CapeNature

Goukamma River Estuary Estuarine Management Plan 2023 to 2027

January 2023

DOCUMENT DESCRIPTION

Document title and version:

Goukamma River Estuary Estuarine Management Plan

Project Name:
CapeNature Marine and Coasts Operations: Estuary Management

Compiled by:

Version 1: CapeNature (2014)

Version 2: Royal HaskoningDHV (2018)

Version 3: CapeNature (2022)

Acknowledgements:

CapeNature

Western Cape Government Environmental Affairs & Development Planning

Chief Directorate: Environmental Sustainability

Directorate: Biodiversity and Coastal Management

Email: coastal.enquiries@westerncape.gov.za

Date:

January 2023

I, Anton Bredell, Minister of Local Government, Environmental Affairs and Development Planning hereby approve the Goukamma River Estuary Estuarine Management Plan for implementation.

Anton Bredell

Digitally signed by Anton Bredell
Date: 2023.06.23 10:48:33 +02'00'

Disclaimer:

The Estuarine Functional Zone depicted in this estuarine management plan will be subject to change based on new data published from time to time.

DOCUMENT USE

The South Africa National Estuarine Management Protocol ('the Protocol'), promulgated in May 2013 (and amended in 2021) under the National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008, as amended 2014) (ICM Act), sets out the minimum requirements for individual Estuarine Management Plans (EMPs).

In 2014, a review was conducted by the National Department of Environmental Affairs: Oceans and Coasts (DEA, 2014) on existing estuarine management plans which were products of the C.A.P.E. Estuaries Management Programme, to ensure, *inter alia*, the alignment of these plans with the Protocol.

This revision of the Goukamma Estuarine Management Plan (EMP), including the Situation Assessment Report and the Management Plan itself, is in response to the adoption of the EMP by CapeNature towards effective management of the estuary and to ensure compliance with the minimum requirements for EMPs as per the Protocol. In summary, this entailed:

- Conversion to accepted Provincial format
- Incorporation of review comments
- Updating the terminology as per the Protocol;
- Final internal review in preparation for formal stakeholder engagement to submit to the Minister for approval.
- Including a summary of the Situation Assessment Report;
- Including a map of the estuary based on the Estuarine Functional Zone;
- Including a description of institutional capacity and arrangements to manage elements of the EMP provided as per the Protocol.

The work of the original authors and input received from stakeholders has been adapted to the most recent DEADP approved layout and the most recent available information has been included. Historical information and data remain relevant and critically important for estuarine management in the long term and must be supplemented by new information when it becomes available. This revision does not represent, or replace, the full 5-year review process required to re-evaluate the applicability of the plan and to provide new information. This process is therefore still urgently required. Nonetheless, this EMP, and supporting Situation Assessment Report, must not be considered a once-off compilation but rather a "living document" that should be regularly updated and amended as deemed necessary.

In preparation for the final EMP approval process, the draft EMP was published for public comment from 28 January to 04 March 2022 (see appendix C : stakeholder consultation report). This was followed by a formal "Comment and Response" process which reviewed and addressed all comments submitted. Minor edits were made to the EMP where appropriate. This document is the final Goukamma Estuary Estuarine Management Plan.

EXECUTIVE SUMMARY

Introduction

Estuaries are recognized as particularly sensitive and dynamic ecosystems, and therefore require above-average care in the planning and control of activities related to their use and management. For this reason, the National Environmental Management: Integrated Coastal Management Act (No. 24 of 2008, as amended by Act 36 of 2014) (ICM Act), via the prescriptions of the National Estuarine Management Protocol (the Protocol), require Estuary Management Plans to be prepared for estuaries to create informed platforms for efficient and coordinated estuarine management.

The Protocol identifies CapeNature as the RMA responsible for developing and coordinating the implementation of the Goukamma Estuary EMP, as the estuary is listed within the Western Cape Protected Area Expansion Strategy and a significant portion is already managed by CapeNature as part of the Goukamma Nature Reserve and Marine Protected Area.

Situation Assessment

The Goukamma River and its perennial tributaries rise in the Outeniqua Mountains and is 204km covering a catchment area of 235 km^2, and flows through plantations, indigenous forest, and fynbos in its upper and middle reaches. In the lower reaches the river flows through farms, the majority being lifestyle farms, and the Goukamma Nature Reserve for the final 2km before entering the sea to the west of Buffalo Bay into the Goukamma Marine Protected Area.

The Goukamma estuary is classified as a Large Temporarily Closed estuary (Van Niekerk, et.al. 2018) and extends 11.8km inland of the mouth. It consists of a single main channel with no confluences. The estuary functional zone, 210ha in extent (van Niekerk, 2017), is predominantly narrow with broad sections near the mouth and in the middle reaches.

The geographical boundaries for the EMP are defined as follows:

- Downstream boundary: Estuary mouth 34° 4'45.93"S; 22°57'14.86"E
- Lateral boundaries: 5 m contour above Mean Sea Level (MSL)
- Upper estuary boundary: 34° 0'29.39"S; 22°56'13.80"E

The most recent National Biodiversity Assessment comprehensively assesses the estuary and is most conveniently summarized in Table 1 below.

Table 1. A summary of the National Biodiversity Assessment for the Goukamma estuary, 2019

Ecosystem Type		Warm Temperate – Large Temporarily Closed
Threat Status		Vulnerable
Protection Levels		Moderate
Priority	**Biodiversity Importance Rating** (>80 = High Importance, 60 - 80=Important >60 = Average Importance) (Turpie *et al*. 2002, Turpie and Clark 2009)	Important (High Importance in terms of Restoration)
	Biodiversity Priority Rating (5 = High priority)	Priority
	In MPA or priority area	Yes
	DFFE Important Fish Nurseries (Very High - Medium = Priority)	Medium
Condition	**Estuary Condition Summary** (A = Unmodified, approximates natural condition; B = Near natural with few modifications; C = Moderately modified; D = Heavily modified; E = Severely modified and F = Critically modified)	
	NBA 2018 Condition Status	Near Natural
	Present Ecological State (2018)	A/B
	Hydrology	B
	Hydrodynamics	B
	Water Quality	B
	Physical habitat	B
	Microalgae	B
	Macrophytes	B
	Invertebrates	B
	Fish	B
	Birds	B
Pressures	**Cumulative Pressure level**	L
	Pressure: Flow modification	L
	Pressure: Pollution	L
	Pressure: Habitat loss	L
	Pressure: Fishing Effort 2018 (DFFE)	M
	Pressure: Invasive alien plants	M
	Pressure: Alien Fish	H
	Artificial Breaching	P
	Pollution source: Catchment (diffuse)	Agric
	DFFE Fishing Effort 2018	M
	DFFE Fishing Effort 2011	M
	2018 DFFE Fishing Catches (tons)	4
	2011 DFFE Fishing Catches (tons)	4
	Bait collection	Yes
	# Alien or extralimital fish spec	1
Restoration	**Recommended Ecological Category**	B
	DFFE Important Fish Nurseries (5 =Very High priority, 3= Priority)	Medium
	Restore/protect base flows	Yes
	Improve river water quality	Agric
	Restore connectivity/ hydrodynamic functioning	Yes
	Remove alien vegetation	Yes
	Control recreational activities impacting on birds	Yes
	Remove/reduce fishing pressure/ bait collection	Yes
	Investigate eradication of alien fish	Yes
	Comment	Remove illegal weirs/dams

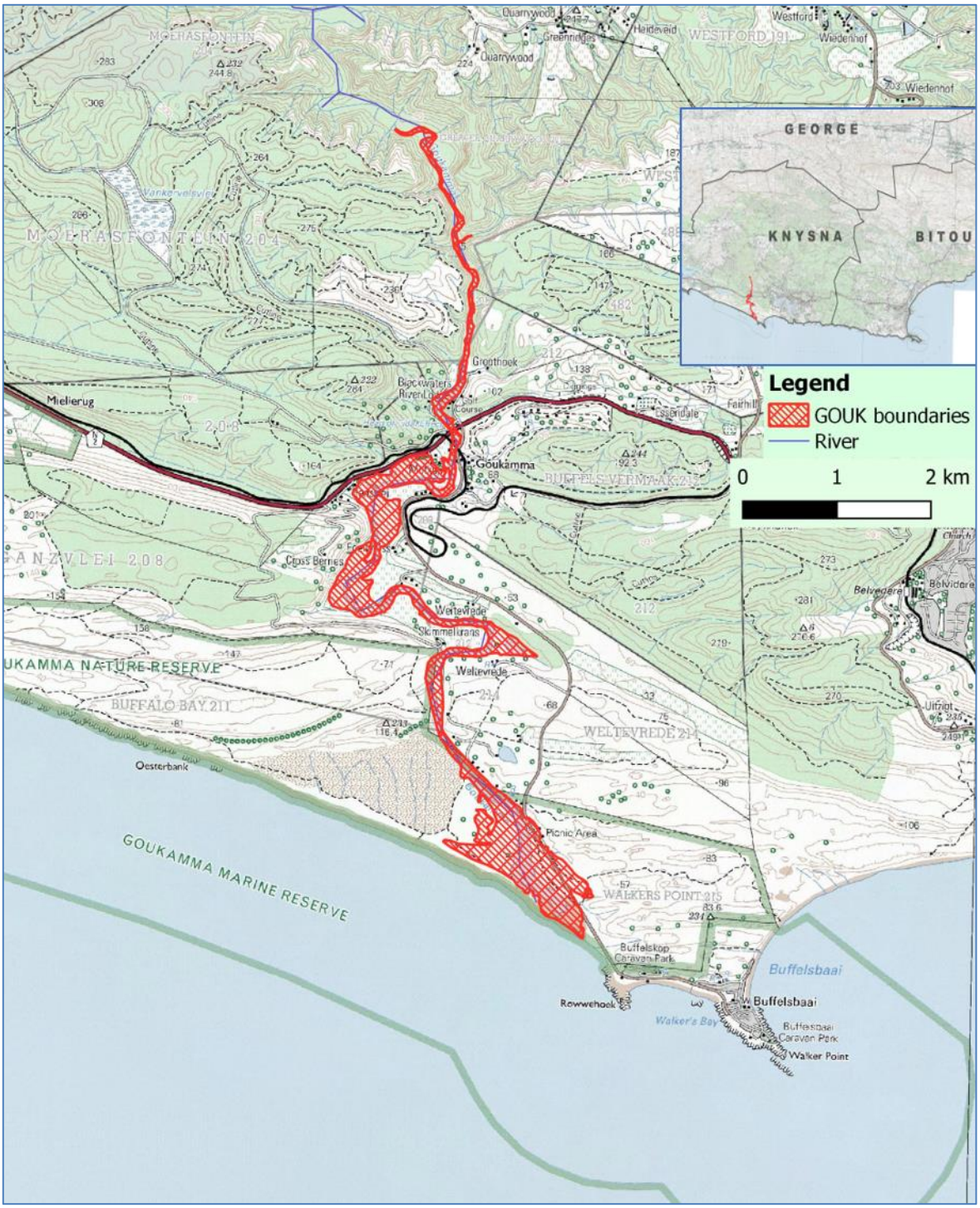

Figure 1. Location of the Goukamma estuary in the Garden Route District

The Present Ecological Status of the Goukamma Estuary is an A/B on the DWS A - F ecological condition scale. The Goukamma Estuary is negatively impacted on by poor water quality, fishing, structures in the intertidal area and flow reduction (- 15%). A number of these impacts can be reversed with little effort and cost.

The recommended ecological condition for the system is an A (Near natural). Several initiatives are in progress to address the pressures on the Goukamma Estuary, including this

Estuary Management Plan.

A Mouth Maintenance Management Plan (MMP) has been approved (2023 to 2027) for the estuary and no artificial breaching of the mouth is allowed at this system at present.

Water is abstracted for agricultural use, as well as for municipal supply to Buffalo Bay town (160 kl/day or 0.1% of the MAR).

Physical structuresin and adjacent to the estuary include road bridges, abstraction weir, picnic sites, jetties, one hand drawn passenger ferry, one hand drawn vehicle ferry and numerous farm fences.

The lower reaches of the Goukamma Estuary fall within the Goukamma Nature Reserve. CapeNature is currently in the process of investigating the possibility of declaring the entire estuary part of the Goukamma Marine Protected Area as part of the development of a regional conservation plan for the cool and warm temperate estuaries. The Goukamma Estuary is also included in the core set of estuaries that needs to be protected to meet biodiversity targets in South Africa (National Estuary Biodiversity Plan [Turpie *et al*. 2012]). The conservation plan stipulates that 50% of the terrestrial marginal area be included as a no-development area and that the recommended ecological water requirement category be an A.

The banks of the Goukamma Estuary are steep with limited intertidal area thus restricting the development of estuarine vegetation. At one point in the lower/middle reaches on the west bank, a steep dune forms the estuary bank and on the opposite east bank terrestrial bush/trees occur. Extensive floodplain areas are also largely absent and are mostly under agriculture. The riparian zone is severely disturbed by farming activities below the N2 bridge. Other disturbed areas exist such as bank slumping, eroding banks and the presence of invasive plants e.g., black wattle (*Acacia mearnsii*) growing in the riparian zone. Apart from transformed and alien species, the dominant vegetation type in the riparian zone is indigenous coastal forest and thicket species.

During low flow conditions, nutrients may be high because of agricultural effluent. Below the N2 bridge there is one small to medium scale dairy farming and two beef cattle farms which occupy approximately 80% of the floodplains. These agricultural activities could promote the growth of algae particularly during low flow conditions. This represents a change from the reference condition as blackwater estuaries are generally nutrient poor. During the last decade, extensive growth of filamentous algae dominated the lower, shallower reaches of the estuary during extended closed mouth conditions (K. Spencer, 2020, *pers com*). Zostera and other macrophytic growth is sparse and intermittent, and there have been unconfirmed reports of Potamegeton in the upper reaches. Past reports have indicated the presence of pipefish which is usually associated with these plants and thus they may have occurred in the estuary in the past. Sediment movement and channel migration in the lower and mouth reaches of the estuary would prevent the establishment of large submerged macrophyte beds. The 1936

and 1942 aerial photographs indicate extensive mobile dune fields on both sides of the mouth. The mouth and lower reaches of the estuary represented an unstable environment which would have reduced the opportunities for macrophyte growth. In addition, this may have led to an increased berm height and higher water levels during closed mouth conditions, which would have prevented the establishment of intertidal salt marsh areas.

The fish fauna of the Goukamma Estuary was sampled in June 1994 (Harrison *et al*. 1995), in March 2006 (Ken Hutchings unpublished data) and biannually, in most years, since 2008 (Lamberth unpublished data).

Physical properties of the estuarine system are detailed highlighting depth, sediment processes and characteristics, temperature, salinity, pH, dissolved oxygen, turbidity, nutrients, and pollution. Freshwater as well as marine (storm) floods are detailed, and recommendations made in respect to future development. A biological description of the estuarine system is provided detailing flora (microalgae, macroalgae and the floodplain/wetland complex), fauna (zooplankton, benthic invertebrates, amphibians and reptiles, freshwater fish, marine and estuarine fish, birds, and mammals).

A review of international agreements and strategies, all forms of national, regional, and local legislation as well as municipal planning and development strategies and other conservation or development framework initiatives that may impact on the management of the Goukamma estuary is undertaken.

The recreational uses of the Goukamma estuary are detailed considering exploitation of living resources, tourism, and non-consumptive use. Water quality and quantity is also detailed making specific reference to the management and description of the catchment, ecological reserve determination process and ecological water requirements. The PES was determined as Category A/B. The REC was set as Category B, like the PES.

Detail is then provided in respect to the estuary's classification, economic value, protected area strategy (protection of habitat types, protection of fish and bird species, type, or level of protection) and rehabilitation requirements.

Vision and Objectives

The Vision for the Goukamma estuarine system is as follows:

> ***"To conserve the Goukamma Estuary as part of a system of sustainable living land and seascapes in the Garden Route that is representative of its unique biodiversity and ecosystem services through integrated management for the benefit of all. "***

There are seven key or overarching management objectives for the Goukamma estuarine system.

Table 2. Overarching management objectives for the Goukamma estuarine system

Water Quality & Quantity	Resource Quality Objectives and the Ecological Reserve requirements are implemented to ensure that all ecological processes and livelihoods are sustained by maintaining a Category A/B classification.
Living Resources & Conservation	A sustainable balance is achieved between the conservation, protection and utilization of living and heritage resources.
Land Use & Infrastructure	Development and associated activities within the designated management area are controlled via legislation in such a way as to sustain existing livelihoods and ensure the maintenance of ecosystem functioning and services.
Institutional & Management Structures	The Goukamma Estuary management area is managed cooperatively and effectively by relevant spheres of government and civil society.
Sustainable Livelihoods	Existing activities and promotion of additional opportunities are managed in a way that ensures compliance with legislation and the maintenance of ecosystem functioning and services.
Tourism & Recreational use	The tourism and recreational potential of the management area are utilized in a responsible manner to benefit all users while ensuring the maintenance of ecosystem functioning and services.
Education & Awareness	Awareness is enhanced through research and education, of the value of estuaries, a sense of ownership and the need for integrated, informed, and cooperative management that will ensure the maintenance of ecosystem functioning and services.

Management Priorities

The EMP provides a set of detailed operational objectives accompanied by a range of management actions which need to be implemented via the various implementing agents, namely relevant government departments, and coordinated by CapeNature as the Responsible Management Authority (RMA). A summary of the operational objectives is provided below, which form the basis of the action plans.

For each of the defined sectors, the respective action plan is preceded by a narrative of the Operational Objectives, and includes:

- The Operational Objective and TPC related to it.
- A list of management actions required.
- Related legal, policy and/or best practice requirements of relevance to specific management actions.
- Monitoring plans to measure effectiveness of actions. If TPCs are not triggered or are brought under control then management actions can be considered effective, however if they continue to be exceeded then changes need to be made (either to management actions, the zonation plan, or operational objectives);
- A work plan identifying when each action should be initiated and by whom; and
- A resource plan detailing the human resources, the sources of funding and, where possible, the finances required to achieve these actions.
- Governance Tool developed and implemented

High, medium as well as low priority actions are summarized for ease of reference.

Spatial Zonation

The purpose of the Estuary Zonation Plan (EZP) is to identify areas along the estuary that have been designated for specific development or land use purposes, or for the delineation of different zones for specific visitor uses. As such the EZP mainly reflects the objectives devised for living resources and conservation, and land use & infrastructure.

In the case of the Goukamma estuarine management area, the EZP defines zones of Protection, which include the Goukamma Nature Reserve and Marine Protected Area; Conservation (critical biodiversity areas/ ecological support areas); multi-use (namely, no motor boat areas, fishing areas, swimming areas, and other zones); Rehabilitation, and Eco-tourism nodes are also detailed.

Implementation

Co-management and effective governance have been identified as a vital aspect to the efficient and effective management of the Goukamma estuarine system. The Protocol identifies CapeNature as the RMA responsible for developing and coordinating implementation of the Goukamma Estuary EMP. However, other Authorities are responsible

for many aspects of estuarine management in the estuary functional zone that falls outside of the Goukamma Nature Reserve so the role of the RMA should be seen as an oversight role linked to shared responsibilities. The entities should come to agreement via a signed co-management agreement where applicable. Implementation of the EMP can be affected through a range of government departments, different agencies, and forums. The role of the Goukamma Estuary Advisory Forum (GEAF) is to provide an advisory service to the RMA on issues specific to the management and implementation of the EMP. The advisory forum also acts as a hub that links all stakeholders, which serves to foster stakeholder engagement and to facilitate the implementation of the project plans identified. The figure below displays the key role players that should be included in its management. **The CapeNature Governance Tool will be used to integrate, monitor, and track management objectives and associated actions listed in the EMP.**

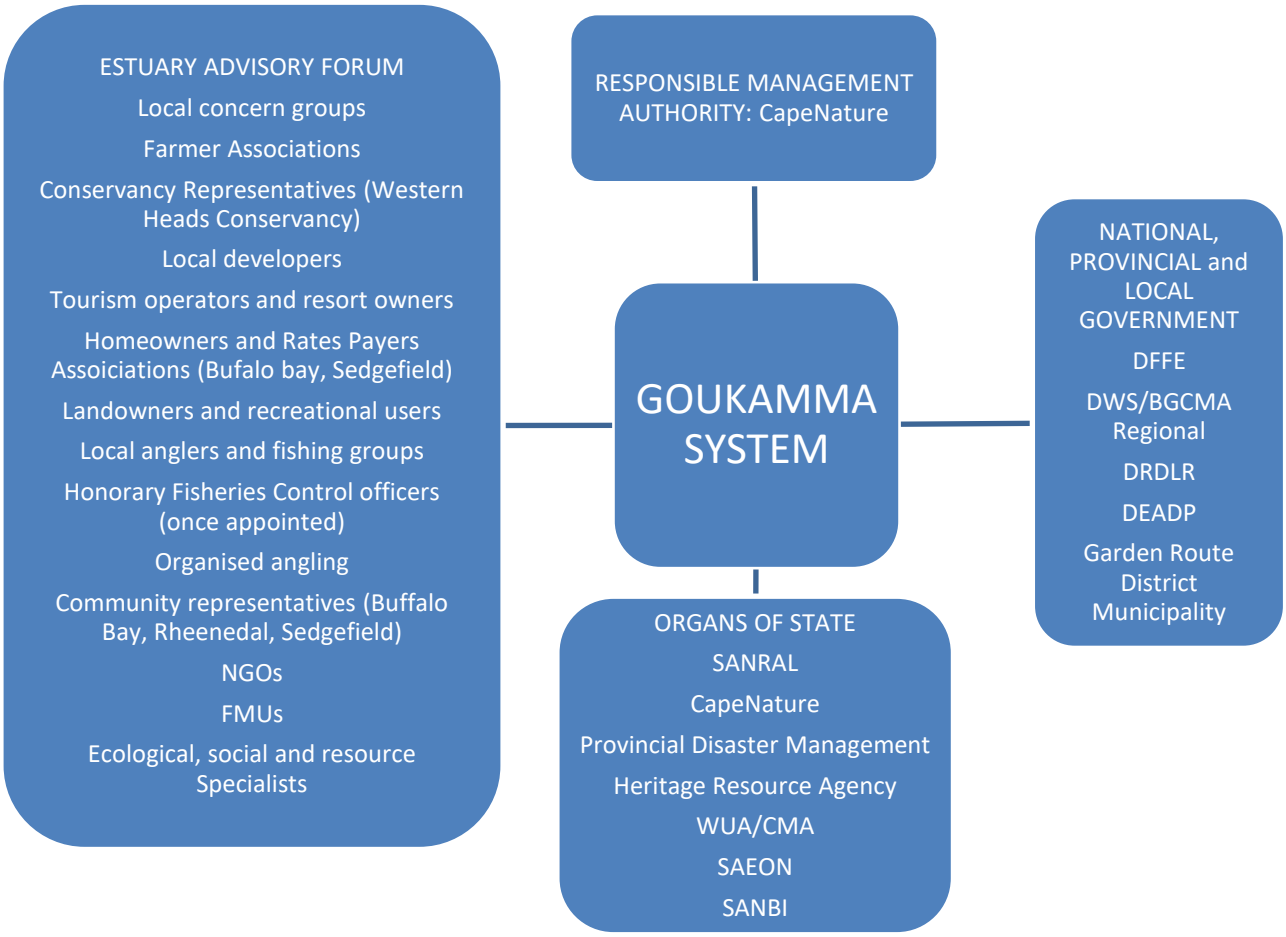

Figure 2. A diagram representing a co-operative structure for integrated estuarine management in South Africa

Integrated Monitoring Plan

The Goukamma Estuary EMP proposes three forms of monitoring, the first two being baseline measurement programmes, e.g., intensive investigations of a wide range of parameters to obtain a better understanding of ecosystem functioning; and long-term monitoring programmes, referring to ongoing data-collection programmes that are done to evaluate continuously the effectiveness of management strategies and management actions within

action plans that are designed to maintain a desired environmental state. The former, includes a detailed description of the baseline requirements, spatial and temporal scales, required resources and sampling & analysis techniques with regards the Thresholds of Potential Concern referred to in the action plans. Long-term monitoring programmes tend to be the responsibility of government departments such as DWS and DFFE who usually contract the services of tertiary & research institutes, and research initiatives themselves, such as the South African Environmental Observation Network (SAEON). However, the RMA can also be involved to ensure that programmes are undertaken and are beneficial to the effective implementation of the EMP. Long-term monitoring programmes for the following components are proposed, namely hydrology, sediment dynamics, hydrodynamics, water & sediment quality, microalgae, invertebrates, fish, and birds.

The third form of monitoring evaluates the performance of the EMP in terms of 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 is a similar process to the Management Effectiveness Tracking Tool (METT) that is already being implemented by CapeNature. This component utilizes 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 to assess whether that vision, objectives and targets are being achieved. This is the responsibility of the RMA, supported by the GEAF. Usually this will involve the adaptation of management strategies and objectives, or aspects of the action plans themselves, although the problem may be with implementation (capacity and finance). Ideally, representatives of the major components, namely conservation & living resources, social & cultural issues, land-use & infrastructure, and water quantity & quality, should evaluate the efficiency of the EMP in the context of their area of responsibility.

Research

Specific research projects were identified to fill the knowledge gaps and provide supplementary data for monitoring programmes. There may be a degree of overlap with the identified long-term monitoring programmes. These include, inter alia, a fishery survey, survey of invertebrate organisms, determination of carrying capacities, study of the effectiveness of sanctuary areas, a study of the effectiveness of the education and awareness programme, and long-term monitoring of habitats and community structures.

TABLE OF CONTENTS

Document title and version: ..... **iii**

Project Name: ..... **iii**

1 INTRODUCTION **1**

2 FRAMEWORK FOR THE DEVELOPMENT OF AN EMP **2**

2.1 Approach 2

2.2 Summary of Legal Framework 3

2.3 Mandate and Responsibilities of the Responsible Management Authority 4

3 SUMMARY OF SITUATION ASSESSMENT **6**

4 VISION & OBJECTIVES **17**

4.1 Vision 17

4.2 Objectives 18

4.2.1 Water Quality & Quantity **18**

4.2.2 Living Resources & Conservation **19**

4.2.3 Land Use & Infrastructure **20**

4.2.4 Institutional & Management Arrangements **21**

4.2.5 Sustainable Livelihoods **22**

4.2.6 Tourism & Recreational Use **22**

4.2.7 Education & Awareness **23**

5 MANAGEMENT PRIORITIES **24**

5.1.1 Water Quantity & Quality **27**

5.1.2 Conservation **34**

5.1.3 Sustainable Utilisation of Living Resources **48**

5.1.4 Land-use & Infrastructure **51**

5.1.5 Institutional & Management Arrangements **58**

5.1.6 Sustainable Livelihoods **61**

5.1.7 Tourism & Recreational Use **63**

5.1.8 Education & Awareness **65**

5.1.9 Restoration of estuary mouth and associated dune system **67**

5.1.10 Research and monitoring **69**

5.1.1 Environmental disasters **71**

6 SPATIAL ZONATION **73**

6.1 Estuarine Zonation Plan 73

6.1.1 Estuarine Boundaries **73**

6.1.2 Coastal Protection Zone and proposed Coastal Management Line 74
6.1.4 Protected & Conservation Zones 77
6.1.5 Rehabilitation Zones 79
6.1.6 Eco-Tourism Nodes 80
7 IMPLEMENTATION 81
7.1 Institutional Arrangements 81
7.1.1 Key Role Players 81
Figure 8: Key role players for the management of the Goukamma estuary system 82
7.1.2 Responsible Management Authority 82
7.1.3 Goukamma Estuary Advisory Forum 82
7.1.4 Government Departments and Organs of State 83
7.2 Recommend Priority Actions 84
8 INTEGRATED MONITORING PLAN 86
8.1 Monitoring 86
8.1.1 Baseline measurement programmes 86
8.1.2 Long-term Resource Monitoring 86
8.2 Performance Review and Evaluation 87
9 RESEARCH PRIORITIES 88
10 RECOMMENDATIONS 90
11 REFERENCES 91
APPENDIX 1: WATER QUALITY GUIDELINES 95
APPENDIX 2: BASELINE MONITORING PROGRAMMES 97
APPENDIX 3: RECOMMENDED LONG-TERM MONITORING PROGRAMME 107
APPENDIX 4: Proposed classes of water resource and resource quality objectives for the Goukamma system, summarized form the Government Gazette No. 42053 111

TABLE OF FIGURES

Figure 1. Location of the Goukamma estuary in the Garden Route District v
Figure 2. A diagram representing a co-operative structure for integrated estuarine management in South Africa x
Figure 3. A framework for integrated estuarine management in South Africa 2
Figure 4. Location of the Goukamma estuarine system within Knysna Local Municipality 4
Figure 5. Objectives for the Goukamma Estuarine Management Plan 18
Figure 6. Map of the geographical boundaries of the Goukamma estuarine system according to 5m topographical contour and defining the EFZ (SANBI National Estuaries Layer). 74
Figure 7. Proposed Coastal Management Line for consideration in future park planning processes (WCG, 2015) 76
Figure 8. Key role players for the management of the Goukamma estuary system 81

TABLETURE

Table 1. A summary of the National Biodiversity Assessment for the Goukamma estuary, 2019 iv
Table 2. Overarching management objectives for the Goukamma estuarine system viii
Table 3. Summary of Operational Objectives 25
Table 4. Recommended TPCs for components of RQO determinations 28
Table 5. Management Actions for Water Quantity and Quality 30
Table 6. Management Actions for Biodiversity (Conservation) 38
Table 7. Management Actions for Human Activities (Conservation) 43
Table 8. Management Actions for Law Enforcement (Conservation) 45
Table 9. Management Actions for Heritage Resources (Conservation) 47
Table 10. Management Actions for Sustainable Utilisation of Living Resources 50
Table 11. Management Actions for Land Use & Infrastructure 53
Table 12. Management Actions for Institutional & Management Structures 59
Table 13. Management Actions for Sustainable Livelihoods 62
Table 14. Management Actions for Tourism & Recreational Use 64
Table 15. Management Actions for Education & Awareness 66
Table 16. Management actions plans for estuary mouth and dune restoration strategic objectives 68
Table 17. Management action plans for research and monitoring 70
Table 18. Management action plans for environmental disasters 72
Table 19. Water Quality Guidelines – Targets for the Natural Marine Environment (DWAF 1995). See Reference List for Sources (EEC) 95
Table 20. Baseline monitoring programmes for Water Quantity (Hydrodynamic & Sedimentary processes) 97
Table 21. Baseline monitoring programmes for Water Quality 98
Table 22. Baseline monitoring programmes for Biodiversity (Conservation) 99
Table 23. Baseline monitoring programmes for Human Activities (Conservation) 101
Table 24. Baseline monitoring programmes for Law Enforcement (Conservation) 102
Table 25. Baseline monitoring programmes for Sustainable Utilisation of Living Resources 103
Table 26.Baseline monitoring programmes for Land Use & Infrastructure 103
Table 27. Baseline monitoring programmes for Sustainable Livelihoods 104
Table 28. Baseline monitoring programmes for Tourism and Recreational Use 105
Table 29. Baseline monitoring programmes for Education and Awareness 105
Table 30. Recommended monitoring programme for the Goukamma 108
Table 31. Proposed classes of water resource and resource quality objectives for the Goukamma system 111

