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Email: coastal.enquiries@westerncape.gov.za

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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.



EXECUTIVE SUMMARY

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

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

Geographical Boundaries

The Palmiet River estuary is defined in the 2018 National Biodiversity Assessment (NBA) (SANBI, 2019) as a large temporarily closed estuarine system in the warm temperate bioregion on the Cape south coast, about 75 km south-east of Cape Town, between Betty's Bay and Kleinmond in the Overstrand Local Municipality (LM), Overberg District. The size of the estuary, as defined by the Estuarine Functional Zone (EFZ), is approximately 26.7 ha, extending over a length of 1.75 km.

Vision and Objectives

The following Vision for the Palmiet River estuary was proposed at a public meeting held in October 2017 in Pringle Bay and supported at a second meeting held in April 2018.

"The Palmiet River estuary is healthy, well managed and formally protected within the Biosphere Reserve as a natural gem that provides sanctuary and corridors for wildlife and recreational space for responsible enjoyment by current and future generations"

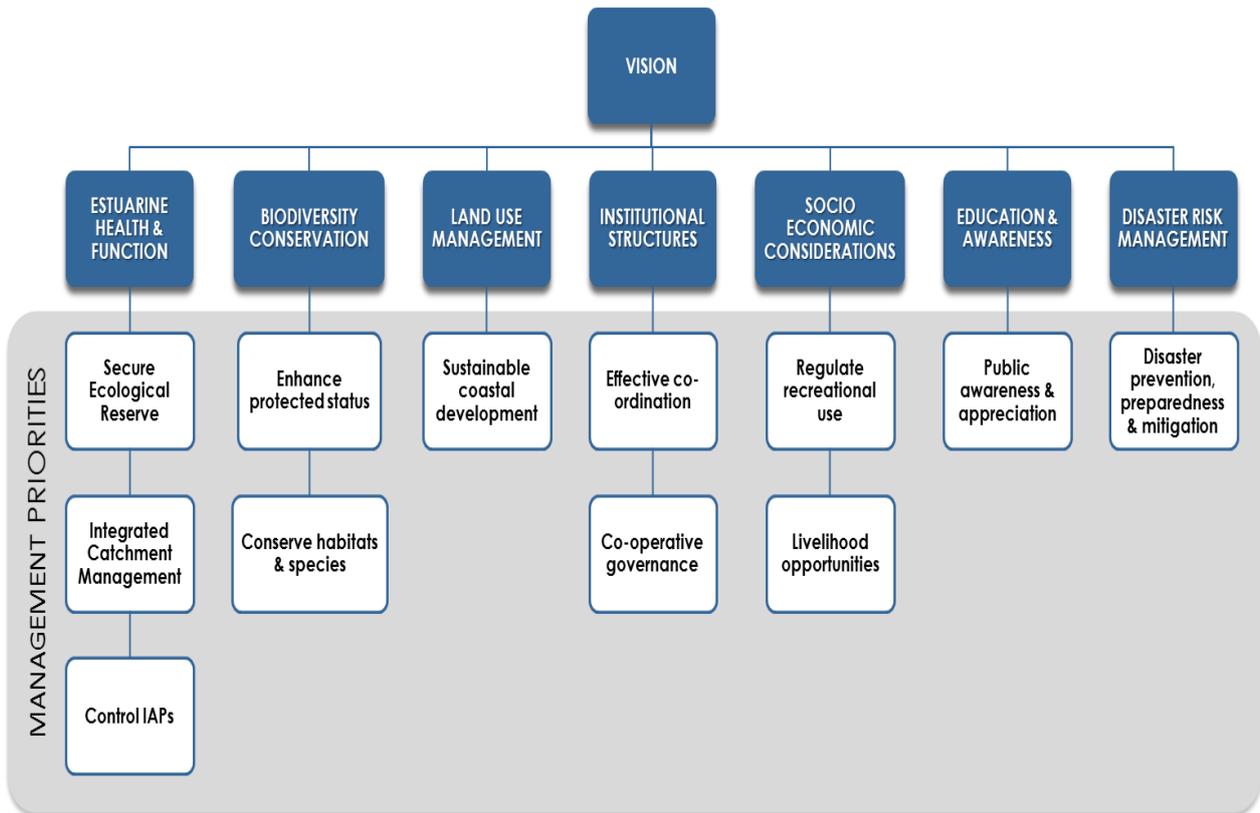
Strategic objectives, performance indicators and priorities for the Palmiet River estuary are as follows:

| Sector / Category | Strategic Objective | Performance Indicator(s) | Priority |
|-------------------|--|--|---------------|
| 1 | Estuarine Health and Function | <p>The ecological health and natural functioning of the Palmiet is improved, its negative ecological trajectory and catchment impacts reversed, and estuary nursery function protected in a hotter, drier future</p> <ul style="list-style-type: none"> • Ecological health improved to B/C condition • Ecological reserves for water quantity and quality are secured and implemented • No additional water abstraction authorised • Nutrient pollution from agriculture reduced • Water quality monitoring programme in place • Invasive alien plant infestation managed • Ecological monitoring programme in place • Fish disease controlled • Ecological integrity of estuary improved and maintained • Increase in number of research and monitoring projects | HIGH |
| 2 | Biodiversity Conservation | <p>The biodiversity of the Palmiet River estuary is conserved</p> <ul style="list-style-type: none"> • Palmiet River estuary formally proclaimed as a Protected Area and/or Marine Protected Area • No-take status established • Spatial zonation plan is adopted and enforced • Estuarine bylaws or regulations are gazetted • EMP incorporated into the Boland Mountain Complex (BMC) Management Plan • Environmental custodianship secured • Reduced habitat degradation and inappropriate behaviour/activities | HIGH |
| 3 | Land-use and Infrastructure Planning and Development | <p>Impacts associated with developments and proposed changes in land-use, including infrastructure and agriculture, are minimised</p> <ul style="list-style-type: none"> • All development and land use changes surrounding and within the EFZ comply with environmental legislation and environmental best practice / risk aversion approach • Further transformation of estuary margins prevented • Reduced negative impacts from agricultural activities | HIGH |
| 4 | Institutional and Management Structures | <p>The Palmiet River estuary is well managed through effective co-operative governance</p> <ul style="list-style-type: none"> • EMP is seamlessly incorporated into the BMC Protected Area Management Plan • Regional estuary advisory forum is established and meets regularly • Estuarine bylaws are drafted • Mandated authorities and participating agencies are well capacitated, actions are fulfilled | MEDIUM |

| | | | | |
|----------|-------------------------------|---|---|---------------|
| | | | <ul style="list-style-type: none"> • Critical management networks are established | |
| 5 | Socio-economic Considerations | Socio-economic benefits are enhanced and regulated to ensure sustainable use of the Palmiet River estuary and its resources | <ul style="list-style-type: none"> • Estuarine usage well understood • Standard operating procedures in place to manage visitor numbers • Signage erected • Reduced habitat loss/degradation and disturbance, and inappropriate behaviour | HIGH |
| 6 | Education & Awareness | Members of society are sensitive to and aware of the value and importance of the Palmiet River estuary | <ul style="list-style-type: none"> • Increase in number of research projects • Signage erected • Information disseminated • Awareness programme developed and successfully implemented on an on-going basis | MEDIUM |
| 7 | Disaster Risk Management | Potential risks that could impact the Palmiet River estuary are reduced (inclusive of climate change impacts) | <ul style="list-style-type: none"> • Rehabilitation of degraded areas • No further development in high risk areas • Flood disaster management plan developed • Contingency plans in place for high risk areas / activities • Disaster impacts are timeously and effectively mitigated • Key infrastructure is well defended | LOW |

Priority management objectives and associated activities

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



Proposed Zonation of activities

Spatial zonation of activities on an estuary is necessary to avoid user conflict and to guide sustainable utilization of resources without degradation of the estuarine environment. The EMP reflects on a habitat sensitivity analysis, legislated boundaries and buffer zones, Western Cape Protected Area Expansion Strategy, the National Estuary Biodiversity Plan, Kogelberg Biosphere Reserve (KBR) zonation as well as the current zonation of activities and land use in terms of the Overstrand LM Town Planning Scheme. Development rules that apply to the Open Space 1: Nature Reserve zoning are also cited.

The proposed zonation includes the proposed protected area, and two specific zones, namely, salt marsh sanctuary and recreation swimming zone and the remaining open water area. In general, the zonation provides for low impact recreational use which does not detract from the sense of place afforded by the surrounding natural landscape.

- **Estuarine Protected Area (No-take)** –

This entails establishing formal protected area status for the entire Palmiet River EFZ. This may be best undertaken through extension of the Kogelberg Nature Reserve (a component of the Boland Mountain Complex) to incorporate the municipal Kleinmond Coast and Mountain Nature Reserve. Subject to the declaration of the protected area, the Palmiet EFZ may obtain further zonation in accordance with a protected area management plan.

The full extent of the Palmiet EFZ, is also to be considered a no-take area. That is, all forms of fishing including angling, netting and fish trapping, and bait harvesting are prohibited.

- **Salt Marsh Sanctuary Zone** – The purpose of this zone is for the specific protection of species or habitats of special conservation concern – in this instance the limited salt marsh habitat. All access is restricted (except for research purposes) to prevent disturbance and/or damage and must be suitably demarcated.

- **Recreation: Swimming Zone** – This zone provides an exclusive zone for swimming adjacent to the Palmiet day camp/picnic site and Palmiet Caravan Park and must be defined by floating buoys.
- **Remaining area** – The remainder of the open water area is open to low impact recreational use of electrical motor boats and rowing/paddling. Swimming in all other areas besides the designated zone must be discouraged.



Proposed spatial zonation of the Palmiet River estuary

Integrated monitoring plan

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

The recommended minimum monitoring requirements to ascertain impacts of current and future pressures on the estuary detailing ecological component, monitoring action, temporal scale as well as spatial scale of monitoring are proposed.

By and large, compliance monitoring will be the responsibility of the CapeNature, Department of Environment, Forestry and Fisheries (DEFF) and Overstrand LM, and will be

undertaken according to legislation and policies applicable and by means of law enforcement and compliance monitoring protocols.

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

Institutional Capacity and Arrangements

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

The 2013 NEMP identifies CapeNature as the RMA, responsible for the co-ordination of the implementation of the Palmiet River EMP because the estuary is proposed in the expanded protected area network of the Western Cape Province. **It is noted that in the amendments to the 2013 NEMP, such responsibilities remain allocated to the applicable conservation authority, in this case CapeNature, in respect to estuaries in protected areas or part of a protected area expansion strategy.** Ultimately, the role of RMA must be designated through formal signed agreement.

Effective implementation of this EMP requires the augmentation of capacity within CapeNature, with the recommended appointment of a regional estuarine management co-ordinator (EMC) within DEA&DP. This individual will play a pivotal co-ordinating role for all other implementing agencies as well as CapeNature departments (e.g. Scientific Services). Specific implementation actions identified in this EMP remain the responsibility of mandated government agencies as well as respective departments within the RMA. 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.

While the establishment of an Estuary Advisory Forum (EAF) for each estuary is no longer a requirement in the 2013 NEMP, the Western Cape Government still support their establishment and recommend that private entities and non-government organisations continue to play a supporting role in the implementation of this EMP. While an individual EAF is not recommended, the establishment of a collective EAF is proposed, incorporating the Rooiels, Buffels and Palmiet estuaries.

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

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

- The Palmiet River estuary is formally protected and included in the BMC;
- No-take status confirmed and enforced;
- No further abstraction is authorised/allowed; and
- The DEA&DP to consider the appointment of a Regional estuarine management co-ordinator/champion within either DEA&DP or CapeNature, to support the RMA.

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ACRONYMS AND ABBREVIATIONS

| | |
|-----------|---|
| amsl | Above mean sea level |
| BMC | Boland Mountain Complex |
| BR | Biosphere Reserve |
| CARA | Conservation of Agricultural Resources Act (Act No. 43 of 1983) |
| CBA | Critical Biodiversity Area |
| CFR | Cape Floristic Region |
| CITES | Convention for the International Trade in Endangered Species |
| CMA | Catchment Management Agency |
| CML | Coastal Management Line |
| CMP | Coastal Management Programme |
| CMS | Catchment Management Strategy |
| CPZ | Coastal Protection Zone |
| CSIR | Council for Scientific and Industrial Research |
| DAFF | Department of Agriculture, Forestry and Fisheries (now DALRRD/ DEFF) |
| DALRRD | Department of Agriculture, Land Reform and Rural Development (formerly DAFF) |
| DEA | Department of Environmental Affairs (now DEFF) |
| DEA&DP | Western Cape Government's Department of Environmental Affairs & Development Planning |
| DEFF | Department of Environment, Forestry and Fisheries (formerly DEA / DAFF) |
| DEFF: WfW | Department of Environment, Forestry and Fisheries: Working for Water |
| DIN | Dissolved Inorganic Nitrogen |
| DIP | Dissolved Inorganic Phosphorous |
| DM | District Municipality |
| DMA | Disaster Management Act (Act No. 57 of 2002) |
| DRDLR | Development of Rural Development and Land Reform (now DALRRD) |
| DRS | Dissolved Reactive Silicate |
| DSL | Development Setback Line |
| DST | Department of Science and Technology |
| DWA | Department of Water Affairs |
| DWS | Department of Water and Sanitation |
| EAF | Estuary Advisory Forum |
| EFZ | Estuarine Functional Zone |
| EIA | Environmental Impact Assessment |
| EMC | Estuarine management co-ordinator |
| EMFIS | Western Cape Estuarine Management Framework and Implementation Strategy |
| EMP | Estuarine Management Plan(s) |
| HWM | High Water Mark |
| I&APs | Interested and Affected Parties |
| IAPs | Invasive Alien Plants |
| ICMA | National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008) |
| IDP | Integrated Development Plan |
| KBR | Kogelberg Biosphere Reserve |
| KBRC | Kogelberg Biosphere Reserve Company |
| LED | Local Economic Development |
| LM | Local Municipality |
| LUPA | Land Use Planning Act (Act No. 3 of 2014) |
| MAR | Mean Annual Runoff |
| MEC | Member of the Executive Council |
| MLRA | Marine Living Resources Act (Act No. 18 of 1998) as amended |
| MRPDA | Mineral Resource and Petroleum Development Act (Act No. 3 of 2014) |
| MSA | Municipal Systems Act (Act No. 32 of 2000) |
| MSL | Mean Sea Level |
| NBA | National Biodiversity Assessment |
| NEM: BA | National Environmental Management: Biodiversity Act (Act No. 10 of 2004) |

| | |
|-----------|---|
| NEM: PAA | National Environmental Management: Protected Areas Act (Act No. 57 of 2003) |
| NEMA | National Environmental Management Act (Act No. 107 of 1998) |
| NEMP | National Estuarine Management Protocol (2013) |
| NWA | National Water Act (Act No. 36 of 1998) |
| PAES | Protected Area Expansion Strategy |
| PES | Present Ecological State |
| RDM | Resource Directed Measures |
| REC | Recommended Ecological Category |
| RMA | Responsible Management Authority |
| SAHRA | South African Heritage Resource's Agency |
| SANBI | South African National Biodiversity Institute |
| SAR | Situation Assessment Report |
| SDF | Spatial Development Framework |
| SOP | Standard Operating Procedures |
| SUDS | Sustainable Urban Drainage Systems |
| SWOT | Strengths, Weaknesses, Opportunities and Threats analysis |
| WC BRA | Western Cape Biosphere Reserves Act (Act No. 6 of 2011) |
| WC DoT&PW | Western Cape Department of Transport: Public Works |
| WC TIA | Western Cape Transport Infrastructure Act (Act No. 1 of 2013) |
| WfW | Working for Water |
| WRC | Water Research Commission |
| WUA | Water Users Association |
| WUL | Water Use Licence |
| WWTW | Waste Water Treatment Works |
| RQO(s) | Resource Quality Objectives |

1 INTRODUCTION

1.1 Background

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

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

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

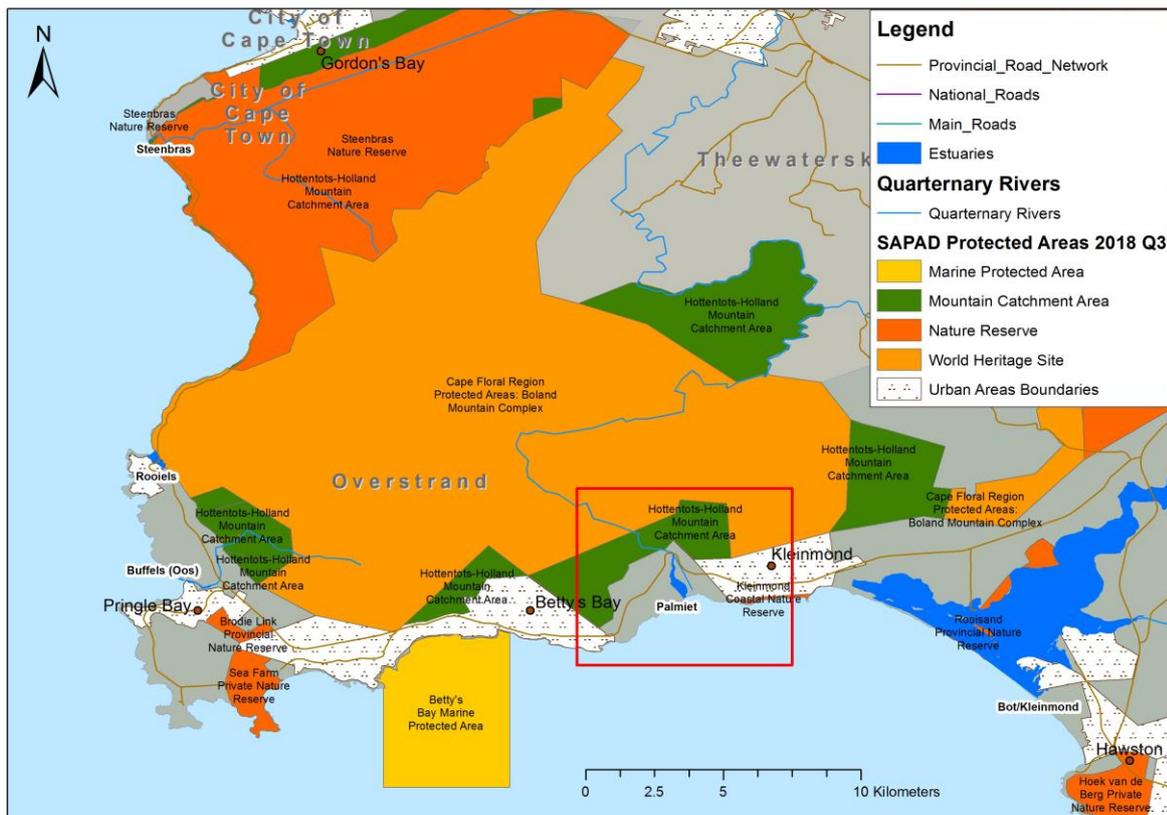


Figure 1: Location of the Palmiet River estuary within the Overstrand Local Municipality

1.2 Purpose of the EMP

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

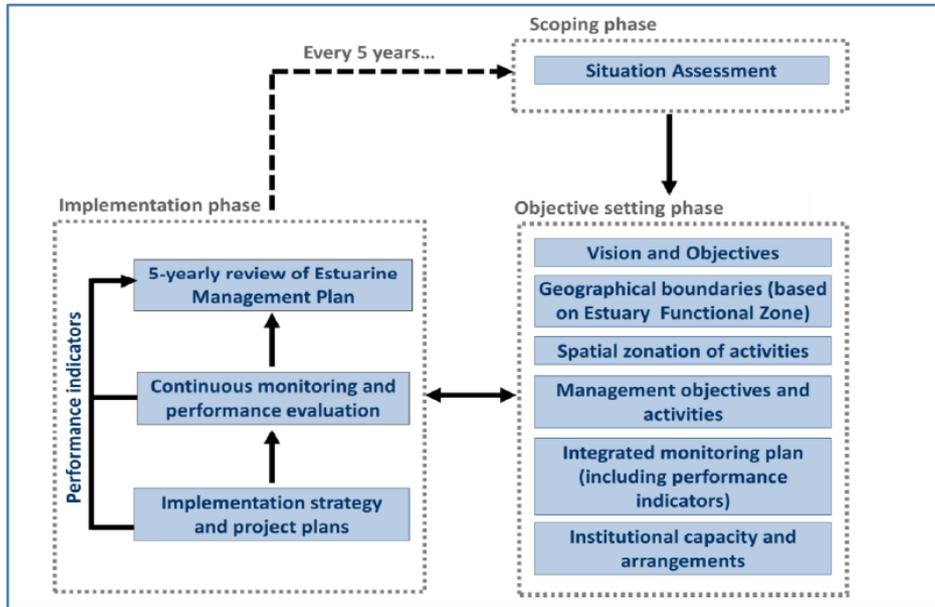


Figure 2: A framework for integrated estuarine management in South Africa

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

Estuarine management is by definition not only focused on the Estuarine Functional Zone (EFZ) but inclusive of coastal hinterland and marine influences, shoreline status, catchment management, climate change and human development impacts such as tourism, recreation and agriculture, amongst many others. This EMP is the primary document for use by the identified Responsible Management Authority (RMA) to facilitate coordination of the identified management interventions to ultimately ensure the longevity of the estuarine system concerned. This is also the critical reference document for the incorporation of estuarine management into the municipal Integrated Development Planning (IDP) and Spatial Development Framework (SDF) processes.

