Western Cape Government
Environmental Affairs and Development Planning

Duiwenhoks River Estuarine Management Plan

Version 5

2019

DOCUMENT DESCRIPTION

Document title and version:

Duiwenhoks River Estuarine Management Plan Version 5

Project Name:

Western Cape Estuarine Management Framework and Implementation Strategy

Client:

Western Cape Government, Department of Environmental Affairs and Development Planning

Royal HaskoningDHV reference number:

MD1819

Authority reference:

EADP 1/2015

Developed by:

Coastwise Consulting & Royal HaskoningDHV

Acknowledgements:

Western Cape Government Environmental Affairs & Development Planning

Directorate: Biodiversity and Coastal Management

Sub-Directorate: Coastal Management

Email: coastal.enquiries@westerncape.gov.za

Date:

2019

This document should be referenced as

Western Cape Government (2019). Duiwenhoks River Estuarine Management Plan Version 5. Western Cape Department of Environmental Affairs and Development Planning.

EXECUTIVE SUMMARY

The National Environmental Management: Integrated Coastal Management Act (Act 24 of 2008) (ICMA) was developed to facilitate the sustainable use and management of South Africa's coastline and coastal and estuarine resources. The ICMA requires that estuaries within South Africa are managed in a co-ordinated and efficient manner, and in accordance with the 2013 National Estuarine Management Protocol (NEMP), the National Coastal Management Programme (CMP) and the Western Cape CMP, which lay out specific objectives for management of the South African coastline, including estuaries. This document represents the first-generation Estuarine Management Plan (EMP) for the Duiwenhoks River estuary developed under the auspices of the Western Cape Estuarine Management Framework and Implementation Strategy (EMFIS), a strategic project emanating from the provincial CMP, specifically priority area 7.

The purpose of this EMP is to provide the Vision of the future desired state of the Duiwenhoks River estuary and guide the management of human activities in and around the system by setting out strategic objectives, management priorities and detailed management strategies with actions/activities. The co-ordination of the implementation of the EMP vests with the responsible management authority (RMA) as per the 2013 NEMP.

Geographical boundaries

The Duiwenhoks River estuary is a permanently open estuarine system, situated on the Cape south-west coast between Witsand and Still Bay within the warm temperate biogeographic region of South Africa, in the Hessequa Local Municipality (LM).

Vision and Objectives

The following Vision for the Duiwenhoks River estuary was proposed at a public meeting held in September 2017 and supported at a second public meeting held in April 2018, both in Vermaaklikheid.

The Duiwenhoks, draining the Langeberg and linking the sea, provides for both today's and tomorrow's biodiversity and community needs

Strategic Objectives for management of the Duiwenhoks River estuary, their indicators and level of priority are indicated below:

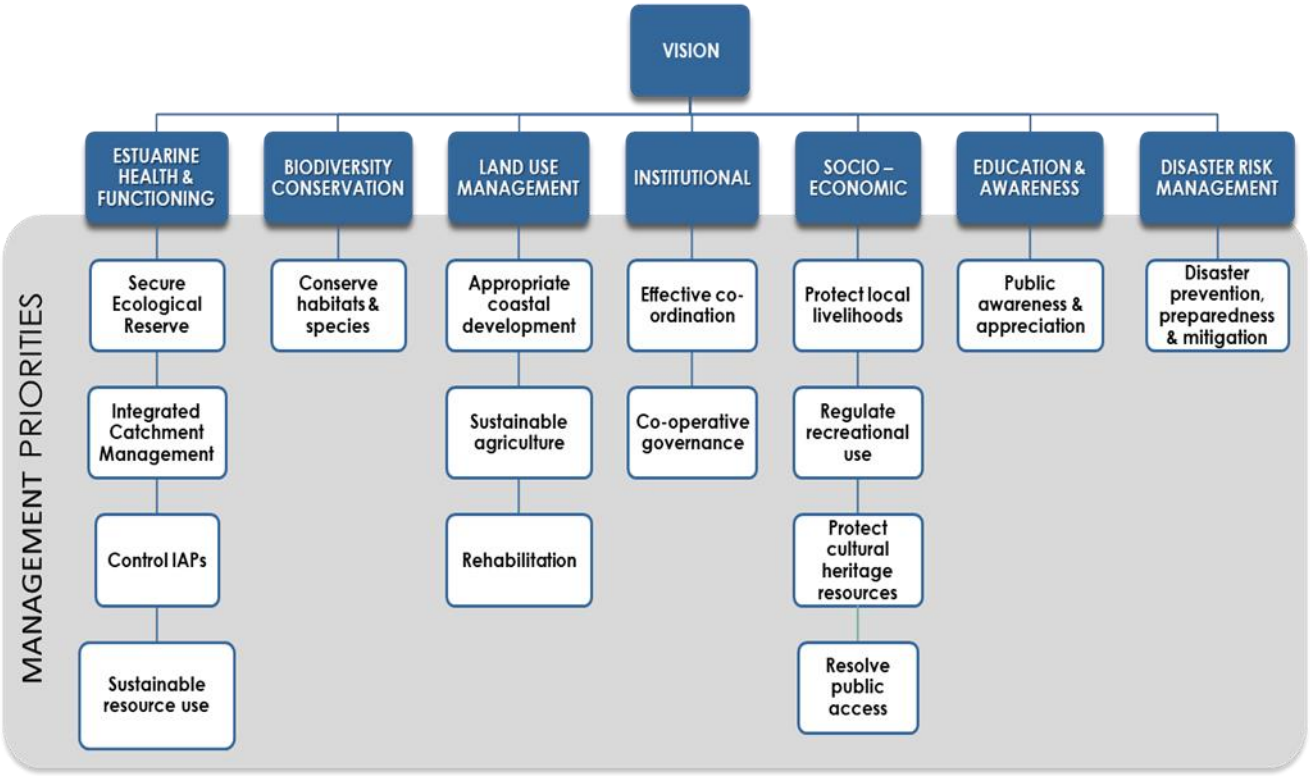
	Sector / Category	Strategic Objective	Performance Indicator(s)	Priority
1	Estuarine Health and Function	The ecological health and natural functioning of the Duiwenhoks River estuary is maintained and safeguarded, living resources are sustainably managed and estuary nursery function protected	• Health state of the estuary is improved from C to B Category • Degraded areas and habitats are restored • Marine living resources utilised within legal limits • Water quality and ecological monitoring programmes in place • Invasive alien plants are eradicated	**HIGH**

			• Alien fish species are eradicated • Increase in number of research projects	
2	Biodiversity Conservation	The biodiversity of the Duiwenhoks River is conserved	• Duiwenhoks EMP incorporated into GCBR Plan and Municipal CMP • Spatial zonation plan is adopted and enforced • No-take zones are established • Stewardship agreements established with land owners • Egyptian Geese controlled • Protection status obtained	**HIGH**
3	Land-use and Infrastructure Planning and Development	Impacts associated with developments and proposed changes in land-use, including infrastructure and agriculture, are minimised	• EMP is seamlessly incorporated into the Hessequa IDP and SDF • All development and land use changes surrounding and within the Estuarine Functional Zone (EFZ) comply with environmental legislation, environmental best practice and risk aversive approach and do not detract from the sense of place • Agricultural best practice is implemented which will ensure retreat from the EFZ and improve water quality • Rehabilitation programme in place • Degraded areas are restored; recovery of riparian margin	**MEDIUM**
4	Institutional and Management Structures	The Duiwenhoks River estuary is well managed through effective co-operative governance	• Estuarine bylaws are drafted • RMA and participating agencies are well-capacitated, well equipped and knowledgeable • Effective co-ordination of estuarine management responsibilities through a designated regional estuarine management co-ordinator • Estuary advisory committee is established and meets regularly	**HIGH**
5	Socio-Economic Considerations	Socio-economic benefits are enhanced and regulated to ensure sustainable use of the Duiwenhoks River estuary and its resources	• Resources utilised within legal and sustainable limits • Local communities are involved and uplifted • Carrying capacity for estuarine uses is upheld; recreational use is regulated effectively • Heritage resources are preserved and honoured • Public access to the coast provided • Public launch site listed	**HIGH**
6	Education, Awareness, Monitoring and Research	Members of society are sensitive to, and aware of, the value and importance of the	• Awareness programme developed and successfully implemented on an on-going basis	**MEDIUM**

		Duiwenhoks River estuary	• Signage erected; information disseminated • Illegal activities are reduced	
7	Disaster Risk Management	Potential risks that could impact the Duiwenhoks River estuary are reduced (inclusive of climate change impacts)	• Risks identified and contingency plans in place • Key/Critical infrastructure is well located and maintained	**LOW**

Priority management objectives and associated activities

An overview of the management objectives and management priorities is provided diagrammatically.



Proposed zonation of activities

Spatial zonation of activities on an estuary is necessary to avoid user conflict and to guide sustainable utilization of resources without degradation of the estuarine environment. Zonation of the Duiwenhoks River estuary is informed by scientific information, municipal and stakeholder inputs, specialist recommendations, recreational and subsistence fishing pressure, existing zonation, and other recreational uses of the estuary. Three zones are proposed for the system, each with specific restrictions.

- **No Wake Zone** – The purpose of this zone is to reduce erosion of river banks, noise disturbance and for safety of other river users, e.g. swimming, canoeing. This zone is currently in play as part of boating etiquette on the estuary and extends from Cob Corner (34°18'51.81"S, 21° 1'7.68"E) along the river home frontage near Vermaaklikheid heading upstream.

- **Fish Sanctuary (No-take) Zone** – The purpose of this zone is to protect the high diversity of fish species utilising this specific section of the estuary (given the high level of fishing pressure throughout most of the system), the open water habitat and thus the overall nursery function of the estuary. No fishing in any form is permitted in this area, including catch and release. This zone extends from Palm Tree Bend (34°20'13.65"S, 21° 1'37.49"E) to the head of the estuary.
- **Bait Harvesting Zone** – The purpose of this zone is to provide protection for the heavily exploited bait organism populations, whilst still providing a designated area for harvesting. The bait harvesting zone extends from Palm Tree Bend (34°20'13.65"S, 21° 1'37.49"E) to the estuary mouth, along the eastern shoreline only.
- Aside from the above stipulated zones, general recreation activities are permitted in line with the Municipal River Bylaws. Water skis, jet skis, ghetto blasting, and speeding are not permitted.
- The terrestrial areas or land below the 5 m contour within the EFZ, will remain zoned as Agriculture or Open Space Zone 3 (Nature Reserve). The Coastal Protection Zone and the Coastal Management Line must be acknowledged, whereby development is discouraged and strict development controls are applicable below these lines.

Proposed zonation of the Duiwenhoks River estuary

Integrated monitoring plan

Monitoring is a crucial aspect of the adaptive estuarine management planning process as the generated data will be used to inform and update management decisions. Three broad categories of monitoring are incorporated into an integrated monitoring plan, namely resource monitoring, compliance monitoring and performance monitoring.

In terms of resource monitoring, there is a flow recorder at the head of the estuary and basic water quality monitoring is undertaken in Heidelberg in respect to the Heidelberg Waste Water Treatment Works. However, there are no known ecological monitoring or research programmes (e.g. water quality, fish or birds, etc.) currently being undertaken for the Duiwenhoks River estuary.

A minimum set of monitoring requirements is proposed, in alignment with the Reserve Determination Methods, to ascertain impacts of current and future pressures on the estuary detailing the ecological component, monitoring action, temporal scale as well as spatial scale of monitoring. The monitoring programme is supported by Ecological Specifications and Thresholds of Potential Concern.

By and large, compliance monitoring in respect to the harvesting of marine living resources will be the responsibility of DEFF (devolved to CapeNature). and will be undertaken according to applicable legislation and policies and by means of law enforcement and compliance monitoring protocols internal to DEFF/CapeNature. The Hessequa LM has published by-laws relating to the management and use of rivers, including estuaries, specifically in respect to boats and vessels. Currently, the river is patrolled, specifically during peak holiday periods, by a River Compliance Officer (a member of the Duiwenhoks Conservancy) appointed by the Hessequa LM with the power to enforce the relevant fishing and boating regulations. However, the compliance and enforcement responsibility for the Duiwenhoks River estuary is largely under-capacitated, given the length of the system and the dispersed nature of human activities.

The performance monitoring plan is proposed to be used by the RMA, and/or identified implementing agents, to assess the effectiveness with which planned management activities contained in the EMP are being performed and ultimately to gauge progress in achieving the vision and objectives. A monitoring plan relative to the proposed management priorities is included.

Institutional Capacity and Arrangements

This EMP should be regarded as a strategic plan that can guide the detailing of management actions and identification of implementing agents/authorities that are mandated to implemented certain actions. While it does not specify the resources (human and financial) required for effective management of the estuary, it does provide for their prioritisation. It also provides for the co-ordination and integration of management actions. Co-management and effective governance have been identified as vital aspects to the efficient and effective management of the Duiwenhoks estuarine system and key role players are identified.

The 2013 NEMP identifies the Hessequa LM, as the RMA responsible for the co-ordination of the implementation of the Duiwenhoks River EMP. **However, it is noted that proposed amendments to the 2013 NEMP allocate such responsibilities to the provincial environmental department unless agreement, or until agreement, is reached with the respective municipality, or conservation authority, to undertake the coordination of the implementation process.** Effective implementation of this EMP may thus require the augmentation of capacity within the Hessequa LM, with the recommended appointment of a regional estuarine co-ordinator within DEA&DP. This individual will play a critical co-ordinating role for all other implementing agencies and Hessequa departments. While an individual EAF for the Duiwenhoks River estuary is not recommended, the establishment of a regional EAF is, incorporating the Duiwenhoks and Goukou the estuaries are supported. The Duiwenhoks Conservancy should remain a critical role player and may be the platform for community involvement in estuarine management initiatives, which promote livelihood

opportunities. All effort should be made to ensure that fishers are represented and part of the EAF.

Key government departments and organs of state are identified and a template provided for the conversion of the priority actions into detailed project plans, which must be prepared and adopted into the respective departmental implementation strategies.

In conclusion, the following items/issues are considered critical towards the ultimate achievement of the vision and should be immediately addressed and/or receive greatest effort in respect to human/financial resources:

- Marine resources are used within legal limits;
- All efforts are made to eradicate invasive alien plants;
- The no-take zone is enforced and enabled through the Marine Living Resources Act;
- Recreational use of the system is regulated effectively;
- Public access is provided and suitably managed;
- An additional public launch site is listed and operated in terms of an approved operational plan; and
- The DEA&DP to consider the appointment of a Regional estuarine management co-ordinator/champion within either DEA&DP or CapeNature, to support the RMA.

TABLE OF CONTENTS

TABLE OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

amsl	Above mean sea level
BGCMA	Breede-Gouritz Catchment Management Agency
CARA	Conservation of Agricultural Resources Act (Act No. 43 of 1983)
CBA	Critical Biodiversity Area
CBOs	Community Based organisations
CFR	Cape Floristic Region
CML	Coastal Management Line
CMP	Coastal Management Programme
CPZ	Coastal Protection Zone
CSIR	Council for Scientific and Industrial Research
CTD	Conductivity-Temperature-Depth
DALRRD	Department of Agriculture, Land Reform and Rural Development
DEA	Department of Environmental Affairs (former)
DEA&DP	Western Cape Government's Department of Environmental Affairs & Development Planning
DEFF	Department of Environmental Affairs, Forestry and Fisheries (former DEA)
DM	District Municipality
DMA	Disaster management Act (Act No. 57 of 2002)
DO	Dissolved Oxygen
DSL	Development Setback Line
DST	Department of Science and Technology
DWA/F	Department of Water Affairs / Forestry (now DHSWS)
DHSWS	Department of Human Settlements, Water and Sanitation (previously DWS)
DWS	Department of Water and Sanitation (now DHSWS)
EAF	Estuary Advisory Forum
EcoSpecs	Ecological Specifications
EFZ	Estuarine Functional Zone
EIA	Environmental Impact Assessment
EMC	Estuarine Management coordinator
EMFIS	Western Cape Estuarine Management Framework and Implementation Strategy
EMP	Estuarine Management Plan(s)
EMPr	Environmental Management Programme
EPIP	Environmental Protection and Infrastructure Programmes
GCBR	Gouritz Cluster Biosphere Reserve
GDP	Gross Domestic Product
HWC	Heritage Western Cape (Provincial Heritage Resources Authority)
HWM	High Water Mark
I&APs	Interested and Affected Parties
IAPs	Invasive Alien Plants
ICM	Integrated Coastal Management
ICMA	National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008)
IDP	Integrated Development Plan
LM	Local Municipality
LUPA	Land Use Planning Act
MEC	Member of the Executive Council
MLRA	Marine Living Resources Act (Act No. 18 of 1998) as amended
MRPDA	Mineral Resource and Petroleum Development Act (Act No. 28 of 2002)
MSA	Municipal Systems Act (Act No. 32 of 2000)
NEM: BA	National Environmental Management: Biodiversity Act (Act No. 10 of 2004)
NEM: PAA	National Environmental Management: Protected Areas Act (Act No. 57 of 2003)
NEMA	National Environmental Management Act (Act No. 107 of 1998)
NEMP	National Estuarine Management Protocol (2013)
NGOs	Non-governmental Organisation(s)

NHA	National Health Act (Act No. 61 of 2004)
NTU	Nephelometric Turbidity Unit
NWA	National Water Act (Act No. 36 of 1998)
PAES	Protected Area Expansion Strategy
RDM	Resource Directed Measures
REC	Recommended Ecological Category
RMA	Responsible Management Authority
RQO(s)	Resource Quality Objectives
SAHRA	South African Heritage Resources Agency
SANBI	South African National Biodiversity Institute
SAPS	South African Police Service
SAR	Situation Assessment Report
SDF	Spatial Development Framework
SOP	Standard Operating Procedure
SWOT	Strengths, Weaknesses, Opportunities and Threats analysis
SZP	Spatial Zonation Plan
TPC	Threshold of Potential Concern
WC DoA	Western Cape Department of Agriculture
WC Dot&PW	Western Cape Department of Transport & Public Works
WC TIA	Western Cape Transport and Infrastructure Act (Act 1 of 2013)
WfW	Working for Water
WQ	Water Quality
WRC	Water Research commission
WUA	Water Users Associations
WUL	Water Use Licence
WWTW	Waste Water Treatment Works

1 INTRODUCTION

1.1 Background

The National Environmental Management: Integrated Coastal Management Act (Act 24 of 2008) (ICMA) was developed to facilitate the sustainable use and management of South Africa's coastline, and coastal and estuarine resources. The ICMA requires that estuaries within South Africa are managed in a co-ordinated and efficient manner, and in accordance with the 2013 National Estuarine Management Protocol (hereafter referred to as the NEMP), the National Coastal Management Programme (CMP) and the Western Cape CMP, which lay out specific objectives for management of the South African coastline, including estuaries.

In response to the directive issued under the ICMA and the 2013 NEMP, the Western Cape Government, and specifically the Provincial Department of Environmental Affairs and Development Planning (DEA&DP), commissioned the development of the Western Cape Estuarine Management Framework and Implementation Strategy (EMFIS), a strategic project emanating from the provincial CMP, specifically priority area 7, to facilitate the consistent development and implementation of Estuarine Management Plans (EMPs) in the Western Cape Province.