ACRONYMS & ABBREVIATIONS

ADU	Animal Demography Unit from UCT
BGCMA	Breede-Gouritz Catchment Management Agency
C.A.P.E.	Cape Action for the People and the Environment
CapeNature	Western Cape Nature Conservation Board
CARA	Conservation of Agricultural Resources Act (Act 43 of 1983)
CBA	Critical Biodiversity Area
CFR	Cape Floristic Region
CMA	Catchment Management Agency
CML	Coastal Management Line
CMP	Coastal Management Programme
CMS	Catchment Management Strategy
CPUE	Catch-per-unit-effort
CPZ	Coastal Protection Zone
CSIR	Council for Scientific and Industrial Research
CWAC	Co-ordinated Waterbird Counts
DFFE	Department of Forestry, Fisheries and Environment
DEA&DP	Western Cape Department of Environmental Affairs & Development Planning
DFFE:O&C	Department of Forestry, Fisheries and Environmental Affairs: Oceans & Coasts Branch (formerly Marine & Coastal Management, MCM)
DIN	Dissolved inorganic nitrogen
DM	District Municipality
DSL	Development Set-Back Line
DWS	Department of Water & Sanitation (formerly Department of Water Affairs & Forestry, DWAF)
EA	Environmental Authorisation (formerly Record of Decision)
EAF	Estuarine Advisory Forum
ECO	Environmental Control Officer
CPB	Eastern Cape Parks Board
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMP	Estuarine Management Plan
EPA	Estuarine Protected Area
EWR	Ecological Water Requirements
EZP	Estuarine Zonation Plan
GNR	Gazette Number Regulation
GRDM	Garden Route District Municipality
HWM	High Water Mark
I&AP	Interested & Affected Party
ICM Act	Integrated Coastal Management Act
IDP	Integrated Development Plan
GEAF	Goukamma Estuary Advisory Forum
KRSBC	Keurbooms River Seagull Breeding Colony
LED	Local Economic Development
LM	Local Municipality
LUPA	Land Use Planning Act
MAR	Mean Annual Runoff
MCC	Municipal Coastal Committee
MEC	Member of the Executive Council
MLRA	Marine Living Resources Act

MLRF	Marine Living Resources Fund
MPRA	Municipal Property Rates Act
MSA	Municipal Systems Act
MSL	Mean Sea Level
NBA	National Biodiversity Assessment
NEM: BA	National Environmental Management Biodiversity Act
NEMA	National Environmental Management Act
NFA	National Forests Act (Act 84 of 1998)
NGO	Non-governmental Organization
NHRA	National Heritage Resources Act
MAR	Natural Mean Annual Runoff
NRF	National Research Foundation
NSRI	National Sea Rescue Institute
NWA	National Water Act
NWRS	National Water Resources Strategies
ORCA	Ocean Research Conservation Africa
PDC	Previously Disadvantaged Community
PES	Present Ecological State
PHRA	Provincial Heritage Resources Agency
Protocol	National Estuarine Management Protocol
RDM	Resource Directed Measures
REC	Recommended Ecological Category
REI	River Estuarine Interface
RMA	Responsible Management Authority
RQO	Resource Quality Objectives
SA	Seashore Act
SAEON	South African Environmental Observation Network
SAHRA	South African Heritage Resources Act
SAIAB	South African Institute for Aquatic Biodiversity
SALTBAA	South African Light Tackle Boat Angling Association
SAMSA	South African Maritime Safety Authority
SANBI	South African National Biodiversity Institute
SANCOR	South African Network for Coastal and Oceanic Research
SANRAL	South African National Roads Agency Limited
SAR	Situation Assessment Report
SCLTBAA	Southern Cape Light Tackle Boat Angling Association
SDF	Spatial Development Framework
SEA	Strategic Environmental Assessment
STW	Sewage Treatment Works
TPC	Threshold of Potential Concern
UCT	University of Cape Town
WESSA	Wildlife and Environmental Society of South Africa
WfW	Working for Wetlands
WMA	Water Management Area
WSA	Water Services Act
WUA	Water User Association
WWTW	Wastewater Treatment Works

1 INTRODUCTION

Estuarine ecosystems are not isolated systems. They form an interface between marine and freshwater systems and are part of regional, national, and global ecosystems either directly via water flows or indirectly through the movement of fauna. In addition to the biota that these estuaries support, they provide a range of goods and services (uses) to the inhabitants of the various regions. Disturbances in one estuary can influence a wide variety of habitats and organisms in the broader freshwater or marine ecosystem. Thus, the interaction between the systems and users creates a delicate balance, the sustainability of which needs to be addressed by some form of management plan.

To address this balance in a consistent manner in the Cape Floristic Region (CFR), the Cape Action for People and the Environment (C.A.P.E.) Estuaries Management Programme developed a holistic and inclusive management process representative of all stakeholders. The programme was governed by a Task Team comprising of officials from C.A.P.E., CapeNature, various government departments Department of Environmental Affairs: Oceans & Coasts Branch (DEA: O&C) (formerly Marine and Coastal Management), the Department of Water & Sanitation (DWS) (formerly Water, Agriculture and Forestry, DWAF), the Eastern Cape Parks Board (ECPB) and the Council for Scientific and Industrial Research (CSIR), which provided the technical support. Each management plan within this programme was developed via an interactive process that utilizes the knowledge and expertise of local stakeholders, whether they be in the private sector (includes civil associations, clubs, tourism etc.), professional, business, or institutional (includes government, parastatals, NGOs, conservation bodies etc.).

The urgent need for EMPs became apparent during the development of the National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008, as amended by Act No. 36 of 2014) (ICM Act). Estuaries and the management thereof have not been adequately addressed by past marine, freshwater, and biodiversity conservation Acts. Estuaries and estuarine management were marginalized since they did not fit the ambit of any one government Department. Estuaries, and the management thereof, now form an integral part of the ICM Act (Chapter 4, Sections 33 and 34), which outlines the need for a National Estuarine Management Protocol (The Protocol). The Protocol identifies the need for the development of EMPs, as these would help to align and coordinate estuaries management at a local level.

CapeNature developed the initial EMP for the Goukamma Estuary, based on the Generic EMP Framework available at the time (Van Niekerk & Taljaard, 2007). This document follows on from the Situation Assessment Report and fulfils the requirements of Objective 2, namely the development of an EMP for the Goukamma estuary and has subsequently been updated according to the 2021 Protocol and supporting EMP Guideline (DEA, 2015).

2 FRAMEWORK FOR THE DEVELOPMENT OF AN EMP

2.1 Approach

The Goukamma Estuary EMP was initially developed based on the key components of the generic framework for EMPs, as proposed in Van Niekerk & Taljaard (2007). The current update places it in line with the Protocol. Figure 1 is a graphical representation of this framework. It is essential to understand that the EMP developed within this framework is not cast in stone but will instead become a 'living document' that can be adapted according to the changing requirements of the system itself and its users. A feedback system involving a regulated monitoring programme and a detailed situation assessment once every five years will allow for changes to be made through the working groups responsible for each sector.

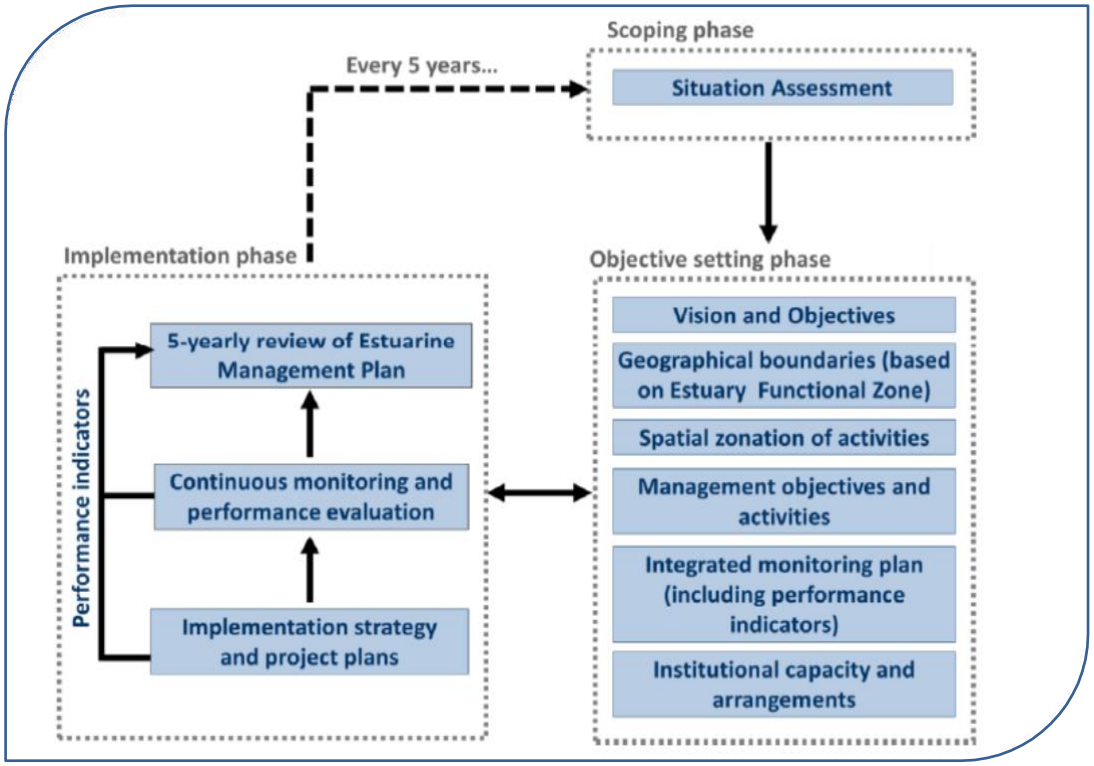

Figure 3. A framework for integrated estuarine management in South Africa

This EMP is a strategic planning document, and as such does not provide detailed, routine planning for the management of the estuary. Furthermore, the ICM Act provides for a report to be submitted to DEA on an annual basis in respect to implementation once an EMP has been signed off and approved. The EMP should also be recognized as a dynamic document, whereby certain components could be revised as important new information becomes available and management priorities change. Adaptive management should be continually pursued through a process of annually reviewing the progress made in achieving the management objectives. Finally, the management plan should be subject to a comprehensive revision on a five-year cycle, as required by the Protocol.

2.2 Summary of Legal Framework

Chapter 4 of the National Environmental Management: Integrated Coastal Management Act (No. 24 of 2008, as amended by Act 36 of 2014) (ICM Act), aims to facilitate the efficient and coordinated management of all estuaries, in accordance with:

a) The Protocol (Section 33) approved by the Ministers responsible for the environment and water affairs; and
b) Estuarine management plans (EMPs) for individual estuaries (Section 34).

The Protocol, promulgated in 2013 and updated in 2021, provides a national policy for estuarine management and guides the development of individual EMPs. It must be ensured that the EMPs are aligned with the Protocol and the National Coastal Management Programme (CMP) (DEA, 2014). The Protocol lays out the following:

a) The strategic vision and objectives for achieving effective integrated management of estuaries in South Africa.
b) The standards for the management of estuaries.
c) The procedures regarding how estuaries must be managed and how the management responsibilities are to be exercised by different organs of state and other parties.
d) The minimum requirements for EMPs.
e) Who must prepare EMPs and the process to be followed in doing so.
f) The process for reviewing EMPs to ensure that they comply with the requirements of the ICM Act.

One of the pillars of successful integrated coastal (including estuarine) management is the establishment of effective institutional arrangements to underpin both cooperative government and cooperative governance. Cooperative governance is a system that allows government and civil society to communicate and contribute to shared responsibility in respect of coastal management objectives and must be well-organized and widely representative of all coastal stakeholders. The ICM Act details the institutional arrangements that will contribute to cooperative coastal management in South Africa. These arrangements are made at national, provincial, and municipal government levels, and the embodiment of cooperative coastal governance is vested in what will be known as coastal committees. The ICM Act provides for the permissive, i.e., if so required, establishment of municipal coastal committees, but at a national and provincial level however, the Minister and MECs of coastal provinces are directed to establish national and provincial coastal committees, respectively. Provincial coastal committees must be established within one year of the commencement of the ICM Act.

The National Coastal Committee (the MINTEC Working Group 7) is established by the Minister, and its powers determined by notice in the Government Gazette. It is supported administratively by the National Department of Forestry, Fisheries and Environmental Affairs (DFFE). The Premier of each coastal province must identify a lead agency (organ of state) that is responsible for the coordination, monitoring, and implementation of the provincial coastal management programme, monitoring the state of the environment in the coastal zone, and identifying relevant trends and priority issues. The lead agency for coastal management is

directly responsible to the MEC. Each metropolitan, district or local municipality which has jurisdiction over the coastal zone may establish a municipal coastal committee. The establishment of Municipal Coastal Committees is discretionary.

The lowest tier of institutional arrangements for estuarine management comprises the Responsible Management Authority (RMA) and the estuary advisory forums. The role of the estuary advisory forum is to act as the hub which links all stakeholders, including both organs of state and civil society, to facilitate cooperative management and effective governance in terms of the EMPs, as well as facilitate and monitor implementation of an EMP.

2.3 Mandate and Responsibilities of the Responsible Management Authority

The Protocol identifies CapeNature as the RMA responsible for developing and coordinating implementation of the Goukamma Estuary EMP, as most of the estuary is currently being included in the Goukamma Marine Protected Area through an active resonation and realignment process. This is according to the Goukamma Nature Reserve Protected Area Expansion Plan as contained in the Protected Area Management Plan.

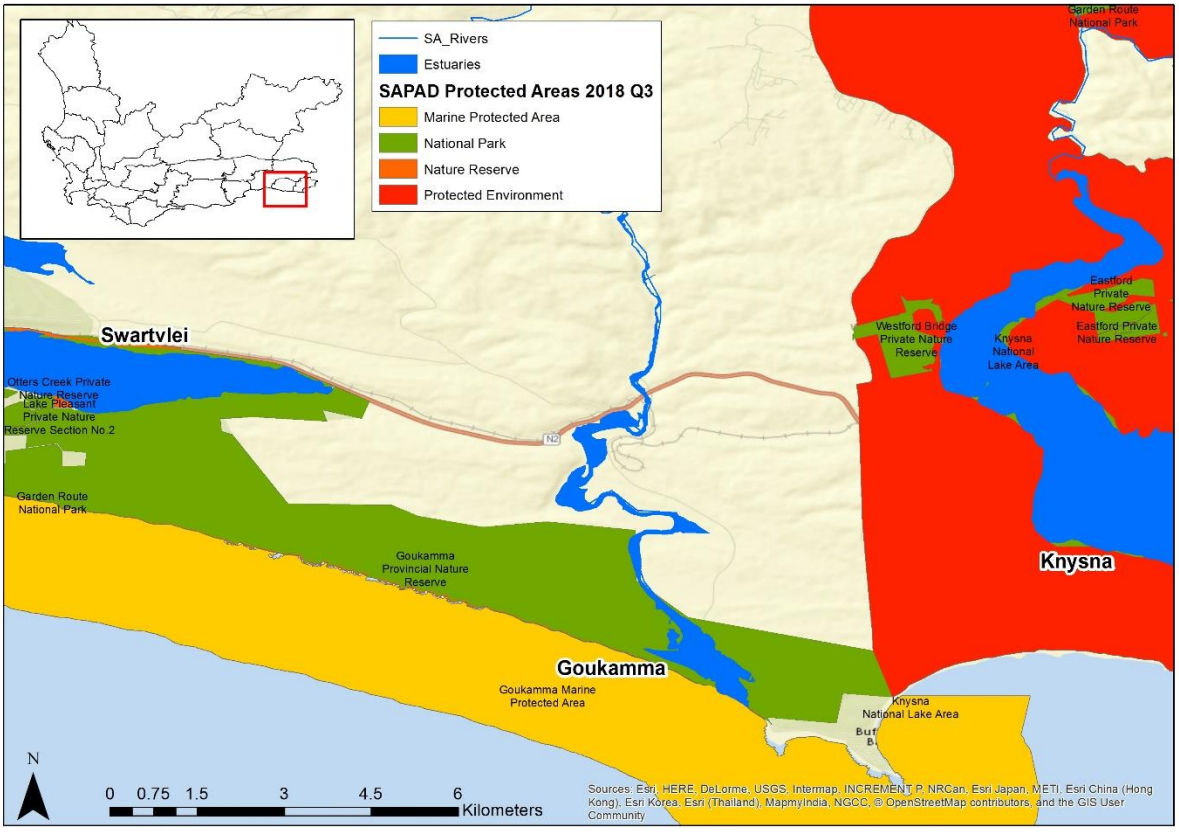

Figure 4. Location of the Goukamma estuarine system within Knysna Local Municipality

The RMA is responsible for overall co-ordination of the actions of other implementing agencies, and not the implementation actions themselves. Section 7.3 of the Protocol 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 Protocol as:

Section 5:	*"…authorities are **responsible for the development of EMPs** and **coordination of the implementation process**…"*
Section 5(e):	*"The identified responsible management authority to development 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… **Integrated**..." and "**incorporated** into that protected area's management plan as contemplated in section 39 of NEMPAA."*

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

a) follow a public participation process in accordance with Part 5 of Chapter 6 of the ICM Act; and
b) ensure that the EMP and the process by which it is developed are consistent with:
   i) the Protocol; 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 ICM Act;
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 (Knysna Municipality, Garden Route District Municipality (GRDM), Western Cape Provincial Government, Department of Water and Sanitation (DWS), Department of Forestry, Fisheries and Environment (DFFE)), will be supported by the Goukamma Estuary Advisory Forum (GEAF) representing all key stakeholder groups on the estuary.

3 SUMMARY OF SITUATION ASSESSMENT

INTRODUCTION

Estuarine ecosystems are not isolated systems. They form an interface between marine and freshwater systems and are part of regional, national, and global ecosystems either directly via water flows or indirectly through the movement of fauna. In addition to the biota that these estuaries support, they provide a range of goods and services (uses) to the inhabitants of the various regions. The interaction between estuaries and users creates a delicate balance, the sustainability of which needs to be addressed by some form of management plan.

The Protocol promulgated in May 2013, and amended in 2021, under the ICM Act identifies the need for the development of EMPs and sets out the minimum requirements for individual EMPs, as these would help to align and coordinate estuaries management at a local level.

A mouth maintenance management plan (MMP) for this estuary has been compiled during the implementation of the Western Cape Estuarine Management Framework and Implementation Strategy (EMFIS) of the Provincial Department of Environmental Affairs and Development Planning (DEA&DP) and has now been approved (2023 to 2027).

BIO-PHYSICAL DESCRIPTION

The Goukamma Estuary is classified as warm temperate predominantly closed estuary which means that the system is blocked off from the sea for varying lengths of time by a sand bar which forms at the mouth. This occurs during low river flows combined with longshore sand movements in the nearshore marine environment. At the coast, the estuary is diverted parallel to the shore by sand dunes and the mouth is situated behind a low sand barrier (James & Harrison 2008).

THE EXTENT OF THE ESTUARINE AREA

The estuary has a tidal reach of approximately 9.2 km and during open mouth periods, flows into the Goukamma Marine Protected Area (MPA). The estuary has an average depth of 1 – 2m with localised deeper channels present in the middle and upper reaches. The estuary mouth breaches naturally at 2.5 – 3 m amsl (Kaselowski 2012).

- Downstream boundary: Estuary mouth 34° 4'45.93"S; 22°57'14.86"E
- Lateral boundaries: 5 m contour above Mean Sea Level (MSL) as depicted by the Estuary Functional Zone in Figure 1.
- Upper estuary boundary: 34° 0'29.39"S; 22°56'13.80"E

PHYSICAL STRUCTURES

The two road bridges at the N2 crossing, at 9km from the mouth act as obstructions to water flow. An old Municipal weir, approximately 300m downstream from the N2 bridge was installed to allow water abstraction for the town of Buffalo Bay, currently allows tidal flow as it was ruptured in the past. There are approximately 13 other smaller structure ranging from small jetties to cattle fence extensions which are present below the N2 bridge. The largest of these accommodates a hand drawn vehicle ferry in the Goukamma Nature Reserve and consists of two sand bagged gabion structures on either side of the estuary. There is no slipway in the estuary.

PHYSICAL PROPERTIES

Depth

The estuary has an average depth of 1 – 2m with localised deeper channels present in the middle and upper reaches. Tidal variation inside the mouth is 1.35 m and decreases to 0.95 m and 0.85 m at low neap tides. Although tidal variation occurs throughout the estuary on the spring tide, active tidal exchange in which the entire water column is flushed occurs primarily in the lower reaches and seldom extents more than three kilometers upstream.

Sediment processes and characteristics

As the estuary is a large predominantly closed system, a mouth maintenance management plan (MMP) for this estuary has been compiled. The MMP identifies the need for a naturally functioning system with no mouth manipulation by machinery, except in times of emergency. The estuary mouth breaches naturally at 2.5 – 3 m amsl (Kaselowski 2012) and open mouth states correlate with winter and spring. Upstream bank erosion, from the now stabilized historically windblown shifting dune field, contributes the most sediment to the lower reaches. Floods are important to temporarily scour open inlets and remove accumulated sediment from the lower reaches.

Temperature

During Kaselowski's study temperature showed a strong seasonal fluctuation between summer and winter with a seasonal difference of ~ 5°C. During closed mouth state temperatures were generally higher and considered to be influenced by freshwater inflows. During this state overtopping of the sandbar by high seas decreases the temperature in the lower reaches near the mouth.

WATER QUANTITY AND QUALITY

Salinity

Salinities range from 13 to 35 ppt ppt during open mouth state and from 0.1 – 23.8 ppt during closed mouth states with highest salinities in the open mouth region. Salinity stratification showed strong differences between surface and bottom values, particularly in the middle and upper, deeper sections of the estuary but showed little difference between open and closed mouth states. The salinity in the surface layers decreased the further away one moves from the mouth.

pH

The pH in the system ranges from 5 to 8.4 which is typical of catchments running off Table Mountain quartzite. The low freshwater pH is kept in balance by the relatively stable pH of seawater. Following mouth state patterns, it can be expected to see a decrease in pH during high freshwater flows and vice versa during extended open mouth states.

Dissolved oxygen

Dissolved oxygen values are related to atmospheric temperature and open mouth state which both influence the temperature of the water. In turn DO shows an increase during winter months and a decrease during summer months. During Kaselowski's study period (2010-2011) deeper waters were hypoxic and a rainfall event of 75mm flowed over these hypoxic waters and forced a breach of the mouth. Little mixing during this rainfall event occurred. This highlights the importance of flood events which ensure thorough flushing of the system. Hypoxic conditions were not common in the lower, shallower reaches of the estuary due to wind turbulence ensuring regular mixing.

Turbidity

Total suspended sediment does not differ between mouth states and turbidity of the Goukamma is influenced by the dissolved humic substances typical of blackwater systems. Transparency of the water column decreased further away from the mouth, typical of blackwater systems but exacerbated by high levels of microalgal cells of pelagic phytoplankton biomass in the middle and upper reaches of the estuary.

Nutrients

Much of the catchment consists of Table Mountain Sandstone resulting in relatively little nutrient enrichment of the river water, while the inorganic nutrient concentrations typically measured in marine waters off the south coast of South Africa are also generally low. The Goukamma estuary report by DWA (2009) shows good quality water with relatively low concentrations of nutrients. These concentrations are influenced by limited agricultural practices on the floodplains and largely due to seepage from of nutrients from these lands. This additional nutrient input, to a relatively consistent inflow of freshwater, elevates the primary production potential of microalgae.

POLLUTION

Sewage – There are no Municipal Wastewater Treatment systems on the river.

Industrial - No industrial activities take place in the catchment.

Agriculture – cattle farms

FLOODS

Freshwater floods

The Goukamma estuary is prone to episodic flooding. This flooding has minimum consequences

for landowners and infrastructure and poses limited risk to human safety. Floodwaters cause erosion, particularly in the lower reaches where a historically shifting dune field has been stabilized by vegetation. Steep, high sand dunes, approximately 2.3km from the mouth are the most prone to this erosion and are largely responsible for much of the sediment in the lower reaches of the estuary.
Back flooding of the low-lying floodplains during extended closed mouth conditions has been a concern for farmers in the past. However, extensive awareness and advocating for estuary health together with considerable understanding and environmental concern from the farmers themselves has allowed the system to remain functioning in a near as possible natural state.

Marine storm surge
Storm surge from the seaward side during extreme storm events has a limited impact to property, infrastructure, and the banks of the estuary.

Recommendations
The following recommendations are made:

- No new developments within the risk area – this could be the 1:100-year flood line or below the 5 m contour.
- Planting of riparian vegetation along the estuary banks where it has been cleared.
- Clearing of debris from the catchment by forestry and those responsible for alien clearing.
- Minor bank stabilization to repair existing damage and to minimize impacts from future events.
- Inland relocation of the tar access road to Buffalo Bay.

BIOLOGICAL DESCRIPTION

FLORA

Phytoplankton

Likely to be dominated by small flagellates and diatoms with chlorophyte cells present in the upper reaches. During open mouth states, marine phytoplankton will dominate the lower reaches, while the middle reaches will be dominated by dinoflagellates due to definite stratification. Levels of phytoplankton are low.

Microalgae
A low biomass of benthic microalgae is expected due to the steep sided nature of banks, marine dominated lower reaches and coarse-grained sediment (DWA, 2009)

Macrophytes

Submerged macrophytes
No beds of macrophytes are present in the estuary, although records of pipefish in the past may indicate some degree of presence of these plants.

Saltmarsh

No saltmarsh habitat exists in the Goukamma. This is likely due to the limited number of sandflats and the high-water levels flooding available areas for extended periods during closed mouth states.

Riparian plants

The terrestrial vegetation is denuded in the middle reaches with some of the remaining intact areas being infested with alien species. Bank slump contributes to the destruction of remaining riparian vegetation.

FAUNA

Invertebrates

No data is available for the Goukamma estuary, but the following can be assumed based on the strong blackwater and limited intertidal habitat characteristics of the estuary (DWA, 2009). The crab, *Scylla serrata*, occurs in the upper reaches.

Zooplankton

A typical low biomass of limited species is expected.

Benthic invertebrates

No data is available for invertebrates, however a microbenthic species, *Callianassa kraussi*, sand prawn, is present in substantial numbers. This species is occasionally targeted by illegal bait collectors.

Freshwater fish

The indigenous species, Cape kurper and longfin eel are known to occur. Alien species include Mozambique Tilapia and large-mouth bass.

Marine and estuarine fish

A total of 33 species have been recorded from the Goukamma Estuary. Of these, estuarine roundherring *Gilchristella aestuaria,* is a category Ia species that spends its entire lifecycle in estuaries; seven species, e.g., barehead goby *Caffrogobius nudiceps* and Cape silverside *Atherina breviceps* (Ib) have marine and estuarine breeding populations; eight species, e.g., white steenbras *Lithognathus lithognathus* and *Argyrosomus japonicus* have to spend at least their first year of life in estuaries; nine species, e.g., groovy mullet *Liza dumerilii* (IIb) and harder *Liza richardsonii* (IIc), have varying degrees of dependence on estuaries and three species are catadromous eels (Va). Overall, there is a high degree of estuarine dependency with 85% of the fish assemblage comprising fish species that are either completely or partially dependent on estuaries. The remaining five species include one marine species blaasop *Amblyrhynchotes honckenii*, three indigenous freshwater species Cape kurper *Sandelia capensis*, Cape galaxias sp. and Eastern Cape redfin *Pseudobarbus afer* and one introduced freshwater species largemouth bass *Micropterus salmoides*.

The high degree of estuarine dependency is typical of temporarily open/closed systems where fish may be required to tolerate frequent or extended periods of mouth closure and the

associated variability in salinity. It also suggests that the Goukamma is an important estuarine nursery for fish. Numerically, the fish assemblage is dominated by the opportunistic *L. richardsonii* (50%) and to a lesser extent *G. aestuaria* (16%), freshwater mullet *Myxus capensis* (10%), Cape stumpnose *Rhabdosargus holubi* (9%) and Knysna sandgoby *Psammogobius knysnaensis* (6%). Fish abundance or density is typical, but species diversity low, when compared to other blackwater systems.

Macrophytes are limited, probably accounting for the low densities of pipefish *Syngnathus temminckii* or large fluctuations in the numbers of R. holubi in the estuary. The sandy nature of the estuary sand-loving benthic species such as Cape sole *Heteromycterus capensis* and *P. knysnaensis* are well represented. In the absence of macrophytes, the relatively high abundance of the latter and other species of goby is probably attributed to their being able to find refuge in the burrows of *Callianassa kraussi* which occur at high densities in the lower reaches of the system. The distribution of fish along the estuaries length is also typical of a blackwater system with opportunistic species such as *L. richardsonii* dominant in the lower and middle reaches, a high abundance and diversity of estuarine-dependent species such as *L. lithognathus* and *R. holubi* in the middle reaches and species with a preference for lower salinities e.g., *Myxus capensis* and *Mugil cephalus* in the upper reaches.

Except for exploited fish species such as dusky kob *Argyrosomus japonicus*, which tend to mirror their coast-wide declines, there is likely to have been little change in the fish assemblage of the Goukamma Estuary from reference to the present day.

Birds

A total of 40 waterbird species have been recorded over the past 20 years, but an average of only 12 species was recorded on the estuary during the winter and summer. Thus, the diversity of the system is rated average (good for a relatively undisturbed blackwater system). An average of 140 birds were counted in summer and 240 birds in winter. Gulls and terns are the most numerous groups of birds and are found mainly at the mouth of the estuary. The majority of these are found in the lower reaches. Terns venture up the estuary, and Kingfishers, Fish Eagle and, more occasionally, Osprey tend to occur throughout. The dominant waders are resident species typical of sandy habitats (e.g., African Black Oystercatcher and White-fronted Plover), grassy areas (Blacksmith Lapwing), and bushy banks (Water Thick-knee). There is a lack of suitable intertidal habitat for migrant waders, which are rare on the estuary, although more species have been recorded in the past. The waterfowl are characterized by a regular winter population of Little Grebe, and winter flocks of Yellow billed Duck. There is a resident population of Fish Eagles, and three species of kingfisher occur on the estuary.

Mammals

Common mammals that may be spotted within the Goukamma Nature Reserve and in close association with the estuaries include the bushpig, caracal, genet, baboon, vervet monkey, blue duiker, bushbuck, grysbok, leopard, mongoose, and the Cape clawless otter.