1.3 Mandate and responsibilities of the RMA

The co-ordination of the implementation of the EMP vests with the RMA as per the 2013 NEMP. One of the key objectives of this EMP is to promote and facilitate the cooperative

governance relationship between the RMA and an existing or new estuary advisory forum (EAF), or any other supporting structures or organisations with estuarine-related duties and functions.

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

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

Specifically, the RMA responsibilities are described by the 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 develop the EMP needs to **budget accordingly for the development of these plans.**”*

Section 8(1): *“The responsible management authority developing an EMP must **actively engage all the relevant stakeholders** including government departments, non-government organisations and civil society in the development and implementation of the EMP.”*

Section 9.1(1) and 9.2: *“...it **must obtain formal approval** for the EMP...” and “Once approved...the EMP shall be... **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 ICMA who develops an EMP must:

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

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

1.4 Structure of Report

This report is structured as follows:

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

2 GEOGRAPHICAL BOUNDARIES

The Palmiet River estuary is defined in the 2018 National Biodiversity Assessment (NBA) (SANBI, 2019) as a large temporarily closed estuarine system in the warm temperate bioregion on the Cape south coast, about 75 km south-east of Cape Town, between Betty's Bay and Kleinmond in the Overstrand Local Municipality (LM), Overberg District. The size of the estuary, as defined by the Estuarine Functional Zone (EFZ), is approximately 26.7 ha, extending over a length of 1.75 km. The geographical boundaries of the estuary, delineating the EFZ, provided in Table 1 and illustrated in Figure 3.

Table 1: The Palmiet River estuary estuarine functional zone

| | |
|-----------------------------|--|
| DOWNSTREAM BOUNDARY: | Estuary mouth (-34.345081° S, 18.994593° E) |
| UPSTREAM BOUNDARY: | 1.67 km from the mouth to the extent of tidal influence (-34.329887° S, 18.989591° E) |
| LATERAL BOUNDARIES: | Approximated by the boundary of estuarine vegetation along each bank, and the 5 m above Mean Sea Level (amsl) contour in the upper reaches |

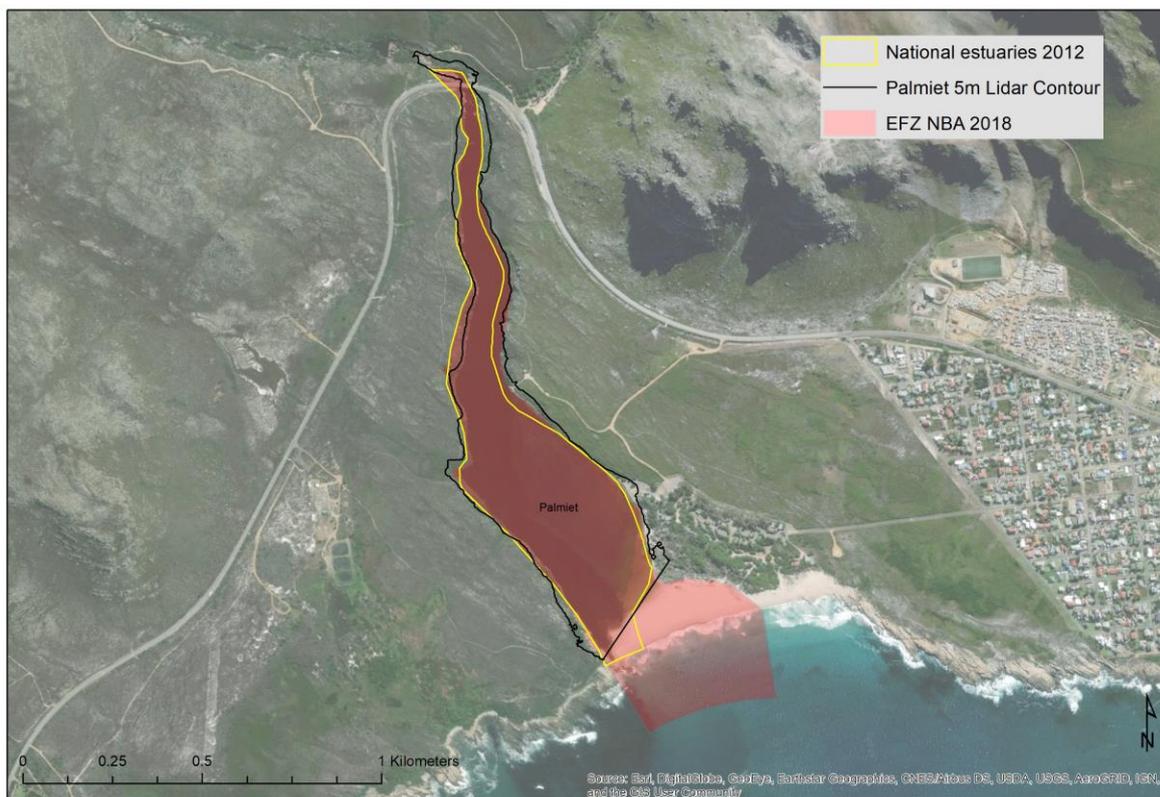


Figure 3: Geographical boundaries of the Palmiet River estuary EFZ showing the 5 m topographical contour and 2018 NBA (SANBI 2019) EFZ boundary

3 SYNOPSIS OF THE SITUATION ASSESSMENT

Introduction

The Palmiet River estuary is defined in the 2018 National Biodiversity Assessment (NBA) (SANBI, 2019) as a large temporarily closed estuarine system situated on the south coast of South Africa, in the Overstrand Local Municipality (LM), between Betty's Bay and Kleinmond, about 75 km south-east of Cape Town.

In accordance with the 2013 National Estuarine Management Protocol (NEMP), developed in terms of the National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008) (ICMA), an Estuarine Management Plan (EMP) must be developed for the Palmiet River estuary. This document is the Situation Assessment Report (SAR) which provides detailed background information in preparation for the management planning process.

Estuary Management Planning Process

The ICMA was developed to facilitate the sustainable use and management of South Africa's coastline, coastal and estuarine resources. The Western Cape Estuarine Management Framework and Implementation Strategy (EMFIS) has been commissioned in order to co-ordinate and integrate estuarine management in the Western Cape Province and thereby optimise the ecological, social and economic value of these systems on an equitable and sustainable basis. The EMFIS has prioritised, amongst other key actions, the development of specific EMPs, in this instance the Palmiet River EMP. The development of this EMP takes cognisance of and is written in accordance with the National Guidelines for the Development and Implementation of Estuarine Management Plans. The development of an EMP is preceded by a scoping phase with the compilation of a SAR reflecting the current status of estuarine management in the specific estuary.

Purpose of the Situation Assessment Report

The information collection component of the Palmiet River EMP, the SAR, has gathered and interpreted the information that will, together with the empirical data gathered on site, serve as the basis for the development of a vision and applicable management objectives for the Palmiet River estuary.

Catchment Characteristics

The geology of the Palmiet River catchment is dominated by sandstone, quartzites and shales of the Table Mountain Group and shales and sandstones of the Bokkeveld Group. Quartzites and shales of the Witteberg Group occur to a lesser extent. The Palmiet estuary is currently situated in a palaeo-valley that is underlain by bedrock composed of Table Mountain group sandstone of the Nardouw Formation.

The climate of the region is typically Mediterranean, comprising of cold wet winters and hot dry summers. The average annual precipitation for the Overstrand LM is 450-830 mm, which falls all year round. The mean average temperatures range from 25.6 °C in January to 6.3°C in July.

The upper Palmiet River catchment has been transformed by pine plantations and irrigated agriculture (predominantly deciduous fruit), with only a small portion of fynbos remaining. There are five major in-stream dams and numerous smaller farm dams on the Palmiet River system that restrict freshwater flow to the estuary. The estuary itself is located within the municipal Kleinmond Coast and Mountain Nature Reserve. Adjacent to the estuary is the Palmiet caravan park and picnic area. The estuary and caravan park are both considered to be part of an ecological corridor and linear open space area. The town of Kleinmond lies approximately 1 km eastwards of the estuary mouth.

Abiotic function

The present mean annual runoff (MAR) of the Palmiet River estuary is estimated at 163.7 million m³. This is a reduction of 36.1% compared with the natural MAR of 256.3 million m³. Floods would have been about 25% greater and occurred about 55% more frequently under Reference Conditions. In general, compared to the natural conditions, a reduction in the occurrence and magnitude of major floods is observed, but such floods are still occurring. Thus, the flood analysis indicates that there is about a 40% reduction in the occurrence of large and intermediate floods to the Palmiet River estuary relative to the Reference Condition. The hydrological data indicate that the magnitude and occurrence of major floods have been reduced significantly.

Five characteristic abiotic states have been identified for the Palmiet River estuary, related to tidal exchange, salinity distribution and water quality.

- State 1, i.e. closed mouth with no exchange, could occur in the Palmiet River estuary when the mouth is closed and river flow ceases, or if river flow is lower than the losses through evaporation and seepage. Reliable data on this situation are not available but, based on observations, it is estimated that this 'state' could occur at river flows of less than 0.05 m³s⁻¹. The present base flows are, according to the available data never lower than 0.2 m³s⁻¹. This state occurs when the berm built up at high wave conditions to a level above the water level in the estuary. Inflows then resulted in a slow increase in water levels until the berm started overflowing again.
- State 2; i.e. the semi-closed mouth, occurs during low flow usually in the summer, when the mouth often shifts on to the rocks at the south-western end of the berm. An almost continuous outflow then occurs, but the rocky sill in the mouth is too high to allow influx of seawater, even during spring tides. The normal functioning of the mouth involving tidal exchange between the estuary and the sea is then interrupted. While it is physically open in terms of river outflow, it is effectively closed in terms of tidal exchange, which is the basis of estuarine functioning. This state is increased by dam development and associated flow reduction. When an estuary mouth closes, it has major effects on the water dynamics and therefore also water chemistry of the estuary. The river flows at which mouth closure/semi-closure occurred ranged from 0.23 to 1.01 m³s⁻¹. The large range is an indication of the influence that high waves and tidal exchange have on such occurrences.
- State 3: Highly stratified with strong marine influence: exists when the mouth is open, and when the river flow is significantly lower than the tidal flows through

the mouth. These indicate that this state will exist when river flow is between 5 and 10 m³ s⁻¹.

- State 4: Highly stratified with strong freshwater influence: usually occurs during the wet season with limited seawater intrusion and strong river influence. It occurs at river flows between approximately 10 m³s⁻¹ and 20 m³s⁻¹. However, there are probably overlaps between State 3 and State 4 at lower flows, and between State 4 and State 5 at higher flows. River flow dominates during this state and only a limited influx of saline water from the sea takes place at high tides.
- State 5: Freshwater dominated: occurs at river flows > 20 m³s⁻¹. The estuary will become totally fresh within a day or three of flows reaching 20 m³s⁻¹, and will stay fresh until the river flow drops below 20 m³s⁻¹ and State 4 re-occurs.

Water quality data on river inflow to the Palmet River estuary show a marked increase in pH in the early 1990's when average pH levels appeared to increase from ~5 to ~7. DIN concentrations show a distinct seasonal signal, with distinct peaks during winter. Winter peaks appeared to have dropped markedly since 2002 from ~1000 µg.l⁻¹ to ~500 µg.l⁻¹. A black water system like the Palmet River is expected to be oligotrophic in its natural state. These exceptionally high winter DIN peaks are therefore most likely associated anthropogenic inputs from agricultural activities in the catchment (although this needs to be confirmed). DIP concentration in river inflow remained low over the years with no distinct seasonal signal. Concentrations showed a slight increase from ~20 µg.l⁻¹ to 30 µg.l⁻¹ in the past 8 years. Dissolved reactive silicate-Si (DRS) also did not show any distinct seasonal pattern, averaging 1500 µg.l⁻¹. The water quality characteristics of the system are described for each of the defined states in terms of major estuarine water quality parameters, including dissolved inorganic nutrients.

In terms of sediment process, the Palmet catchment has a naturally low sediment yield. The sediment dynamics within the estuary are not well understood because of lack of information. Dam developments on the river can affect the sediment dynamics of the Palmet River estuary in two opposing ways, sedimentation resulting from a reduction in flood occurrence, while dams in the lower catchment will act as a sediment trap and could reduce sediment supply to the estuary.

Biotic function

Measured phytoplankton chl-a ranged from 2.12 to 7.76 µg L⁻¹ in December, and 1.48 to 4.82 µg L⁻¹ in April. These concentrations were low compared to permanently open estuaries but higher than expected in such a short estuary with a fast flow regime. Measurements suggest that phytoplankton cells were imported from the river and sea. A small dam, just behind the weir above the coastal road, may be the source of the phytoplankton biomass as there was little evidence of phytoplankton in the river upstream of the weir. A number of factors could influence benthic microalgal biomass in the Palmet River estuary, poor light penetration through the tannin-stained water column, low sediment organic content, sediment scour, nutrient concentration, and mouth conditions.

The small area of the Palmet River estuary and the steep rocky banks restrict the development of estuarine plant communities. There are no rooted submerged

macrophytes because of high flows, unstable substrate and low light permeability of the estuary. The only comprehensive botanical survey of the estuary took place in the 1980s. They reported that the filamentous green algae *Cladophora* and *Enteromorpha* occurred in the estuary between December and April. On the central, eastern bank of the estuary a small salt marsh exists on a sheltered region of the sandflat and 12 different salt marsh species have been reported. The reduction in flooding and extended drought periods resulted in stagnant water conditions and an increase in macroalgal growth which is a problem as decomposition of the organic load leads to anoxic conditions. The increase in the duration of semi-closed mouth conditions would increase macroalgal growth. Higher water levels and closed mouth conditions would result in inundation and die-back of the small area of salt marsh. This reduction in river flow would reduce allochthonous inputs from the river.

No comprehensive study of the zooplankton has been undertaken but biomass values indicate a very depauperate fauna. This is typical for black-water systems, and zooplankton is unlikely to play an important part in the functioning of the estuary. In terms of benthic invertebrates, the number of species in the estuary is low. Most of these are benthic (>75%), with some associated with rocky substrata (2 species) and about 4-5 insect species spending part of their life cycle in the aquatic medium. There is no information on the hyperbenthos, but it is predicted that the hyperbenthos is extremely low in biomass or abundance. In respect of intertidal macrofauna, the sandprawn *Callinassa kraussi* colonises the intertidal sandbank in the lower estuary, equating to about 35% of the total surface area of the estuary covered by high tide. The gastropod *Hydrobia* and the polychaete *Ceratonereis* are also important on the intertidal sandbank, although from a biomass perspective, they probably contribute <10% to total intertidal biomass. Recent sampling of the Palmiet shows that invertebrate species richness increased from 31 species in 1980 to 40 in 2015, despite lower sampling effort in 2015.

A total of 25 fish species representing 16 families have been recorded from the Palmiet River estuary. Five of these are entirely dependent on estuaries to complete their lifecycle. A further 14 species are at least partially dependent on estuaries. In all, 90 % of the fish species recorded from the Palmiet can be regarded as either partially or completely dependent on estuaries for their survival. No purely marine species have been recorded from the Palmiet River estuary. Excluding the two indigenous and three introduced fish of freshwater origin, the 20 species listed in the Palmiet River estuary compare favourably with those recorded from the nearby, seasonally open Kleinmond Estuary (17 species), and normally closed Bot Estuary (12 species).

Overall, fish numbers are low. The low benthic algal biomass accounts for the relatively low numbers of Mugilidae compared to other estuaries. High macroalgal biomass during the summer months can provide habitat for *Syngnathus temminckii* and *Rhabdosargus holubi*, but night-time respiration and eventual decomposition may lower oxygen levels, thus excluding them. Low benthic oxygen conditions during states 1 and 2 may account for the low numbers of benthic species such as *Solea bleekeri* and *Caffrogobius* spp. for much of the time. Of the 14-sea spawning estuarine-dependent species, ten spawn during winter and/or spring which enables them to enter estuaries

in early summer when flows are reduced but the mouths still open. Nine species were recorded recruiting into the estuary, of which seven enter the system during the summer months. Ripe adults of five species were observed in the estuary from September through to March, none during the winter. No clear seasonal patterns in food preference was found for any of the fish species examined from the estuary. It is likely however, that food availability drops during the winter floods when much of it is washed out to sea.

An emerging concern is the occurrence of pathogenic water mould *Aphanomyces invadans*, which now occurs in the estuary and throughout the Palmiet River system. In 2015, it was found infecting and causing 100% mortality of barehead goby *Caffrogobius nudiceps* in the Palmiet Estuary. Fish susceptibility is most likely related to changes in inflowing water chemistry from acidic to basic. This disease has a high mortality rate and it poses a significant threat to the wild and introduced fish populations of the entire Palmiet river system, including the estuary.

The Palmiet River estuary contains relatively few waterbird species relative to other estuaries in the region. A total of 24 waterbird species have been recorded on the estuary, of which at least three are probably not very frequent visitors to the estuary. The estuary does not support important populations of any species of conservation significance. The only Red Data species recorded in the area, the African Penguin, is likely to have been recorded on the beach in front of the estuary and is certainly not in any way dependent on the estuary. Thus, the estuary is not of particular importance in terms of its waterbirds. The estuary's avifauna is dominated by terns and gulls. The presence of terns in the estuary is probably highly variable on a tidal as well as a seasonal basis. Gulls are relatively common on the estuary, and their increase in numbers probably reflects their general population increases in the south-western Cape to some extent. Waders are conspicuously absent from the estuary, in spite of a relatively large area of intertidal flats, which have a reasonably high invertebrate biomass per unit area. The low overall numbers and diversity of birds on the estuary have been ascribed to the small size of the estuary, low nutrient status and lack of habitat diversity and thus low food availability, and human disturbance.

Ecological Health Status, Importance, and Recommended Future State

The Palmiet Estuarine Health Assessment was done as part of a Rapid determination of the Environmental Water Requirements for the Palmiet River Estuary. The health condition (also referred to as the Present Ecological State (PES)) of an estuary is typically defined on the similarity of its current condition to an estimated natural condition. The overall ecological health of the Palmiet River estuary is in a C Category.