This document represents the first -generation EMP for the Duiwenhoks River estuary (Figure 1) developed under the auspices of the Western Cape EMFIS.

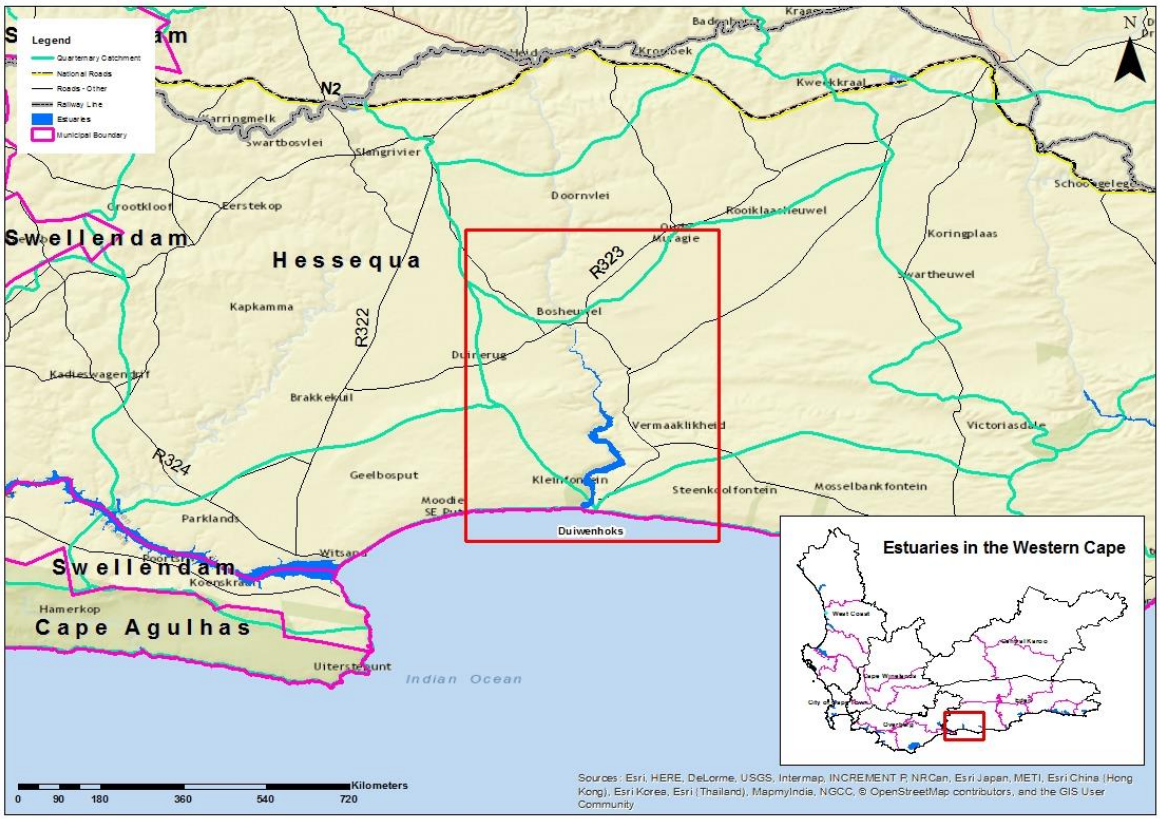


Figure 1: Location map of the Duiwenhoks River estuary within the Hessequa Local Municipality

1.2 Purpose of the EMP

The development of an EMP is a three-phase process, as illustrated in Figure 2, comprising an initial scoping phase, followed by an objective setting phase, and finally an implementation phase. An adaptive management approach should be adopted during the latter phase with detailed reviews bring conducted at five-yearly intervals.

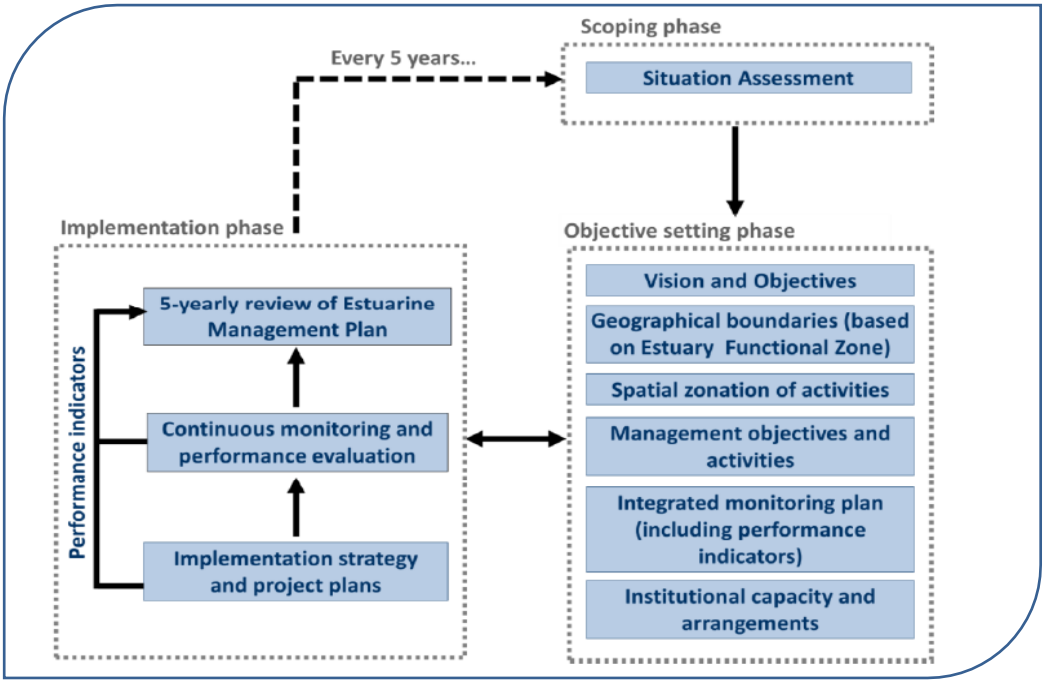


Figure 2: A framework for integrated estuarine management in South Africa

This report constitutes the second objective and core component of the estuarine management planning process, namely the EMP. The purpose of this component is to provide the Vision of the future desired state of the Duiwenhoks River estuary and guide the management of human activities in and around the system by setting out strategic objectives, management priorities and detailed management strategies with actions/activities.

Estuarine management is by definition inclusive of coastal hinterland and marine influences, shoreline status, catchment management, climate change and human development impacts such as tourism, recreation and agriculture, amongst many others. This EMP is the primary document for use by the identified Responsible Management Authority (RMA) to facilitate coordination of the identified management interventions to ultimately ensure the sustainability of the estuarine system concerned. This is also the critical reference document for the incorporation of estuarine management into the municipal Integrated Development Planning (IDP), Spatial Development Framework (SDF), Coastal Management Programme (CMP) and municipal CMP processes.

1.3 Mandate and responsibilities of the RMA

The co-ordination of the implementation of the EMP vests with the RMA as per the 2013 NEMP. One of the strategic objectives of this EMP is to promote and facilitate the cooperative governance relationship between the RMA and an existing or new estuary advisory forum (EAF), or any other supporting structures or organisations with estuarine-related duties and functions.

The designated RMA is responsible for the development of the EMP and the overall co-ordination of the actions of other implementing agencies, and not necessarily the implementation actions themselves. Section 7.3 of the 2013 NEMP indicates that:

"…management actions…shall be translated into project plans by the responsible government department that is responsible for certain aspects of estuary management (as per legislative mandates…"

Specifically, the RMA responsibilities are described by the 2013 NEMP as:

Section 5:	*"…authorities are **responsible for the development of EMPs** and **coordination of the implementation process**…"*
Section 5(7)(e):	*"The identified responsible management authority to develop the EMP needs to **budget accordingly for the development of these plans**."*
Section 8(1):	*"The responsible management authority developing an EMP must **actively engage all the relevant stakeholders** including government departments, non-government organisations and civil society in the development and implementation of the EMP."*
Section 9.1(1) and 9.2:	*"…it **must obtain formal approval** for the EMP…" and "Once approved…the EMP shall be formally adopted by the responsible management authority and signed by the head of the responsible management authority."*

The responsible body contemplated in Section 33(3)(e) of the ICMA who develops an EMP must:

a) follow a public participation process in accordance with Part 5 of Chapter 6 of the ICMA; and
b) ensure that the EMP and the process by which it is developed are consistent with:
   i) the 2013 NEMP; and
   ii) the National CMP and with the applicable provincial CMP and CMP referred to in Parts 1, 2 and 3 of Chapter 6 of the ICMA;
c) If applicable, ensure that relevant legislation is enacted to implement the EMP; and
d) Submit an annual report to the Minister on the implementation of the EMP, the legislation and any other matter.

Coordination of the implementation actions by the RMA and its strategic partners can be supported by an EAF representing all key stakeholder groups on the estuary.

1.4 Structure of Report

This report is structured as follows:

- **Section 2** introduces the estuary and details the **geographical boundaries** of the estuary, i.e. the management area to which this EMP applies;
- **Section 3** provides a synopsis of the **situation assessment,** thereby providing context to the vision, strategic objectives and management objectives and management priorities;
- **Section 4** presents the **local vision and strategic objectives** as informed by the stakeholders, for the management of the Duiwenhoks River estuary. They collectively describe the desired future state and provide the overarching logical framework for the action plans;
- **Section 5** prescribes the **management priorities** and associated **activities,** i.e. the required actions and activities to be undertaken within the next 5 years, captured as individual action plans. This EMP contains refined or detailed management objectives accompanied by action plans to facilitate implementation, and in this manner, serves to mobilise and co-ordinate all relevant government departments, institutions and other role players to undertake specific actions within their mandate or sphere of influence;
- **Section 6** describes the various components and zones included in the proposed **spatial zonation** of the estuary;
- **Section 7** set out the **integrated monitoring plan** encompassing resource monitoring, compliance monitoring, as well as performance monitoring in respect to achieving the objectives of the EMP;
- **Section 8** details the **institutional capacity and proposed arrangements** that are required to implement the actions contained in the plan, including key role players and participating institutions, and the recommended projects provided for in the action plans; and
- **Section 9** details key **recommendations** and **concludes** the plan.

2 GEOGRAPHICAL BOUNDARIES

The Duiwenhoks River estuary is a permanently open estuarine system, situated on the Cape south-west coast between Witsand and Still Bay within the warm temperate biogeographic region of South Africa, in the Hessequa Local Municipality (LM).

The geographical boundaries of the estuary are defined as follows (Table 1 and Figure 3):

Table 1: The Duiwenhoks River estuary estuarine functional zone

DOWNSTREAM BOUNDARY:	34°21'54.31"S 21° 0'0.51"E (Estuary mouth)
UPSTREAM BOUNDARY:	34°15'5.87"S 20°59'30.95"E (Road bridge crossing)
LATERAL BOUNDARIES:	5 m contour above Mean Sea Level (amsl) along each bank

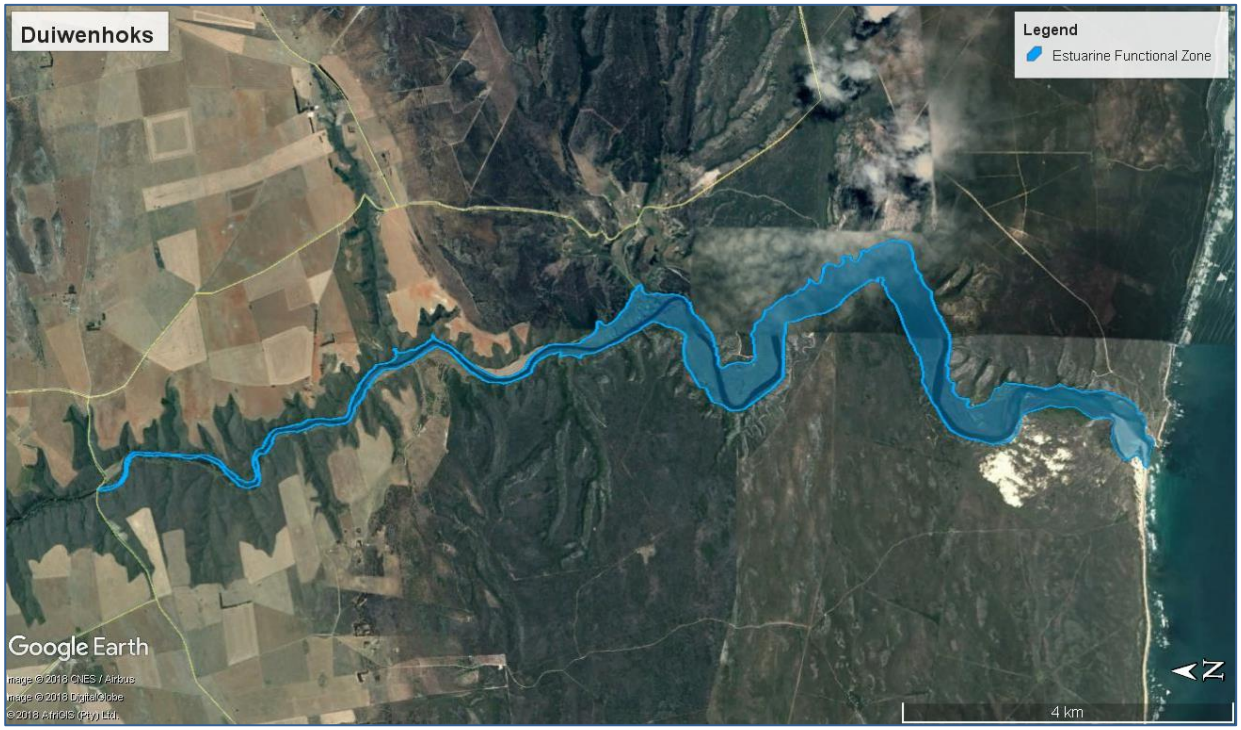


Figure 3: Geographical boundaries of the Duiwenhoks River estuary based on the 5 m topographical contour

3 SYNOPSIS OF THE SITUATION ASSESSMENT

Introduction

The Duiwenhoks River estuary is situated in the Hessequa Local Municipality (LM) and is one of 22 estuaries in the Garden Route (Formally Eden) District Municipality (DM). The Duiwenhoks River is a small river and the estuary which is classified as a permanently open estuary, is approximately 11 km long.

Catchment Characteristics

The Duiwenhoks River lies within a climatic region which receives rainfall almost equally each season, with minor peaks in autumn and spring. Winds are predominantly westerly and south-westerly, especially during winter and spring with an average daily maximum velocity of 54 km/h.

The Duiwenhoks River drains the Langeberg Mountains and flows south to the coast. The upper catchment consists of Table Mountain Group sandstone where after the river then passes through Cretaceous sedimentary rocks and Devonian shales before the estuarine reaches cut through limestone overlain by Quaternary sands.

The majority of the catchment consists of privately-owned farms: citrus and dairy farming dominate the upper catchment, while wheat is the major crop on the lower catchment. Other land uses include scrubland, low fynbos, thicket, bush clumps and high fynbos. A very small percentage consists of planted grassland.

Abiotic Function

The catchment area of the Duiwenhoks River falls within the Gouritz Water Management Area and covers an estimated 53 140 km^2. The mean annual precipitation of the area is 498 mm with a mean annual evaporation of 404 mm. No large dams are present in the Duiwenhoks catchment. The largest dam, the Duiwenhoks Dam, has a capacity of about 6 million m^3.

The mouth of the Duiwenhoks River estuary is permanently open due to the blasting of a 10 m wide channel through the reefs on the seaward side of the mouth to allow for launching of fishing boats from the estuary. The creation of this channel resulted in the stabilisation of the mouth position reducing natural mouth location variations.

Water quality information has been collected from the Duiwenhoks River estuary at interrupted intervals since 1977 by the Department of Human Settlements, Water and Sanitation. It has been observed that under extreme low flow conditions an increase of salinity occurs across the entire estuary eliminating the River-Estuary Interface. Dissolved oxygen concentrations in the Duiwenhoks River estuary reflect well oxygenated conditions. Turbidity generally decreased with an increase in salinity, suggesting that the river was introducing more turbid waters into the system, compared with the sea. Dissolved inorganic nitrogen concentrations shows a relationship with anthropogenic influences.

Biotic Function

There are little historic data associated with microalgae available for the Duiwenhoks River estuary. Phytoplankton biomass has been referred to being low which corresponds with the generally high turbidity caused by high inorganic particle loads.

The Duiwenhoks River estuary has intact salt marshes occurring with zonation that are typical of that found in permanently open Cape estuaries. Three zones could be identified based on the elevation and depth to groundwater. Submerged macrophytes colonise the mudflats and sandflats and important species are *Zostera capensis* and *Ruppia cirrhosa*. Alien invasive plants occur sporadically along the banks of the river. Historical changes of the distribution of habitats have been noted. Sand and mudflats, salt marsh and riparian vegetation increased from 1942 to 2009. Degraded floodplain and dune vegetation decreased in area cover with the degraded floodplain showing the greatest decrease since 1942 as farmlands were abandoned and colonised by riparian vegetation consisting of riparian thicket and dune fynbos.

Unfortunately, no quantitative data are available for invertebrates, and only an average biomass value is recorded for zooplankton. Species recorded were typical of estuaries along the south coast and included four burrowing bait organisms (bloodworm, mudprawn, sandprawn and pencil bait).

Fish sampling has been done by the Department of Environment, Forestry and Fisheries (DEFF) twice annually since 2002. Forty-seven species of fish from 26 families have been recorded in the Duiwenhoks River estuary which is comparable to estuaries of equivalent size.

In the past decade the avifauna has been dominated by piscivorous gulls and terns and benthivorous waders in the Duiwenhoks River estuary.

Ecological Health Status, Importance, Recommended Future State, and Ecosystem Services

The overall ecological health of the Duiwenhoks River estuary is in a Category C. In terms of conservation importance, the estuary is not one of the national priority estuaries requiring formal protection and it is deemed to be of 'low importance'. However, the functional importance of the Duiwenhoks River estuary was high as it is an important fish nursery with a number of Red data and exploited fish species occurring in high numbers in the system. The estuary is also a very important conduit for eels which are a Convention on international Trade in Endangered Species listed species. Therefore, it was established that the Duiwenhoks River estuary should be managed to a Category B. The Ecological Specifications and Thresholds of Potential Concern, as well as the long-term monitoring programme in line with the accepted methods are provided

Estuaries typically provide a range of services that have economic or welfare value. Apart from providing the regulating services of climate regulation and disturbance regulation, it is evident that the Duiwenhoks River estuary provides important ecosystem services towards fish nursery areas, production of fish and medicinal elements and input to structure and composition of biological communities.

Impacts and Potential Impacts

The environmental processes, activities and developments that pose a threat to the Duiwenhoks River estuary include the following:

- *Environmental hazards* – drought, floods and climate change impacts;
- *Land-use and infrastructure development* – the lower reaches of the system have been transformed by road infrastructure. The mouth of the estuary was modified by the blasting of a 10 m channel and the construction of farm dams and run-of-river abstraction from Duiwenhoks Dam has impacted flow of the river;
- *Water quality and quantity issues* – Agricultural activities have impacted on the river water quality by increased input of nutrients and a decrease of fresh water input due to abstraction of water. The draining of wetlands for agricultural activities have altered river flow and flood regimes as well as allow for the infestation of alien vegetation; and
- *Exploitation of natural resources* – Natural habitat has been lost due to grazing and trampling by livestock. Overfishing and unsustainable harvesting of bait species will add pressures to the system together with disturbing bird presence.