LEGISLATION AND PLANNING & DEVELOPMENT STRATEGIES

The purpose of this section is to review all forms of legislation that may have an impact on the management of the Goukamma estuary. This review incorporates international agreements and strategies, all forms of national, regional, and local legislation as well as municipal planning and development strategies and other conservation or development framework initiatives. Specific reference is made to the requirements of the ICM Act and the Protocol. CapeNature is identified as the Responsible Management Authority.

Existing management plans, development strategies, policies and conservation initiatives detailed include the Western Cape Provincial Spatial Development Framework, the Climate change strategy and action plan for the Western Cape, the Western Cape Provincial Coastal Management Programme, the Garden Route District Coastal Management Programme, the Knysna LM Integrated Development Plan and Spatial Development Framework as well as other regional initiatives. The National Biodiversity Assessment is an important reference document.

RECREATIONAL USE

EXPLOITATION OF LIVING RESOURCES

According to DWA, 2009, 19 tons of fish are removed from the system each year. This is a questionably high number and should be confirmed. Recent improvements in policing have likely reduced the take from the system. A known concern of subsistence fishers, many illegal, exists in the lower reaches of the estuary, however, this group is of a limited number of anglers, however, all species and size classes are retained.

Occasional illegal bait collecting occurs but is always quickly addressed and as a result is largely controlled to have a minimal impact. There is often a peak of activity during holiday periods by ignorant holiday makers.

TOURISM AND NON-CONSUMPTIVE USE

Several resorts, ranging from rustic to upscale accommodation are available to the tourist on the estuary and numerous accommodation options are available in the nearby coastal town of Buffalo Bay.

A small number of non-consumptive activities take place primarily on the lower reaches of the estuary and at a recreational node near the N2. These are canoeing, pedal boating, swimming, picnicking, bird watching and hiking.

There are a few established tour operators in the larger area who utilize the estuary and CapeNature Nature Reserve as a site for conducting guided tours.

THE WAY FORWARD

THE ESTUARINE MANAGEMENT PLAN

Key to the formulation of an EMP was the organization of a stakeholder workshop to develop a vision and objectives for the Goukamma estuary based on the Situation Assessment (this report) and the future needs and desires of the stakeholders. These outcomes together with the assessment provided by Turpie and Clark (2007), the Reserve Determination study and the

C.A.P.E. Generic Framework for EMPs was used to formulate the first generation EMP. This has been updated with recent important documents including the updated Reserve Determination, and the Protocol and associated guidelines as well as the outcomes of the 2018 National Biodiversity Assessment.

ISSUES RAISED BY STAKEHOLDERS

Not many issues were identified during stakeholder meetings, and these are proposed to be addressed in the EMP. The main issue relates to mouth management and the resultant back flooding of farmlands during closed mouth situations.

MANAGEMENT OF THE CATCHMENT

The Goukamma catchment's management strategy, although not clearly defined consist of several national, local, and municipal structures. These include the National Department of Forestry, Fisheries and Environmental Affairs, including the Oceans and Coasts Branch, SANParks, the Provincial Department of Environmental Affairs and Development Planning, the National and Provincial Department of Water Affairs and Sanitation, other National and Provincial offices of departments/directorates, e.g., Agriculture, Tourism and Land Affairs, and the Knysna LM within the Garden Route District Municipality.

CATCHMENT DESCRIPTION

The catchment basin spans an area of 235 km^2 and forms part of the greater Gouritz Water Management Area (WMA). Only the upper reaches of the rivers within the Gouritz WMA are in a natural and good ecological state while the lower reaches depict good to fair status due to upstream cumulative impacts (RHP 2007). According to assessments (RHP 2007), the upper reaches of the Goukamma River (Homtini River) depict a good ecological status while the status of the lower reaches is unknown; however, it is assumed to be like that of the Lower Karatara River which depicts a good ecological status. The catchment is relatively undisturbed in terms of human impacts, the mainland-use being commercial forestry (78%) and agricultural activities interspersed with a few small urban areas.

The catchment is in the process of being classified in terms of resource quality and specific Resource Quality Objectives will be developed for sections of the river as well as the estuary. These will be published in a National Gazette by DWS. These will become law and monitoring the implementation of these flow and non-flow related objectives will become critical into the future.

ECOLOGICAL STATUS

Rivers

The Ecological Reserve has been calculated for the catchment and estuary (see detail later in document). Biological monitoring activities of the Goukamma River was undertaken as part of a provincial initiative between Department of Water and Sanitation (DWS) and CapeNature to fulfil the objectives of the National River Health Programme (RHP).

WATER QUANTITY

The Goukamma estuary is considered oligotrophic, meaning that increases in nutrients (i.e., organic materials) could have negative effects on the biogeochemistry of the system.

ECOLOGICAL WATER REQUIREMENTS

Goukamma River Reserve Assessment

According to Resource Quality Objectives gazetted in November 2018, the MAR is set at 46.25 million m^3/annum. This shows a further reduction from 49 MCM/a as determined by a DWS study in 2010, which in turn also reflected a reduction from 58MCM previously. Reason is primarily attributed to afforestation (78%), alien infestations (15%) and irrigation and domestic abstractions (7%).

According to the NBA (2018), the Biodiversity Importance Rating placed the estuary as "Important"; Biodiversity Priority rating at "Priority" and ranked the importance rating in terms of Important Fish Nurseries as "medium" which reflects the Condition Status as "Near Natural".

According to the Water Research Commissions Report (Adams, 2016), the Goukamma carried an importance rating of 57 and the estuary receives 80% of its mean annual runoff.

SOCIO-CULTURAL IMPORTANCE

Although the Goukamma estuary is of significant value to local inhabitants regarding resource use and recreational pursuits, no information was available on the socio-cultural importance of the freshwater systems, other than the rivers being an important source of agricultural and domestic water supply for the region.

PRESSURES/RISKS/THREATS

Pressures currently contributing to the present state of the Goukamma estuary, in terms of water quantity and quality issues are the increasing pressure of seasonal demand for water in the holiday town of Buffalo Bay. This demand can, at times, be considered excessive. Fishing, particularly low-level subsistence fishing where all species of any size class are kept, is an ever-present threat to the nursery function of the estuary. Pollution from agricultural nutrient inputs can result in a rapid decrease in the health of the system.

ECONOMIC VALUE

While some studies have been conducted on the economic importance and value add of the Goukamma Marine Protected Area, very little has been understood of the economic value of the estuary itself. Undoubtedly, with the addition of the estuary to the MPA, the benefits of the MPA would be carried over to the estuary and these benefits would be increased due to the

estuary inclusion.

The following economic values have been placed on the Goukamma estuary (Turpie, Clark & Hutchings, 2006):

- Subsistence – did not rank amongst the top 20 temperate systems, however, with the position in relation to Wilderness, Swartvlei, Knysna and Keurbooms, which all ranked high, this estuary could be considered valuable to subsistence fishers.
- Property – the estuary did not rank amongst temperate systems in terms of property value related to estuaries.
- Tourism – did not rank amongst temperate systems in terms of tourism value attributed but carried a value of R350 000 annual visitor expenditure.
- Nursery (protection of juvenile organisms) – ranked 13th amongst temperate systems with a value of R12.6 million per annum.
- Existence value – ranked 5th amongst the top 40 temperate estuaries.

PROTECTED AREA STRATEGY AND POTENTIAL

Protection of Habitat Types

Targets for the protection of the extent of the estuarine habitat was set at the whole estuary and for no development on the banks of the estuary at 75% by Turpie and Clark, 2007. Special protection and rehabilitation of riparian vegetation should receive attention.

Type or Level of Protection

For conservation targets and goals to be achieved, 80% of temperate estuaries needed some form of partial protection rather than a few with total protection. The partial protection of 80% of estuaries is deemed desirable from a management perspective, in that it would facilitate the introduction of an almost universal sanctuary zone in each estuary, which is marked by standard markers, which in turn would facilitate public awareness about the estuarine protection system.

The zonation strategy means that individual estuaries may contain a fully protected (sanctuary) area, which would include terrestrial margins, and a conservation area that would be zoned according to the vision and objectives/requirements for that estuary. Sanctuary areas would fulfil the same function as an Estuarine Protected Area (EPA) and as such would have to be set up and managed by an organ of the state. Conservation areas may be managed by a wide variety of styles within a co-management setup where the community and an Estuary Advisory Forum are the main role players.

The Goukamma estuary in Perspective

Based on the findings of Turpie and Clark (2007), the following can be said about the Goukamma estuary with regards to requirements in terms of protection:

- The Goukamma Estuary is one of the core set of temperate estuaries required to meet the targets for biodiversity protection of estuarine resources.
- Current protection was medium and full protection is recommended.
- The recommended extent of undeveloped margin is 75%; and
- The recommended minimum water requirement falls under the A management class.

RESTORATION/REHABILITATION

The most important requirement for rehabilitation on the Goukamma estuary was clearing of alien vegetation in riparian vegetation and in the lower catchment, improvement of farming practices in floodplains, particularly bank erosion sites caused by animals and the removal of a historic flood damaged weir.

CLIMATE CHANGE

There are several threats associated with climate change that are of relevance to estuaries, their users, and the surrounding area. These include decreased rainfall (drought), increased rainfall and frequency of freshwater floods, increased water temperature (marine/estuary), sea-level rise and increased frequency and intensity of storm events.

OPPORTUNITIES AND CONSTRAINTS

POTENTIAL FOR PROTECTION OF THE GOUKAMMA RIVER ESTUARY

The Goukamma estuarine system is one of 88 temporarily open/closed estuaries in the Warm Temperate zone. The Estuary importance was signified as a highly important estuary and is listed as a Desired Protected Area in the C.A.P.E. Estuaries Conservation Plan for the temperate areas of South Africa. Furthermore, the Goukamma estuary is included in the Western Cape Protected Area Expansion Strategy. Achievement of formal protected status will certainly facilitate improved management of key physio-chemical drivers of estuarine health such as the quantity and quality of freshwater reaching the estuary, and protection of the estuary from encroaching developments and overexploitation of living marine resources.

POTENTIAL FOR RESTORATION

The environmental reserve determination study conducted for the Goukamma estuarine system in 2007 identified that the estuary had been partially degraded through anthropogenic activities. This includes transformation of riverine vegetation buffers, old weir structures restricting tidal flows, nutrient loading from agricultural practices.

SOCIO-ECONOMIC DEVELOPMENT OPPORTUNITIES

The biophysical characteristics as well as the aesthetic appeal of the Goukamma estuary denotes potential opportunities for local socio-economic development. There are resorts, B&Bs and guesthouses to visit in the vicinity of the Goukamma estuary. There are additional opportunities for employment through environmental management initiatives for the estuary. An existing environmental education center has potential to be used by the private sector or NGOs to help with educating school groups and other interest groups.

4 VISION & OBJECTIVES

The above Situation Assessment Report provided a sound basis from which to set a realistic and achievable Vision, as well as Management Objectives for the Goukamma Estuary management area. It also ensured that, at the time of the stakeholder workshop, expectations were aligned with the opportunities and constraints of the ecological and socio-economic environments prevailing at the time. The objectives are listed in priority order to guide subsequent management decisions and the detailed management objectives form the foundation for quantitative, operational objectives.

4.1 Vision

The Vision should be inspirational, representing a higher-level statement of strategic intent, and should take into account the overall Vision set for estuaries within the greater CFR.

The Vision for estuaries in the CFR is:

> ***"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 Vision for the Goukamma estuarine system is as follows:

> ***"To conserve the Goukamma Estuary as part of a system of sustainable living land and seascapes in the Garden Route that is representative of its unique biodiversity and ecosystem services through integrated management for the benefit of all. "***

4.2 Objectives

The key or overarching management objectives are generally qualitative statements of the values defined in the Vision and should be statements of outcomes rather than means of achievement. The following key sectors need to be specifically addressed in terms of the main objectives:

Figure 5. Objectives for the Goukamma Estuarine Management Plan

The vision and overarching or key objectives may be achieved through various management strategies, and these should be investigated and evaluated to optimally utilize financial and human resources that are detailed in the Action Plans. Detailed management objectives are available for achieving the key objectives for the various sectors.

4.2.1 Water Quality & Quantity

Resource Quality Objectives and the Ecological Reserve requirements are implemented to ensure that all ecological processes and livelihoods are sustained by maintaining a Category B classification[1].

- Enforce existing legislation in terms of the National Water Act (Act 36 of 1998; NWA) with respect to water use (Ch. 4, Parts 1 to 6), catchment management (Ch. 2, Part 2) and water quality (Ch. 3, Part 4), and the Garden Route DM Health By-laws (water quality).
- A Rapid EWR ('Reserve') Assessment[2] (and subsequent re-assessment) has been

[1] An ecological category classification of B means that there should be near natural with few modifications to the system.

[2] *A Catchment Management Strategy (CMS) is developed by the CMA in accordance with the NWA (Ch. 2, Part 2) for the protection, use, development, conservation, management, and control of water resources within its water management area. Specifically, this includes the classification of the water resource and the resource quality objectives (RQOs; NWA Ch. 3, Parts 1 & 2;* Government Gazette No.42053, Notice No.1298, Nov 2018*) aligned with that classification, i.e., Reserve Study. The Breede-Gouritz CMA (BGCMA), was formed in 2014 following the amalgamation of the Breede-Overberg and Gourtiz WMA.*

Conducted (NBA, 2018) and stated that the Recommended Ecological Category for the Goukamma Estuary should be B (*near natural with few modifications*). This study concluded that the pressures currently contributing to the degraded health of the Goukamma Estuary are poor water quality, fishing, structures in the intertidal area and flow reduction. A number of these impacts can be reversed with very little effort (or cost).

- Undertake water quality monitoring, according to the reserve determination methods and taking the Resource Quality Objectives into account.

4.2.2 Living Resources & Conservation

A sustainable balance is achieved between the conservation, protection and utilization of living and heritage resources.

- Increase capacity of law enforcement and/or monitoring officers, both within existing structures, e.g. CapeNature, DEA&DP, Department of Forestry, Fisheries and Environmental Affairs (DFFE) and Municipality and in the form of Honorary Fisheries Control Officers (HFCO) who are trained volunteers from within the affected community/stakeholder base appointed in terms Chapter 2, Section 9 of the Marine Living Resources Act (Act No. 18 of 1998). Enforce existing legislation that pertains to activities that impact on terrestrial (riparian area) and estuary ecosystems, particularly in terms of the MLRA, National Environmental Management Act (Act 107 of 1998; NEMA) and associated Environmental Impact Assessment (EIA) Regulations, National Environmental Management: Protected Areas Act (NEM:PAA Act No. 57 of 2003), National Water Act (NWA), Conservation of Agricultural Resources Act (Act 43 of 1983; CARA), National Forests Act (Act 84 of 1998;), ICMA and Municipal by-laws.
- Develop an Estuary Zonation Plan (EZP) that denotes certain activities and structures within certain zones, e.g., jetties & slipways, boating, access points, priority conservation areas (all undisturbed and sensitive areas located within the coastal protection zone – including wetlands, flood lines and rehabilitation areas.
- Promote low-impact, non-consumptive activities such as walking trails, bird watching, canoeing and sports events.
- No commercial fisheries or mariculture operations are to be considered for the Goukamma Estuary.
- Removal of alien vegetation within the catchment and estuary management area.
- Increase the amount of estuarine area with conservation status in line with the Western Cape Protected Area Expansion Strategy. Part of the Goukamma Estuary is situated within a Provincial Nature Reserve. It has been proposed that this area as well as the rest of the estuary be included in the Goukamma MPA/Provincial Nature Reserve. While fish and bait organisms are not under severe threat from excessive levels of exploitation, it has been proposed that parts of the first 3km of the estuary become a no take area for the fish and bait organisms. More effective compliance monitoring should also take place to afford the entire estuary with sufficient protection.

- Establishment of a Goukamma Estuary to Catchment Corridor in cooperation with landowners that would link the Goukamma Nature Reserve to a broader catchment corridor.
- Protect and rehabilitate sensitive estuary riparian areas and estuary-associated habitats – these would include the bank areas in the region of the access roads, the estuary mouth and the associated dune systems, heavily impacted cattle use sites on banks. Where sensitive areas are identified on private land, best practice farming methods need to be developed in association with the landowners to conserve these areas.
- Enforce the provisions of the National Heritage Resources Act (Act 25 of 1999; NHRA) for sites and structures of cultural and historical significance.
- Do not allow any form of angling competition, unless aligned to a CPUE study for specific fishery assessment purposes.
- Ensure that a Disaster Management Plan is developed for the estuary and surrounds and ensure that this plan is integrated into the Local and District Municipality Disaster Management plans.
- Ensure local capacity to implement Disaster Management Plan, e.g., training, equipment, staff availability, combined operations, etc.

4.2.3 Land Use & Infrastructure

Development and associated activities within the designated management area are controlled via legislation in such a way as to sustain existing livelihoods and ensure the maintenance of ecosystem functioning and services.

- Regulate all activities within 100 m of the high-water mark or within the 1:100 year flood line/5m contour line in accordance with the EIA Regulations, within the 100 and 1 000 m Coastal Protection Zone (CPZ) in accordance with the ICM Act (Chapter 1, Sections 16 and 17 until the Coastal Management Line for the Garden Route District has been developed) and in accordance with the Control of Vehicles in the Coastal Zone Regulations (Government Notice 1399; 2001; known as the Off Road Vehicle or ORV Regulations) and the Seashore Act[3].
- Enforce the provision of the Western Cape Provincial Spatial Development Framework (SDF) with regards coastal (includes estuaries) development and flood lines[4].
- Promote equitable and controlled access to coastal public property as defined in the ICM Act.

[4]*This strategy would include the licensing, operation (or closure) and maintenance of jetties and slipways and the leasing of structures below the high-water mark. Private slipways and jetties are administered under the Seashore Act, while Municipal or Provincial slipways are administered under the ORV Regulations. However, once the relevant sections of ICMA are promulgated (Chapter 7, Section 65 and Chapter 12, Section 95) and the Seashore Act is repealed, leasing will be administered under the former Act, and owners will have 24 months in which to re-apply. If no existing lease is in place or the structures are in a severe state of disrepair, a Repair and Removal order can also be extended under ICMA (Chapter 12, Section 96).*

[4] *The provision states that: "No further urban development shall be permitted on open coast lines that are vulnerable to erosion, inlets that are susceptible to increased storm activity, riverbanks that are liable to flooding, coastal buffer zones and ecological setback lines in estuaries and below the 1:50 year flood lines (erven) and the 1:100-year flood line (building platform).*

- Promote agricultural practices in accordance with the CARA to avoid (minimize) erosion and damage to sensitive habitats and indigenous vegetation (includes the catchment).
- Develop and enforce an EZP that regulates land use and development (as defined in the ICM Act[6] within the terrestrial portion of the designated estuarine area. As can be seen from the definition of "development" (see Footnote), this does NOT refer to farming activities such as planting and grazing, unless it involves the removal of indigenous vegetation. If this is the case, then an assessment will need to be conducted to determine the impact and methods of minimizing this impact.
- Ensure adequate services for sanitation treatment and disposal in accordance with the Water Services Act (Act 108 of 1997; WSA; Chapter 1, Section 3), Municipal Systems Act (Act 32 of 2000; MSA; Chapter 8, Part 2) and the appropriate Chapter of the Knysna Municipality By-laws pertaining to water supply, sanitation services and industrial effluent.
- Incorporate the recommendations (including the EZP) from this EMP into the Municipal SDF, which in turn will inform the Integrated Development Plan (IDP).
- Manage structures and privately owned and developed land in such a way as to prevent further bank erosion, siltation of the estuary and damage during flood events.
- Develop a strategy to deal with the threat of sea-level rise and permanent flooding of riparian land and property. The strategy will need to be based on the principles and protocols described in the National Climate Change Response Strategy and will likely be developed at the National level; it will need to consider aspects such as relocation (of people, structures, and infrastructure) and compensation.
- Provide incentives (e.g., rates rebates; Municipal Property Rates Act 6 of 2004) for landowners or lessees to manage portions of their land as conservation areas to protect biodiversity and/or provide for educational initiatives. Stewardship programmes can be set up to develop the Goukamma Estuary to catchment corridor.
- Ensure implementation of the Mouth management Plan

4.2.4 Institutional & Management Arrangements

The Goukamma estuary is managed cooperatively and effectively by relevant spheres of government and civil society (CapeNature Governance Tool).

- RMA to support and chair the local estuarine advisory forum (Goukamma Estuary Advisory Forum (GEAF), which is representative of all relevant spheres of government and civil society, to ensure the implementation of the EMP; this includes ensuring that relevant government departments fulfil their obligations e.g. DEA&DP, Department of Forestry,

[6] **"development"**, in relation to a place, means any process initiated by a person to change the use, physical nature or appearance of that place, and includes—
(a) the construction, erection, alteration, demolition or removal of a structure or building:
(b) a process to rezone, subdivide or consolidate land;
(c) changes to the existing or natural topography of the coastal zone; and
***(d)* the destruction or removal of indigenous or protected vegetation.**

Fisheries and Environment (DFFE) and DWS – assisted by the Breede-Gouritz Catchment Management Agency, (BGCMA) and that the objectives of the EMP are captured within all relevant management and planning documents, e.g. SDF, IDP and a Catchment Management Strategy (CMS) and the November 2018 gazette notice that includes RQOs (Government Gazette No.42053, Notice No.1298, Nov 2018). These can be seen in Table 31.

- Create awareness and ensure accountability amongst government institutions that have a mandate to enforce all forms of legislation applicable to the management area.
- Ensure that all arrangements between government departments with regards administering legislation are made clear to all affected stakeholders.
- Ensure that all government institutions and their staff comply with all relevant legislation and regulations, e.g., certificate of competence (skippers' ticket) for staff responsible for estuary patrols.
- Ensure that all government institutions make provisions in terms of funds and human resources to undertake priority management actions according to their legislated mandate.

4.2.5 Sustainable Livelihoods

Existing activities and promote additional opportunities are managed in a way that ensures compliance with legislation and the maintenance of ecosystem functioning and services.

- Ensure compliance of all existing activities (e.g., recreational fishery and tourism-based operations) with legislation and management plans that regulate against potential impacts on the management area, its inhabitants, and users.
- Promote the development of new initiatives that will benefit previously disadvantaged communities and that will comply with legislation and management plans that regulate against potential impacts on the management area, its inhabitants, and users.

4.2.6 Tourism & Recreational Use

The tourism and recreational potential of the management area are utilized in a responsible manner to benefit all users while ensuring the maintenance of ecosystem functioning and services.

- Market and promote the Goukamma estuary as an eco-friendly destination that is part of the greater Garden Route experience and highlight conservation initiatives and the importance to biodiversity protection.
- Promote non-consumptive recreational activities within the management area that include activities for the public, as well as organized sporting events, e.g., swimming, canoeing, or kayaking, rowing, bird watching, walking trails and mountain biking (some of these would include terrestrial areas such as the Goukamma Nature Reserve).
- Ensure that all recreational and tourist activities comply with Municipal By-laws, the EZP and

all legislation.

4.2.7 Education & Awareness

Awareness is enhanced through research and education, of the value of estuaries, a sense of ownership and the need for integrated, informed, and cooperative management that will ensure the maintenance of ecosystem functioning and services.

- Facilitate educational workshops for local authorities, in particular town planners and directors, about the value of estuaries (ecological, social, and economic), the EMP and its context within all forms of legislation (e.g., MLRA, ICM Act, NEMA & EIA Regulations, NWA, and CARA) and planning schemes (e.g., SDF and IDP) and the consequences of irresponsible development within the estuarine area.
- Facilitate training courses for estuarine and terrestrial reserve managers, municipal authorities, local management institution members, catchment management agencies and water user association members.
- Implement a public awareness campaign (estuary value/natural heritage, biodiversity, threats, and conservation efforts) via pamphlets, notice boards, direct engagement with users by compliance authorities, school tour groups and illustrated talks given by relevant specialists. Ensuring cooperation by users through education and awareness initiatives and not only through direct application of the law (e.g., fines and arrests) has the potential to more effective in the long run.
- Empower CapeNature field rangers (includes river control) and municipal authorities through an education initiative involving relevant national and regional legislation, local by-laws, zoning of the estuary and general knowledge of fauna and flora within the management area.
- Encourage research projects (tertiary institutions) aimed at enhancing the existing knowledge and filling in knowledge gaps of the Goukamma estuary. These projects can be used to enhance the efficacy of the EMP through amended Management actions and monitoring programmes.
- Identify priority monitoring programmes required to make effective management decisions.
- Identify research priorities and market research opportunities and projects at research institutions.
- Source funds for priority research

5 MANAGEMENT PRIORITIES

A full range of management actions has been identified to facilitate the achievement of the detailed management objectives given per sector; actions related to Living Resources and Conservation have been separated. These actions relate to more refined Operational Objectives. The Operational Objectives specify quantitative, measurable standards, target values and limits or thresholds of potential concern (TPCs[6]) for indicators relevant to issues within each of the main sectors. These need to consider any existing standards, regulations (legislation), operational policies or guidelines, as well as available resources. Table 1 overleaf provides a summary of the Operational Objectives.

For each of the defined sectors, the respective action plan is preceded by a narrative of the Operational Objectives, and includes:

- The Operational Objective and TPC related to it.
- A list of management actions required.
- Related legal, policy and/or best practice requirements of relevance to specific management actions.
- Monitoring plans to measure effectiveness of actions. If TPCs are brought under control then management actions can be considered effective, however if they continue to be exceeded then changes need to be made (either to management actions, the zonation plan, or operational objectives).
- A work plan identifying when each action should be initiated and by whom; and
- A resource plan detailing the human resources, the sources of funding and, where possible, the finances required to achieve these actions.

The action plans are detailed in Table 3 to Table 17.

Several National acts contain provisions that dictate to authorities (including managers), landowners and recreational users with regards to activities that are allowed, or at least should be regulated, within estuaries or within prescribed distances from estuaries. It must be clearly understood that all management recommendations (including aspects of the Spatial Zonation – see Section 6.1, made in this EMP are based on this existing legislation. As such, all existing activities, whether within urban, rural or the immediate estuarine areas, should already conform to these recommendations. This EMP merely serves to create an awareness of what activities should be considered according to the existing legislation. In so doing, the sustainable use of land and resources should be optimized to

[6] TPCs are defined as measurable endpoints related to specific indicators that, if reached, prompt management intervention. In essence, TPC endpoints should be defined in such a way that they provide early warning signals of potential non-compliance with operational objectives (Taljaard & Van Niekerk 2007a). Relevant indicators and recommended TPCs for many of the operational objectives detailed below have been taken from McGwynne & Adams (2004).

benefit all user groups and the estuarine ecosystem itself.

In the absence of a comprehensive ecological reserve assessment, and ongoing research efforts that continue to provide new information on many aspects of the biology and ecology of the management area, some of the action plans must be considered preliminary and may change as more information becomes available.

Table 3. Summary of Operational Objectives

Water Quantity & Quality
W1: Ecological Reserve and instream flow
W2: Pollutants
W3: Microbial organisms and pathogens
W4: Achievement of the RQOs through a comprehensive EWR assessment
W5: Ensure that allocated flows reach the Goukamma estuary
Biodiversity (Conservation)
B1: Maintenance of plant communities
B2: Eradication of alien vegetation
B3: Maintenance of intertidal invertebrate species (sand prawn)
B4: Maintenance of water bird populations partially or highly dependent on estuaries
B5: Maintenance of fish populations
B6: Protection and rehabilitation of wetlands and saltmarsh areas
B7: Restoration of original flow regime
B8: Include the Goukamma Estuary in the MPA declaration or declare estuary a PNR
B9: Inform stakeholders informed of all ongoing and proposed conservation initiatives
Human Activities (Conservation)
HA1: Ensure carrying capacity of estuary is not exceeded
HA2: Regulate bait collection activities
HA3: Regulate the number of fishing competitions and format
Law Enforcement (Conservation)
LE1: Improve law enforcement capacity
LE2: Enforce & monitor developments in the context of their EAs
LE3: Enforce adherence to EZP and Municipal By-laws
LE4: Formalize the delegation of powers by Knysna LM to CapeNature for administration of EZP and By-laws
Heritage Resources (Conservation)
HR1: Identify and preserve heritage resources and sites of cultural significance
Sustainable Utilisation of Living Resources
E1: Regulate bait collecting activities
E2: Regulate recreational fishing activities
E3: Regulate number and format of fishing competitions and ensure compliance
Land Use & Infrastructure
LU1: Regulate the nature & extent of land-use & infrastructure
LU2: Monitor the number of applications for development and/or rezoning of land within the management area and catchment
LU3: Ensure the use of planning and management tools to guide development

LU4: Streamline application and authorization process for repairs to flood damage and standardize methods used for rehabilitation
LU5: Initiate discussions with National DEA and Provincial DEA&DP with regards a sea-level rise strategy for affected people, property, and infrastructure
LU6: Assess potential threat of sea-level rise, flooding, and storm events
LU7: Determine SANRAL's intentions for the access road to Buffalo Bay currently running through a lower floodplain
Institutional & Management Structures
IMS1: Reconstitute the Estuary Advisory Forum
IMS2: Ensure the integration of estuarine and catchment management related processes
IMS3: Ensure compliance by staff with skipper's license requirements (undergo certification)
IMS4: Appointment of an Estuarine Management Co-Ordinator within the RMA
IMS5: Secure funding for priority management actions from appropriate government departments and implementing agents
IMS6: Inter-governmental department arrangements
Sustainable Livelihoods
SL1: Existing activities compliant with all forms of legislation and planning frameworks
SL2: Promote non-consumptive enterprises involving previously disadvantaged communities which are compliant with all forms of legislation and planning frameworks
Tourism & Recreational Use
T1: Recognition of the Goukamma management area as a premier eco-tourism destination
T2: Promote organized sporting events
Education & Awareness
EA1: Initiate educational workshops on the value of the management area, its context within planning frameworks and legislation and consequences of poor decision making
EA2: Develop and enable an interactive public awareness campaign
Restoration
EDR11: Understand the dune ecosystem and its impact on sand movement and the estuary mouth
EDR2: Develop an estuary mouth management protocol
Research and Monitoring
RM1: Research projects need to be identified and implemented
Environmental Disasters
ED1: Recognition that environmental disasters occur, and the Management Authority needs to be prepared for these

5.1.1 Water Quantity & Quality

The NWRS provides for the development of a CMS by a CMA or WUA, which will ensure both the classification of the water resource (Goukamma) and the required RQOs. The RQOs for a catchment have been gazette in November 2018 and its associated riverine and estuarine systems relate to the following aspects:

- the water quantity of freshwater inflow into the estuary (ecological reserve); and
- the water quality of freshwater inflow at the head of the estuary and water quality within the estuary.