Major drivers of change in the system were a significant reduction in river inflow (floods and baseflows), increased mouth closure; reduced sediment scouring and an increased nutrient load from the catchment. Of special concern were the occurrence of macrophyte blooms in the estuary as a result of increase nutrients, reduced baseflow and closed (or semi-closed) mouth conditions. Die-off of these macrophyte blooms causes hypoxic or anoxic conditions in the estuary, which in turn puts the rest of the ecosystem under stress. An additional concern was the long periods of artificial droughts

the estuary was currently experiencing, and the impact this would have on fish recruitment.

The 2011 National Biodiversity Assessment, developed a biodiversity plan for the estuaries of South Africa by prioritising and establishing which estuaries should be assigned partial or full Estuarine Protected Area status. The Palmiet River estuary forms part of the core set of priority estuaries in need of protection to achieve biodiversity targets in the National Estuaries Biodiversity Plan. 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 or B. In addition, the Palmiet River estuary falls within the Kogelberg Biosphere Reserve and is also part of a regional conservation plan for the cool and warm temperate estuaries of South Africa.

The Estuary Importance Score for an estuary takes size, the rarity of the estuary type within its biographical zone, habitat diversity and biodiversity importance of the estuary into account. Biodiversity importance, in turn is based on the assessment of the importance of the estuary for plants, invertebrates, fish and birds, using rarity indices. The functional importance of the Palmiet River estuary was rated as average as it is of some importance as a fish nursery area and a conduit for eels which are Convention on International Trade in Endangered Species (CITES) listed species. Overall, Palmiet River estuary was deemed of 'Average Importance'.

The Recommended Ecological Category (REC), or desired state, signifies the level of protection assigned to an estuary from a flow perspective. The major pressures currently contributing to the degraded health of the Palmiet River estuary are poor water quality and reduction in river inflow in summer. These impacts can be mitigated with little effort. Therefore, based on the recommended health status for a protected area and the ease with which this can be achieved for the Palmiet River estuary, the REC for the Palmiet River estuary is a Category B. However, it is noted that the 2018 NBA (SANBI 2019) suggests a Category C.

Key interventions required to achieve the REC include:

- Manage anthropogenic nutrient and organic matter inputs to the estuary through improved agricultural and urban landscape management;
- Improve the compliance monitoring of fishing and bait collection activities on the estuary.
- Restrict bait collection when the mouth is closed, since recruitment cannot occur during extended periods of mouth closure as it leads to the depletion of important food resources in the estuary.
- Install a fish ladder at the gauging weir, and an eelway at the dams, to facilitate migration of fishes into the lower river reaches.

Ecological Specifications and thresholds of potential concern for various abiotic and biotic attributes were developed as part of the Environmental Water Requirements study for the Palmiet River estuary. These are included in the future monitoring programme of the system, which incorporates baseline surveys to collect data and information to improve the understanding of the ecosystem functioning and a long-

term monitoring programme to assess whether management objectives are being achieved.

Important Ecosystem Goods and Services

The natural environment provides a range of valuable ecosystems services (also termed goods and services) to society, including provisioning services (such as food, water and other resources), regulating services (e.g. climate regulation, as well as air and water purification), cultural services (e.g. aesthetic, spiritual, recreational, educational and cultural benefits), and life-support services (such as nutrient cycling and soil formation). The rating of all these services for the Palmiet River estuary is low except for the refugia/nursery areas and export of materials and nutrients which are medium, and the structure and composition of biological communities' service is rated as high. The yearly nursery monetary value for this estuary is R900 000, which is the second highest value when compared to the other estuaries along the Kogelberg Coast. The main recreational activities taking place within the Palmiet River estuary include boating, swimming, walking/hiking, picnicking, very limited fishing primarily from the western shores, and bait harvesting. These activities increase during the peak holiday periods. Illegal fishing by means of gill netting, is problematic.

Impacts or Potential Impacts

In summary, there are some major pressures on the Palmiet River estuary, which is currently in a moderately modified condition. However, the system is on a negative trajectory of change related to key pressures in the catchment, namely significant reduction in river inflow, increased mouth closure, reduced sediment scouring, limited bait collection and fishing, and an increased nutrient load from the catchment. Water quantity and quality in the Palmiet River estuary is compromised almost entirely by poor catchment management, which includes numerous dams, plantations and intensive agriculture. The weir immediately upstream of the estuary completely blocks the recruitment several fish species into the freshwater reaches of the catchment.

Overview of Socio-Economic Context

The Overstrand LM covers a land area of approximately 1708 km², and covers the areas of Hangklip/Kleinmond, Greater Hermanus, Stanford and Greater Gansbaai. The municipal area has a coastline of approximately 230 km long, stretching from Rooi-Els in the west to Quinn Point in the east. The Overstrand LM is the second most populated local municipality within the Overberg DM, with an estimated total population of 93 408 people and has an average growth rate of 3.42%.

Of the population aged 20 years and older, 2% have no form of schooling (StatsSA, 2016). There are 35 719 households in the Overstrand LM, of which 78% have access to piped water within their dwellings. Electricity for lighting is provided to 97% of all households. Approximately 35 553 people are economically active, with an overall unemployment rate of 23.3%, and a youth unemployment rate of 31.1%. Approximately 36% of the population earns an average household income of less than R38 200 per annum, while a further 16.4% receive no income at all. In respect to poverty, the poverty headcount shows that the number of poor people within the Overstrand LM increased from 1% of the population in 2011 to 1.6% in 2016. Approximately 35 553 people are

economically active (both employed and unemployed but looking for work), with an overall unemployment rate of 23.3 %, and a youth unemployment rate is 31.1 %. Approximately 36 % of the population earn an average household income of less than R38 200 per annum, while a further 16.4 % receive no income at all.

Within the estuary surrounds, the Palmiet River estuary and its catchment, falls within Ward 10 of the Overstrand LM, which has a total population of 5 881 people. The closest settlement to the Palmiet River estuary is the town of Kleinmond, which has a total population of 6634 and a population density of 930 persons per km². Approximately 63.6% of this population falls within the economically active-age group between 15-64 years and 20.3% has a higher education.

In terms of the local economy, the Overstrand LM contributed 31.6% to the district Gross Domestic Product at the end of 2015. The economy grew by 3.3% per annum between 2005 and 2015. The three main sectors in 2015 contributing to this growth were the commercial services sector (58.1%), the manufacturing sector (14.2%) and the government and community, social and personal services sector (14.1%). The Overstrand LM employed 28.8% of the districts labour force in 2015, with a growth rate of 2.9% during the 2005-2015 period even though there were significant job loses prior and during the recession. These jobs have been recovered and about 8 491 (net) additional jobs have been created since 2005.

The direct and indirect benefits derived from estuarine ecosystem services are manifested directly or indirectly in tangible income and employment. There are no known subsistence communities that rely on the natural resources of the Palmiet River estuary for their livelihoods or income generation. The main form of social dependency associated with the estuary relates to its recreational use during the summer months. These activities include swimming, fishing, bait collection and boating.

In terms of Local Economic Development (LED), opportunities to reduce poverty and socio-economic pressures, including poaching and other illegal activities, should be sought. For example, the main focus of the Overstrand LM is: tourism, aquaculture/agriculture, manufacturing, finance, real estate and business services, as well as the secondary service industry. As tourism is a major draw card for the region, eco-adventure activities and other sectors related to tourism, such as catering and accommodation, retail and wholesale, transport and business services should be investigated as avenues for LED opportunities.

Legislative Instruments and Related Strategies / Programmes

The main directive for instituting estuarine management stems from the ICMA and the associated 2013 NEMP, which prescribes the national estuarine management objectives, the contents and minimum requirements of EMPs, as well as assigns responsibilities for developing and coordinating EMPs to various levels of government based on municipal jurisdiction. According to the 2013 NEMP, the overall co-ordination of the implementation of the EMP for the Palmiet River estuary vests with Overstrand LM as the identified Responsible Management Authority (RMA), given the location of the estuary fully within its municipal boundary. **It is noted that proposed amendments to the**

2013 NEMP allocate such responsibilities to the provincial environmental department unless agreement, or until agreement, is reached with the respective municipality to undertake the coordination of the implementation process. Under the legislative review, key legal instruments that are applicable to estuarine management are described, and include national, provincial and local management documents. At the local management level, both the Overberg District Municipality Integrated Development Plan (IDP) and the Overstrand LM IDP address the management of estuaries within their jurisdiction areas, e.g. the Overberg District Coastal Management Programme advocates the preservation of the coastal zone, and all watercourses, wetlands and estuaries are considered vital components of the ecological infrastructure of the region.

Opportunities and Constraints

A Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis for the management of the Palmiet estuary was undertaken. One of the main strengths is that the estuary and its catchment fall within the Kogelberg Biosphere Reserve, which is South Africa's first biosphere reserve, while the river course above the R44 road bridge is protected within the Hottentot-Hollands Mountain Catchment Area and the Kogelberg Nature Reserve, both of which are component of the Boland Mountain Complex (BMC) Protected Area, further reinforcing the desire for protected area status. It is also afforded some level of protection under the informal municipal Kleinmond Coast and Mountain Nature Reserve. The proximity of these conservation areas should increase the chances of extending the protected area to include the estuary, which would ensure protection of the river-estuarine continuum. The major threat to the system stems from the numerous impoundments in the catchment and growing water demand, which have placed the system on a negative trajectory of change. These will have a significant effect on base flows and floods reaching the estuary, sediment scouring, mouth dynamics and estuary processes, as well as water quality. However, given the limited development in and around the system, and the fact that the most serious impacts are flow related, it is perceived that such impacts will be potentially easily reversible. Overexploitation of living resources and poaching is another serious issue affecting the estuary, as well as fish disease and catchment water pollution. Potential threats which will jeopardise the health and function of the system include continued poor catchment management, increasing agriculture activities and malpractices, and water resource development in the catchment. These will render poor water quality in the estuary with knock on effects for the ecology and contribute to closure of the system.

The functional importance of the Palmiet River estuary was considered average on a national scale as it is of some importance as fish nursery. The estuary is also an important conduit for eels which are CITES listed species. The estuary also forms part of the core set of priority estuaries in need of protection to achieve biodiversity targets in the National Estuaries Biodiversity Plan and the regional conservation plan where 50% of the terrestrial marginal area should remain undeveloped, it should be considered a full no-take zone (i.e. a sanctuary closed to all forms of harvesting of living resources), and the REC should be an A or B.

In terms of opportunities for restoration, the restoration measures required to improve the present health of the Palmiet River estuary (as per Ecological Water Requirement assessment) include:

- Managing anthropogenic nutrient and organic matter inputs to the estuary through improved agricultural and urban landscape management;
- Improving the compliance monitoring of fishing and bait collection activities on the estuary.
- Restricting bait collection when the mouth is closed, since recruitment cannot occur during extended periods of mouth closure as it leads to the depletion of important food resources in the estuary.
- Installing a fish ladder at the gauging weir, and an eelway at the dams, to facilitate migration of fishes into the lower river reaches.

Recommendations to Address Major Information Gaps

The current information available on the Palmiet River estuary is outdated (or lacking) and monitoring needs to be undertaken to update the available baseline information which will be used to facilitate the management of the estuary.

Ecological monitoring, should be undertaken, the results of which can be compared to the baseline information to highlight any impacts that are occurring and to monitor the state of the estuary. Scientific research into the prevalence of the fish disease, EUS should be prioritised.

All data generated through regional and local projects and monitoring programmes should be sourced, collated and stored at a central repository to build up long –term datasets to facilitate adaptive estuarine management.

Agreements and regulations regarding the use and operation of the live aboard houseboat need to be clarified.

4 VISION & OBJECTIVES

4.1 Vision

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

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

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

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

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

The following Vision for the Palmiet River estuary was proposed at a public meeting held in October 2017 in Pringle Bay¹ and supported at a second meeting held in April 2018²

“The Palmiet River estuary is healthy, well managed and formally protected within the Biosphere Reserve as a natural gem that provides sanctuary and corridors for wildlife and recreational space for responsible enjoyment by current and future generations”

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

- The estuary's beauty, current healthy state and good management;
- The estuary's value and the need to ensure its formal protection and inclusion within the Biosphere Reserve;

¹ Minutes of the 1st stakeholder meeting for the Rooiels, Buffels and Palmiet River estuaries, 11 October 2017, Pringle Bay Community Hall, Pringle Bay

² Minutes of the 2nd stakeholder meeting for the Rooiels, Buffels and Palmiet River estuaries, 23 April 2018, Proteadorp Community Hall, Kleinmond

- The estuary's importance in protecting biodiversity and providing a sanctuary;
- The importance of managing and effectively policing resource use and criminal and/or unsocial behaviour;
- The linkage that the estuary provides between the surrounding landscape and sea;
- The role that the estuary plays in providing a recreational space;
- The role that the estuary provides in terms of local economic benefits; and
- The need to manage activities around the estuary to ensure that these values are retained.

4.2 Strategic Objectives

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

The strategic objectives for the Palmiet River estuary were discussed at the stakeholder meeting. Based on the feedback received from the participants, the strategic objectives for the Palmiet River estuary align with the following identified sectors or categories of issues:

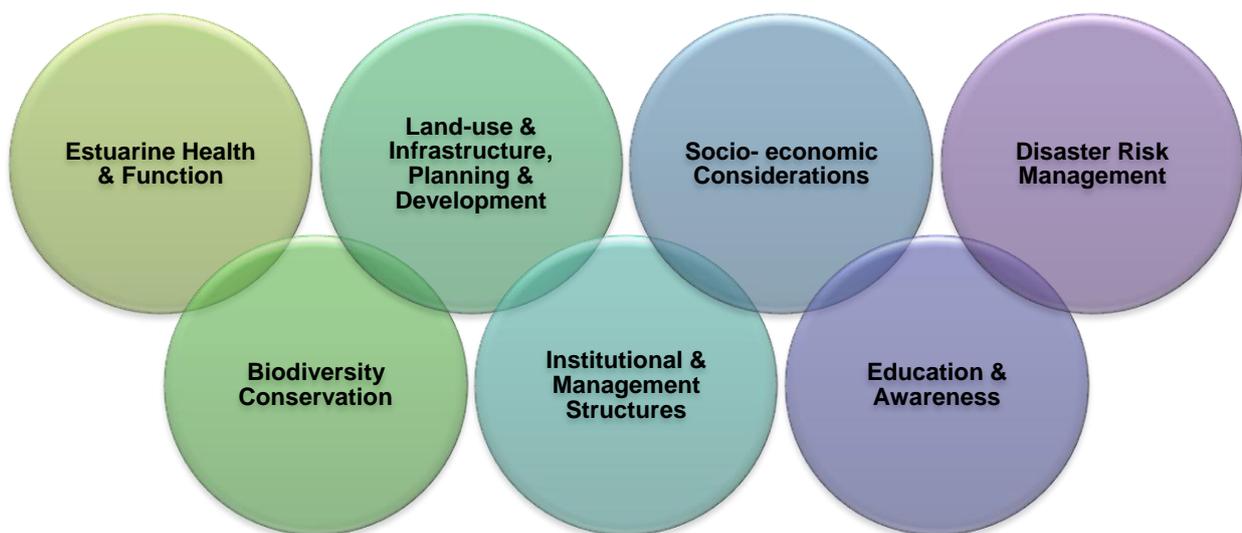


Figure 4: Sectors or categories of issues relevant to the management of the Palmiet River estuary

According to these categories, the key objectives for the Palmiet River estuary are as follows:

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

| Sector / Category | Strategic Objective | Performance Indicator(s) | Priority |
|--|---|---|-------------|
| 1 Estuarine Health and Function | The ecological health and natural functioning of the Palmiet is improved, its negative ecological trajectory and catchment impacts reversed, and estuary nursery function protected in a hotter, drier future | <ul style="list-style-type: none"> • Ecological health improved to B/C condition • Ecological reserves for water quantity and quality are secured and implemented • No additional water abstraction authorised • Nutrient pollution from agriculture reduced • Water quality monitoring programme in place • Invasive alien plant infestation managed • Ecological monitoring programme in place • Fish disease controlled • Ecological integrity of estuary improved and maintained • Increase in number of research and monitoring projects | HIGH |
| 2 Biodiversity Conservation | The biodiversity of the Palmiet River estuary is conserved | <ul style="list-style-type: none"> • Palmiet River estuary formally proclaimed as a Protected Area and or Marine Protected Area • No-take status established • Spatial zonation plan is adopted and enforced • Estuarine bylaws or regulations are gazetted • EMP incorporated into the Boland Mountain Complex (BMC) Management Plan • Environmental custodianship secured • Reduced habitat degradation and inappropriate behaviour/activities | HIGH |
| 3 Land-use and Infrastructure Planning and Development | Impacts associated with developments and proposed changes in land-use, including infrastructure and agriculture, are minimised | <ul style="list-style-type: none"> • All development and land use changes surrounding and within the EFZ comply with environmental legislation and environmental best practice / risk aversion approach • Further transformation of estuary margins prevented • Reduced negative impacts from agricultural activities | HIGH |

| | | | | |
|----------|---|---|--|---------------|
| 4 | Institutional and Management Structures | The Palmiet River estuary is well managed through effective co-operative governance | <ul style="list-style-type: none"> • EMP is seamlessly incorporated into the Boland Mountain Complex (BMC) Management Plan • Regional estuary advisory forum is established and meets regularly • Estuarine bylaws are drafted • Mandated authorities and participating agencies are well capacitated, actions are fulfilled • Critical management networks are established | MEDIUM |
| 5 | Socio-economic Considerations | Socio-economic benefits are enhanced and regulated to ensure sustainable use of the Palmiet River estuary and its resources | <ul style="list-style-type: none"> • Estuarine usage well understood • Standard operating procedures in place to manage visitor numbers • Signage erected • Reduced habitat loss/degradation and disturbance, and inappropriate behaviour | HIGH |
| 6 | Education & Awareness | Members of society are sensitive to and aware of the value and importance of the Palmiet River estuary | <ul style="list-style-type: none"> • Increase in number of research projects • Signage erected • Information disseminated • Awareness programme developed and successfully implemented on an on-going basis | MEDIUM |
| 7 | Disaster Risk Management | Potential risks that could impact the Palmiet River estuary are reduced (inclusive of climate change impacts) | <ul style="list-style-type: none"> • Rehabilitation of degraded areas • No further development in high risk areas • Flood disaster management plan developed • Contingency plans in place for high risk areas / activities • Disaster impacts are timeously and effectively mitigated • Key infrastructure is well defended | LOW |

5 PRIORITY MANAGEMENT OBJECTIVES AND ASSOCIATED ACTIVITIES

After the review of the background information, as well as after conducting stakeholder engagement, a SWOT analysis of the Palmiet River estuary under the current management practices was prepared.

Table 3: SWOT Analysis

| STRENGTHS <i>(highlights, uniqueness?)</i> | WEAKNESSES <i>(what could be improved?)</i> |
|--|--|
| <ul style="list-style-type: none"> • Largely undeveloped, sparsely populated landscape immediately adjacent to estuary • A predominantly open estuary that serves as a critical nursery area • A system of noteworthy aesthetic/scenic beauty • Some level of protection afforded by informal municipal nature reserve • Banner of Hottentots Holland Mountain Catchment / BMC area and KBR as a conservation-worthy area • Unrestricted (vehicle, pedestrian) and maintained access to various points of estuary for recreation and resource use • Recreational areas defended against dynamic coastal processes | <ul style="list-style-type: none"> • System is on a negative trajectory of change • Numerous impoundments in the catchment and significantly reduced base flows and floods • Increasing mouth closure and alteration of estuarine functioning • Pollution from the catchment affecting water quality (especially agricultural pollution from diffuse runoff) • A thoroughfare for illegal activities, specifically marine poaching, including gill netting • Invasive alien plant infestation • Fish disease affecting wild and farmed fish populations within the catchment and in the estuary with the propensity to spread to other aquatic ecosystems through boating • Some transformation of estuary margins |
| OPPORTUNITIES <i>(Opportunities for positive change)</i> | THREATS <i>(what could prevent the EMP from working?)</i> |
| <ul style="list-style-type: none"> • Very little development in and around the system thus little management intervention is required to maintain, or improve its condition • Major impacts are flow-related and thus potentially reversible • Obtain formal protected area status • Estuary and catchment forms part of the KBR which should assist in leveraging funding for compliance and monitoring • Local buy-in from Overstrand LM, residents of Kleinmond and business owners for custodianship of estuary • Increased public awareness | <ul style="list-style-type: none"> • Continued poor catchment management • Increasing agricultural activities and malpractices • Significant water resource development in the catchment and over-abstraction • Closure of estuary and change in estuarine functioning • Risk of backflooding as a result of closure • Significant water quality issues and knock on effects for ecology • Overexploitation of living resources and poaching/gillnetting |

| | |
|---|---|
| <ul style="list-style-type: none"> Monitoring & scientific research Updating of available ecological data | <ul style="list-style-type: none"> Climate change, increased drought conditions and loss of aquatic habitats, and increased winds and fire risk. |
|---|---|

The management objectives detailed below were informed by the SWOT analysis and critical issues identified as part of the scoping phase and stakeholder engagement. They represent the focus areas for the 5-year cycle of this EMP. An illustrative overview of the priority management objectives for the Palmiet River estuary is provided in Figure 5 below.