Socio-economic Context

The Hessequa LM is the largest of seven municipalities in the Garden Route District, with an estimated total population of 54 236 people. Population density is low with an estimated 9 persons/km^2. The Duiwenhoks River estuary and its catchment falls within Ward 3 of the Hessequa LM, one of the largest wards which stretches over a large rural area. The primary sectors include agriculture and mining but the community services sector was the largest and most important economic sector within the Hessequa LM.

The Duiwenhoks River estuary holds socio-economic value in terms of its recreational value, subsistence value and nursery value as well as unique cultural importance to the residents and communities that live in this area which include Vermaaklikheid and the historical settlement of Puntjie on the eastern side of the estuary mouth. Transformation of agricultural smallholdings into weekend farms, second homes and holiday accommodation were noted with the resultant reduction in agricultural employment opportunities as well as access to the banks. Access to the mouth of the system is also problematic. Private property, namely the Puntjie historical settlement, the Rivermouth Private Nature Reserve as well as neighbouring farms, are negatively impacted by illegal and other activities. Launching into the system, other than at the formally listed launch site higher up the system, is via informal slipways with the need to register an additional public launch site with accompanying amenity seen as very important. Informal as well as recreational fishing does take place on the system, which is monitored by the Duiwenhoks Conservancy during peak season. Additional insight gained from stakeholder engagement is detailed in the SAR and details perspectives from local community members, authorities and some land owners.

The Working for Wetlands Programme has specifically identified a project for the Duiwenhoks River estuary with the goal to ensure water and food security for the region, which will provide employment opportunities. Other existing employment opportunities

are provided at Puntjie where several Vermaaklikheid and surrounding area residents are reported to be regularly employed on the property.

Legislative Instruments and relevant Strategies, Plans and Policy Directives

The legislative framework specific to estuarine management is the Integrated Coastal Management Act and the accompanying 2013 NEMP. The 2013 NEMP provides national policy and ensures alignment by providing a national vision and objectives for achieving effective integrated management of estuaries, amongst other things. The 2013 NEMP identifies the responsible management authority (RMA) per estuary, in this instance the Hessequa Local Municipality. **It is noted that proposed amendments to the 2013 NEMP allocate such responsibilities to the provincial environmental department unless agreement, or until agreement, is reached with the respective municipality, or conservation authority, to undertake the coordination of the implementation process. Ultimately, the role of the RMA must be designated through formal signed agreement.** Key legal instruments that are applicable to estuarine management are then described, and include national, provincial and local management documents. These key instruments are also generally indicated in respective CMPs.

Opportunities and Constraints

A Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis for the management of the Duiwenhoks River estuary was undertaken. One of the strengths of the Duiwenhoks Estuary is that it is relatively remote and small resulting in very little development in and around the system thus little management intervention is required to maintain. Other strengths include opportunities for employment and generally good farming practices,

Overall, the Duiwenhoks River estuary was not identified as a national priority estuary in need of formal protection at the national level but it was rated as a highly important system. However, a stewardship agreement between the owners of the surrounding farms land and CapeNature can be entered into under the CapeNature Biodiversity Stewardship Programme (CapeNature, 2016), towards reducing the negative impacts on the estuary, undertaking various aspects of rehabilitation and gradually improving its ecological condition. Access issues need to be urgently resolved to prevent ongoing conflict with private land owners, holidays makers and community members.

In respect to priority restoration activities, rehabilitation of estuarine habitat, increase of base flows through removal of alien vegetation and compliance monitoring of fishing activities within the estuary are prescribed in order to achieve the Recommended Ecological Category (Category B). Further opportunities include the registration of a public launch site, improved fisheries related compliance and enforcement as well as the formalisation of a suitable public access.

Information Gaps and Recommendations

Various information gaps have been identified for the Duiwenhoks River estuary with a minimum long-term monitoring programme, in line with the accepted Reserve Determination Methods, recommended.

4 LOCAL VISION & OBJECTIVES

4.1 Vision

The Vision for an estuary should be inspirational, representing a higher level of strategic intent and aligned with the strategic objectives of the 2013 NEMP, Western Cape CMP and the greater Cape Floristic Region (CFR). The National Vision and Vision of the Estuaries of the CFR are as follows:

The estuaries of South Africa are managed in a sustainable way that benefits the current and future generations

The estuaries of the CFR will continue to function as viable systems which are beautiful, rich in plants and animals, attract visitors, sustain our livelihoods and uplift our spirits

The 2016 Western Cape Provincial Coastal Management Programme (PCMP), which identifies estuarine management as one of its nine priority areas and sets out the goal for the Western Cape as:

Co-ordinated and integrated estuarine management which optimises the ecological, social and economic value of these systems on an equitable and sustainable basis

The following Vision for the Duiwenhoks River estuary was proposed at a public meeting held in September 2017 and supported at a second public meeting held in April 2018, both in Vermaaklikheid.

The Duiwenhoks, draining the Langeberg and linking the sea, provides for both today's and tomorrow's biodiversity and community needs

The vision highlights the following aspects of the estuary that are valued and need to be preserved or enhanced:

- The linkage that the estuary serves between the mountainous hinterland and the marine environment;
- The value of the estuary from a biodiversity perspective;
- The dependency of the local community on the goods and services provided by the estuary; and
- The need to manage activities around the estuary in a sustainable manner to ensure that these needs are maintained into the future.

4.2 Strategic Objectives

Objectives are qualitative statements of the values derived from the vision and typically reflect the overarching issues. They should answer the following question, *"How will you know when you have achieved the Vision?"*. The strategic objectives inform the development of the detailed management strategies that are carried forward as plans of action.

The strategic objectives for the Duiwenhoks River estuary were discussed at the stakeholder meeting. Based on the feedback received from the participants present, as well as input from additional stakeholders, the strategic objectives for the Duiwenhoks River estuary align with the following identified sectors or categories of issues (Figure 4):

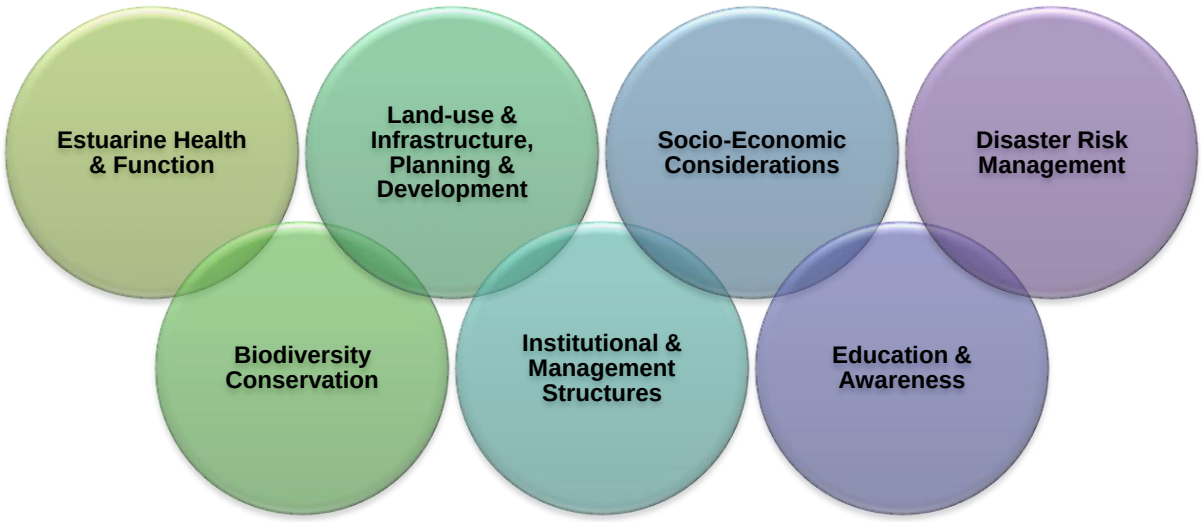


Figure 4: Sectors or categories of issues relevant to the management of the Duiwenhoks River estuary

According to these categories, the strategic objectives for the Duiwenhoks River estuary are as follows:

Table 2: Strategic Objectives for management of the Duiwenhoks River estuary, their indicators and level of priority

	Sector / Category	Strategic Objective	Performance Indicator(s)	Priority
1	Estuarine Health and Function	The ecological health and natural functioning of the Duiwenhoks River estuary is maintained and safeguarded, living resources are sustainably managed and estuary nursery function protected	• Health state of the estuary is improved from C to B Category • Degraded areas and habitats are restored • Marine living resources utilised within legal limits • Water quality and ecological monitoring programmes in place • Invasive alien plants are eradicated • Alien fish species are eradicated	**HIGH**

			• Increase in number of research projects	
2	Biodiversity Conservation	The biodiversity of the Duiwenhoks River is conserved	• Duiwenhoks EMP incorporated into GCBR Plan and municipal CMP • Spatial zonation plan is adopted and enforced • No-take zones are established • Stewardship agreements established with land owners • Egyptian Geese controlled • Protection status obtained	**HIGH**
3	Land-use and Infrastructure Planning and Development	Impacts associated with developments and proposed changes in land-use, including infrastructure and agriculture, are minimised	• EMP is seamlessly incorporated into the Hessequa IDP and SDF • All development and land use changes surrounding and within the Estuarine Functional Zone (EFZ) comply with environmental legislation, environmental best practice and risk aversive approach and do not detract from the sense of place • Agricultural best practice is implemented which will ensure retreat from the EFZ and improve water quality • Rehabilitation programme in place • Degraded areas are restored; recovery of riparian margin	**MEDIUM**
4	Institutional and Management Structures	The Duiwenhoks River estuary is well managed through effective co-operative governance	• EMP is seamlessly incorporated into the Hessequa IDP and SDF • Estuarine bylaws are drafted • RMA and participating agencies are well-capacitated, well equipped and knowledgeable • Effective co-ordination of estuarine management responsibilities through a designated regional estuarine management co-ordinator • Estuary advisory committee is established and meets regularly	**HIGH**
5	Socio-Economic Considerations	Socio-economic benefits are enhanced and regulated to ensure sustainable use of the Duiwenhoks River estuary and its resources	• Resources utilised within legal and sustainable limits • Local communities are involved and uplifted • Carrying capacity for estuarine uses is upheld; recreational use is regulated effectively • Heritage resources are preserved and honoured • Public access to the coast provided • Public launch site listed	**HIGH**
6	Education, Awareness,	Members of society are sensitive to, and aware of, the value	• Awareness programme developed and successfully	**MEDIUM**

	Monitoring and Research	and importance of the Duiwenhoks River estuary	implemented on an on-going basis • Signage erected; information disseminated • Illegal activities are reduced	
7	Disaster Risk Management	Potential risks that could impact the Duiwenhoks River estuary are reduced (inclusive of climate change impacts)	• Risks identified and contingency plans in place • Key infrastructure is well located and maintained	**LOW**

5 PRIORITY MANAGEMENT OBJECTIVES AND ASSOCIATED ACTIVITIES

After the review of the background information, as well as after conducting stakeholder engagement, SWOT analysis of the Duiwenhoks River estuary under the current management practices was prepared (Table 3).

Table 3: SWOT Analysis

STRENGTHS *(highlights, uniqueness?)*	**WEAKNESSES** *(what could you improve?)*
• Remote and limited access • Garden Route (previously Eden) District ICMP has been developed to facilitate co-ordinated management • Supporting ecological services • High historical and cultural value • Community interest in the system • Private Nature Reserve and proclaimed national monument at the mouth • Large dune fields on the Western shore • Employment opportunities within Puntjie • Detailed assessments (bathymetry) undertaken and ecological understanding of the system • Limited agricultural cultivation in the floodplain • Limited grazing and trampling of salt marshes • Water quality as well as biological monitoring undertaken • Rated as a highly important estuary • Important nursery for exploited and currently collapsed fish stocks & conduit for eels	• Transformation of former agricultural activity in along the banks into weekend farms, second homes and holiday accommodation with resultant decrease in employment activities and restriction of access • Former upstream waste water treatment works potentially still affecting water quality • Lack of involvement by riparian landowners • Clarity required regarding boat launching needs • Anti-social behaviour of visitors accessing the mouth • Continued accessing and polluting of private property • Reported criminal activities • Clarity required regarding coastal access / urgent need to resolve access to the coastal zone • Reported fisheries non-compliance as well as over fishing and bait collection • Alien invasive plants • Resource depletion • 18% reduction in mean annual runoff and increased abstraction of fresh water (many off stream dams for irrigated agriculture)
OPPORTUNITIES *(Opportunities for positive change)*	**THREATS** *(what could prevent the EMP from working?)*
• Rehabilitation of wetlands around estuary • Alien vegetation eradication programme to improve baseflows • Fisheries related compliance and enforcement • Sustainably managed recreational boat launching • Maintenance of connectivity with marine environment • Increased communication as well as awareness and education of riparian land owners/farmers	• Water quality impacts predominantly as a result of Agricultural activities and the infestation of alien vegetation • Limited alternative livelihood/Local Economic Development (LED) opportunities • Reactionary (vs proactive) response to management requirements when necessary • Uncoordinated and haphazard management interventions • Climate change and loss of aquatic ecosystem • Reported illegal activities

• Formalisation of suitable coastal access • Formalisation of suitable beach area with applicable services installed and maintained • Formalised and rationalise jetties and slipways • Proposed simple, user friendly code of conduct for property owners renting out accommodation • Improvement of estuarine health (from C to B rating) • Potential for protected area status	• Need to confirm political will as well as resources/ capacity required/available • Lack of willingness of private land owners to support the municipality in securing public access to the coastal zone

The priority management objectives detailed below were informed by the SWOT analysis and other critical issues identified as part of the scoping phase and stakeholder engagement.

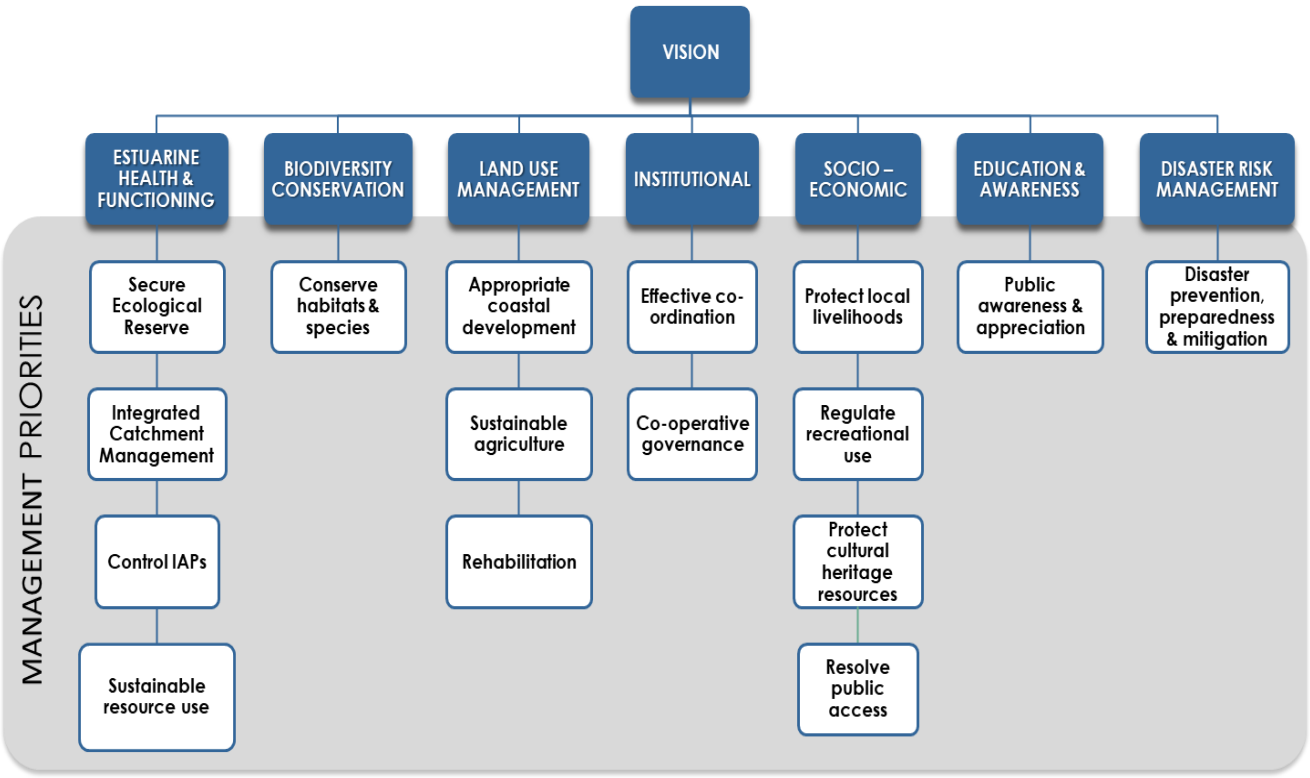


Figure 5: Summary of priority management objectives per management sector

5.1 Estuarine Health and Function

Strategic Objective 1: The ecological health and natural functioning of the Duiwenhoks River estuary is maintained and safeguarded, living resources are sustainably managed and estuary nursery function protected

Table 4: Management Objectives and Actions for Estuarine Health and Function (includes water quantity and quality as well as utilisation of living resources)

	Action	Relevant Legislation	Performance Indicator	Priority	Responsibility
Management Objective 1.1: Secure adequate quantity and quality of freshwater input to improve and maintain ecosystem health and functioning					
a.	Lobby Department of Human Settlements, Water and Sanitation (DHSWS) Minister to sign off the recommended freshwater reserves	National water Act (NWA)	• Meetings held; correspondence written • Recommended reserve(s) signed off • Base-flows secured • Health state of the estuary is improved from C to B Category	HIGH	Breede-Gouritz Catchment Management Agency (BGCMA), Responsible Management Authority (RMA), Hessequa Local Municipality (LM)
b.	Once classification study signed off, follow up on implementation of water resource classification process	NWA	• Meetings held; correspondence written • Water resource classified • Baseflows preserved and restored	HIGH	BGCMA, RMA, Hessequa LM
c.	Maintain DHSWS flow gauging station (H8H001) at the head of the estuary	NWA	• Flow gauging probe well maintained by DHSWS • Data generated	HIGH	DHSWS, BGCMA
d.	Develop and implement a water resource utilisation plan for surface and groundwater resources (including registration & licensing)	NWA	• Utilisation plan developed and adopted • Abstraction limits established • Database of users compiled and maintained	HIGH	BGCMA, DHSWS

e.	Identify abstraction and discharge points (both legal and illegal) and take compliance action in respect to illegal operations	NWA, Integrated Coastal Management Act (ICMA)	• Patrols undertaken • Offenders identified and prosecuted	HIGH	DHSWS, Hessequa LM
f.	Implement and document DEFF and DHSWS policy to not allow Waste Water Treatment Works (WWTW) to discharge to the estuary in respect to any new proposed developments	NWA	• Discharge of wastewater prohibited	HIGH	RMA, DHSWS, Department of Environmental Affairs, Forestry and Fisheries (DEFF), Hessequa LM
g.	Catchment water flow and quality to be summarised and reported on	NWA	• Annual report submitted to RMA and EAF	LOW	DHSWS, BGCMA
h.	Monitor natural mouth dynamics (in partnership with neighbouring land owners and other Interested and Affected Parties (I&APs))	NWA (Resource Directed Measures (RDM))	• Mouth dynamics documented • Photographic database generated	HIGH	RMA, Duiwenhoks Conservancy
i.	Undertake basic water quality monitoring on a monthly basis, taking Resource Quality Objectives (RQOs) into account	NWA	• Estuary Water Quality (WQ) database maintained to facilitate long term database • EMP informed by monitoring results going forward	HIGH	RMA, BGCMA, CapeNature
j.	Undertake biannual monitoring of bird populations, taking RQOs into account	NWA, national Environmental Management: Biodiversity Act (NEM:BA)	• Data produced and reported on • Data incorporated into EMP 5 year review	MEDIUM	RMA, BGCMA, CapeNature
k.	Undertake seasonal monitoring fish populations (inclusive of recruitment and resource needs), taking RQOs into account	NWA, NEM: BA, Marine Living Resources Act (MLRA)	• Data produced and reported on • Data incorporated into EMP 5 year review	MEDIUM	DEFF, South African National Biodiversity Institute (SANBI), CapeNature, Duiwenhoks