The NBA (2018) for the Goukamma estuary classified the various components as follows:

- Present Ecological State (PES) – Category A/B[7];
- Ecological Importance and Sensitivity (EIS) – High; and
- Recommended Ecological Category (REC) – Category B (Category A cannot be attained due to existing developments, infrastructure, and activities). The following components, listed in Ch. 3 (Section 13) of the NWA, form the basis of all RQO determinations:
- The Ecological Reserve for human needs (e.g., irrigation and household use) and the ecological requirements of the estuary;
- the instream flow;
- the water level;
- the presence and concentration of substances in the water (nutrients, physical variables, and toxic substances);
- the characteristics and quality of the water resource and the instream and riparian habitat;
- the characteristics and distribution of aquatic biota; and
- any other characteristic of the water resource in question.

The recommended TPCs for the above components, based on the updated rapid level (desktop) assessment, are provided in Table 4.

[7] A = Unmodified, approximates natural condition; B = Near natural with few modification

Table 4. Recommended TPCs for components of RQO determinations

Ecological Reserve[8]	• The TPC for estuary requirements is <84.9% of the MAR and no dams in the catchment. • A comprehensive EWR assessment is required; the TPC would be if management of the estuaries continued to be based on the Rapid (desktop) assessment. Approach DWS for latest information.
Instream flow	• A minimum river flow of 2.2 m^3/s, i.e., TPC is flow of < 2.2 m^3/s. • This flow must be measured at the lowest DWS gauging weir [K6H19]. Compliance monitoring and enforcement blitz considered (annual). • Any abstraction that reduces the availability of water to the Reserve may be declared a stream flow reduction activity (NWA; Ch. 4, Section 36) and may be temporarily controlled, limited, or prohibited by a CMA in accordance with Schedule 3, Item 6 of the NWA (this can include abstraction for activities such as golf estates).
Pollutants	• TPCs expressed in appropriate units (standards set by the Eco Specs (Appendix 1), and by DWAFs' Water Quality Guidelines for the Natural Marine Environment – see Appendix 2; DWAF 1995[9]) for physical/chemical variables, inorganic nutrients, and toxic substances (includes heavy metals, nitrates, and phosphates[10] and petroleum-based products).
Microbial organism and pathogens	• TPCs expressed in appropriate units (standards set by DEA's Water Quality Guidelines for Recreational Use, DEA 2012)). • For example, the TPC for *E. coli* is a range of >100units /100 ml in 80% of samples and 2 000 units/100 ml in 95% of samples for full and intermediate contact recreation for marine (and estuarine) waters.
Characteristics and distribution of key **aquatic invertebrate biota (**sand prawns) as indicators of water quality problems	• A TPC of 30% deviation from baseline counts should be set. This is dealt with under the Conservation (Biodiversity and Human Activities) and Living Resources Operational Objectives detailed below. • Caution is advised as decreases may be due to factors other than water quality or quantity (freshwater inflow), such as poor recruitment, natural predation, utilization by humans or flooding/storm events.

[8] Note that under extreme conditions (e.g., severe drought), emergency measures may allow for an increase in the diversion amount required to meet human needs, and as such the river flow may fall below the TPC. Human needs do not include abstraction for residential, golfing or equestrian/polo estates (NWA; Chapter 6, Section 67; Schedule 1).

[9] These guidelines are currently under review and will be updated soon

[10] This will include most products that contaminate freshwater runoff from farmlands and commercial forestry plantations.

Water User Association	• Set up a WUA in the catchment and this needs to be included in the Breede Gouritz CMA so that a CMS can be developed and implemented. This will facilitate a catchment to coast management approach and assist in the future development of a comprehensive reserve assessment that will more accurately define the RQOs. The TPC would be if a CMA was not established, and a CMS not developed.
Off channel storage	• No dams are required for water storage in the catchment. A consideration was made for an off-channel storage dam to supplement Knysna's' water supply, effectively a catchment transfer scheme, in the past. • The old Transnet train station reservoir still services a development node around the train station. Use and management of this abstraction point must be reviewed and permitted with revised conditions. • Ensure compliance with EWR assessment by ensuring that allocated flows reach the estuary, and that off-channel storage is not considered. • Improve monitoring and management of old railway station reservoir use • The TPC would be non-compliance with EWR assessment resulting in reduced flows below recommended levels, and if off channel storage was proposed.

Table 5. Management Actions for Water Quantity and Quality

Management Actions	Legal Requirements	Monitoring Plans	Work Plan	Resource Plan
Operational Objective W1: Ecological Reserve and instream flow; TPC is if < 84.9% of combined MAR enters the estuaries or if flow rate decreases below 2.2 m^3/s.				
Ensure that the minimum flow requirements for the estuary are maintained via restricting water abstraction and impoundment activities in the catchment.	NWA - Ch. 3 (Parts 1 and 2); Government Gazette No.42053, Notice No.1298, Nov 2018	Monthly monitoring of flow at lowest DWS station. Monitoring and measurement of all lower abstraction points and a TPC of total abstraction amount be set against these points. All water use activities and licenses in the catchment to be assessed for compliance with Reserve requirements. All future water use licenses to be considered in the context of the Reserve requirements. Monthly basic water quality parameters need to be monitored, e.g., salinity, do, temperature, turbidity etc. to identify the different estuarine states, the ecological reserve implementation as well as significant changes in water quality due to lack of freshwater inflows.	DWS is responsible; should be initiated immediately due to drought risks and development (demand) pressure. Knysna LM to be involved as they rely on abstraction to supply Buffalo Bay and surrounds. Recommendations of water saving schemes for Buffalo Bay should be developed particularly for holiday season periods.	RMA DWS CMA DFFE
If the Ecological Reserve requirements are not being met, abstraction activities may be declared as streamflow reduction activities and temporarily controlled, limited or prohibited.	NWA - Ch. 4 (Section 36; Schedule 3 (Item 6); Government Gazette No.42053, Notice No.1298, Nov 2018			
Engage with DWA to conduct a Comprehensive Ecological reserve assessment.	NWA - Chapter 3 (Parts 1 and 2); Government Gazette No.42053, Notice No.1298, Nov 2018	Monitor progress of interactions with DWA and progress of assessment.	Forum to engage with DWA (Resource Protection or Resource Directed Measures Directorates) immediately to conduct the assessment.	**Human** - DWA: Resource Protection; Knysna Municipality. **Financial** - DWA (Resource Protection)

Management Actions	Legal Requirements	Monitoring Plans	Work Plan	Resource Plan
Operational Objective W2: Pollutants; TPCs will vary according to pollutants and DWS water quality guidelines.				
Identify source of pollution and take steps to remedy or mitigate. Sources may include contaminated runoff (stormwater, agricultural return flows, fertilizers from residential properties and estates) and fuel spills. Investigate use of Sustainable Drainage Systems (SUDS) for stormwater runoff.	NWA - Ch.3 (Part4), and RQOs (Ch.3, Parts1and 2); DWAF Water Quality Guidelines (Recreational Use-marine); Municipal by-laws (Waste Management and Municipal Health).	Regular water quality monitoring at set stations along the length of each estuary (including point sources, e.g., golf course and River Deck) and in the rivers above the head of each estuary. Water quality monitoring according to RDM methods and taking RQOs into account.	Joint responsibility between CapeNature, Knysna LM and DWS (CapeNature should take long- term lead role). Monitoring is ongoing and needs to be done monthly or if contamination is visible. Basic pollution response to be developed locally and coordinated with provincial response (GRDM to lead)	**Human-** DWS: Water Quality/Pollution; Knysna LM: Municipal Services. **Financial-** DWS to assist with start-up funding, thereafter Knysna LM (Financial Services) must source and provide funds.

Management Actions	Legal Requirements	Monitoring Plans	Work Plan	Resource Plan
Operational Objective W3: Microbial organisms and pathogens; TPCs will vary according to microbial organism or pathogen and DWAF water quality guidelines.				
Identify source and type of contamination and take steps to remedy or mitigate (provision and maintenance of basic services and infrastructure). Main sources are spills from intensive farming, urban runoff, and overflowing sewerage infrastructure at River Deck. Potential contamination from cattle grazing on floodplain.	NWA-Ch.3 (Part4) and RQOs (Ch.3, Parts1and 2); Ch.4 (discharge, pipelines, outfalls etc.); ICM Act (Ch. 8, Section 69); DWAF Water Quality Guidelines (marine); Municipal by-laws (Waste Management and Municipal Health).	Regular water monitoring at known point sources to specifically detect microbial and pathogen infestations. Monitoring should include extra sampling during times of heavy rains (increased runoff) and before organized sporting events. Water quality monitoring according to RDM methods and taking RQOs into account.	DWS is lead authority on water quality, but this function should be fulfilled by Knysna LM who are also responsible for sewerage infrastructure. Basic pollution response to be developed locally and coordinated with provincial response	Human- DWS: Water Quality/Pollution; Knysna LM: Municipal Services and Infrastructure Development. Financial- Knysna LM (Financial Services) must source and provide funds for infrastructure upgrade and maintenance.
Operational Objective W4: Development of a CMS and revision of the RQOs through a comprehensive reserve assessment; TPC is if a CMS is not developed and if the RQOs are not revised through a comprehensive reserve assessment.				
Once a WUA is set up and a CMA is established, ensure that it develops a CMS that will include the determination of RQOs through a comprehensive reserve assessment (includes estuary- and river-specific water quality parameters and estuary- and river-specific water quantity requirements).	NWA; CMS (Ch.2 Part2), RQOs (Ch.3, Parts 1 and 2); Government Gazette No.42053, Notice No.1298, Nov 2018	Monitor the achievement of the RQOs for the catchment and estuary. Once these have been developed then the estuary- and river-specific parameters (water volume and physical parameters) can be monitored.	Critically important and must be initiated immediately – a detailed assessment may take up to five years. The DWS has overall responsibility, but this is also the function of the BGCMA. This EMP is to be embedded in the CMS.	**Human-** DWS: Catchment Manager and Resource Protection. Consultants or research institutions may be appointed to update the RQOs. The RMA collaborative structure is to assist with field work (e.g.) monitoring **Financial-** cost of updating the RQOs may vary.

Management Actions	Legal Requirements	Monitoring Plans	Work Plan	Resource Plan
Operational Objective W5: Establishment of a CMA; TPC is if CMA were not established.				
Lobby for the establishment of a CMA (developed from the existing WUA in accordance with the requirements of the National Water Resource Strategy. Integrate this CMA into the broader Breede Gouritz CMA	NWA; Chapter 2 Part 1; Government Gazette No.42053, Notice No.1298, Nov 2018	Monitor progress of setting up a WUA and linking this to the CMA.	Should be prioritized by DWA (RDM) and happen as soon as possible to facilitate W6 below.	**Human** - Lobbying can be done by GEMF Executive; DWS: Resource Protection and BGCMA (CEO) to drive process. **Financial** - unsure, but probably not more than R30 000 to establish. Running costs in the region of R20 000/annum (source is DWS: RDM Division).

5.1.2 Conservation

Operational objectives for conservation purposes should be targeted at protecting biodiversity within the management area by ensuring that the diversity, distribution and abundance of aquatic plant, bird, fish, and benthic invertebrate communities is maintained or restored. These objectives can be defined in terms of TPCs for a range of indicators that firstly reflect aspects of biodiversity itself, secondly are aimed at controlling human activities that may impact on habitats and living resources, and thirdly deal with enforcement issues. The conservation of heritage resources is also dealt with under this sector.

5.1.2.1 Biodiversity

- Presence and extent of plant communities.
  The recommended TPC is a 10% reduction in area covered by each plant community type. Baseline data on coverage can be obtained from aerial photographs or reference photographs from elevated vantage points along the estuary. The water is sufficiently clean to allow for monitoring of submerged macrophytes using photographs.
- Clearing of areas infested by alien vegetation and removal of debris.
  The TPC is an area >10% of the total indigenous vegetation that is occupied by alien invasives. Baseline and reference data for infested areas can be obtained from conservation initiatives, aerial photographs, on-site line transects and local knowledge.
- Densities of intertidal invertebrate species, primarily sand prawn.
  Under normal conditions (excluding complete loss of populations due to flooding), invertebrate densities of dominant benthic species should not deviate from average baseline levels (fixed sites and at fixed times post mouth closure/opening events) by more than 30%. (DWS, 2015). Baseline trends can be obtained from regular timed counts of burrows using random quadrats over an initial two-year period.
- Presence and abundance of waterbird communities, with a focus on red-data species, those that are highly or partially dependent on estuaries, breeding aggregations or activity and the presence of nests.
  Since rare birds or those requiring very specific habitats are usually the first to be affected by change, the TPC for species richness should be the loss of a single species over a short period of time. The TPC for species diversity should be a 30% loss over a long (5-6 year) period. There are two TPCs for numbers of birds; a drop in 30% for resident species over a five- year period; and a drop in 50% for migratory species over a 10-year period. Baseline data should be in the form of data from the Avian Demography Unit's (ADU; based at UCT) Coordinated Waterbird Counts (CWAC).
- Maintenance of fish populations/abundance as measured by catch-per-unit-effort (cpue).
  There are currently no recommended TPCs for *CPUE* probably because catch data is not widely available for individual estuaries, however it is recommended that a decrease of >10% from baseline values for dusky kob, white steenbras and leervis and a decline of >20% from baseline values for all other species

be adopted. This is a difficult objective to achieve on an estuary-specific basis; if the TPC is attained on a single system, it must be noted that the cause cannot be attributed to fishing pressure in that estuary alone as we are dealing with a national resource. Declines can be due to fishing pressure elsewhere or recruitment failure due to natural events. Nevertheless, the TPC may be used to detect trends at a national level and prompt intervention at a higher level.

- Rehabilitation of wetland and riparian areas
  Rehabilitation by restricting access, creating a buffer zone (must be reflected in SDF) and improving flow conditions via removal of barriers, drifts and/or installation of culverts. The TPC would be if no action to improve these areas were taken or if an arrangement with regards to outside the Provincial Nature Reserve could not be made with landowners.
- Access Points
  Establishment of a specific access points along the estuary that allows people access to the estuary in a managed manner. The TPC would be if uncontrolled access across and into the estuary were allowed.
- Protected Area Expansion
  Increase the amount of estuarine area with conservation status. This process is captured in the Western Cape Protected Area Protected Area Strategy and will be administered by CapeNature. This may involve formal stewardship agreements with landowners, conservation servitudes or the expropriation of land. The TPC would be if no additional land within the EFZ was formally protected.
- Conservation Initiatives.
  Remain informed of all conservation initiatives that affect the immediate management area. The TPC would be if stakeholders were unaware of ongoing and proposed conservation initiatives.

5.1.2.2 Human Activities

- Number of persons visiting the estuary and their activity, i.e., carrying capacity.
  The physical, social (includes cultural and psychological aspects) and ecological carrying capacities (together grouped as recreational carrying capacity) have not been calculated for the Goukamma estuary, and a comprehensive study is required to determine these values; once calculated the TPCs for each would be any value more than that capacity. Baseline data can be collected during a survey that records the different types of activities and the respective number of participants on the water and on the bank and the number of boats on the water. Carrying capacity for boats can be calculated according to a DWS model but may also be regulated by estuary stakeholders in line with the estuary Vision.
- Illegal bait collecting and adherence to MLRA regulations
  All forms of bait collection (prawns, cast nets) are illegal. The TPC for compliance with the MLRA regulations should be very high, i.e., a single person operating outside the law should be cause for concern (see law enforcement and living resources below).
- Number of fishing competitions

Since no competitions take place on the estuary there is no TPC. However, the RMA must consider applications to host competitions in the future, it will be up to them to determine a TPC (number allowed per year and format, e.g., catch-and-release).

- Amend existing CapeNature/Knysna Municipality Amenity By-laws to include provisions for controlling activities within the management area. The TPC would be if the management area or at least the estuaries are not specifically addressed in the CapeNature regulations of by-laws.

5.1.2.3 Law Enforcement

- Capacity of law enforcement or compliance monitoring
  Capacity for law enforcement or compliance monitoring must be increased with regards the (primarily) MLRA, ICMA, NWA, EIA Regulations, CARA, Seashore Act and Municipal By-laws. Authority institutions need to train and appoint additional staff to conduct regular patrols and/or site visits, and recreational users need to take an active interest and undergo training to be appointed as voluntary compliance officers. Increasing capacity in some instances is either a National (DWA for NWA, DFFE for CARA and DEA for ICMA) or regional issue (DEA&DP for EIA Regulations), and this EMP will concentrate on locally based institutions. The TPCs would be no additional compliance staff in key departments, no voluntary compliance officers, and the continued incidence of non- compliant activities. The desired result would be to ultimately reduce the number of incidents or offenders to zero or at least reduce them significantly from what they are now.
- Enforcement and monitoring of conditions in terms of Environmental Authorizations (EA) for developments and activities as the result of the EIA process.
  Due to the sensitive nature of estuarine systems, all development will have some degree of a negative impact (direct and indirect) on their functioning, irrespective of intentions. The TPC for this objective must be very high and even a single offence must be seen as unacceptable. Baseline data is set out in the form of the conditions of the EA; these conditions must be complied with and enforced by an independent environmental control officer (ECO) to reduce impacts.
- Adherence to the EZP and revised Municipal By-laws.
  The zonings and By-law provisions regulate activities to ensure the safety of the public, the maintenance of ecosystem functioning and the protection of sensitive shallow water habitats. As such the TPC should be 2 incidents/week outside of peak holiday season and 5 incidents/day during peak season.
- Formal agreement between Knysna LM to CapeNature for administration of the EZP, formulation and enforcement of By-laws and funding.
  This would involve a contractual arrangement and the possible payment to CapeNature of an annual fee. The TPC would be if no formal arrangement existed and if funding were not made available.

5.1.2.4 Heritage Resources

- The identification, evaluation, and preservation of all heritage resources in terms of the NHRA.

  This would include sites and buildings or structures of historical and/or cultural significance. According to Section 34 of the NHRA, no structure older than 60 years may be altered or demolished without a permit issued by the Provincial Heritage Resources Agency (PHRA – Western Cape Provincial Office of SAHRA). The TPC should be high, and damage or removal of structures older than 60 years should not be permitted unless they are in such a state of deterioration that they pose a health and safety risk or impact on the aesthetics of the area. The issuing of repair or removal orders under the ICM Act for structures below the HWM needs to abide by the requisite provisions of the NHRA as well.

Table 6. Management Actions for Biodiversity (Conservation)

Management Actions	Legal Requirements	Monitoring Plans	Work Plan	Resource Plan
Operational Objective B1: Maintenance of Plant communities; TPC of 10% reduction in surface area of any plant community type is exceeded.				
If declines are due to water quality, then proceed as for actions detailed in Table 2 (W2 and W3), e.g., provision and maintenance of infrastructure, use of SUDS for stormwater.	Water quality legislation as for W2 and W3.	Aerial or fixed-point photographs or on-site visual census can be used to determine vegetation type and cover. Water quality monitoring as for W2 and W3). Monitoring according to RDM methods and taking RQOs into account.	Plant cover monitoring to be done once a year by tertiary institute or organizations such has ORCA with help from RMA and/or GEAF members. Water quality work plan and mandate as for W2 and W3.	**Human-** As for W2 and W3 if water quality is the cause; CMA; tertiary institute students or scientists. **Financial-** As for W2 and W3 is water quality is the cause; monitoring costs from corporate funding or research funding.
If cause is due to human disturbance, then enforce CapeNature regulations, Municipal by-laws, and Zonation Plan to reduce flood damage, trampling; enforce National legislation to prevent clearing of indigenous riparian vegetation and damage to wetlands.	Municipal by-laws (for Zonation Plans); NEMA (Ch. s1&5; EIA Regulations); Seashore Act (Sections 3&10); NFA (Ch.3, Section1); NEM: BA (Ch. 4, Part 1). CapeNature Ordinance, Proposed MPA regulations.	Aerial or fixed-point photographs or on-site visual census can be used to determine vegetation type and cover. Compliance w.r.t. Municipal by-laws and National legislation.	Plant cover monitoring to be done once a year by tertiary institutes/ RMA and/or GEAF members. Management actions to be reviewed and amended if they prove to be ineffective, i.e., if TPC is attained. Responsible agents are DEA, DEA&DP and CapeNature and Knysna LM.	**Human-** DFFE: Biodiversity & Conservation, and Environmental Quality & Protection Directorates; DEA&DP: Environmental Management & Protection and Development Planning Divisions; Knysna LM: Development Planning. **Financial-** existing budgets from National (DFFE) & Provincial (DEA&DP) government; Knysna LM (Strategic Services); monitoring costs from corporate or research funding.
Operational Objective B2: Eradication of alien vegetation; TPC of >10% of riparian vegetation infested by alien vegetation is exceeded.				
Contracted service providers to initiate clearing of vegetation in affected areas and removal of debris from	NEM: BA (Ch.5, Part2); NEMA; CARA (Sections 6 & 8)	Ensure eradication of alien vegetation to levels below the TPC – on site inspections or aerial photographs can be used.	As soon as TPC is attained; Lead agent is DFFE but in cooperation with DWS, landowners and initiatives like WfW.	Human- Primarily DFFE: WfW; contracted service providers; private landowners Financial- DEA (Working for Water, WfW); CapeNature; funds need to be approved for assistance to private

Management Actions	Legal Requirements	Monitoring Plans	Work Plan	Resource Plan
cleared sites (use for firewood, wood chips etc.).				landowners using own funding to conduct eradication/ control
Operational Objective B3: Maintenance of intertidal invertebrate species (sand prawn); TPC is densities below 30% of baseline counts for invertebrates and below 90% of baseline estimates for Knysna seahorse.				
If declines are due to water quality, then proceed as for actions detailed for W2 and W3, e.g., improved provision and maintenance of infrastructure, use of SUDS for stormwater.	Water quality legislation as for W2 and W3.	Water quality monitoring as for W2 and W3; bi-annual quadrat counts or line transects over two-year period for baseline data. Monitor recovery period after decline. Monitoring according to RDM methods and taking RQOs into account.	Invertebrate monitoring to be done bi-annually by tertiary institute or possibly WESSA. Water quality workplan and mandate as for W2 and W3.	**Human-** As for W2 and W3 if water quality is the cause; tertiary institutes; WESSA. **Financial-** As for W2 and W3 is water quality is the cause; monitoring costs from research or donor funding.
If cause is from human disturbance, then increase capacity to enforce CN regulations, By-laws and EZP to reduce trampling of habitat and disturbance of submerged and intertidal habitat; improve capacity to enforce access legislation. The proclamation of the estuary as an MPA/PNR will address these issues.	Municipal By-laws and EZP; MLRA (Ch.3, Section 14); NEM: BA (Ch. 4, Part 2).	Compliance w.r.t. CapeNature regulations, By-laws, EZP and National legislation; baseline data from bi-annual quadrat counts or line transects.	All forms of legislation and EZP to be enforced immediately. If TPC is attained, then capacity to enforce needs to be addressed. Responsible agents are CapeNature rangers and HFCOs appointed in terms of MLRA for compliance; DEA for NEM:BA compliance (may devolve to CapeNature; and KM or CapeNature for By-laws (EZP); baseline estimates and monitoring by tertiary institutions or organizations.	**Human -** CapeNature; DFFE to train and appoint HFCOs; DFFE: Biodiversity & Conservation and Oceans & Coast; KM or CapeNature for regulations and By-laws (EZP); tertiary institutions for assessment and monitoring. **Financial -** DFFE for compliance funding; KM (Financial Services - funding for CapeNature to enforce By-laws and EZP); research funds and donor funding.
Operational Objective B4: Maintenance of water bird populations partially or highly dependent on estuaries; TPC for species richness is one species; TPC for diversity is 30% loss over 5/6 years; TPC for number of resident birds is 30% loss over 5 years; TPC for migratory birds is 50% loss over 10 years.				

Management Actions	Legal Requirements	Monitoring Plans	Work Plan	Resource Plan
If declines are due to water quality, then proceed as for MAPs detailed in Table 6.1 (W2 and W3), e.g., improved provision and maintenance of infrastructure.	Water quality legislation as for W2 and W3.	Water quality monitoring as for W2 and W3; bi-annual quadrat counts, or line transects over two-year period for baseline data. Monitor recovery period after decline.	Invertebrate monitoring to be done bi-annually by tertiary institute or RMA. Water quality work plan and mandate as for W2 and W3.	**Human -** As for W2 and W3 if water quality is the cause, tertiary institutes. **Financial -** As for W2 and W3 if water quality is the cause; monitoring costs from research or donor funding.
If declines are due to water quality, then proceed as for actions detailed for W2 and W3.	Water quality legislation as for W2 and W3.	Bi-annual bird counts; water quality monitoring as for W2 and W3. Monitoring according to RDM methods and taking RQOs into account.	Bi-annual bird counts to be done by RMA or UCT's ADU (CWAC counts); water quality workplan and mandate as for W2 and W3.	**Human-** As for W2 and W3 if water quality is the cause; UCT's ADU; Birdlife Plett. **Financial-**As for W2 and W3 is water quality is the cause; research funds for CWAC counts.
Operational Objective B5: Maintenance of fish populations; TPC for dusky kob & white steenbras is >10% decrease from baseline values and >20% from baseline values for all other species.				
Address levels of fishing effort, and ensure compliance with regulations	MLRA (Sections 14&43); NEM: BA (Ch. 4, Part 2).	Compliance with legislation; levels of effort and cpue to be measured by dedicated fisheries survey. Monitoring according to RDM methods and taking RQOs into account.	Continuous from implementation of EMP. DFFE is responsible National authority with help from MLRA appointed officers; tertiary institutions to conduct fishery survey.	**Human-** MLRA appointed CapeNature rangers; DFFE appointed voluntary compliance officers; research students. **Financial-** DFFE (MLRF); boat registration / launch fees, permit levies etc. to assist voluntary compliance officers; research funds for fishery survey.
Operational Objective B6: Protection and rehabilitation of wetlands and saltmarsh areas; TPC is if these areas are not protected or rehabilitated.				
Create single access points to all intertidal saltmarshes to restrict trampling and erosion.	Municipal By-laws; EZP; ICM Act-Ch.2, Section13 for access, and Ch.2, Part2 (coastal protection zone).	Monitor compliance in terms of use of access points.	Municipality and CapeNature to manage access points (signboards) and monitor compliance. Must be addressed within the first two years.	**Human -** CapeNature **Financial -** CapeNature

Management Actions	Legal Requirements	Monitoring Plans	Work Plan	Resource Plan
Investigate ways to rehabilitate the wetland areas used for agricultural activities and minimize impacts in the future; create riparian buffer zone around sensitive areas.	ICM Act-Ch.2, Section 13 (for access), and Ch.2, Part 2 (coastal protection zone); CARA (includes Sections 6,8&12); Municipal SDF for restoration of wetlands.	Monitor recovery of impacted areas and establishment of riparian buffer zones in cooperation with landowners. Monitoring according to RDM methods and taking RQOs into account.	GEAF to facilitate cooperation with landowners. RMA, DFFE, DEA, Working for Wetlands (WfW) and Western Cape Wetlands Forum (WCWF). Municipality responsible for adherence to SDF ideals. Must be addressed within the first two years.	**Human -** Affected landowners in cooperation with DFFE: Land Care and Support & Development; DEA&DP; KM: Development Planning; WfW; SANBI; WCWF. **Financial -** DFFE and DEA to assist with rehabilitation costs; costs for rehabilitation due to illegal activities must be covered by landowner.
Operational Objective B7: Restoration of original flow regime; TPC is if this is not at least considered by all relevant parties.				
The removal of the old weir structure below the N2 bridge and restoration of the original channel; the feasibility of accomplishing these needs to be investigated.	Various aspects of Ch.4 of the NWA (stream flow reduction activities and restoration); EIA Regulations for associated activity.	Monitor progress of discussions between relevant authorities. If undertaken, then EIA process and operational phase must be closely followed.	The RMA must facilitate discussions between DWS, DEA&DP and Knysna LM. Process can be initiated within first two years.	**Human-** RMA together with DEA&DP: Development Planning; DWS: Resource Protection. **Financial-** No cost for meeting; costs for EIA, removal of weir and restoration of flow – Knysna LM.
Operational Objective B8: Include the Goukamma Estuary in the MPA declaration or declare estuary a PNR; TPC is if this is not achieved in the next 12 months				
CapeNature and DEA to include the Goukamma Estuary in the proposed resonation of the Goukamma MPA. If this process is not possible CapeNature needs to initiate a process to declare the estuary a PNR.	MLRA and NEM: PAA	Ongoing discussions with all stakeholders need to take place. Public meetings to take place to accept any comments. Intention to declare notice to be published by DFFE Declaration notice to be placed in gazette by DFFE.	The GEMF can facilitate discussions between all parties concerned	**Human -** GEMF together with DFFE need to communicate process to stakeholders. **Financial -** CapeNature to cover costs of public meetings and DFFE to cover gazette costs.

Management Actions	Legal Requirements	Monitoring Plans	Work Plan	Resource Plan
Operational Objective B9: Inform stakeholders of all ongoing and proposed conservation initiatives; TPC is if stakeholders are unaware of ongoing and proposed initiatives.				
GEMF to keep stakeholders informed of all ongoing/proposed activities; RMA can be informed by government departments and service providers	Not applicable.	Not applicable.	RMA to engage government representatives (over the next two years), primarily DEA&DP, DEA, and Municipality (Local and District) with regards ongoing and proposed initiatives and then disseminate information to stakeholders	**Human-** RMA take the initiative and engage relevant government institutions. **Financial-** No costs

Table 7. Management Actions for Human Activities (Conservation)

Management Actions	Legal Requirements	Monitoring Plans	Work Plan	Resource Plan
Operational Objective HA1: Ensure carrying capacity of estuary is not exceeded; TPC is when numbers exceed carrying capacity.				
Regulate number users accessing the estuary at any specific times. High use demand over peak periods and weekends; the GEMF will need to determine how to regulate numbers in line with the Vision; primarily an issue during peak holidays.	CapeNature regulations (access control?)	Monitor visitor numbers to determine threshold for safety and confrontation amongst users.	The GEMF can initiate this immediately in cooperation with CapeNature.	**Human** - GEMF executive in cooperation with CapeNature **Financial** - No costs involved.
Operational Objective HA2: Regulate bait collection activities; TPC is a 30% decrease in population size of any bait organism; and a single user that is non-compliant.				
Enforce MLRA regulations to ensure compliance.	MLRA (Section 14; Ch. 6)	Initial detailed survey (summer/winter to determine distribution, abundance, and population structure) followed by bi-annual random quadrats within designated sites for population density estimates; Monitor illegal bait collectors (recreational and subsistence).	Ongoing from time of EMP inception; lead agent is RMA for compliance; Knysna LM and CapeNature for revised EZP if required; tertiary institutions for population density estimates.	**Human-** CapeNature; DFFE: Resource Management (training and appointing voluntary compliance officers); CapeNature and Knysna LM: Strategic Services for revised EZP; research students. Combined operations. **Financial-** DFFE (MLRF); independent research funds; boat registration/ launch levies to assist voluntary compliance officers.

