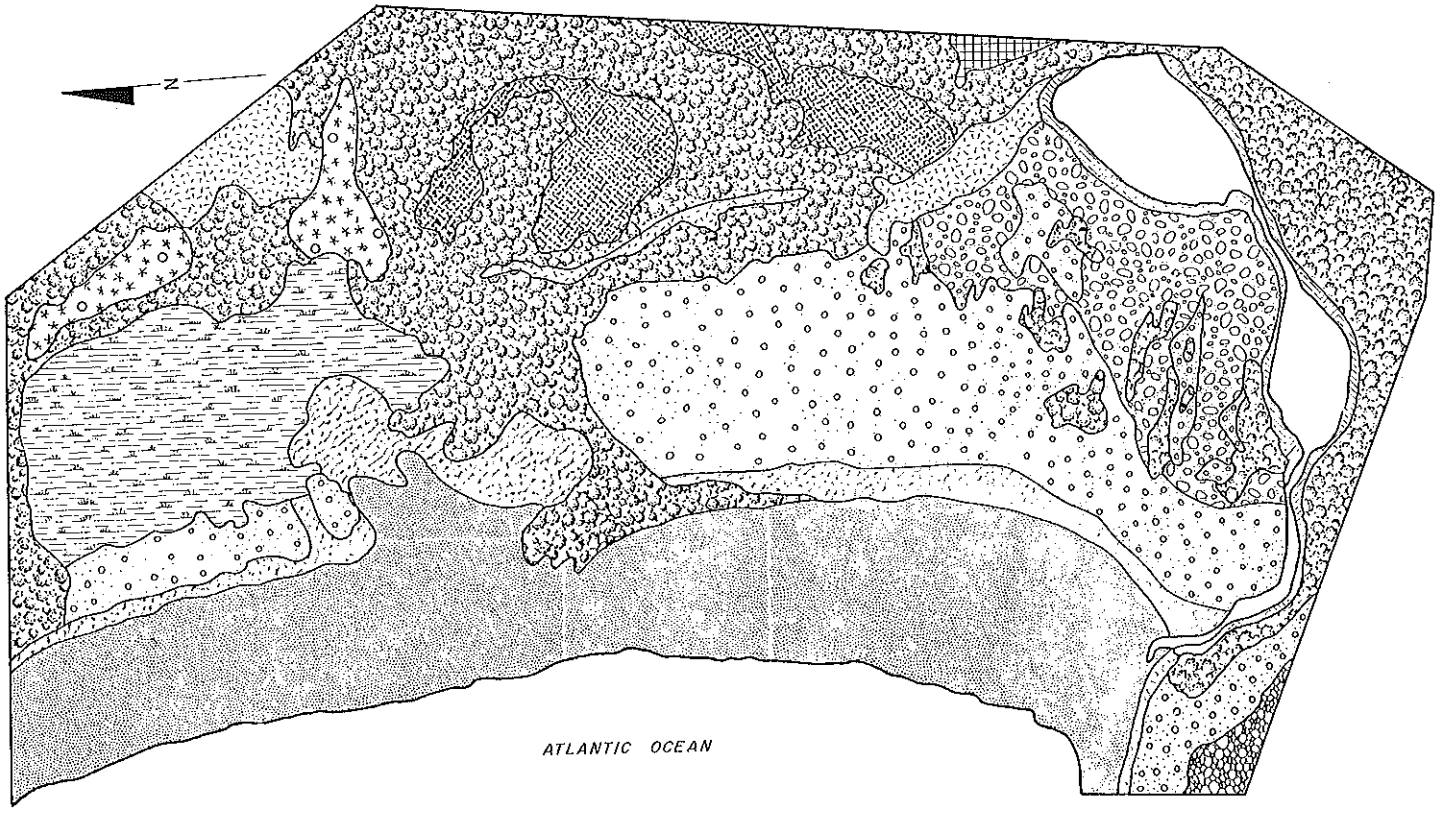
This wetland community is found around the vleis and is dominated, in most parts, by *Sporobolus virginicus* and *Scirpus maritimus*. Numerous other herbs, such as *Limonium scabrum, Triglochin striata, Sarcocornia natalensis* and *Apium graveolens* are also present. Small patches of emergent plants can also be found near the edges of the vleis e.g. *Typha capensis, Schoenoplectus triqueter, Mariscus thunbergii,* while some sedges, for example, *Juncus kraussi* and *Scirpus nodosus* are present in some areas.

Zonation, related to the height above water level, is evident in this vegetation type, except possibly to the south of the upper vlei where much disturbance has taken place and *Paspalum vaginatum* dominates.



CENTRESPREAD: Major natural and man-made features of the Noordhoek/Wildevoëlvlei basin

FIG. 10 : Major vegetation mapping units of the lower Noordhoek / Wildevoëlvlei wetlands.



LEGEND

- Sporobolus virginicus / Scirpus maritimus Fringe Vegetation
- Paspalum vaginatum / Chondropetalum tectorum Seasonally Flooded Areas
- Reed Swamps
- Juncus kraussii Seepage areas
- Dune Pioneers
- Restio eleocharis / Metalasia muricata Dune Scrub
- Hind Dune Scrub
- Proteoid Coastal Fynbos
- Restioid Coastal Fynbos
- Aliens
- Sand
- Water
- Sewage Works

0 200 400 600m
Approximate Scale

(b) *Paspalum vaginatum/Chondropetalum tectorum* - Seasonally Flooded Areas

To the north of the study area, the hind dune slack becomes seasonally flooded with run-off water and is totally dominated by *Paspalum vaginatum* in the very wet areas, with numerous tussocks of *Chondropetalum tectorum, Juncus kraussii* and *Scirpus nodosus*. Occasional herbs related to pioneer situations (see below) are found in the drier areas.

(c) Reed Swamps

To the east of this, in the Papkuilsvlei area, relatively large patches of *Phragmites australis* and *Typha capensis* were found.

(d) *Juncus kraussii* Seepage Areas

From the Papkuilsvlei towards the upper Wildevoëlvlei, there seems to be a seepage line completely dominated by *Juncus kraussi* with occasional *Ornithogalum thyrsioides*. During very wet seasons, these areas might become flooded, as is indicated by the presence of *Sarcocornia natalensis* and *Spergularia media*.

5.1.5 Terrestrial Vegetation

(a) Dune Pioneers

This sparse vegetation type is found on the foredunes and is dominated by herbs and grasses such as *Arctotheca populifolia, Tetragonia decumbens* and *Agropyron distichum*.

(b) *Restio eleocharis/Metalasia muricata* - Dune Scrub

This vegetation type is found on both sides of the outlet channel of the vleis. However, to the south, *Restio eleocharis* is dominant with numerous herbs and occasional shrubs. To the north, the restioids are not as dominant and shrubs such as *Olea exasperata, Nylandtia spinosa* and *Chironia baccifera* are more common. Numerous dense patches of *Euclea racemosa, Rhus glauca* and *Pterocelastrus tricuspidatus* are also found in this area.

(c) Hind Dune Scrub

On the tall protected dune to the south of the mouth, dense *Sideroxylon inerme, Cussonia thyrsiflora,* and *Sutherlandia fruticosa* scrub is present.

(d) Coastal Fynbos

Two types of coastal fynbos were found in this area. The first is found immediately north of the vleis and consists of a dense mid-high scrub dominated by *Leucodendron coniferum* and *Cephalus africanus*. The other coastal fynbos type is found to the north-east of the vleis, is less dense, contains very few shrub species (although numerous herb species are common to both types) and is dominated by *Thamnochortus erectus*.

(e) Aliens

The dominant aliens in this area are *Acacia saligna* and *A. cyclops*. They dominate large areas around the vleis, mostly on coastal sands. To the south-west of the vleis many *Hakea,* Australian Myrtle and *Eucalyptus* are also present in what might originally have been coastal mountain fynbos.

Both the wetland and terrestrial vegetation show distinct zonation patterns. The wetland zonation is on a micro scale and due mainly to differing water regimes. The terrestrial zonation is on a larger scale and can be attributed to soil types, protection and disturbance (for example, there is a distinct zonation from the pioneers through coastal scrub to coastal fynbos). This type of situation generally leads to a diverse and interesting vegetation. However, much of this vegetation has been replaced by alien plants which dominate large areas. For this reason, and the fact that this is one of the few places on the Cape Peninsula where coastal fynbos is found, a gradual removal of the aliens is recommended to allow the vegetation to revert to its natural state which could then be conserved.

5.2 Fauna

5.2.1 Zooplankton

No zooplankton data are available for the Wildevoëlvlei but Boland's work in 1974 on the northern backshore tidal lagoon gives details of the species found together with their distribution and abundance in the area he studied (Appendix II).

5.2.2 Aquatic Invertebrates

No data are available for the Wildevoëlvlei or the other fresh water bodies of the wetland system. Boland (1974) gives a detailed account of the fauna found in the northern backshore lagoon. The permanent macrofauna in this area are made up mainly of the isopod, *Pontogeloides latipes*, the anomuran *Callianassa kraussi*, the polychaete *Capitella capitata* and the dipteran larva *Tendipes* sp.

Kelp and other algae washed into the backshore lagoon and deposited onto a drift line, is broken down by the amphipod *Talorchestia*, the isopod *Tylos granulatus* and kelp fly larvae. A full list of the macro- and microfauna is given in Appendix II.

According to Boland, an interesting feature of the distribution of the sand prawn *(Callianassa kraussi)* on the Noordhoek beach is the depth to which it burrows (in places > 1 m). He maintains that this may be an attempt by these organisms to select a position where they are best able to tolerate the changes in salinity and water level which occur in this area.