					Conservancy, (Potential funding from WRC, DST)
l.	Eradicate/control (predatory) alien invasive fish species in the system	NEM:BA, MLRA	• Focussed fishing competitions • Decline in alien fish populations	MEDIUM	DEFF, Duiwenhoks Conservancy,
m.	Undertake full RDM monitoring every 3 years	ICMA, NWA	• Required basic monitoring undertaken • Data produced and reported on • Data incorporated into EMP 5-year review	MEDIUM	DHSWS, BGCMA, RMA (funding from Water Research commission (WRC), Department of Science and Technology (DST))
Management Objective 1.2: Ensure estuary requirements are integrated into catchment processes to ensure healthy water quality					
a.	Catchment land use map developed and updated annually	NWA	• Updated land use map produced every year	MEDIUM	DHSWS, BGCMA
b.	Land use and effluent management included in the Catchment Management Strategy (CMS)	NWA	• CMS reduces nutrient pollution from agricultural practices and identifies additional sources of pollution (land use and effluent) to the estuary and provides mitigation strategies • CMS includes all actions and strategies of the EMP	LOW	BGCMA
c.	Water use plan updated on an annual basis	NWA	• Updated water use plan produced every year	LOW	DHSWS (Resource protection)
d.	SDF and environmental overlay updated as and when required	Municipal Systems Act (MSA)	• Updated SDF and overlays produced	MEDIUM	Hessequa LM
e.	For the existing Heidelberg WWTW, Duiwenhoks estuary to be included in municipal waste water management plan	MSA	• Waste water plan takes cognisance of downstream impacts	HIGH	Hessequa LM

Management Objective 1.3: Control the spread and densification of invasive alien plant species					
a.	Identify and prioritise infested areas	Conservation of Agricultural Resources Act (CARA), NWA	• Priority areas identified • Appropriate methods of control determined	HIGH	RMA, DEFF: Working for Water (WfW), Duiwenhoks Conservancy
b.	Develop and implement invasive alien species eradication programme	CARA, NWA	• Invasive Alien Plants (IAPs) eradication programme implemented • Increased area of IAPs removed	HIGH	RMA, DEFF: WfW, Duiwenhoks Conservancy
Management Objective 1.4: Ensure sustainable resource use through an effective level of compliance management					
a.	Determine and adopt the carrying capacity of the system for subsistence and recreational harvesters/fishers	MLRA, ICMA	• Carrying capacity established based on scientific information and enforced • Improved fish and invertebrate populations	HIGH	RMA. CapeNature, DEFF
b.	Monitor and regulate the number of harvesters/fishers on the system according to carrying capacity	MLRA	• Monitoring programme developed and implemented • Monthly counts of number of harvesters and users • Ad hoc patrols • Number of permit holders • Investigative surveys/ questionnaires undertaken	MEDIUM	Duiwenhoks Conservancy, CapeNature, DEFF
c.	Initiate and enforce ban on night fishing	MLRA	• Ad hoc patrols conducted • Incidents of poaching reduced • Transgressors prosecuted	When adopted	DEFF
d.	Deploy additional human resources for compliance and enforcement, particularly to address illegal activities (gill netting/poaching and other)	MLRA	• Ad hoc patrols conducted • Incidents of poaching reduced • Transgressors prosecuted	HIGH	CapeNature/ DEFF, Duiwenhoks Conservancy

e.	Develop a regional compliance monitoring network and deploy human resources when required	MLRA, NEMA, NEM:BA, MSA	• Network established • Rapid response protocol(s) developed • Incidents reported and documented • Transgressors prosecuted	MEDIUM	CapeNature, DEFF, DHSWS, Hessequa LM
f.	Undertake creel survey during peak seasons	MLRA	• Catch statistics determined • Data produced and reported on • Data incorporated into EMP 5-year review	MEDIUM	DEFF, Duiwenhoks Conservancy

5.2 Biodiversity Conservation

<u>Strategic Objective 2</u>: The biodiversity of the Duiwenhoks River estuary is conserved.

Table 5: Management Objectives and Actions for Biodiversity Conservation

	Proposed Activity/Action	Relevant Legislation	Performance Indicator	Priority	Responsibility
Management Objective 2.1: Ensure the conservation of estuarine habitats and indigenous species					
a.	Incorporate Duiwenhoks EMP into the GCBR Management Plan as well as the municipal CMP	ICMA, Western Cape Biosphere Reserves Act (WC BRA)	• EMP included in management plans for the Gouritz Cluster Area	MEDIUM	RMA, CapeNature, GCBR
b.	Adopt, implement and enforce spatial zonation plan which include a no-take areas to protect fish and invertebrate populations from overexploitation	ICMA, National Environmental Management: Protected Areas Act (NEM: PAA), MSA	• Special/closed areas established and demarcated • EFZ controls enforced and offenders prosecuted • No further permanent development in the EFZ (e.g. only new sacrificial infrastructure within EFZ permitted) • No infilling of EFZ • Reduced habitat loss/degradation and disturbance, and inappropriate behaviour/ activities • Reduced illegal activities • Improved fish and invertebrate populations	HIGH	RMA, DEFF, Hessequa LM
c.	Develop and publish appropriate estuarine bylaws/guidelines/regulations	ICMA, MSA	• Bylaws developed and gazetted	HIGH	RMA, Hessequa LM, DEFF

	to support spatial zonation, in particular no-take/sanctuary zone				
d.	Institute a control programme to reduce the number of Egyptian geese in the surrounding habitat	NEM:BA	• Potential problem investigated • Control programme developed and implemented	MEDIUM	CapeNature
e.	Engage with landowners and stakeholders to enter into stewardship agreements for adjacent properties (convey above resolution regarding protection)	National Environmental Management Act (NEMA)- (Duty of Care)	• Meeting with adjacent land owners convened • Signed agreements with land owners • Degraded areas rehabilitated • Integrity of estuarine margin improved	MEDIUM	CapeNature Duiwenhoks Conservancy
f.	Engage with landowners and stakeholders regarding sustainable land use activities	NEMA (Duty of Care), Land Use Planning Act (LUPA)	• Meeting with adjacent land owners convened • Signed agreements with land owners • Unsustainable land-use activities prevented • Integrity of estuarine margin improved	MEDIUM	RMA, CapeNature, Hessequa LM
g.	Implement protection status (e.g. Special Management Area, formal Protected Area (PA) status, stewardship agreements, or conservation servitude in SDF, etc.)	NEM:PAA, ICMA, MSA, LUPA, WC BRA	• Protection for the estuary established and published • Support for Private Nature Reserve provided • Custodian/ Management authority assigned	HIGH	RMA, CapeNature, DEFF
h.	Instate educational signage to promote conservation	NEM: PAA, NEM:BA	• Signage created and erected in key public spaces	LOW	CapeNature

5.3 Land-use and Infrastructure Planning and Development

Strategic Objective 3: Impacts associated with developments and proposed changes in land-use, including infrastructure and agriculture, are minimised.

Table 6: Management Objectives and Actions for Land-use and Infrastructure Planning and Development

	Action	Relevant Legislation	Performance Indicator	Priority	Responsibility
Management Objective 3.1: Ensure appropriate and sustainable coastal development adjacent to the Duiwenhoks River estuary, considering ecosystem services and sense of place					
a.	RMA to adopt and facilitate implementation of the EMP by ensuring the incorporation of the EMP and spatial zonation plan into all municipal and relevant government department planning documents and processes (e.g. municipal IDP, SDF, zoning scheme & overlay, Water Use Licence (WUL) Applications, Environmental Impact Assessment (EIA) Applications)	MSA, LUPA, NEMA, ICMA	EMP included in all relevant planning documents	HIGH	RMA, all authorities
b.	Implement coastal management line and associated development controls	ICMA, LUPA, MSA	• No further permanent development, infilling or land transformation of EFZ in the EFZ (e.g. only new sacrificial infrastructure permitted) • Transgressors prosecuted • Corrective action undertaken • Reduced habitat loss/degradation and disturbance, and inappropriate behaviour	HIGH	Hessequa LM, DEA&DP
c.	Ensure that all proposed developments adhere to the full suite of relevant	NEMA, NWA, NEM:BA,	• Inspections undertaken • New developments are compliant • Architectural style of region is maintained	HIGH	RMA, Hessequa LM, CapeNature

	environmental legislation and architectural guidelines to maintain the sense of place	NEM: PAA, NHA	• Sense of place is retained		
d.	Rationalisation of all jetties and slipways and ensure they are licensed in terms of the Seashore Act, NEMA as well as listed in terms of the Public Launch Site Regulations	Seashore Act, NEMA	• Inspections undertaken • Transgressors prosecuted • Corrective action undertaken • All jetties/slipways registered • Jetties and slipways database developed and maintained	HIGH	CapeNature
e.	Use EAF as source of I&APs for Environmental Impact Assessments (EIAs)	MSA, LUPA, ICMA, NEMA	• EAF partakes in development planning affecting the estuary • Impacts on the estuary are mitigated/ prevented	HIGH	RMA, Hessequa LM, Overberg DM, DEA&DP
Management Objective 3.2: Promote sustainable agricultural practices					
a.	Lobby farmers to implement agricultural best practice specifically to reduce nutrient enriched return flow and sediment erosion from surrounding farms and catchment	CARA, NWA, NEM:BA	• On-going relationship with farmers developed • Land-use setback developed, retreat from EFZ • Improved quality of agricultural return flow • Use of inorganic fertilisers reduced • Recovery of riparian zone/marginal habitat	MEDIUM	RMA, DEFF: WfW, Duiwenhoks Conservancy
b.	Develop and implement best practice guidelines for riparian rehabilitation and protection (addressing reed removal, livestock grazing, burning, etc.)	CARA	• Guidelines developed and implemented On-going relationship with farmers developed • Land-use setback developed • Recovery of riparian zone/marginal habitat	MEDIUM	Department of Agriculture, land Reform and Rural Development (DALRRD), Farmers Association

Management Objective 3.3: Rehabilitate degraded and transformed areas					
a.	Identify detrimental activities, compile degradation profiles and identify priority areas for rehabilitation	NEM:BA, NWA, CARA,	• Degradation profiles compiled • Priority areas needing rehabilitation identified	HIGH	RMA, DALRRD, Duiwenhoks Conservancy
b.	Develop and implement rehabilitation programme (with ongoing maintenance of rehabilitated areas)	NEM:BA, NWA, CARA,	• Rehabilitation programme developed • Priority degraded areas restored	HIGH	RMA, DALRRD, Duiwenhoks Conservancy
c.	Lobby for landowners rectify damages/ degraded areas on their property	NEM:BA, NWA, CARA	• On-going relationship with landowners developed • Degraded areas restored (e.g. revegetation with estuarine vegetation)	HIGH	RMA, CapeNature, Duiwenhoks Conservancy

5.4 Institutional and Management Structures

<u>Strategic Objective 4:</u> The Duiwenhoks River estuary is well managed through effective co-operative governance.

Table 7: Management Objectives and Actions for Institutional and Management Structures

	Action	Relevant Legislation	Performance Indicator	Priority	Responsibility
Management Objective 4.1: Ensure effective co-ordination of estuarine management responsibilities					
a.	RMA adopts and incorporates the EMP and the spatial zonation plan into planning documents (e.g. IDP, SDF, environmental overlay, disaster management plan, etc.)	MSA, LUPA, NEMA, ICMA	• EMP and zonation plan adopted by RMA • EMP included in all relevant planning documents	HIGH	RMA, Hessequa LM
b.	Undertake needs analysis and identify skills required	ICMA	• Needs and skills identified • Motivation for acquisition drafted and approved • Equipment purchased and maintained	LOW	RMA
c.	Implement skills development, training or co-opt additional members / secondment for estuarine management and undertake mentoring of RMA	ICMA	• Motivation for training drafted and approved • Staff attend relevant accredited training courses • Memorandum of understanding to be developed for secondments	LOW	RMA, DEA&DP, DEFF
d.	Develop good communication protocols and processes with implementing agents (Working relationships with mandated departments developed & agreements entered into per management action)	ICMA	• Project champions identified • Networks established, and contacts database compiled • Regular email correspondence	MEDIUM	RMA
e.	Source support and additional budget, and confirm budget allocation annually	Relevant legislation	• An action plan for securing future funding drafted and approved • Funding secured for 5 year cycle	HIGH	All authorities

f.	Constitute and maintain a regional EAF (or other applicable forum, e.g. protected area advisory forum) to facilitate co-operative governance	ICMA, MSA, LUPA, NWA, NEM: PAA, MRPDA	• EAF constituted (Membership includes representatives of government and stakeholders/civil society) • Regional EAF meets on a quarterly basis • Meetings are minuted	HIGH	RMA
g.	Identify and invite missing stakeholders/ interest groups to partake in regional EAF	ICMA	• Networks established • Stakeholder database developed and regularly updated	HIGH	RMA
h.	EMC present on critical forums to ensure that estuarine issues are tabled, e.g. CMA, Water Users Associations (WUA), Agriculture groups etc.		• RMA & EMC attendance at critical forum meetings • Meetings are minuted	HIGH	RMA
i.	Monitor and report on the progress of EMP actions and achievements on annual basis	ICMA	• Feedback received from participating agencies • Biannual and annual reporting to DEFF and EAF, undertaken by EMC • Action plans updated as and when required • Provincial/National take over management of system, where performance is poor	MEDIUM	RMA
j.	Undertake formal 5 year review as prescribed by the 2013 NEMP	ICMA	• Motivation for updated drafted and approved • Funding confirmed • Terms of Reference drafted • Consultants appointed • Plan updated	LOW	RMA
k.	Monitor and report on the progress of EMP actions and achievements on annual basis	ICMA	• Feedback received from participating agencies • Biannual and annual reporting to DEFF and EAF, undertaken by EMC • Action plans updated as and when required	MEDIUM	RMA supported by all participating

Management Objective 4.2: Define and enable co-operative governance					
a.	Identify and implement procedures to ensure cooperative governance between all gov. depts. with a mandate to act	ICMA, Inter-governmental relations Act (IGRA)	• Roles and responsibilities defined and accepted via Memorandum of understanding signed between RMA and spheres of government and participating agencies • Regional EAF meets on a quarterly basis • Meetings are minuted • Active collaboration of various implementing agents	HIGH	All authorities
b.	EAF to monitor performance of RMA in respect to implementation of plan	ICMA	• Authorities to provide formal feedback on mandated activities • Regional EAF meets on a quarterly basis	MEDIUM	All authorities, All stakeholders
c.	Individual agencies to identify and address training needs, with possible secondment to address training and capacity shortfalls	ICMA	• Motivation for training drafted and approved • Staff attend relevant accredited training courses • Memorandum of understanding to be developed for secondments	LOW	All authorities
d.	Individual agencies to allocate resources, create and fill posts (including project champions), and acquire necessary infrastructure, resources and equipment of fulfil their mandates	MSA, NWA, ICMA, NEMA, NEM: PAA	• Need and Desirability investigation undertaken • Motivation for acquisition drafted and approved • Equipment purchased and maintained • Project champion(s) for allocated management actions • Staff appraisals in respect to management actions and projects	LOW	All authorities
e.	Mandated authorities and participating agencies to confirm budget allocations for mandated activities/actions	MSA, NWA, ICMA, NEMA, NEM: PAA	• Formal feedback from authorities on mandated activities	LOW	All authorities

			• Motivation for budget drafted and approved • Funding secured for 5 year cycle		
f.	Combined compliance monitoring and enforcement operations need to be planned to address illegal activities	Applicable legislation	• Operations planned and actioned • Prosecutions taken forward • Convictions made	MEDIUM	South African Police Service (SAPS), DEFF, DEA&DP, DEFF, CapeNature, etc.

5.5 Socio-Economic Considerations

<u>Strategic Objective 5</u>: Socio-economic benefits are enhanced and regulated to ensure sustainable use of the Duiwenhoks River estuary and its resources.

Table 8: Management Objectives and Actions for Social-economic Considerations

	Action	Relevant Legislation	Performance Indicator	Priority	Responsibility
Management Objective 5.1: Protect and improve local livelihoods					
a.	Subsistence/vulnerable users need to be identified, formalised (to protect their right to fish) via a permitting system based on the carrying capacity (Obj 2.2) and an established no-take area, and monitored	MLRA	• Subsistence users quantified and identified • Set number of permits issued • Co-management options for resource management investigated and implemented • Catches monitored, data generated and reported on	HIGH	DEFF, CapeNature
b.	Annual report provided to the RMA and EAF with regards to value of fishing and bait harvesting	MLRA	• Living resource use reported on • Data incorporated into EMP 5 year review	MEDIUM	DEFF
c.	Investigate and implement alternate livelihoods opportunities that promote non-consumptive enterprises involving historically disadvantaged communities, which are compliant with all forms of legislation and planning frameworks	ICMA	• Target groups/areas identified • Potential alternatives identified • Community projects initiated • Employment opportunities realised • Existing employment opportunities at Puntjie confirmed and maintained	HIGH	RMA, Hessequa LM, Molly Lazarus Trust
d.	Assist people from local vulnerable communities through training programmes (e.g. guiding courses), and by creating links with the Environmental Protection and Infrastructure Programmes (EPIP), Non-	ICMA	• Trained members of the local communities • Employment opportunities • EPIP programmes engaged	HIGH	RMA, Duiwenhoks Conservancy, Hessequa LM, DEFF: WftC, WfW etc.