Management Actions	Legal Requirements	Monitoring Plans	Work Plan	Resource Plan
Operational Objective HA3: Regulate the number of fishing competitions and format; TPC (number and adherence to format) will need to be determined by RMA.				
If competitions are considered in future, the RMA will need to regulate the number of fishing competitions and determine a format (e.g., catch and release) in cooperation with organized angling bodies. This EMP, however, recommends that no competitions be allowed.	Municipal By-laws (regulating recreational activities on estuary); policies of angling clubs or organizations.	Monitor number of competitions and adherence to format.	Implement only if competitions are considered in future. Knysna LM & CapeNature in cooperation with organized angling bodies.	**Human-** CapeNature to lead and engage with organized angling; Knysna LM: Corporate Services to revise By-laws. **Financial -** No costs involved.

Table 8. Management Actions for Law Enforcement (Conservation)

Management Actions	Legal Requirements	Monitoring Plans	Work Plan	Resource Plan
Operational Objective LE1: Improve law enforcement capacity; TPCs are non-compliant users and a low conviction rate.				
Appoint and train two additional CapeNature rangers and establish agreements with other institutions to enforce a variety of legislation on their behalf.	No legislation covers the appointment of rangers, but they need to be appointed to enforce the MLRA (on behalf of DFFE), the NWA (on behalf of DWA), the ICM Act (on behalf of DEA) and the Municipal By-laws and EZP (on behalf of the Knysna Municipality).	Monitor the process of appointing additional rangers; and number of incidents of non-compliance.	Initiate immediately. CapeNature is responsible for appointment, training, and liaising with other institutions with regards enforcing legislation on their behalf. KM needs to be active in supporting CapeNature.	**Human** - CapeNature in cooperation with relevant government departments. **Financial** - each additional ranger should cost in the region of R200 000/annum (includes training and running costs).
Appointment of HFCOs from amongst estuary users; HFCOs to liaise and coordinate amongst each other and with CapeNature on combined operations (if protected area not expanded)	Appointed in terms of the MLRA (Chapter 2, Section 9).	Monitor number of newly appointed HFCOs and their activities.	HFCOs need to be trained and appointed as a matter of urgency. Training is by DFFE who also monitor their activities. This can be encouraged from the start but will be ongoing as volunteers become available.	**Human -** DFFE: Monitoring, Control & Surveillance **Financial -** costs to be carried by individual
Appointment of a Municipal Environmental Officer to work closely with CapeNature and the GEMF.	MSA (Chapter 7, Sections 66,67 & 68).	Monitor process of appointment and activities.	Knysna Municipality is responsible, and this is a matter of urgency.	**Human -** KM: Corporate Services (Human Resources). **Financial -** KM: Financial Services (annual salary of R200 000 plus running costs to perform duties @ R50 000/annum).

Management Actions	Legal Requirements	Monitoring Plans	Work Plan	Resource Plan
Operational Objective LE2: Enforce & monitor developments in the context of their EAs; TPC is any non-compliance with the EA conditions.				
Enforce compliance with EA conditions and report any infringements.	All legislation referred to in EA - this will vary according to nature of development or activity; EIA regulations	Inspections of all sites where activities or developments are taking place; ensure independent environmental control officer is appointed.	Regular (weekly) from the time an activity or development is authorized; responsible authority is mostly DEA&DP but may include other government agencies such as DWS; DEA, or DFFE, independent environmental control officer.	**Human-** DEA&DP: Development Planning and Environmental Management & Protection; independent environmental control officer. **Financial-** costs will vary depending on scope of project, but developer must cover the costs.
Operational Objective LE3: Enforce adherence to EZP and Municipal By-laws; TPC is 10 incidents/week outside of peak season and 5/day in peak season.				
Enforce provisions of the EZP and Municipal By-laws.	MSA (Ch.3); delegation of authority (Ch.7, Section 59).	Monitor number of incidents of non-compliance.	Knysna LM is responsible for enforcing By-laws and EZP is the RMAs responsibility. This must be implemented immediately and will be ongoing.	**Human-** Knysna LM: Corporate Services; CapeNature **Financial-** Knysna LM: Financial Services; CapeNature
Operational Objective LE4: Formalise the delegation of powers by Knysna LM to CapeNature for administration of EZP and By-laws; TPC is if no formal arrangement was made and if funding was not provided.				
MOU to be developed and signed between Knysna Municipality and CapeNature detailing delegation of powers and funding arrangements.	MSA (Chapter 7, Section 59).	Monitor progress and content with regards the contract between the parties.	Knysna Municipality in conjunction with CapeNature. Must happen immediately.	**Human -** KM: Corporate Services (Legal) and CapeNature. **Financial** - financial assistance required in the region of R30 000/annum.

Table 9. Management Actions for Heritage Resources (Conservation)

Management Actions	Legal Requirements	Monitoring Plans	Work Plan	Resource Plan
Operational Objective HR1: Identify and preserve heritage resources and sites of cultural significance; TPC is if resources are not identified and protected or if they are ignored by other legislation.				
Identify, list, and evaluate all heritage resources in the management area (includes all structures older than 60 years) and ensure they are preserved and protected. Ensure NHRA is applied in conjunction with other legislation. Align with management planning and processes of the Cape Floral Region World Heritage Site.	NHRA - Ch. 2 (Sections 27 to47); Ch.3 (Sections 48 to 51).	Monitor compilation of heritage resources and structures list and any activities that involve or may impact on these resources and structures.	Western Cape Provincial Office of SAHRA in cooperation with owners and lessees. This is not a high priority issue and can be implemented within 5 years, i.e., before the 5-year re-evaluation period.	**Human-** SAHRA: Western Cape Provincial office in cooperation with the Knysna LM: Corporate Services and GEAF (representing landowners and lessees). **Financial-** costs to be covered by SAHRA for listings; maintenance of resources to be covered by owners or lessees.

5.1.3 Sustainable Utilisation of Living Resources

Operational objectives for the sustainable use of living resources should be targeted at enforcing the existing Protected Areas that fall within the management area, local By-laws and the EZP that protect habitats or resources, existing legislation (e.g., MLRA) and the inspection of recreational fishing licenses. If fishing competitions are introduced, then these will need to be regulated as well.

5.1.3.1 Protected Areas

- Include the entire Goukamma Estuary in the MPA declaration process
- Declare the estuarine aquatic area between the present Goukamma Provincial Nature Reserve (GPNR) boundary and the upstream estuary boundary (9.2km) a PNR if the MPA declaration does not get approved

5.1.3.2 Sustainable use of bait organisms

- All individuals collecting bait organisms in the estuary must adhere to regulations promulgated in accordance with the provisions of the MLRA, e.g., bag limits, licenses, and no-sale.
  The TPC for compliance should be high; a single incident of non-compliance as well as the occurrence of repeat offenders should be cause for concern.
- Subsistence bait fishery.
  No subsistence bait fishery must be considered for the Goukamma Estuary unless a detailed study can prove that it will be sustainable and not impact significantly on the bait organisms and their habitat.

5.1.3.3 Sustainable utilization of fish resources

- All fishers must be in possession of valid recreational licenses and adhere to all regulations.
  The TPC for compliance to these regulations should be very high due to the threatened nature of many fish stocks, i.e., a single person operating outside the law should be cause for concern.

5.1.3.4 Fishing competitions

- If competitions are allowed to take place in future, all competitive angling structures hosting the event must adhere to the conditions specified by the RMA (e.g., catch and release format) and the provisions of the MLRA.
  There is no defined TPC for this indicator as fishing competitions alone are unlikely to be the direct cause of the reduction in fish populations on a national scale. However, the TPC for compliance to the MLRA and estuary specific regulations during competitions should be very high, i.e., a single person operating outside the law should be cause for concern, possibly resulting in a moratorium on all future events.

5.1.3.5 Availability of licenses

- Recreational permit (license) is required by all fishers who catch or collect fish and/or bait organisms.
  These permits are currently available at branches of the South African Post Office, which means they are not available after hours, on public holidays or over weekends, which poses a problem for many tourists and charter operators. This issue has

been raised at other venues and is clearly not specific to the Goukamma Estuary. It needs to be addressed at a higher level, and meetings have already been held between the South African Federation of Sport & Sea Angling and DFFE (Directorate: Monitoring, Surveillance and Control and the Assistant Director: Marine Living Resources Fund Revenue Management). However, representation is needed from those fishers who are not affiliated with organized angling bodies. The GEAF will need to engage with DFFE on behalf of stakeholders in this regard.

Table 10. Management Actions for Sustainable Utilization of Living Resources

Management actions	Legal Requirements	Monitoring plans	Work plan	Resource plan
Operational Objective E1: Regulate bait collection activities; TPC is a single incident of non-compliance or a single repeat offender.				
Enforce legislation pertaining to bait collection (includes possession of recreational permit)	MLRA (Ch. 2, Section 13 and Ch. 3, Section 14; Ch. 6).	Monitor levels of compliance with regards to MLRA regulations.	Continuous from implementation of EMP; DFFE is lead agent but delegated to CapeNature; voluntary compliance officers. Enforcement personnel to operate regular monitoring non- compliance; estuary users can assist by reporting incidents of non-compliance.	**Human-** CapeNature (and MLRA appointed rangers); voluntary compliance officers. **Financial-** DFFE to assist CapeNature from MLRF
Operational Objective E2: Regulate recreational fishing activities; TPC is a single incident of non-compliance.				
Enforce legislation in the form of MLRA regulations (includes possession of recreational permit). Carry out the national marine line fish surveys.	MLRA (Ch. 2, Section 13 and Ch. 3, Section 14; Ch. 6).	Monitor levels of compliance with regards to MLRA regulations.	Continuous from implementation of EMP; DFFE is lead agent but delegated to CapeNature; voluntary coastal officers. Enforcement personnel to operate daily monitoring of non-compliance; estuary users can assist by reporting incidents of non-compliance.	**Human-** CapeNature (and MLRA appointed rangers); voluntary compliance **Financial-** DFFE to assist CapeNature from MLRF
Operational Objective E3: Regulate number and format of competitions and ensure compliance; TPC is a single incident of non-compliance.				
Regulate number and format of fishing competitions if considered in future; a catch-and-release format should be enforced together with the MLRA Regulations.	MLRA (Section14 & Ch.6); Municipal By-laws for organized events; organized angling policies.	Number of competitions to be determined and monitored; participants to be assessed for compliance with MLRA regulations and competition specific rules.	Would depend on when and if competitions are allowed; the RMA is the authority that may grant permission to hold competitions; RMA to coordinate with organized angling structures to investigate feasibility of catch-and-release format.	**Human -** organized angling bodies in coordination with RMA **Financial-** no cost apart from levy that may be applied by Council to hold competitions.

5.1.4 Land-use & Infrastructure

- Nature and extent of land use and infrastructure associated with the estuary and catchment.

  The TPCs for this objective are not in the form of target values or quantitative, measurable standards but are instead broad statements of intent as follows:

  - Planning should allow for the maintenance of a riparian zone along the length of the estuary where sensitive habitats (e.g., wetlands, supratidal saltmarsh, and indigenous vegetation) occur. The implementation of the CML, CPZ, flood lines and inclusion of Critical Biodiversity Areas within all planning schemes should allow for this.
  - Preferably no additional development (structures) on the floodplain (CPZ; 1:100-year flood line) for safety reasons and sense of place. Agricultural activities within this area are at risk from floods, but compensation for damages is at least covered by the CARA.
  - Development and land use in the catchment and estuarine area should not lower water quality or interfere with normal hydrodynamic or sedimentary processes and cycles; the remnants of the old N2 weir on the Goukamma would be dealt with under this statement.
  - Development proposals should be evaluated through the EIA procedure and guided by the EMP specifically and the broader, soon to be completed, Breede- Gouritz CMS.

  Baseline data would be in the form of town planning schemes or development frameworks (e.g., SDF and IDP) that would need to be compared to a visual display (map) of all activities and infrastructure within the defined estuarine area to ascertain compliance and conformity with the estuary Vision.

- Number of applications for new development and/or rezoning of land associated with the management area and catchment (relevance to water abstraction and the impact on the Ecological Reserve requirements).

  There is currently no quantitative value defining a TPC for this objective's indicator but any increase in the number of applications compared to the last five years should be cause for concern. All applications should be guided by the EIA process. Should applications receive a favorable EA, the development should be assessed by an independent environmental auditor approved by both the DEA&DP and the local Advisory to ensure compliance. Any deviations from the EA conditions should be regarded as unacceptable and viewed as non-compliant. Baseline data in the form of development/rezoning applications can be obtained from the Knysna LM or DEA&DP; ideally the number of applications should decrease, as the Vision of the estuary becomes a reality.

- CapeNature has developed a formal tourism node on the banks of the Goukamma Estuary.

  Best practice management interventions should take place at this node.

- The inclusion of the management area in planning and management tools.

  The TPC would be if the defined management area were not considered at all in planning and management documents.

The functioning and value of the Goukamma estuary needs to be reflected in the SDF and IDP and should be a significant factor in any EIA assessment. All decisions regarding development and planning in the management area need to be guided by these planning and management tools. Baseline data is available in the form of current SDF and IDP documents, this EMP, both the Knysna Preliminary EMFs and the Eden District Coastal Management Programme (CMP).

- Streamline the application and authorization process for the repair of flood damaged land and infrastructure and institute a standardized protocol that would determine rehabilitation methods.

  The TPC would be if no arrangement could be reached and if landowners continued to either struggle to obtain authorization or continued to operate illegally.
- Equitable and controlled access to the coastal public property for all estuary users, including the disabled (wheelchair access).

  This would require an assessment of existing access points and an identification of either additional access points, upgrading for wheelchair access or closure of existing points (if they are detrimental to the well-being of the system, e.g., multiple access points and pathways through supratidal saltmarsh and wetland areas). TPC would be if equitable and controlled access were not achieved.
- Initiate discussions for the development and implementation of a strategy to cope with the potential threat of sea-level rise, flooding, and storm events on low-lying areas (people, property, and infrastructure).

  This strategy would need to be based on the National Climate Change Response Strategy for South Africa, which highlights the implications of climate change, identifies key issues and problems and details strategic objectives, principles, and proposals. Recommendations as to what this strategy should contain are beyond the scope of this EMP. As such this EMP recommends that the RMA engages with government now to determine a way forward. The TPC would be if discussions were not initiated with National DEA and Provincial DEA&DP and if a strategy were not in place within the next five to ten years in the vicinity of the mouth. The TPC would be if clarification were not obtained from SANRAL or if the road were not removed in the future.[11]
- Engage with the South African National Roads Agency Limited (SANRAL)

  It must be determined what their intentions are regarding the existing access road that crosses through the estuary flood plain.

[11] The following document may also be useful as a starting point for discussion: Umvoto Africa. (2010). Sea Level Rise and Flood Risk Assessment for a Select Disaster Prone Area along the Western Cape Coast. Phase 1 Report: Eden District Municipality Sea Level Rise and Flood Risk Literature Review. Prepared by Umvoto Africa (Pty) Ltd for the Provincial Government of the Western Cape Department of Environmental Affairs and Development Planning: Strategic Environmental Management (May 2010).

Table 11. Management Actions for Land Use & Infrastructure

Management actions	Legal requirements	Monitoring plans	Work plan	Resource plan
Operational Objective LU1: Regulate the nature & extent of land-use & infrastructure; TPCs are broad statements of intent (management actions).				
Implement the CPZ and CML, flood lines and Critical Biodiversity Areas - ensure all activities taking place are in accordance with relevant legislation; offer incentives (rates rebates) for private landowners to manage areas as conservation zones.	NEM: BA (Ch. 4, Part 1); NEMA (Ch. 5; EIA Regulations); ICM Act (Ch. 2 Section 16); CARA (Section 6); Municipal SDF.	Compliance with legislation controlling activities in this zone; monitor applications for activities within the zone.	Initiate as soon as EMP is implemented and integrate with SDF; DEA, DFFE, DEA&DP, CapeNature and Knysna LM are responsible; DFFE in catchment; GEAF members can register as I&APs in any applications	**Human-** DEA&DP: Environmental Management & Planning; DFFE: Land Care; DEA: Biodiversity & Conservation and O&C; CapeNature; Knysna LM: Strategic Services. **Financial-** DEA, DFFE, DEA&DP and Knysna LM budgets- part of existing responsibilities.
No additional development (structures) on the floodplain within the 1:100 flood line and coastal protection zone (this includes Critical Biodiversity Areas)-enforce recommendations in planning frameworks (SDF); offer incentives (rates rebates) for private landowners to manage areas as conservation zones.	NEM: BA (Ch. 4, Part 1); NEMA (Ch. 5; EIA Regulations); ICM Act (Ch. 2, Section 16; Ch. 3, Section 28); SDF/IDP; CARA (Section 6); Western Cape Provincial SDF; Municipal SDF.	Compliance with legislation restricting activities in this zone; monitor applications for activities within the CPZ, floodplain or 1:100 flood line.		
Developments and land use in the catchment and estuarine area should not lower water quality or interfere with normal hydrodynamic or sedimentary processes-ensure all developments and activities do not impact negatively on water quality by enforcing relevant legislation.	NWA (Sections 19&21); NEMA (Ch.5; EIA Regulations); ICM Act (Ch.8, Section 69); CARA (Sections 6 & 12); Municipal SDF/IDP.	Monitor EIA process to ensure all impacts are adequately mitigated; ensure compliance with ROD conditions; monitor water quality parameters according to RQOs (as for W2 and W3); ensure compliance with legislation and planning frameworks.	Initiate as soon as EMP is implemented and integrate with SDF; DEA&DP, DWS and Knysna LM are responsible agents; DFFE in catchment; GEAF, CMA and WUA can monitor infringements and register as I&APs for any applications within estuarine area. Knysna LM to provide and maintain basic services	**Human-** DEA&DP: Environmental Management & Protection, DWS: Resource Protection; DFFE: Land Care; Knysna LM: Strategic Services and Infrastructural Development. **Financial-** developers to cover costs of EIA and monitoring of ROD conditions; Knysna LM (Infrastructural Development) for supply and maintenance of basic services.

Management actions	Legal requirements	Monitoring plans	Work plan	Resource plan
			to avoid contaminated runoff (see W2 and W3).	
Proposed development should be guided by the EIA procedure and the EMP specifically and the broader catchment management plan - register as I&AP for all development applications and ensure compliance with all legislation.	All legislation controlling aspects of development within the EIA process - this will vary according to nature of activity but will include aspects covered by the NWA (Section 19; Ch. 4), NFA (Ch. 3, Section 1), NEMA (Ch. 5; EIA Regulations); CARA (Sections 6 & 12); HRA (Ch.2, Parts1&2), ICM Act (Ch.2, Section16; Ch.3, Section 28) & Municipal SDF/IDP.	Monitor the EIA process for each application and ensure compliance with all legal requirements.	Initiate immediately-for all new applications and review of applications currently under consideration; DEA&DP is EIA authority.	**Human**- DEA&DP: development Planning is lead agent; guided by EMP and Knysna LM: Strategic Services and RMA. **Financial-** no additional cost to existing running costs of DEA&DP or Knysna LM.
Operational Objective LU2: Monitor the number of applications for development and/or rezoning of land within management area and catchment; there are no quantitative TPCs but an increase in applications over a five-year period should be cause for concern.				
GEAF to be used as a source of I&APs for all development and rezoning applications and ensure compliance with all legislation and planning frameworks.	All legislation controlling aspects of development within the EIA process-this will vary according to nature of development or activity but will	Record numbers of new applications for comparison to recent years; monitor the EIA process for each application to ensure it fulfils legal requirements.	Applicable GEAF	**Human-** DEA&DP: Development Planning and Environmental Management & Protection is lead agent with various departments from DWS and DFFE depending on application or activity; guided by EMP and Knysna LM: Strategic Services and GEAF. **Financial-** no additional cost to existing running costs (budgets), i.e.,

Management actions	Legal requirements	Monitoring plans	Work plan	Resource plan
	include aspects covered by the NWA (Section19; Ch.4), NFA (Ch.3, Section1), NEMA (Ch.5; EIA Regulations), CARA (Sections 6&12), NHRA (Ch.2, Parts1&2), ICM Act (Ch.2, Section 16; Ch.3, Section 28) & Municipal SDF/IDP.		members[12] to register as I&AP for all new applications and check municipal records for compliance regarding older applications; DEA&DP, DWS, DFFE and Knysna LM are responsible for ensuring correct procedures are followed.	part of existing responsibilities.
Operational Objective LU3: Ensure the use of planning and management tools to guide development; TPC would be the exclusion of the Goukamma management area in any of these frameworks.				
Ensure that the management area is specifically addressed in all planning and management frameworks and considered in all EIAs.	ICM Act (Ch.4); SDF/IDP (in the form of specific management plans (e.g., this EMP and the future CMS); SEAs or Conservation Development Frameworks.	Review of all existing planning and management frameworks for inclusion of management area; monitor progress of all new management & planning documents through direct participation (GEAF).	Planning and management consultants together with RMA are responsible for addressing management area in frameworks and policies.	**Human-** Knysna LM: Strategic Services (Development Planning). **Financial-** Knysna LM: Financial or Strategic Services for developing frameworks.

[12] The GEAF cannot register as an I&AP as an institution as it will comprise representatives of the various commenting authorities, who thus cannot act as I&APs as well as decision-makers.

Management actions	Legal requirements	Monitoring plans	Work plan	Resource plan
Operational Objective LU4: Streamline application and authorization process for repairs to flood damage and standardize methods used for rehabilitation; TPC would be the ongoing difficulty with the authorization process and hap-hazard rehabilitation efforts.				
Establish a protocol to deal with bank stabilization and rehabilitation after flood events and adopt a standardized methodology.	Aspects of the EIA Regulations, including exemption from the application process once authorization has been granted previously.	Monitor progress of initiative – once landowners buy-in to the process and agree to pay for materials it can be initiated.	Initiate immediately. Knysna LM and CapeNature to liaise with DEA&DP, DEA and DFFE (structural engineers). If landowners buy-in, then this aspect can be initiated immediately. A Maintenance Management Plan for the impacted area (sometimes covering several landowners properties) needs to be developed and submitted to DEA&DP	**Human-** RMA and affected riparian landowners; CapeNature; DEA&DP: Environmental Management & Protection; DEA:O&C); DFFE: Land Care. **Financial-** Co-operative best practice project to be developed.
Operational Objective LU5: Initiate discussions with National DEA and Provincial DEA&DP with regards a sea-level rise strategy for affected people, property, and infrastructure; The TPC would be if this were not addressed or if a clear strategy were not in place within the next five to ten years.				
Approach National and Provincial authorities to enter discussions about a sea-level rise strategy for the Goukamma management area.	Strategy would need to be based on the National Climate Change Response Strategy (September 2004).	GEMF to initiate meeting and monitor progress of strategy development.	GEMF to engage National DEA and DEA&DP with the assistance of Knysna LM representative on the forum; The DEA is responsible authority in terms of climate change; within the next three years.	**Human** - GEMF executive to liaise with CapeNature and Knysna LM to approach National DEA and DEA&DP. **Financial** - costs for meeting (travel and venue) may be covered by KM.
Operational Objective LU6: Assess potential threat of sea-level rise, flooding, and storm events; TPC would be if such a strategy were not at least discussed with the authorities.				
RMA to engage with government to determine a way forward i.to. of	ICM Act	RMA to initiate meeting and monitor progress of	Within the next five to ten years. RMA, DEA, and	**Human-** RMA to liaise with DEA: O&C and DEA&DP: Environmental

Management actions	Legal requirements	Monitoring plans	Work plan	Resource plan
responding to potential threat of sea-level rise, flooding, and storm events on low-lying areas		negotiations.	DEA&DP are relevant parties.	management & Planning. **Financial-** no costs for strategy meetings.
Operational Objective LU7: Determine SANRAL's intentions for the access road to Buffalo Bay currently running through a lower floodplain; TPC would be if clarification were not received or if no bypass were to be built in future.				
Initiate a meeting with SANRAL to discuss options.	Government Gazette 213 of 1985. If bypass were to be built then controlling legislation would apply (e.g., EIA Regulations, ICM Act; NEM: BA and By-laws to a lesser extent).	RMA to initiate meeting and monitor progress of negotiations.	Not a priority; to be considered within the next five years. SANRAL, DEA&DP, CapeNature, DEA and Knysna LM are relevant parties.	**Human-** RMA to liaise with SANRAL, DEA&DP, DEA:O&C; CapeNature and Knysna LM: Strategic Services. **Financial-** no costs for facilitating meetings; costs covered by all attending parties.

5.1.5 Institutional & Management Arrangements

- Goukamma Estuary Advisory Forum (GEAF)
  That would act on behalf of stakeholders to engage government (at all levels) on planning and management issues. The TPC would clearly be the absence of such a Forum. Any such Forum needs to reflect the needs and aspirations of all stakeholders and should be based on democratic principles to represent all stakeholder groups and local, regional, and national government institutions. This would ensure that a cooperative and not a prescriptive approach to management would be adopted and should secure long- term commitment from government.
- Integration of estuarine and catchment management related processes.
  Essentially CMAs develop and implement strategies for water resource use, on behalf of its members, according to the NWRS; this would include the RQOs needed to manage water quantity & quality aspects of the EMP. The Goukamma estuary falls under the jurisdiction of the BGCMA. The TPC for the Goukamma catchments would be the lack of interaction between catchment and estuary associations. Such agencies or associations need to reflect the needs and aspirations of all stakeholders and should be represented by all civil society groups and local, regional, and national government institutions.
- Compliance by all government institutions and their staff with all legislation and regulations.
  The TPC would be if officials continued to be non- compliant.
- Co-operative government arrangements.
  Ensure that all arrangements between government departments with respect to administering legislation are made clear to all stakeholders, e.g., CapeNature's oversight of the MLRA, Municipal By-laws and Merchant Shipping Regulations implemented by DFFE, the Municipality and the South African Maritime Safety Authority (SAMSA) respectively. The TPC would be if stakeholders were not aware of who was responsible for administering legislation.
- Secure the funds from appropriate government departments and implementing agents required for priority management actions.
  CapeNature needs to ensure that individual agencies allocate resources, create and fill posts (including project champions), acquire necessary infrastructure, resources, and equipment, and confirm future budget allocation to fulfil their mandates. The TPC would be if government departments and implementing agents did not secure funds to fulfil management actions related to their mandates. Develop and implement the CapeNature Governance Tool.

Table 12. Management Actions for Institutional & Management Structures

Management actions	Legal requirements	Monitoring plans	Work plan	Resource plan
Operational Objective IMS1: Reconstitute the Estuary Advisory Forum; TPC would be the absence of such an institution.				
Reconstitute the Goukamma Estuary Advisory Forum (GEAF) so that all management issues pertaining to the management area can be discussed with all stakeholders and relevant authorities can be held accountable; integrate with Municipal Coastal Committee (MCC) and BGCMA.	ICM Act (Ch. 4), the Protocol	Monitor progress of RMA and ensure it fulfils its obligations; ensure integration with MCC and BGCMA.	Initiate immediately - assemble members and elect chairman and committee; constitute GEAF and set mandate and responsibilities. CapeNature will be lead authority and chair.	**Human-** CapeNature Protected Area manager and support staff; all stakeholders **Financial-** CapeNature **Governance:** CapeNature to develop and implement the Governance tool for the Goukamma Estuary
Operational Objective IMS2: Ensure the integration of estuarine and catchment management related processes; TPC would be if no integration and interaction existed between relevant institutions.				
Integrate BGCMA and GEAF activities through representation on both bodies by selected representatives (ideally respective chairpersons)	None that specifically deals with integration, but this is advisable to ensure effective cooperative governance from catchment to coast.	Ensure integration and keep record of number and types of projects or management scenarios that are resolved or addressed cooperatively.	Initiate immediately; integrate GEAF and BGCMA and identify opportunities to interact (interaction will primarily be about water quality& quantity and land-use issues). Institutions are themselves responsible for integration assisted by DWS. EMP to be embedded in CMS.	**Human-** BGCMA and GEAF chairpersons; assistance from DWS and RMA/ Knysna LM or CapeNature. **Financial-** DWS (RDM) and Knysna LM: Strategic Services.
Operational Objective IMS3: Compliance by staff with skippers' license requirements; TPC would be if rangers operated without the required license.				
All staff who will be conducting patrols and compliance monitoring to undergo certification.	Merchant Shipping Regulations (Section 10 of Marine Notice 13).	Ensure compliance.	Rangers to undergo inland skippers' course and examination. SAMSA is lead authority, but course and examination are delegated to accredited institutions or individuals. Initiate in first	**Human-** Authorities rangers; accredited service providers and SAMSA: Mossel Bay Office. **Financial-** each authority (R1100 per individual for course and certification).

Management actions	Legal requirements	Monitoring plans	Work plan	Resource plan
			year.	
Operational Objective IMS4: Appointment of an Estuarine Management Co-Ordinator within the RMA. The TPC would be if no official were appointed.				
Appointment of an Estuarine Management Co- Ordinator within the RMA to work closely with GEAF.	MSA (Ch.7, Sections 66,67 & 68).	Monitor process of appointment and activities.	RMA is responsible and this is a matter of urgency.	**Human-** CapeNature HR Services (Human Resources). **Financial-** CapeNature (annual salary of R200 000 plus running costs to perform duties @R50 000/annum).
Operational Objective IMS5: Secure funding for priority management actions from appropriate government departments and implementing agents; TPC would be if government departments and implementing agents did not secure funds to fulfil their management actions.				
Individual agencies to allocate resources, create and fill posts (including project champions), and acquire necessary infrastructure, resources, and equipment of fulfil their mandates, and confirm future budget allocations	A variety of legislation will apply depending on the authority and participating agencies	Monitor progress of discussions with relevant institutions	Within the first two year (negotiations and legalities may take time); the RMA can take the lead role.	**Human-** RMA to coordinate with all management authorities, government departments and participating agencies **Financial**- minimal costs for interaction and discussion.
Operational Objective IMS6: Inter-governmental department arrangements; TPC would be if stakeholders were unaware of arrangements and responsibilities.				
Inform stakeholders through the GEMF and media of all intergovernmental arrangements regards administration of legislation. Primarily refers to arrangements with CapeNature.	Various Acts make provisions for the responsibility of administering the Act to be devolved to agencies other than the prescribed lead agency.	GEMF to receive clarification from all relevant government departments with regards their responsibilities and delegated authority under specific legislation.	Initiate once GEMF has been established; GEMF executive, CapeNature can take the lead role.	**Human -** GEMF executive with CapeNature to consult all government departments that are key role players. **Financial** - no costs involved.

5.1.6 Sustainable Livelihoods

- Existing activities all comply with legislation, management plans and planning documents that regulate against potential impacts on the management area, its inhabitants, and users.

  The TPC should be a single activity that does not comply with legislation, management plans or planning documents. Baseline data would need to be acquired from a variety of sources including DEA&DP (for EA on developments; jetty and slipway licenses), the Knysna LM (for land-use authorizations and compliance with the SDF, IDP and By-laws), DWS (water quality), DEA, DFFE and CapeNature. Development (LED) structures in combination with civic-based organizations. An audit of all activities The TPC would be if no activities should be conducted by an independent assessor to determine compliance and the need for corrective measures. This objective includes aspects such as the issuing of licenses for operations such as fishing charters and commercial river cruises.
- Encourage the initiation of non-consumptive activities that involve previously disadvantaged communities (PDCs) and that comply with legislation, management plans and planning documents.