The distribution and abundance of the aquatic invertebrates in the backshore lagoons is governed by the quality and quantity of water, both fresh and marine, which enters the system. During the wet winters there is a large input of fresh water from the landward side and also of sea water as a result of overwash during the winter storms. The southern backshore lagoon receives nutrient-rich water from the Wildevoëlvlei outlet which feeds this lagoon particularly when the beach berm obstructs the outlet.

In summer there is a reduction of both fresh water from the land and salt water from the sea. This, together with increased evaporation due to higher temperatures and the strong offshore southerly winds, results in a concentration of nutrients which leads to prolific algal growth, eutrophic and eventually hypersaline conditions in the ever-reducing pools of water. The species composition, abundance and distribution of the aquatic fauna would mirror these changes in their habitat, with the whole cycle recommencing as the backshore lagoons become re-established and recolonized at the onset of winter.

Although the sand prawn *(Callianassa kraussi)* populations in the northern backshore lagoon and the sand mussels *(Donax serra)* found in the intertidal area are difficult to obtain, they are nevertheless exploited to a limited degree by anglers for use as bait. (J v d Horst, pers. comm. and ECRU Survey 83.11.24, pers. obs.). Many water boatman *(Corixidae)* were caught in a D-net haul made in the upper vlei on 83.11.21.

5.2.3 Fish

During the ECRU Survey of 83.11.21 D-net trawls were made in both the upper and lower Wildevoëlvleis while gill nets were set in the lower vlei only.

A 100 m D-net trawl in the upper vlei produced one juvenile mullet *(Liza richardsoni)*. No fish or other aquatic fauna were caught in the haul made in the lower vlei. Numerous mullet were observed in the lower vlei, the outlet channel and amongst the mats of rotting algae at the mouth. A shoal of fish resembling Tilapia were seen in the shallow water of the outlet channel but they unfortunately eluded capture.

The gill nets set in the lower vlei for six hours on 83.11.24, caught ten mullet *(Liza richardsoni)* and a second setting of 24 hours (from 16h00 on 83.11.24 to 16h00 on 83.11.25) caught a large number of *L. richardsoni* and two big *Mugil cephalus* with fork lengths of 54,0 cm and 38,0 cm respectively. The size ranges of the gill net catches seem to indicate different year classes, which would suggest regular recruitment from the sea. The fish all had a large amount of fat surrounding the gut, indicating that they were in good condition with abundant food.

On 6 February 1984 officials of the Cape Department of Nature and Environmental Conservation set gill nets in the Noordhoek Saltpan (Island Glades Marina). They caught four springer *(Mugil cephalus)* ranging in size from 60,6 cm to 66,8 cm (fork length), four harder *(Liza richardsoni)* 38,9 cm to 44,2 cm (fork length) and numerous small tilapia *(Oreochromis mossambicus)* maximum size 12,0 cm (S Thorne, pers. comm.).

The springer and harder are marine/estuarine species which cannot breed in enclosed inland waters, their large size indicating that they must have been trapped in the Saltpan. They may have been introduced artificially by man or entered the system during an exceptionally wet winter when a connection with the tidal backshore lagoons may have existed. A resident of Noordhoek claims to have canoed from these lagoons through to the Saltpan via the drainage canal which was dug at the time dredging of the Saltpan took place for the proposed Island Glades Marina (see centrespread). Such a connection would have allowed the mullet to migrate into the Saltpan.

Although tilapia are indigenous to South Africa, they are not endemic to the Western Cape, therefore those found in the Wildevoëlvleis and the Saltpan must have been released in these systems or found their way there via overflow from nearby farm dams or the sewage works.

The presence of mullet in the backshore lagoons was noted by Boland (1974), (Appendix II).

5.2.4 Amphibians and Reptiles

During the ECRU Survey on 83.11.21 numerous platannas *(Xenopus)* were caught in the D-net trawl of the upper vlei and a large Cape cobra *(Naja nivea)* was seen on the shores of the vlei.

An internal report on the Noordhoek area, drawn up in December 1981 by the Department of Environment Affairs, using information supplied by Mr A L de Villiers of the Cape Department of Nature and Environmental Conservation lists a total of 54 species of amphibians, tortoises, snakes and lizards that occur or are likely to occur within the Noordhoek/Wildevoëlvlei valley and its immediate environs (Appendix III).

Included amongst the species of frog found in the area are the Cape platanna *(Xenopus gilli)* and the micro frog *(Microbatrachella capensis)* which are listed as rare and endangered species (Mc Lachlan, 1978). It should be apparent that survival of these amphibians is directly related to the preservation of their habitat within the wetland system.

Two species of snake, the Cape-many-spotted snake *(Amplorhinus multimaculatus)* and the rinkhals *(Hemachatus haemachatus)* which appear on the Wildevoëlvlei/ Noordhoek distribution list, are also considered as being severely threatened in the Cape Peninsula (Mc Lachlan, 1978).

5.2.5 Birds

One of the most important conservation aspects of the Wildevoëlvleis and the Noordhoek wetlands is the habitat it provides for waterfowl and wetland avifauna.

Winterbottom (1960) considered the Noordhoek Saltpan, before it was dredged, as one of the strongholds of the Yellowbill Duck in the Western Cape and at times it also supported large numbers of Greater and Lesser Flamingo. After dredging in 1974 the character of the Saltpan changed and it was no longer suitable for waders and the birds which prefer shallow seasonal pans (Giliomee, 1984). The continuous flow of treated sewage effluent into the Wildevoëlvlei has also altered the seasonal nature of these pans by changing them into permanent shallow lakes. This will have adversely affected some species but benefited others which prefer permanent nutrient-rich waters. The changes that have taken place in these water bodies do, however, place greater emphasis on the need to conserve the numerous small seasonal pans occurring within the wetland system for those species of bird which are adapted to and require this form of habitat.

The tables and check lists given by Winterbottom (1960), Summers, Pringle and Cooper (1976) and the unpublished list of the Western Cape Wader Study Group (June 1982 and July 1983) indicate that the Wildevoëlvlei/Noordhoek wetlands constitute a very important wetland habitat, particularly as part of the chain of wetlands throughout the Western Cape. An appendix by R K Brooke of the Percy FitzPatrick Institute of African Ornithology given in Graupner and Cohen (unpublished internal report, DEA, 1981) lists 181 species of birds occurring in the Noordhoek/Wildevoëlvlei area. Of these, 103 species are confined mainly to the wetlands and coastal areas. As the survival of these species is ultimately linked to the maintenance of their habitat, it is important that the Noordhoek/ Wildevoëlvlei wetlands and adjacent coastal areas are conserved.

A list of wetland species recorded by Underhill and Cooper (1983) from the Wildevoëlvleis and its environs is given in Appendix IV.

With South Africa being a signatory to the Ramsar Convention on Wetlands of International importance as waterfowl habitats, we have a responsibility to protect migrant species receiving protection in the Northern Hemisphere (Summers, Pringle and Cooper, 1976).

According to Graupner and Cohen (unpublished internal report, DEA, 1981) and Blandy (in prep.) the Noordhoek backshore tidal lagoons are an important habitat for waders and coastal birds such as the Black Oyster-catchers and White-fronted Plover which are known to breed in this area.

During the ECRU Survey in November 1983, large numbers of waterfowl, which included Egyptian and Spurwing geese, African Shelduck, Yellowbill Duck and Cape Teal were seen in the numerous small flooded pans and depressions in the Papkuilsvlei area.

5.2.6 Mammals

A checklist of mammals recorded from the area covered by the 1:50 000 quarter degree grid squares of the Cape Peninsula 3418 AB and AD is given in Appendix V (Stuart *et al.*, unpublished and Stuart, 1981). Graupner and Cohen (unpublished internal report, DEA, 1981) list the mammals of the Noordhoek area together with a description of their preferred habitats. They also mention species which possibly occur or used to occur in the area. It is of interest to note that skeletal remains of the African elephant *(Loxodonta africana)* and the black rhinoceros *(Diceros bicornis)* have been found at Noordhoek. They state that the Cape clawless otter *(Aonyx capensis)* "probably occurred in the Noordhoek area until the recent past." Positive spoor identification of *A. capensis* was made at the mouth of the Wildevoëlvlei outlet channel during the ECRU survey on 83.11.21.

Species which are known to occur specifically within the Noordhoek/Wildevoëlvlei wetlands are indicated by means of an asterix in Appendix V (J v d Horst and other local residents, pers. comm.).

The inclusion within the Cape Peninsula Nature Area of a large portion of the low-lying wetlands adjacent to the beach has secured the future of many of the smaller mammals in this area. This, however, will only be possible if the use of the area is strictly controlled and if effective measures are adopted to prevent setting of snares and to keep dogs out of the area.

6. SYNTHESIS

Traditionally the Noordhoek/Wildevoëlvlei basin has been essentially an agricultural area. Dairy and vegetable farming was, and still is, carried out in the Noordhoek basin and central areas while the dry, warmer southern parts of the valley were used for poultry and vegetable farming on a smaller scale.

Kommetjie on the southern edge of the area has always been a traditional seaside holiday resort for people living in the built-up areas of Cape Town. Many of the original families who had holiday homes at Kommetjie when it was first established, are still living in the area.

After the spectacular Chapman's Peak drive was cut into the precipitous mountain slopes above the sea between Hout Bay and Noordhoek in 1922, the Noordhoek valley, the deserted beach and the Noordhoek wetlands became an important part of the scenic drive around the Cape Peninsula.