	Governmental Organisations (NGOs), Community Based organisations (CBOs), donors and commercial operators.				
Management Objective 5.2: Regulate recreational use on the Duiwenhoks River estuary					
a.	Determine carrying capacities for each water-based activity in consultation with relevant organs of state, specifically power boat carrying capacity (number of boats and engine size)	WC EMFIS Jetskis and Motorised Watercraft Guidelines 2019	• Carrying capacities determined • Revised boating bylaws if required • Notification gazetted • Bylaws enforced	MEDIUM	Hessequa LM,
b.	Develop clear regulations/by-laws to manage each use. Users need to be monitored and impacts need to be recorded.	ICMA	• Regulations/bylaws developed and gazetted • Regulations/bylaws enforced • Counts of users recorded • Impacts recorded	MEDIUM	Hessequa LM,
c.	Monitor and regulate number of boats launching or taking part in a specific activity and/or format (e.g. angling competitions).	PLS Regulations	• Counts of boats on the water recorded • Counts of boat licenses/users/ participants recorded • Carrying capacity enforced • Boat usage regulated	MEDIUM	Hessequa LM,
d.	Physically demarcate (e.g. land beacons, buoys etc.) and enforce spatial zonation plan to protect estuarine habitats and other users	ICMA, NEM: PAA, SAMSA Regulations, WC EMFIS Jetskis and Motorised Watercraft Guidelines 2019	• Zones demarcated • EFZ controls enforced and offenders prosecuted • Reduced habitat loss/degradation and disturbance, and inappropriate behaviour	HIGH	RMA, SAMSA, CapeNature/ Duiwenhoks Conservancy

e.	Informative signage, indicating zonation and allowable activities, to be placed at strategic points	ICMA, NEM:PAA	• Signage created and erected in key public spaces	LOW	RMA, Hessequa LM,
f.	Develop Standard Operating Procedure (SOP) to regulate high visitor numbers and minimise environmental disturbance/damage during peak season	ICMA, NEM:PAA, MSA	• SOP developed • SOP implemented as and when required • Memorandum of understanding signed between necessary parties	HIGH	RMA, Hessequa LM, Necessary authorities
g.	Annual report on the recreational use of the estuary and associated impacts	ICMA, NWA	• Data produced and reported on • Data incorporated into EMP 5 year review	MEDIUM	RMA, Hessequa LM / Duiwenhoks Conservancy
Management Objective 5.3: Preserve and manage cultural heritage resources					
a.	Maintain a spatially explicit database of cultural heritage resources (middens, caves, homesteads)	National Heritage Act (NHA)	• Information gathered, and database developed • Heritage assets categorised and mapped	MEDIUM	SAHRA, Heritage Western Cape (HWC)
b.	Investigate and implement measures to protect areas of cultural heritage importance	NHA	• Measures investigated • Cultural Heritage Management programme developed • Site-specific management guidelines and maintenance plans developed for all sites	MEDIUM	SAHRA, HWC
Management Objective 5.4: Investigate, resolve and formalise public access					
a.	Investigate and implement the provision of public access to the coastal zone	ICMA, Provincial Coastal Access Strategy and Plan (PCASP)	• Obtain legal opinion in respect to the provision of access taking cognisance of private land • Negotiate the provision of access • If not successful, designate public access servitude to provide for public access • Develop code of conduct for users of public access • Maintain public access	HIGH	Hessequa LM, DEA&DP

b.	Review informal/private launch sites on the estuary and address the need for a public launch site (listing)	ICMA: Public launch Site Regulations	• Confirm need for additional public launch site • Determine appropriate location for public launch site • Get Council approval to make application for listing • Make application and manage launch site, should approval be granted • Operational Plan developed for public boat launch sites	HIGH	Hessequa LM, DEA&DP
c.	Investigate the need for and provide for public amenity at the public launch site (if approved) and at the public access site	MSA, NEMA	• Undertake assessment of minimum requirements • Obtain Council approval and funding • Appoint EAP and obtain environmental authorisation (if required) • Appoint service provider and construct facilities • Maintain facilities	HIGH	Hessequa LM

5.6 Education and Awareness

<u>Strategic Objective 6</u>: Members of society are sensitive to, and aware of, the value and importance of the Duiwenhoks River estuary.

Table 9: Management Objectives and Actions for Education and Awareness

	Action	Relevant Legislation	Performance Indicator	Priority	Responsibility
Management Objective 6.1: Promote high levels of public awareness and appreciation of the value of the Duiwenhoks River estuary					
a.	Develop and effective education and awareness programme for residents, and visitors to the Duiwenhoks River estuary	ICMA	• Education & awareness programme developed and implemented at schools and through interest groups • Increased educational opportunities at group gatherings, community meetings, conferences etc.	MEDIUM	RMA, Duiwenhoks Conservancy
b.	Source and/or commission educational and informative material including signage, posters, pamphlets and webpage design	ICMA, WC BRA	• Educational signage erected at strategic points • Posters and pamphlets erected/ disseminated • Duiwenhoks estuary webpage operational	MEDIUM	RMA, GCBR, Duiwenhoks Conservancy
c.	Engage and educate all estuary users	ICMA	• Reduction in illegal activities • Appropriate boat usage • Reduced habitat loss/degradation and disturbance, and inappropriate behaviour • Informative surveys/talks undertaken	LOW	Duiwenhoks Conservancy, DEFF

5.7 Disaster Risk Management

<u>Strategic Objective 7</u>: Potential risks that could impact the Duiwenhoks River estuary are reduced (inclusive of climate change impacts).

Table 10: Management Objectives and Actions for Disaster Risk Management

	Action	Relevant Legislation	Performance Indicator	Priority	Responsibility
Management Objective 7.1: Disaster prevention, preparedness & mitigation					
a.	Identify, estimate costs, prioritise and rehabilitate areas of bank erosion, trampling, disturbed riparian vegetation (priority areas and hot spots).	NEMA, Western Cape Transport Infrastructure Act (WC TIA) (Act 1 of 2013)	• Priority areas needing rehabilitation identified • Degradation profiles compiled • Rehabilitation programme developed • Priority degraded areas restored	MEDIUM	Western Cape Department of Transport & Public Works (WC DoT&PW), Hessequa LM, CapeNature, RMA
b.	Identify areas and infrastructure at risk of flooding and erosion, and include in relevant plans (e.g. regional disaster management plan) accompanied by an early warning system	Disaster Management Act (Act 57 of 2002) (DMA), WC TIA	• High risk areas identified • Relevant plans updated with early warning and monitoring systems and evacuation protocols, and contingency plans for high erosion and flood risk areas.	HIGH	RMA, WC DoT&PW, Hessequa LM, CapeNature, WC Dept of Local Gov.: Disaster Management
c.	Develop and implement contingency plans to address specific sources of pollution (oil spill, chemical spill etc.)	NWA, ICMA	• Identify specific sources of pollution (in addition to agricultural run-off) • Contingency plans developed and approved • Contingency plan to include a health incident evacuation plan, identifying	MEDIUM	RMA, Hessequa LM, CMA, DHSWS, DEFF

			actions, timing and responsible agencies and actors. • Mitigation / clean-up undertaken • Investigation initiated, and enforcement actions undertaken		

6 PROPOSED ZONATION OF ACTIVITIES

6.1 Introduction

Spatial zonation of activities on an estuary is necessary to avoid user conflict and to guide sustainable utilization without degradation of the estuarine environment. The Spatial Zonation Plan (SZP) provides a means of geographically transposing the aims of the management objectives, where applicable, and is informed by the following (DEA, 2015):

- The geographical boundary of the estuary also indicating important habitats (e.g. floodplain, open water, reed beds, sandflats, etc.);
- Areas designated for the conservation and protection of biodiversity;
- The surrounding land uses and existing infrastructure;
- Appropriate buffers in which land use and development are strictly controlled and monitored; and
- Zones where certain types of activities (recreational, commercial, industrial, harvesting etc.) are permissible and others not permissible.

6.2 Habitat zones

A habitat sensitivity analysis is the baseline which guides the differentiation of the various zones, specifically identifying:

- threatened, ecologically important habitats as no-go or minimal disturbance zones;
- those areas which can support controlled, sustainable exploitation of marine living resources; and
- those areas where various forms and levels of appropriate water-based recreation are acceptable.

The habitat map shown in Figure 6 is used as the baseline for the identification of sensitive estuarine habitats and informs the zonation of activities in the Duiwenhoks River estuary.

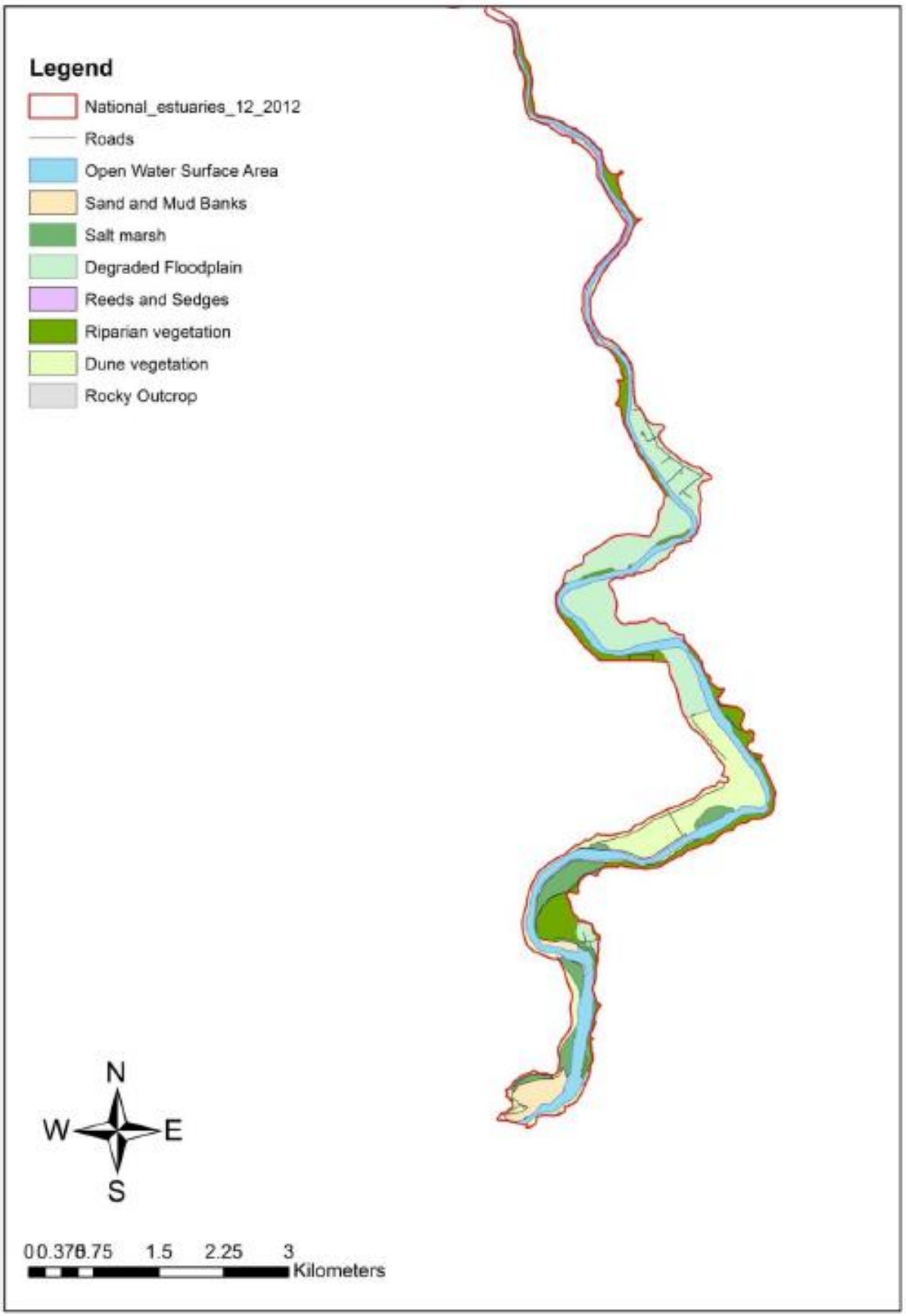


Figure 6: Habitats identified in the Duiwenhoks River estuary

6.3 Legislated Coastal Boundaries and Buffer Zones

6.3.1 Estuarine Functional Zone

The ICMA defines an estuary as "*a body of surface water -*

a) that is permanently or periodically open to the sea;
b) in which a rise and fall of the water level as a result of the tides is measurable at spring tides when the body of surface water is open to the sea; or
c) in respect of which the salinity is higher than fresh water as a result of the influence of the sea, and where there is a salinity gradient between the tidal reach and the mouth of the body of surface water".

Similarly, the National Water Act (NWA) defines an estuary as "*a partially or fully enclosed water body that is open to the sea permanently or periodically, and within which the seawater can be diluted, to an extent that is measurable, with freshwater drained from land*".

The EFZ is defined by the 2014 Environmental Impact Assessment (EIA) Regulations (as amended in 2017) (GN 324) as "*the area in and around an estuary which includes the open water area, estuarine habitat (such as sand and mudflats, rock and plant communities) and the surrounding floodplain area*", as defined by the 5 m topographical contour (referenced from the indicative mean sea level). The 2013 NEMP acknowledges the EFZ as the geographical boundary of estuaries in South Africa. In practice, it is found that the 5 m topographic contour approximates the EFZ for most estuaries in South Africa. It is consequently commonly used to delineate the EFZ in the absence of specific biophysical assessments.

6.3.2 Coastal Protection Zone and proposed Coastal Management Line

The Integrated Coastal Management (ICM) Act defines a default **Coastal Protection Zone (CPZ)** which, in essence, consists of a continuous strip of land, starting from the High Water Mark (HWM) and extending 100 m inland in developed urban areas zoned as residential, commercial, or public open space, or 1 000 m inland in areas that remain undeveloped or that are commonly referred to as rural areas. It also includes certain sensitive or at-risk land such as estuaries, littoral active zones and protected areas.

The Provincial Member of the Executive Council (MEC,) in consultation with the Local Municipalities, is required to refine and formally adopt the CPZ. A process is currently underway to formally establish a CPZ for the Western Cape Coastline. In accordance with provisional delineation of the CPZ for estuaries in the Garden Route DM (formerly Eden DM), as per draft delineations recommended in the Coastal Set-back / Management Lines for the Eden District project (WCG, 2015), the CPZ is informed by a coastal risks zone approximated by the **10 m amsl contour or 1:100yr floodline** around an estuary, whichever is wider.

The ICMA also provides for the establishment of a **Coastal Management Line (CML)**, designed to limit development in ecologically sensitive or vulnerable areas, or an area where dynamic natural processes pose a hazard or risk to humans. A CML, as envisaged

by the amended Integrated Coastal Management (ICM) Act, is informed by the projections of risk emanating from dynamic coastal processes such as sea level rise or erosion, information on ecological or other sensitivities adjacent to the coast, as well as the location and extent of existing development and existing executable development rights. The CML is a continuous line, seawards of which lies:

- Areas of biophysical or social sensitivities such as sensitive coastal vegetation identified as priority conservation areas and formal protected areas,
- those areas that should be left undeveloped, or only be granted appropriately restricted development rights, due to a high risk from dynamic coastal processes, or
- coastal public property.

In estuaries, the CML is delineated by the 5 m amsl contour or 1:100yr floodline, whichever is wider, to differentiate a zone where formal development should be discouraged. The coastal boundaries for the Duiwenhoks River estuary are illustrated in Figure 7.

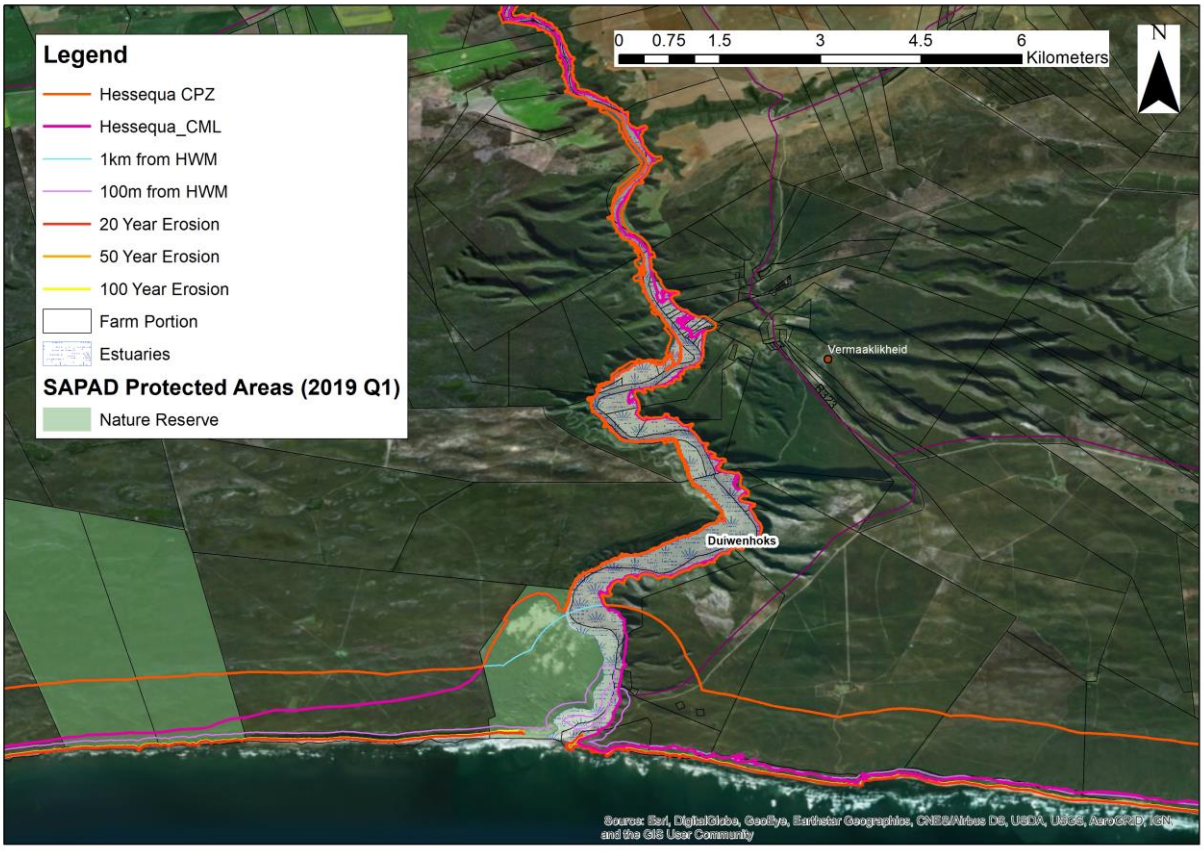


Figure 7: Coastal boundaries of the Duiwenhoks River estuary and risk projections (WCG, 2015)

6.3.3 Environmental Impact Assessment regulatory line

In respect of the EIA regulatory scheme, an additional line called the Development Set-Back Line (DSL) needs to be differentiated as it relates to the 'development set-back' referred to in the EIA regulations[1] rather than the coastal management lines described in the ICM Act. However, as part of the on-going process of defining coastal management lines for the Western Cape, it is currently **proposed that the CML, as defined under ICMA, also be used as the DSL**.

Reference to development set-backs is found in the EIA Listing Notices that list a range of activities that require different levels of environmental impact assessment and the issuing of an environmental authorisation prior to being undertaken.