  Opportunities will need to be identified by the Municipality through their Local Economic Development structures in combination with CapeNature and civic-based organizations. The TPC would be if no activities involving previously disadvantaged communities were initiated and if those that were initiated failed to comply with legislation, management plans or planning documents.

Table 13. Management Actions for Sustainable Livelihoods

Management actions	Legal requirements	Monitoring plans	Work plan	Resource plan
Operational Objective SL1: Existing activities compliant with all forms of legislation and planning frameworks; TPC would be any activity not complying with these regulations.				
Engage relevant government authorities to address activities that do not comply with legislation and planning frameworks.	Applicable legislation is contained in the NWA (Sections 19 & 21); NEMA (Ch. 5; EIA Regulations); MLRA (Ch. 3); NFA (Ch. 3, Sections 1&2); ICM Act (Ch. 2, Section16; Ch. 3, Section 28); CARA (Section 6); NHRA (Ch. 2, Parts 1&2); NEM: BA (Ch. 4); NEM: PAA (Ch. 4), SDF/IDP; municipal by-laws and local management plans	Review all existing activities for compliance with legislation and planning frameworks; monitor all proposed new activities for compliance; monitor rehabilitation where applicable.	Initiate within first two years; RMA to advise municipality and government departments such as DEA&DP, DWS, DFFE and DEA irt applicable legislation and planning frameworks.	**Human-** RMA to engage government representatives from DEA&DP, DWS, DEA, and DFFE **Financial -** no costs.
Operational Objective SL2: Promote non-consumptive enterprises involving previously disadvantaged communities which are compliant with all forms of legislation and planning frameworks; TPC would be no new initiatives and non-compliance with these regulations.				
Engage community representatives, Knysna Municipality (LED initiatives) and civic organizations to identify opportunities and ensure they are compliant with all forms of legislation. Initiatives aimed at non-consumptive activities should be encouraged to alleviate pressure on living resources	Applicable legislation is contained in the NWA (Sections 19 & 21); NEMA (Chapter 5; EIA Regulations); NFA (Chapter 3, Sections 1&2); ICM Act (Chapter 2, Section 16; Chapter 3, Section 28); CARA (Section 6); NHRA (Chapter 2, Parts 1&2); NEM: BA (Chapter 4); SDF/IDP; Municipal By-laws and local management plans.	Monitor progress with regards initiation of new activities and their compliance with regulations.	Initiate within two years; Knysna Municipality (possibly CapeNature) and community leaders to engage all stakeholders (including DFFE) to identify opportunities and draft operational frameworks to ensure compliance.	**Human** - KM: Strategic Services (LED); DFFE: Coastal Livelihoods; community leaders; advice from CapeNature. Financial - KM: LED; National Government (poverty alleviation

5.1.7 Tourism & Recreational Use

- Actively market the Goukamma estuary as an eco- tourism destination by highlighting aspects such as biodiversity importance and recreational opportunities.
  Many tourism websites already highlight Goukamma, the greater Knysna area and the Garden Route as tourist attractions, but specific reference to the estuary is required. The area is aesthetically appealing and has a lot to offer both local and international tourists. The TPC would be if this did not happen.
- Promote organized sporting events in addition to the ones already taking place to increase exposure and attract visitors.
  The TPC would be if no new events (e.g., trail running, adventure racing, rowing, and swimming) were to take place or if existing ones were to stop.
- Implement all aspects of the EZP that apply to recreational use and enforce all legislation and Municipal Public Amenities and By-laws pertaining to recreational activities.
  The TPC would be if recreational users did not abide by the EZP (use areas) and contravened legislation and by-laws. (This aspect is covered under Conservation –Human Activities as well as Law enforcement).
- Regulation of boating.
  All petrol motors are not permitted on the estuary. All skippers should be in possession of a skipper's license and therefore be familiar with safety precautions and the rules of the road (right of way).

Table 14. Management Actions for Tourism & Recreational Use

Management Actions	Legal Requirements	Monitoring Plans	Work Plan	Resource Plan
Operational Objective T1: Recognition of the Goukamma management area as a premier eco-tourism destination; TPC would be if this were not to happen.				
Lobby Knysna LM tourism to market the area on their website and in brochures; lobby tourist operators, guesthouses / B&Bs, Plett Chamber of Business and local media to promote the area on their websites and in their publications.	None.	Monitor websites, tourism office, tourist facilities and local newspapers for information, brochures, articles etc.	Initiate over a three-year period. RMA to advise Knysna LM tourism, tourist industry, local media, and Knysna Chamber of Business.	**Human**- RMA, representatives from tourism industry and Knysna LM: Tourism, editors of local media publications and Knysna Chamber of Business. **Financial**- No significant cost to RMA (e-mail, phone calls, internet searches); Knysna LM: Tourism; advertising in media.
Operational Objective T2: Promote organized sporting events; TPC would be if no additional events took place or if existing events were cancelled.				
Knysna LM to promote the area as a sporting venue and ensure safe and healthy environment; engage sporting organizations.	None per se but aspects detailed in water quality actions will apply indirectly here as well.	Monitor number of new events being held. Need to ensure events remain low impact.	Initiate over a three-year period. Knysna LM to interact with sports bodies; safe and healthy environment needs to be ensured (see water quality actions; W2 and W3).	**Human-** Knysna LM: Community Services (Parks & Recreation) and sporting bodies. **Financial-** costs to host events covered by sporting bodies, Knysna LM (Community Services) and sponsors.

5.1.8 Education & Awareness

- Educational workshops hosted by the GEAF should be organized at least once a year to educate local authorities, in particular town planners, municipal managers, and estuary managers about the value of the management area, the EMP and its context within planning strategies, key legislation, and the consequences of irresponsible development within the management area.

  Potential TPCs would be no workshops, poor attendance at workshops and ongoing poor decision making with regards issues affecting estuaries (e.g., water abstraction for golf estates that threatens the Ecological Reserve). A simple questionnaire for local authorities would provide baseline data as to their current awareness level with regards estuarine management.

- An interactive public awareness campaign should be introduced and aimed at all user groups and age groups.

  The TPCs would be a lack of easily accessible information (sign boards, pamphlets), poor attendance of workshops or environmental awareness lectures by target groups (e.g., school groups, estuary users and fishermen) and a general poor level of understanding of estuaries and associated legislation by the public (this latter aspect would be reflected in the reduction of non-compliance incidents and would continue CapeNature's aim to educate rather than fine first-time offenders). Baseline data should comprise the extent of visual aids within the estuarine area, public interaction with the RMA and the local GEAF and level of knowledge of regulations (e.g., recreational fishing regulations). Organizations such as WESSA, WWF-SA, GRBR can be approached to assist with interacting with DEA to raise awareness.

- Tertiary and research institutions as well as government departments need to be involved in research projects that will address specific management concerns, monitoring requirements and gaps in knowledge.

  The TPCs would either be a lack of research, a decrease in the number of research projects or the continued lack of data required to inform monitoring programmes. Baseline data should comprise the number of tertiary institutions involved in research, the areas of research and the aspects that need to be addressed through directed research.

Table 15. Management Actions for Education & Awareness

Management actions	Legal requirements	Monitoring plans	Work plan	Resource plan
Operational Objective EA1: Initiate educational workshops on the value of the management area, its context within planning frameworks and legislation and consequences of poor decision making; TPCs would be no workshops, poor attendance or continued poor decision making that affects estuaries.				
Initiate series of workshops with help from DEA, DWS, DFFE, DEA&DP, Knysna LM, and organizations such as WESSA.	White Paper for Sustainable Coastal Development (Section C, Ch.10); ICM Act (Ch. 5, Section 38).	Keep record of number of workshops and attendance by government department and Knysna LM staff; participants to submit to a questionnaire to test awareness, understanding and effectiveness of workshop.	Initiate over a two-year period; ongoing. DEA is responsible for marine / coastal education on a national level, but the workshops can be hosted by the RMA/Knysna LM, GEAF, or WESSA.	**Human-** DEA: Environmental Quality & Protection and O&C and CapeNature; participating government and municipal staff; WESSA; specialists from tertiary & research institutions. DEA&DP coastal education and awareness programme **Financial-** primarily DEA and CapeNature
Operational Objective EA2: Develop and enable an interactive public awareness campaign; TPCs would be no visual aids, lack of public interest and poor level of understanding of estuaries and the regulations that govern their well-being.				
Ensure visual aids (notice boards) are erected at key-points (launch sites and resorts); host school/tourist groups for interactive tours of the management area; educate fishermen about regulations during compliance monitoring patrols (verbal and pamphlets); utilize CapeNature eco- tourism facilities for education workshops or awareness initiatives.	White Paper for Sustainable Coastal Development (Section C, Ch.10); ICM Act (Ch. 5, Section 38).	Monitor placing of notice boards and ensure their content is relevant to the Goukamma management area scenario; provide school groups and public (distribute through organizations or clubs) with a questionnaire to determine effectiveness of the programme.	Initiate over a two-year period. DEA is responsible for education on a national level (CoastCare Programme) and should coordinate visual content of sign boards with CapeNature and Knysna LM; GEAF, WESSA and GRBR can host school and tourist groups at eco-tourism facilities in CapeNature; fisheries inspectors and voluntary compliance officers to educate fishermen.	**Human-** DEA: Environmental Quality & Protection and O&C to supply notice boards with Knysna LM (Environmental Officer) and CapeNature input; WESSA, GRBR; specialists from tertiary and research institutions. **Financial-** primarily DEA; investigate corporate sponsorship; cost of additional signage R50 000.

5.1.9 Restoration of estuary mouth and associated dune system

- Identify knowledge gaps with regards to dune management in the mouth area of the Goukamma Estuary. The TPC will be triggered if this gap analysis process is not initiated and will also be triggered if no follow up research and monitoring takes place
- Source existing data to support decision making.
  The TPC will be triggered if no data exists and no process is initiated to access new data.
- Arrange a specialist mouth management workshop to assist with the development of a mouth management protocol. The TPC will be if this workshop is not organized, a mouth management protocol is not developed and in the event of artificial mouth management processes being proposed, a submission of an Estuary Mouth Maintenance Plan to DEA&DP is not carried out.
- An informative public awareness programme needs to be set up to keep members of the public and stakeholders (including the GEMF) informed.
  The TPC will be if no public participation process is set up and the public are not made aware of available information and decision-making processes.

Table 16. Management actions plans for estuary mouth and dune restoration strategic objectives

Management actions	Legal requirements	Monitoring plans	Work plan	Resource plan
Operational Objective EDR1: Understand the dune ecosystem and its impact on sand movement and the estuary mouth; TPC would be if this were not to happen.				
Identify knowledge gaps with regards to dune management in the mouth area of the Goukamma Estuary. Source existing data to support decision making and set up research programmes to address any data gaps	Need to apply legislation when managing dune systems (e.g., EIA Regulations, ICM Act; NEM:BA and By-laws to a lesser extent).	Monitor system and develop required research and monitoring programmes. Make informed management decisions.	Initiate over a three-year period. GEAF executive to interact with CapeNature, Knysna Municipality, DEA&DP, specialists.	**Human** - CapeNature, Knysna Municipality and GEAF executive, and specialists to assess situation and develop a clear way forward. **Financial** - Once identified, the costs of monitoring and research need to be covered.
Operational Objective EDR2: Develop an estuary mouth management protocol; TPC would be if no additional events took place or if existing events were cancelled.				
Set up a specialist workshop aimed at developing a Goukamma Estuary mouth management plan and associated MMP. CapeNature has developed a MMP	Need to apply legislation when managing dune systems (e.g., EIA Regulations, ICM Act; NEM:BA and By-laws to a lesser extent).	Carry out the required monitoring protocols that will inform the outcomes of the mouth management workshop	Set up the mouth management workshop in 2014.	**Human** - CapeNature to drive this process. DEA&DP to gazette for public comment **Financial** - costs to host workshop

5.1.10 Research and monitoring

- Research projects aimed at enhancing the existing knowledge and filling in knowledge gaps of the Goukamma Estuary need to be identified and implemented.
  The TPC will be realized if no research gap analysis is carried out and no research institutions are contacted to make them aware of the research priorities
- Funding to support research is critical.
  The TPC will be reached if no funding is sourced for the top three priority research projects within 12 months of the approval of this EMP
- Monitoring programmes are needed to provide data upon which decision making and management interventions are based.
  Priority monitoring programmes need to be identified and implemented. The TPC will be reached if no assessment of required monitoring takes place and a further TPC will be triggered if no monitoring programmes are initiated within 12 months of the approval of this plan.

Table 17. Management action plans for research and monitoring

Management actions	Legal requirements	Monitoring plans	Work plan	Resource plan
Operational Objective RM1: Research projects need to be identified and implemented. TPC would be if no research were identified and conducted.				
Identify key areas where research efforts should be concentrated (e.g., water quality & quantity; fishery survey; rehabilitation areas/methods; actively engage government and tertiary & research institutions to initiate projects.	None	Monitor progress of all research activities concerned with the Goukamma management area and ensure that outcomes are practical and effectively used in long term monitoring programmes that will guide the implementation of the EMP.	Initiate immediately; CapeNature can interact with government and tertiary & research institutions (includes SANCOR and NRF facilities). Government departments such as DWS and DEA may initiate projects on their own and institutions such as CSIR and SAEON can be involved in long term monitoring projects. Members of organizations such as Environmental Forums and Conservancies can also participate in monitoring programmes.	**Human-** CapeNature to liaise with government departments and partners to identify research needs in cooperation with tertiary institutions. **Financial-** major research programmes are funded from a variety of sources- may be direct from government departments or through institutions such as the NRF, CSIR or SANCOR; corporate sponsors may also be approached.
Identify priority monitoring programmes required to make effective management decisions. Market monitoring opportunities and projects at research institutions and source funds for priority monitoring.	None.	CapeNature has an eco-matrix which identified research and monitoring projects.	Initiate over a three-year period. GEMF executive to interact with tertiary institutions to market research priorities.	**Human** - GEMF executive and CapeNature to drive this process **Financial** - No significant cost to GEMF (e-mail, phone calls, internet searches); Funds will be needed once research priorities have been identified - donor funds can be sourced.

5.1.1 Environmental disasters

- A Disaster Management Plan (DMP) must be developed for the estuary.
  The TPC will be realized if the DMP is not developed within 12 months of the approval of this plan.
- The estuary DMP needs to be integrated into the Local and District Municipality Disaster Management plans.
  The TPC will be triggered if this does not happen within 12 months of the approval of this plan.
- The existence of local capacity to implement Disaster Management Plan is essential.
  A formal capacity development strategy needs to be developed within six months of the approval of this plan. This should include the updating of all contact details and procedures. The TPC will be triggered if this strategy is not completed within six months of the approval of this plan

Table 18. Management action plans for environmental disasters

Management actions	Legal requirements	Monitoring plans	Work plan	Resource plan
Operational Objective ED1: Recognition that environmental disasters occur, and the Management Authority needs to be prepared for these; TPC would be if this were not to happen.				
Ensure that a Disaster Management Plan is developed for the estuary and ensure that this plan is integrated into the Local and District Municipality Disaster Management plans and contains updated contact and communication details. Capacity needs to be developed to implement these plans.	NEMA, National Disaster Management Act.	Early warning systems need to be developed, e.g., Weather SA; Eden District DM Office, Knysna M DM Office	Immediate effect and needs to include all role players (National, Provincial and Local Government)	**Human** - GEAF executive, DEA, DEA&DP, DM, KM, specialists **Financial** - DM processes cover costs

6 SPATIAL ZONATION

Management objectives for the Goukamma estuary have been translated into an Estuarine Zonation Plan (EZP) and applicable operational objectives which provide further detail to the management objectives described above. However, this is not applicable to all management objectives, as clearly the EZP cannot include the strategies for aspects of water quantity & quality, education & awareness programmes, institutional & management structures, and sustainable livelihoods. As such, the EZP mainly reflects the objectives devised for living resources & conservation and land use & infrastructure.

6.1 Estuarine Zonation Plan

The spatial zonation of the Goukamma estuary is represented visually in Figure 4 - Figure 7 and comprises the following:

6.1.1 Estuarine Boundaries

Historically, the C.A.P.E. Estuaries Programme considered the NWA definition of an estuary as the most appropriate. It reads as follows; "*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*."

For the purposes of determining the Resource Directed Measures (RDM), DWS defines the geographical boundaries of an estuary as follows; "*the seaward boundary is the estuary mouth and the upper boundary the full extent of tidal influence or saline intrusion, whichever is furthest upstream, with the five meter above mean sea level (MSL) contour defined as the lateral boundaries*."

The ICM Act further 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".

The 5 m topographic contour encapsulates the Estuarine Functional Zone (EFZ), which in turn is defined by 2014 EIA Regulations (GNR 985) under the National Environmental Management Act (NEMA 1998) 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…*". In this way, certain activities are not permitted within an estuary without prior Environmental Authorisation. It provides a useful guideline for a coastal management line, as much of the land below this mark is currently subject to flooding or may be in the future due to climate change (sea-level rise and increased flooding). Although the 5 m contour falls well within the 1 000 m Coastal Protection Zone (CPZ); it must be included in all

planning documents. The EFZ of the Goukamma system is depicted below in Figure 6.

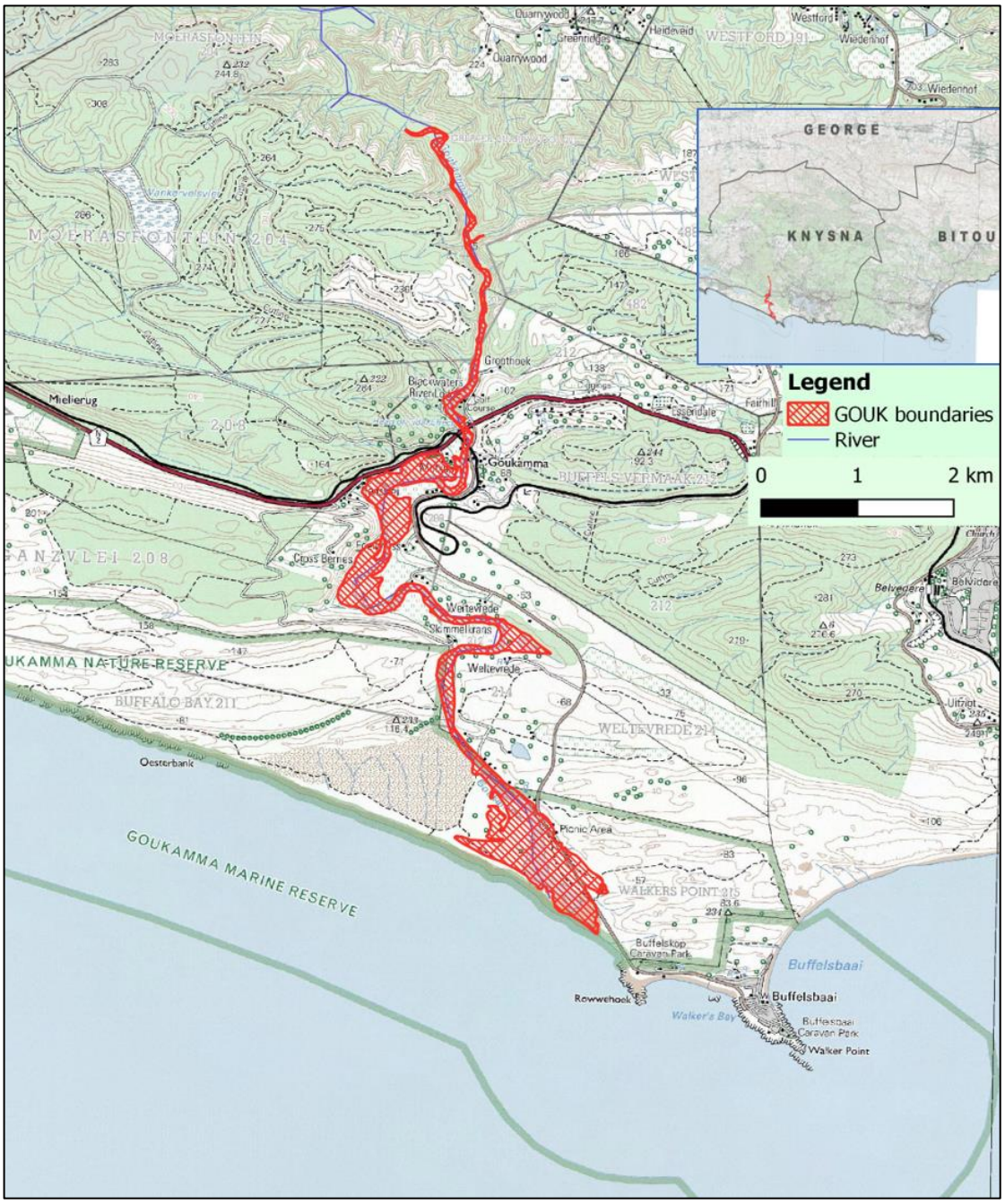

Figure 6. Map of the geographical boundaries of the Goukamma estuarine system according to 5m topographical contour and defining the EFZ (SANBI National Estuaries Layer).

For the purposes of this EMP, the geographical boundaries of the tidal portion of the Goukamma estuary have been defined in terms of the NWA definition, with the terrestrial management component being defined by the extent of the CPZ as defined in the ICM Act.

6.1.2 Coastal Protection Zone and proposed Coastal Management Line

The ICM Act defines a default **Coastal Protection Zone (CPZ)** which, in essence, consists of a

continuous strip of land, starting from the HWM and extending 100m inland in developed urban areas zoned as residential, commercial, or public open space, or 1 000m 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. In essence, if the Goukamma Estuary is embedded in the MPA this will not be required.

The Provincial 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 Eden, as per draft delineations recommended in the Coastal Management Lines for the Eden District project (WCG, 2015), the CPZ is informed by a coastal risks zone approximated by the **5m above msl contour or 1:100yr flood line** around an estuary, whichever is wider. In respect to the latter, flood lines serve as important guidelines for land-use and town planning, in that they indicate areas of high risk where development should not be allowed. Not only must future town planning schemes take these into account, but they would also provide an indication to landowners with regards existing activities or structures that are at risk.

The ICM Act 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 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 above msl contour or 1:100yr flood line, whichever is wider, to differentiate a zone where formal development should be discouraged.

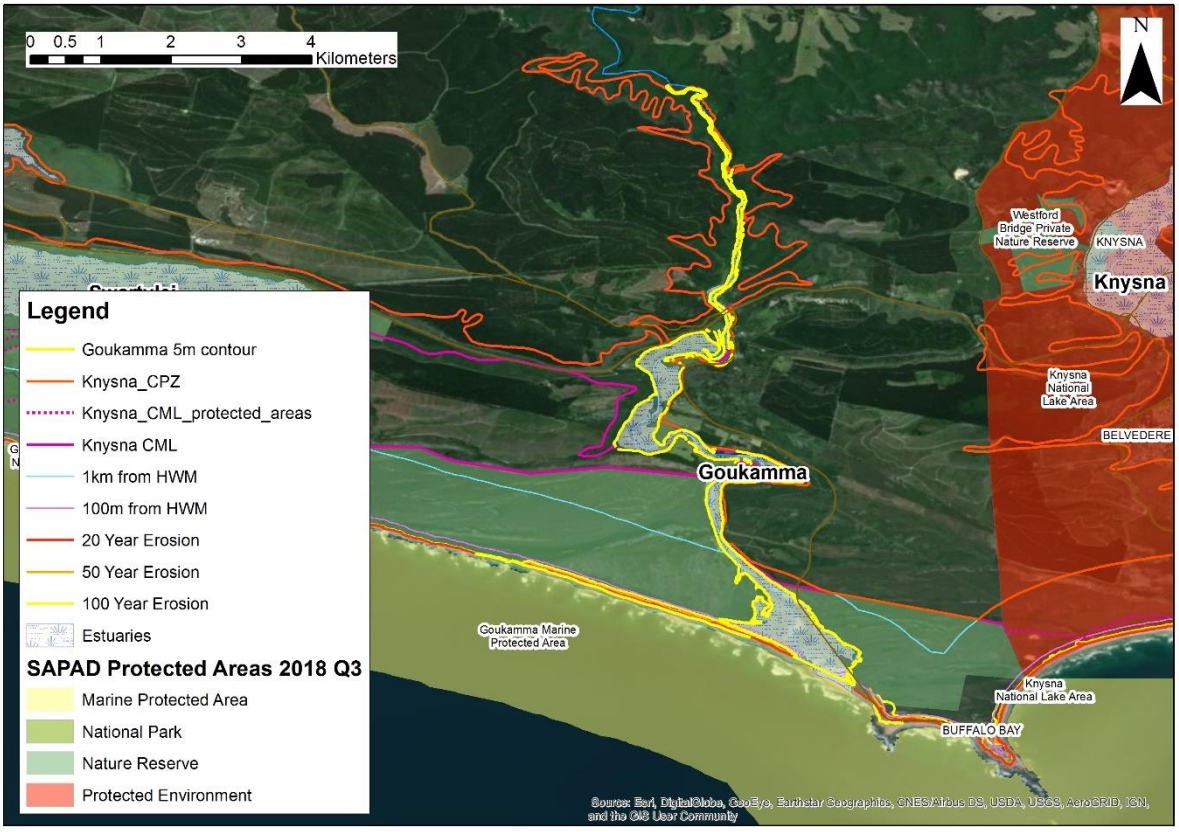

Figure 7. Proposed Coastal Management Line for consideration in future park planning processes (WCG, 2015)

It must be made clear that these zones are designed to restrict certain activities that may interfere with the estuary and its sensitive riparian areas, but it does NOT mean that no activities may take place. Activities that should be restricted, or at least assessed prior to authorization are those listed in the NWA that require a license (e.g., water use), the EIA Regulations (see Government Notices R386 & R387) and those affecting sustainable development and sensitive ecosystems as defined in the principles of Chapter 1 (Section 2) of the NEMA. These zones do NOT indicate that landowners may not operate within their boundary, i.e., they do not lose this land, but they must adhere to sound environmental principles when conducting any activities. In terms of ICMA, no privately owned land can be expropriated unless there is some form of compensation (see ICM Act Section 9), and only for the purpose of extending the coastal public property zone, i.e., this does NOT apply to the 100- and 1 000-meter CPZ areas. The CPZ may be extended beyond the 100 and 1 000 m limits if circumstances dictate that it will be beneficial to the environment or affected habitat.

6.1.3 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[13] rather than the coastal management lines described in ICMA. 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 setbacks 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 authorization 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 full-blown EIA. In some cases, however, a development set-back line (Coastal Management 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 Department of Environmental Affairs.

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 setbacks 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 do not 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 activity will apply. For example, the beach in front of seafront houses is not considered 'built-up' and environmental authorizations will be required to execute any listed activities on that beach.

6.1.4 Protected & Conservation Zones

The current Marine Protected Area Expansion process (CapeNature 2014) has motivated for the inclusion of the Goukamma Estuary as part of the Marine protected Area. At present 30% of the estuary is within the Goukamma Provincial Nature Reserve. No formal management regulations exist. The harvesting of marine living resources is based on regulations implemented by the National DFFE permitting process. There is a strong feeling amongst stakeholder that the conservation status of the estuary needs to be increased (Stakeholder meeting, March 2014).

[13] The Environmental Impact Assessment Regulations, 2014, published under Government Notice No. 982 in Gazette No. 3822 of 4 December 2014, in terms of sections 24(5) and 44 of the National Environmental Management Act, 1998 (Act No. 107 of 1998)

The estuarine area that falls outside of the Provincial Nature Reserve has no conservation status at present. As part of the MPA Rezoning process it is proposed that the estuarine area below the high-water mark, currently public property, is included in the expanded MPA. The estuary will become a controlled zone within the MPA which will allow management strategies and regulations to be developed to address estuary use.

The proposed MPA extends from the mouth up to approximately 9.2 km upstream and includes the banks of the estuary where sensitive and conservation worthy estuarine vegetation occurs. The MPA is divided into three zones as follows:

Zone 1 (Proposed MPA Controlled Zone) extends from the mouth to 3.3km mark and from the middle of the estuary channel up to the high tide mark. This area includes other conservation worthy flora and fauna and will be set aside for low intensity recreation and ecotourism. Disturbance to avifauna and other wildlife and vegetation will be minimized through imposition of restrictions as for Zone A (minimum height restriction for aircraft and a ban on the use of motorized transport). Pedestrian access should also be restricted to established paths and board walks only. Bird hides, boardwalks and clearly demarcated paths need to be established in this area to facilitate and promote ecotourism activities in this zone. Non-motorized boats will be allowed.

Zone 2 (Proposed MPA Restricted Zone) extends from the 3.3kms mark upstream to the boundary of the estuary (9,2km) and from the middle of the estuary channel up to the 5m contour line. This area is proposed a fish, bait (invertebrate) and water bird sanctuary. Catching or collection of fish and bait species (invertebrates) will not be permitted in this area. Disturbance to avifauna will be minimized through a minimum height restriction for aircraft (minimum altitude 1 500 m), and a ban on the use of motorized transport (ORVs, motorcycles and quad bikes). Pedestrian access will be restricted to established paths and board walks only.

Zone 3 (Terrestrial Zone or estuary functional zone) extends from 3.3kms mark upstream to the 9.2km mark and includes the channel and banks of the estuary between the high tide mark and the 5m contour line. This includes privately owned land. The management planning process will endeavor to develop best practice agricultural processes in this area (e.g., CARA). This area should be set aside for medium intensity recreation and ecotourism activities. Disturbance to avifauna and other wildlife and vegetation will be minimized. This area should act as a corridor between the coastal area and the inland habitats. Pedestrian access should also be restricted to established paths and board walks.

Restricting the use of petrol or diesel boat engines to management and research use only will also minimize disturbance to wildlife and the wilderness atmosphere on the system without overly restricting ability of visitors to enjoy the benefits thereof. It may be necessary, though, to provide exemptions for certain uses, provided these are kept to a minimum and are properly motivated (e.g., management and enforcement, tourism operators).

Boundaries between zones must be re indicated in the finalized zonation map and will be clearly demarcated on the ground with beacons and signage, indicating what

restrictions are in force in each zone of the estuary.

Examples of activities that would need to be controlled or restricted to specific areas include swimming areas, organized sporting events, building of jetties, slipways, and other permanent structures (developments), bird watching and access to the water's edge (estuary and coastal) for people and vehicles.

No-swimming zones

- No swimming in other designated activity areas
- No swimming within 10m of any jetty, ponts or slipway.
- No swimming between the CapeNature gate and the mouth area when the mouth is open. This is for safety reasons as people may be swept to sea with the outgoing tide.

Jet-skis

No jet-skis are currently allowed to operate on the Goukamma Estuary.