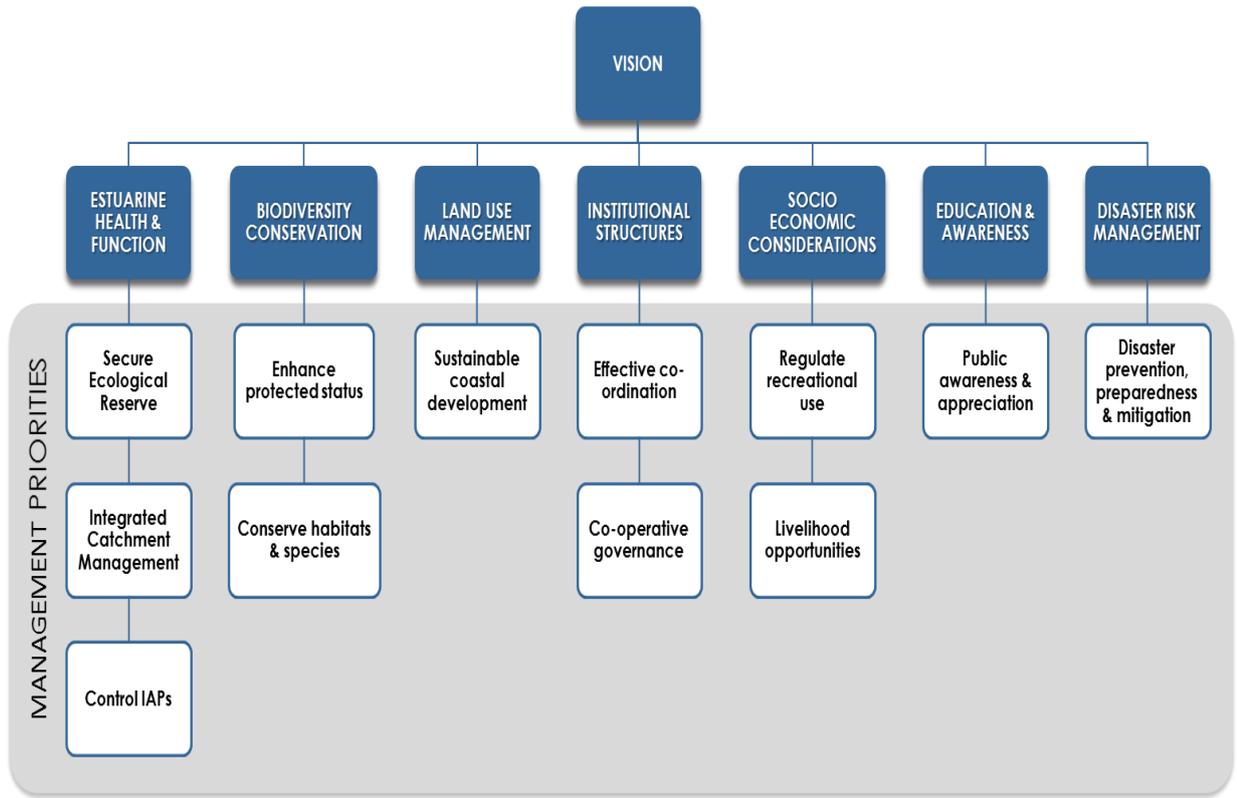


Figure 5: Summary of management priorities per management sector

5.1 Estuarine Health and Function

Strategic Objective 1: The ecological health and natural functioning of the Palmiet is improved, its negative ecological trajectory and catchment impacts reversed, living resources are sustainably managed and estuary nursery function protected in a hotter, drier future.

Table 4: Management Objectives and Actions for Estuarine Health and Function (includes water quantity)

| Action | Relevant Legislation | Performance Indicator | Priority | Responsibility | |
|--|--|--------------------------|---|----------------|---|
| Management Objective 1.1: Secure adequate quantity and quality of freshwater input to improve and maintain ecosystem health and functioning | | | | | |
| a. | Lobby Department of Water and Sanitation (DWS) Minister to sign off the recommended freshwater reserve, ensuring that the minimum flow requirement (specifically baseflow) for the estuary is restored, despite lower projected rainfall in future | National Water Act (NWA) | <ul style="list-style-type: none"> • Meetings held and correspondence written • Recommended reserve(s) signed off • Continuous monitoring of inflow at gauging weir in catchment • Review and amendment of allocations made • Baseflow restored • Ecological condition improved from category C to category B/C | HIGH | Breede-Gouritz Catchment Management Agency (BGCMA), DWS |
| b. | Once classification study signed off, follow up on implementation of water resource classification process | NWA | <ul style="list-style-type: none"> • Meetings held and correspondence written • Water resource classified | HIGH | BGCMA, RMA |
| c. | Monitor natural mouth dynamics (in partnership with DWS, neighbouring land owners and other Interested and Affected Parties (I&APs)) | NWA (RDM) | <ul style="list-style-type: none"> • DWS to maintain water level recorder in the mouth • Mouth state documented • Photographic database generated | HIGH | RMA |
| d. | Implement and document Department of Environment, Forestry and Fisheries (DEFF) and DWS policy to not allow Waste Water Treatment Works (WWTW) discharge to the estuary | NWA | <ul style="list-style-type: none"> • Discharge of wastewater prohibited | MEDIUM | RMA, DWS, DEFF, Overstrand LM |

| Action | Relevant Legislation | Performance Indicator | Priority | Responsibility |
|--|--|---|----------|--|
| e. Implement agricultural best practice specifically to reduce nutrient enriched return flow and sediment erosion from surrounding farms and catchment. | Conservation of Agricultural Resources Act (CARA), NWA | <ul style="list-style-type: none"> • Engagement with famers in catchment initiated • Best practice methods promoted and implemented | MEDIUM | Department of Agriculture, Land Reform and Rural Development (DALRRD) |
| f. Undertake detailed investigation of specific estuarine impacts/cumulative pressures (identifying stresses and responses) with full recognition of future climatic conditions | NEM:BA | <ul style="list-style-type: none"> • Negotiate with research organisations to undertake research • Research undertaken • Research results inform EMP | MEDIUM | RMA, KBRC, CapeNature, Overstrand LM |
| g. Undertake seasonal monitoring of fish and bird populations, taking Resource Quality Objectives (RQOs) into account | NWA | <ul style="list-style-type: none"> • Identify species / sensitive habitats of concern - generate guidelines if required • Identify and monitor indicator species (to assess ecosystem functionality) • Data produced and reported on • Data incorporated into EMP 5-year review | MEDIUM | RMA, DEFF, South African National Biodiversity Institute (SANBI), Cape Nature, (funding from WRC, DST) |
| h. Undertake full Resource Directed Measures (RDM) monitoring every 3 years | ICMA, NWA | <ul style="list-style-type: none"> • Required basic monitoring undertaken • Data produced and reported on • Data incorporated into EMP 5-year review | LOW | DWS, BGCMA, RMA (funding from Water Research Commission (WRC), Department of Science and Technology (DST)) |

| Action | | Relevant Legislation | Performance Indicator | Priority | Responsibility |
|--|---|-----------------------------|---|----------|---------------------------|
| i. | Investigate the extent of fish disease within the Palmiet River estuary and develop an action plan to eradicate the disease | MLRA | <ul style="list-style-type: none"> Investigation study completed | HIGH | DEFF, SANBI, CapeNature |
| Management Objective 1.2: Ensure estuary requirements are integrated into catchment processes to ensure healthy water quality | | | | | |
| a. | Catchment land use map developed and updated annually | NWA | <ul style="list-style-type: none"> Updated land use map produced every year Potential sources of pollution identified Early warning system established to alert users of possible health threats | MEDIUM | DWS |
| b. | Land use and effluent management included in the Catchment Management Strategy (CMS) | NWA | <ul style="list-style-type: none"> CMS reduces nutrient pollution from agricultural practices and identifies additional sources of pollution (land use and effluent) to the estuary and provides mitigation strategies | LOW | BGCMA |
| c. | Water use plan updated on an annual basis | NWA | <ul style="list-style-type: none"> Updated water use plan produced every year | LOW | DWS (Resource protection) |
| d. | SDF and environmental overlay updated as and when required | Municipal Systems Act (MSA) | <ul style="list-style-type: none"> Updated SDF and overlays produced | MEDIUM | Overstrand LM |
| e. | Catchment water quality to be summarised and reported on | NWA | <ul style="list-style-type: none"> Annual report submitted to RMA and EAF | LOW | BGCMA, DWS |

| Management Objective 1.3: Minimise pollution by addressing activities that lead to poor water quality | | | | | |
|--|--|--------------------------------|---|--------|--|
| a. | Identify activities, monitor and control all discharges (i.e. stormwater, septic tank seepages, feeder streams). | MSA, NWA, ICMA | <ul style="list-style-type: none"> Monitoring strategy addressing causes of pollution developed Patrols undertaken by appropriate municipal dept. Blocked systems reported, inappropriate activities halted and reported Mitigation / clean-up undertaken Identity and prosecute offenders | MEDIUM | Overstrand LM |
| b. | Implement waste management plan, with a focus on peak visitor periods | NEM: Waste Management Act, MSA | <ul style="list-style-type: none"> Appropriate preparation for peak periods Clean-up operations undertaken after peak visitor periods | LOW | Overstrand LM, RMA, |
| c. | Lobby farmers to implement agricultural best practice, specifically to reduce nutrient enriched return flow | NWA, CARA | <ul style="list-style-type: none"> Engagement with famers in catchment initiated Best practice methods promoted and implemented Improved water quality variables | MEDIUM | DALRRD, BGCMA, |
| d. | Undertake basic water quality monitoring on a quarterly basis, taking RQOs into account | NWA | <ul style="list-style-type: none"> Estuary water quality database maintained to facilitate long term monitoring EMP informed by monitoring results going forward | HIGH | RMA, BGCMA, CapeNature |
| Management Objective 1.4: Control the spread and densification of invasive alien plant species | | | | | |
| a. | Identify and prioritise infested areas | CARA, NWA | <ul style="list-style-type: none"> Priority areas identified Appropriate methods of control determined | MEDIUM | RMA, DEFF: Working for water (WfW), CapeNature |
| b. | Develop and implement invasive alien species eradication programme | CARA, NWA | <ul style="list-style-type: none"> IAPs eradication programme implemented Increased area of IAPs removed and kept clear | MEDIUM | DEFF: WfW, CapeNature |

5.2 Biodiversity Conservation

Strategic Objective 2: The biodiversity of the Palmiet River estuary is conserved.

Table 5: Management Objectives and Actions for Biodiversity Conservation (including compliance and enforcement)

| Action | Relevant Legislation | Performance Indicator | Priority | Responsibility |
|--|---|---|----------|--|
| Management Objective 2.1: Obtain protected area status of the Palmiet River estuary | | | | |
| a. Expand protected area of the Boland Mountain Complex (BMC) and KBR to include/absorb Kleinmond Coast and Mountain Nature Reserve (and the Palmiet estuary) | ICMA, NEM: PAA, Western Cape Biosphere Reserves Act (WC BRA), MSA | <ul style="list-style-type: none"> • Authorities meetings convened and minuted • Protected area expanded to include Kleinmond Coast and Mountain Nature Reserve, and estuary • Protected area gazetted • Conservation authority appointed | HIGH | CapeNature, Kogelberg Biosphere Reserve Company (KBRC) |
| b. Incorporate Palmiet River EMP into BMC Protected Area Management Plan and KBR Plan | ICMA, NEM: PAA, WC BRA | <ul style="list-style-type: none"> • EMP included in management plans for the Kogelberg Area | HIGH | RMA, CapeNature, KBRC |
| c. Lobby KBRC to establish an estuarine division to ensure commitment to estuarine matters in the region | WC BRA, ICMA | <ul style="list-style-type: none"> • Estuarine division established, and estuarine co-ordinator appointed | HIGH | RMA, KBRC, CapeNature |
| d. Include estuary as a Conservation Priority in CMS, DALRRD / DEFF management processes, and municipal environmental overlay | ICMA, NWA, NEM: PAA, MSA, Land Use Planning Act (LUPA) | <ul style="list-style-type: none"> • Palmiet R. estuary included in key strategic and planning documents | HIGH | RMA, CapeNature, Overstrand LM, BGCMA, DEFF, DALRRD |
| e. Engage with landowners and stakeholders to encourage environmental custodianship on adjacent properties. | National Environmental Management | <ul style="list-style-type: none"> • Meeting with adjacent land owners convened • Signed agreements with land owners • Degraded areas rehabilitated • Integrity of estuarine margin improved | LOW | KBRC, RMA |

| Action | Relevant Legislation | Performance Indicator | Priority | Responsibility |
|---|-----------------------------------|---|----------|--------------------------------------|
| | Act (NEMA) (Duty of Care) | | | |
| Management Objective 2.2: Ensure the conservation of estuarine habitats and indigenous species by establishing and enforcing the Palmiet River estuary as a no-take system | | | | |
| a. Adopt, implement and enforce spatial zonation plan, which also designates the Palmiet River estuary as a no-take system | ICMA, NEM: PAA, WC BRA, MSA, MLRA | <ul style="list-style-type: none"> • Establishment of formal protected area status • Establishment of no-take protection status • EFZ controls enforced and offenders prosecuted • No further permanent development in the EFZ (e.g. only new sacrificial infrastructure within EFZ permitted) • No infilling of EFZ or Coastal Protection Zone (CPZ) • Recommended degree of undeveloped margin implemented (as per NBA) • Reduced habitat loss/degradation and disturbance, and inappropriate behaviour/activities | HIGH | RMA, CapeNature, KBRC, Overstrand LM |
| b. Develop/revise and publish estuarine bylaws or regulations to support spatial zonation | MSA, ICMA | <ul style="list-style-type: none"> • Bylaws developed and gazetted | MEDIUM | Overstrand LM |
| c. Deploy human resources for compliance and enforcement monitoring in reference to MLRA | MLRA | <ul style="list-style-type: none"> • Monitoring programme developed and implemented • Increased patrols and monitoring conducted • Incidents of poaching reduced • Transgressors prosecuted • Improved fish and invertebrate populations | HIGH | DEFF, CapeNature |
| d. Develop a regional compliance monitoring network and deploy human resources to | MLRA, NEMA, NEM:BA, MSA | <ul style="list-style-type: none"> • Network established • Rapid response protocol(s) developed • Incidents reported and documented | MEDIUM | CapeNature, KBRC, DEFF, |

| Action | Relevant Legislation | Performance Indicator | Priority | Responsibility |
|---|--|---|----------|--------------------------------------|
| | | <ul style="list-style-type: none"> • Transgressors prosecuted | | DWS, Overstrand LM |
| e. Instate informative and educational signage to indicate protected area status and establishment of no-take zone | WC BRA, NEM: PAA, National Environmental Management: Biodiversity Act (NEM:BA) | <ul style="list-style-type: none"> • Signage created and erected in key public spaces • Reduced habitat loss/degradation and disturbance, and inappropriate behaviour/activities | MEDIUM | KBRC, CapeNature |
| f. Engage with landowners and stakeholders regarding sustainable land use activities | NEMA (Duty of Care) LUPA | <ul style="list-style-type: none"> • Meeting with adjacent land owners convened • Signed agreements with land owners • Unsustainable land-use activities prevented • Integrity of estuarine margin improved | LOW | RMA, KBRC, CapeNature, Overstrand LM |

5.3 Land-use and Infrastructure Planning and Development

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

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

| Action | Relevant Legislation | Performance Indicator | Priority | Responsibility |
|--|--------------------------|---|----------|---|
| Management Objective 3.1: Ensure appropriate and sustainable coastal development in and around the Palmiet River estuary, considering ecosystem services and sense of place | | | | |
| a. Incorporate Palmiet EMP into BMC Protected Area Management Plan and KBR Plan as well as the Kleinmond Coast and Mountain Nature Reserve Plan (if developed) | ICMA, NEM: PAA, (WC BRA) | <ul style="list-style-type: none"> EMP included in management plans for the Kogelberg and Kleinmond Areas | HIGH | CapeNature, KBRC, RMA |
| b. Estuarine zoning and activity restrictions to be incorporated into all relevant government department planning documents and processes (e.g. Water Use Licence (WUL) Applications) | MSA, LUPA, NEMA, | <ul style="list-style-type: none"> EMP included in all relevant planning documents | HIGH | All authorities |
| c. Implement coastal management line and associated development controls | ICMA, LUPA, MSA | <ul style="list-style-type: none"> No further permanent development, infilling or land transformation in the EFZ (e.g. only new sacrificial infrastructure permitted) Transgressors prosecuted Corrective action undertaken Reduced habitat loss/degradation and disturbance, and inappropriate behaviour | HIGH | Overstrand LM, CapeNature, DEA&DP |
| d. Use EAF as source of I&APs for Environmental Impact Assessments (EIAs) | MSA, LUPA, ICMA, NEMA | <ul style="list-style-type: none"> EAF partakes in development planning affecting the estuary Impacts on the estuary are mitigated/prevented | HIGH | RMA, Overstrand LM, Overberg DM, DEA&DP |

5.4 Institutional and Management Structures

Strategic Objective 4: The Palmiet River estuary is well managed through effective co-operative governance.