The growth of Cape Town's southern suburbs and in particular the Fish Hoek, Simonstown and Sun Valley areas made it essential that access to this part of the Peninsula be improved. This resulted in the construction of the Ou Kaapse Weg over the Steenberg Plateau in 1968 and of the Glencairn Freeway from Sun Valley to Glencairn in 1978. These roads shortened the travelling time between

Cape Town, Fish Hoek and Simonstown considerably as they avoided the narrow congested coastal road between Muizenberg and Fish Hoek. They also made the Noordhoek and Kommetjie areas far more accessible.

This improved access together with the desire by many people living within the confines of Cape Town's suburbia to "escape" to a quiet rural environment, created a potential within the Noordhoek/Kommetjie area for subdivision of the former farms and smallholdings into smaller units and rural type townships or estates. In fact increased farming costs and reduced returns had led to a tendency for subdivision even before the improved access offered by the construction of the Ou Kaapse Weg route. The property booms of the late 60s and early 80s also resulted in much speculative subdivision and dealing in property within the area. It was during these periods that the subdivision of San Michele and Chapman's Peak Estate took place as well as the development of the Coloured township Ocean View near Kommetjie. The dredging of the Noordhoek Saltpan for the creation of a waterside real estate development also took place during the early 1970s and an acute shortage of low cost housing led to the development of the housing scheme at Sun Valley by the Cape Divisional Council beginning in 1969.

An important consequence of all these developments was the necessity to provide for adequate sewage disposal. The old Fish Hoek treatment plant was neither well-placed nor large enough to handle the increased load, hence the new Wildevoëlvlei treatment works were constructed to serve the existing townships as well as the projected expansion within the Noordhoek/Kommetjie region. This treatment plant discharges treated effluent into the Wildevoëlvlei which were previously seasonal pans which dried out in summer but which now contain water throughout the year.

Particular attention was focused on Noordhoek in 1980/81 when plans to expand the kaolin mining activities within the area were published. Kaolin had been mined at Brakkekloof, above Sun Valley, for many years, and there were a few smaller pits nearer Noordhoek and alongside the road towards Kommetjie. This mining is all open cast and most of it is carried out at a low intensity.

Following a public outcry about planned expansion of the kaolin mining operations, the Department of Constitutional Development and Planning commissioned a firm of ecological consultants to carry out an environmental impact assessment. Unfortunately the results of the entire assessment were not made public but three areas were identified and reserved for possible future exploitation of kaolin. The impact assessment states that if and when exploitation took place this was to be very strictly controlled to minimize environmental damage.

The kaolin "issue", however, also focused attention on a number of other important environmental aspects of the Noordhoek/Wildevoëlvlei area, including the coastal lowland fynbos which occurs within the low-lying wetland. It has been pointed out that this is the most seriously neglected part of the entire Fynbos Biome (Prof. J R Grindley, UCT *in litt.)*.

The high aesthetic and scenic values of the area were stressed, for overseas tourists as well as for local tourists and the inhabitants of Cape Town, who rated the undeveloped Noordhoek beach and wetlands very high on their list of favoured areas (Co-ordinating Council for Nature Conservation in the Cape, *in litt.)*.

Other aspects which were highlighted by the kaolin mining impact assessment was the need to protect the wetland system as a habitat for waterfowl, the general sensitivity of the wetlands insofar as water levels, pollution and the water

table/plant community relationship was concerned. The fact that flooding problems could arise if development were to be allowed in low-lying areas was also pointed out.

The need to conserve areas of coastal lowland fynbos and special wetland habitat types together with their associated fauna as mentioned by Hey (1978) and highlighted by the impact assessments carried out in the Noordhoek/Kommetjie area, no doubt played a big part in ensuring that a large proportion of the wetland system and the coastal strip were included in the Cape Peninsula Nature Area which was proclaimed by the Department of Environment Affairs under the Physical Planning and Utilization of Resources Act No. 88 of 1967.

Increasing demands for smallholdings or 'country estates', together with the desire by most of the present residents of the Noordhoek/Kommetjie basin to retain the special rural atmosphere which originally attracted them to the area, has necessitated a review of the existing town planning schemes for the entire area by the administrative and management authority, that is, the Cape Divisional Council. The revised scheme will have to take all the environmental, agricultural, industrial and socio-economic factors into account.

The need for co-ordinated action had been recognized by the Central Government in the 1960s when the idea of "guide plans" was put forward to direct the orderly spatial development of large urban complexes. This concept resulted in a non-statutory draft guide plan for the Cape Metropolitan Area which was published as a draft in 1984.

Insofar as the Noordhoek/Kommetjie area is concerned, the draft guide plan states that "the highest priority must be given to drawing up a master plan in terms of Section 6A(13) of the Physical Planning Act No. 88 of 1967 for the area between Durbanville, Fisantekraal and Kraaifontein as well as for the **Fish Hoek/ Kommetjie/Noordhoek Area** with a view to the future urbanization of these areas."

The guide plan also mentions the fact that because of the limitation imposed by high potential agricultural land on the borders of the Metropolitan area and the steep slopes of the mountain areas, higher residential densities than those that occur at present, should be aimed for in the Peninsula area (densities at that stage were approximately 25 persons per hectare and a possible future density factor of 35 persons per hectare was suggested).

In this respect it must be assumed that this refers to the existing level in urban areas of the Peninsula because, the guide plan continues "In spite of the desire for higher residential densities in general, urban densities in the Peninsula's mountain range" (which no doubt includes the Noordhoek area) "must be kept as low as possible, while emphasis must be placed on nature conservation and recreational development."

Extracts from the final recommendations from the Cape Metropolitan Area Draft Guide Plan which must be used as general planning guidelines in drawing up the Structure Plan for the Noordhoek/Kommetjie basin are given in Appendix VI.

Before concluding the report with recommendations based largely on those of the Draft Guide Plan it may be useful to try and identify the most sensitive and critical components of the system and what actions or factors are likely to threaten these components. A similar exercise was carried out by Graupner and Cohen (unpublished internal DEA report, 1981) when they assessed the desirability of conserving the Noordhoek/Wildevoëlvlei basin.

The most sensitive components which can be identified are:

(i) The entire low-lying inter-connected system of wetlands which are associated with the habitat for waterfowl and the endangered coastal fynbos which may in turn be linked to a critical vegetation/high water table relationship.

(ii) The barrier dunes at the edges of the backshore lagoons and the hummock dune/blow-out area in the central portion of the basin.

(iii) The beach environment, particularly in view of the major geomorphological processes that have taken place and are taking place and the potential effects of these on possible future developments in the area.

(iv) Last and by no means least, the scenic and aesthetic value of the basin as a whole.

Actions and factors which may be detrimental to the above components and the processes governing them are:

(i) Pollution of the wetlands from urban stormwater input, enriched sewage effluent, polluted seepage from refuse dumping sites and possible pollution as a result of future mining operations.

(ii) Changes to the Saltpan and Wildevoëlvleis by

(a) dredging,
(b) continuous water supply in the form of treated sewage effluent and
(c) the planned future development adjacent to these water bodies.

(iii) Farming practices which may be incompatible with conservation of the wetlands, waterfowl and the coastal fynbos.

(iv) Groundwater extraction for farming, mining or household use. This could lead to changes in the vegetation/water table relationship which in turn could lead to re-activation of the sensitive stabilized dune areas.

(v) Encroachment of alien vegetation which poses a threat to the coastal fynbos, the wetland waterfowl habitat and the aesthetic attraction of the area.

(vi) General human disturbance in the wetlands and on the dunes by trampling, destruction of vegetation, disturbance of wildlife, littering and pollution.

(vii) The visual impact of housing and other developments, mining and refuse disposal sites.

Obviously these detrimental factors and actions will reduce future options for use of the region. Nevertheless the very real needs of the present and future residents of the area as well as the public in general cannot be ignored, in particular:

(i) The rights and aspirations of the present property owners and residents must be considered.

(ii) The needs of people who wish to live in a rural/small holding type of environment within a reasonable distance of their places of work. Of

special significance in this respect is the keeping of horses and provision of horse-riding facilities. It is significant that most major cities of the world provide for horses and horse-riding on the outskirts of the built-up suburbs.

(iii) The fact that higher-potential agricultural land must not be allowed to become unproductive.

Conclusions and Recommendations

(a) The existing main roads and the Nature Area boundary form a convenient demarcation for the formal metropolitan type of "one erf one owner" township. It is recommended that no further township development of this type should take place inside the area bounded by the Chapman's Peak main road to the junction of the road leading up to San Michele, then along the road to the Noordhoek Shopping Centre, then along the western boundary of the Sun Valley Estension up to the junction of this boundary with the Kommetjie/Fish Hoek main road, then along this road up to a point where this road comes closest to the upper Wildevoëlvlei (see centrespread).

(b) The Nature Area should be extended to include the entire Divisional Council Amenity Area (Ptn 933) to the north-east of the existing Nature Area boundary and the two portions of De Goede Hoop 930 to the north (see centrespread). If it is not feasible to include these properties within the Nature Area, consideration should be given to including at least as much of the area situated below the 5 m contour as possible.

(c) The farming operations or development of private properties within the Nature Area must be compatible with the conservation objectives laid down for the area.

(d) The land between the Nature Area boundary and the proposed limit for metropolitan township development (see (a) above) should be zoned as an extensive rural residential area, that is, properties with a minimum size limit of at least two hectares except where smaller subdivision rights are already in existence. This zone would act as a buffer strip between the Nature Area and the high density metropolitan housing developments. The health and building regulations should allow for the keeping of animals and certain agricultural activities.