Motorized vessel areas

No motorized vessels may operate on the Goukamma Estuary.

Organized sporting events

The revised Municipal By-laws and the CapeNature regulations need to stipulate where and when organized sporting events may take place.

Angling

Angling, with a valid saltwater license, may take place anywhere within the permitted area within the Goukamma estuary. It is recommended that the revised CapeNature regulations/ Municipal By-laws include the following provisions:

- No fishing from any bridge over the estuary
- No fishing line may be left unattended
- No spearfishing

Jetties and slipways

All existing jetties and slipways are indicated on the EZP. The construction/maintenance (repair after storm/flood damage), location and leasing of jetties and slipways should be done in accordance with NEMA and the EIA Regulations, Seashore Act (until repealed), ICMA and revised Municipal By-laws. See Section 4.4 for a more detailed description of the issues surrounding slipways and jetties.

6.1.5 Rehabilitation Zones

Rehabilitation, primarily in the form of dune and mouth management processes, alien vegetation removal (estuary and catchment area), bank rehabilitation in the area where the access road is being eroded away, general best practice stabilization processes, rehabilitation of flood damaged structures and improving degraded wetland areas will need to be

addressed.

Additional data is required to be able to make management decisions with regards to the management of the dune systems in and around the estuary mouth. Specific mouth and dune management protocols need to be developed and implemented within this specific rehabilitation zone.

Although the removal of alien vegetation within the riparian area is seen as a priority this must not be done to the detriment of bank stability. Sections of the Goukamma Estuary, where the access road crosses the flood plain and where farming practices are taking place in the flood plain show signs of erosion and collapse. While floodwaters are largely responsible for this, the situation may have been exacerbated through the initial removal of stabilizing vegetation. There are some sections where alien removal has been done, but an agreement between landowners and DEA needs to be reached whereby landowners can undertake to remove aliens using their own resources provided funding is made available. The removal of debris after clearing must be stressed, otherwise it accumulates and poses a potentially catastrophic destructive force when carried downstream by floodwaters.

Areas within the CapeNature recreational site have been damaged by floodwaters and need to be repaired.

The predicted rise in sea-level combined with freshwater floods and extreme storm events is likely to place much of the existing low-lying areas (developed and undeveloped) within the management area under threat. As water levels rise and floods become more frequent or severe, actions such as rehabilitation, constructing berms or sea walls, realigning access and residential roads and relocating infrastructure (sewerage, electricity, and telecommunications) may suffice over the short term, but ultimately a relocation strategy may need to be considered for the long term. This should be considered within the context of the Municipal IDP and in the framework of a Disaster Management Plan.

All designated CBAs should be regarded as rehabilitation zones as past activities have led to the degradation of the habitat to some degree.

6.1.6 Eco-Tourism Nodes

An established eco-tourism node has been located near the mouth by CapeNature. This is managed as a formal tourism facility. An additional accommodation facility and golf course in the upper stretches of the estuary exists. The rest of the estuary is bordered by agricultural land.

7 IMPLEMENTATION

7.1 Institutional Arrangements

7.1.1 Key Role Players

It is essential that this EMP is regarded as a strategic plan that can guide the detailing of implementation actions and identification of implementing agents. Therefore, it does not specify the required resources (human and financial) required for proper management of the estuary. However, it does 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. **This will be tracked using the CapeNature Governance Tool.**

Co-management and effective governance have been identified as a vital aspect to the efficient and effective management of the Goukamma estuarine system. Figure 8 displays the key role players that should be included in its management.

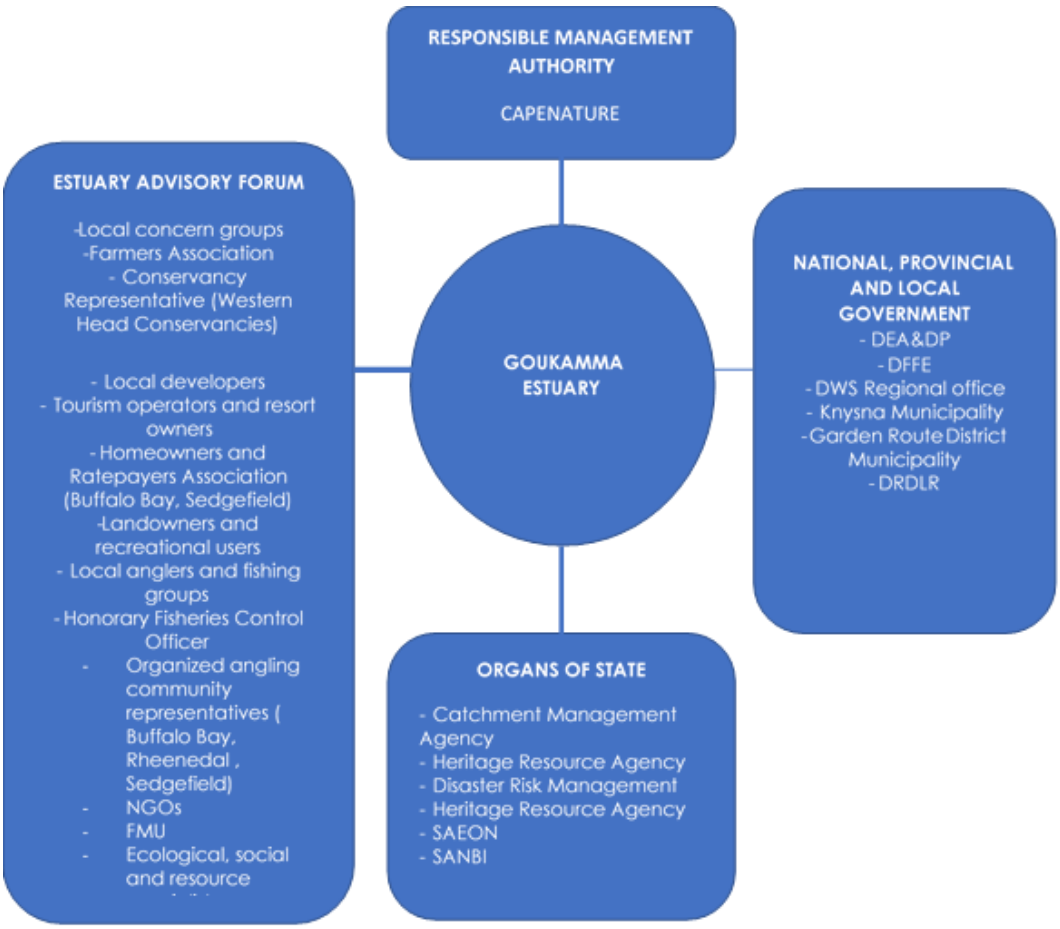

Figure 8. Key role players for the management of the Goukamma estuary system

Figure 8: Key role players for the management of the Goukamma estuary system

7.1.2 Responsible Management Authority

The Protocol identifies **CapeNature**, or its assigned representative, as the **Responsible Management Authority (RMA)**, responsible for the development of the Goukamma EMP as well as being responsible for the co-ordination of its implementation. **CapeNature** is already responsible for the management of the Goukamma Nature Reserve and for many aspects of estuarine management. The Knysna Municipality and CapeNature should come to agreement via a signed Memorandum of Understanding to co-manage the estuary. Implementation of the EMP can be affected through a range of different forums and agencies. The RMA should hold the responsibility of chairing and facilitating the Estuary Advisory Forum meetings.

7.1.3 Goukamma Estuary Advisory Forum

According to the Protocol, the role of the **Goukamma Estuary Advisory Forum (GEAF)** is interpreted as providing an advisory service to the RMA on issues specific to the management and implementation of the EMP, as well as being the hub that links all stakeholders, which serves to foster stakeholder engagement and to facilitate the implementation of the project plans identified.

The broader **community** will be able to voice concerns and raise issues via the GEAF. This includes Ratepayers' Associations, NGO's, community groups, conservancies, etc., and representatives from surrounding industry and agriculture. Local members will play an invaluable role in providing on the ground, local insight, and support to the authorities. Any representatives are obliged to raise issues identified by their constituents and to provide feedback to the constituents. Importantly, the Forum will not represent or supplant the individual positions of its members unless specifically mandated to do so.

More specifically, the GEAF should consist of the following:

1. A **chairperson** representing the RMA who will take the lead in coordinating and facilitating the forum;
2. **Government Representatives** of the major management sectors/areas with executive powers in terms of respective legislation:
    a. Conservation & Living Resources;
    b. Land-use and infrastructure development;
    c. Water quantity and quality; and
    d. Social (and cultural) issues.
3. Representatives of all the above **remaining institutions and interest groups**. Existing institutions such as CMAs, WUAs or catchment forums and conservancies may be used instead of establishing a new separate forum, but these would need to be expanded to include representatives from all interest groups.

The GEAF serves to keep all stakeholders informed of the progress and effectiveness of the EMP, identifies areas of concern and makes management recommendations that may need to be incorporated into the EMP, liaises with government departments, through the RMA, to ensure they fulfil their legal obligations and interacts with tertiary and research institutions to help coordinate research programmes. The principal functions of the GEAF may include:

- Promoting co-operative governance between stakeholders;
- Providing the platform to voice concerns and raise issues;
- Assisting the RMA leveraging funding for implementation of various actions and project plans;
- Motivating for supportive legislation (by-laws) for estuarine management;
- Disseminating information and providing feedback to stakeholders on estuary-related issues; and
- Promoting environmental awareness and capacity building regarding estuarine issues.

The GEAF and its members may also be directly involved with monitoring programmes by collecting data (physical measurements or visual observations) and can act as the eyes and ears for law enforcement authorities. All members of the GEAF must be provided with a list of contact numbers for government department representatives who have the mandate to act so that they may be contacted whenever stakeholders observe activities that do not comply with the EMP requirements.

7.1.4 Government Departments and Organs of State

The successful implementation of the Goukamma EMP may be seen as also dependent on the contribution of several governmental role players, including:

- CapeNature as Responsible Management Authority is responsible for general conservation in the region, including the Goukamma Nature Reserve, biological monitoring, compliance management and facilitating rehabilitation;
- Knysna LM, and Garden Route DM: Responsible for fulfilling key municipal roles, 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, and monitoring (e.g., DEA&DP, Department of Transport and Public Works, etc.);
- Relevant National Government departments especially DEA, DWS (via the regional office), DFFE, Department of Rural Development and Land Reform (DRDLR); and Department of Science and Technology (DST); and
- Organs of State, such as BGCMA and the CSIR.

The DEA is responsible for national standardisation of estuarine management and approval of provincially led EMPs. Direct involvement in individual estuaries, such as the Goukamma system, will occur via existing forums for intergovernmental coordination. These forums will

have the management of the various estuarine systems on their agenda from time to time.

- The Garden Route District 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.

A crucial element towards achieving the vision and objectives of this plan, 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 to 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.

7.2 Recommend Priority Actions

It is the recommendation that the following MAPs be implemented as a matter of **high priority**:

- Establish a GEAF that is democratic and representative of all stakeholders, interest groups and government departments.
- Ensure that the EMP is accepted by CapeNature, the Municipality and the MEC, and then Gazetted and incorporated into the Municipal SDF and IDP frameworks.
- Coordinate a meeting with relevant stakeholders to resolve the issue surrounding the access road.
- All aspects related to water quality and quantity except W8 (the abstraction of water below the DWA measuring station is of particular concern).
- Determine the carrying capacity of the estuaries in line with the Vision.
- Land-use & infrastructure MAPs LU1, 2, 4 & 5.
- Compliance monitoring in respect of living resources.
- Increase CapeNature's capacity for compliance monitoring and encourage volunteers to be trained and appointed as HFCOs.
- Evaluate the need for a formal arrangement between Knysna Municipality and CapeNature for administration of By-laws and EZP.
- Initiate the process required to develop the Goukamma Estuary to Catchment Corridor.
- Inform stakeholders of inter-governmental arrangements pertaining to administration of legislation.
- Identification of research requirements.
- Incorporate the Goukamma estuary into the MPA or a Provincial Nature Reserve
- Establish the zoning of the estuary in accordance with the EZP

The following MAP should be considered **medium priority**:

- Develop or amend existing CapeNature regulations and Public Amenities By-laws (reference to management area, control of human activities, inclusion of EZP, etc.).
- Compliance with EZP and amended By-laws.
- Identification of monitoring and research requirements (priority must be given to sustainability of resources; and the effects of poor water quality on ecosystem health and functioning).
- Protection and rehabilitation of estuary banks and wetlands (includes establishing a buffer zone in cooperation with landowners and protection of riparian zone).
- Inform stakeholders of all ongoing and planned conservation initiatives.
- Secure funding from locally generated revenue.
- MAPs for sustainable livelihoods (compliance of existing activities and identification new activities to benefit PDCs).
- Educational workshops and public awareness campaign.

The following MAPs should be considered **low priority**:

- Equitable and controlled access to Coastal Public Property.
- MAPs for tourism & recreational use.

The following MAPs are a **lower priority** and can be addressed within the timeframes indicated:

- Regulation of existing livelihoods and the identification of additional opportunities involving members of previously disadvantaged communities within the **next four years**.
- Develop the eco-tourism nodes
- within the terrestrial reserves over the **next five years**.
- A fishery survey (comprising both fish and bait aspects) should be conducted **every five years**.
- Identification, evaluation and protection of heritage and cultural resources within the **next five years**.
- Determine SANRALs plans for the access road over the **next five years**.
- Investigate the feasibility of conducting a comprehensive reserve assessment (this may need to take place over a **five-year period**).
- Regulation of fishing competitions (number and format) if these are allowed in the future.
- Enforce compliance by developers in respect of the ROD conditions as they become available.
- Address illegal netting and fishing in the estuary

The EMP in its current form will be reviewed **after five years**. It will be the responsibility of the GEMF executive team to produce a State-of-the-Estuary Report, which essentially involves revisiting the Situation Assessment and Evaluation that was performed in Phase I of this project. This will be followed by a round of revision and/or refinements of the Objective-setting and Implementation phases as and where necessary, e.g., it may be necessary to adjust aspects of a MAP or monitoring programme.

8 INTEGRATED MONITORING PLAN

8.1 Monitoring

There are two components to monitoring, namely baseline measurement programmes and long-term monitoring programmes, and it is important to note the difference between them in the context of the EMP framework (Taljaard & van Niekerk 2007b).

8.1.1 Baseline measurement programmes

Baseline measurement programmes usually refer to short-term or once-off, intensive investigations of a wide range of parameters to obtain a better understanding of ecosystem functioning; they may also involve the investigation of non-ecological data to determine an existing situation with regards to compliance, land-use patterns, institutional & management structures, alternative livelihoods, and education & awareness initiatives. These programmes would normally be a part of the Situation Assessment and the Objective-setting Phases within the framework. In the context of this EMP, baseline data is required to determine the state of many issues in relation to the TPCs described in the action plans.

A detailed description of the baseline requirements, spatial and temporal scales, required resources and sampling & analysis techniques with regards the TPCs referred to in the action plans is provided in Appendix 3 (see McGwynne & Adams 2004 for rational behind monitoring). Baseline monitoring programmes are not required for all aspects of the EMP, e.g., identification and evaluation of heritage resources and the management actions for the Institutional & Management Structures section. Some aspects of these baseline programmes, e.g., *cpue* and population (invertebrates and birds) monitoring will also form part of long-term programmes (see below).

8.1.2 Long-term Resource Monitoring

Long-term monitoring refers to ongoing data-collection programmes that are done to evaluate continuously the effectiveness of management actions within action plans that are designed to maintain a desired environmental state. Data from these programmes are used to determine or anticipate when particular TPCs have been or will be exceeded so that responses to potentially negative impacts, including cumulative effects, can be implemented in good time. Long-term programmes usually involve biotic and abiotic components concerned with the bio-physical aspects such as water quantity & quality, conservation and living resources. However, accumulated data from baseline programmes associated with land-use & infrastructure, management & institutional structures, sustainable livelihoods, and education & awareness can be analysed over the long-term as well to ensure that the Vision for the Goukamma management area is achieved and maintained. Long-term programmes often form part of detailed scientific surveys or research projects conducted by tertiary and research institutions, but they may also take the form of less complex initiatives such as records of compliance with legislation and records of activities in the context of the EZP or Municipal By-laws.

The long-term monitoring programme described in Appendix 4 (Table 26) was initially developed to determine the requirements for the Ecological Reserve and then to assess the effectiveness of the prescribed reserve (see Taljaard & Van Niekerk 2007a). However, in most instances data from this programme can also be used as indicators of other management concerns where the ecological reserve specifically is not responsible for the observed pattern or scenario. For example, the long-term monitoring of fish could reveal a decline in biodiversity or species richness that could be due to RQO parameters but could equally be due to human activities such as fishing, episodic events causing habitat change, seasonal migrations, national trends in fish populations or large-scale fluctuations in climate.

The details of the long-term monitoring programme have been amended by the updated EWR Assessment (DWS, 2015). The following components are included hydrology, sediment dynamics, hydrodynamics, water & sediment quality, microalgae, macrophytes, invertebrates, fish, and birds.

Long-term monitoring programmes tend to be the responsibility of government departments such as DWS and DEA who usually contract the services of tertiary & research institutes such as CSIR, SAIAB, SAEON and Universities. However, the RMA and GEAF can also be involved to ensure that programmes are undertaken and are beneficial to the effective implementation of the EMP.

8.2 Performance Review and Evaluation

Evaluation of the EMP will become the responsibility of the RMA. This is 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 (METT). The Governance Tool will be used to manage systems, processes, and results.

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, CMS, WCPAES, NBA, RQOs and/or CMP. This review is the responsibility of the RMA. This to assess whether that vision, objectives and targets are being achieved. This will involve revisiting the Situation Assessment to determine the progress or changes that have come about because of the EMP, in terms of the objectives that were originally set, as well as any changes in legislation or policies. Data from the monitoring programmes will also indicate whether the management objectives have been achieved. In a situation where these targets have not been achieved, the RMA will need to determine which aspects of the EMP need to be altered to rectify these shortfalls. Usually this will involve the adaptation of management strategies and objectives, or aspects of the action plans themselves, although the problem may be with implementation (capacity and finance). Monitoring programmes may also be altered to supply specific data to fill

existing knowledge gaps.

Ideally, representatives of the major components, namely conservation & living resources, social & cultural issues, land-use & infrastructure, and water quantity & quality, should evaluate the efficiency of the EMP in the context of their area of responsibility. It is essential that representatives from the BGCMA are included within the GEAF structure to address the RQO-related issues.

An audit should be undertaken alongside the evaluation to determine and grade the success and failures with the implementation of the management plan according to the specified performance indicators.

9 RESEARCH PRIORITIES

The following research needs that should fill the knowledge gaps and provide supplementary data for monitoring programmes have been identified and should be initiated as soon as possible. The RMA, CapeNature, should play a leading role in prioritizing these research needs and motivating for the required studies to be implemented. Although some information is available new research efforts are needed to update our knowledge of the system. The RMA may approach tertiary and research institutions such as Universities, the CSIR and NRF institutions such as SANCOR, SAIAB and SAEON to create an awareness of what is required. There may be a degree of overlap with the long-term monitoring programmes defined in Section 8 above.

- Fishery survey comprising bait organisms and fish. Key elements include fishing/collecting effort, *cpue*, user dynamics, target fish species, catch composition, bait utilization in relation to existing regulations (waste), motivation for using resources, economic value of the fishery, degree of compliance and conflict between different fishing fraternities.
- Invertebrate organisms - key elements should include densities, recovery periods after disturbance (collecting and trampling that alter habitat; flood events), impact of various collecting methods (pumps vs. digging), community structures before and after disturbance, effect of pollutants in the sediment, mortality due to birds foraging after collection activities, effect on birds by bait collectors and larval settlement times & location along the tidal cross-section.
- Effectiveness of protected area with regards invertebrate populations, health of estuarine habitat and birds (species richness and breeding success).
- The carrying capacity of the estuary needs to be determined so that the RMA can make an informed decision about the numbers of users utilizing the system at any given time. Some data can be collected as part of the fishery survey, but some aspects such as sense of place, pollution due to engine emissions and incidents of confrontation between all user groups will need to be addressed by a dedicated project.

- A social based project to determine the effectiveness of the education & awareness programme and the attitude toward the EMP and those management actions which have directly affected users, e.g., controlled access to sanctuary areas, skiing areas, no swimming zones etc.
- A Comprehensive EWR assessment to substantiate the results from the desktop revaluation that was conducted (DWS,2015). This will be required if the Vision of a Category A/B system is to be realized.
- Long term monitoring of habitats and community structures in relation to RQOs to determine requirements and effectiveness of the ecological reserve.
- The effect of poor water quality (sewerage and heavy metals) on ecosystem functioning.
- A multi-disciplinary study aimed at resolving the issues surrounding the subsistence bait fishery. The study will need to cover social, economic, and resource-based aspects and ultimately determine whether this industry is sustainable at present levels of effort (permit numbers and quotas) and with existing collecting methods (e.g., digging). Recommendations as to sustainable levels of effort can be made or alternatively recommendations as to alternate activities for participants can be made.
- Tidal flows, salinity intrusion and freshwater inflow in the upper reaches, i.e., the extent and importance of the REI.
- The impact of poor water quality on the nursery function of the estuary.
- A collation of long-term monitoring data that provides information about the birds and animals (abundance, location etc.) that occur in these unique systems. This should be linked with all available similar information on the river systems to provide a more complete picture.
- Impact of sea-level rise, flooding, and storm events on the low-lying areas, with the goal of developing a relocation strategy for affected people, properties, and infrastructure.

10 RECOMMENDATIONS

The following recommendations are made to assist/ improve management of the Goukamma estuary:

- Future revisions of the zonation plan should also consider flexible recreational use areas as well as peak user days regulations.
- Liaise with DWS to undertake a comprehensive, detailed EWR study, including an up-to-date survey of biota, in support of the Classification process, supported by detailed monitoring and numerical modelling studies.

11 REFERENCES

Adams, J. Cowie, M. & van Niekerk, L. 2016. Assessment of completed ecological water requirements for South African estuaries and responses to changes in freshwater inflow. Water Research Commission Report No. KV 352/15.

Australian water quality guidelines for fresh and marine waters. 1992. Australian and New Zealand Environment and Conservation Council, Australia.

Canadian water quality guidelines. 1992. Updated version of Canadian water quality guidelines 1987. Prepared by the Task Force on Water Quality Guidelines of the Canadian Council of Resource and Environmental Ministers.

CapeNature. 2007. Western Cape Province State of Biodiversity. CapeNature Report. 175pp.

CapeNature. 2014. Goukamma Estuary Situation Assessment.

CWAC. 2014. Coordinated Waterbird Counts (Goukamma River Mouth: Mouth – Reserve boundary), Animal Demography Unit, University of Cape Town.

DEA, 2012. South African water Quality Guidelines for Coastal Marine Waters. Volume 2: Guideline for Recreational Use.

DEA, 2014. National Estuarine Management Protocol. Review of Existing Estuarine Management Plans 2007-2014. Department of Environmental Affairs, Cape Town.

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

DEA&DP, 2012. The Establishment of Coastal Set-back Lines for the Overberg District. Report prepared by SSI Engineers and Environmental Consultants for the Western Cape Department of Environmental Affairs and Development Planning.

DWAF 1995. South African Water Quality Guidelines for Coastal Marine Waters. Volume 2: Recreational Use. 124pp.

DWAF. 2000. Ecological Importance and Sensitivity and Present Ecological State tables. Compiled by Dr CJ Kleynhans.

DWAF. 2004. Operational Policy: Using Water for Recreational Purposes Version 1.1. Prepared by Directorate Water Abstraction and Instream Use, Sub-directorate Environment and Recreation, Department of Water Affairs and Forestry.

DWAF. 2007. Institute for Water quality Studies, Resource Quality Services Reports, Data: Aquatic Resource Data. http://www.dwaf.gov.za/IWQS/report.htm.

DWAF. 2008. Methods for determining the Water Quality component of the Ecological Reserve. Report prepared for Department of Water Affairs and Forestry, Pretoria, South Africa by P.A. Scherman of Scherman Consulting.

EPA. 1986. Quality criteria for water. EPA 440/5-86-001. United States Environmental Protection Agency, Washington, USA.

Holness, S., Bradshaw, P. & Brown, A. 2010. Draft: Critical Biodiversity Areas of the Garden Route. Conservation Planning Technical Report. Garden Route Initiative. South African National Parks. 35pp.

James, NC and Harrison, TD. 2008. A preliminary survey of the estuaries on the south coast of South Africa, Cape St Blaize, Mossel Bay – Robberg Peninsula, Plettenberg Bay, with particular reference to the fish fauna. *Transactions of the Royal Society of South Africa*. 63: 111–127.

Kaselowski, T and Adams, JB. 2013. Not so pristine – characterizing the physio-chemical conditions of an undescribed temporarily open/closed estuary. WaterSA, 39: 627 – 636.

Kaselowski, T. 2012. Physio-chemical and microbial characteristics of the Goukamma Estuary. Unpublished MSc thesis, Nelson Mandela Metropolitan University, 119pp

Kleynhans, CJ and Louw, MD. 2007: Module A: EcoClassification and EcoStatus determination in River EcoClassification: Manual for EcoStatus Determination (version 2). Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No. TT 329/08.

Kleynhans, CJ; Louw, MD; Thirion, C; Rossouw, N and Rowntree, K. 2005: River Ecoclassification: Manual for Ecostatus Determination. First draft for training purposes.

McGwynne, L. and Adams, J. 2004. Protocols contributing to the management of estuaries in South Africa, with a particular emphasis on the Eastern Cape province. Volume II, Report E: A monitoring protocol for South African estuaries. Water Research Commission Report no. TT 237/04.

RHP. 2007. State of Rivers Report: Rivers of the Gouritz Water Management Area 2007. Department of Water Affairs, Pretoria.

Taljaard, S. & Van Niekerk, L. 2007a. C.A.P.E. Estuaries Guideline 5: Promoting appropriate water quantity & quality management in estuaries.

Taljaard, S. & Van Niekerk, L. 2007b. C.A.P.E. Estuaries Guideline 6: Monitoring programmes

for implementation in South African estuaries.

Turpie, J and Clark, B. 2007. Development of a conservation plan for temperate South African estuaries on the basis of biodiversity importance, ecosystem health and economic costs and benefits. C.A.P.E. Regional Estuarine Management Programme. Final Report; August 2007. 125pp.

Van Niekerk, L. & Taljaard, S. 2007. Proposed generic framework for Estuarine Management Plans. C.A.P.E. Estuaries Programme.

Van Niekerk, L. & Taljaard, S. 2007. Proposed generic framework for Estuarine Management Plans. C.A.P.E. Estuaries Programme.

Van Niekerk, L. 2017. National Biodiversity Assessment: Estuarine Component GIS data layer *BSP_estuarine_functional_zone_201701_gw*. CapeNature GIS Metadata file: SSD14/3/8/7/11.

Water Research Centre. 1990. Design guide for marine treatment schemes. Volume II. Environmental design and data collection. Report No. UM 1009. Water Research Centre, Swindon, UK.

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

Whitfield, AK. 1992. A characterization of southern African estuarine systems. South African Journal of Aquatic Sciences, 18: 89-103.

Department of Water Affairs (DWA), 2010. Resource Directed Measures: Reserve Determination studies for selected surface water, groundwater, estuaries and wetlands in the Outeniqua catchment: Ecological Water Requirements Study – Main Report: Outeniqua Reserve Study (K10-K50, K60G). Report No. RDM/K000/02/CON/0907.

Whitfield, A and Bate, G, 2007. A Review of Information on Temporarily Open/Closed Estuaries in the Warm and Cool Temperate Biogeographic Regions of South Africa, with Particular Emphasis on the Influence of River Flow on These Systems. Interim report to the Water Research Commission on the Project "The freshwater requirements of intermittently open Cape estuaries". WRC Report No 1581/1/07

Van Niekerk, L., Adams, J.B., Lamberth, S.J., Taljaard, S., Weerts, S.P. 2019. Restoration measures needed to improve the condition and productivity of South African estuaries.

NBA, 2018, a. Van Niekerk, L., Adams, J.B., James, N., Lamberth, S.J., MacKay, C.F., Turpie, J.K., Rajkaran, A. Weerts, S.P. & Whitfield, A.K., 2019, 'Chapter 3: A new Ecosystem Classification for South African estuaries' in South African National Biodiversity Assessment 2018: Technical

Report. Volume 3: Estuarine Realm. CSIR report number CSIR/SPLA/EM/EXP/2019/0062/A. South African National Biodiversity Institute, Pretoria. Report Number: SANBI/NAT/NBA2018/2019/Vol3/A.

APPENDIX 1: WATER QUALITY GUIDELINES

Table 19. Water Quality Guidelines – Targets for the Natural Marine Environment (DWAF 1995). See Reference List for Sources (EEC)

	Canada	US-EPA	EEC (after UK)	Australia	DWAF (1995a)
Physico-chemical Properties					
Salinity				Change should be < 5 units from background levels.	
pH	6.5 to 8.5		6 to 9	5 to 9	No target value selected but 6.5 to 8.5 is optimal.
Floating matter (including oil and grease)	Free of substances that form objectionable deposits or that float (debris, scum, oil and nuisance organisms).	Free of substances that form objectionable deposits or that float (debris, scum and oil).	Floating materials such as wood, plastic articles, etc. should be absent	Oil and petrochemicals should not be noticeable as a visible film.	No floating particulate matter, debris, oil, grease, wax, scum, foam and residues from land-based sources that may cause nuisance.
	Should not be present in concentrations that could be visible, detected by odour or deposited on the shoreline (oil and grease).		No visible film on surface of the water (oil).	Nuisance organisms (phytoplankton scum, macrophytes) should not be present in excessive amounts.	No material from non-natural land-based sources, which will settle to form putrescence.
			No lasting foam.		No submerged objects ad other sub-surface hazards, which arise from non-natural origins and which would be a danger, cause nuisance or interfere with any designated or recognized use.
Suspended solids					No increase by >10% of ambient concentration.
Colour/turbidity/clarity	Turbidity should not be increased > 5 NTU over natural turbidity when turbidity is low (< 50 NTU).	Water should be free from substances producing objectionable colour or turbidity.	No abnormal change in colour.	Natural clarity should not be reduced by more than 20%.	Turbidity and colour acting singly or in combination should not reduce photic zone by >10 % of background levels.
	Clarity (Secchi disc) - 1.2 m; swimming areas clear to the bottom.		Secchi disc depth - 1 m (90%ile; guide) and 2 m (95%ile; mandatory).	Natural reflectance should not be changed by more than 50%.	Colour (substances in solution) of water should not exceed background levels by > 35 Hazen units.
	Colour - maximum limit of 100 Pt-Co counts.			Horizontal sighting of a 200 mm black disc should exceed 1.6 m.	
Dissolved oxygen			80 to 120% saturation (90%ile).		