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

| Action | Relevant Legislation | Performance Indicator | Priority | Responsibility | |
|--|--|------------------------|--|----------------|---------------|
| Management Objective 4.1: Ensure effective co-ordination of estuarine management responsibilities | | | | | |
| a. | Facilitate incorporation of Palmiet EMP into BMC and KBR Management Plans to facilitate implementation of EMP | ICMA, NEM: PAA, WC BRA | <ul style="list-style-type: none"> EMP included in management plans for the Kogelberg Area | HIGH | RMA |
| b. | RMA adopts and incorporates the EMP and the spatial zonation plan into planning documents | MSA, LUPA, NEMA, ICMA | <ul style="list-style-type: none"> EMP and zonation plan adopted by RMA EMP included in all relevant planning documents | HIGH | RMA |
| c. | Develop/revise and publish estuarine bylaws or regulations to facilitate implementation of EMP and support spatial zonation | MSA, ICMA | <ul style="list-style-type: none"> Bylaws developed and gazetted | MEDIUM | Overstrand LM |
| d. | Undertake needs analysis and identify skills and equipment shortages | ICMA, NEM: PAA, WC BRA | <ul style="list-style-type: none"> Needs and shortages identified Motivation for acquisition drafted and approved Equipment purchased and maintained | LOW | RMA |
| e. | Implement skills development, training or co-opt additional members / secondment for estuarine management | ICMA, NEM: PAA, WC BRA | <ul style="list-style-type: none"> Motivation for training drafted and approved Staff attend relevant accredited training courses MOU to be developed for secondments | LOW | RMA |
| f. | Develop good communication protocols and processes with implementing agents (The RMA to develop working relationships with mandated department & agreements need | ICMA | <ul style="list-style-type: none"> Project champions identified Networks established, and contacts database compiled Regular email correspondence | MEDIUM | RMA |

| Action | Relevant Legislation | Performance Indicator | Priority | Responsibility |
|--|--|---|----------|-----------------|
| to be developed to address each management action). | | | | |
| g. Source support and additional budget, and confirm budget allocation annually | ICMA, MSA, LUPA, NWA, NEM: PAA, Mineral Resource and Petroleum Development Act (MRPDA) | <ul style="list-style-type: none"> An action plan for securing future funding drafted and approved Funding secured for 5-year cycle | HIGH | All authorities |
| h. Constitute a regional estuary advisory forum (EAF) (or other applicable forum, e.g. protected area advisory forum) to facilitate co-operative governance | ICMA, MSA, LUPA, NWA, NEM: PAA, MRPDA, | <ul style="list-style-type: none"> EAF constituted (Membership includes representatives of government and stakeholders/civil society) Regional EAF meets on a quarterly basis Meetings are minuted | HIGH | RMA |
| i. Identify and invite missing stakeholders/ interest groups to partake in regional EAF | ICMA | <ul style="list-style-type: none"> Networks established Stakeholder database developed and regularly updated | HIGH | RMA |
| j. EMC present on critical forums to ensure that estuarine issues are tabled, e.g. CMA, Water Users Association (WUA), Agriculture groups etc. | | <ul style="list-style-type: none"> EMC attendance at critical forum meetings Meetings are minuted | HIGH | DEA&DP |
| k. Monitor and report on the progress of EMP actions and achievements on annual basis | ICMA | <ul style="list-style-type: none"> Feedback received from participating agencies Biannual and annual reporting to DEFF and EAF, undertaken by EMC Action plans updated as and when required | MEDIUM | RMA, DEA&DP |
| l. Undertake formal 5-year review as prescribed by the 2013 NEMP | ICMA | <ul style="list-style-type: none"> Motivation for updated drafted and approved Funding confirmed Terms of Reference drafted | LOW | RMA |

| Action | Relevant Legislation | Performance Indicator | Priority | Responsibility | |
|--|--|---|---|----------------|-----------------------------------|
| | | <ul style="list-style-type: none"> • Consultants appointed • Plan updated | | | |
| Management Objective 4.2: Define and enable co-operative governance | | | | | |
| a. | Identify and implement procedures to ensure cooperative governance between all government depts. with a mandate to act | ICMA, Inter-governmental relations Act (Act 13 of 2005) | <ul style="list-style-type: none"> • Roles and responsibilities defined and accepted via MOUs signed between RMA and spheres of government and participating agencies • Regional EAF meets on a quarterly basis • Meetings are minuted • Active collaboration of various implementing agents | HIGH | All authorities |
| b. | EAF to monitor performance of RMA in respect to implementation of plan | ICMA | <ul style="list-style-type: none"> • Authorities to provide formal feedback on mandated activities • Regional EAF meets on a quarterly basis | MEDIUM | All authorities, All stakeholders |
| c. | Individual agencies to identify and address training needs, with possible secondment to address training and capacity shortfalls | ICMA | <ul style="list-style-type: none"> • Motivation for training drafted and approved • Staff attend relevant accredited training courses • MOU to be developed for secondments | LOW | All authorities |
| d. | Individual agencies to allocate resources, create and fill posts (including project champions), and acquire necessary infrastructure, resources and equipment of fulfil their mandates | MSA, NWA, ICMA, NEMA, NEM: PAA | <ul style="list-style-type: none"> • Need and Desirability investigation undertaken • Motivation for acquisition drafted and approved • Equipment purchased and maintained • Project champion(s) for allocated management actions • Staff appraisals in terms of management actions and projects | LOW | All authorities |

| Action | Relevant Legislation | Performance Indicator | Priority | Responsibility |
|---|--------------------------------|---|----------|-----------------|
| e. Mandated authorities and participating agencies to confirm budget allocations for mandated activities/actions | MSA, NWA, ICMA, NEMA, NEM: PAA | <ul style="list-style-type: none"> Formal feedback from authorities on mandated activities Motivation for budget drafted and approved Funding secured for 5-year cycle | LOW | All authorities |

5.5 Socio-economic Considerations

Strategic Objective 5: Socio-economic benefits are enhanced and regulated to ensure sustainable use of the Palmiet River estuary and its resources.

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

| Action | Relevant Legislation | Performance Indicator | Priority | Responsibility |
|---|---|--|----------|----------------------------|
| Management Objective 5.1: Regulate recreational use of the estuary | | | | |
| a. Adopt, demarcate and enforce spatial zonation plan to protect estuarine habitats and other users | ICMA, NEM: PAA, WC BRA | <ul style="list-style-type: none"> • Expansion of protected area • EFZ controls enforced and offenders prosecuted • Reduced habitat loss/degradation and disturbance, and inappropriate behaviour | HIGH | RMA, CapeNature/KBRC |
| b. Informative signage, indicating zonation and allowable activities, to be placed at strategic points | ICMA, NEM: PAA | <ul style="list-style-type: none"> • Signage created and erected in key public spaces | LOW | KBRC |
| c. Quantify and monitor the types of estuarine use (e.g. canoes, boats, live aboard boat, etc) and user | ICMA, WC EMFIS Jetski and Motorised Watercraft Guideline (2019) | <ul style="list-style-type: none"> • Estuarine uses defined • Number and type of watercraft • Incidents of illegal activities recorded and reported • Ongoing data collection | MEDIUM | RMA |
| d. Develop Standard Operating Procedures (SOP) to regulate high visitor numbers and minimise environmental disturbance/damage during peak season | ICMA, NEM: PAA, MSA | <ul style="list-style-type: none"> • SOP developed • SOP implemented as and when required • MOU signed between necessary parties | HIGH | RMA, Necessary authorities |

Management Objective 5.2: Develop and regulate local livelihoods associated with the estuary

| | | | | | |
|-----------|--|----------|--|-----|-------------------------------------|
| a. | Investigate and implement alternate livelihoods that promote non-consumptive enterprises involving previously disadvantaged communities, which are compliant with all forms of legislation and planning frameworks | NEM: PAA | <ul style="list-style-type: none"> • Target groups identified • Potential alternatives identified • Sustainability study initiated • Community projects identified | LOW | RMA, CapeNature, KBRC Overstrand LM |
|-----------|--|----------|--|-----|-------------------------------------|

5.6 Education and Awareness

Strategic Objective 6: Members of society are sensitive to and aware of the value and importance of the Palmiet River estuary.

Table 9: Management Objectives and Actions for Education and Awareness

| Action | Relevant Legislation | Performance Indicator | Priority | Responsibility |
|---|----------------------|---|----------|----------------|
| Management Objective 6.1: Promote high levels of public awareness and appreciation of the value of Kogelberg estuaries | | | | |
| a. Develop and effective education and awareness programme for residents and visitors to the Kogelberg coast | ICMA | <ul style="list-style-type: none"> • Education & awareness programme developed and implemented at schools and through interest groups • Increased educational opportunities at group gatherings, community meetings, conferences etc. | MEDIUM | KBRC |
| b. Source and/or commission educational and informative material including signage, posters, pamphlets and webpage design | ICMA | <ul style="list-style-type: none"> • Educational signage erected at strategic points • Posters and pamphlets erected/ disseminated • Kogelberg estuaries webpage operational | MEDIUM | KBRC |
| c. Engage and educate estuary users (including illegal fishers/harvesters) | ICMA | <ul style="list-style-type: none"> • Reduction in illegal activities • Reduced habitat loss/degradation and disturbance, and inappropriate behaviour • Informative surveys/talks undertaken | LOW | KBRC, DEFF |

5.7 Disaster Risk Management

Strategic Objective 7: Potential risks that could impact the Palmiet River estuary are reduced (inclusive of climate change impacts).

Table 10: Management Objectives and Actions for Disaster Risk Management

| Action | Relevant Legislation | Performance Indicator | Priority | Responsibility | |
|---|---|--|---|----------------|--|
| Management Objective 7.1: Disaster prevention, preparedness and mitigation | | | | | |
| a. | Identify, estimate costs, prioritise and rehabilitate areas of bank erosion, trampling, disturbed riparian vegetation (priority areas and hot spots). | NEMA, Western Cape Transport Infrastructure Act (WC TIA) (Act 1 of 2013) | <ul style="list-style-type: none"> Priority areas needing rehabilitation identified Degradation profiles compiled Rehabilitation programme developed Priority degraded areas restored Signage installed informing public of rehabilitation process More robust / resilient alternatives installed | MEDIUM | Western Cape Department of Transport: Public Works (WC DoT&PW), Overstrand LM, CapeNature, KBRC, RMA |
| b. | Identify areas and infrastructure at risk of drought, flooding and erosion, and include in relevant plans (e.g. regional disaster management plan) | Disaster Management Act (Act 57 of 2002) (DMA) WC TIA | <ul style="list-style-type: none"> High risk areas identified Relevant plans updated with early warning and monitoring systems and evacuation protocols, and contingency plans for high erosion and flood risk areas. | HIGH | RMA, WC DoT&PW, Overstrand LM, CapeNature, KBRC, WC Dept of Local Gov: Disaster Management |
| c. | Develop and implement contingency plans to address specific sources of pollution (WWTW failure, oil spill, chemical spill etc.) | NWA, ICMA | <ul style="list-style-type: none"> Identify specific sources of pollution (in addition to agricultural run-off) Contingency plans developed and approved Contingency plan to include a health incident evacuation plan, identifying | MEDIUM | RMA, Overstrand LM, CMA, DWS, DEA |

| | | | | | |
|--|--|--|---|--|--|
| | | | actions, timing and responsible agencies and actors. <ul style="list-style-type: none">• Mitigation / clean-up undertaken• Investigation initiated, and enforcement actions undertaken | | |
|--|--|--|---|--|--|

6 PROPOSED ZONATION OF ACTIVITIES

6.1 Introduction

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

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

6.2 Habitat zones

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

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

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

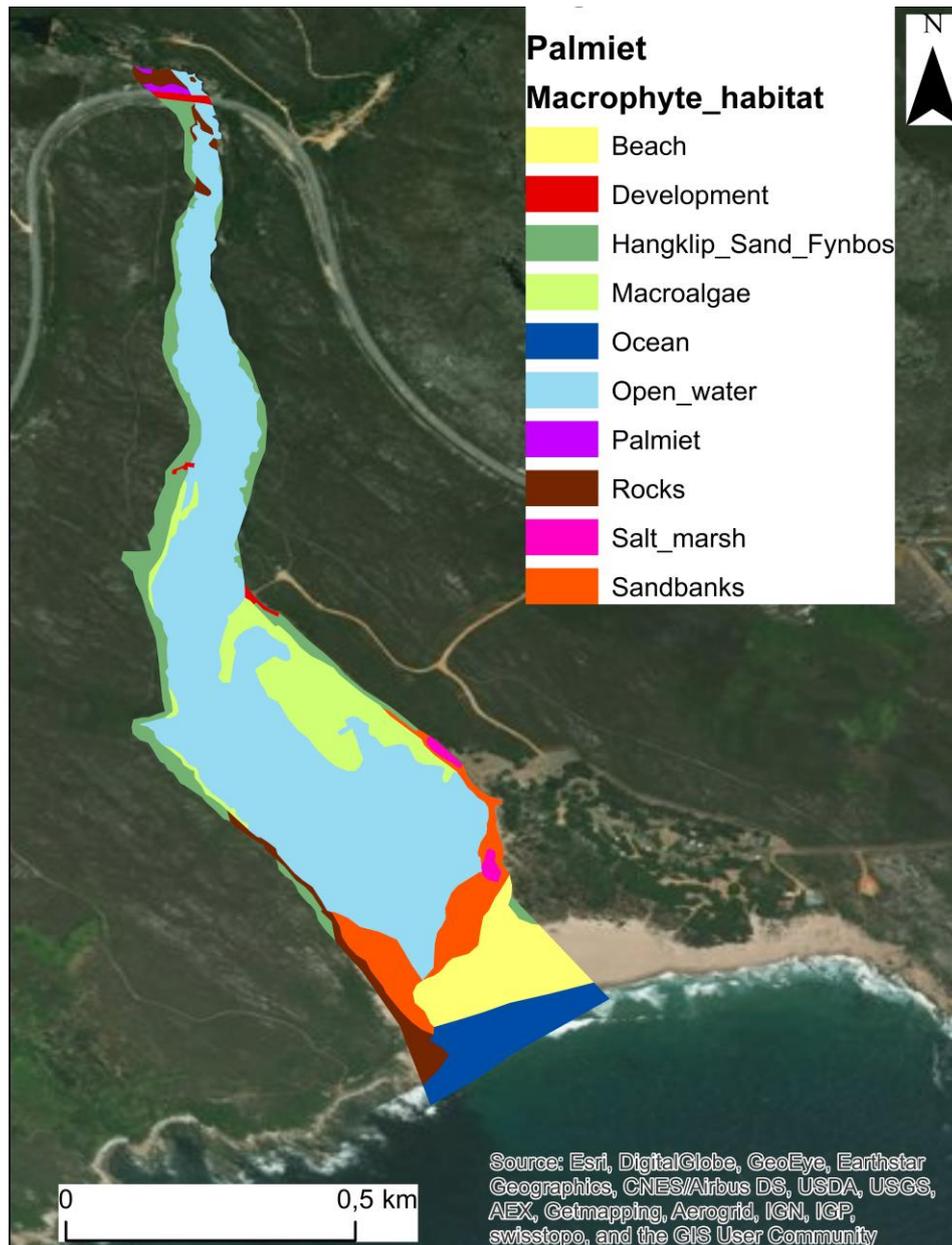


Figure 6: Habitats identified in the Palmiet River estuary

6.3 Legislated Coastal Boundaries and Buffer Zones

6.3.1 Estuarine Functional Zone

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

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

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

However, the 2018 National Biodiversity Assessment provides a more detailed definition of an estuary, that is: “a partially enclosed permanent water body, either continuously or periodically open to the sea on decadal time scales, extending as far as the upper limit of tidal action, salinity penetration or back-flooding under closed mouth conditions. During floods an estuary can become a river mouth with no seawater entering the formerly estuarine area or, when there is little or no fluvial input, an estuary can be isolated from the sea by a sandbar and become fresh or even hypersaline” (SANBI 2019).

The EFZ is defined by the 2014 Environmental Impact Assessment (EIA) Regulations (as amended in 2017) (GN 324) as “the area in and around an estuary which includes the open water area, estuarine habitat (such as sand and mudflats, rock and plant communities) and the surrounding floodplain area”, as defined by the 5 m topographical contour (referenced from the indicative mean sea level). The 2013 NEMP acknowledges the EFZ as the geographical boundary of estuaries in South Africa. In practice, it is found that the 5 m topographic contour approximates the EFZ for most estuaries in South Africa. It is consequently commonly used to delineate the EFZ in the absence of specific biophysical assessments. Where biophysical information is available, the EFZ can be delineated according to the presence of estuarine vegetation or features such as wetlands that are directly supportive of the estuary. This approach informed the EFZ used in the 2018 NBA (SANBI, 2018) (see Figure 3).

6.3.2 Coastal Protection Zone and proposed Coastal Management Line

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

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

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

coastal processes such as sea level rise or erosion, information on ecological or other sensitivities adjacent to the coast, as well as the location and extent of existing development and existing executable development rights. The CML is a continuous line, seawards of which lies:

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

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

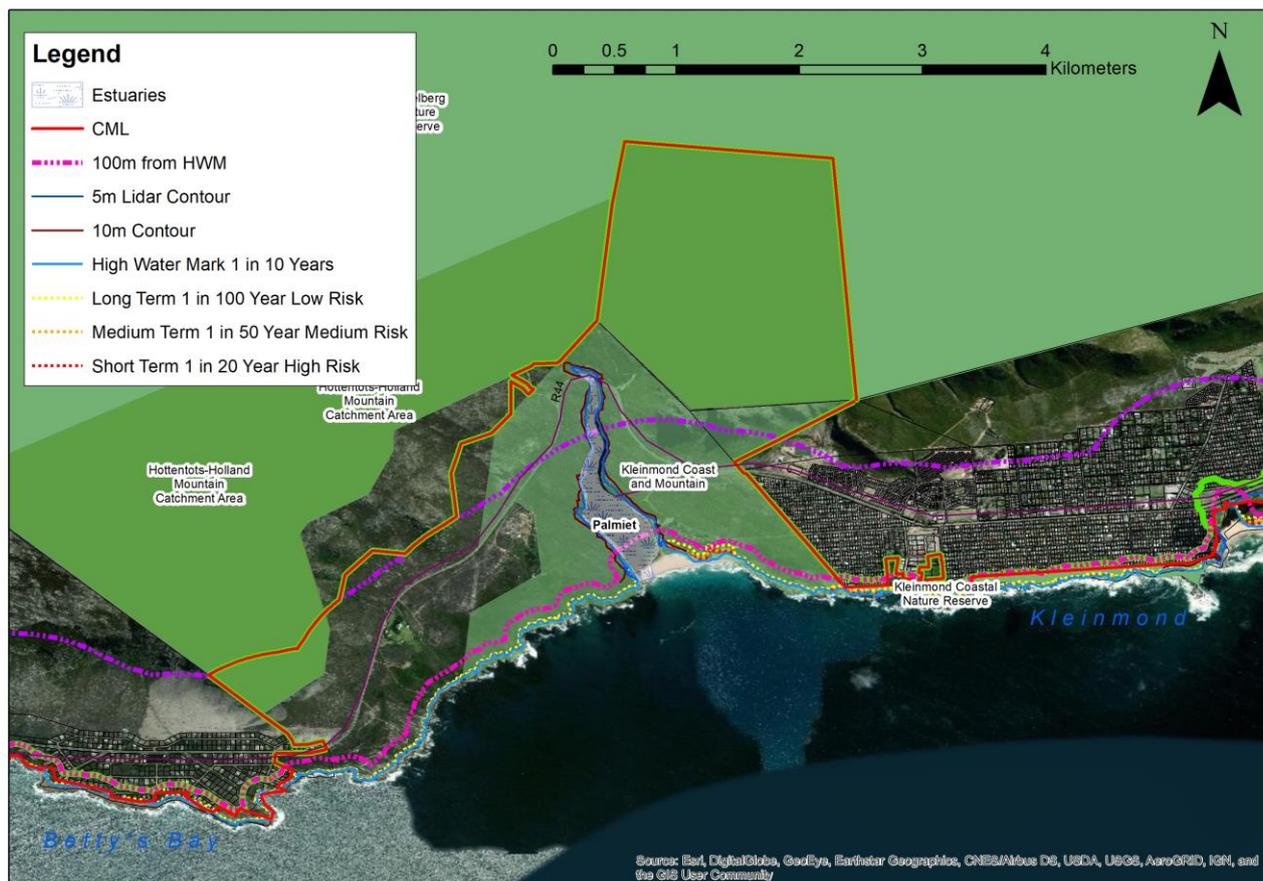


Figure 7: Coastal boundaries of the Palmiet River estuary and risk projections (WCG, 2015)

6.3.3 Environmental Impact Assessment (EIA) 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 regulations³ rather than the coastal management lines described in the ICM Act. However, as part of the on-going process of defining coastal management lines for the Western Cape, it is currently **proposed that the CML, as defined under ICMA, also be used as the DSL.**

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

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

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

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

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

³ The Environmental Impact Assessment Regulations, 2014 (as amended in 2017), published under Government Notice No. 326 in Gazette No. 40772 of 4 April 2017, in terms of sections 24(5) and 44 of the National Environmental Management Act, 1998 (Act No. 107 of 1998))

6.4 Zonation of Activities

6.4.1 Current zonations and uses

The table below lists the surrounding land use types as per the Overstrand Municipal Town Planning Scheme (Figure 8) and activities occurring in and/or adjacent to the Palmiet River estuary (Table 11). While the Palmiet River EFZ falls within the area designated the Kleinmond Coast and Mountain Nature Reserve, it is not formally proclaimed as a municipal nature reserve (T Dry 2017, pers.comm.⁴) but rather zoned as Open Space Zone 1: Nature Reserve.