(e) No permanent fixed structures should be permitted below the 5 m contour line (see centrespread) and no in-filling of land situated below this level should be allowed.

(f) If the Noordhoek Saltpan cannot be conserved in its present form, low-density suitably designed housing grouped in clusters in order to maximize the amount of open space, or some form of recreational development could be considered for this area. The maintenance of the highest water quality within this body of water is of prime importance for the success of any project undertaken at this site. Any form of development planned here should provide guarantees of being able to achieve the above ideal.

(g) Recreational use of the Nature Area must be very carefully planned and controlled. Bridle and footpaths must be demarcated and well defined particularly within the dune areas. The fact that private properties fall within the Nature Area does not give the general public automatic right of access to these properties; such access could, however, be negotiated with the property owners.

(h) Off-road vehicles, should be banned from the Nature Area, particularly in the dune areas.

(i) Management of the Wildevoëlvleis and especially the standard of the effluent from the sewage treatment discharged into them should be of the highest standard to maintain their ecological function and avoid health hazards.

(j) The provision of recreational facilities within the Noordhoek/Kommetjie basin should vary from high density intensive facilities such as caravan parks, chalets etc. which could be considered at the Noordhoek "corner", the Saltpan and at the Kommetjie end of the beach, to simpler facilities consisting merely of cleared paths, bird watching hides and odd rest spots which could be considered towards the central parts of the wetlands and beach.

(k) Concerted systematic removal of all alien vegetation should be undertaken as soon as possible, particularly within the Nature Area.

(l) An alternative site and method of refuse disposal other than that presently being used, just north of the Saltpan should be investigated.

(m) The kaolin reserves should only be exploited if no alternative sources are available. If mining is carried out it must be very strictly controlled to keep the environmental impact to a minimum.

(n) Any structures erected or developments carried out in the vicinity of the beach must take the changing morphology of the beach into consideration.

The wild, unspoilt scenic aspect of this beach is its greatest asset and should be preserved at all costs.

Finally, it is recommended that an overall formal management plan should be drawn up for the entire area from Noordhoek to Fish Hoek and Kommetjie, including that portion of the proclaimed Cape Peninsula Nature Area which falls within the basin. This management plan should be administered by a sub-committee of the Cape Divisional Council appointed specifically for that purpose and must include representatives from the Local Area boards and the Cape Peninsula Nature Area management committee.

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8. REFERENCES

Literature Cited

BIRCH, G F (1979). Nearshore quaternary sedimentation off the south coast of South Africa. In: *Marine Geoscience Unit. Technical Report* No. 11, Joint Geological Survey/Univ. of Cape Town Marine Geoscience Unit: 128-147.

BLANDY, C (in prep.). The Noordhoek Valley - proposed Structure Plan. Divisional Council of the Cape, Engineers Department, Town Planning Branch. *Report* No. TP85/4.

BOLAND, J (1974). The ecology of Noordhoek beach. *B.Sc. Hons. Project.* (Zoology), University of Cape Town. 42 pp (unpublished).

BULPIN, T V (1980). *Discovering Southern Africa.* Cape Town, T V Bulpin Publications. 899 pp.

CAPE METROPOLITAN AREA DRAFT GUIDE PLAN (1984). Vol. 1: Peninsula. Guide plan committee for the Cape Metropolitan area. 233 pp.

DIVISIONAL COUNCIL OF THE CAPE (1983). Water Pollution Control Branch, *Annual Report* for 1982.

FROMME, G A W (in prep.). The dynamics of the Wildevoëlvlei-Noordhoek basin. Stellenbosch. CSIR Report T/SEA (to be published).

GASSON, B (1984). An examination of the climatic processes, patterns and peculiarities of the Noordhoek-Kommetjie area. University of Cape Town, Department of Urban and Regional Planning. *Unpublished Report.*

GILIOMEE, J H (1984). Ecological considerations in the development of the saltpan for residential purposes. University of Stellenbosch, Faculty of Agriculture. *(Unpublished Report).* 29 pp.

HAUGHTON, S H (1933). *The geology of Cape town and adjoining country. An explanation of Sheet No. 247 (Cape Town).* Pretoria Department of Mines. Geological Survey. 77 pp.

HEY, D (Commissioner) (1978). *Report* on the future control and management of Table Mountain and the Southern Peninsula Mountain Chain. Pretoria. Government Printer. 113 pp.

HEYDORN, A E F and TINLEY, K L (1980). Estuaries of the Cape. Part I. Synopsis of the Cape coast. Natural features, dynamics and utilization. Stellenbosch. *CSIR Research Report* 380. 96 pp.

HILL KAPLAN SCOTT AND PARTNERS (1972). *Kommetjie estates Ltd. Preliminary feasibility study.* Project 3837. Cape Town. 344 pp.

MACLEAN, G L (1985). *Roberts' birds of South Africa.* Cape Town, Trustees of the John Voelcker Bird Book Fund. 848 p.

McLACHLAN, G R (1978). South African red data book - reptiles and amphibians. Pretoria. *S. Afr. Natl. Programmes Rep.* 23. 53 pp.

MIDGLEY, J F (1975). *Kommetjie, C P. Its story.* Kommetjie, J Midgley. 90 pp.

MIDGLEY, D C and PITMAN, W V (1969). Surface water resources of South Africa. *Report* No. 2/69. Hydrological Research Unit. University of Witwatersrand. 127 pp.

NOBLE, R G and HEMENS, J (1978). Inland water ecosystems in South Africa - a review of research needs. Pretoria. *S. Afr. Natl. Programme Rep.* 34. 150 pp.

ROGERS, J (1980). *First report on the Cenozoic sediments between Cape Town and Elands Bay.* Pretoria. Geological Survey. Department of Mineral and energy Affairs. 107 pp.

SKENE, D (1983). Noordhoek Beach: A study of the response of the beach and surf zone to the high energy wave regime. *Honours project report.* Oceanography Department, University of Cape Town (unpublished).

SMITH-BAILLIE, A L *et al.* (1976). *Soil survey of the Cape Peninsula.* Pretoria. Soil and Irrigation Research Institute. Department of Agricultural Technical Services. 65 pp.

SOUTH AFRICA (REPUBLIC). Physical Planning and Utilization of Resources *Act* No. 88 of 1967.

SOUTH AFRICA (REPUBLIC). Water *Act* No. 54 of 1956.

SOUTH AFRICA (REPUBLIC). *Government Notice* R553 of 1962. Regional standards for industrial effluents. Government Gazette Extraordinary 5 April 1962: 9.

SOUTH AFRICAN WEATHER BUREAU (1965). Climate of South Africa, Part 9. Average monthly rainfall up to the end of 1960. *WB* 29.

STUART, C T (1981). Notes on the mammalian carnivores of the Cape Province, South Africa. *Bontebok* 1. 58 pp.

STUART, C T, LLOYD, P H and HERSELMAN, J C (1980). Preliminary distribution maps of the Cape Province (excluding Cetacea). Cape Provincial Administration, Department Nature and Environmental Conservation. *Unpublished Research Report.* Mammals. 176 pp.

SUMMERS, R W, PRINGLE, J S and COOPER, J (1976). *The status of coastal waders in the South-Western Cape, South Africa.* Cape Town. Percy FitzPatrick Inst. of African Ornithology. 162 pp.

SWART, D H and SERDYN, J de V (1982). Statistical analysis of visually observed wave data from voluntary observing ships (VOS) for the South African coast. Stellenbosch. *CSIR Report* T/SEA .... (to be published).

TREASURE, P A (1977). *Kaolin deposits of Noordhoek Valley, Cape Peninsula.* Pretoria. Geological Survey. Department of Mines. 32 pp.

UNDERHILL, L G and COOPER, J (1983). Counts of waterbirds at coastal wetlands in Southern Africa: Estuaries 1979-1981. *Unpublished report,* interim version UWETLD. Cape Town, Western Cape Wader Study Group and Percy FitzPatrick Institute of African Ornithology.

VAN DER MERWE, I J, ZIETSMAN, H L and VAN DER MERWE J H (1981). Koalienontginning in die omgewing van Vishoek, Noordhoek en Kommetjie - 'n meningsopname. Universiteit van Stellenbosch, *Instituut vir Kartografiese Analise, Publikasie* No. 9/981. 19 pp.

VAN HEERDEN, I (1985). Barrier/estuarine processes; Bot River estuary - an interpretation of aerial photographs. *Trans. Roy. Soc. S. Afr.* 45, Parts 3 and 4: 239-251.

VAN HEERDEN, I (in prep.). Aeolian processes at Noordhoek Beach.

VISKOR (1981). Wind readings, Hout Bay, 1979 to 1981. Viskor-gauge AES. *Plan* Nos F55 x 389-2 (unpublished). 5 pp.

WAHER, J (1971). An ecological survey of Noordhoek saltpan. *Project report.* Botany Department, University of Cape Town (unpublished). 43 pp.

WHITTEN, D G A and BROOKS, J R V (1978). *A dictionary of geology.* Middlesex, England. Penguin. 493 pp.

WINTERBOTTOM, J M (1960). Report on the Cape bird club vlei counts, 1952-58. *Ostrich* XXXI(4): 135-168.

Maps

CAAP DE GOEDE HOOP. Caart der Situatie van de Caap de Goede Hoop. S W van der Graaf, Barbier 1786. (Government Archives. No. M1-960).

CAPE DIVISION: Rockland's Point and Hout River mouth to Muizenberg and Chapman's Bay. M J Brink, 1901. (Government Archives No. M3-2517).