Typically, an activity would be listed in the form of a range of thresholds which, if exceeded, trigger the need for an environmental impact assessment in the form of a Basic Assessment or an EIA. In some cases, however, a development set-back line is used as spatial reference to include or exclude activities. The EIA regulations indicate that: "*development setback" means a setback line defined or adopted by the competent authority*". This implies that if such a setback is defined, the setback delineation replaces the default parameters for an activity, as read within the context of that activity. The competent authority in the Western Cape is DEA&DP or the National DEFF.

The EIA regulations also refer to whether a development is in front or behind the line – for a coastal development set-back this equates to any development seaward of the line being 'in front of', whilst landward of the line being 'behind'.

An important further point to note is that the development set-backs are usually linked to the presence of urban built-up areas. The regulations indicate that "*urban areas" means areas situated within the urban edge (as defined or adopted by the competent authority), or in instances where no urban edge or boundary has been defined or adopted, it refers to areas situated within the edge of built-up areas*". These exclusion areas create *de facto* islands in the area below the DSL, within which the specifically excluded EIA triggers don't apply.

The Western Cape Government, as designated competent authority, considers the area below/seaward of existing development as falling outside of the 'built-up area'. Therefore, any exclusions based on a listed activity taking place within the built-up area would not apply to this strip of coastal land, and the prescriptions for environmental assessments related to the particular activity will apply. For example, the beach in front of seafront houses is not considered 'built-up' and environmental authorisations will be required to execute any listed activities on that beach.

[1] The Environmental Impact Assessment Regulations, 2014 (as amended in 2017), published under Government Notice No. 326 in Gazette No. 40772 of 4 April 2017, in terms of sections 24(5) and 44 of the National Environmental Management Act, 1998 (Act No. 107 of 1998)

6.4 Zonation of Activities

6.4.1 Current zonations and uses

According to the Hessequa Municipal Town Planning Scheme, the majority of land surrounding the Duiwenhoks River estuary is zoned as either Agriculture in the upper reaches, or Open Space - Nature Reserve in the lower reaches. Figure 8 illustrates the applicable farm boundaries referred to in Table 11, which lists the activities currently occurring in and/or adjacent to the Duiwenhoks River estuary.

Table 11: Current zonations and activities occurring in and/or adjacent to the Duiwenhoks Estuary

LAND USE	DESCRIPTION
Open Space Zone 3 – Nature Reserve	Puntjie settlement, and Portions 5, 8 & 9 of the Farm Kleinefontein, No. 503
	The Duiwenhoksriviersmond Private Nature Reserve is located on the western bank at the mouth of the estuary on Farm Kleinefontein, No. 505
Agriculture Zone 1	Vermaaklikheid settlement, and all other land adjacent to the estuary (unless otherwise stated)
Gouritz Cluster Biosphere Reserve: Buffer Zone	The Duiwenhoks River estuary falls within the terrestrial buffer zone between the transformed agricultural farmland in the north and the marine environment to the south. Duiwenhoksriviersmond Private Nature Reserve is considered a core terrestrial area
ACTIVITIES	
Walking / Hiking / Birdwatching / Mountain biking	Popular amongst visitors
Fishing	Recreational and subsistence, Illegal activities (commercial linefish and gillnetting)
Bait harvesting	Recreational and subsistence
Motorised Boating	Throughout the system, from private launch sites, and private properties/jetties, river cruises, and access to sea for marine fishing. Water skis, jet skis, ghetto blasting, and speeding are not permitted on this river.
No-wake Zone	The region upstream of Cob Corner in proximity to riverside houses is deemed a No-wake Zone, according to the Cape Nature/Duiwenhoks Conservancy brochure (2009) / Hessequa boating by-laws
Canoeing / Paddling	Throughout the system, mostly around river-side homes and holiday accommodation
Swimming	Occurs throughout the system, mostly inshore in close proximity homes and holiday accommodation, and jetties

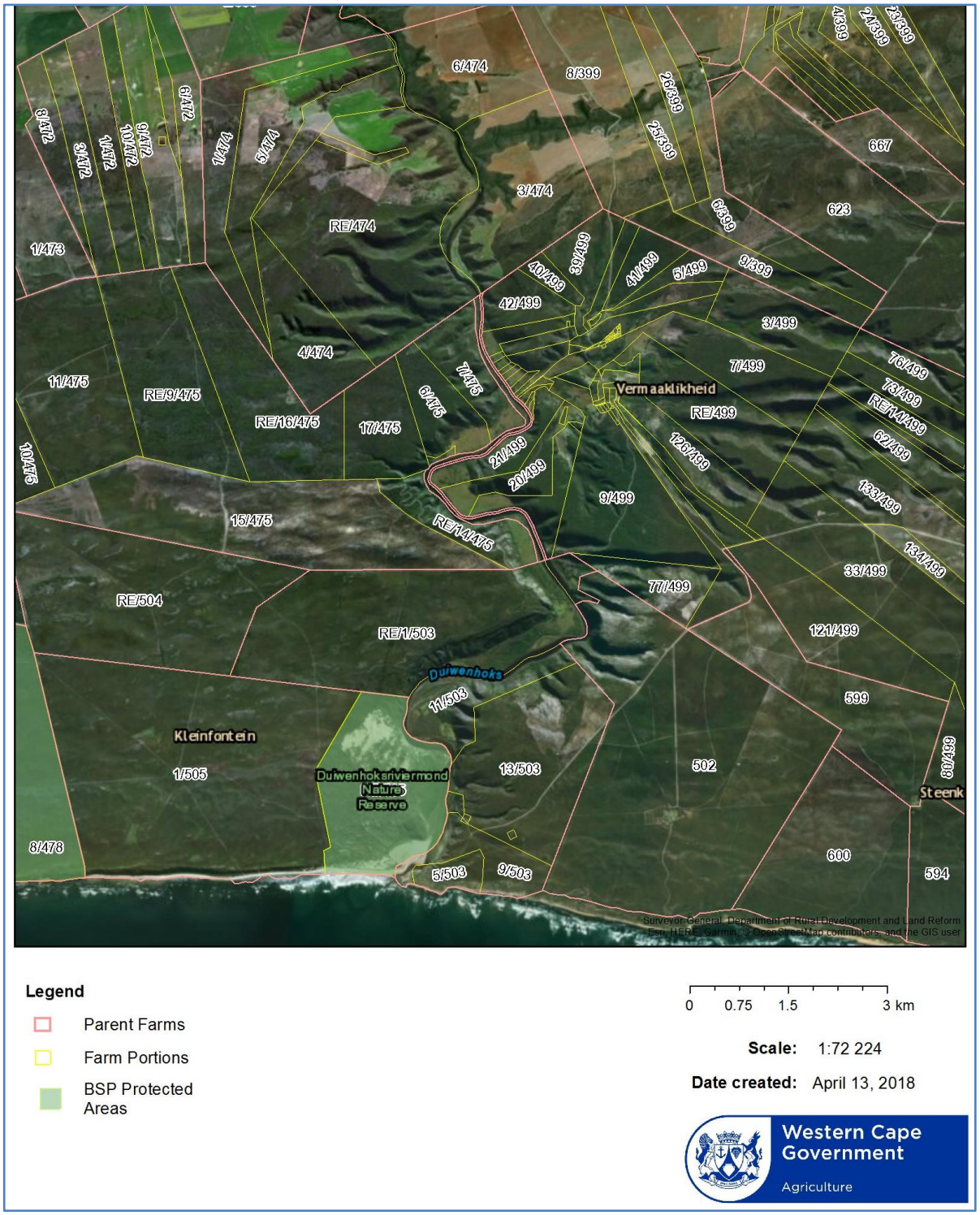


Figure 8: Map illustrating farm boundaries and private nature reserves around the Duiwenhoks River estuary (WCDoA, 2018)[2]

[2] It is noted that Puntjie is not correctly reflected as a private reserved area on farm mapper, Dr Charlie Human, Molly Lazarus Trust Duiwenhoks meeting, Plattekloof, 13 June 2018

6.4.2 Proposed spatial zonation

The zonation of the Duiwenhoks River estuary is informed by scientific information in the SAR (WCG, 2018), specialist recommendations, recreational and subsistence fishing pressure, existing zonation of the estuary (CapeNature/Duiwenhoks Conservancy, 2009) and other recreational use in the system. Three zones are proposed for the water body of the Duiwenhoks River estuary, namely a No Wake Zone, a Fish Sanctuary Zone, and designated Bait Harvesting Zone (Figure 9):

- **No Wake Zone** – The purpose of this zone is to reduce erosion of river banks, noise disturbance and for safety of other river users, e.g. swimming, canoeing. This zone is currently in play as part of boating etiquette on the estuary and extends from Cob Corner (34°18'51.81"S, 21° 1'7.68"E) along the river home frontage near Vermaaklikheid heading upstream.
- **Fish Sanctuary (No-take) Zone** – The Duiwenhoks River estuary has been identified as critically important nursery habitat. The greatest diversity and abundance of fish species reside in middle to upper portions of the estuary (WCG, 2018). The purpose of this zone is thus to protect fish species utilising this section of the estuary (given the high level of fishing pressure throughout most of the system), the open water habitat and the overall nursery function of the estuary. No fishing in any form is permitted in this area, including catch and release. This zone extends from Palm Tree Bend (34°20'13.65"S, 21° 1'37.49"E) to the head of the estuary.
- **Bait Harvesting Zone** – The purpose of this zone is to provide protection for the heavily exploited bait organism populations, whilst still providing a designated area for harvesting. The bait harvesting zone extends from Palm Tree Bend (34°20'13.65"S, 21° 1'37.49"E) to the estuary mouth, along the eastern shoreline only. That is, bait harvesting is not permitted on the western shore in this zone, or from either shore upstream of Palm Tree Bend.
- Aside from the above stipulated zones, general recreation activities are permitted in line with the Municipal River Bylaws. Water skis, jet skis, ghetto blasting, and speeding are not permitted.
- The terrestrial areas or land below the 5m contour, will remain zoned as Agriculture or Open Space Zone 3 (Nature Reserve). The CPZ and the CML must be acknowledged, whereby development is discouraged and strict development controls are applicable below these lines. Formal development or construction activities in these areas will be regulated according to the EIA Regulations and any future controls related to the CPZ or CML

With the general absence of community members and holiday home owners at the stakeholder engagement meetings, further consultation and community buy-in will need to be obtained in order for the zonation to be effective in its purpose and adhered to. Estuarine management plans are designed to be "living documents" which can be amended to accommodate changing circumstances. Therefore, should the zonation be altered following further consultation and/or other amendments made, the Duiwenhoks River EMP would have to be formerly amended to take cognizance of the changes.

Figure 9: Proposed zonation of the Duiwenhoks River estuary

Allowable activities in these zones are to be managed as per Table 12 below.

Table 12: Zonation prescriptions for the Duiwenhoks River estuary

ZONE/USE	CONDITIONS OF USE	RELEVANT LEGISLATION	RESPONSIBLE AUTHORITY	ENFORCEMENT
No Wake Zone	• Adherence to Hessequa boating regulations • All motor boats must be registered and skippers in possession of a valid license • Speed restriction of 'idling speed' i.e. max 10 km per hour • No jetskis, waterskis, or towing of people or structures • Boating competitions - non-motorised only • Bird hides, canoeing, hiking and mountain biking where appropriate • Overlaps with No take zone – no fishing and no bait harvesting	Municipal Bylaws Merchant Shipping Act/ Small Vessel Safety Regulations 2007 MLRA	Hessequa LM SAMSA DEFF	Hessequa LM/ Duiwenhoks Conservancy DEFF/CapeNature
Fish Sanctuary Zone (No take zone) **(to protect faunal populations / sensitive habitat)**	• No fishing of any kind (except for approved research purposes) • No bait harvesting of any kind except for approved research purposes) • Motorised boats permitted • Adherence to Hessequa boating regulations • All motor boats must be registered and skippers in possession of a valid license • No jetskis, waterskis, or towing of people or structures • No fishing competitions • Bird hides, hiking and mountain biking where appropriate	MLRA Municipal Bylaws Merchant Shipping Act/ Small Vessel Safety Regulations 2007	DEFF/ CapeNature Hessequa LM SAMSA	DEFF/ CapeNature Hessequa LM/ Duiwenhoks Conservancy

	• Access restricted to designated routes and boardwalks • Control of visitor numbers, frequency and group sizes in marginal areas to reduce trampling and disturbance	ICMA,		
Bait Harvesting Zone **(to allow for controlled harvesting)**	• Permitted harvesting of bait organisms according the MLRA Regulations (bag limits, species, gear, etc.) • Harvesting from eastern shore only • Harvesting of bait organism prohibited throughout the system, except this zone • Motorised boats permitted • Adherence to Hessequa boating regulations • All motor boats must be registered and skippers in possession of a valid license • No jetskis, waterskis, or towing of people or structures	MLRA Municipal Bylaws Merchant Shipping Act/ Small Vessel Safety Regulations 2007	DEFF/ CapeNature Hessequa LM SAMSA	DEFF/ CapeNature Hessequa LM/ Duiwenhoks Conservancy

6.4.3 Areas requiring rehabilitation

Given the length of the system, rehabilitation of the Duiwenhoks River estuary may be considered extensive. The primary activity is the eradication of invasive alien vegetation throughout the EFZ, extending into the adjacent properties and into the catchment, coupled with the rehabilitation of at least 10% of the degraded estuarine habitat within the riparian areas (see Figure 6 for degraded areas).

A site-specific inventory of areas requiring rehabilitation is required and is a specified management action. Attention should also be given to areas where marginal vegetation has been cleared to provide access or river views.

Beyond the EFZ, the peat lands upstream of the estuary in the greater catchment should be rehabilitated to improve the regulation of river inflow to the estuary so as to maintain critical estuarine processes and patterns (DWS, 2014).

7 INTEGRATED MONITORING PLAN

According to the standards for estuarine management, management actions should be based on sound scientific evidence. Thus, monitoring is a crucial aspect of the adaptive estuarine management planning process as the generated data will be used to inform and update management decisions. However, the collection, processing and interpretation of such data, particularly ecological data, are generally costly and time-consuming and often require considerable scientific expertise.

In the context of estuarine management, there are three broad categories of monitoring which should be incorporated into an integrated monitoring plan, namely resource monitoring, compliance monitoring and performance monitoring (DEA, 2015). These components are discussed in the following sections.

7.1 Resource Monitoring

The primary aim of resource monitoring is to collect and evaluate data which will inform management on the ecological health of an estuary, as well as the intensity and nature of uses/activities that potentially influence its health state (DEA, 2015). The necessary data requirements for various components of the estuarine environment are prescribed by the Intermediate EWR determination for the Duiwenhoks (DWS, 2015). An account of the current monitoring activities and the prescribed EWR monitoring requirements are provided below.

7.1.1 Current Resource Monitoring

- DHSWS flow recorder: The DHSWS has a permanent water flow recorder (H8H001) at the road bridge at head of the Duiwenhoks River estuary, which monitors river flow into the estuary continuously. It is of the utmost importance that this monitoring continues.
- Water quality: A basic water quality monitoring programme funded by the Breede-Gouritz Catchment Management Agency is currently in place on the Duiwenhoks River in the region of Heidelberg. There are two sampling points, one above the Heidelberg WWTW (above the N2 road bridge) and one below the WWTW (1.6km downstream of N2 road bridge, which are sampled on a monthly basis. Variables measured include pH, suspended solids, electrical conductivity, chemical oxygen demand, ammonia, PO_4, *E. coli* and faecal coliforms. It is imperative that this monitoring programme is maintained and the data stored and utilised to inform the future management of the Duiwenhoks River estuary.

There are no known ecological monitoring or research programmes (e.g. water quality, fish or birds, etc.) currently being undertaken for the Duiwenhoks River estuary.

7.1.2 Recommended Resource Monitoring

The recommended long-term monitoring programme, the purpose of which is to test for compliance with Ecological Specifications (EcoSpecs) and Threshold of Potential Concern (TPC) and to continuously improve understanding of ecosystem function, is presented in

Error! Reference source not found.. While all components in the long-term monitoring programme remain important, particularly to increase the confidence of the EWR determination, certain primary (abiotic) data, as highlighted in **Error! Reference source not found.** (Appendix 1), are of highest priority.

7.1.2.1 Resource Quality Objectives / Ecological Specifications

Resource Quality Objectives (RQOs) or Ecological Specifications (EcoSpecs) are clear and measurable specifications of ecological attributes (in the case of estuaries - hydrodynamics, sediment dynamics, water quality and different biotic components) that define a specific ecological category, in the case of the Duiwenhoks River estuary, a Category B.

Thresholds of potential concern (TPC) are defined as measurable end points related to specific abiotic or biotic indicators that if reached (or when modelling predicts that such points will be reached) prompts management action. In essence, TPCs should provide early warning signals of potential non-compliance to ecological specification (i.e. not the point of 'no return'). EcoSpecs and the TPCs representative of a Category B for the Duiwenhoks River estuary, are presented in Table 15 (Appendix 2).

7.1.3 Research Needs

Research needs are identified as:

- A detailed flood analysis is outstanding;
- Freshwater input into the river as well as water levels;
- No data is available on input of toxic substances to the river;
- Sediment and inorganic nutrient data for the River is not available; and
- Limited data on microalgae, invertebrates and birds are available.

7.2 Compliance Monitoring

Compliance monitoring refers to the monitoring of the type and intensity of uses/activities and developments within an estuary/EFZ. Such monitoring is usually prescribed in relevant legislation, regulations, policies, standards, guidelines and or permits and license agreements (DEA, 2015). The purpose of this form of monitoring is to test whether activities are compliant with the established limits and objectives as well as to detect growing pressures on resources.

7.2.1 Current compliance monitoring

The Hessequa LM has published by-laws relating to the management and use of rivers, including estuaries, specifically in respect to boats and vessels (Prov. Gaz, 7030, 6 September 2012). Enforcement of these by-laws' vest with the LM and may be devolved to another organization. Currently, the river is patrolled, specifically during peak holiday periods, by Hessequa municipal officials as well as by a River Compliance Officer (a member of the Duiwenhoks Conservancy) appointed by the Hessequa LM with the power to enforce the

relevant fishing and boating regulations[3]. However, the compliance and enforcement responsibility for the Duiwenhoks River estuary is largely under-capacitated, given the length of the system and the dispersed nature of human activities.

7.2.2 Recommended compliance monitoring

By and large, compliance monitoring will be the responsibility of the Hessequa LM, DEFF and CapeNature, and will be undertaken according to legislation and policies applicable and by means of law enforcement and compliance monitoring protocols.

It is imperative that the current appointment of a River Compliance Officer remain in place, however, additional personnel are required for more effective law enforcement and compliance monitoring, and could potentially include Honorary Officers.

It is recommended that a scheduled compliance/law enforcement programme be developed to ascertain the intensity of estuary usage, enforce management controls as per this EMP, with more frequent monitoring undertaken during peak holiday periods) (Table 13).