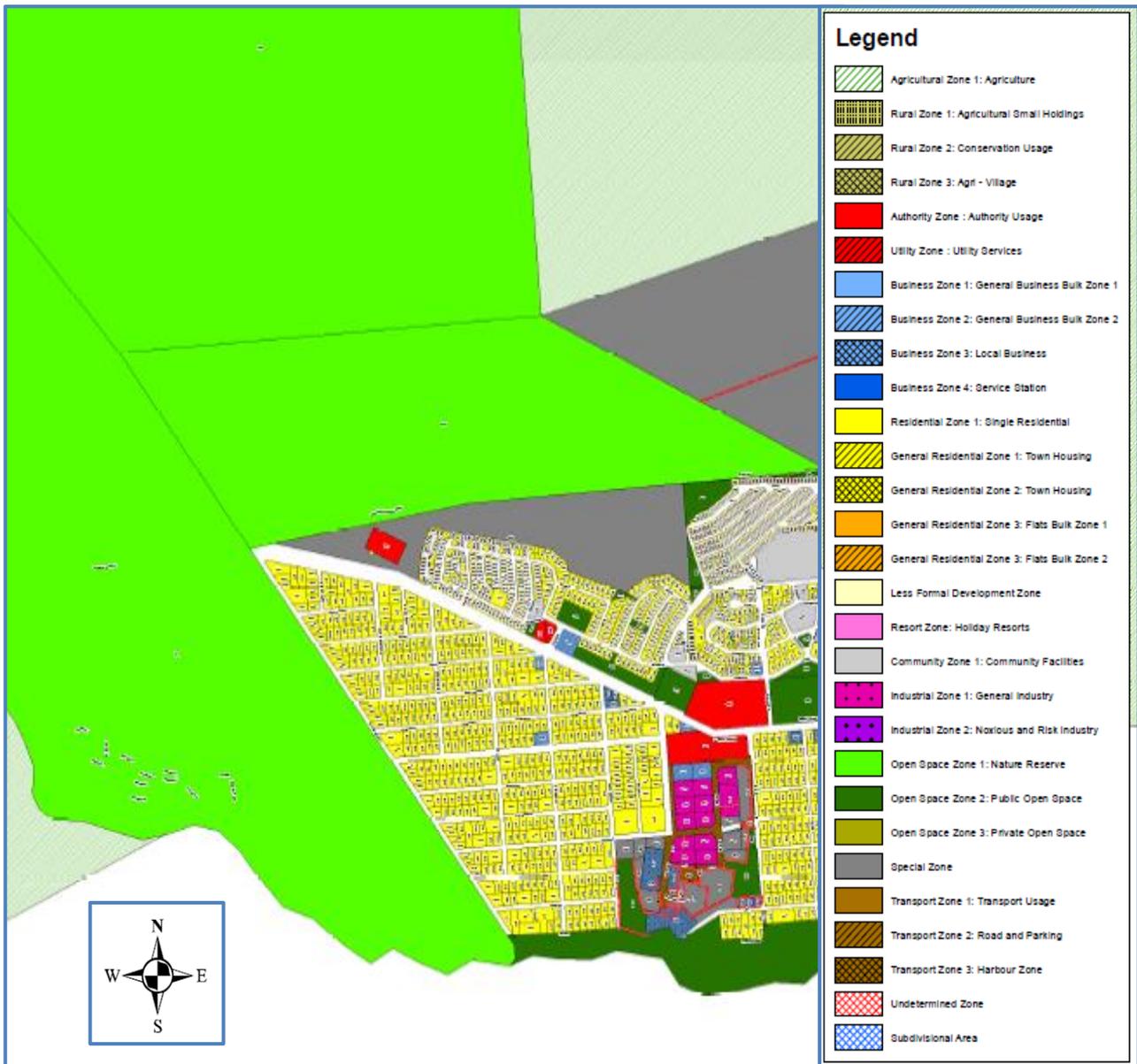


Figure 8: Extract of the Overstrand Municipality Town Planning Scheme for Kleinmond

⁴ Mr. Taron Dry, Overstrand Municipality

Table 11: Current zonations and activities occurring in and/or adjacent to the Palmiet River estuary

| LAND USE | DESCRIPTION |
|--|--|
| Open Space Zone 1: Nature Reserve | The Palmiet River EFZ falls within an area zoned as Nature Reserve, albeit that the Kleinmond Coast and Mountain Nature Reserve is not formally proclaimed. The zoning does, however, afford the area protection. The Palmiet Park Caravan Park well as picnic area also falls within this zoning. |
| Residential (single residential 1) | While not directly adjacent the EFZ, the town of Kleinmond's residential erven zoned as single residential 1 abut the open space zone 1. |
| Agriculture Zone 1: Agriculture | While not directly adjacent the EFZ, the area to the West of the EFZ is zoned as Agriculture but is currently infested with invasive alien plants. This area adjacent the EFZ is where the Municipal WWTW is located. |
| Kogelberg Biosphere Reserve (KBR): Core Area | The Palmiet River EFZ would appear to be zoned as a terrestrial core area within the KBR (CapeNature, 2012) |
| ACTIVITIES | DESCRIPTION |
| Fishing | Recreational angling and reported illegal gill-netting (poaching) |
| Boating | Palmiet Slipway public launch site next to the historical Pont point on the eastern shore managed by the Kleinmond Boat Club |
| Camping | Adjacent the mouth in the Palmiet Caravan Park (municipal) |
| Bridge jumping | From the R44 bridge |
| House boat | House boat reported to be owned by the Vaal family |
| Bait harvesting | Limited sand prawn pumping on eastern bank adjacent the caravan park and Palmiet picnic area / day camp |
| Swimming | Swimming associated with public amenity, adjacent the parking/picnic area and on western bank of the estuary |
| Estuarine and beach-based recreational activities | Sunbathing, picnicking etc. on the expansive beach / sand bar as well as on banks of estuary as well as at the bridge near the weir at the Fairy Glen picnic area/day camp |
| White-water rafting | Upstream of the R44 bridge |

6.4.2 Proposed spatial zonation

Zonation of the Palmiet River estuary is informed by the National Estuary Biodiversity Plan (Turpie et al. 2012), Western Cape Biodiversity Spatial Plan, the KBR zonation (CapeNature, 2012), as well as the Overstrand LM town planning scheme prescriptions.

As priority estuary in terms of the National Estuary Biodiversity Plan (Turpie et al., 2012), the Palmiet River estuary is to be considered a full no-take system (i.e. no fishing or harvesting of marine living resources) and 50% of the margin is to remain undeveloped (or behind an appropriate development setback line).

The Palmiet River estuary is also a priority system in terms of the Western Cape Protected Area Expansion Strategy enacted by CapeNature and a core biodiversity area in terms of the KBR. Establishing formal protected area status may be best achieved through extension of the BMC to incorporate the municipal Kleinmond Coast and Mountain Nature Reserve.

For the Overstrand LM, the term 'Nature Reserve', as defined in the Town Planning Scheme controls, is "a national park or environmental conservation area that has been declared or registered as a nature reserve in terms of legislation whether in public or private ownership, for the purpose of conserving and managing wild life, flora and fauna, in a predominantly natural habitat; it includes conservation use but does not include tourist facilities or tourist accommodation" (Overstrand LM, 2013). In this instance, however, tourism facilities and tourist accommodation are considered to be consent uses and are allowed. Other consent uses include: dwelling units, environmental facilities, rooftop base station, transmission tower, utility service, any other related use permitted by Council.

The zonation includes the proposed protected area, and two specific zones, namely, salt marsh sanctuary and recreation swimming zone (Figure 9). In general, the zonation provides for low impact recreational use which does not detract from the sense of place afforded by the surrounding natural landscape.

- **Estuarine Protected Area (No-take)** – This entails establishing formal protected area status for the entire Palmiet River EFZ. Subject to the declaration of the protected area, the Palmiet EFZ may obtain further zonation in accordance with a protected area management plan.

The full extent of the Palmiet EFZ, is also to be considered a no-take area. That is, all forms of fishing including angling, netting and fish trapping, and bait harvesting are prohibited.

- **Salt Marsh Sanctuary Zone** – The purpose of this zone is for the specific protection of species or habitats of special conservation concern – in this instance the limited salt marsh habitat. All access is restricted (except for research purposes) to prevent disturbance and/or damage and must be suitably demarcated. Should the habitat area expand overtime, the zonation must similarly expand to protect this habitat.
- **Recreation: Swimming Zone** – This zone provides an exclusive zone for swimming adjacent to the Palmiet day camp/picnic site and Palmiet Caravan Park and must be defined by floating buoys. The boundary of this zone is somewhat flexible, and may be adjusted to accommodate fluctuating water levels but must always demarcate safe swimming conditions. Swimming should not be permitted in the mouth, or in close proximity to the main channel, during open mouth conditions for safety reasons.
- **Remaining area** – The remainder of the open water area is open to low impact recreational use of electrical motor boats and rowing/paddling. Swimming in all other areas besides the designated zone must be discouraged.

Due to the small size and shallow nature of the system, specifically during open mouth conditions, powerboating is not permissible on the Palmiet River estuary. Kitesurfing and parasailing are also prohibited activities throughout the system because of their disturbance to birds and estuarine habitat (margins and estuarine floor).

Formal development or construction activities in any of the zones are to be regulated according to the EIA Regulations and any future controls emanating from the Provincial determination of coastal management lines. Allowable activities in these zones are to be managed as per Table 12 below.



Figure 9: Proposed zonation of Palmiet River EFZ

Table 12: Proposed zonation prescriptions for the Palmiet River estuary

| ZONE/USE | CONDITIONS OF USE | RELEVANT LEGISLATION | RESPONSIBLE AUTHORITY | ENFORCEMENT |
|----------------------------------|---|---|------------------------------|---------------|
| PALMIET PROTECTED AREA | <ul style="list-style-type: none"> Compliance with protected area management plan stipulations and any future zonations | NEM: PAA WC Biospheres Reserves Act (BRA) | CapeNature | CapeNature |
| | <ul style="list-style-type: none"> No fishing or baiting collecting in any way or form Walking/hiking, picnicking permitted | MLRA | DEFF | CapeNature |
| SALT MARSH SANCTUARY ZONE | No access allowed unless for: <ul style="list-style-type: none"> Research Nature observations under strictly controlled conditions Environmental education | NEM: PAA | CapeNature | CapeNature |
| | No fishing, bait collecting, or removal plants at any time by any means except scientific research affiliated with a research institution. <ul style="list-style-type: none"> Walking/hiking, picnicking permitted | NEM: PAA, MLRA | DEFF, CapeNature | CapeNature |
| RECREATION: SWIMMING | <ul style="list-style-type: none"> Swimming/bathing permitted No boats or watercraft Compliance with water quality guidelines for recreational use | NEM: PAA, MSA, Bylaws | | |
| | <ul style="list-style-type: none"> No fishing or baiting collecting in any way or form | MSA | Overstrand LM | Overstrand LM |
| | <ul style="list-style-type: none"> Walking/hiking, picnicking permitted | MLRA | DEFF | CapeNature |
| GENERAL OPEN WATER | <ul style="list-style-type: none"> Canoes, kayaks, paddle skis, rowing boats permitted Electric motor boats – speed limit 10 km/h – aimed at ensuring safety and security of all users. No power boats, including jetskis No parasailing, kite boarding, wind surfing | NEM: PAA MSA, Bylaws | Overstrand LM, CapeNature | Overstrand LM |
| | <ul style="list-style-type: none"> No fishing or baiting collecting in any way or form Walking/hiking, picnicking permitted | MLRA | DEFF | CapeNature |

In the interim of formalising and declaring a protected area, development rules for the Kleinmond Coast and Mountain Nature Reserve which apply are:

- A site development plan must be submitted to the satisfaction of Council;
- Council may require an environmental study and/or environmental management plan; and
- Council must determine the development rules applicable to a land unit, when:
 - The zoning of a land unit to this zone is approved;
 - Any environmental impact report is considered;
 - Any environmental management plan is considered;
 - Any site development plan is approved;
 - Prior to the approval of any building plans or engineering services; and
 - Structures/buildings may be erected with the written consent of Council, should Council deem it necessary, provided that Council may impose conditions relating to design, architecture, and developments parameters.

6.4.3 Areas requiring rehabilitation

The existing retaining wall and gabion baskets defending the Palmiet estuary day camp need to be well maintained to prevent injury or further degradation and subsequent environmental damage. Alternatively, this must be removed and rehabilitated to natural estuarine habitat.

Ad hoc access paths created through the dune scrub vegetation on the eastern shoreline adjacent to the Palmiet Caravan Park should be rehabilitated and closed in favour of a single, formalised (e.g. boarded) access route to prevent damage to the vegetation.

The areas west of the EFZ within the Kleinmond Coast and Mountain Nature Reserve are priority areas for rehabilitation in terms of invasive alien vegetation removal.

7 INTEGRATED MONITORING PLAN

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

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

7.1 Resource Monitoring

7.1.1 Current Resource Monitoring

Current resource monitoring includes:

- **Continuous flow recording of river inflow.** There is a continuous record available from the DWS gauging station G4H007 just upstream of the Palmet River estuary; and
- **Continuous water level recordings.** A continuous water level recorder is installed on the eastern bank in the middle of the estuary (Station G4R009-A01).

It is imperative that this monitoring continue to support adaptive management going forward.

7.1.2 Resource Quality Objectives / Ecological Specifications or

Resource Quality Objectives (RQOs) or Ecological Specifications (Ecospecs) are clear and measurable specifications of ecological attributes (in the case of estuaries - hydrodynamics, sediment dynamics, water quality and different biotic components) that define a specific ecological category in this case a Category B (DWS, 2012).

Thresholds of potential concern (TPC) are defined as measurable end points related to specific abiotic or biotic indicators that if reached (or when modelling predicts that such points will be reached) prompts management action. In essence, TPCs should provide early warning signals of potential non-compliance to ecological specification (i.e. not the point of 'no return'). This implies that the indicators (or monitoring activities) selected as part of long-term monitoring programme need to include biotic and abiotic components that are particularly sensitive to changes in river inflow. The EcoSpecs, as well as the TPCs, representative of a Category B for the Palmet River estuary as described by DWS, are presented in Table 13 (Appendix 1) (DWS, 2012; 2018).

7.1.3 Recommended Resource Monitoring Programmes

The purpose of long-term monitoring programmes, in this context, is to assess (or audit) whether the Ecospecs (defined as part of the Ecological Reserve determination process) are being complied with after implementation of the Reserve. In addition, these programmes can also be used to improve and refine the Ecological Reserve measures (including the Ecospecs), in the longer-term through an iterative process (Taljaard *et al.*, 2003)

Although baseline studies and long-term monitoring programmes have different purposes, it is extremely important that long-term monitoring programmes follow on from similarly structured baseline studies. In essence, the monitoring activities selected for the long-term monitoring programme should be derived from the monitoring activities conducted as part of the baseline studies, but implemented on a less intensive spatial and/or temporal scale (Taljaard *et al.*, 2003).

Summaries of the Baseline Data Requirements and the Long-Term Monitoring Programme are included in Table 14 and Table 15 of Appendix 2, respectively. These take the earlier described details into account and also include the specific actions and associated human resources to obtain such data. The activities have been prioritised in the tables.

7.1.4 Research needs

The current information available on the Palmiet River estuary is outdated (or lacking) and continuous monitoring needs to be undertaken to update the available baseline information which will be used to facilitate the management of the estuary.

Ecological monitoring, as recommended above, should be undertaken, the results of which can be compared to the baseline information to highlight any impacts that are occurring and to monitor the state of the estuary. Scientific research into the prevalence of the fish disease, should be prioritised.

All data generated through regional and local projects and monitoring programmes, as well as data analysis, should be sourced, collated and stored at a central publicly accessible repository to build up long –term datasets to facilitate adaptive estuarine management.

7.2 Compliance Monitoring

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

By and large, compliance monitoring will be the responsibility of the DEFF and/or CapeNature (until such time that the area is formally declared a protected area), and will

be undertaken according to legislation (e.g. MLRA) and policies applicable and by means of law enforcement and compliance monitoring protocols.

It is recommended that a scheduled compliance/law enforcement programme be developed, beginning with frequent patrols to ascertain degree and timing of estuary use (e.g. holiday periods), and then modified based on the findings.

Compliance monitoring should include:

- Number of fishers/harvesters;
- Species targeted and catch volume;
- Gear utilised; and
- Number of offences, arrests and convictions for contravening regulations stipulated in the Marine Living Resources Act (No 18 of 1998).

In addition, there is no known information regarding the level of boating activity on the estuary. Such data should be collected as part of the compliance programme.

The following guiding principles are extracted from the Kogelberg Nature Reserve Management Plan (CapeNature, 2012) and are considered to be of relevance in establishing formal protected area status and a level of compliance and enforcement on the Palmiet River estuary:

- Reserve Management and personnel will ensure that all law enforcement actions are executed in a fair, reasonable and objective manner, with due respect for Human Rights and in accordance with applicable Law;
- Reserve Management and personnel will identify and prioritise sensitive areas and species and prioritise law enforcement patrols accordingly, in order to ensure that resources are allocated in the most efficient and effective manner;
- Reserve Management and personnel will partner with local law enforcement role-players, such as SAPS, local authorities and Oceans and Coasts, in order to effectively utilise resources to combat biodiversity crime within the protected area; and
- Reserve Management will liaise with adjacent communities, in conjunction with relevant components, in order to identify and prioritise areas of natural and cultural heritage significance, in order to effectively manage impacts and to prevent illegal activities in these areas.

As a component of boat use, agreements and regulations regarding the use and operation of the live-aboard houseboat need to be clarified.

7.3 Performance Monitoring (Review & Evaluation)

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

frequency of the collection of the performance data and the targets that should be achieved.