CAPE OF GOOD HOPE. An eye-sketch taken from the heights A and B of Hout Bay and Chapman Bay near Cape Good Hope. Capt. Edward Rieu, 1790. (Government Archives No. M1-3544).

CAPE OF GOOD HOPE. Survey of Cape of Good Hope showing Robben Island, Cape of Good Hope with False Bay. W F W Owen and A T E Vidal, 1822. (Government Archives No. M1-1388).

CAPE PENINSULA. Map of the Cape Peninsula. Robben Island and coast to the immediate north of the peninsula. C Neumann Thomas, 1890. (Government Archives No. M3-1806).

SOUTH AFRICA 1:50 000 Sheet 3418 AB + AD. Simonstown, 3rd edition. Pretoria, Government Printer. 1978.

SOUTH AFRICA 1:1000 000 Geological map. Southwestern sheet. Gravity edition. Pretoria. Government Printer. 1978.

SOUTH AFRICA, NAVY 1:100 000 Chart 636. Africa South Coast, Table Bay to False Bay 1933-63. The Hydrographer. 1964.

Aerial Photography

Date	Job No.	Photos Nos	Scale	Colour	Source
March 1944	61/44	323	1:18 000	B&W	Trig. Survey
1958	424	7034,7035	1:30 000	B&W	Trig. Survey
68-10-21	620	507	1:20 000	B&W	Trig. Survey
Feb. 1977	282	169, 171	1:64 000	Col.	University of Natal
79-04-21	326	388, 390, 391	1: 9 800	Col.	University of Natal
80-04-01	348	50	1:20 000	B&W.	University of Natal

GLOSSARY OF TERMS USED IN PART II REPORTS

ABIOTIC: non-living (characteristics).

AEOLIAN (deposits): materials transported and laid down on the earth's surface by wind.

ALIEN: plants or animals introduced from one environment to another, where they had not occurred previously.

ALLUVIUM: unconsolidated fragmental material laid down by a river or stream as a cone or fan, in its bed, on its floodplain and in lakes or estuaries, usually comprised of silt, sand or gravel.

ANAEROBIC: lacking or devoid of oxygen.

ANOXIC: the condition of not having enough oxygen.

AQUATIC: growing or living in or upon water.

ARCUATE: curved symmetrically like a bow.

BARCHANOID (dune): crescent-shaped and moving forward continually, the horns of the crescent pointing downwind.

BATHYMETRY: measurement of depth of a water body.

BENTHIC: bottom-living.

BERM: a natural or artificially constructed narrow terrace, shelf or ledge of sediment.

BIMODAL: having two peaks.

BIOGENIC: orginating from living organisms.

BIOMASS: a quantitative estimation of the total weight of living material found in a particular area or volume.

BIOME: major ecological regions (life zones) identified by the type of vegetation in a landscape.

BIOTIC: living (characteristics).

BREACHING: making a gap or breaking through (a sandbar).

CALCAREOUS: containing an appreciable proportion of calcium carbonate.

CALCRETE: a sedimentary deposit derived from coarse fragments of other rocks cemented by calcium carbonate.

CHART DATUM: this is the datum of soundings on the latest edition of the largest scale navigational chart of the area. It is -0,900 m relative to the land levelling datum which is commonly called Mean Sea Level by most land surveyors.

COLIFORMS: members of a particularly large, widespread group of bacteria normally present in the gastro-intestinal tract.

COMMUNITY: a well defined assemblage of plants and/or animals clearly distinguishable from other such assemblages.

CONGLOMERATE: a rock composed of rounded, waterworn pebbles 'cemented' in a matrix of calcium carbonate, silica or iron oxide.

CUSP: a sand spit or beach ridge usually at right angles to the beach formed by sets of constructive waves.

"D" NET: a small net attached to a "D" shaped frame riding on skids and pulled along the bottom of the estuary, used for sampling animals on or near the bottom.

DETRITUS: organic debris from decomposing plants and animals.

DIATOMS: a class of algae with distinct pigments and siliceous cell walls. They are important components of phytoplankton.

DYNAMIC: relating to ongoing and natural change.

ECOLOGY: the study of the structure and functions of ecosystems, particularly the dynamic co-evolutionary relationships of organisms, communities and habitats.

ECOSYSTEM: an interacting and interdependent natural system of organisms, biotic communities and their habitats.

EDDY: a movement of a fluid substance, particularly air or water, within a larger body of that substance.

ENDEMIC: confined to and evolved under the unique conditions of a particular region or site and found nowhere else in the world.

EPIFAUNA: animal life found on the surface of any substrate such as plants, rocks or even other animals.

EPIPHYTE: a plant living on the surface of another plant without deriving water or nourishment from it.

EPISODIC: sporadic and tending to be extreme.

ESTUARY: a partially enclosed coastal body of water which is either permanently or periodically open to the sea and within which there is a measurable variation of salinity due to the mixture of sea water with fresh water derived from land drainage (Day, 1981).

EUTROPHICATION: the process by which a body of water is greatly enriched by the natural or artificial addition of nutrients. This may result in both beneficial (increased productivity) and adverse effects (smothering by dominant plant types).

FLOCCULATION (as used in these reports): the settlement or coagulation of river borne silt particles when they come in contact with sea water.

FLUVIAL (deposits): originating from rivers.

FOOD WEB: a chain of organisms through which energy is transferred. Each "link" in a chain feeds on and obtains energy from the preceding one.

FYNBOS: literally fine-leaved heath-shrub. Heathlands of the south and south-western Cape of Africa.

GEOMORPHOLOGY: the study of land form or topography.

GILL NET: a vertically placed net left in the water into which fish swim and become enmeshed, usually behind the gills.

HABITAT: area or natural environment in which the requirements of a specific animal or plant are met.

HALOPHYTES: plants which can tolerate saline conditions.

HAT (Highest Astronomical Tide) and LAT (Lowest Astronomical Tide): HAT and LAT are the highest and lowest levels respectively, which can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions; these levels will not be reached every year. HAT and LAT are not the extreme levels which can be reached, as storm surges may cause considerably higher and lower levels to occur (South African Tide Tables, 1980).

HUMMOCK (dune): a low rounded hillock or mound of sand.

HYDROGRAPHY: the description, surveying and charting of oceans, seas and coastlines together with the study of water masses (flow, floods, tides, etc.).

HYDROLOGY: the study of water, including its physical characteristics, distribution and movement.

INDIGENOUS: belonging to the locality; not imported.

INTERTIDAL: generally the area which is inundated during high tides and exposed during low tides.

ISOBATH: a line joining points of equal depth of a horizon below the surface.

ISOHYETS: lines on maps connecting points having equal amounts of rainfall.

ISOTHERMS: lines on maps joining places having the same temperature at a particular instant, or having the same average, extremes or ranges of temperature over a certain period.

LAGOON: an expanse of sheltered, tranquil water. (Thus Langebaan lagoon is a sheltered arm of the sea with a normal marine salinity; Knysna lagoon is an expanded part of a normal estuary and Hermanus lagoon is a temporarily closed estuary (Day 1981)).

LIMPID: clear or transparent.

LITTORAL: applied generally to the seashore. Used more specifically, it is the zone between high- and low-water marks.

LONGSHORE DRIFT: a drift of material along a beach as a result of waves breaking at an angle to the shore.

MACROPHYTE: any large plant as opposed to small ones. Aquatic macrophytes may float at the surface or be submerged and/or rooted on the bottom.

MARLS: crumbly mixture of clay, sand and limestone, usually with shell fragments.

MEIOFAUNA: microscopic or semi-microscopic animals that inhabit sediments but live quite independently of the benthic macrofauna.

METAMORPHIC: changes brought about in rocks within the earth's crust by the agencies of heat, pressure and chemically active substances.

MHWS (Mean High Water Springs) and MLWS (Mean Low Water Springs): the height of MHWS is the average, throughout a year when the average maximum declination of the moon is 23°, of the height of two successive high waters during those periods of 24 hours (approximately once a fortnight) when the range of the tide is greatest. The height of MLWS is the average height obtained by the two successive low waters during the same periods (South African Tide Tables 1980).

MORPHOMETRY: physical dimensions such as shape, depth, width, length etc.

OLIGOTROPHIC: poor in nutrients and hence having a paucity of living organisms.

OSMOREGULATION: the regulation in animals of the osmotic pressure in the body by controlling the amount of water and/or salts in the body.

PATHOGENIC: disease producing.

PERIPHYTON: plants and animals adhering to parts of rooted aquatic plants.

PHOTOSYNTHESIS: the synthesis of carbohydrates in green plants from carbon dioxide and water, using sunlight energy.

PHYTOPLANKTON: plant component of plankton.

PISCIVOROUS: fish eating.

PLANKTON: microscopic animals and plants which float or drift passively in the water.

QUARTZITE: rock composed almost entirely of quartz recemented by silica. Quartzite is hard, resistant and impermeable.

RIPARIAN: adjacent to or living on the banks of rivers, streams or lakes.

RIP CURRENT: the return flow of water which has been piled up on the shore by waves, especially when they break obliquely across a longshore current.

SALINITY: the proportion of salts in pure water, in parts per thousand by mass. The mean figure for the sea is 34,5 parts per thousand.

SECCHI DISC: a simple instrument used to measure the transparency of water.

SHEET FLOW: water flowing in thin continuous sheets rather than concentrated into individual channels.

SLIPFACE: the sheltered leeward side of a sand-dune, steeper than the windward side.

TELEOST: modern day bony fishes (as distinct from cartilaginous fishes).

TROPHIC LEVEL: a division of a food chain defined by the method of obtaining food either as primary producers, or as primary, secondary or tertiary consumers.