Table 13: Recommended compliance monitoring requirements

USE/ ACTIVITY	INDICATOR	FREQUENCY	TARGET/ LIMIT	LEGISLATION	RESPONSIBILITY
FISHING	• Number of fishers • Number of harvesters • Species targeted • Catch volume • Gear utilised • Number of offences/ transgressions	Monthly, increased to weekly during peak season	Target species and limits as per MLRA regulations	MLRA	DEFF/CapeNature
BOATING	• Number of boats and other vessels • Main locations of boating • Number of boat licenses • Number of skipper's licenses • Adherence to no-wake zone • Adherence to boating by-laws • Number of offences/ transgressions	Monthly, increased to weekly during peak season	Carrying capacity to be determined	Merchant Shipping Act (Act 51 0f 1957) Small Vessel Safety) Regulations Boating bylaw	SAMSA

[3] Minutes of the stakeholder meeting for the Duiwenhoks River estuary, 24th April 2018, Vermaaklikheid School, Erf 49/78, Vermaaklikheid

7.3 Performance Monitoring (Review & Evaluation)

A performance monitoring plan is used by the RMA, and/or identified implementing agents, to assess the effectiveness with which planned management activities contained in the EMP are being performed and ultimately to gauge progress in achieving the vision and objectives. This component utilises the performance indicators included for the various actions, specifically the management priorities, and includes a temporal scale or the frequency of the collection of the performance data and the targets that should be achieved.

Ultimately the EMP must be holistically reviewed every 5 years from the date it was adopted, ideally in line with the review cycles of the applicable IDP, SDF and/or CMP. This review is the responsibility of the RMA. According to the 2013 NEMP, this review should include an assessment of:

- The effectiveness of the EMP and success with meeting the objectives (i.e. the performance monitoring plan);
- Environmental changes at a local or a wider scale that could affect the estuarine resources or the implementation of the EMP; and
- Changes (if any) to legislation, land-use planning, goals or policies that may require the EMP to be amended.

This review may involve revisiting the SAR to determine the progress or changes that have come about because of the EMP in terms of the objectives that were originally set. It may also require the EMP to be amended, including a revision of the objectives, amendments to the management actions, and/or monitoring protocols. Ideally, representatives and experts in the major sectors (e.g. water quantity and quality, land-use and infrastructure planning and development), should evaluate the efficiency of the EMP in the context of their mandate or area of expertise. Public participation will be required before the amended EMP can be approved.

Table 16 in Appendix 3 provides the performance monitoring plan relative to the proposed management priorities.

8 INSTITUTIONAL CAPACITY & ARRANGEMENTS

It is essential that this EMP is regarded as a strategic plan that can guide the detailing of management actions and identification of implementing agents. Therefore, it does not specify the required resources (human and financial) required for effective management of the estuary. It does, however, offer a schedule or phased planning approach that incorporates capacity building and implementation at the local level over a five-year period. It is crucial that champions/project leaders/teams are identified who will be responsible for the formulation of detailed project plans and the implementation thereof.

8.1 Key Role Players

Co-management and effective governance have been identified as vital aspects to the efficient and effective management of the Duiwenhoks estuarine system. Figure 10 displays the key role players that should be included in its management.

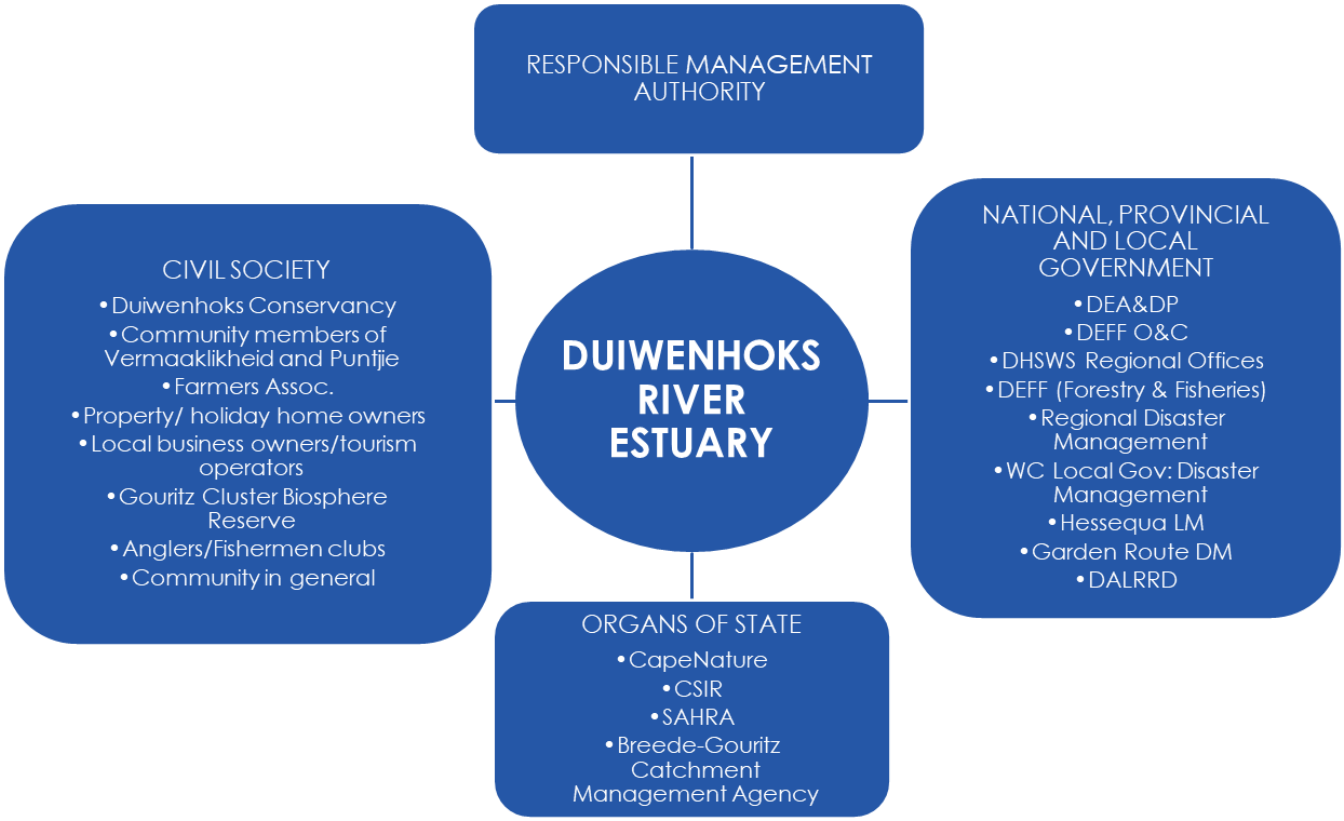


Figure 10: Key role players for the management of the Duiwenhoks river estuarine system

8.2 Responsible Management Authority

The 2013 NEMP identifies the Hessequa LM, or its assigned representative, as the RMA, responsible for the co-ordination of the implementation of the Duiwenhoks River EMP. Effective implementation of this EMP may require the augmentation of capacity within the

Hessequa LM, with the recommended appointment of a regional coastal and estuarine management co-ordinator (EMC). This individual will play a critical co-ordinating role for all other implementing agencies and Hessequa departments. **It is noted that proposed amendments to the 2013 NEMP allocate such responsibilities to the provincial environmental department unless agreement, or until agreement, is reached with the respective municipality to undertake the coordination of the implementation process.**

Specific implementation actions identified in this EMP remain the responsibility of mandated government agencies as well as respective departments within the RMA. For example, the DHSWS and/or the municipality will monitor water quality, while the DEFF will ensure compliance with matters related to fisheries. It is crucial that champions/project leaders/teams are identified who will be responsible for the formulation of detailed project plans and the implementation thereof.

Progress towards achieving the objectives set out in this EMP should be reviewed on an annual basis by the RMA and communicated to stakeholders as well as to DEA&DP and DEFF via an annual report. This EMP will need to be revisited and updated after five years to reflect goals that have been achieved and to accommodate changing priorities.

8.3 Government Departments and Organs of State

The key to successful implementation of this EMP is the commitment and contribution of all spheres of government to the process, including:

- Hessequa LM as RMA; responsible for providing key municipal services, as well as the provision of management, technical and legislative support;
- Garden Route DM: Responsible for health and safety issues relating to water and sanitation, disaster management, as well as the provision of management and technical support;
- Western Cape Government departments: Responsible for legislatively mandated responsibilities as well as support, including compliance, funding, research and monitoring (e.g. DEA&DP);
- Relevant National government departments, especially DEFF, DHSWS (via the regional office), Department of Agriculture, Land Reform and Rural Development (DALRRD); and DST; and
- Organs of State: CapeNature, BGCMA, Council for Scientific and Industrial Research (CSIR), South African Heritage Resource's Agency (SAHRA), etc.

A crucial element towards achieving the vision and objectives of this plan, now and in future, is to ensure that the responsible authorities and their constituent departments, fulfil their roles and responsibilities as identified within the EMP. In terms of practical implementation of the EMP, each responsible government department is required to produce internal project plans linked the identified management actions, and in line with their legislative mandates. Funding and staff resources will need to be sourced within each respective sector department and/or institute. Alternatively, departments may fund other entities to undertake their necessary functions on their behalf.

The DEA is generally responsible for national standardisation of estuarine management and approval of provincially-compiled estuarine management plans. Direct involvement in individual estuaries will occur via existing forums for intergovernmental coordination. These forums will have the estuarine management on their agendas, and include:

- Garden Route (Eden) Municipal Coastal Committee: Responsible for facilitating co-management, effective governance and district level co-ordination of coastal and estuarine management issues; and
- Western Cape Provincial Coastal Committee: Responsible for facilitating co-management and effective governance and provincial co-ordination of estuarine management.

8.3.1 Project Plans for Implementation

Effective implementation of this EMP requires the conversion of the priority actions into detailed project plans, which must be prepared and adopted into the respective departmental implementation strategies. A template for such project plans is provided in the EMP Development Guideline (DEA, 2015) and is attached as Appendix 4 for ease of reference. This template can also be utilised to facilitate the implementation of other projects proposed in the EMP.

8.4 Other Key Role Players

The Duiwenhoks Conservancy has successfully been registered as a Non-Profit Company (NPC) and a Non-Profit Organisation (NPO) whose goal is to preserve the areas unique character and beauty for current and future generations, making it accessible to all, though in a controlled manner, and to encourage the use of its resources in a sustainable way. They propose to do this by raising funds and involving local communities in projects that generate livelihoods and have positive environmental spin-offs so that all communities have a stake in the sustainable use of the area. They will support and implement initiatives to manage conservation, conserve biodiversity and address the impacts of climate change on local communities (Duiwenhoks Conservancy, 2018).

The Duiwenhoks Conservancy should remain a critical role player and should be considered the platform for community involvement in estuarine management initiatives, which promote livelihood opportunities. All effort should be made to ensure that fishers are represented and part of the EAF going forward.

8.5 Estuary Advisory Forum

While the establishment of an EAF for each estuary is no longer a requirement in the 2013 NEMP, the Western Cape Government continues to support their establishment and recommend that private entities and non-government organisations continue to play a supporting role in the implementation of this EMP. While an individual EAF for the

Duiwenhoks is not recommended, the establishment of a regional EAF is, incorporating the Duiwenhoks and Goukou the estuaries is supported.

Government departments should be represented on this regional EAF by delegates mandated by the respective department to do so. Each government representative on the EAF will be tasked to convey recommendations to his/her department and report back to the EAF on behalf of the department. Moreover, representatives from the authority/ies who have executive powers within the specific sector should also be present. This ensures that recommendations are executed and resources are made available for priority tasks or activities. This also streamlines the flow of information and decreases the turnaround time of required interventions.

The various local members of the EAF will play an invaluable role in providing on the ground, local insight and support to the various authorities as well as to the RMA.

9 RECOMMENDATIONS AND CONCLUSION

The following items/issues are considered critical towards the ultimate achievement of the vision and should be immediately addressed and/or receive greatest effort in respect to human/financial resources:

- Marine resources are used within legal limits;
- All efforts are made to eradicate invasive alien plants;
- The no-take zone is enforced and enabled through the Marine Living Resources Act;
- Recreational use of the system is regulated effectively;
- Public access is provided and suitably managed;
- An additional public launch site is listed and operated in terms of an approved environmental management programme; and
- The DEA&DP to consider the appointment of a Regional estuarine management co-ordinator/champion within either DEA&DP or CapeNature, to support the RMA.

In conclusion, this plan adopts the principle of adaptive management and presents an integrated and holistic approach to addressing not just the impacts but also the social and economic drivers that affect estuarine health. The actions proposed in this EMP reflect an ongoing process of implementation and should accommodate potential amendment due to changing circumstances. They are the first steps of a long-term process designed to secure ongoing and sustainable improvements to the current situation.

10 REFERENCES

CapeNature/Duiwenhoks Conservancy (2009). Duiwenhoks River Holiday Information and Recommended River Manners Brochure. URL <https://duiwenhoksconservancy.co.za/resources/>. Accessed13 April 2018.

CapeNature, (2012). Kogelberg Nature Reserve Complex Management Plan 2013-2018.

Department of Environmental Affairs (DEA), (2015). Guidelines for the Development and Implementation of Estuarine Management Plans in terms of the National Estuarine Management Protocol. Cape Town.

Department of Environmental Affairs (DEA), (2013). National Environmental Management Integrated Coastal Management Act 2008 (Act No. 24 of 2008): National Estuarine Management Protocol (NEMP).

Duiwenhoks Conservancy, (2018). URL: <http://duiwenhokconservancy.co.za >. Accessed 13 April 2018.

GCBS, (2017). Gouritz Cluster Biosphere Reserve. URL < http://www.gouritz.com>. Accessed 13 April 2018.

Hessequa Municipality, (2017). Draft Hessequa Integrated Development Plan (IDP) 2012 - 2017, 4th Review. Hessequa Municipality.

Newman, B.K. and Watling, R.J., (2007). Definition of baseline metal concentrations for assessing metal enrichment of sediment from the south-eastern Cape coastline of South Africa. *Water Sa*, *33*(5), pp.675-692.

StatsSA, (2011) Hessequa Municipality. Key Statistics from the 2011 National Census. Statistics South Africa. Accessed 29 October 2018. URL: http://www.statssa.gov.za/?page_id=993&id=overstrand-municipality.

Wazimap, (2016). Community Survey data 2016. URL: https://wazimap.co.za/profiles/municipality-WC042-hessequa/ . Accessed 29 October 2018.

WC DoA (2018). Cape Farm Mapper v 2.1.3. Western Cape Department of Agriculture. URL: https://gis.elsenburg.com/apps/cfm/ Accessed 13 April 2018.

WCG, (2015). *Coastal Management (Set-back) Lines for the Eden District,* 31 March 2015. Western Cape Government Environmental Affairs and Development Planning.

WCG, (2018). Duiwenhoks River Situation Assessment Report Version 3. Western Cape Department of Environmental Affairs and Development Planning

APPENDIX 1: RECOMMENDED LONG TERM MONITORING REQUIREMENTS

Table 14: Recommended minimum requirements for long-term monitoring for the Duiwenhoks Estuary (priority components are highlighted) (DWS, 2015)

COMPONENT	MONITORING ACTION	TEMPORAL SCALE (FREQUENCY AND WHEN)	SPATIAL SCALE (NO. STATIONS)
Hydrodynamics	Record water levels	Continuous	Near the mouth of the estuary
	Measure freshwater inflow into the estuary	Continuous	Near head of estuary (H8H001)
	Aerial photographs of estuary (spring low tide)	Every three years	Entire estuary
Sediment dynamics	Monitoring berm height using appropriate technologies	Quarterly	Mouth
	Bathymetric surveys: Series of cross section profiles and a longitudinal profile collected at fixed 500 m intervals, but in more detail in the mouth including the berm (every 100 m). Vertical accuracy at least 5 cm	Every three years (and after large resetting event)	Entire estuary
	Collect sediment grab samples (at cross section profiles) for analysis of particle size distribution and organic content (and ideally origin, i.e., microscopic observations)	Every three years	Entire estuary
Water quality	Collect data on conductivity, temperature, suspended solids, pH, inorganic nutrients (N, P and Si) and organic content (TP and Kjeldahl N) in river inflow	Monthly, continuous	Near head of estuary (H8H001)
	Collect samples for pesticides/herbicide and metal determinations in river inflow	Every 3 – 6 years if baseline shows contamination	Near head of estuary (H8H001)
	Collect *in situ* continuous salinity data with mini Conductivity-Temperature-Depth (CTD) probe at a depth of about 1 m	Continuous	Three sites – 5 km, 10 km from the mouth head and near head of estuary (above 16 km from mouth)
	Record longitudinal *in situ* salinity and temperature pH, DO, turbidity profiles	Seasonally	Entire estuary (13 stations)
	Collect surface and bottom water samples for inorganic nutrients (and organic nutrient) and suspended solid analysis, together the *in situ* salinity, temperature, pH, dissolved oxygen and turbidity profiles	Every three years (high flow and low flow) or when significant change in WQ expected	Entire estuary (13 stations, coinciding with microalgae and invert sampling sites)

COMPONENT	MONITORING ACTION	TEMPORAL SCALE (FREQUENCY AND WHEN)	SPATIAL SCALE (NO. STATIONS)
	Measure pesticides/herbicides and metal accumulation in sediments (for metals investigate establishment of distribution models – see Newman and Watling, 2007)	Every 3 – 6 years, if results show contamination	Entire estuary, including depositional areas (i.e., muddy areas)
Microalgae	▪ Record relative abundance of dominant phytoplankton groups, i.e., flagellates, dinoflagellates, diatoms, chlorophytes and blue-green algae. ▪ Chlorophyll-a measurements taken at the surface, 0.5 m and 1 m depths, under typically high and low flow conditions using a recognised technique, e.g., spectrophotometer, High Performance Liquid Chromatography or fluoroprobe. ▪ Intertidal and subtidal benthic chlorophyll-a measurements (4 replicates each) using a recognised technique, e.g., sediment corer or fluoroprobe.	Low flow surveys every three years	Along length of estuary minimum five stations
Macrophytes	▪ Ground-truthed maps to update the map produced for 2013 and to check the areas covered by the different macrophyte habitats. ▪ Record boundaries of macrophyte habitats and total number of macrophyte species in the field. ▪ Assess extent of invasive species within the 5 m contour line. ▪ Check for loss of reed and sedge area in the middle reaches (5-10 km). Check for increase in bare areas in salt marsh habitat from mapping. ▪ Measure macrophyte and sediment characteristics along transects in the main salt marsh areas. Percentage plant cover measured in duplicate 1 m^2 quadrats along the transects and an elevation gradient from the water to the terrestrial habitat. ▪ Duplicate sediment samples collected in three zones along each transect to represent the lower intertidal, upper intertidal and supratidal salt marsh. Analysed in the laboratory for sediment moisture, organic content, electrical conductivity, pH and redox potential. In the field measure depth to water table and ground water salinity.	Summer survey every three years	Entire estuary for mapping (transect sites as shown in DWS 2015)