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

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

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

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

8 INSTITUTIONAL CAPACITY & ARRANGEMENTS

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

8.1 Key Role Players

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

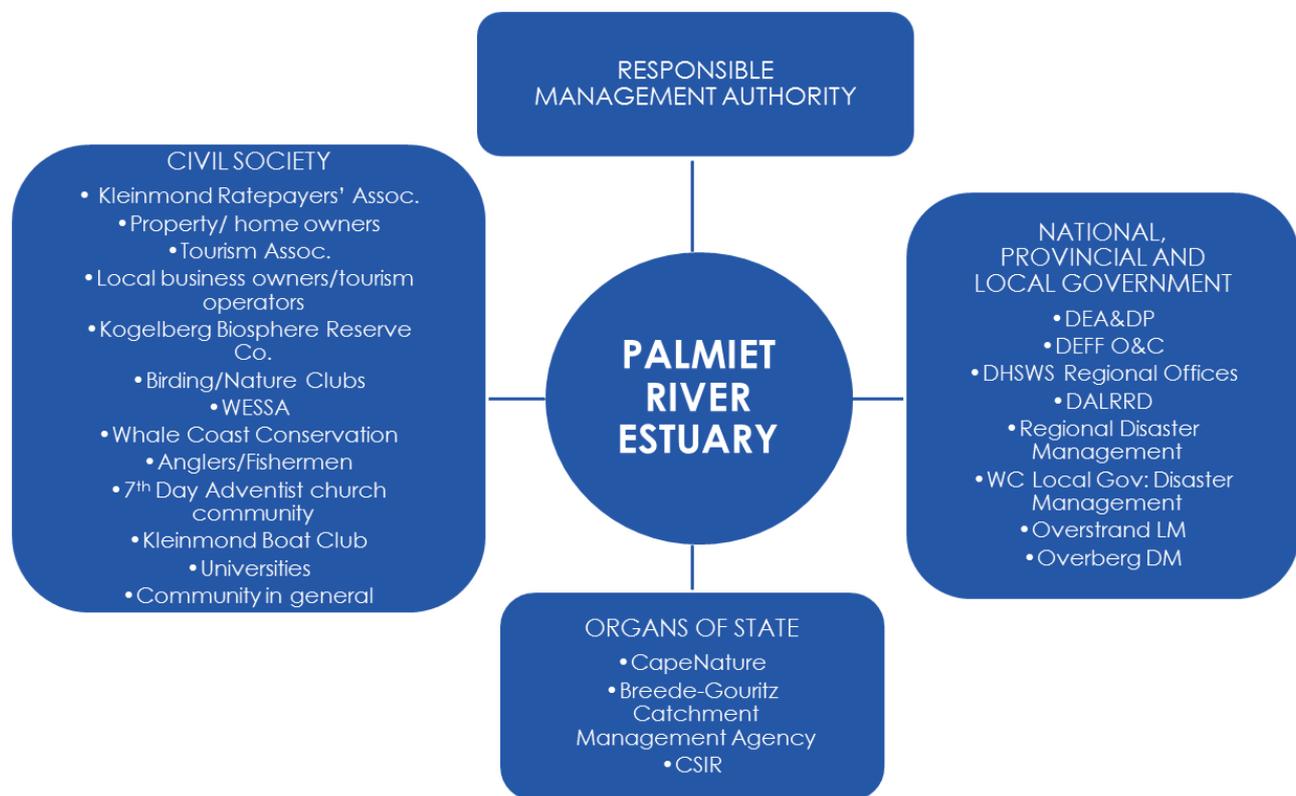


Figure 10: Key role players for the management of the Palmiet river estuarine system

8.2 Responsible Management Authority

The 2013 NEMP identifies CapeNature as the RMA, responsible for the co-ordination of the implementation of the Palmiet River EMP because the estuary is proposed in the expanded protected area network of the Western Cape Province. **It is noted that in the amendments to the 2013 NEMP, such responsibilities remain allocated to the applicable conservation authority, in this case CapeNature, in respect to estuaries in protected areas or part of a**

protected area expansion strategy. Ultimately the role of RMA must be designated through formal signed agreement.

Effective implementation of this EMP requires the augmentation of capacity within CapeNature, with the recommended appointment of a regional estuarine management co-ordinator (EMC) within DEA&DP. This individual will play a critical co-ordinating role for all other implementing agencies as well as CapeNature departments (e.g. Scientific Services).

There is an additional and existing support structure within the Kogelberg Biosphere Reserve Company (KBRC), advised by a strong technical management committee and funded by DEA&DP. The appointment of a regional estuarine management co-coordinator could alternatively be explored and promoted within this structure.

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

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

8.3 Estuary Advisory Forum

While the establishment of an EAF for each estuary is no longer a requirement in the 2013 NEMP, the Western Cape Government still support their establishment and recommend that private entities and non-government organisations continue to play a supporting role in the implementation of this EMP. While an individual EAF is not recommended, the establishment of a collective EAF is, incorporating the Rooiels, Buffels, and Palmiet estuaries.

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

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

8.4 Government Departments and Organs of State

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

- CapeNature as RMA; who is also responsible for general conservation in the region, biological monitoring, compliance management and facilitating rehabilitation
- Overstrand Local Municipality: responsible for providing key municipal services, as well as the provision of management, technical and legislative support;
- The Overberg District Municipality: Responsible for issues relating to water and sanitation, disaster management, recreation as well as the provision of management and technical support;
- Western Cape Government departments: Responsible for legislatively mandated responsibilities as well as support, including compliance, funding, research and monitoring;
- Relevant National government departments, especially DEFF, DWS (via the regional office), Department of Agriculture, Land Reform and Rural Development (DALRRD); and Department of Science and Technology (DST); and
- Organs of State: CapeNature, Breede-Gouritz Catchment Management Agency, Council for Scientific and Industrial Research (CSIR), etc.

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

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

- The Overberg Municipal Coastal Committee: Responsible for facilitating co-management, effective governance and district level co-ordination of coastal and estuarine management issues;
- Western Cape Provincial Coastal Committee: Responsible for facilitating co-management and effective governance and provincial co-ordination of estuarine management; and
- Western Cape Estuaries Task Team: Responsible for facilitating provincial co-ordination of estuarine management.

8.4.1 Project Plans for Implementation

Effective implementation of this EMP requires the conversion of the priority actions into detailed project plans, which must be prepared and adopted into the respective

departmental implementation strategies. A template for such project plans is provided in the EMP Development Guideline (DEA, 2015) and is attached as Appendix 4 for ease of reference. This template can also be utilised to facilitate the implementation of other projects proposed in the EMP.

9 RECOMMENDATIONS AND CONCLUSION

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

- The Palmiet River estuary is formally protected and included in the BMC;
- No-take status confirmed and enforced;
- No further abstraction is authorised/allowed; and
- The DEA&DP to consider the appointment of a Regional estuarine management co-ordinator/champion within either DEA&DP or CapeNature, to support the RMA.

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

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APPENDIX 1: ECOLOGICAL SPECIFICATIONS

Table 13: EcoSpecs and Thresholds of Potential Concern for the Palmiet Estuary (Category B) (DWA, 2012; DWS, 2018)

| COMPONENT | | ECOLOGICAL SPECIFICATION | | | | | THRESHOLD OF POTENTIAL CONCERN | | | | | POTENTIAL CAUSES | | |
|---|--|--|------|------|------|------|---|------|------|------|------|--|------|-------------|
| Water Quantity (hydrology & hydrodynamics) | | Maintain a flow regime to create the required habitat for birds, fish, macrophytes, microalgae and water quality. Maintain connectivity with marine environment at a level that ensures water quality and habitat remains suitable for biota typically found in the estuary | | | | | H1: River inflow distribution patterns differ by more than 5 % from that of Scenario 6. (i.e. recommended flow scenario for the Palmiet). H2: Monthly average river inflow below 1.0 m ³ /s persists for longer than three months in a row. H3: Total annual inflow <175 million m ³ for more than 5 years in a row. H4: Estuary mouth permanently open H5: Average tidal amplitude near the mouth during low flows (summer) must not change by >10% from established baseline. | | | | | Illegal abstractions from rivers upstream, operational releases not executed correctly or drought condition. | | |
| | | | | | | | | | | | | | | |
| MMR/MAR (%Nat) | | 76.6 | 49.2 | 39.1 | 48.2 | 43.6 | 43.0 | 41.1 | 46.4 | 57.3 | 74.4 | 86.6 | 90.5 | 70.1 |
| Water Quality | | Salinity distribution not to exceed TPCs for fish, invertebrates, macrophytes and microalgae (see above). | | | | | WQ1: Salinity values below 10 ppt for longer than three months in a year. | | | | | Illegal abstractions from the river upstream, operational releases not executed correctly or drought conditions. | | |

| | | | |
|--------------------------|---|---|---|
| Water Quality | System variables (Temperature, pH, turbidity, dissolved oxygen, suspended solids and turbidity) not to exceed TPCs for biota (see above). | WQ2: River inflow: Summer temperature <20 °C; pH >8; Dissolved oxygen <4 mg/l. WQ3: Average Secchi disc depth in estuary < 2 m WQ4: pH > 8.5 in estuary WQ5: Average DO concentration in water column of estuary <4 mg/l (except in deeper areas during closed mouth or semi-closed states). | Potential bottom releases for a dam during summer (low temperature water) Inappropriate agricultural practices in catchment (organic loading). |
| | Inorganic nutrient concentrations not to exceed TPCs for macrophytes and microalgae (see above). | WQ7: River inflow: Average DIN concentration >100 µg/l (dry season) or >500 µg/l (wet season); WQ8: Average DIP concentration >10 µg/l (dry season) and >50 µg/l (wet season). WQ9: Average DIN concentrations in freshwater section >100 µg/l (dry season) (marine waters may have higher conc's linked to upwelling) and >500 µg/l (wet season) WQ10: Average DIP concentrations >10 µg/l (dry season) (marine waters may have higher conc's linked to upwelling) and >50 µg/l (wet season). | Inappropriate agricultural practices in catchment (e.g. fertilizers). |
| | Presence of toxic substances not to exceed TPCs for biota (see biotic components above). | WQ11: Trace metals concentrations in estuary exceed target values as per SA Water Quality Guidelines for coastal marine waters (DWA 1995). TPCs for trace metals in sediments still need to be established. WQ12: Pesticides/herbicides: baseline studies to be undertaken before TPCs can be set. | Inappropriate agricultural practices in catchment (e.g. pesticides/herbicides). |
| Sediment dynamics | Flood regime to maintain the sediment distribution patterns and aquatic habitat (instream physical habitat) so as not to exceed TPCs for biota (see above). | S1: River inflow distribution patterns (flood components) differ by more than 20 % (in terms of magnitude, timing and variability) from that of the present state (2009). S2: Suspended sediment concentration from river inflow deviates by more than 20 % of the sediment | Modification to inflow at head of estuary. Significant reduction in floods to the Palmiet River estuary. |

| | | | |
|---------------------------|---|---|---|
| | | <p>load-discharge relationship to be determined as part of baseline studies (present state 2009).</p> <p>S3: Findings from the bathymetric surveys undertaken as part of the Palmiet Monitoring programme indicate changes in the sedimentation and erosion patterns in the estuary have occurred (± 0.5 m) in the lower reaches.</p> | Changes in mouth breaching techniques. |
| | Changes in sediment grain size distribution patterns not to exceed TPCs in benthic invertebrates (see above). | <p>S4: The median bed sediment diameter deviates by more than a factor of two from levels to be determined as part of baseline studies (present state 2009).</p> <p>S5: Sand/mud distribution in the middle and upper reaches change by more than 10 % from present state (2009).</p> <p>S6: Changes in tidal amplitude at the tidal gauge of more than 20 % from present state (2009).</p> | Modification to inflow at head of estuary; Catchment activities; Estuary mouth changes. |
| Phytoplankton | Maintain low phytoplankton biomass. Maintain microalgal group diversity as measured for the baseline survey. | <p>A1: Increase in phytoplankton biomass to 20% greater than the baseline concentrations.</p> <p>A2: Deviation in phytoplankton group diversity to 20 % of that found for baseline conditions.</p> | <p>Elevated nutrient concentrations in the inflowing freshwater.</p> <p>Reduced freshwater inflow.</p> |
| Benthic microalgae | Maintain high subtidal benthic microalgal biomass during the closed mouth phase and low intertidal benthic microalgal biomass during the open phase. Epipellic diatoms indicative of brackish conditions should be found during the closed phase. | <p>A3: Deviation in benthic microalgal biomass by 20 % compared to baseline concentrations.</p> <p>A4: No brackish epipellic diatoms are found during the closed phase.</p> | <p>Elevated nutrient concentrations in the inflowing freshwater.</p> <p>Change in mouth condition. Increase in salinity.</p> |
| Macrophytes | Maintain the distribution of plant community types i.e. macroalgae (<i>Cladophora</i> and <i>Ulva</i> spp.) during closed/semi-closed mouth brackish conditions (~1 ha) and intertidal salt marsh (~0.1 ha). No invasive species | <p>M1: Greater than 20 % change in the area covered by different plant community types for baseline open and closed mouth conditions.</p> <p>M2: Presence of invasive species.</p> | <p>Change in flow and mouth condition resulting in low (near fresh) salinity.</p> <p>Change in mouth condition and associated water level fluctuations.</p> |

| | | | |
|----------------------|--|--|--|
| | e.g. <i>Spartina alterniflora</i> present on the salt marsh. | | |
| | Prevent excessive filamentous macroalgal growth. Area covered should be less than 50 % of the open water surface area. | M3: Macroalgae cover greater than 50 % in 1 m ² quadrats. Macroalgae cover greater than 50 % of the open water surface area in the eastern channel and above sand bank in the lower reaches of the estuary. Macroalgal wet biomass is greater than 500 g m ⁻² . | Elevated nutrient concentrations. Prolonged closed mouth conditions and lack of freshwater floods and flushing. |
| | Maintain the zonation of salt marsh and distribution of different species along an elevation gradient. Ensure the long-term persistence of intertidal salt marsh species such as <i>Triglochin striata</i> and <i>Cotula coronopifolia</i> . | M4: Loss of <i>Triglochin spp.</i> and <i>Cotula coronopifolia</i> from the small saltmarsh area. | Reduced freshwater inflow and high salinity. Increased closed mouth conditions, high water levels and loss of intertidal habitat. |
| | Prevent hypersaline sediment and groundwater conditions in the salt marsh. Sediment electrical conductivity should be approximately 30 mS and similar to groundwater values. | M5: Sediment and groundwater electrical conductivity is greater than 30 mS for the salt marsh area. | Reduced freshwater inflow and high salinity. Reduced floods and flushing of salts from supratidal and floodplain salt marsh areas. |
| Invertebrates | <p>Density of sandprawn burrow openings should exceed 75 per m² in the highest density areas in the lower estuary.</p> <p>Amphipods should numerically dominate the benthic fauna (<i>Grandidierella sp.</i> and <i>Corophium triaenonyx</i>) living on the sediment surface in the middle and upper estuarine reaches respectively.</p> <p>In the zooplankton, the density of <i>Pseudodiaptomus hessei</i> should range between 100 and 5000 m³ in the summer in the mid-estuary region.</p> | <p>I1: The abundance of <i>Callinassa kraussi</i> burrows in the lower estuary drops below 50 counts per m² in the highest density areas.</p> <p>I2: Amphipods do not dominate the surface dwelling benthic fauna.</p> <p>I3: <i>Pseudodiaptomus hessei</i> disappears from the zooplankton for prolonged periods (months).</p> | The mouth remains closed or semi-closed for extended periods, leading to persistent low salinity values (<5 ppt) throughout the estuary. |

| | | | |
|--------------|--|--|--|
| Fish | <p>Retain the following fish assemblages in the estuary (based on abundance):</p> <ul style="list-style-type: none"> - Estuarine species (10-20 %); - Estuarine associated marine species (80-90 %); and - Indigenous freshwater species (± 1 %). - All numerically dominant species are represented by 0+ juveniles. | <p>F1: Level of estuarine species increases above 60 % of total abundance. F2: Level of estuary associated marine species drops below 60 % of total abundance. F3: Alien <i>Lepomis macrochirus</i> and <i>Micropterus</i> spp. dominate in the upper reaches. F4: Absence of 0+ juveniles of any of the dominant fish species.</p> | <p>Recruitment failure due to prolonged drought, mouth semi-/closure and extension of these conditions into the August-December peak recruitment period \Rightarrow proportion estuary breeders \uparrow</p> <p>Have eaten all the indigenous fish, high predation on recruiting elvers.</p> <p>-Breeding failure or impaired recruitment.</p> |
| Birds | <p>Retain regular representation of waders, gulls, and terns, and overall waterbird species richness of seven or more species.</p> | <p>B1: Estuary becomes regularly used by waterfowl species such as Redknobbed Coot. B2: Waders or terns are absent from the estuary for five consecutive counts.</p> | <p>Regular or prolonged periods of mouth closure, high water levels, proliferation of weed and loss of intertidal foraging areas.</p> |

APPENDIX 2: RECOMMENDED BASELINE REQUIREMENTS AND LONG-TERM MONITORING PROGRAMME

Table 14: Summary of data requirements to set a baseline for long-term monitoring in the Palmiet River estuary (DWA 2012) (Orange = high priority, yellow = medium priority, and white = low priority)

| Ecological Component | Monitoring Action | Temporal Scale (Frequency and When) | Spatial Scale (No. of Stations) |
|--------------------------|---|---|--|
| Water Quality | Toxic substances (herbicides/pesticides) in river inflow | Monthly over a wet and dry season | DWS Station G4H007 |
| | Organic nutrients (C, N and P) (dissolved and particulate) in river inflow | Monthly for one year | DWS Station G4H007 |
| | Organic nutrients (C, N and P) flux across the estuary-sea boundary | Intensive survey during marine dominated state (State 3) | Mouth of estuary |
| | Accumulation of benthic organic nutrients (C, N and P) in estuary | Once-off intensive survey during closed/semi-closed states | Entire estuary, focussing on depositional areas. |
| | Accumulation of toxic substances (e.g. selected pesticides/herbicides) in sediments (if contamination in river inflow is significant) | Once-off intensive survey during closed/semi-closed states | Entire estuary, focussing on depositional areas. |
| Hydrodynamic | Continuous water level recordings. | Continuous. | At Station G4R009 near mouth. Already undertaken by DWS. |
| | Accurate flow gauging of river inflow to estuary. | Continuous. | At Station G4H007, weir just upstream of estuary. Already undertaken by DWS. |
| | Aerial photographs of estuary (photographed at spring low tide) at 1:2000 scale. | Every five years. | Entire estuary. |
| | Near-shore wave data records (only if available). | | |
| Sediment dynamics | Bathymetric survey: series of cross-sections and a longitudinal profile collected at about 300m intervals, but in some locations a previous survey. More detailed at the mouth. Vertical accuracy should be better than 2 cm. | Five years, with an additional three surveys (every two months) after a major flood event to establish the rate of deposition in the system | Entire estuary. |
| | Set of sediment grab samples at cross-sections for grading analysis. | Once off. | Entire estuary. |

| Ecological Component | Monitoring Action | Temporal Scale (Frequency and When) | Spatial Scale (No. of Stations) |
|----------------------|--|--|--|
| | Set of core samples (2.0 m) save at cross-sections for grading analysis, age and origin (Isotope analysis). | Once off. | Entire estuary say every 1.0 km. |
| | Sampling of suspended sediment (and organic matter) required to quantify actual sediment and organic yield and variability. | Weekly, but daily during floods, for at least five years. | Upstream of estuary. |
| Macrophytes | Two field visits to update the Geographic Information System (GIS) vegetation map by identifying the distribution of the different plant community types and species. However this would not capture the dynamics of the submerged macrophytes or macroalgal that would need to be monitored on at least a monthly basis. | At least once during an open and closed mouth condition. | Entire estuary. |
| Microalgae | Phytoplankton and Benthic microalgae: sample for biomass and species composition during an open and closed mouth condition to establish baseline conditions. For phytoplankton chlorophyll <i>a</i> measurements taken at the surface, 0.5 m and 1 m depths. Cell counts of dominant phytoplankton groups, i.e. flagellates, dinoflagellates, diatoms, chlorophytes and blue-green algae completed for the different sites. For benthic microalgae measure intertidal and subtidal benthic chlorophyll <i>a</i> and epipellic diatoms need to be collected for identification. | At least once during an open and closed mouth condition. | Five stations along the length of the estuary. |
| Invertebrates | Collect quantitative samples for zooplankton after dark. Zooplankton samples to be collected at mid-water level where possible. Chlorophyll- <i>a</i> data must be collected at all sites and on all sampling occasions. | Samples to be collected in the dry and wet season over two years. Times should be selected to maximise low and high flow conditions. | Collections at five sites. |
| | Subtidal benthic samples to be collected using a grab sampler and sieved through 500 micron aperture mesh. | Samples to be collected in the dry and wet season over two years. Times should be selected to maximise low and high flow conditions. | Collections at five sites that correspond to the zooplankton stations. |

| Ecological Component | Monitoring Action | Temporal Scale (Frequency and When) | Spatial Scale (No. of Stations) |
|----------------------|--|--|--|
| | Setting of prawn and crab traps. | Samples to be collected in the dry and wet season over two years. Times should be selected to maximise low and high flow conditions. | Collections to be done in the uppermost part and in the lower reaches. |
| Fish | Conduct fish surveys using both seine and gill nets as primary gear. | Quarterly over one year, covering all four seasons and representative of temperature and average river inflow of that season. Both open and closed mouth phases need to be monitored in a particular year, with particular emphasis on juvenile marine fish recruitment. | Entire estuary (6). |
| Birds | Waterbird counts for the whole estuary. | Monthly counts over a period of one year and counting at low tide when open. A high level of replication is justified by the variability of the system, and the ease with which it can be counted. | Entire estuary (divided into three sections). |