TROUGH: a crescent shaped section of beach between two cusps.

WAVE HEIGHT (average energy wave height): an index which reflects the distribution of average incident wave energy at inshore sites along the coast presented as a wave height.

WETLANDS: areas that are inundated or saturated by surface or ground water frequently enough to support vegetation adapted to life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.

ZOOPLANKTON: animal component of plankton.

References:

DAY, J.H. (ed.)(1981). Estuarine ecology with particular reference to Southern Africa. Cape Town, A.A. Balkema.

SOUTH AFRICAN TIDE TABLES (1980). Retreat C.P. The Hydrographer. South African Navy.

APPENDIX I: Physical features and species composition of the vegetation mapping units recognized at Wildevoëlvleis and adjacent wetlands.

Mapping Unit	Area	% of area studied	Cover (%)	Height (m)
Sporobolus virginicus *Scirpus maritimus* Fringe Vegetation	12,72	1,58	95	0,1
Paspalum vaginatum/ *Chondropetalum tectorum* Seasonally-flooded Areas	64,61	7,91	80	0,2
Reed Swamps	15,38	1,88	100	2,5
Juncus kraussii Seepage Areas	21,54	2,64	100	0,6
Dune Pioneers	42,77	5,24	10	0,1
Restio eleocharis *Metalasia muricata* Dune Scrub	141,23	17,29	60	0,8
Hind Dune Scrub	4,61	0,57	100	2,0
Proteoid Coastal Fynbos	47,61	5,84	60	1,2
Restioid Coastal Fynbos	32,62	3,99	40	0,6
Aliens	228,00	27,93	100	3,0
Sand	172,31	21,10		
Water	30,46	3,73		
Sewage Works	2,46	0,30		
Total	816,60			

Sporobolus virginicus/Scirpus nodosus Fringe Vegetation
Apium graveolens (r) *Cotula coronopifolia* (+) *Crassula glomerata* (+) *Juncus kraussii* (+); *Limonium scabrum* (+); *Mariscus thunbergii* (r); *Paspalum vaginatum* (2); *Polypogon monspeliensis* (+); *Romulea* sp (r); *Samolus porosus* (+); *Sarcocornia natalensis* (+); *Schoenoplectus triqueter* (+) (emergent) *Scirpus maritimus* (3); *S. nodosus* (+); *Spergularia media* (+); *S. rubra* (+); *Sporobolus virginicus* (2); *Triglochin striata* (1); *Typha capensis* (+).

Paspalum vaginatum/Chondropetalum tectorum Seasonally Flooded Areas
Chondropetalum tectorum (2); *Juncus kraussi* (1); *Paspalum vaginatum* (3); *Scirpus nodosus* (+).

Reed Swamps
Phragmites australis (5); *Typha capensis* (5).

APPENDIX I: (continued)

Juncus kraussii Seepage Areas
Juncus kraussi (5); *Ornithagalum thyrsoides* (+); *Sarcocornia natalensis* (r); *Spergularia media* (r).

Dune Pioneers
Agropyron distichum (+); *Arctotheca populifolia* (1); *Chrysanthemoides monilifera* (+); *Cotyledon orbiculare* (+); *Cynodon dactylon* (+); *Heteroptilis suffruticosa* (+); *Metalasia muricata* (+); *Myrica cordifolia* (r); *Passerina* sp (+); *Pentzia suffruticosa* (+); *Senecio elegans* (+); *Tetragonia decumbens* (+).

Restio eleocharis/Metalasia muricata Dune Scrub
Carpobrotus acinaciformis (+); *Chironia baccifera* (+); *Crassula dichotoma* (+); *C. subulata* var *subulata* (r); *Ehrharta villosa* (+); *Euclea racemosa* (+); *Ficinia dunensis* (+); *Helichrysum crispum* (+); *Lasiochloa longifolia* (+); *Metalasia muricata* (2); *Moraea fugax* (+); *Nylandtia spinosa* (+); *Olea exasperata* (1); *Pterocelastrus tricuspidatus* (+); *Restio eleocharis* (4); *Rhus glauca* (1); *Ruschia macowanii* (+).

Hind Dune Scrub
Asparagus sp (1); *Cassine peragua* (+); *Cussonia capensis* (1); *Euclea racemosa* (+); *Knowltonia capensis* (+); *Olea exasperata* (1); *Rhus glauca* (1); *Salvia aurea* (+); *Sideroxylon inerme* (1); *Sutherlandia fruticosa* (+).

Proteoid Coastal Fynbos
Arctotheca calendula (+); *Aspalathus nigra* (+); *Cephalus africanus* (1); *Helmuthia membranacea* (+); *Leucodendron coniferum* (1); *Lightfootia tenella* (+); *Metalasia muricata* (1); *Moraea fugax* (+); *Nemesia psammophila* (+); *Osteospermum dentatum* (+); *Pelargonium myrrhifolium* (+); *Protea scolymocephala* (+); *Stoebe cinerea* (+); *Ursinia anethoides* (+); *Tetraria brachyphylla* (+).

Restioid Coastal Fynbos
Agathosma bodkinii (+); *Aristea macrocarpa* (1); *Aspalathus nigra* (+); *Briza maxima* (r); *Carpanthea pomeridiana* (+); *Cephalus africana* (1); *Disa cornuta* (r); *Ehrharta calycina* (1); *Heteroptilis suffuticosa* (+); *Nemesia psammophila* (+); *Pelargonium myrrhifolium* (+); *Pentaschistus patula* (+); *Phylica stipularis* (+); *Polygala garcinii* (r); *Protasparagus capensis* (1); *Serruria glomerata* (1);- *Sporobolus virginicus* (+); *Tetraria brachyphylla* (+); *Thamnochortus erectus* (2); *Ursinia anethoides* (r).

Alien Dominated Areas
Acacia cyclops (2); *A. saligna* (4); *Asparagus africana* (+); *Briza maxima* (1); *Carpobrotus edulis* (+); *Eucalyptus cladocalyx* (+); *E. globulus* (+); *E. lehmannii* (+); *Euclea racemosa* (r); *Ehrharta villosa* (+); *Hakea gibbosa* (1); *H. sericea* (+); *Helichrysum crispum* (r); *Lagurus ovatis* (+); *Lobostomon montanus* (r); *Lolium perenne* (+); *Pinus pinaster* (1); *P. pinea* (+); *Rhus glauca* (+); *R. laevigata* (+); *Sonchus* sp (+); *Sporobolus virginicus* (1); *Stenotaphrum secundatum* (+); *Pentaschistus angulata* (1); *Polycarpon tetraphyllum* (+); *Carpenthea pomeridiana* (+).

APPENDIX II: Macro- and microfauna of the northern Noordhoek beach and backshore tidal lagoon (from Boland, unpublished Honours project 1974)

Species list		Locality where found
Ciliates of a number of spp. of Protozoa		found in all areas
Nemertea	*Cerebratus fuscus* (proboscis worms)	intertidal area of the beach
Unidentified Nematodes		found in all areas
Polychate	*Capitella capitata* (bristle worms)	backshore lagoon area
Oligochaete	*Lumbricus* sp. (worm)	in the driftline of the backshore lagoon
Copepod	*Cyclops* sp.	backshore lagoon area
Cladocera	*Daphnia* sp. (water fleas)	backshore lagoon area
Ostracoda	*Pseudocypris* sp.	backshore lagoon area
Isopoda	*Exospaeroma laeviusculum*	intertidal area of the beach
(sea lice)	*Eurydice longicornis*	intertidal area of the beach
	Pontogeloides latipes	backshore lagoon area
	Tylos granulatus	backshore lagoon area
Amphipoda	*Mandibulophoxus* n. sp.	intertidal area of the beach
(beach-fleas)	*Talorchestia quadrispinosa*	backshore lagoon and drift line
Tanaidacea	*Apseudes minutus*	backhore lagoon and intertidal area
Mysidacea	*Gastrosaccus psammodytes*	intertidal area of the beach
Anomura	*Callianassa kraussi* (sand prawn)	backshore lagoon area
Hexapoda	*Pachyphaleria capensis*	driftline of backshore lagoon
	Philontus sp.	driftline and backshore lagoon
Fly larvae Anthomyiidae		backshore lagoon area
Ephydridae (shore flies)		driftline of backshore lagoon
Teudipedinae	(*Tendipes* sp.)	backshore lagoon area
Tetanoceridae (marsh flies)		driftline of backshore lagoon
Xanthocanace capense (kelp fly)		driftline and backshore lagoon
Mollusca	*Donax serra* (white mussel)	intertidal area of the beach
Gastropoda	*Bullia digitalis* (whelk)	intertidal area of the beach
Pisces	*Mugil cephalus* (mullet)	backshore lagoon
Amphibia	*Xenopus* sp. (tadpoles)	backshore lagoon area in fresh water pools

APPENDIX III: Amphibians and reptiles of the Noordhoek area. (Information supplied by Mr A L de Villiers, Cape Department of Nature and Environmental Conservation)

AMPHIBIANS

Xenopus laevis	Common Platanna
Xenopus gilli	Cape Platanna - a rare and endangered species
Capensibufo rosei	Cape Mountain Toad - found in seepage zones in fynbos
Bufo pardalis	Leopard Toad
**Breviceps gibbosus*	Cape Rain Frog
Breviceps montanus	Cape Mountain Rain Frog
Breviceps rosei	Sand Rain Frog
Tomopterna delalandii	Cape Sand Frog
Rana fuscigula	Cape Rana

APPENDIX III: (continued)

Rana grayii	Spotted Rana
Rana montana	Cape Grass Frog - found in seepage zones in fynbos
**Microbatrachella capensis*	Micro Frog - a rare and endangered species
Cacosternum boettgeri	Common Caco
Arthroleptella lightfooti	Cape Chirping Frog - found in seepage areas on mountain slopes
**Kassina wealei*	Rattling Kassina
**Hyperolius horstockii*	Arum Lily Frog

The species marked with an asterisk have not yet been recorded from this area but are likely to occur here.