COMPONENT	MONITORING ACTION	TEMPORAL SCALE (FREQUENCY AND WHEN)	SPATIAL SCALE (NO. STATIONS)
Invertebrates	▪ Collect duplicate zooplankton samples at night from mid-water levels using WP2 nets (190 um mesh) ▪ Collect grab samples (5 replicates) (day) from the bottom substrate in mid-channel areas at same sites as zooplankton (each sample to be sieved through 500 µm). ▪ Collect sled samples (day) at same zooplankton sites for hyper benthos (190 um) ▪ Intertidal invertebrate hole counts using 0.25 m^2 grid (5 replicates per site). Establish the species concerned using a prawn pump. ▪ Collect sediment samples using the grab for particle size analysis and organic content (at same sites as zooplankton)	Every two years mid-summer	Minimum of three sites along length of entire estuary. For hole counts – three sites on sandy substrata near the mouth (western shore).
Fish	▪ Record species and abundance of fish, based on seine net and gill net sampling. Sampling with a small beam trawl for channel fish should also be considered. ▪ Seine net specifications: 30 m x 2m, 15 mm bar mesh seine with a 5 mm bar mesh with a 5mm bar mesh 5 m either side and including the cod-end ▪ Gill nets specifications: Set of gill nets each panel 30 m long by 2 m deep with mesh sizes of 44 mm, 48 mm, 51 mm, 54 mm, 75 mm, 100 mm and 145 mm ▪ Trawl specification: 2 m wide by 3 m long, 10 mm bar nylon mesh in the main net body and a 5 mm bar in the cod-end	Twice annually, Spring/Summer and autumn/winter	Entire estuary (10 stations) Spacing of station Stations ~ length/10
Birds	Undertake counts of all non-passerine water birds, identified to species level (DWS 2015)	Annual winter and summer surveys	Entire estuary (about six sections, must be standardised)

APPENDIX 2: ECOLOGICAL SPECIFICATIONS

Table 15: EcoSpecs and Thresholds of Potential Concern for the Duiwenhoks River estuary (Category B)

COMPONENT	ECOSPECS	THRESHOLDS OF POTENTIAL CONCERN
Hydrology	Maintain flow regime as per recommended ecological flow	River inflow: ▪ < 0.1 m^3/s for more than one month a year ▪ < 1.0 m^3/s for more than three months a year
Hydrodynamics	Maintain connectivity with marine environment	Average tidal amplitude < 10% of present observed data from the water level recorder in the estuary near the mouth during low flows (summer)
Sediments	▪ Flood regime to maintain the sediment distribution patterns and aquatic habitat (instream physical habitat) for biota ▪ No significant changes in sediment grain size and organic matter distribution patterns for biota ▪ No significant change in average sediment composition and characteristics ▪ No significant change in average bathymetry	▪ Average sediment composition in any survey (% fractions) along estuary change from that of the Present State (2014 baseline, to be measured) by 30% ▪ Average organic fraction in sediment along length of estuary > 5% ▪ Average bathymetry along main channel in the middle and lower reaches (8 km upstream) change by 30% in any survey from that of the Present State (2015 baseline, to be measured) (system expected to significantly fluctuate in terms of bathymetry between flood) ▪ Average bathymetry along main channel in the upper reaches (above 8 km from the mouth – above Zone C) change by 10% in any survey from that of the Present State (2015 baseline, to be measured)
Water quality	Salinity distribution not to cause exceedance of TPCs for biota (see below)	▪ Salinity > 0 at head of estuary ▪ Average salinity in Zone D > 5 ▪ Average salinity in Zone C > 20 ▪ Average salinity 5 km upstream from mouth > 20 more than three months of the year
	System variables (pH, dissolved oxygen and turbidity) not to cause exceedance of TPCs for biota (see below)	River inflow: ▪ 6.0 < pH > 7.5 ▪ DO < 5 mg/ℓ ▪ Suspended solids > 5 mg/ℓ (low flow) Estuary: ▪ Average turbidity > 10 Nephelometric Turbidity Unit (NTU) (low flow) ▪ Average 6.0 < pH > 8.5 (increasing with increase in salinity) ▪ Average DO < 5 mg/ℓ

COMPONENT	ECOSPECS	THRESHOLDS OF POTENTIAL CONCERN
	Inorganic nutrient concentrations (NO_3-N, NH_3-N and PO_4-P) not to cause in exceedance of TPCs for macrophytes and microalgae (see below)	River inflow: ▪ NOx-N >150 µg/ℓ over 2 consecutive months ▪ NH_3-N > 20 µg/ℓ over 2 consecutive months ▪ PO_4-P > 20 µg/ℓ over 2 consecutive months Estuary (except during upwelling or floods): ▪ Average NOx-N > 150 µg/ℓ single concentration > 200 µg/ℓ ▪ Average NH_3-N > 20 µg/ℓ during survey, single concentration > 100 µg/ℓ ▪ Average PO_4-P > 20 µg/ℓ during survey, single concentration > 50 µg/ℓ
	Presence of toxic substances (e.g., trace metals and pesticides/herbicides) not to cause exceedance of TPCs for biota (see below)	River inflow: ▪ Trace metals (to be confirmed) ▪ Pesticides/herbicides (to be confirmed) Estuary: ▪ Concentrations in water column exceed target values as per SA WQ Guidelines for coastal marine waters (DWAF, 1995) ▪ Concentrations in sediment exceed target values as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)
Microalgae	▪ Maintain a low median phytoplankton biomass ▪ Maintain a high median intertidal benthic microalgal biomass ▪ Prevent formation of localised phytoplankton blooms	▪ Median phytoplankton chlorophyll a (minimum five sites) exceeds 3.5 µg/ℓ ▪ Median intertidal benthic chlorophyll a (minimum five sites) exceeds 42 mg/m^2 ▪ Site specific chlorophyll a concentration exceeds 20 µg/ℓ and cell density exceeds 10 000 cells/ mℓ
Macrophytes	▪ Maintain the distribution of macrophyte habitats, particularly the salt marsh, reeds and sedges. ▪ Maintain the integrity of the salt marsh. ▪ Maintain the reed and sedge stands in the middle and upper reaches of the estuary. ▪ Rehabilitate 10% of the floodplain habitat by removing any agricultural berms and invasive plants. ▪ Maintain the integrity of the riparian zone	▪ Greater than 20 % change in the area covered by salt marsh and reeds and sedges (2013 survey) ▪ Increase in bare areas in the salt marsh because of a decrease in moisture and increase in salinity. Hypersaline sediment caused by evaporation, infrequent flooding or rainfall on this area. ▪ Loss and die-back of reeds fringing the estuary 5-10 km upstream from the mouth; salinity should not be greater than 20 for three months. ▪ Drying of floodplain habitat. Invasive plants (e.g., black wattle, prickly pear, *Tamarix*) cover > 5% of total floodplain area. ▪ Unvegetated, cleared areas along the banks caused by human disturbance.
Invertebrates	▪ Maintain presence of sand prawn *Callichirus kraussi* on sand banks in lower estuary	▪ Sand prawn density should not deviate from average baseline levels (as determined in

COMPONENT	ECOSPECS	THRESHOLDS OF POTENTIAL CONCERN
	▪ Maintain the presence of REI species in the upper estuary for specific invertebrate communities associated with REI (zooplankton and benthos)	the eight visits undertaken in the first two years) by more than 40 % in each season ▪ Dominant species in the REI zone (zooplankton and benthos) should not deviate from average baseline levels (as determined in the 8 visits undertaken in the first two years) by more than 40 % in each season
Fish	Fish assemblage should comprise the 5 estuarine association categories in similar proportions (diversity and abundance) to that under the reference. Numerically assemblages should comprise: ▪ Ia estuarine residents (50-80%) ▪ Ib marine and estuarine breeders (10-20%) ▪ IIa obligate estuarine-dependent (10-20%) ▪ IIb estuarine associated species (5-10%), ▪ IIc marine opportunists (20-80%) ▪ IV indigenous fish (1-5%) ▪ V catadromous species (1-5%) Category Ia species should contain viable populations of at least 4 species (including *G.aestuaria, Hyporamphus capensis, Omobranchus woodii*). Category IIa obligate dependents should be well represented by large exploited species especially *A. japonicus, L. lithognathus, P. commersonii, Lichia amia*). REI species dominated by both *Myxus capensis* and *G. aestuaria*.	▪ Ia estuarine residents < 50% ▪ Ib marine and estuarine breeders < 10% ▪ IIa obligate estuarine-dependent <10% ▪ IIb estuarine associated species < 5% ▪ IIc marine opportunists < 50% ▪ IV indigenous fish < 1% ▪ V catadromous species < 1% Ia represented only by *G. aestuaria* ▪ IIa exploited species in very low numbers or absent ▪ REI species represented only by *G. aestuaria*, *Myxus capensis* absent.
Birds	The estuary should contain a diverse avifaunal community that includes representatives of all the original groups. Tern roosts should be seen at the estuary on a regular basis. Apart from gulls, terns and regionally increasing species such as Egyptian Goose, the estuary should generally support more than 50 birds.	▪ Numbers of birds other than gulls, terns and regionally increasing species fall below 50 for three consecutive counts. ▪ Numbers of waterbird species drop below ten for three consecutive counts.

APPENDIX 3: PERFORMANCE MONITORING PLAN

Table 16: Performance Monitoring Plan for the Duiwenhoks River estuary

MANAGEMENT OUTPUT	PERFORMANCE INDICATOR	TEMPORAL SCALE (frequency)	RELEVANT LEGISLATION	RESPONSIBLE AUTHORITY
1. ESTUARINE HEALTH AND FUNCTION				
1.1 Secure adequate quantity and quality of freshwater input to improve and maintain ecosystem health and functioning	• Recommended reserve(s) signed off and implemented • Sustained base flow • Flow gauging station installed (if a priority estuary) • Natural mouth dynamics • Monitoring on the state of the catchment and estuary • Water quality monitoring programme in place • Ecological monitoring programmes (fish and birds) in place • Health state of the estuary is improved from C to B Category	• Monitoring Twice a year	NWA, ICMA, NEM: BA, MLRA	DHSWS, BGCMA, RMA, Hessequa LM, DEFF, CapeNature, SANBI
1.2 Ensure estuary requirements are integrated into catchment processes to ensure healthy water quality	• Critical catchment maps updated • Municipal waste water plan takes cognisance of downstream impacts • Effective catchment management • Good catchment water quality preserved	• Twice a year	NWA, MSA, CARA, NEM:BA, NEM;PAA	DHSWS, BGCMA, DEFF, Hessequa LM, SANBI
1.3 Control the spread and densification of invasive alien plant species	• Priority areas mapped • IAPs eradication programme implemented • Increased area / tonnes of IAPs removed	• Annually	CARA, NWA	RMA, DEFF: WfW, CapeNature, Hessequa LM
1.4 Ensure sustainable resource use through an effective level of compliance management	• Carrying capacity established and enforced • Increased patrols and monitoring conducted • Regional compliance network established • Reduction in illegal activities • Improved fish and invertebrate populations • Reduced habitat degradation and inappropriate behaviour/activities	• Twice a year	ICMA, MLRA	DEFF, CapeNature

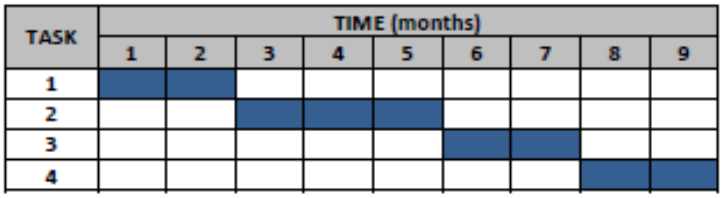
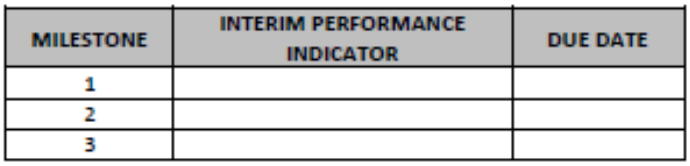
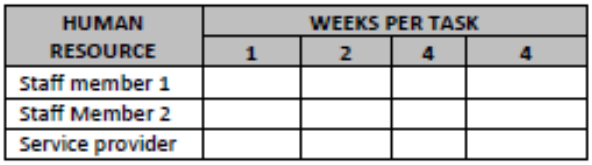
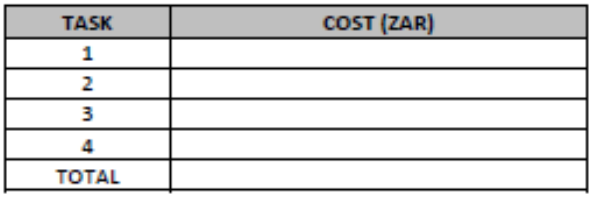
MANAGEMENT OUTPUT	PERFORMANCE INDICATOR	TEMPORAL SCALE (frequency)	RELEVANT LEGISLATION	RESPONSIBLE AUTHORITY
	• Alien fish species eradicated			
2. BIODIVERSITY CONSERVATION				
2.1 Ensure the conservation of estuarine habitats and indigenous species	• No-take/ Sanctuary areas designated • Designated bait harvesting area • Spatial zonation plan adopted, implemented and enforced • EMP included in management plan for the GCBR • Level of protection obtained with a designated custodian • Signage created and erected in key public spaces • Appropriate regulations and bylaws are gazetted and enforced to protect fauna and flora • Egyptian Geese controlled • Stewardship agreements signed; participation of land owners and stakeholders • Reduced habitat degradation and inappropriate behaviour/activities	• Twice a year	ICMA, NEMA, MLRA, LUPA, NEM: PAA, NEM:BA, WC BRA	CapeNature, GCBR, DHSWS, DEFF
3. LAND USE AND INFRASTRUCTURE DEVELOPMENT PLANNING				
3.1 Ensure appropriate and sustainable coastal development in and around the Duiwenhoks River estuary, considering ecosystem services and sense of place	• Duiwenhoks EMP included in all relevant planning documents • Bylaws developed and gazetted • No new development, infilling or land transformation in the EFZ • All jetties and slipways licensed • Inspections undertaken, transgressors prosecuted, and remedial actions implemented • Regional EAF partakes in development planning affecting the estuary	• Annually	ICMA, LUPA, NEMA Seashore Act	GCBR, Hessequa LM, DEADP and applicable authorities
3.2 Promote sustainable agricultural practices	• Agricultural best practice implemented and enforced • Management guidelines developed for riparian areas and activities • Riparian areas rehabilitated and protected	• Twice a year	NWA, CARA	DALRRD, RMA,

MANAGEMENT OUTPUT	PERFORMANCE INDICATOR	TEMPORAL SCALE (frequency)	RELEVANT LEGISLATION	RESPONSIBLE AUTHORITY
3.3 Rehabilitate degraded and transformed areas	• Rehabilitation programme developed and implemented • On-going relationship with landowners developed • Degraded areas restored (e.g. revegetation with estuarine vegetation, stormwater control)	• Twice a year	NEM:BA, NWA, CARA	RMA, DALRRD, CapeNature
4. INSTITUTIONAL AND MANAGEMENT STRUCTURES				
4.1 Ensure effective co-ordination of estuarine management responsibilities	• RMA is designated, commitment secured from affected municipalities • Duiwenhoks EMP adopted and incorporated into GCBR management plan • Regional Estuarine management function established in RMA • RMA official(s) are well-trained and knowledgeable • Regional EAF constituted and chaired by RMA • Good communication and working relationship established with implementing agencies • Regional EAF supported and meets on quarterly basis • Stakeholder database maintained • Annual reporting undertaken by RMA • Funding secured for 5 year cycle	• Quarterly	ICMA, MSA, NEMA, LUPA, NWA	RMA, Hessequa LM, Garden Route DM, applicable authorities
4.2 Define and enable co-operative governance	• MOUs signed between RMA and spheres of government and participating agencies • Active collaboration of various institutions, private and civil stakeholders • Individual agencies knowledgeable and with capacity and resources to carry out mandated actions • Formal review of EMP every 5 years	• Annually	MSA, NWA, ICMA, NEMA, WC BRA, CARA	All applicable authorities
5. SOCIO-ECONOMIC CONSIDERATIONS				
5.1 Protect and improve local livelihoods	• Subsistence users identified and a set number of permits issued • Feasibility of mariculture operation investigated	• Twice a year	MLRA, ICMA	DEFF, Hessequa LM /

MANAGEMENT OUTPUT	PERFORMANCE INDICATOR	TEMPORAL SCALE (frequency)	RELEVANT LEGISLATION	RESPONSIBLE AUTHORITY
	• Community projects initiated, increased employment • Local communities trained and included in local EPIP projects			Duiwenhoks Conservancy
5.2 Regulate recreational use	• Carrying capacity determined and enforced • River bylaws enforced • Monitoring programme in place for recreational use • SOP implemented during peak holiday season	• Quarterly	MSA, ICMA,	RMA, Hessequa LM, DEA&DP
5.3 Preserve and manage all cultural heritage resources	• Heritage resources mapped and inventory maintained • Cultural Heritage Management Programme developed, including site-specific management and maintenance guidelines	• Annually	NHRA, MSA	SAHRA, HWC
5.4 Investigate, resolve and formalise public access	• Public access as well as amenity provided and maintained • Informal launch sites investigated and Public launch site listed as well as appropriate amenity provided • Operational boat launch sites managed in accordance with a Management Plan	• Quarterly	ICMA	Hessequa LM, DEA&DP
6. EDUCATION AND AWARENESS				
6.1 Promote high levels of public awareness and appreciation of the value of estuaries	• Education & awareness programme developed and implemented • Hessequa estuaries webpage operational • Educational signage erected, and information disseminated to residents and visitors • Active engagement with estuary users • Reduced illegal fishing activities • Reduced habitat loss/degradation and disturbance, and inappropriate behaviour	• Every 3 years	ICMA	RMA, GCBR, Hessequa LM

7. DISASTER RISK MANAGEMENT				
7.1 Reduce the potential risks within the estuary, inclusive of climate change impacts	• Degraded / eroded areas rehabilitated • Appropriate defence installed for critical infrastructure • Estuarine issues incorporated in relevant disaster management planning documents • No future development within EFZ, and development setback from EFZ • Pollution contingency plans in place	• Every 3 years	NEMA, ICMA, WC TIA, DMA	RMA, Western Cape Dept of Transport: Public Works (WC DoT&PW), WC Dept of Local Gov: Disaster Management, Hessequa LM, CapeNature

APPENDIX 4: PROJECT TEMPLATE

ACTION	Describe the action to be undertaken
COMPLETION DATE	Provide date of expected completion
PERFORMANCE INDICATOR	
Requirements stipulated in policy and legislation	
Available methods, protocols and best practice-guides	
Spatial zonation consideration (e.g. limits/targets)	
Detailed work plan	Task 1: Task 2: Task 3: Task 4:
Scheduling	
Milestone/interim performance indicator	
Responsibilities for different tasks	E.g. Identify specific departments, personnel and/or service providers responsible for execution of this action
Monitoring and reporting plan	E.g. • Define data and information to measure in order to monitor performance indicator/s • Specify frequency at which data/information should be collected/monitored • Where and when to report on progress
Human resource plan	
Financial resource plan	

TASK	TIME (months)								
	1	2	3	4	5	6	7	8	9
1									
2									
3									
4									

MILESTONE	INTERIM PERFORMANCE INDICATOR	DUE DATE
1		
2		
3		

HUMAN RESOURCE	WEEKS PER TASK			
	1	2	4	4
Staff member 1				
Staff Member 2				
Service provider				

TASK	COST (ZAR)
1	
2	
3	
4	
TOTAL	

Source: DEA (2015)