	Canada	US-EPA	EEC (after UK)	Australia	DWAF (1995a)
Nutrients					
General	Waters should be free of substances that produce undesirable aquatic life.	Waters should be free of substances that produce undesirable or nuisance aquatic life.			
Nitrate				No single value. Levels at which problems have been experienced are between 10 and 60 ug/l.	
Phosphate				No single value. Levels at which problems have been experienced are between 1 and 10 ug/l.	
Total phosphorous		0.1 ug/l (elemental).			
Inorganic nutrients					
Cyanide				0.1 mg/l.	
Hydrogen sulphide			40 ug/l (24 hr max average).		No target value - can cause unpleasant odours.
Gypsum					
Arsenic			500 ug/l total (95%ile).	0.05 mg/l.	
Cadmium				0.005 mg/l.	
Chromium			500 ug/l total (95%ile).	0.05 mg/l.	
Copper			500 ug/l total (95%ile).		
Iron			3 000 ug/l total (95%ile).		
Lead			500 ug/l total (95%ile).	0.05 mg/l.	
Mercury				0.001mg/l.	
Nickle			500 ug/l total (annual arithmetic mean).	0.1 mg/l.	
Silver				0.05 mg/l.	
Zinc			500 ug/l total (95%ile).		
Inorganic nutrients					
Total petroleum hydrocarbons			0.3 mg/l 90%ile (mineral oils).		
Polycyclic aromatic hydrocarbons				0.01 ug/l.	

APPENDIX 2: BASELINE MONITORING PROGRAMMES

Table 20. Baseline monitoring programmes for Water Quantity (Hydrodynamic & Sedimentary processes)

Objective	Indicator & TPC	Resources	Spatial	Temporal	Sampling & Analysis
WHS1: Record freshwater inflow at head of estuary.	Recommended inflow according to the Ecological Reserve requirement; TPC is inflow volume less than the recommendation.	**Human** - DWS. **Budget** – DWS - cost of flow gauging station installation and analysis of data	Flow gauging station above head of estuary at a site below the lowest abstraction point	Data is logged daily.	Flow data logged daily and collected bi-annually for analysis or monthly during times of drought. XY graphs off low against time. Decrease flow could indicate increased abstraction or impoundment but could be natural cycle.
WHS2: Frequency and duration of episodic events (floods and storms)	Type of event (flood) and duration; this is a natural phenomenon and TPCs are not relevant.	**Human** – RMA **Budget** – no costs	The estuarine area.	Whenever the events occur.	Record the event, its duration and time of year. These data are important as they help explain sedimentation patterns, scouring, duration periods for recovery and mouth dynamics.
WHS3: Changes in bathymetry as a measure of long-term sedimentation processes.	Depth profile of estuary at selected sites; TPC is a bathymetric profile that varies significantly from historical records.	**Human** – estuarine sediment dynamics specialist (consultant or from tertiary/ research institution). **Budget** - research funding from tertiary institutions.	Water body within the designated estuarine area.	Every three years or after episodic events.	Graphic display of bathymetry at sites overtime. Sediment accumulation could indicate increased erosion due to bad land-use practices or increased input from marine and Aeolian origins; could ultimately lead to mouth closure or reduced access for boats.

Table 21. Baseline monitoring programmes for Water Quality

Objective	Indicator & TPC	Resources	Spatial	Temporal	Sampling & Analysis
WQ1: Concentrations of water quality parameters in river inflow.	Levels of sediment (silt), nutrients and pollutants. TPCs are determined by safety & health standards.	**Human** - DWS. **Budget** - DWS- cost of water sampling and analysis from above head of estuary.	Sample station at a site above the head of the estuary.	Monthly, with additional samples prior to sporting events; also, if suspected contamination is reported.	Water sample analysis and presentation of data in XY graphs to show temporal fluctuations of each parameter. Values outside the norm can indicate pollution or contamination of water.
WQ2: Frequency and location of fish & invertebrate kills; macro- and micro-algal blooms; non-natural floating objects and surface contaminants; and areas with bad smells.	Observe the occurrence and location of these aspects. TPCs are not defined per se but are exceeded when indicators are visible.	**Human** – CapeNature, Municipal environmental officer, GEAF, and river users. **Budget** - none for observations; DWS or Municipal for investigation of cause.	Designated estuarine area.	Observations can be made during normal daily activities or responsibilities.	Occurrence and location to be recorded; cause to be investigated by DWS or Knysna LM (possibly delegated to CapeNature). Analysis could show pollution by effluent discharge, nutrient enrichment, or low oxygen levels; cause may also be natural, e.g., low temperature.
WQ3: Concentration of bacteriological contaminants.	Total coliform (*E. coli*) counts. TPC for estuary-counts in 80% of samples over time should be <100counts/100ml; and <2000 counts/100 ml in 95% of samples.	**Human** – Knysna LM. **Budget** – operating budget from Community Protection Services.	Waterbody within the designated estuarine area; may be at known point source sites.	Weekly samples; prior to organized sporting events; when bad odours or sewage spills are noticed or suspected.	Plot *E. coli* counts as XY graphs against time for each station. Increase in counts to above the TPC indicates contamination and hence a health hazard to estuary users.
WQ4: Concentrations of constituents that determine water quality.	All water quality parameters, e.g., salinity, oxygen, nutrients, turbidity, and heavy metals. TPCs are the values recommended by the DEA Water Quality Guidelines for the natural marine environment (Recreational Use – DEA, 2012))	**Human** – specialists either from GEAF or research/tertiary institution. **Budget** – DWS or funding from tertiary/research institution.	Several stations (every 1-2km) along estuary including mouth and head region; must also include discharge site for desalination plant	At least seasonally (monthly if possible); at high tide during neap tide cycle allowing for tidal lag for stations upstream of the mouth.	Natural variability to be determined over 5-year period (can use data from Ecological reserve study as historical record). Plot data as XY graph against time for each station and constituent. Increased levels of most constituents could indicate or lead to increased eutrophication, algal blooms, or contamination. Low oxygen could lead to or explain mass mortalities and indicate eutrophication. Abnormal salinity can indicate problems with the desalination plant.

Table 22. Baseline monitoring programmes for Biodiversity (Conservation)

Objective	Indicator & TPC	Resources	Spatial Scale	Temporal	Sampling & Analysis
B1: Maintenance of plant communities	Area of cover; TPC is 10% reduction in area covered by any plant community type	**Human** – Cape Nature rangers, members of GEAF, organisation such as ORCA and municipal environmental officer. **Budget** – cost of aerial and/or reference photographs.	The designated management area, should include concentrate on saltmarshes, wetlands and areas dominated by submerged macrophytes.	Aerial photographs every 5 years for Situation Assessment Report; reference photographs bi-annually for seasonal variation at selected sites	Aerial photos from Dept. of Surveys & Mapping; reference photos from fixed elevated positions at low tide. Initial ground trothing may be required. Surface area of each community type plotted on a map; habitat type and plant cover at reference sites plotted; Reduction could indicate pollution or episodic event; increase could also indicate pollution (blooms) or successful rehabilitation efforts or optimum environmental conditions.
B2: Control of alien vegetation	Area of cover; TPC is if more than 10% of management area (and catchment) is infested with alien vegetation	**Human** – DWS and DFFE. **Budget** – cost of aerial photographs and reference transects.	Concentrate on immediate estuarine management area and riparian areas in catchment.	Aerial photographs every 5 years for Situation Assessment Report; reference transects at disturbed sites annually.	Aerial photos from Dept. of Surveys & Mapping; reference transects at disturbed or cleared sites. Surface area of indigenous & alien vegetation plotted on a map every 5 years; XY graphs of vegetation type against year in disturbed areas to track recovery
B3: Maintenance of invertebrate populations (primarily mudprawn and sand prawn) and Knysna seahorse	Population densities; TPC is densities below 30% of baseline counts for invertebrates.	**Human** – students or staff from tertiary or research institute; members of GEAF and WESSA. **Budget** – research funding from tertiary or research institutions; corporate donors.	Several representative habitats for sand prawn, mudprawn and seashore to account for natural variability within the system.	Bi-annual.	Prawns: Random quadrats above low spring tide level where number of burrows are counted; sampling to include breeding and recruitment seasons. Baseline data set may be set up after 2 years; plot XY graphs of number of burrows again time of year. Reasons for decrease may not be human induced and could be due to natural variation or episodic events.

B4: Maintenance of waterbird populations	• Species richness: TPC is loss of a single species. • Species diversity: TPC is 30%loss over 5 years • Bird numbers: TPC is 30% decrease for resident species over 5 years and decrease of 50% for migratory species over 10 years	**Human** – CapeNature, members of GEAF, birding clubs; ADU from UCT for CWAC counts. **Budget** – own costs for bird clubs or GEAF members; ADU from UCT	CWAC reference site	Twice yearly (winter (June-July) and summer (January-February).	Counts to be done over spring low tide period and outside peak disturbance periods and record prevailing conditions; counting areas mapped and representative of a range of estuary habitat types. Plot species richness, diversity, and number again time of year and habitat type; long term period (5-10 years) is required to allow for detection of natural fluctuations; detailed analysis to be done by CWAC.
B5: Maintenance of fish populations	CPUE: TPC for dusky kob, white steenbras and leervis is 10% reduction in baseline values; TPC for all other species is 20% reduction in baseline • values	**Human** – student from tertiary research institute to conduct fishery survey. **Budget** – research funding from tertiary or research institutions.	Water body within the designated estuarine area	Fishery survey to be conducted every 5 years.	Survey to be in the form of roving creel surveys and access point inspections. Data to include catch (number & weight) and time fished. CPUE to be plotted against time for each species; Declines can be due to water quality issues in the system or stock declines at National level.
B6: Protection and rehabilitation of wetlands.	Loss or degradation of wetland or saltmarsh area in the indicator; the TPC is any loss or decline from present levels	**Human** – members of GEAF or estuarine co-Ordinator. **Budget** –cost of aerial and/or reference photographs (already accounted for in B1)	Concentrate on Gansvlei, Buffalo Valley and others.	Annual survey.	Survey can be done on site or reference photographs can be used. Compare to historical record to detect loss of habitat or damage. Declines can be due to human disturbance or episodic events.
B7: Restoration of original flow regime above N2 weir	Reduced or impeded flow; TPC is if this is not at least considered by all relevant parties	**Human-** RMA together with DEA&DP: Development Planning; DWS: Resource Protection; SANRAL; **Financial-** No cost for meeting; costs for EIA, removal of pylons and restoration of flow may be prohibitive (likely several millions).	Wetland and estuarine area below N2 bridge	Annual progress report on discussions until conclusion reached.	Review of meeting minutes and actions. Once conclusion is reached, monitor of flow according to RDM procedures.

B9: Increase the amount of estuarine area with conservation status.	Estuarine area with conservation status; TPC is if no additional land within the EFZ was conserved	**Human-** CapeNature to run with the process. **Financial-** Part of operational costs. Expropriation of land and declaration of PA will incur costs.	Entire estuarine area.	Immanent gazetting by National Department. Annual progress update on stewardship agreements	Assessment of all potential land parcels in terms of property boundaries and ownership. Survey to be done by surveyor general. Ownership of land to be determined through deeds office.

Table 23. Baseline monitoring programmes for Human Activities (Conservation)

Objective	Indicator & TPC	Resources	Spatial	Temporal	Sampling & Analysis
HA1: Ensure carrying capacity of estuary is not exceeded	Number of powered vessels in use; TPC is when carrying capacity is exceeded.	**Human** – CapeNature river patrols. **Budget** –part of normal daily activities and running costs.	Designated estuarine area; can be limited to specific zones based on type of activity in accordance with EZP	Twice a month with an increase in regularity during peak holiday periods	Count number of boats in use on the water in the various zones and compare to carrying capacity determined by CapeNature.
HA2: Control human activities that impact on invertebrate (bait organism) populations	Compliance with regulations (bag limits, collecting methods, licenses, closed areas); TPC is continued instances of non-compliance	**Human** – CapeNature and voluntary compliance officers for compliance. **Budget** – MLRF for CapeNature; voluntary compliance officers funded from boat launch or registration fees.	Designated estuarine area	Compliance monitoring to be done regularly.	Number of incidents of non-compliance to be recorded if there is no decline then capacity for monitoring is insufficient or awareness of Regulations is poor

Table 24. Baseline monitoring programmes for Law Enforcement (Conservation)

Objective	Indicator & TPC	Resources	Spatial	Temporal	Sampling & Analysis
LE1: Improve law enforcement capacity	Incidence of non-compliance and high conviction rates; TPC is an increase in incidents of non-compliance with key legislation (e.g., MLRA, CARA, NEMA & EIA Regulations and NWA, also EZP and By-laws) and a decrease in conviction rate	**Human** – All authority institutions tasked with administering legislation; voluntary compliance officers **Budget** – individual govt departments; Knysna LM to fund CapeNature activities, voluntary compliance officers funded from locally generated revenue.	Management Area	Capacity should be improved within 2 years of EMP implementation.	Record number of law enforcement personal after 2 years and compare to existing numbers. Record numbers of incidents of non-compliance and successful convictions and compare between years.
LE2: Compliance with EAs issued as part of EIA process	Incidence of non-compliance; TPC is any form of non-compliance	**Human** - Primarily DEA&DP, but also DWS, DEA and Knysna LM; independent environmental control officer appointed in terms of EA, GEAF members as registered I&APs. **Budget** –part of normal responsibilities for government depts; developer pays for environmental control officer	Management Area	Initiate immediately upon implementation of EMP.	Record number and type of developments approved; note activities of environmental site officer and incidents of non-compliance with ROD conditions. Data should be tabulated and presented to authorities for analysis and further action against non-compliant developers

Table 25. Baseline monitoring programmes for Sustainable Utilisation of Living Resources

Objective	Indicator & TPC	Resources	Spatial	Temporal	Sampling & Analysis
E2: Ensure maintenance of bait organism and fish populations through compliance with regulations	Number of incidents of non-compliance with MLRA Regulations; TPCis either an increase in incidents or no decline from existing levels	**Human** – CapeNature and MLRA appointed voluntary compliance officers. **Budget** – CapeNature funds (supported by MLRF); Voluntary compliance officers can be supported from locally generated revenue.	Management Area.	Daily as part of routine estuary patrols.	Record number of incidents and compare monthly to detect trends. Impacts will also be reflected in number and density of invertebrates and possibly CPUE for fish (may be due to other factors; see B3 and B5 above).

Table 26.Baseline monitoring programmes for Land Use & Infrastructure

Objective	Indicator & TPC	Resources	Spatial	Temporal	Sampling & Analysis
LU1: Maintenance of demarcated 100m and 1000m buffer zones, CMLs and CBAs.	Compliance with legislation applicable to the various zones; TPC is any infringements within these zones.	**Human -** DEA&DP, DWS DEA, DFFE and CapeNature officials; Environmental Control Officer (ECO) appointed in terms of the EAs for EIA; municipal environmental officer and town planning; members of GEAF. **Budget** -part of normal responsibilities for government departments; developer pays for ECO and rehabilitation	Designated management area.	Visual monitoring can be done on an ad hoc basis during normal daily activities or responsibilities.	Land-use patterns adjacent to the estuary to be mapped; records kept of applications for activities that will infringe on this riparian zone and registration of the GEAF members as I&APs; amount of bank erosion and habitat degradation in the vicinity of existing developments to be noted; non-compliance with regards the buffer zone and CBAs to be noted.
LU2: Restrict additional development (structures) on the floodplain or within 1:100-year flood line.	Number of applications for new developments within the floodplain or 100-year flood line; TPC is any new applications for development.		Flood plain or100-year flood line within the designated management area.		Land-use patterns adjacent to the estuary to be mapped; records kept of applications for activities that will infringe on the flood plain area and registration of the GEAF members as I&APs. Number of new applications for development or activities to be noted.

LU3: No alteration of water quality and normal hydrodynamic & sedimentary cycles due to development and land-use.	RQO parameters; TPC would be any activity that negatively impacts on the RQOs.	**Human** - DEA&DP and DWS personnel; ECO appointed in terms of the EAs. **Budget** – part of normal responsibilities for government departments; developer pays for ECO.	Designated management area and catchment.	Bi-annual for DWS (may form part of more detailed long-term monitoring programme) and ongoing for DEA&DP and ECO as activities are approved and EA issued.	DWS to perform regular sampling of RQOs and analyze in the context of activities that may have negative impacts. DEA&DP and ECO to ensure conditions and mitigation detailed in EAs are complied with.
LU4: Land-use & development proposals evaluated through EIA procedure and guided by planning and management frameworks (e.g., SDFs, CMS, and this EMP).	Compliance with EIA procedures and adherence to strategies and management plans; TPC is non-compliance in this regard and lack of regard for Management framework recommendations.	**Human** - DEA&DP, DWS, DEA, DFFE, CapeNature and Knysna LM (Town Planning) personnel; representatives of GEAF and BGCMA. **Budget** – part of normal responsibilities for government departments; no cost to GEAF for monitoring processes.	Goukamma management area and catchment.	Ongoing; exact timing will depend on when applications for activities are received by DEA&DP, DWS, DEA or DFFE	All activities to be reported to DEA&DP, DWS, DEA, DFFE, Knysna LM to determine whether they comply with EIA requirements and existing management frameworks. GEAF members to register as I&APs for all proposed activities to ensure procedure is followed and ideals of planning and management frameworks are considered in assessment and decision-making process. Number of applications to be noted and number of applications approved without adhering to planning and management framework recommendations to be noted.

Table 27. Baseline monitoring programmes for Sustainable Livelihoods

Objective	Indicator & TPC	Resources	Spatial	Temporal	Sampling & Analysis
Sustainable Livelihoods					
SL1: Ensure all existing and proposed future activities and livelihoods dependent on or may impact on the estuary (tourism, business, agriculture) comply with legislation management plans and frameworks	Compliance with legislation and planning and management frameworks; TPC would be any non-compliance or conformity	**Human -** Various national/provincial and Municipal departments CapeNature; PDC leaders; tourism operators and representatives, GEAF. **Budget** – Monitoring compliance is part of department running costs (Knysna LM to assist funding for CapeNature).	Designated Goukamma Management area and catchment area.	Ongoing – all existing activities can be reviewed for compliance over 2 years; new activities reviewed as they evolve.	Assess all existing activities in the context of legislation (e.g., MLRA, NEMA & EIA regulations, NWA, NFA, CARA, NHRA) and frameworks (e.g., SDF/IDP, EMP and CMS). Record of non-compliance and report to responsible authorities (e.g., municipal planning, DWS or DEA&DP) then monitor response from authorities.

Table 28. Baseline monitoring programmes for Tourism and Recreational Use

Objective	Indicator & TPC	Resources	Spatial	Temporal	Sampling & Analysis
Sustainable Livelihoods					
T1: Recognition of the Goukamma management area as an eco-tourism destination.	Websites and brochures featuring the management area; TPC is if this did not happen or if occurrence was low.	**Human-** Knysna LM tourism in cooperation with GEAF and tourist operators and associated businesses. **Budget-** costs insignificant (mainly time).	Initially the immediate Knysna LM area but can expand to Provincial and finally National.	Initial stage after three years, leading up to National exposure after five to 10 years.	Record number of websites and/or brochures that specifically mention the Goukamma management area and its attraction for tourists. An increase in the number of tourists, brochures, and "hits" on websites per year to illustrate improvement.
T2: Promotion of organized sporting events.	Number of events held per annum; TPC would be no increase or a reduction.	**Human-** GEAF with Knysna LM and organized sports representatives. **Budget -** no costs (mainly time).	Initially locally (e.g., school events), then expand to include more Provincial and National events.	Initiate over a three-year period after EMP implementation.	Record number of organized sporting events in past decade and compare to number over the 5 years after IMP implementation. If there is no increase, the reasons for decline in number of events must be ascertained (e.g., water quality).

Table 29. Baseline monitoring programmes for Education and Awareness

Objective	Indicator & TPC	Resources	Spatial	Temporal	Sampling & Analysis
EA1: Increase awareness of estuaries and their value amongst government and municipal workers and managers; also, awareness of responsibilities for management in terms of legislation	Attendance at workshops and questionnaire; TPC would be poor workshop attendance and poor evaluation results reflected in the questionnaire.	**Human** – Primarily DEA:O&C, CapeNature, and Knysna LM with assistance from GEAF and specialists from govt dept. and tertiary & research institutes. **Budget** – National government (DEA), Knysna LM and corporate donors.	Initially Knysna LM but can expand to include Eden District.	Once a year.	Attendance at workshops and successful completion of questionnaires to be recorded. Analysis should show a steady attendance record and an increase in the level of understanding of the importance of estuaries and awareness of responsibilities.

EA2: Increased public awareness of the Goukamma management area.	Number of public notice boards, number of school groups and questionnaire; TPC would be no visible notice boards, few school tour groups and continued public ignorance.	**Human** – GEAF and CapeNature can monitor signage; levels of awareness through questionnaires can be coordinated amongst institutions hosting workshops. **Budget** – DEA to cover costs of questionnaires; corporate donors to assist funding of education centre (venue).	Goukamma management area.	Notice boards and signage to be erected within two years of IMP implementation; educational drive can start immediately with courses or tours being run on demand.	Assess placement of notice boards and their content; record number of school tour groups; and assess completion of questionnaires. Analysis should show an increase level of understanding through successful completion of questionnaires and a steady attendance by school groups (includes return visits from schools each year).
EA3: Research projects initiated that fill knowledge gaps and provide information for monitoring programmes.	Number of research projects; TPCs would be few research projects and continued lack of data for monitoring programmes.	**Human** – CapeNature, Knysna LM and GEAF to Monitor number of research projects. **Budget**– No costs involved for monitoring.	Goukamma management area.	Initiate immediately assessment of ongoing research projects and outstanding, requirements can be done once a year.	Number and type of research projects to be recorded and related to areas of concern with regards to knowledge gaps and monitoring data. Must ensure interaction between Knysna LM, GEAF and tertiary & research institutions and a sharing of knowledge.

APPENDIX 3: RECOMMENDED LONG-TERM MONITORING PROGRAMME

The former monitoring programmes have been updated/replaced by the EWR monitoring programme (DWS, 2015).

The recommended monitoring programme to improve the confidence of the EWR study, as well as to monitoring implementation in terms of meeting ecological RQOs is presented in Table 29. Specifically, the following crucial monitoring should continue/commence as soon as possible:

- Continuous water level recordings at the pont/picnic area and at the N2 Bridges in the Goukamma Estuary to monitor mouth state and tidal variation;
- Monitoring of salinity structure and water quality (e.g., nutrients and dissolved oxygen) under various river flow conditions **for at least a 3-5 year period, especially covering extreme low flow periods;**
- Bathymetric survey of the Goukamma Estuary between the N2 bridges and the mouth
- Invertebrates and fish surveys

The implementation of the monitoring programme should be undertaken through collaboration by various responsible departments in Department of Water and Sanitation (DWS), as well as other national and provincial departments and institutions responsible for estuarine resource management such as Department of Forestry, Fisheries and Environment (DFFE), Department of Environmental Affairs (DEA: Oceans and Coasts), South African National biodiversity Institute (SANBI), CapeNature, as well as relevant municipal authorities. It is recommended that the estuarine management planning process and the associated institutional structures (as required under the Integrated Coastal Management Act, 2008) be used as a mechanism to coordinate and execute this long-term monitoring programme.

Table 30. Recommended monitoring programme for the Goukamma (priorities are highlighted)

Ecological component	Monitoring action	Spatial scale	Temporal scale
Hydrology	For larger systems record river inflow at head of estuary (smaller systems hydrology to be simulated every 10 years)	Upstream of head of estuary in Homtini Pass (to be confirmed)	Continuous
Hydrodynamics	Record water levels (to record mouth state and tidal variation)	Near mouth (K6T018)	Continuous
	Aerial photography (or using high resolution satellite imagery i.e., 5x5 m pixel size, e.g., Google Pro or BirdEye) (e.g., to map mouth position over time)	Entire estuary	Annual after spring rain period
Sediment dynamics	Monitoring berm height using appropriate technologies	Mouth	Quarterly
	Bathymetric surveys: Series of cross section profiles and a longitudinal profile collected at fixed (e.g., 300-500 m intervals) but in more detail in mouth including berm (every 100 m). Vertical accuracy at least 5 cm	Entire estuary	Every three years (and after large resetting event)
	Set sediment grab samples (at cross section profiles) for analysis of particle size distribution (and ideally origin, i.e., microscopic observations)	Entire estuary	Every three years
Water quality	Electrical conductivity, pH, inorganic nutrients, and organic content (e.g., TP and Kjeldahl N) in river inflow *(preferably also suspended solids and temperature)*	Entire estuary	Monthly continuous (as in DWS monitoring programme)
	Salinity and temperature profiles (and any other in situ measurements possible e.g., pH, DO, turbidity)	8-10 stations along length of estuary	Ideally monthly for the first year and then quarterly
	Inorganic nutrient concentrations (together with above)	8-10 stations along length of estuary	Every three years (high and low flows) or when significant change in water quality expected
	Measure pesticides/herbicides and metal accumulation in sediments (for metals investigate establishment of distribution models	Entire estuary, including depositional areas (i.e.,	Once-off, then every three – six years, if results show

Ecological component	Monitoring action	Spatial scale	Temporal scale
	– see Watling and Newman, 2007).	muddy areas)	contamination
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, HPLC, fluoroprobe. Intertidal and subtidal benthic chlorophyll-*a* measurements (four replicates each) using a recognised technique, e.g., sediment corer or fluoroprobe.	Along length of estuary minimum five stations	Quarterly, for first two years and then low flow surveys every three years
Macrophytes	Map area covered by different macrophyte habitats using recent imagery. Conduct field survey to record total number of macrophytes habitats, identification, and total number of macrophytes species, number of rare or endangered species, or those with limited populations. Assess extent of invasive species in EFZ.	Entire estuary (mapping)	Every three years in summer
Invertebrates	Collect duplicate zooplankton samples at night from mid-water levels using WP2 nets (190 um mesh) along estuary. Collect sled samples (day) at same zooplankton sites for hyper benthos (190 um). Collect grab samples (five replicates) (day) from the bottom substrate in mid-channel areas at same sites as zooplankton (each sample to be sieved through 500 um). Collect sediment samples using the grab for particle size analysis and organic content (at same sites as zooplankton) (*preferably link with sediment dynamics*)	Minimum of three sites along length of entire estuary	
	Intertidal invertebrate hole counts using 0.25 m^2 grid (five replicates per site). Establish the species concerned *(Callichirus kraussi)* using a prawn pump.	For hole counts –three sites in each of muddy or sandy areas	Quarterly, for first two years and then every two years mid-summer

Ecological component	Monitoring action	Spatial scale	Temporal scale
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 2 m, 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 Gill net sampling can be replaced by a large mesh seine (44 mm stretch mesh, 100 m x 2 m) 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	8-10 stations along length of estuary	Quarterly, over at least one year to account for the seasons, then twice annually spring/ summer and autumn/ winter
Birds	Undertake counts of all non- passerine water birds, identified to species level.	Entire estuary (approximately seven sections)	Quarterly, over at least one year to account for the seasons, then twice annually summer and winter

APPENDIX 4: Proposed classes of water resource and resource quality objectives for the Goukamma system, summarized form the Government Gazette No. 42053

Table 31. Proposed classes of water resource and resource quality objectives for the Goukamma system

Component	Sub-component	Indicator	RQO Narrative	RQO Numeric												
Quantity	Flow	MMR/MAR (% Nat)	Maintain flow regime	Months	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	**Annual**
				MMR/ MAR (%Nat)	87.5	88.8	87.5	85.7	85.5	87.1	86.9	88.2	87.2	86.5	88.5	88.3	**87.5**
Quality	Nutrients	DIN	Inorganic nutrient concentrations not to exceed TPCs for macrophytes and microalgae	DIN not >100µg/L once-off.												
		DIP		DIP not > 20µg/L once-off												
	Salinity	Salinity	Salinity distribution not to exceed TPCs for fish, invertebrates, macrophytes and microalgae													
	System variables	Turbidity	System variables not to exceed TPCs for biota	Turbidity >10 NTU in low flow												
		Dissolved oxygen		>5 mg/L in estuary												
	Pathogens	Enterococci	Concentrations of waterborne	≤ 185 Enterococci/100 ml (90th percentile)												

			pathogens should be maintained in an acceptable category for full contact recreation	
		Escherichia coli		≤500 E. coli/100 ml (90th percentile)
Habitat	Hydrodynamics	Mouth state	Maintain connectivity with marine environment at a level that ensures water quality and habitat remains suitable for biota typically found in estuary	Estuary mouth permanently open
		Tidal variation		Average tidal amplitude near the mouth during low flows (summer) must not change by >30% from established baseline
	Sediment	Sediment characteristic, channel shape/size	Flood regime is sufficient to maintain natural bathymetry and sediment characteristics	Channel shape/size, sediment grain size and organic matter must not change by >30% from established baseline
Biota	Microalgae	Biomass and community composition of phytoplankton and benthic microalgae community	Maintain the composition and richness of phytoplankton and benthic microalgae groups and medium-low biomass	Maintain median phytoplankton/benthic microalgae biomass: phytoplankton not> 1.0 µg/L (median), benthic microalgae not > 11 mg/m^2 (median); phytoplankton not> 20 µg/L and/or cell density not >10 000 cells/ml (once off); Prevent formation of phytoplankton blooms
	Macrophytes	Extent, distribution, and richness of macrophytes	Maintain extent, distribution, and richness of macrophyte	Maintain distribution of macrophyte habitats; prevent the spread of invasive trees (e.g., Acacia spp.) in the riparian zone

			groups, limit colonization/spread of the EFZ by alien species	
	Invertebrates	Macrofauna community composition, abundance, and richness	Maintain the composition, richness, and abundance of different groups of benthic macrofauna and zooplankton	Establish presence/absence of sand prawn Callichuis kraussi on sand banks in lower estuary, establish presence/absence of the copepod Pseudodiaptomus hessei or estuarine congeneric in the zooplankton of the estuary, populations of these species should not deviate from average baselines (as determined in first three visits) by more than 30%
	Fish	Fish community composition, abundance, and richness	Maintain composition, richness, and abundance of different groups of fish, prevent colonization/increase of alien species	Fish assemblages should comprise the 5 estuarine association categories in similar proportions (diversity and abundance) to that under the reference (see 2015 EWR report); numerically assemblage should comprise: Ia estuarine residents (50-80% of total abundance), Ib marine and estuarine breeders (10-20%), IIa obligate estuarine dependent (10-20%), IIb estuarine associated species (5-15%), IIc marine opportunists (20-80%), III marine vagrants (not more than 5%), IV indigenous fish (1-5%), V catadromous species (1-5%); Category Ia species should contain viable populations of at least 4 species ; Category IIa obligate dependents should be well represented by large exploited species
	Birds	Avifauna community composition, abundance, and richness		Maintain population of original groups of birds present on the estuary; number of birds in any group, other than species that are increasing regionally, such as Egyptian geese, should not drop below the baseline median (determined by past data and or initial surveys) number of species and/or birds counted for three consecutive summer or winter counts