TORTOISES/TERRAPINS

Chersina angulata	Angulated Tortoise - occurs in low-lying sandy areas
Homopus areolatus	Padloper - occurs on lower mountain slopes
Pelomedusa subrufa	Cape Terrapin - occurs in low-lying marshy areas

SNAKES

Typhlops lalandei	Pink Earth Snake
Leptotyphlops nigricans	Black Worm Snake
Lycodonomorphus rufulus	Brown Water Snake
Lamprophis fuscus	Yellow-bellied House Snake
Lamprophis aurora	Aurora Snake
Lamprophis inornatus	Olive House Snake
Pseudaspis cana	Mole Snake
Duberria lutrix	Souther Slug-eater
Dasypeltis scabra	Rhombic Egg-eater
Crotaphopeltis hotamboeia	Herald Snake
Amplorhinus multimaculatus	Cape Many-spotted Snake - this species is severely threatened on the Cape Peninsula
Dispholidus typus	Boomslang
Psammophylax rhombeatus	Rhombic Skaapsteker
Psammophis notostictus	Whip Snake
Psammophis crucifer	Cross-marked Grass Snake
Aspidelaps lubricus	Coral Snake
Elaps lacteus	Southern Dwarf Garter Snake
Hemachatus haemachatus	Rinkals - this species is severely threatened on the Cape Peninsula
Naja nivea	Cape Cobra
Bitis arietans	African Puff Adder
Bitis atropos	Cape Mountain Adder

LIZARDS

Lizard taxonomy is in a state of confusion at the moment and certain groups are undergoing revision. It is therefore difficult to give an accurate account of the lizard species occurring in the Noordhoek area and the following list is by no means complete.

Phyllodactylus porphyreus	Marbled Gecko
Pachydactylus geitje	Ocellated Gecko
Agama atra	Rock Agama
Agama hispida	Cape Spiny Agama
Bradypodion pumilum	Cape Dwarf Chameleon
Scelates bipes	Silver Sand Lizard
Mabuya capensis	Cape Striped Skink
Acontias meleagris	Golden Sand Lizard

APPENDIX III: (continued)

Tetradactylus seps	Short-legged Plated Lizard
Tetradactylus tetradactylus	Whip Lizard
Meroles knoxii	Ocellated Sand Lizard
Cordylus cordylus peersi	Black Zonure (Endemic to Cape Peninsula)
Pseudocordylus microlepidatus	Crag Lizard - usually only found on the higher mountain slopes

APPENDIX IV: Wetland associated birds from the Wildevoëlvlei and environs as recorded on 29 and 30 January 1981 (from Underhill and Cooper, 1983 unpublished).

New Robert's number	Name	Number at various localities			
		Back-beach overwash pans	Wildevoël-vleis	Wildevoël-vlei sewage works	Saltpan
6	Great crested grebe		2		
8	Little grebe		4	3	
55	Whitebreasted cormorant		7	12	
58	Reed cormorant			1	
60	Darter		1	7	
62	Grey heron	2	5	1	1
63	Blackheaded heron			1	
67	Little egret	1	2	1	
81	Hamerkop		1	1	
84	Black stork		2		
95	African spoonbill				1
102	Egyptian goose		1	11	7
104	Yellowbill duck			51	
106	Cape teal	2	43	15	2
108	Redbill teal		6	4	
112	Cape shoveler		7	14	3
113	Southern pochard			10	1
116	Spurwinged goose			6	
148	Fish eagle		2		
226	Moorhen			1	
228	Redknobbed coot			17	482
245	Ringed plover	8			
246	Whitefronted plover	205	2		
249	Threebanded plover		2	2	2
254	Grey plover	1			
258	Blacksmith plover		17	20	39
264	Common sandpiper		2	2	
270	Greenshank	6	1		1
272	Curlew sandpiper	279			
274	Little stint		2		
281	Sanderling	365			
286	Ethiopian snipe			1	
290	Whimbrel	1			
294	Avocet	47			
295	Blackwinged stilt	6	35		
298	Water dikkop			8	

APPENDIX IV: (continued)

New Robert's number	Name	Number at various localities			
		Back-beach overwash pans	Wildevoël-vleis	Wildevoël-vlei sewage works	Saltpan
312	Kelp gull	7			
316	Hartlaub's gull	3		23	
322	Caspian tern	2	1		
324	Swift tern	4			
326	Sandwich tern	3			
327/8	Common/arctic tern			5	
428	Pied kingfisher		3		
429	Giant kingfisher		3		
713	Cape wagtail	2	7		7

APPENDIX V: Mammals recorded or likely to occur in the area covered by the 1:50 000 quarter degree grid squares of the Cape Peninsula, 3418 AB and AD (from Stuart *et al.* unpublished and Stuart, 1981)

Known to occur in area	Common name	Scientific name	Remarks
	Bats	*Miniopterus schreibersi*	Cave dwelling, needs open water
		Epitesicus capensis	Hunts over open water
		Rhinolophus clivosus	Cave dwelling - only local migrations
	Forest shrew	*Myosorex varius*	Utilises dense vlei and marsh areas
	Red musk shrew	*Crocidura flavescens*	Wide distribution
	Cape golden mole	*Chrysochloris asiatica*	Only on west side of Cape Province
	Chacma baboon	*Papio ursinus*	Wide distribution - mountainous areas
*	Cape fur seal	*Arctocephalus pusillus*	Occasionally along the shore
	Leopard seal	*Hydrurga leptonyx*	Occasionally along the shore
	Cape dassie	*Procavia capensis*	Confined to rocky areas
	Hartmanns zebra (introduced)	*Equus zebra harmannae*	Found in Cape Point Nature Reserve (rare)
	Common duiker	*Sylvicapra grimmia*	Wide distribution prefers woodland savanna
	Red hartebeest (introduced)	*Alcelaphus buselaphus*	Found in Cape Point Nature Reserve
	Bontebok (introduced)	*Damaliscus dorcas dorcas*	Found in Cape Point Nature Reserve (rare)
	Springbok (introduced)	*Antidorcas marsupialis*	Found in Cape Point Nature Reserve
	Steenbok	*Raphicerus campestris*	Prefers open grassland areas with cover
*	Grysbok	*Raphicerus melanotis*	Typical coastal fynbos sp. - likes cover
*	Grey rhebuck	*Pelea capreolus*	Prefers mountain grasslands
*	Vlei rat	*Otomys irroratus*	Restricted to marshy area near permanent water
	Saunders vlei rat	*Otomys saundersae*	Mountain species - needs dense vegetation
	Krebs fat mouse	*Steatomys krebsi*	No habitat information
*	Striped mouse	*Rhabdomys pumilio*	Dense grasslands
	Cape spiny mouse	*Acomys subspinosus*	No habitat information
	Pygmy mouse	*Mus minutoides*	Wide distribution - needs good ground cover
*	House mouse (alien sp.)	*Mus musculus*	Commensal with man - storeroom, out-houses etc.
	Verreauxs rat	*Praomys verreauxi*	Rare species
*	Black rat (alien sp.)	*Rattus rattus*	Commensal with man - storerooms etc.
*	Cape porcupine	*Hystrix africaeaustrali*	Wide distribution
*	Cape dune-mole rat	*Bathyergus suillus*	Found in dune areas of west and southern Cape
*	Cape mole rat	*Georychus capensis*	Occurs in loose sandy soils near water
*	American grey squirrel (introduced)	*Sciurus carobipensis*	Escaped from captivity, spread throughout Peninsula where suitable habitat exists
*	Striped polecat	*Ictonyx striatus*	Wide distribution
*	Small-spotted genet	*Genetta genetta*	Wide distribution - scrub or woodland areas
*	Large-spotted genet	*Genetta tigrina*	Wide distribution - scrub or woodland areas
*	Cape grey mongoose	*Herpestes pulverulentus*	Wide distribution - adapts to presence of man
*	Water mongoose	*Atilax paludinosus*	Wide distribution - dependent on permanent water
*	Wild cat	*Felis libyca*	Wide distribution - needs cover
*	Caracal	*Felis caracal*	Wide distribution - needs cover
*	Cape clawless otter	*Aonyx capensis*	New record, ECRU Survey 23.11.83 requires permanent water and edge cover

APPENDIX VI: Extracts from the final recommendations in the Cape Metropolitan Area Draft Guide Plan which pertain to the Noordhoek/Kommetjie basin.

(a) "The protection of the area's natural assets such as coastal areas, mountain areas, river banks, streams and other expanses of water, vlei areas and the other sensitive nature areas that are regarded as of particular ecological importance, and the judicious use of these areas for a variety of recreational and tourist attractions in such a way that it will be consistent with the general principle of conservation."

(b) "The establishment of new smallholding complexes within the Peninsula area must be restricted. Exceptional cases that are found to have merit must not take over good agricultural land or be a possible obstruction to future urban development." Areas of high agricultural potential have been identified in the central portion of the Noordhoek/Kommetjie basin, in the vicinity of the "Salt Pan."

(c) "Urban development on gradients that are steeper than 1:6 must be approached with great circumspection and preferably discouraged."