Table 15: Long-term monitoring programme proposed for the Palmiet River estuary (DWA 2012) (Orange = high priority, yellow = medium priority, and white = low priority)

| Ecological component | Monitoring action | Related TPC | Temporal scale (frequency and timing) | Spatial scale (no. of stations) | Human Resources (as days/year) | | | | | |
|----------------------|---|-------------|---------------------------------------|---|---|------|-----------|------|-----------|------|
| | | | | | Sampling | | Analysis | | Reporting | |
| | | | | | Scientist | Tech | Scientist | Tech | Scientist | Tech |
| Water Quality | Conductivity, temperature, suspended matter, dissolved oxygen, pH, inorganic nutrients and organic content in river inflow. | WQ3 | At least monthly | At Station K2H002Q01, weir just upstream of estuary | Already included in DWA's water quality monitoring programme. | | | | | |

| Ecological component | Monitoring action | Related TPC | Temporal scale (frequency and timing) | Spatial scale (no. of stations) | Human Resources (as days/year) | | | | | |
|----------------------|---|--------------|--|---|--|------|--|------|-----------|------|
| | | | | | Sampling | | Analysis | | Reporting | |
| | | | | | Scientist | Tech | Scientist | Tech | Scientist | Tech |
| | Longitudinal salinity and temperature profiles (<i>in situ</i>) | WQ1 WQ2 | Measured when biotic surveys require information for interpretation, alternatively every three years | Entire estuary (5 stations) | - | 2 | - | - | 1 | - |
| | Water quality measurements along length of estuary (surface and bottom samples) for pH, dissolved oxygen, suspended solids/turbidity/Secchi, inorganic nutrients and particulate organic nutrients. | WQ4 to WQ9 | Measured when biotic surveys require information for interpretation, alternatively every three years | Entire estuary, plus sampling points in river and sea (7 stations). | See related biotic components - samples can be collected as part of biotic survey. | | <i>In situ</i> measurements. Accredited analytical laboratory. | | 1 | - |
| | Survey on benthic organic nutrients and toxic substances accumulation (e.g. selected pesticides). | WQ10 to WQ11 | Every six years, if deemed necessary in future | Focus on depositional areas | - | 2 | Depend on parameters selected. Accredited analytical laboratory. | | 1 | - |
| Hydrodynamics | Water level recordings. | H1 to H4 | Continuous | At causeway near mouth. | Included in DWA national monitoring programme. | | | | 1 | - |
| | Flow gauging. | H1 to H4 | Continuous | One station at position representative of inflows to estuary. | Include in DWA national monitoring programme. | | | | 1 | - |
| | Aerial photographs of estuary (spring low tide). | H1 to H4 | Five years | Entire estuary | Should be recommended for inclusion in DEAT national coastal survey programme. | | | | 1 | - |

| Ecological component | Monitoring action | Related TPC | Temporal scale (frequency and timing) | Spatial scale (no. of stations) | Human Resources (as days/year) | | | | | |
|----------------------|---|-------------|---|---------------------------------|--------------------------------|------|-----------|------|-----------|------|
| | | | | | Sampling | | Analysis | | Reporting | |
| | | | | | Scientist | Tech | Scientist | Tech | Scientist | Tech |
| Sediment | Bathymetric survey: series of cross-section profiles and a longitudinal profile collected at fixed 300 m intervals, but more detailed in the mouth (vertical accuracy better than 2 cm). | S1 - S3 | Five years | Entire estuary | 1 | | | | 4 | |
| | Set sediment grab samples (at cross section profiles) for analysis of particle size distribution (PSD) and origin (i.e. using microscopic observations). | S4 – S6 | Five years | Entire estuary | | | | | 1 | |
| | Suspended sediment and organic matter. | | Weekly, but daily during floods | Upstream of estuary | | | | | 10 | |
| Phytoplankton | Phytoplankton biomass (chlorophyll a) measurements taken at the surface, 0.5 m and 1.0 m depths. Cell counts of dominant phytoplankton groups, i.e. flagellates, dinoflagellates, diatoms, chlorophytes and blue-green algae. Measurements for the open and closed mouth condition. | A1 and A2 | One year after reserve implementation thereafter every three years | Five stations | 2 | | | | 2 | 3 |
| Benthic microalgae | Benthic microalgae biomass (intertidal and subtidal benthic chlorophyll a) measurements. Epipellic diatoms need to be collected for identification. Measurements for the open and closed mouth condition. | A3 and 4 | One year after reserve implementation thereafter every three years | Five stations | 2 | | | | 2 | 3 |
| Macrophytes | Use aerial photographs to quantify area covered by different plant community types and produce a vegetation map for the open mouth condition. Conduct field surveys during the closed and open mouth condition to document the species composition and area | M1– M5 | One year after reserve implementation thereafter every three years. | Entire estuary | 2 | | | | 2 | 3 |

| Ecological component | Monitoring action | Related TPC | Temporal scale (frequency and timing) | Spatial scale (no. of stations) | Human Resources (as days/year) | | | | | |
|----------------------|--|-------------|---|---------------------------------|--------------------------------|------|-----------|------|-----------|------|
| | | | | | Sampling | | Analysis | | Reporting | |
| | | | | | Scientist | Tech | Scientist | Tech | Scientist | Tech |
| | covered by the different plant community types. Measure salt marsh and macroalgal (submerged macrophyte if present) percentage cover in 1.0 m ² quadrats along three permanent transects (one for saltmarsh/macroalgae and two macroalgae transects. Sample for macroalgal biomass in the lower reaches of the estuary. Measure sediment characteristics, depth to groundwater and groundwater salinity along the salt marsh transects. | | | | | | | | | |
| Invertebrates | Collect quantitative samples for zooplankton after dark. Zooplankton samples to be collected at near-surface and mid-water level, depending on water depth. Chlorophyll-a data must be collected at all sites and on all sampling occasions. High priority. | I1 and I2 | Samples to be collected twice a year. Times should be selected to maximise low and high flow conditions. | All five or six sampling sites | 2 | | | | 4 | - |
| | Subtidal benthic samples to be collected using a grab sampler and sieved through 500 micron aperture mesh. High priority. | I1 and I2 | Samples to be collected twice a year. Times should be selected to maximise low and high flow conditions. Once a year at the end of | All five sampling sites. | 2 | | | | 4 | - |

| Ecological component | Monitoring action | Related TPC | Temporal scale (frequency and timing) | Spatial scale (no. of stations) | Human Resources (as days/year) | | | | | |
|----------------------|---|-------------|--|--|--------------------------------|------|-----------|------|-----------|------|
| | | | | | Sampling | | Analysis | | Reporting | |
| | | | | | Scientist | Tech | Scientist | Tech | Scientist | Tech |
| | Hole counts to establish sand prawn densities. A representative sample of the population to establish size class distribution. High priority. | | summer after the dry season. | At sites in the middle and lower estuary. | 2 | | | | 2 | - |
| | Collect shrimps and prawns that are non-burrowers | I1 and I2 | Samples to be collected twice a year. Times should be selected to maximise low and high flow conditions. | In uppermost section of the estuary, and in the lower reaches. | 2 | | | | 2 | - |
| Fish | Conduct fish surveys using both seine and gill nets as primary gear. | F1 - 4 | Two years after implementation conduct a closed/semi-closed and open phase survey, followed by two surveys every three years thereafter. | Entire estuary (6 stations) | 2 | | | | 3 | 1 |

| Ecological component | Monitoring action | Related TPC | Temporal scale (frequency and timing) | Spatial scale (no. of stations) | Human Resources (as days/year) | | | | | | |
|----------------------|---------------------------------------|-------------|---------------------------------------|---------------------------------|--------------------------------|------|-----------|------|-----------|------|---|
| | | | | | Sampling | | Analysis | | Reporting | | |
| | | | | | Scientist | Tech | Scientist | Tech | Scientist | Tech | |
| Birds | Bi-annual bird counts of the estuary. | B1 and 2 | Mid-summer and mid-winter. | Whole estuary | 1 | | | | | 0 | 1 |

APPENDIX 3: PERFORMANCE MONITORING PLAN

Table 16: Recommended Performance Monitoring Plan for the management of the Palmiet River estuary

| MANAGEMENT OUTPUT | PERFORMANCE INDICATOR | TEMPORAL SCALE (frequency) | RELEVANT LEGISLATION | RESPONSIBLE AUTHORITY |
|--|--|---|----------------------|-----------------------------------|
| 1. ESTUARINE HEALTH AND FUNCTION | | | | |
| 1.1 Secure adequate quantity and quality of freshwater input to improve and maintain ecosystem health and functioning | <ul style="list-style-type: none"> Recommended reserve(s) signed off and implemented Minimum flow requirement restored Agricultural best practice implemented Good water quality ensured Mouth dynamics monitored Investigation undertaken of specific estuarine impacts Ecological monitoring programme (fish and birds) implemented Fish disease eradicated Annual reporting on state of estuary Ecological condition improved from category C to category B/C | <ul style="list-style-type: none"> Twice a year for DWS Annual for DEFF | NWA, CARA | DWS, BGCMA, CapeNature, RMA, DEFF |
| 1.2 Ensure estuary requirements are integrated into catchment processes to ensure healthy water quality | <ul style="list-style-type: none"> Critical catchment maps updated Effective catchment management Good catchment water quality preserved | <ul style="list-style-type: none"> Twice a year | MSA, NWA, NEM: PAA | RMA, CapeNature, BGCMA, DWS |
| 1.3 Minimise pollution by addressing activities that lead to poor water quality, especially agricultural return flow as a result of over fertilisation | <ul style="list-style-type: none"> Polluting activities monitored and controlled Environmental best practice in agriculture is implemented and enforced Waste management plan implemented Water quality programme implemented | <ul style="list-style-type: none"> Quarterly | NWA, ICMA, MSA | RMA, BGCMA, DWS, DALRRD |
| 1.4 Control the spread and densification of invasive alien plant species | <ul style="list-style-type: none"> Detailed maps of invasive vegetation produced and priority areas identified IAPS eradication programme implemented Increased area / tonnes of IAPs removed | <ul style="list-style-type: none"> Annually | CARA, NWA | RMA, DEFF: WfW, CapeNature, KBRC |

| MANAGEMENT OUTPUT | PERFORMANCE INDICATOR | TEMPORAL SCALE (frequency) | RELEVANT LEGISLATION | RESPONSIBLE AUTHORITY |
|---|---|---|---|--|
| 2. BIODIVERSITY CONSERVATION | | | | |
| 2.1 Enhance the protected area status of the Palmiet River estuary | <ul style="list-style-type: none"> • Kleinmond Coast and Mountain Nature Reserve incorporated into BMC • Palmiet EMP incorporated into Kogelberg Nature Reserve, BMC and KBR Plans • KBRC establishes an estuarine division for the Kogelberg estuaries • Participation of land owners and stakeholders in environmental custodianship | <ul style="list-style-type: none"> • Quarterly until resolution achieved | ICMA, NEM: PAA, WC BRA, NEMA | RMA, CapeNature, KBRC |
| 2.2 Ensure the conservation of estuarine habitats and indigenous species by establishing and enforcing the Palmiet River estuary as a no-take system | <ul style="list-style-type: none"> • Spatial zonation plan adopted, implemented and enforced • No-take status established and enforced • Signage created and erected in key public spaces • Reduced habitat degradation and inappropriate behaviour/activities • Healthy fish and invertebrate populations • Compliance and enforcement monitoring programme, and regional network developed and implemented • Educational signage erected | <ul style="list-style-type: none"> • Annually | NEM: PAA, MLRA, NWA NEM: BA, WC BRA, MSA, LUPA | RMA, KBRC, CapeNature, DEFF, Overstrand LM |
| 3. LAND USE AND INFRASTRUCTURE DEVELOPMENT PLANNING | | | | |
| 3.1 Ensure appropriate and sustainable coastal development in and around the Palmiet River estuary, considering ecosystem services and sense of place | <ul style="list-style-type: none"> • Palmiet EMP approved and incorporated into Kogelberg Nature Reserve, BMC, and KBR Plans • EMP included in all relevant planning documents • Regional EAF partakes in development planning affecting the estuary • No new development, infilling or land transformation in the EFZ • Inspections undertaken, transgressors prosecuted, and remedial actions implemented | <ul style="list-style-type: none"> • Annually | ICMA, NEM: PAA, WC BRA, LUPA, MSA, NEMA | KBRC, CapeNature, Overstrand LM, Overberg DM, DEA&DP |

| MANAGEMENT OUTPUT | PERFORMANCE INDICATOR | TEMPORAL SCALE (frequency) | RELEVANT LEGISLATION | RESPONSIBLE AUTHORITY |
|---|---|---|---|--|
| 4. INSTITUTIONAL AND MANAGEMENT STRUCTURES | | | | |
| 4.1 Ensure effective co-ordination of estuarine management responsibilities | <ul style="list-style-type: none"> • Palmiet EMP approved and incorporated into Kogelberg Nature Reserve, BMC and KBR Plans • Bylaws developed and gazetted to support zonation and protect EFZ • KBRC establishes an estuarine division for the Kogelberg estuaries • Regional Estuarine management function established and EMC appointed • RMA official(s) are well-trained and knowledgeable • Funding secured for 5-year cycle • Regional EAF constituted and chaired by RMA • Stakeholder database maintained • Annual reporting undertaken by RMA • Good communication and working relationship established with implementing agencies | <ul style="list-style-type: none"> • Quarterly | ICMA, MSA, LUPA, NWA, NEM: PAA, MRPDA, WC BRA | RMA, CapeNature, DEA&DP |
| 4.2 Define and enable co-operative governance | <ul style="list-style-type: none"> • MOUs signed between RMA and spheres of government and participating agencies • Active collaboration of various institutions, private and civil stakeholders • Individual agencies knowledgeable and with capacity and resources to carry out mandated actions • Regional EAF constituted and meets on quarterly basis • Formal review of EMP every 5 years | <ul style="list-style-type: none"> • Annually | ICMA, NEMA, MSA, NEM: PAA, WC BRA | RMA supported by all authorities |
| 5. SOCIO-ECONOMIC CONSIDERATIONS | | | | |
| 5.1 Regulate non-extractive use | <ul style="list-style-type: none"> • EFZ demarcated with markers/signage (if necessary) which are maintained • EFZ controls enforced and offenders prosecuted • SOP for peak holiday season developed and implemented | <ul style="list-style-type: none"> • Annually | ICMA, NEM: PAA, WC BRA, MSA | RMA, Overstrand LM, CapeNature/KBRC, Necessary authorities |

| MANAGEMENT OUTPUT | PERFORMANCE INDICATOR | TEMPORAL SCALE (frequency) | RELEVANT LEGISLATION | RESPONSIBLE AUTHORITY |
|--|--|---|-----------------------------|--|
| | <ul style="list-style-type: none"> Monitoring programme for estuarine use implemented | | | |
| 5.2 Develop and regulate local livelihoods associated with the estuary | <ul style="list-style-type: none"> Alternative livelihood opportunities investigated and implemented | <ul style="list-style-type: none"> Annually | ICMA, NEM: PAA, WC BRA, MSA | RMA, Overstrand LM, CapeNature/KBRC, |
| 6. EDUCATION, AWARENESS, MONITORING AND RESEARCH | | | | |
| 6.1 Promote high levels of public awareness and appreciation of the value of the Kogelberg estuaries | <ul style="list-style-type: none"> Education & awareness programme developed and implemented Educational signage erected, and information disseminated Kogelberg estuaries webpage operational Reduced illegal fishing activities | <ul style="list-style-type: none"> Every 3 years | ICMA, MLRA | KBRC, DEFF |
| 7. DISASTER RISK MANAGEMENT | | | | |
| 7.1 Disaster prevention preparedness and mitigation | <ul style="list-style-type: none"> Degraded / eroded areas rehabilitated Signage installed informing public of rehabilitation process Appropriate defence installed for critical infrastructure Estuarine issues incorporated in relevant disaster management planning documents Contingency plans developed and implemented Future development setback from EFZ | <ul style="list-style-type: none"> Every 3 years | NEMA, ICMA, WC TIA, DMA | RMA, WC DoT&PW, Overstrand LM, CapeNature, KBRC, WC Dept of Local Gov: Disaster Management |

APPENDIX 4: PROJECT TEMPLATE

| ACTION | Describe the action to be undertaken | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| COMPLETION DATE | Provide date of expected completion | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PERFORMANCE INDICATOR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Requirements stipulated in policy and legislation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Available methods, protocols and best practice-guides | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Spatial zonation consideration (e.g. limits/targets) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Detailed work plan | Task 1: Task 2: Task 3: Task 4: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Scheduling | <table border="1"> <thead> <tr> <th rowspan="2">TASK</th> <th colspan="9">TIME (months)</th> </tr> <tr> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> <th>6</th> <th>7</th> <th>8</th> <th>9</th> </tr> </thead> <tbody> <tr> <td>1</td> <td style="background-color: #4F81BD;"></td> <td style="background-color: #4F81BD;"></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>2</td> <td></td> <td></td> <td style="background-color: #4F81BD;"></td> <td style="background-color: #4F81BD;"></td> <td style="background-color: #4F81BD;"></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td style="background-color: #4F81BD;"></td> <td style="background-color: #4F81BD;"></td> <td style="background-color: #4F81BD;"></td> <td></td> </tr> <tr> <td>4</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td style="background-color: #4F81BD;"></td> <td style="background-color: #4F81BD;"></td> </tr> </tbody> </table> | TASK | TIME (months) | | | | | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 1 | | | | | | | | | | 2 | | | | | | | | | | 3 | | | | | | | | | | 4 | | | | | | | | | |
| TASK | TIME (months) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Milestone/interim performance indicator | <table border="1"> <thead> <tr> <th>MILESTONE</th> <th>INTERIM PERFORMANCE INDICATOR</th> <th>DUE DATE</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> <td></td> </tr> <tr> <td>2</td> <td></td> <td></td> </tr> <tr> <td>3</td> <td></td> <td></td> </tr> </tbody> </table> | MILESTONE | INTERIM PERFORMANCE INDICATOR | DUE DATE | 1 | | | 2 | | | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MILESTONE | INTERIM PERFORMANCE INDICATOR | DUE DATE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Responsibilities for different tasks | E.g. Identify specific departments, personnel and/or service providers responsible for execution of this action | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Monitoring and reporting plan | E.g. <ul style="list-style-type: none"> Define data and information to measure in order to monitor performance indicator/s Specify frequency at which data/information should be collected/monitored Where and when to report on progress | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Human resource plan | <table border="1"> <thead> <tr> <th rowspan="2">HUMAN RESOURCE</th> <th colspan="4">WEEKS PER TASK</th> </tr> <tr> <th>1</th> <th>2</th> <th>4</th> <th>4</th> </tr> </thead> <tbody> <tr> <td>Staff member 1</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Staff Member 2</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Service provider</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> | HUMAN RESOURCE | WEEKS PER TASK | | | | 1 | 2 | 4 | 4 | Staff member 1 | | | | | Staff Member 2 | | | | | Service provider | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HUMAN RESOURCE | WEEKS PER TASK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Staff member 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Staff Member 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Service provider | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Financial resource plan | <table border="1"> <thead> <tr> <th>TASK</th> <th>COST (ZAR)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> </tr> <tr> <td>2</td> <td></td> </tr> <tr> <td>3</td> <td></td> </tr> <tr> <td>4</td> <td></td> </tr> <tr> <td>TOTAL</td> <td></td> </tr> </tbody> </table> | TASK | COST (ZAR) | 1 | | 2 | | 3 | | 4 | | TOTAL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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Source: DEA (2015)