(d) "No urban development or other permanent structures may be allowed within an area judged by the Administrator to be a floodplain. The Administrator may relax or waive this prohibition in special circumstances. (Section 169A(2) of the Water Act, 1956 (Act 54 of 1956), relates to this matter)."

(e) "In cases where exceptional natural assets are affected by township development, such natural assets, including watercourses, must be retained as open spaces in township lay-outs."

(f) "No further conventional township development may be allowed in the Peninsula Mountain Area (the Noordhoek/Kommetjie basin falls within this area), except where such township establishment had already been approved on the date of the approval of this Guide Plan, provided that the Administrator may allow a certain degree of consolidation for already approved township areas. Available land in this area set aside for urban development can, however, be used for development related to recreation and tourism, as well as for **extensive residential occupation** on the units of the size for which provision is made in existing town planning schemes. Where there are no town planning schemes or such provision has not been made, these areas may be subdivided into units of not less than 2 ha with the permission of the Administrator."

(g) "The utilisation of the areas set aside as nature areas must be aimed basically at the conservation and maintenance of the natural environment."

(h) "Development within such nature areas aimed at the utilisation of these areas for purposes of tourism and recreation may only take place in areas that have been approved by the Administrator and subject to such provisions as he deems necessary, provided that the Minister of Environment Affairs and Fisheries' permission is also obtained for those nature areas that have already been reserved in terms of section 4 of the Physical Planning Act, 1967 (Act 88 of 1967)."

APPENDIX VI: (continued)

(i) "Any structure or facility in a nature area must be placed in such a way that the natural environment is marred as little as possible. The controlling authority concerned may set requirements as regards the design and position of such structures or facilities."

(j) "The owner of each subdivision in a nature area that is **privately owned** should have the right to build one house with outbuildings and to provide an access road to that house, but this must be done in accordance with the requirements as mentioned above."

(k) "The provision of general engineering services such as water purification works, sewerage works and dumping sites should take place on a regional basis where practicable."

(l) "When identifying sites for new sewerage purification works in the peninsula area, local authorities must consult with the Department of Health and Welfare, the Department of Environment Affairs and the Cape Provincial Administration at an early stage."

(m) "Before any new sites for the dumping of rubbish are used, the necessary geological and hydrological investigations must be done to determine the suitability of the sites, considering also the type of waste, e.g. toxic industrial waste, that is to be dumped."

(n) "Dumping sites must be so managed that they have the minimum harmful effect on the environment so that the sites can be used again for other purposes in the longer term."

APPENDIX VII: Guide to available information

ESTUARY / RIVERMOUTH / LAGOON: WILDEVOËLVLEI/NOORDHOEK (WETLANDS)

Guide to available information

		Sources of information	Birch	Blandy	Boland	Bulpin	Cape Metr Area Draft Guide Plan	Div. Council of the Cape	Fromme	Gasson	Gilliomee	Haughton	Hey	Heydorn and Tinley	Hill Kaplan Scott and Partn.	Maclean	McLachlan	Midgley and Pitman	Midgley	Noble and Hemens
MANAGE-MENT		Historical				*					*								*	
MANAGE-MENT		Conservation/Utilization		*			*				*		*	*	*					*
MANAGE-MENT		Management/Planning		*			*				*		*	*	*					
MANAGE-MENT		Legislation					*				*		*							
MANAGE-MENT		Water		*							*		*	*	*			*		*
BIOTIC		Food webs/Ecosystems									*									
BIOTIC	Fauna	Mammals																		
BIOTIC	Fauna	Birds														*				
BIOTIC	Fauna	Reptiles															*			
BIOTIC	Fauna	Amphibians									*						*			
BIOTIC	Fauna	Fish			*						*									
BIOTIC	Fauna	Molluscs			*															
BIOTIC	Fauna	Crustaceans			*															
BIOTIC	Fauna	Other aquatic invertebrates			*						*									
BIOTIC	Fauna	Terrestrial invertebrates									*									
BIOTIC	Fauna	Zooplankton			*															
BIOTIC	Flora	Terrestrial vegetation									*									
BIOTIC	Flora	Semi-aquatic vegetation									*									
BIOTIC	Flora	Aquatic vegetation									*									
BIOTIC	Flora	Algae																		
BIOTIC	Flora	Phytoplankton																		
BIOTIC		Microbiology																		
ABIOTIC	Chemistry	Pollution						*			*									
ABIOTIC	Chemistry	Eutrophication									*									
ABIOTIC	Chemistry	General Chemistry						*												
ABIOTIC		Salinity																		
ABIOTIC	Physics	Circulation and mixing																		
ABIOTIC	Physics	Hydrology / Flood regime							*					*	*			*		*
ABIOTIC	Physics	Oceanography							*											
ABIOTIC	Physics	Climate								*					*					
ABIOTIC	Geology	Sedimentology	*						*						*					
ABIOTIC	Geology	Palaeoenvironment	*																	
ABIOTIC	Geology	Geology	*						*			*			*					
ABIOTIC	Physiography	Morphology							*						*					
ABIOTIC	Physiography	Dams/Obstructions													*					
ABIOTIC	Physiography	Catchment characteristics							*					*	*			*		*
YEAR (DATE OF INFORMATION)			1979	-	1974	1980	1984	1983	-	1984	1984	1933	1978	1980	1972	1985	1978	1969	1975	1978

ESTUARY / RIVERMOUTH / LAGOON

WILDEVOëLVLEI/NOORDHOEK
(WETLANDS)

Sources of information	YEAR (DATE OF INFORMATION)	ABIOTIC: Physiography: Catchment characteristics	Physiography: Dams/Obstructions	Physiography: Morphology	Geology: Geology	Geology: Palaeoenvironment	Geology: Sedimentology	Physics: Climate	Physics: Oceanography	Physics: Hydrology / Flood regime	Physics: Circulation and mixing	Salinity	Chemistry: General Chemistry	Chemistry: Eutrophication	Chemistry: Pollution	BIOTIC: Microbiology	Flora: Phytoplankton	Flora: Algae	Flora: Aquatic vegetation	Flora: Semi-aquatic vegetation	Flora: Terrestrial vegetation	Fauna: Zooplankton	Fauna: Terrestrial invertebrates	Fauna: Other aquatic invertebrates	Fauna: Crustaceans	Fauna: Molluscs	Fauna: Fish	Fauna: Amphibians	Fauna: Reptiles	Fauna: Birds	Fauna: Mammals	Food webs/Ecosystems	MANAGEMENT: Water	Legislation	Management/Planning	Conservation/Utilization	Historical
		Guide to available information																																			
Rogers	1980	*		*	*	*	*																														
Skene	1983			*			*																														
Smith-Baillie **et al**	1976			*				*																													
South Africa Physical Planning Act	1967																																*	*		*	
South Africa Water Act	1956																																*	*			
South Africa Governm. Notice	1962														*																		*	*			
South African Weather Bureau	1965							*																													
Stuart	1981																															*					
Stuart, Lloyd and Herselman	1980																															*					
Summers, Pringle and Cooper	1976																														*						
Swart and Serdyn	1982						*		*		*																										
Treasure	1977				*																																
Underhill and Cooper	1983																														*						
Van der Merwe **et al**	1981				*																														*	*	
Van Heerden	1985			*	*		*	*	*																										*		
Van Heerden	-			*	*		*	*	*																										*		
Viskor	-							*																													
Waher	1971														*			*	*	*	*												*		*	*	

ESTUARY / RIVERMOUTH / LAGOON	YEAR (DATE OF INFORMATION)	ABIOTIC													BIOTIC																MANAGEMENT				
		Physiography			Geology			Physics				Salinity	Chemistry			Flora					Fauna									Food webs/Ecosystems	Water	Legislation	Management/Planning	Conservation/Utilization	Historical
WILDEVOëLVLEI/NOORDHOEK (WETLANDS)		Catchment characteristics	Dams/Obstructions	Morphology	Geology	Palaeoenvironment	Sedimentology	Climate	Oceanography	Hydrology / Flood regime	Circulation and mixing		General Chemistry	Eutrophication	Pollution	Microbiology	Phytoplankton	Algae	Aquatic vegetation	Semi-aquatic vegetation	Terrestrial vegetation	Zooplankton	Terrestrial invertebrates	Other aquatic invertebrates	Crustaceans	Molluscs	Fish	Amphibians	Reptiles	Birds	Mammals					
Sources of information		Guide to available information																																
Whitten and Brooks	1978				*																													
Winterbottom	1960																												*					
MAPS																																		
Caap de Goede Hoop	1786			*																														*
Cape Division	1901			*																														*
Cape of Good Hope	1790			*																														*
Cape of Good Hope	1822			*																														*
Cape Peninsula	1890			*																														*
S.A. 1:50 000 Sheet 3418 AB & AD	1978	*		*																														
S.A. 1:1 000 000 Geol-Map	1978			*	*																													
S.A. Navy 100 000 Chart 636	1964			*																														

NOTES

PLATE I:

A view of the Noordhoek wetlands and the backshore overwash lagoons. The Ocean View township, Wildevoëlvlei and sewage treatment works can be seen in the background, with Papkuilsvlei and the Noordhoek rural residential area in the foreground (83-10-09).

PLATE II:

The two full backshore lagoons photographed during October 1984. Brown peat-stained water from Papkuilsvlei is flowing out to sea in the central beach area, a phenomenon which has not occurred for many years.

PLATE III:

Dense mats of filamentous algae in the eutrophic conditions found in the outlet channel of the Wildevoëlvlei. The wreck of the *Kakapo* can be seen on the beach in the centre of the photograph. (83-11-21).